Chapter 2 - Affected Environment

Chapter 2 – Rafting Caldera Rapid

Chapter 2 – Affected Environment

This chapter describes the affected environment of the upper Klamath River Canyon, including the general setting, land uses, and a description of the outstandingly remarkable values for which the river was designated a national wild and scenic river. This chapter will also discuss the Area of Critical Environmental Concern (ACEC) and the values for which it was designated under the "Klamath Falls Resource Management Plan and Final Environmental Impact Statement" (KFRMP/FEIS 1995).

General Setting and Background Information

Physiography

The Klamath River lies within the High Cascades Physiographic Province and borders the Basin and Range Province on the west (Franklin and Dyrness 1973). The only rivers in Oregon and California that bisect the Cascade Range are the Klamath and Columbia in Oregon and the Pit in California. The upper Klamath River drains south central Oregon, east of the Cascade Range.

The river begins at the lower end of Lake Ewauna in the city of Klamath Falls, Oregon, and flows southwesterly into California and west to the Pacific Ocean (see Map 1). The planning area portion of the upper Klamath River flows through a steep-walled, basalt canyon in Klamath County, Oregon, and Siskiyou County, California.

The topography in the planning area varies from flat to gently sloping along the river benches to almost vertical at the canyon walls. The canyon rim's basalt cliffs rise to 1,000 feet above the river. The average river gradient in Segment 1 is 75 feet per mile; Segment 2 is 27 feet per mile from river mile (RM) 219.5 to 214.3, and 77 feet per mile from RM 214.3 to 209.3; and Segment 3 is 32 feet per mile (see Map 3).

Annual precipitation, most commonly in the form of rain, ranges from 15 to 20 inches during fall, winter, and spring. Summers are hot and dry with occasional thunderstorms developing in the late afternoon. In the winter, snow falls on the rim of the canyon, but only rarely accumulates on the canyon floor. Winter temperatures in the canyon drop into the low 20s (degrees Fahrenheit) and summer temperatures climb into the high 80s or 90s.

Air quality is generally good within the canyon because it is far removed from population centers or industrialized areas.

Geology

Regional geology: The upper Klamath River is in a transition area between the High Cascade and Basin and Range Provinces. High Cascade features include Quaternary-age volcanic flows, mostly basaltic and andesitic, which cap older volcanic deposits; cinder cones from the upper Pleistocene; and Holocene pyroclastic eruptive centers. Numerous dikes and plugs of andesite, rhyolite, and basalt intrude the volcanic rocks near Copco Lake. Significant volcanic centers along the Cascade Range include Mt. McLoughlin, 30 miles north of the area, and Mt. Shasta, 40 miles south. Local Basin and Range features include a series of fault block mountains separated by basins; and normal faults that run in a north-northwest direction with the down-thrown side to the northeast, creating an echelon or stair-step pattern. Evidence of these fault patterns is found 30 miles north and 30 miles east of the planning area. The planning area has low seismotectonic (earthquake) activity; however, there is ongoing tectonic activity to the west.

Lithology: The oldest exposed rocks in the planning area are a series of rapidly weathering middle to upper Miocene-age tuff of unknown thickness, with varying degrees of welding. The rare Salt Caves anticline structure occurs in this welded tuff. The cause of the Salt Caves folded structure is unknown, but is considered unlikely to have a tectonic origin (that is, resulting from structural deformation of the Earth's crust). The Miocene tuff is overlain by upper Tertiary- to Pleistocene-age basalts and andesites that are approximately 900 to 1,000 feet thick; the basalts and andesites are overlain by Quaternary alluvium, colluvium, talus, lacustrine, and landslide deposits. Landslides are most common in the southern half of Segment 2.

Mineral Resources: No economically valuable mineral deposits are known to exist in the planning area. Potential mineral resources are too remote or of insufficient quality or quantity to be extracted economically. These potential resources include gravel deposits, diatomite (clay) beds, basalt and andesitic basalt quarry sites (used for roads and as riprap), and geothermal resources located in the planning area. There are no federal oil, gas, or geothermal leases in the planning area, and there are no mineral permits or leases. The wild and scenic river designation precludes mineral location and leasing within 0.25 miles on either side of the river Segment 2 (see Map 2).

Detailed soils information is found under the Vegetation and Soils section throughout this document.

Description of Affected Resources and Facilities

Scenic Resources

The visual quality of a landscape is based on landscape character. The stronger the influence of form, line, color, and texture, the more interesting the landscape; the more visual variety in a landscape, the more aesthetically pleasing it is. An assessment of landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications is used to classify the scenic quality of the area. During the rating process, each of these factors is ranked on a comparative basis with similar features within the planning area. A visual resource management (VRM) class rating is then made to manage the quality of the visual environment and to reduce the visual impact of development activities (BLM Handbook H-8410-1).

The upper Klamath River Canyon was evaluated by the BLM in 1977 and 1981. Segments 1, 2, and 3 received a Scenic Quality Class A evaluation - the highest scenic quality classification. Based on this classification, the area was then classified as VRM Class II. The VRM Class II management objective is to retain the existing character of the landscape. Management activities in VRM Class II areas should not attract the attention of the casual observer. The upper Klamath River from the J.C. Boyle Powerhouse to the Oregon/California state line was designated the Klamath Scenic Waterway by majority vote in 1988, in part because of the valued scenic resources.

Recreation

The major recreational activities within the planning area include whitewater boating, fishing, hunting, and camping. Additional activities include sightseeing, hiking, photography, picnicking, wildlife observation, driving for pleasure on existing roads, trapping, off-highway vehicle use, and horseback riding. Most recreational use occurs below the J.C. Boyle Powerhouse in Segments 2 and 3. The lower half of Segment 1 and all of Segment 2 and Segment 3 are managed by the BLM primarily under a semi-primitive motorized recreation opportunity spectrum class, with emphasis on float boating, fishing, camping, and other compatible uses.

Off-highway vehicle use is limited to designated roads and trails within the Klamath River ACEC; however, some unauthorized or illegal travel off of designated routes occurs, especially in Segment 2 by full-sized vehicles, all-terrain vehicles, and motorcycles.

Overall recreation visitation to the planning area is estimated by BLM to be 10,000 visitors per year. Recreation use is very light during the shoulder seasons of April-mid June and September-October, light to moderate on week days in the summer, and moderate to heavy on holiday and some mid summer weekends. Limiting factors to recreation use of the area may include the distance from population centers, the rough condition of the access roads, and the relative lack of developed camping and recreation facilities.

Existing recreation facilities include Topsy Recreation Site, Spring Island River Access area, primitive and semi-primitive fire-safe campsites, the Klamath River Campground, Stateline River Access, and five fishing accesses. One additional fishing access (Fishing Access # 1, PacifiCorp) is located immediately west of the planning area boundary. Existing trails are limited to the Klamath River Edge Trail, which extends from Frain Ranch (west side) north to the Turtle Camp area in Segment 2. This trail, presently available to motorized use, is maintained for nonmotorized uses only. Other user-created trails are found along the river at developed fishing access sites and at major rapids for fishing or scouting purposes (see Maps 3 and 13).

The recreational values of the planning area are presently recognized by a number of other agencies and organizations, including the National Park Service ("Nationwide Rivers Inventory"), Oregon Department of Energy ("Pacific Northwest Rivers Study"), ODFW (direct testimony, 1985), and the Oregon State Parks and Recreation Division ("Statewide Comprehensive Outdoor Recreation Plan).

Whitewater Boating

There are approximately 370 miles of whitewater boating rivers in Jackson, Josephine, Curry, Klamath, Douglas, and Siskiyou Counties, of which the upper Klamath River accounts for 17 miles (Table 2-1). The remaining 353 miles of whitewater boating opportunities occur on seven rivers (Rogue, Illinois, Umpqua, lower Klamath, Scott, Upper Sacramento, and Salmon Rivers). The upper Klamath River is the only river in Klamath County that sustains any significant whitewater boating activity throughout the year.

One of the unique features of the upper Klamath River is the late season whitewater boating opportunity provided as a result of year-round releases from the J.C. Boyle Dam/Powerhouse system. At least one generator must be operating to provide adequate flows for whitewater rafting.

Even if neither generator is operating, the river can still be floated by kayak or canoe from the BLM launch site to Frain Ranch (five miles). Historically (1985 from 1998) during typical summer operations, one generator operated daily for 2-8 hours between 8 a.m. and 4 p.m., increasing the river flow from approximately 350 to 1,500 cfs, the minimum flow required for rafting in Segments 2 and 3 (BLM 1989).

Since the summer of 1998, PacifiCorp has varied the release schedule to include more releases that start later in the day, starting the release as late as 2-4 p.m. This change in

Table 2-1. – Whitewater boating rivers in Oregon and northern California [1]

River	Season accessible for given class of rapids	General whitewater classification (class) [1]	Controlled flow	Trip length (days)	Floatable river length (miles)
Oregon					
Lower Rogue	Year-round	II–IV	Yes	1–5	84
Snake-Hell's Canyon	Year-round	III–IV	Yes	1–5	49
Upper Klamath	*Year-round*	*III–V*	*Yes*	*1–2*	*17*
John Day (lower)	December–June	II–III	No	1–5	69
Illinois	March–May	III–V	No	3–5	40
Owyhee (lower)	March–June	III–IV	No	3–5	55
Owyhee (upper)	March–June	III–V	No	3–5	39
Clackamas	April–June	III–V	Yes	1	20
Grand Ronde	April–June	II–III	No	1–4	44
North Umpqua	April–June	III–IV	No	2	33
Lower Deschutes	April–September	III–IV	Yes	1–3	99
California					
Lower Klamath	Year-round	III	Yes	1–5	100+
South Fork American	Year-round	II–III	Yes	1–2	30
Trinity	Year-round	II–III	Yes	1–3	83
Salmon	November–June	III–V	No	1–3	21
Scott	December–June	III–V	No	1–2	18
Upper Sacramento	March–May	III–IV	Yes	1	25
North Fork American	April–June	III–V	No	1	8
Yuba	April–June	III–V	No	1–2	28
Middle Fork American	April–July	II–IV	Yes	3	24
Middle Fork Feather	April–September	IV–V	Yes	3–5	32

[1] Class I = I - Easy: moving water with a few riffles and small waves; few or no obstructions.
Class II = Easy to medium: rapids with waves up to three feet, and wide clear channels; some maneuvering is required around obvious obstacles.
Class III = Medium to moderately difficult: rapids with high irregular waves, narrow channels, rocks, and holes; often requires complex maneuvering.
Class IV = Difficult to very difficult: long, turbulent rapids with powerful waves and holes; many obstacles requiring precise, expert maneuvering; scouting from shore is often necessary.
Class V = Extremely difficult: long, technical, and very violent rapids with highly congested routes which nearly always must be scouted from shore; dangerous drops, unstable eddies, irregular currents, and horrendous holes are often encountered; requires experience, self-confidence, and good physical condition.
Class VI = Nearly impossible and extremely impossible: difficulties of Class V carried to the extreme of navigability; mishap could be hazardous to life for teams of experts only, after close study and with all precautions taken; generally considered inaccessible for commercial purposes.

scheduling reflects changing market conditions for wholesale electric power, as well as anticipated regional electric power shortages during summer heat waves.

This shift in water release start times has impacted whitewater boating opportunities by either forcing boaters to launch their trips later in the day, or to cancel or postpone their trips due to the timing of the water release.

Historically, the J.C. Boyle Powerhouse was shut down for two weeks in July each year to perform maintenance; however, in recent years this maintenance work has been shifted to September to avoid the prime rafting season (BLM). During winter and spring both generators operate, increasing the flows to 2,500 cfs or higher. Adequate flows for boating opportunities in Segment 1, upstream from the powerhouse, are available very sporadically when excess water is spilled from the J.C. Boyle Dam, usually in late winter and early spring.

The upper Klamath River offers exceptional whitewater boating opportunities downstream from the J.C. Boyle Powerhouse. There are 74 rapids in Segments 1 and 2 (RM 220.1) more than in a comparable length on most other rivers in the western United States.

Rapids are given a difficulty rating of Class I to VI on the International Scale of River Difficulty. The rapids on the upper Klamath River can be divided into three sections based on similar river difficulty ratings, shown in Table 2-2. The river in the first section, RM 220.1 to 214.3, drops 27 feet per mile, creating less technical rapids (Class I-III) for intermediate boating opportunities (see Map 3).

In the second section, RM 214.3 to 209.3 (see Map 3), the river drops 77 feet per mile, creating several long, turbulent rapids that require precise, expert maneuvering and provide a challenging whitewater experience (Class III-V). The short distance of this section, combined with the quantity and classification of rapids, provides an experience not found in late summer and early fall on other rivers in Oregon and northern California.

The lower section, RM 209.3 to 204, drops 32 feet per mile, creating rapids similar to those in the first section (Class I-III) that provide intermediate boating opportunities (see Map 3).

The rafting season on the upper Klamath River generally starts in early to mid-May, depending on the weather (see Table 2-3 for use statistics). Early season rafting, from May through late June, consists primarily of private boaters from the local area and commercial outfitters who are running guide training camps and some early commercial trips. The middle of the season, from July through mid-September, is the peak commercial use season (Table 2-4).

Commercial trips are launched seven days a week during this period if adequate water releases are available. Use peaks on weekends in July and August, and it is not uncommon for 6-10 multi-boat commercial trips to launch on a midsummer Saturday or Sunday.

During peak commercial rafting days, the launch area, popular stops such as the scouting area at Caldera rapids, and the takeout areas at Stateline and Access 1 are congested and crowded with people and vehicles. Waiting lines develop for access to boat ramps, toilets, and beach space. There are more complaints from local residents about unsafe driving of rafting shuttle vehicles, and there are increased chances for conflicts between rafting groups and other recreationists such as anglers and campers.

Table 2-2. – Whitewater classification on the upper Klamath River

River Section	Class [1]				
	I	II	III	IV	V
RM [2] 220.1–214.3 (launch to Caldera Rapid)	14	9	1	0	0
RM 214.3–209.3 (Caldera rapid to state line)	1	9	13	3	2
RM 209.3–204 (state line to upstream of Access #1)	13	7	2	0	0

[1] Class I = I - Easy: moving water with a few riffles and small waves; few or no obstructions.
Class II = Easy to medium: rapids with waves up to three feet, and wide clear channels; some maneuvering is required around obvious obstacles.
Class III = Medium to moderately difficult: rapids with high irregular waves, narrow channels, rocks, and holes; often requires complex maneuvering.
Class IV = Difficult to very difficult: long, turbulent rapids with powerful waves and holes; many obstacles requiring precise, expert maneuvering; scouting from shore is often necessary.
Class V = Extremely difficult: long, technical, and very violent rapids with highly congested routes which nearly always must be scouted from shore; dangerous drops, unstable eddies, irregular currents, and horrendous holes are often encountered; requires experience, self-confidence, and good physical condition.
Class VI = Nearly impossible and extremely impossible: difficulties of Class V carried to the extreme of navigability; mishap could be hazardous to life for teams of experts only, after close study and with all precautions taken; generally considered inaccessible for commercial purposes.
[2] RM = River mile.

Table 2-3.—Upper Klamath River annual use statistics for whitewater rafting (1994 through 2001)

Use Statistics	1994	1995	1996	1997	1998	1999	2000	2001
Commercial Rafting Use Levels								
Number of One Day Trips	283	330	372	374	295	307	359	287
Number of Overnight Trips	69	80	70	51	30	41	33	23
Total Number of Trips	352	410	442	425	325	348	392	310
Number of Outfitters with commercial use (active)	14	14	22	24	20	19	18	16
Total number of outfitters	20	25	27	26	26	23	22	22
Number of passengers (user days)	4,471	5,763	5,963	5,509	4,081	4,614	5,100	3,575
Average number of passengers per trip	10.6	14.0	13.4	13.0	12.6	13.4	12.8	11.5
Private/Self Outfitted Boating Use Levels								
Number of trips	86	55	40	27	24	34	34	22
Number of Boaters (user days)	735	602	244	317	314	283	269	124
Average Number of Boaters per Trip	6.8	9.6	6.1	11.1	7.2	6.7	7.3	5.6

Table 2-4.—Upper Klamath River monthly commercial boating use, 1998

Month	Number of trips	Visitor use days [1]
May	7	57
June	29	268
July	109	1,390
August	140	1,948
September	39	391
October	2	35
Totals	326	4,089

[1] Passenger use days only.

Late season boating activity from mid-September through November is limited to occasional commercial trips and regional private boaters, and also seems to correlate to warm, sunny weather.

The commercial rafting outfitters tend to be based in two geographical areas. The local companies are based in Medford/Ashland, Mt. Shasta, and Klamath Falls. Most of the other outfitters are based in the river-running areas of central California such as the South Fork of the American River, and the Tuolumne River near Yosemite National Park. Their clientele tend to be a mix of local/regional residents, and destination tourists who may have come from any point in the country or world.

Since the upper Klamath River was popularized for rafting in 1980, the number of people rafting the river with outfitters showed steady increases, with some variations for drought or economic conditions, until 1996. Since then, boating use levels have been relatively steady. This trend may be due to a number of factors: weather and regional economy, the aging of the baby boomer demographic, and less interest in risk activities such as whitewater rafting (see Table 2-3).

A large part of the late summer and early fall popularity of the upper Klamath River is due to the relative scarcity of this resource. Within the region, there are very few other rivers that offer raftable flows and a high quality Class IV and V whitewater experience at this time of year. Most boaters (75 percent) indicated in a user survey that if they were unable to float the upper Klamath River due to lack of sufficient flows from the J.C. Boyle Powerhouse, they would try to reschedule an upper Klamath River trip rather than float a substitute river (Oregon State University 1990).

Private boaters are not required to obtain a use permit; therefore private boating use is not counted as accurately as commercial use. Private use appears to be fairly steady at approximately 500 visitors per year. Most of the private boating occurs on Saturday, Sunday, and Monday's during the summer (BLM observations).

Commercial rafting is managed through the BLM Special Recreation Permit process to ensure that outfitters are professional and meet minimum standards, as well as to control the amount of commercial use.

In 1996, during a period of steady growth in commercial rafting use, a moratorium was placed on commercial rafting permits. At that time, there were 27 permits in place. Since then, the number of permits has decreased to 22, due to rafting outfitters going out of business, or deciding to stop offering tours on the upper Klamath. The moratorium capping the number of permits will be in effect until this plan is finalized.

Fishing

The upper Klamath River, managed as a wild trout river in all three segments, provides an excellent trout fishery and is among one of the better fly fishing rivers in Oregon. The Klamath Basin provides a wide variety of angling opportunities, but only the upper Klamath River provides virtually unlimited river access and an excellent catch rate for large wild rainbow trout on a major river. Only the Deschutes River rivals it in Oregon. Angling success, as defined by catch rates, varies depending on stream flows, with low flows providing the highest catch rates.

Currently, the upper Klamath, Rogue, and lower Klamath are the only major rivers in the region (Klamath, Jackson, Josephine, and Douglas Counties in Oregon and Siskiyou County in California) that are open to trout angling year-round. The Pit and Trinity Rivers, outside the region in California, also provide year-round trout angling opportunities.

Spring comes early to the upper Klamath River Canyon, providing the earliest angling opportunity for a river fishery in Klamath County. The majority of fishing use occurs during spring and fall. Most anglers in the canyon are residents of nearby communities (via BLM contacts) who usually come to fish for one day at a time. The river's reputation for producing large wild rainbow trout in this reach draws anglers from outside the region who come to fish for more than one consecutive day. A 1984 creel survey (City of Klamath Falls 1986) indicated that 87 percent of all anglers on the upper Klamath River are from Oregon and the remaining 13 percent are from California.

Hunting

Hunting occurs primarily on open benches along the river and in draws along the canyon rim. Black-tailed deer, silver-gray squirrels, mountain and valley quail, and turkeys are hunted. Additional recreational hunting occurs in spring and early summer for ground squirrels and marmots. In Oregon, hunting is regulated by the ODFW, and in California, by the California Department of Fish and Game.

Camping

The remote Klamath River Canyon offers campers a semi-primitive experience. This experience is more primitive downstream from Frain Ranch than above. The opportunity for isolation from the sights and sounds of people is a characteristic feature of the canyon that campers enjoy. Camping occurs either at Frain Ranch, at BLM designated sites, or at upland benches along the roads, usually by commercial whitewater boaters and anglers in the summer. Rafting outfitters providing 2-day trips camp either at Frain Ranch or upstream at BLM designated sites (BLM trip card information) These sites provide the last streamside access with open benches for camping before entering the long, steep, rugged, and narrow section of river. Support vehicles can drive to these areas and establish camp, which contributes to a safer raft trip with less weight in the rafts. Some camping occurs in the spring and fall, primarily by those who are hunting and fishing.

Recreation Sites and Facilities

Public recreation sites and facilities are located throughout the planning area (see Map 3). Immediately upstream from J.C. Boyle Dam is Topsy Recreation site. Topsy provides the most developed camping and day use site in the planning area. Site amenities include paved roads and campsites, toilet, water, recreational vehicle dump station, boat ramp and dock, and accessible fishing platform. Visitation at Topsy is light to moderate during most of the May-September season, except for some mid summer weekends when it fills to capacity.

The BLM Spring Island River Access facility with toilet, picnic table, message board, and registration drop box is located at RM 220.1, approximately 0.25-mile below the J.C. Boyle Powerhouse. No overnight parking or camping is allowed. Approximately three miles below the boat launch area on river-right is the Klamath River Campground with three semi-primitive campsites with tables, vault toilets, and fire pits.

Five additional fire-safe sites are available along the river’s edge, down to approximately RM 216. There are several primitive campsites at Frain Ranch. No recreational access or facilities are provided from approximately RM 214.3 to the Oregon/California state line.

The jointly managed BLM/PacifiCorp Stateline River Access area with toilets and primitive campsites is located at RM 209, just downstream of the Oregon/California state line. PacifiCorp provides fishing access on private land through five gated entrances along Topsy Road in Segment 3 with parking space, toilets, and message boards. An additional river access for raft take-out is located just upstream from Copco Reservoir at Access 1.

Roads and Access

The upper Klamath River Canyon is readily accessible from the four major population centers in the southern Oregon and northern California region. West of the canyon, Interstate 5 extends north/south through Medford, Ashland, and Yreka (Map 1).

East of the canyon, U.S. Highway 97 runs north-south through Klamath Falls and Weed. Both highways provide access from the major metropolitan areas of Portland, Oregon, and

Sacramento and San Francisco, California. State Highway 66, one mile north of the planning area, provides east/west access between Klamath Falls and Ashland. Regularly scheduled commercial air service is available at the Medford and Klamath Falls airports, and there are daily rail and bus services to Klamath Falls.

The main transportation route to the river is by State Highway 66 (Green Springs Highway), an east/west route between U.S. Highway 97 and Interstate 5. Physical and administrative access is provided to the river corridor by several improved and seasonal roads in the canyon. Public access is currently unrestricted; however, on some road segments that cross private land, public use is at the discretion of the landowner. Approximately seven miles west of Keno, Oregon, where State Highway 66 crosses the Klamath River, there are two access roads; one leading to the Topsy Road, which parallels the east side of the river in all three segments, and the other to the J.C. Boyle Powerhouse Road which parallels the west side of the river in Segments 1 and 2 (see Map 3). Picard Road from Dorris, California, provides public access to the Topsy Road from the southeast. Both Siskiyou and Klamath County maintain this road.

The road network (approximately 77 miles in the planning area) provides access to hydroelectric facilities, private land, and recreation sites (see Table 2-5 for road mileages within the planning area). Use of roads by recreationists includes general sightseeing, nature study, off-highway vehicle travel, and river access for camping, fishing, whitewater boating and waterplay.

The graveled Powerhouse Road enters the planning area above the forebay in Segment 1 (RM 223) and is routed along the western canyon wall. The road generally remains far above the river, descending to streamside only at the powerhouse area, the BLM campsite (approximately RM 217), and where it ends at the Oregon/California border. A graveled flume maintenance road runs adjacent to the concrete flume and along the western canyon wall in Segment 1. This road is much closer to the river than the Powerhouse Road and affords fishing access and fine views.

There is motorized access to the Klamath River from the Powerhouse Road in Segment 1 at the northern planning area boundary, as well as at several points along the flume road. In Segment 2, river access is at the powerhouse (RM 220.3), the BLM raft launch area (0.25-mile downstream from the powerhouse), the BLM campsite (RM 217), on both sides of the river near Frain Ranch (RM 215), and across from the Salt Caves (RM 211.8).

Table 2-5.—Road network features within the planning area [1]

	Segment 1		Segment 2		Segment 3		**Total**	
Ownership	Miles	Road Density[2]	Miles	Road Density[2]	Miles	Road Density[2]	**Miles**	**Road Density[2]**
BLM	5.4	3.6	26.7	3.3	2.7	1.2	**34.8**	**2.9**
PacifiCorp	3.7	12.3	10.7	6.3	14.3	1.6	**28.8**	**2.6**
State of Oregon			1.0	5.0			**1.0**	**5.0**
USFS					1.0	1.0	**1.0**	**1.0**
Private	1.5	3.0	5.0	3.3	4.4	1.0	**10.9**	**1.7**
Total	**10.6**	**4.6**	**43.4**	**3.8**	**22.4**	**1.3**	**76.5**	**2.5**

[1] The road length and density figures for Segment 3 and for the planning area as a whole underestimate actual road length for Segment 3, as a result of limited road inventory information on private lands.
[2]Calculated as miles of road per square mile of land area

From the northern planning area boundary to approximately RM 213, the Powerhouse Road is generally passable year-round. This public access road is maintained by PacifiCorp from State Highway 66 to the powerhouse. Beyond the powerhouse, the unimproved access road consists of a single-lane, rocky roadbed. Free public access on this road is provided under the terms of the current FERC license to PacifiCorp.

From RM 213 to the state line, the road is usually impassable in the winter and early spring due to snow and mud. Portions of the Powerhouse Road and other roads in the southwest portion of Segment 2 are closed seasonally (as part of the Pokegama Cooperative Seasonal Closure) to minimize intrusions into deer winter range and road damage.

Though much of the northern portion of the Topsy Road is outside of the planning area, the entire length of this road serves as an important public access route into the river canyon. Topsy Road is routed high above the river in Segments 1 and 2, descends to river level at RM 208 in California, and remains at river level through Segment 3 to Copco Reservoir. The Oregon portion of Topsy Road is classified by Klamath County as a “local access” road with no designated party responsible for road maintenance (Klamath County has jurisdiction over the road, however). The California portion of this road is accessible by the public and maintained by Siskiyou County.

Public access to the river from the Topsy Road is available during much of the year at Frain Ranch in Segment 2, as well as at a few other locations. Above RM 209 in Segment 3, the BLM raft take-out area provides easy access to the river. There are five designated fishing public access points to the river on private land with parking spaces along Topsy Road in Segment 3 provided by PacifiCorp. Two bridges along Topsy Road (Rock Creek and Shovel Creek) are affecting stream and riparian processes.

Other roads on the west side of the river include a seasonal dirt road that begins above the canyon rim and intersects the Powerhouse Road at RM 211 and 209.5, and a seldom-used jeep road that parallels the river between the Powerhouse Road and the river between RM 216.3 and 215 (Turtle Camp Road). Other roads on the east side of the river include numerous constructed and user-created roads in the vicinity of Frain Ranch, a number of roads in the vicinity of a large meadow near Rock Creek, and private roads that provide access to ranches and timber in California.

Roads within the planning area are predominantly surfaced with either native materials (such as soil) or crushed rock or gravel. Pavement or cinder surfacing is rare in the planning area (see Table 2-6 for a summary of road surface types and conditions). Of the road segments inventoried in 2001, approximately one-third were in poor condition (meaning that they were either very rocky, extremely rutted, or were washboarded). Most of the roads in poor condition were native surface roads that receive little maintenance.

Due to their location and/or condition, some road segments may be contributing to resource degradation. Damage to cultural sites has been documented both along the river and elsewhere in the canyon. Noxious weeds may be dispersed by vehicle traffic and road maintenance activities. In areas of poor drainage, on steep grades, and near stream crossings and riparian areas, road use may be causing sediment contributions, enhanced runoff, or damage to vegetation and soils. The 2001 road inventory documented no sites with obvious resource damage (in this case, meadow damage or braided roads) in Segment 1, 21 sites in Segment 2, and 12 sites in Segment 3. The documented sites in Segment 3 are associated with irrigated meadows or irrigation ditches, and do not currently present a high potential for resource damage, given that most roads in this segment are not open for public access.

Table 2-6.—Road surface types and conditions within the planning area

Surface type	Condition [1]	Segment 1	Segment 2	Segment 3	Total w/in Planning area Miles	Percent
Native surface	Good	1.6	13.5	4.4	19.5	25
Native surface	Poor	0.8	9.0	3.9	13.7	18
Crushed rock	Good	7.6	8.8	7.0	23.4	31
Crushed rock	Poor	0.0	5.9	0.2	6.1	8
Vegetated	Good	0.2	2.8	1.3	4.3	6
Vegetated	Poor	0.0	1.9	2.0	3.9	5
Cinder	Good	0.1	0.1	0.0	0.2	<1
Cinder	Poor	0.0	0.0	0.0	0.0	0
Paved	Good	0.4	0.3	0.0	0.7	1
Paved	Poor	0.0	0.0	0.0	0.0	0
Unknown surfacing/ condition		0.0	1.0	3.8	4.8	6

[1] Roads characterized as being in poor condition include those that are rocky, rutted, or washboarded.

Cultural Resources and Traditional Uses

Cultural resources within the planning area are divided into three categories (1) prehistoric, (2) historic, and (3) current Native American traditional use. Prehistoric resources are associated with Native Americans and date before the time of contact with European settlers (A.D. 1850). Information about these resources is recovered through scientific archaeological investigations and oral histories. Historic resources date after A.D. 1850 and are more than 50-years old. In the planning area they are associated with early stagecoach and freight travel, early ranching and logging activities, and in one case, sacred use by Native Americans.

Prehistoric

Archaeological surveys, excavations, and artifact analyses have been conducted within the planning area over the last 43 years. Initial investigations by the University of Oregon in the late 1950s were prompted by the construction of the J.C. Boyle Powerhouse and Dam (Newman and Cressman 1959). Later, as part of the proposed Salt Caves Hydroelectric Project, the City of Klamath Falls (1984-1986) surveyed land and test excavated 20 sites within the planning area. In 1989, 750 acres of BLM-administered land in the planning area were surveyed (Class III - Intensive Field Inventory) by the BLM. The BLM also initiated a contract in 1989 to integrate and consolidate information obtained during the past 30 years from sites in the canyon with data from the 1950's into a single cohesive framework (Mack 1991) to help assess the suitability of the Klamath River Canyon for the wild and scenic river designation.

The Upper Klamath River Canyon Project started in 1992, to collect the canyon's ecosystem data and develop a land use history of the area. Surveys, excavations, and analyses have provided information about prehistoric activities in the canyon. Consultation with Native Americans has yielded information on the prehistory of the planning area and its relation to the lives and culture of living people, and enhanced the scope of our understanding of the prehistoric use of the canyon.

Over 100 prehistoric sites have been located in the upper Klamath River Canyon. The wide variety of known sites within the river corridor demonstrates intense prehistoric use of the canyon by Native Americans. Use of the canyon by Native Americans dates back to at least 5500 B.C.; however, archaeological data (radiocarbon dates, time-sensitive projectile points, and pottery) indicates that most of the sites within the planning area were occupied from A.D. 900 to A.D. 1850 (Late Prehistoric Period) (Mack 1995).

The wide diversity of riverine-associated plants and animals, the trade and communication corridor provided by the river, and the relatively mild winter climate within the canyon are just a few of the factors which explain the concentration of prehistoric sites in the planning area.

The diversity of site types in the canyon and archaeological evidence of the prehistoric diet indicate that the upper Klamath River Canyon was occupied year-round from at least A.D. 900 until approximately A.D. 1800 (Mack 1989). Present are fishing, gathering, and hunting camps, and pit house villages (pit houses are circular depressions reflecting a semi-subterranean prehistoric house structure.

Using ethnographic accounts (Silver 1978), the pit house villages have been interpreted as winter villages, while lithic scatters (concentrations of flaked stone debris and tools) are viewed as fishing, gathering, or hunting camps depending on location, used in the spring, summer, and fall. It is apparent that the large diversity of plant and animal resources in the canyon allowed year-round use of the canyon, rather than only seasonal use as is common for most of the riverine areas of the region.

Occupation of a river corridor on a year-round basis was an uncommon occurrence in this regionæthe distribution of plant and animal resources is usually over a wide area necessitating the seasonal movement of people from place to place. Archaeological analysis has shown that the prehistoric diet included the use of fish, acorns, large and small mammals, turtles, birds, and various plants (Silver 1978).

Due to the biological diversity of the canyon, resources were readily available within the planning area during different seasons of the year: anadromous fish in the spring and late summer; turtles in the spring, summer, and fall; acorns in the fall; and large game being taken primarily in the fall (Mack 1983).

In addition to the sites found within the canyon, sites that are easily accessible from the canyon have been found in areas where roots, seeds, and berries are available. These sites show that resource areas adjacent to the canyon were also used prehistorically to increase and supplement the Native American subsistence base.

Ethnographic accounts (Silver 1978; Spier 1930; Kroeber 1925; Gleason 2001) and artifacts recovered from sites within the planning area indicate the area was used by a variety of cultural groups and at different times. One group has been identified as the Shasta Nation of northern California.

In addition, the federally recognized Modoc and Klamath Tribes of the Klamath Basin, the Takelma of the upper Rogue River, and possibly the Pit River Indians of northeastern California are known to have used the area. Common to all of these Tribes was the use of winter pit house villages, hunting and fishing camps, and a subsistence pattern in which anadromous fish; acorns (where available), large and small mammals, and various plants were major parts of their diet.

Cultural differences between these Tribes are largely attributed to their geographic position and the influences of Tribes from outside of this region. These cultural differences resulted in the use by each Tribe of distinctive artifact forms, including projectile points, ground stone, and pottery. Pottery recovered at one site suggests that this site was occupied by the Takelma prior to its use by the Shasta. Burials and flaked stone tools show that some of the sites within the southern portion of the canyon were used by the Shasta. Projectile point types also indicate that the Modoc, Klamath, and possibly the Pit River Indians used sites within the canyon.

The wide range of artifacts from sites in the planning area shows that use of the canyon by different Tribes changed over the last 2,000 years. This is important because it shows that territorial boundaries between the different Tribes using the canyon did not remain the same through time (an assumption often made about the boundaries of prehistoric culture areas), but changed as each group expanded or decreased its Tribal area.

Archaeological investigations over the last four decades in the upper Klamath River Canyon have provided information about prehistoric use of the canyon, as well as the region. Excavations at ten of the pit house village sites have yielded information about the prehistoric diet, burial practices, architectural features, and aspects of tool manufacturing and use.

Several of these sites are very large and could provide more detailed information about prehistoric use of the canyon. Tribal boundary fluctuations, trade of raw material and finished products, and a greater understanding of the early use of the canyon are just a few of the research questions that could be pursued by additional research in the canyon.

Archaeological sites are eligible for nomination to the National Register of Historic Places if they have yielded, or may be likely to yield, information important in prehistory or history (BLM Regulations, 36 CFR 60.4[d]). The archaeological data from sites within the canyon make all sites eligible for nomination to the National Register of Historic Places and collectively as an Archaeological District. Current management direction is to evaluate the Klamath River Canyon for nomination to the national register of historic places as an archaeological district (KFRMP/FEIS).

Historic

After the 1850's, Native Americans continued to use the canyon for hunting, fishing, gathering, spiritual purposes, trade, and inter-Tribal communications. However, due to encroachment by Euro Americans, their activities were not as prevalent as in prehistoric times. Ethnographic and Euro American historic accounts (see Theodoratus et al. 1989) present only a generalized level of information concerning historic use by Native Americans.

Consultations with Native Americans yield a different perspective on historic use of the area. This perspective reflects a continuous link between prehistoric and historic cultural and spiritual uses, a linkage that has continued into the present; tying the lives of members of the Klamath Tribes and Shasta Nation with those of their ancestors who once inhabited the canyon.

Ethnographic investigations in association with archaeological research (City of Klamath Falls 1985) have identified use of one village site for religious ceremonies associated with the 1870 Ghost Dance, a Native American religious cult that first developed in the early 1870's on the Great Plains and then spread to Tribes in the west. Ceremonies were conducted so the deceased would return to the earth and help the living Native Americans regain control of their destiny. This religious doctrine was apparently transmitted from the Klamath Tribe, down the Klamath River, to the northern California Tribes (Spier 1927). This Ghost Dance site was probably part of the southward spread of the religion.

The upper Klamath River Canyon has been used extensively by Europeans since the 1850's. The terraces and flood plains along the river and several meadow areas above the river were excellent locations for agricultural and ranching activities. These areas were the focus of European settlers in the canyon.

The earliest European explorers in the vicinity of the planning area were members of Peter Skene Ogden's Hudson Bay Company expedition of 1826-27 (LaLande 1987). In their search for fur-bearing animals in southern Oregon, Ogden's party traveled along the western canyon rim (within the planning area). Unable to access the river because of the steep canyon wall, the explorers left the canyon rim near RM 222.5. Traveling southwest across the Pokegama Plateau (the area north of the river) the party again reached the river near Copco Reservoir and continued westward through the Cascade Range (LaLande 1987). Thirty years later (1856) Mart Frain, a noteworthy local figure, followed the river northward from the mining town of Yreka, California, to the Klamath Basin. Upon reaching the Klamath Basin, Frain began the first trade with local Native Americans.

Settlement and ranching started in the 1860's when one of the first settlers, A.M. Johnson, homesteaded near the Klamath Hot Springs in 1860 (Hessig 1978). Settlement increased after the construction of the Topsy Road in the 1870s (Bartoy 1995).

The Topsy Road, a stagecoach freight road, is a prominent historical landmark of the planning area. Topsy Road parallels the river for 11.4 miles (5.1 miles in Segment 2; 6.3 miles in Segment 3) on the south and east side of the river. Bisecting the Cascade Range, this road was officially opened for wagon and stage travel in 1875 between Yreka, California, and the Klamath Basin.

However, as early as 1865, freight for Fort Klamath was carried up the river canyon along a route closely approximating Topsy Road. Topsy Road underwent three construction periods: (1) initial construction from 1874 to 1875; (2) a second construction period in 1887, when the steepness of the grade was lessened; and (3) the final period of construction in 1890 when Topsy Road and Topsy Grade were cut into a vertical basalt face. From 1875 to the early 1900s, when the road to Ashland, Oregon, was improved, and the railroad reached Klamath Falls via a route east of the river canyon, Topsy Road provided the only year-round access to Klamath Falls and to towns east of the Klamath Basin.

Daily travel occurred with an overnight stop at the Beswick Hotel and Klamath Hot Springs in Segment 3 (see Map 4), and livery stops at the Way Station Ranch (0.5-mile north of the California/Oregon state line in Segment 2) and Overlong Station, which is above Topsy Grade.

The Beswick Hotel and Klamath Hot Springs complex in Segment 3 provided a popular overnight stop for stage passengers and freight drivers, as well as a vacation resort/health spa. The resort had a hotel, post office, store, saloon, swimming pool, restorative hot springs, dance pavilion, stables, plus living quarters for employees.

In its heyday as a famous spa, the hot springs were visited by such noted guests as President Herbert Hoover, author Zane Gray, and pilot Amelia Earhart. The first Beswick Hotel was constructed around 1870; a second hotel, built in 1887, was destroyed by fire in 1915.

Stones from the second hotel were used to construct a dance pavilion around 1920; this, too, was destroyed by fire. The post office, store, and saloon, all housed within the same building; swimming pool; stables; and living quarters for the resort employees are still standing today and are visible from the road and river.

Way Station, a livery stable and log cabin associated with travel on Topsy Road, is still standing. The location of Overton Station, another livery stop, is identified by several poplar trees above Topsy Grade.

Two additional historic ranch sites are found along Topsy Road; Kerwin Ranch, where the foundations and apple orchard are still visible, and the Frain Ranch, purchased by Mart Frain in 1888 and deeded to his three sons in 1893. The Frain Ranch contains the visible remains of a log cabin, root cellar, barn, and garage. The orchard, pasture lands, and the log cabin are visible from the river.

A pioneer cemetery, the Way Cemetery, is located off Topsy Road and contains the graves of Mart Frain and members of the Way, Ward, Ovelton, and Hoover families (all early ranching families). Topsy School, at the foot of Topsy Grade, was attended by children of the nearby ranches and logging camps.

All located within Segment 2, these historic sites display historical markers containing brief, descriptive accounts, courtesy of the local historical society. Two other historic ranches within Segment 2, the Hoover and Butler Ranches are on the west side of the river.

In addition to being a communication and travel corridor, the upper Klamath River played a major role in the logging operations of the area. The first cutting of timber started in the 1860s. Nearby ranchers and farmers cut posts for fences, poles and lumber for building construction, and fuelwood for home heating. The first commercial cutting was done in 1888 on the Oregon side north of the river, east of Hoover Ranch, and south of the river around Kerwin Ranch. Logs were pulled by horses along a ground-level chute made of logs braced side-by-side, to a landing at the river's edge. These logs were floated to a mill at Pokegema (later Klamathon), California, in 1891 (Helfrich 1966).

A major engineering feature of these logging activities was a wooden log chute, known as the Pokegama log chute, which was cut into the western canyon wall in Segment 3 (see Map 4) and put into operation in 1892. For ten years, logs were brought from the Pokegama Plateau by train and unloaded at the top of the chute.

The logs were pushed onto the chute, and by gravity, slid down into the river. The logs were then floated down the river to the mill at the town of Klamathon. At the height of its operation, 300 logs per day were carried down the 2,000-foot chute and over 110 men were employed along the river to facilitate movement of the logs downstream.

Today the only reminder of the log chute is a cut at the top of the canyon rim and a scar where the chute cut through the hillside, which are both visible from the river and Topsy Road.

Native American Traditional Uses

Traditional use by Native Americans of the upper Klamath River Canyon began before contact with Euro Americans and has continued into the present. Today, members of the Klamath Tribe and the Shasta Nation continue to use the canyon for spiritual purposes, hunting, fishing, gathering, and other cultural activities.

Many of the traditional use areas can be considered traditional cultural properties. A traditional cultural property is defined as a property that "is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in the community's history, and (b) are important in maintaining the continuing cultural identity of the community" (National Register Bulletin No. 38).

The Klamath and Shasta consider the river and canyon sacred because of their historical use by Tribal ancestors and present day use by Tribal members. From a spiritual perspective, the river expresses the value of life to the Klamath Tribes.

Innumerable stone cairns throughout the canyon attest to its long and continued spiritual use. These cairns are pages in the Klamath People's history, a very real conduit to the lives and spirits of those who walked the earth in the near and distant past. Further, the land and river are spiritually powerful to the Klamath People.

In the Native American world view, unlike that of Euro Americans, the land and the lives of the people who inhabit it are inextricably intertwined; to destroy the land is to unravel the fabric of life in which the people live. The upper Klamath River is one of the few parts of the region left that has been relatively untouched by development over the past 150 years. For the Klamath and their neighboring Tribes, the river and its canyon are very much a part of what makes them a people (Klamath Tribe 1989, personal communication).

A similar value of the river canyon is expressed by the Shasta Nation; to them this area represents a crucial link with the spiritual world:

> "For generations individual members, our spiritual leaders, and medicine persons have traveled to these burials to communicate with the Great Creator, to perform rituals, and to prepare for specific religious and medicinal ceremonies. The area contains places where our medicine people ascend, as they have throughout history, to their position … the first medicine power was received there, and the first practitioners of that power were brought forth and taught there . . . " Guidance for daily life and for crises that individuals in the Tribe must face comes from those sites" (Hall 1985).

The various forms of spiritual use of an area by Native Americans do not fall within categories readily familiar to religions of western society. Religious use of a particular area encompasses a wide range of elements and observances.

Rituals can be practiced on an individual level where a person observes a particular practice as part of their daily activities. Small group observances might involve a family group with a religious specialist (shaman/doctor) who with esoteric knowledge has special access to supernatural power often used for curing or life-crisis events (for example, the death of a loved one). Other rituals and ceremonies involve the participation of all society's members in events considered to be vital to the society as a whole (essential resources such as fish, acorns, and epos). These larger rituals renew and emphasize members' needs for, and dependence on, the total society. The rituals must be performed properly according to well-established rites that involve time, place, and symbolic objects (Theodoratus et a1. 1989).

The concept of spiritual/supernatural power is a basic element in all Native American religions practiced in the planning area. Native Americans in the planning area had/have strong development of the religious concepts through their intimate day-to-day contact with the environment (trees, rocks, springs, weather, shapes, and animal life, etc.) many, which potentially contained power. Spirit-quests by individuals at special locations embodied with supernatural qualities were/are important (Theodoratus et al. 1989).

Native Americans also value the canyon for other important cultural activities. The river area has long been used for fishing, gathering, and hunting; as a meeting place between the area's various Tribes and bands; as shared fishing villages; and as a site of inter-Tribal exchange and communication. There are no instream water rights for the Native Americans who use the Klamath River within the planning area. The area also contains archaeological and environmental information and material that sheds light upon the culture and history of the Klamath, their neighbors, and their ancestors (Klamath Tribe 1989, personal communication).

Vegetation and Soils

Special Status Plant Species

There are no documented sites of federally listed threatened or endangered plants in the planning area. Limited surveys have been conducted, but there have been no systematic surveys covering the entire planning area. Species of special concern that have been documented in the planning area include the mountain lady slipper orchid (*Cypripedium* *montanum*), Greene's mariposa lily (*Calochortus greenei*), Bolander's sunflower (*Helianthus bolanderi*), red-root yampah (*Perideridia erythrorhiza*), Howell's false-caraway (*Perideridia howellii*), and Lemmon's catchfly (*Silene lemmonii*) (Table 2-7). Several other special status plant species occur nearby and may potentially be found in the planning area. Several populations of Bellinger's meadow foam (*Limnanthes floccosa* ssp. *bellingeriana*), a Bureau sensitive species, have been found within the Pokegama area, which is adjacent to the west rim of the upper canyon just outside the planning area boundary. Numerous populations of a Bureau tracking species, the pygmy monkey-flower (*Mimulus pygmaeus*), have also been found at many sites within the Pokegama area. Short-podded thelypody (*Thelypodium brachycarpum*), a Bureau assessment species, is a forb that historically has been found on the Klamath River near the town of Keno (Abrams 1944), and, therefore, may occur in the planning area.

Survey and Manage Species

The diverse collection of plant communities and habitats in the Klamath River Canyon potentially support populations of survey and manage (see Glossary) organisms, including fungi, lichens, bryophytes (mosses and liverworts), and vascular plants. The only survey and manage plant documented to occur in the planning area is the mountain lady slipper orchid (*Cypripedium montanum*), a Category C vascular plant species. Category C species require pre-disturbance surveys be conducted before on-the-ground management projects are implemented. Recent surveys at a strategic survey plot within the Klamath River Canyon near the Oregon-California border found a lichen (*Peltigera collina*) which was recently removed from survey and manage list by the 2001 "Survey and Manage Record of Decision."

Noxious Weeds

Noxious weeds are plant species designated under federal, state, or local laws and ordinances to cause economic loss and/or harm the environment. Noxious weeds generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, parasitic, toxic, a carrier or host of destructive insects or plant and animal diseases, and are nonnative, new, or not common to the United States.

Populations of Russian knapweed (*Acroptilon repens*), yellow starthistle (*Centuarea solstitialis*), poison hemlock (*Conium maculatum*), Scotch broom (*Cytisus scoparius*), St. John's wort (*Hypericum perforatum*), yellow toadflax (*Linaria vulgaris*), Himalayan blackberry (*Rubus discolor*), and puncture vine (*Tribulus terrestris*) have been documented

Table 2-7.—Special status plant species known to occur within the planning area

Common name	Scientific name	Status[1]	Number of populations
Greene's mariposa lily	*Calochortus greenei*	BS	9
Mountain lady slipper orchid	*Cypripedium montanum*	BT	1
Bolander's sunflower	*Helianthus bolanderi*	TS	2
Red-root yampah	*Perideridia erythrorhiza*	BS	11
Howell's false-caraway	*Perideridia howellii*	TS	3
Lemmon's catchfly	*Silene lemmonii*	TS	3

[1] BS = Bureau sensitive species; BT = Bureau tracking species.

and mapped within the planning area through incidental surveys by BLM staff and university researchers (Table 2-8).

Limited surveys along roads have been conducted in the past, but there have been no systematic surveys covering the entire planning area, and most of these populations were found in the course of other activities. Several populations of diffuse knapweed (*Centuarea diffusa*) have been documented in the Topsy/Grenada area just east of the canyon rim adjacent to Section 1 of the planning area. Several populations of Dyer's woad (*Isatis tinctoria*) have been found within the Pokegama area, which is adjacent to the west rim of the upper canyon just outside the planning area boundary. Populations of hoary cress (*Cardaria draba*) have been reported from the California portion of the planning area, but those sites have not been documented or mapped.

The current emphasis for noxious weed management in the planning area is treating known populations of along roadsides with either spot applications of EPA approved chemicals or using biological control methods.

Vegetative Communities

The Upper Klamath River Canyon is narrow and steep, averaging one mile or less from rim to rim from J.C. Boyle Dam on the north end of the planning area to RM 215 above Frain Ranch. South of this point the canyon gradually widens, and slopes are not quite as steep. Elevation ranges from 4,400 feet along the top of south canyon rim, to about 2,580 feet at RM 204 below Spannaus Ranch at the south end of the planning area.

The vegetation of the planning area is distinctly different from adjacent areas above the rims, especially above RM 215. The plant communities are an extension of the warm, dry chaparral and woodlands of northern California, mixed with plant communities of the east slope of the Cascades and Sierra Nevada. The variety of topographic features, aspects, elevation, and soils, has created a complex mosaic of plant communities. See Appendix J for listing of plant species that occur in the planning area.

A map of current vegetation by plant community has been developed using 1999 Landsat satellite imagery. This imagery recorded vegetation on a grid of 30-meter square pixels (approximately 90 feet square, or 0.2 acre in size). Each pixel was classified by the majority vegetation type on the area. An analysis was conducted, ground checked for accuracy, and

Table 2-8.—Known noxious weed sites within the planning area

Common name	Scientific name	Number of populations	Acres infested
Russian knapweed	*Acroptilon repens*	1	0.1
Yellow starthistle	*Centuarea solstitialis*	33	278.4
Poison hemlock	*Conium maculatum*	12	6.3
Scotch broom	*Cytisus scoparius*	1	0.1
St. John's wort	*Hypericum perforatum*	14	9.7
Yellow toadflax	*Linaria vulgaris*	2	1.5
Himalayan blackberry	*Rubus discolor*	23	13.2
Puncture vine	*Tribulus terrestris*	1	0.5

then the pixels were aggregated by dominant plant community to form the current vegetation map (see Map 5). The major plant communities identified are conifer forest and woodland, dense oak woodland, open oak woodland, juniper woodland, mixed shrub, rabbitbrush-sagebrush, dry meadow, riparian, and irrigated meadow. Table 2-9 summarizes the acres by plant community for the planning area.

Conifer forest and woodland: This is the largest plant community and covers 8,366 acres or 43 percent of the 19,765-acre planning area. This community includes mixed ponderosa pine-Douglas fir stands (commonly found on lower slopes and benches), small pockets of Douglas fir below upper canyon rims, pine-oak-juniper stands on drier sites, and steep, rocky slopes with scattered pine, oak, and shrub.

An inventory of the Cascade Forest Reserve and adjacent lands in Oregon was published in 1900 (Leiberg 1900). The Klamath Canyon, referred to as Klamath Gap, was described as "a rocky and precipitous gorge, the slopes and bottom timbered with scattered trees, and the forest along the north bluff badly burned." Before European settlement of the area (circa 1870), periodic lightning-ignited natural fires and Native American burning maintained these forests in an open condition. These recurring fires burned through forest stands generally as relatively light ground fires and limited understory vegetation to perennial grass and only occasional groups of smaller trees. Widely spaced, large-diameter Ponderosa pine and Oregon white oak gave much of the area a savanna-like appearance.

Over the last 130 years, elimination of burning by Native Americans, grazing of ground fuels, and active fire suppression, have limited fire as a disturbance agent in most of these communities. Assuming an average fire-return interval of 15 years, an average of eight light ground fires has been missed. In many stands, the Douglas fir understory component has increased in density, as has the pine understory. Extremely dense stands with ladder fuels that

Table 2-9.—Plant communities in the planning area (in acres)

Plant community[1]	BLM	USFS	PacifiCorp	Other private	State of Oregon	Total of all ownerships
Conifer forest and woodland	3,315	235	2,220	2,481	115	8,366
Dense oak woodland	612	0	287	135	0	1,034
Open oak woodland	1,803	162	1,706	715	3	4,389
Juniper woodland	0	12	53	7	0	72
Mixed shrub	1,272	161	1,466	401	0	3,300
Rabbitbrush/sagebrush	184	0	480	91	0	755
Dry meadow	340	28	267	146	0	781
Riparian	45	3	246	37	0	331
Irrigated meadow [2]	0	0	374	0	0	374
Total	7,571	601	7,099	4,013	118	19,402[3]

1. The extent of mapped vegetation communities are subject to revision based on new or updated information.
2. Small riparian, dry meadow, and other upland communities, are included within this acreage. The actual extent of irrigated meadows is approximately 290 acres.
3. Total surface areas in planning area is 19,765 (19,402 land +363 water)

can carry ground fires to the forest canopy are the result. Accumulated logs and other dead material also contribute to the risk of stand-replacement fires. The dense, stressed stands are also at high risk for insect attack, primarily by bark beetles.

Management of BLM lands in Oregon is directed by the 1995 resource management plan. Commercial forest lands total 1,689 acres. Timber sales and other forest and woodland treatments can be implemented for wildlife, fuels, and other resource benefits. Sales or treatments must conform to requirements of the 1994 "Northwest Forest Plan." To date, timber harvest has been minimal. The last timber sale on BLM lands on the Oregon side was in 1985 at Long Point, at the extreme north end of the planning area. PacifiCorp lands include a small acreage of commercial forest. Some were partially cut in the 1970s. U.S. Timberlands owns 845 acres within the planning area on the Oregon side. Most of these lands are above the canyon; therefore management activities do not affect visual resource values as seen from the river.

Overall, the conifer forests and woodlands have overstories of Ponderosa pine, Douglas fir, or Oregon white oak, with incense cedar, sugar pine, California black oak, white fir, and western juniper less frequently found. Shrub species can include snowberry, western serviceberry, mountain mahogany, deerbrush, wedgeleaf ceanothus, Oregon grape, rabbitbrush, and gooseberry. More common forbs include wild strawberry, lupine, buckwheat, common buttercup, pussytoes, Nuttal's gayophytum, and Puget balsamroot. Common grasses include cheatgrass, hairy brome, medusa head wild rye, needle grass, pine bluegrass, blue wild rye, and western fescue. A complete list of known plant species occurring in the planning area appears in Appendix J.

Oak woodlands: The oak woodland communities are mapped as dense oak woodland (1,034 acres or 5 percent of the planning area), and open oak woodland (4,389 acres or 22 percent of the planning area). Crown cover of overstory trees was the one factor used to divide these oak communities. Oregon white oak is the dominant tree, and these woodlands and adjacent areas form the far eastern edge of its natural range. California black oak is a minor component of some stands. Black oak in this area forms the far northeast portion of its natural range (Little 1971).

Besides Oregon white oak and California black oak, other tree species include ponderosa pine, Douglas fir, incense cedar, and western juniper. Shrub species include mountain mahogany, wedgeleaf ceanothus, manzanita, poison oak, deerbrush, snowberry, western serviceberry, and rabbitbrush. Common forbs and grasses are Puget balsamroot, mountain dandelion, yarrow, Soloman plume, large-flowered collomia, wooly sunflower, buckwheat, tarweed, cheatgrass, blue bunch wheatgrass, needle grass, hairy brome, two-flowered fescue, Idaho fescue, pine bluegrass, bottlebrush squirreltail, junegrass, and medusahead wild rye.

The oak woodlands are usually found on hot, dry sites. Under natural conditions prior to European settlement, frequent lightning-caused fires and Native American burning maintained these woodlands in an open, savanna-like condition. Most of the oak suckers sprouting from root collars of snags would be killed back by these periodic fires, as were conifer seedlings originating from adjacent stands. The oak woodlands of today are much denser than presettlement communities. Scattered older trees (300 to 350-years old), with spreading crowns (instead of forming a savanna) now share a more closed woodland with an understory of younger oak 90 to 180-years old, as well as invasive conifers.

Until recently, management of the oak woodlands has been limited to removal of minor volumes of posts and fuelwood. In 1997 (approved under "Klamath Falls Resource Area RMP"), a hand thinning of younger oaks was done near Hoover Ranch on BLM land. Objective of the treatment was to increase growth of the oaks and increase production of acorns (mast) for mule deer, acorn woodpeckers, and other wildlife. A total of 214 acres of BLM oak thinning (out of 2,415 acres of oak woodlands) has been completed to date.

Presently (January 2002), a new and possibly exotic disease has been discovered in oak woodlands in California. Sudden oak death, caused by a *Phytopthora* fungus, has killed a large number of oaks in California, especially near the Pacific coast. California black oak has proven to be highly susceptible, while Oregon white oak's susceptibility is thought to be low (Oregon Department of Agriculture 2001). The nearest incidence of this disease is in Curry County, west of the planning area.

Juniper woodland: This community covers only 72 mapped acres, or less than 1 percent of the planning area. Western juniper is not the major component of arid woodlands, as it is in the foothills to the east. Western juniper, a major component of arid foothill woodlands to the east, can be found (also in old growth form) on rocky slopes. In limited areas, the century-long absence of natural fire has permitted juniper to invade adjacent lands. In other plant communities (particularly the conifer forest and woodland, and the oak woodlands), juniper occurs as a minor component as mostly scattered individual trees. Common shrub species include deerbrush, rabbitbrush, mountain mahogany, and gooseberry. Common forbs are buckwheat, common buttercup, pussytoes, Nuttall's gayophytum, and Puget balsamroot. Cheatgrass, hairy brome, medusahead wild rye, needlegrass, and pine bluegrass are some common grasses.

Mixed shrub: The mixed shrub community is found throughout the planning area on both slopes and benches. It covers 3,300 acres or 17 percent of the planning area. Species composition and relative abundance of species varies with site location, but common shrubs include birchleaf and curlleaf mountain mahogany, wedgeleaf ceanothus (a critical mule deer browse in this community), manzanita, poison oak, deerbrush, serviceberry, snowberry, and rabbitbrush. Oregon white oak can be abundant as a small, shrubby tree. Forbs and grasses are well developed in open areas and include Puget balsamroot, mountain dandelion, yarrow, Soloman plume, large-flowered collomia, wooly sunflower, buckwheat, and tarweed. Common grasses are cheatgrass, blue bunch wheatgrass, needle grass, hairy brome, two-flowered fescue, pine bluegrass, and bottlebrush squirreltail.

Rabbitbrush/Sagebrush: This shrub community is dominated by sagebrush and rabbitbrush, and is mapped as rabbitbrush-sagebrush, with 755 acres, or 4 percent of the planning area. This community has a more open shrub cover, and the areas between the shrubs support many species of forbs and grasses. Forbs include Puget balsamroot, mountain dandelion, yarrow, Soloman plume, large-flowered collomia, wooly sunflower, buckwheat, tarweed, California poppy, least hopclover, and tidy-tips. Grasses include bluebunch wheatgrass, needle grass, hairy brome, two-flowered fescue, pine bluegrass, bottlebrush squirreltail, cheatgrass, soft cheat, bulbous bluegrass, foxtail barley, and few-flowered wild oatgrass.

Dry meadow: The dry meadow community totals 781 acres, or 4 percent of the planning area. This community is typically dominated by forbs and grasses. They often have been heavily grazed by livestock, and are dominated by exotic annual grasses such as cheatgrass and medusahead wild rye. Other common grasses include pine bluegrass, bottlebrush squirreltail, soft cheat, bulbous bluegrass, foxtail barley, and few-flowered wild oatgrass. Forb species include large-flowered collomia, wooly sunflower, buckwheat, tarweed, California poppy, least hopclover, and tidy-tips. Some of the areas mapped as the dry meadow community are seasonally wet in the spring, and support sedges and rushes in the wettest portions, which dry out in the summer.

Riparian communities: These communities occur in narrow bands along the river, on the edges of islands in the river, in drainages within the canyon, and as components of upland wet meadows that are scattered throughout the canyon. These communities total only 331 acres or 2 percent of the planning area. Due to the confined nature of the canyon in some reaches, and fluctuating water levels from the outflow of the J.C. Boyle Powerhouse, the extent of streamside vegetation is limited (Scott et al. 1993). The lack of alluvial surfaces along the

Klamath River may also contribute to the limited extent of riparian communities. Channel incision and floodplain isolation have reduced the extent of riparian and wetland communities on both the Klamath River and tributary streams.

Common riparian overstory species include Oregon white oak, birch, white alder, ponderosa pine, and Oregon ash. Black cottonwood occurs along Shovel Creek and may occur elsewhere. Blue elderberry, Lewis mockorange, willow, Douglas spirea, and western wild grape are common in the shrub layer. Common forbs include watercress, monkey-flower, speedwell, cattail, and boreal bog-orchid. Reed canary grass, sedges, and rushes are also present. Reed canary grass forms large monotypic patches along the river, since it has a competitive advantage under conditions characterized by extreme and frequent water level fluctuation and poor water quality (Conchou and Fustec 1988; Guard 1995; Antieau 2000). Although not a major component of the riparian community, stands of quaking aspen are found in some drainages. Upland springs and seeps support riparian-type vegetation, which includes many of these same species.

Irrigated meadow: The exact extent of irrigated meadows is not known at this time. Analysis of air photos suggests that approximately 374 acres of land adjacent to the river in Segment 3 are irrigated meadows.

Since there are pockets of land within that section that do not qualify as irrigated meadow, the total actual area of irrigated meadow in Segment 3 is approximately 290 acres (Miller 2002, personal communication). The remainder (80 acres) of the mapped 374 acres consists of dry meadow, riparian vegetation, and inclusions of upland vegetation types within individual meadows. PacifiCorp manages the 290 acres of irrigated meadow for hay production (100 acres) and pasture.

Soils in these areas are derived from riverine and floodplain sediments and have textures ranging from clay-rich to gravelly, often arranged in complex patterns. These soil types have varying water holding capacities, with the more clay-rich types typically holding water longer than the gravelly types. Flood irrigation is supplied to the meadows via a series of ditches that divert water from the river and the Shovel Creek drainage. Because of undulating terrain and mixed soils, delivery of sufficient irrigation water to drier or better-drained areas (coarse-textured soils) may result in delivery of excess water to moister or more poorly-drained (clay soils) areas. In most years, natural inundation or sub-irrigation from the river is limited to narrow bands along the margins of the river or low spots on the landscape that are hydrologically connected to the river by bands of coarse-textured soils (Miller 2001, personal communication).

Vegetation in the meadows is primarily a mixture of grasses that has evolved over the past 130 years of agricultural use. The most common grasses are timothy, orchard grass, and various perennial species of brome and bluegrass. Various clover and rye species occur less frequently, while western fescue, meadow fescue, alfalfa, and meadow foxtail occupy drier sites. Bullrush and willow occupy sites on the margins of pastures, and rushes occur in wetter portions of Shovel Creek meadow and the meadow to the north of Hessig Ranch. Dense sod mats form when decomposition is impaired by moist conditions. Star thistle may compete strongly if irrigation is curtailed as a result of increased nitrogen availability (from decaying grasses) and decreased competition from irrigated annual species. Fertilization with nitrogen, sulfur, and phosphorus occurs annually at the beginning of the growing season, and haying typically occurs from mid-June to August. Pastures are managed on a short-term (every few weeks for example) grazing rotation system (Miller 2001, *personal communication*).

Soils

Most renewable resources depend upon soil. Soils store and release water to streams and wetlands, and provide a medium for plant growth. The combined influences of climate, vegetation, topographic relief, parent materials, and time interact to form soils with unique sets of characteristics. These characteristics determine the productive capability of soil and its management requirements.

The Natural Resources Conservation Service (formerly the Soil Conservation Service) has delineated geographic areas that have a distinctive pattern of soils, topography, and drainage. These "map units" often consist of multiple "soil series" that intermingle to the degree that it was not feasible to map them separately. Soils series can consist of numerous variants that reflect slope and slope aspect. For the general discussion that follows, these subdivisions of soils series are not mentioned specifically.

The planning area is located in a transitional area exhibiting some characteristics of immediately adjacent major geologic provinces. These include the High Cascades and the Basin and Range provinces. Variation in landforms and, to a lesser extent, parent materials, results in the diversity of soils types in the planning area. The soils within the planning area exhibit a range of characteristics typical of soils in a topographically complex area (City of Klamath Falls 1989).

Although many of these soil types have a limited distribution (less than 100 acres), a few soils types extend over large areas within the analysis area (Table 2-10). See Map 6 for the distribution of soils in the planning area.

Oregon Soils Summary

The primary soil series in the Oregon portion of the planning area are the Bogus, Greystoke, McMullin, and Skookum series. The following descriptions are from the "Soil Survey of Jackson County Area, Oregon" (USDA-SCS 1993).

Table 2-10. Soil Survey Information

Map unit	Acres[1]	% of planning area
Oregon soils		
Bogus-Skookum (1–12%)	968	5
Greystoke stony loam	816	4
Skookum-Bogus	1,238	6
Skookum-Rock outcrop-McMullin	886	5
Skookum-Rock outcrop-Rubble land (35–70%)	4,188	22
Terrabella Clay	70	<0.5
California soils		
Bogus stony to very stony loam	2,362	12
Jenny Clay and Jenny cobbly clay	174	1
Lassen-Kuck complex, stony and Lassen-Rock outcrop-Kuck complex	5,433	28
Lithic Haploxerolls-Rock outcrop complex	1,058	5
Medford clay loam, cool	327	2
Miscellaneous Oregon and California soils	1,882	10

[1] Approximately 363 acres of the entire planning area is water.

The Bogus-Skookum complex consists of very deep, well-drained soils on old terraces. They formed in residuum and colluvium derived dominantly from andesite, tuff, and breccia. Permeability is slow, runoff is slow, and the hazard of water erosion is slight. Potential plant community includes Douglas-fir, Ponderosa pine, Oregon white oak, California black oak, Oregon grape, common snowberry, wedgeleaf ceanothus, Idaho fescue, mountain brome, bluebunch wheatgrass, and pine bluegrass.

The Greystoke stony loam consists of deep, well-drained soil on hillslopes. It formed in colluvium derived from andesite. Permeability is moderately slow, runoff is rapid, and the hazard of water erosion is high. Potential plant community includes Douglas fir, Ponderosa pine, incense cedar, Oregon grape, pachystima, and fescue. Within this soil series, 48 acres within the planning area have been classified as fragile non-suitable woodlands under the BLM Timber Productivity Capability Classification system.

This inventory classifies timber stands based on their inherent soil properties and landform characteristics. Sites are designated as fragile, nonsuitable woodlands if they are judged to be biologically and/or environmentally incapable of supporting a sustained yield of timber.

The Skookum-Bogus complex is on hillslopes and shares similar physical properties and potential plant communities to the Bogus-Skookum complex.

The Skookum-Rock outcrop-McMullin complex is on plateaus and shares common characteristics to other Skookum series with the following traits from the McMullin series. Permeability is moderate, runoff is medium to rapid, and the hazard of water erosion is moderate to high. Potential plant community includes mixed shrubs, Idaho fescue, bluebunch wheatgrass, and pine bluegrass.

Soils within the Oregon portion of the planning area generally have slow infiltration rates when wet. This is a consequence of moderately high proportions of clay, especially in subsurface horizons. Despite the potential for surface runoff, most soils in the planning area have a low susceptibility to sheet and rill erosion of surface horizons. This is due to the high proportion of coarse fragments on the soil surface.

A small portion (approximately 70 acres) of the planning area in Oregon contains Terrabella clay loam soils, which are prime farmland soils (as defined by the U.S. Department of Agriculture (see Map 6). These soils are located in the vicinity of the Hayden Creek, Chert Creek, and Way Creek wet meadows.

Two soil series comprise 50 percent of the planning area, the Skookum series, and Lassen-Kuck complex. Both these soil series/complex series are comprised of 35-50 percent clay particles. Many of the other soil series within the planning area are also high in clay content. Due to this physical property, the potential for shrink-swell of these soils exists. The importance of shrink-swell in these soils may allow some amelioration of soil compaction over time. Further study is needed to determine the time frame and extent of this compaction amelioration

California Soils Summary

The primary soil series in the California portion of the planning area are the Bogus, Jenny, Lassen-Kuck complex, Lithic Haploxerolls-Rock outcrop complex, and Medford. The following descriptions are from the “Soil Survey of Central Siskiyou County California Central Part” (USDA-SCS 1983).

The Bogus stony to very stony loam are very deep, well-drained soils on mountains. These soils are derived dominantly from tuff (volcanic ash). Runoff is rapid, and the hazard of water erosion is high. Potential plant community includes Ponderosa pine, Douglas fir, with an understory of needlegrass, fescue, lupine, and roundleaf snowberry.

Jenny clay and Jenny cobbly clay are very deep, well-drained soils on terraces. These soils formed in alluvium and are derived dominantly from extrusive igneous rock (primarily basalt). Runoff is slow to medium; hazard of water erosion is slight to moderate. Soils within this series are classified as moderate to good agricultural soils. Potential plant community includes western juniper, bluebunch wheatgrass, Idaho fescue, bottlebrush squirreltail, and sulphur flower.

Lassen-Kuck complex stony and Lassen-Rock outcrop-Kuck complex are moderately deep, well-drained soils on hills. These soils formed in residuum derived dominantly from extrusive igneous rock (weathering of primarily basalt). Permeability is slow, runoff is medium to rapid, and the hazard of water erosion is moderate to high. Potential plant community includes western juniper, bluebunch wheatgrass, beardless wheatgrass, and Idaho fescue.

Lithic Haploxerolls-Rock outcrop complex is comprised of rock outcrops, and shallow, excessively drained soils on mountains. These soils formed in residual material derived from intrusive igneous or metamorphic rock.

Medford clay loam cool is very deep, moderately drained, soils on alluvial fans. These soils formed in alluvium derived from mixed rock sources. Permeability is moderately slow, runoff is slow to rapid (dependent on slope), and the hazard of water erosion is slight to high (also dependent on slope, slight on slopes less than 2 percent, high on slopes greater than 15 percent). Soils within this series are classified as moderate to good agricultural soils. Potential plant community includes western juniper, scattered oaks, Thurber needlegrass, and bottlebrush squirreltail.

Soils within the California portion of the planning area generally have slow infiltration rates when wet (for the same reasons as the soils within the Oregon portion).

Soil Erosion as a Result of Mass Movement

The planning area is relatively active in terms of erosion and mass soil movements, particularly within Segment 2. The Klamath River Canyon is thought to be a relatively youthful canyon that is actively downcutting. Evidence of this is the steep canyon slopes; the narrow, relatively straight river channel; and the abrupt change in river gradient at RM 214.3 (the Caldera area below Frain Ranch) (City of Klamath Falls 1989).

Landslides are common primarily in Segment 2 of the planning area. Landslides are present along both side slopes of the canyon. Large slides are thought to occur primarily where tuff (compact ash) is overlain with large basalt blocks, which collectively are known as basalt-caped tuff. Through natural erosion, which may cause slope steeping, the failure in tuff layers may allow the basalt to begin a down slope migration.

Benches and terraces found within the canyon may have been formed when massive landslides dammed the river and created upriver lakes. Lake sediment collected behind the landslide causing the formation of benches and terraces. Erosion breached a channel through the landslide allowing the river to resume its course (City of Klamath Falls, 1989).

Soil fungi and soil bacteria, as well as their associated predators such as various protozoa, nematodes, microarthropods, and earthworms are a necessary component of the ecosystem in order to maintain productivity of the soil community, which directly correlates to the health of the above ground plant community. Soil organisms maintain productivity by nutrient cycling of plant material, and fauna material (soil organism feces and dead soil organisms). The conversion of this “compost” into available forms of nutrients and minerals is necessary for plant growth (Ingham, E.R. 1997). Factors, which negatively affect the health of soil organisms, should be avoided or minimized during KFRA resource management projects.

Terrestrial Species and Habitat

The diversity of vegetation along the river attracts large numbers of wildlife. Because the river bisects the Cascades, this has become an important migration, movement, and dispersal corridor for wildlife and bird species.

Appendix K lists all species identified through established surveys or documented during field visits. We have also listed species with the high potential to occur within the study area based on species range, habitat availability, and expert opinions. The BLM is the primary agency that manages to maintain or improve wildlife habitat on public lands, while Oregon and California State fish and wildlife agencies manage the populations.

Recent habitat enhancement projects in or near the canyon include prescribed fire to rejuvenate brushfields for critical big game winter range, and oak thinning projects to improve health and mast crop production of oak communities. These oak communities are unique, and it is estimated that 90 percent of the historic range of the Oregon white oak communities have been lost due to urbanization, agriculture, and fire suppression.

The oak communities in the upper Klamath River Canyon make up the eastward most extension of their range. BLM manages oak habitats within the canyon for big game, turkeys, and a variety of landbird species that use these habitats. Several of these species have been identified by Partners in Flight as priority landbird species, such as the western bluebird, Lewis' woodpecker, the acorn woodpecker, and the vesper sparrow.

Special Status Species

The diverse plant communities found in the upper Klamath River Canyon provide a great variety of wildlife habitats and wildlife species. Appendix K displays the list of suspected and documented species in the upper Klamath River Canyon. This list also details special federal or state status species. Federal status of Threatened (FT) or Endangered (FE) receives full protection under the Endangered Species Act (ESA). Other federal special status categories include Bureau Assessment (BA), which could require alterations in project design to protect species or habitat and Bureau tracking (BT) which only requires documentation of the presence of the species.

Oregon special status species are listed as:

SE: State Endangered
ST: State Threatened
C: Critical
V: Vulnerable
P: Peripheral/Naturally Rare
U: Undetermined Status

Abbreviations used in CA (California State):

CSC: Species of Special Concern
SE: State Endangered
ST: State Threatened
FP: Fully Protected

Survey and Manage Species

Survey and manage organisms are considered rare or uncommon species within the range of the northern spotted owl which includes western Washington, western Oregon, and northwestern California, including the eastern flank of the Cascade Range. Survey work for these organisms includes both project surveys before habitat-disturbing activities, and strategic surveys (landscape-scale surveys) conducted at permanently established current vegetation survey plots located on a 3.4- or 1.7-mile grid across the Pacific Northwest Region.

The plots sampled each year are a randomly selected subset of these locations. The diverse habitats in the Klamath River Canyon potentially support populations of survey and manage organisms, including terrestrial and aquatic mollusks.

Terrestrial species/Habitat

Historical use of the upper Klamath River Canyon included homesteading, livestock production, and timber harvestingæthe canyon was also used as a major travel route. Despite this historical use and the current hydroelectric developments and recreation activities, the canyon remains relatively remote and undisturbed. With the surrounding sparsely-settled forests and rangelands, the canyon provides the habitat quality needed by the many species of wildlife found in and around the canyon.

The diverse terrestrial habitat within the planning area supports a large number of wildlife species. Several species of wildlife are found or expected in the surrounding environment that either reside within the planning area or use canyon habitat to some extent, including at least 197 species of birds, 67 species of mammals, and 34 species of reptiles and amphibians (herptiles) (see Appendix K).

Birds

Of the 197 known species of birds within the planning area, some reside year-round and others are seasonal or migratory. There are at least 19 known species of raptors, 44 species of water-associated birds, six upland game birds, and 109 landbirds. The other 19 species are woodpeckers or miscellaneous birds. Federal and state status is documented in Appendix K.

Because the Klamath River Canyon cuts across the Cascades, it is a natural migration corridor. The extensive rimrock, cliffs, and large trees in the canyon provide an abundance of nesting substrate for raptors. Osprey, bald eagle, prairie falcon, and American kestrel have multiple known nest sites in the planning area. Some raptors get special consideration through the current RMP, the *Endangered Species Act* and the *Migratory Bird Treaty Act*. These special considerations are seasonal restrictions to management activities and buffer zones around protected nest sites.

The fish inhabiting the Klamath River provide a good prey base for bald eagles and osprey in the canyon. At least two pair of bald eagles (federal and Oregon State listed threatened, California State listed endangered) nest within the planning area and appear to be year-round residents of the canyon. One pair has nested in the canyon every year since 1979 and, except for 3 years, has successfully fledged young (Isaacs and Anthony 2001). The pair has used four different nest sites since 1979, and all are located within the canyon in Segment 2. The other nest was officially documented in 2001 but communications with rafting companies and observation of the nest indicate that it was probably present for several years.

Two other pairs of bald eagles nest outside the planning area, but within 0.75 miles of J.C. Boyle Dam. They likely forage in J.C. Boyle Reservoir and in Segments 1 and 2. One nesting pair was discovered in 1983 and the other in 1998. Both have continued to nest in the vicinity. In 2001 all nest sites were occupied but only three young were produced. Migrating and wintering bald eagles are also found in the canyon.

Ospreys nest in the planning area and generally use the tops of large snags or live trees adjacent to the river for nest and perch sites. These birds are commonly seen foraging up and down the river. There are two known nest sites within Segment 2. At least one pair has nested in recent years, including 1999. There are also at least six nests adjacent to J.C. Boyle Reservoir whose occupants likely forage in the reservoir and Segments 1 and 2. There are several more nests in Segments 2 and 3.

Many prairie falcon nest sites have been documented in the planning area, one in Segment 1 and five in Segment 2. In Segment 2, one nest site is located on a cliff ledge 35 to 45 feet directly above the river; the others are on cliffs away from the river just below the canyon rim. Surveys done in 1984 and 1985 by the City of Klamath Falls (1986) show that a maximum of four of the sites in Segments 1 and 2 were occupied. In 2000, three of the historic nest sites in Segment 2 were monitored and two sites produced young. The recent status of nest sites in Segment 3 is unknown.

Other raptors found in the planning area include the red-tailed hawk, American kestrel, sharp-shinned hawk, Coopers hawk, great horned owl, long-eared owl, and western screech owl. The northern goshawk and northern pygmy owl, both Oregon State sensitive species, inhabit the planning area and may nest in or near the canyon. Golden eagles are commonly seen foraging in the canyon and are known to nest near the planning area.

The Klamath River Canyon is within the range of the federally listed northern spotted owl. The canyon lies within the main connectivity area between owl populations in northern California and the southern Cascades in Oregon. Below the planning area, the canyon opens up and the large expanses of open/grass communities may be a barrier to dispersal of young birds. The timber stands in the upper canyon may be an important part of the connectivity habitat between nesting/roosting/foraging habitat in southern Oregon and nesting/roosting/foraging habitat in northern California.

Through BLM's spotted owl banding program (District files), it has been documented that several spotted owls have successfully dispersed across the canyon. One particular owl was raised on the north rim of the canyon. Two years later it nested in Negro Creek just south of the planning area. The owls from the site in Negro Creek have been radioed and monitored and show use of portions of the planning area in Segment 3.

Although the peregrine falcon was removed from the federal Endangered Species List during 1999, it is still listed as endangered by state agencies in Oregon and California, and considered a sensitive species by the USFS and BLM. Peregrines historically nested in the canyon, with last known production in 1969 (Pagel 1999). No successful breeding was documented after this point.

One historic nest site is in Segment 2 and another is located a few miles south of the canyon in California, near Segment 3. Peregrines are known to migrate through and winter in the canyon and sightings have increased in the last few years. The most recent sighting occurred in June 1997, where one adult peregrine was seen (BLM observations 1997). In 1999, a habitat analysis study (Pagel 1999) for the peregrine falcon was conducted on BLM lands in Oregon including the area within Segment 2. The study by Pagel was designed to look at potential cliff complexes and summarize the habitat quality as low, medium, or high for nesting potential. Five sites were identified in Segment 2, one as low, one as medium, and three sites were identified as high.

These three "high potential" sites were monitored in 2000 and 2001 by BLM personnel and no peregrines were located. All three sites were occupied by prairie falcons in recent years. Because of the abundant prey base, use of the canyon as a migration corridor, and the abundance of suitable falcon nesting habitat, the potential exists for peregrines to reoccupy historic nest sites or establish new nest sites in the planning area as the species continues to recover.

A large area in southern Oregon and northern California, including the planning area, was designated as a management area for the recovery of the peregrine falcon (Pacific Coast American Peregrine Falcon Recovery Team 1982). In the "Final Eligibility and Suitability Report for the Upper Klamath Wild and Scenic River" (1990), the BLM had designated a portion of the cliffs in Segment 1 (cliffs near Big Bend) as protected habitat for falcons. The KFRMP/FEIS protects all cliff areas and talus slopes and in a 100-foot buffer around cliffs from ground-disturbing activities.

Wet meadows adjacent to slow-moving portions of the river provide feeding, resting, and nesting habitat for several species of waterfowl. Canada geese, wood ducks, and common mergansers are known to nest in Segments 2 and 3; and mallard, cinnamon teal, and Barrow's goldeneye, potentially nest along the river. Barrow's goldeneye is listed as a sensitive species in Oregon and by the BLM and USFS. Tundra swans and green-wing teal also use river habitat. There are many fish fingerlings found in the river, which provide a food source for double-crested cormorants, king fishers, and mergansers, all of which are common throughout the canyon.

Meadows, oak woodlands, grasslands, and dense shrub are important habitats for feeding and brood-rearing of upland game birds such as California and mountain quail, wild turkey, and chukar. The latter two were introduced into the canyon in the 1950s and 60s. Redlegged partridge, a species similar in appearance and related to the chukar, were introduced into the canyon by the ODFW in the spring of 1989. No chukar or redlegged partridge are considered to persist (ODFW 1999) after the earlier releases and there are currently no plans to continue to release either chukar or partridge into the area (ODFW 1999). Wild turkeys have been released as late as 1998 within or adjacent to the canyon. ODFW is currently working on a statewide management plan for future releases and management of the species. Mountain quail populations are currently under investigation statewide as a proposed threatened and endangered species. Incidental observations over the past 5 years by BLM personnel have identified several areas within the canyon that contain reproductive populations of mountain quail. Although ruffed grouse historically inhabited the planning area, no recent sighting records exist. This grouse may be present in areas that contain moist woody vegetation near springs and seeps or areas near the few aspen stands found in the canyon. This type of habitat is very limited within the canyon and likely limits the presence of ruffed grouse. Acorns from the abundant oaks found in the planning area are an important food source for turkeys. Turkeys also prefer wooded meadows adjacent to the river. Blue grouse, mourning dove, and quail are also present in the planning area. All of the game birds found in the planning area are open to hunting during season and all are permanent residents, except the mourning dove, which is migratory. Hunting seasons for each species are set by the California or Oregon wildlife management agencies. Hunting seasons in general are from late August through January. Each species has its own season that usually lasts for a short time (7 days for elk; 45 days for waterfowl).

A large variety of landbirds (80 species) have been documented in the Klamath River Canyon through an ongoing study initiated in 1997, which includes mist-netting and censusing. The diversity of habitats and geographic location of the river allows several bird species, which occur in California and the Rogue Valley, to penetrate into southwestern Klamath County (Summers 1993). These conditions contribute to the diversity of bird species found in the canyon. A list of all bird species expected and documented in the Klamath River Canyon is included in Appendix K.

Landbirds are of concern due to long-term population declines and habitat loss. At least two dozen species that breed in Oregon are known to have experienced long-term population declines based on breeding bird survey data. Riparian zones and oak woodland have been identified by the Oregon and Washington Chapter of Partners in Flight as two of four priority habitats for conservation based on the criteria of species declines and vulnerability to habitat loss (Andelman and Stock 1994). Both of these habitat types are present in the study area.

In addition, Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds" (66 FR 3853) dated January 17, 2001, directs federal agencies to take certain actions to conserve migratory birds in furtherance of the Unites States' obligations under the *Migratory Bird Treaty Act* and migratory bird conventions. In 2003, the BLM will be entering into a memorandum of understanding with the USFWS that outlines measures to ensure migratory bird conservation in conjunction with carrying out agency missions.

Although riparian habitat is limited in the canyon, it is a very important migration and breeding habitat type for landbirds. Over 60 percent of the species identified by Partners in Flight as neotropical migratory birds use riparian areas in the West during the breeding season, or as stopover sites during migration (Krueper 1993). In addition, riparian areas may harbor up to 10 times the number of migrants, as adjacent, nonriparian habitats (Stevens et al. 1977, *as cited in Rich [1999]*).

From 1997 to 2001, mist netting stations were set up at Frain Ranch (PacifiCorp land) to collect data on landbird demographics as well as baseline information on bird diversity and trends. This station is located on a bench along the river in habitat that includes riparian vegetation.

Additional data was collected through mist-netting in 1998 and 1999 at Keno Dam to determine bird use of the riparian zone. Preliminary results of the mist netting station data show that the Frain Ranch site consistently has some of the highest bird capture rates during the breeding season when compared to six other riparian sites being sampled in the Upper Klamath River Basin.

Results of the mist-netting study are that the most abundant species captured during the breeding/post breeding period were purple finches and song sparrows over the three years sampled for which data is available (1998-2000). Other abundant species included the warbling vireo, yellow warbler, lazuli bunting, lesser goldfinch, and Wilson's warbler. With the exception of the purple finch, all of these species are considered to be either riparian dependent or obligate species based on vegetation associations presented by Rich (1999). A list of the five most common species by year captured at the Frain Ranch constant effort mist netting station is presented in Table 2-11.

A total of 23 bird species, considered riparian associates, have been documented at the Frain Ranch and Keno Dam sites to date. Although sampling time was limited at Keno Dam, the most common species found during the breeding/post breeding period were the purple finch, yellow warbler, Audubon's warbler, Western tanager, song sparrow, western wood pewee, and spotted towhee.

During fall migration at the Frain Ranch site, the purple finch and song sparrow were the most consistently abundant species during the 1997 through 2000 period. Other species found to be common were the golden-crowned sparrow, pine siskin, hermit thrush, fox sparrow, and warbling vireo.

In addition to mist-netting, several survey routes for censusing songbirds were established in the Klamath River Canyon in 1998. These routes cover a variety of habitats including conifer forest and woodland, oak woodland and dry meadow over a length of approximately 15 miles. The purpose of these routes is to gather baseline data on bird species diversity, relative abundance, and habitat relationships of birds occurring in the canyon.

Oak woodlands, which are common in the lower elevation areas of the canyon, are important for approximately 100 native landbird species during their breeding season (Altman 2000). Oak/pine woodland, as defined by Altman (2000), refers to habitat including both oak-dominated woodland and mixed oak-pine habitats. Species most associated with this habitat include Lewis' woodpecker, western bluebird, and white-breasted nuthatch. Species such as the ash-throated flycatcher and acorn woodpecker are considered obligate or near-obligate to the oak woodland component (Altman 2000). All of these species, except the ash-throated flycatcher, have been documented in the canyon. The Lewis' woodpecker, an Oregon State

Table 2-11.— Abundance of landbird species*

	Yearly abundance ranking				
Bird species	**1997**	**1998**	**1999**	**2000**	**Total rank**
Bird abundance during the breeding/post breeding season					
Purple finch	N/A	1	1	1	1
Song sparrow	N/A	2	2	2	2
Warbling vireo	N/A	3	4	3	3
Lazuli bunting	N/A	4	5	–	4
Yellow warbler	N/A	–	3	–	5
Western tanager	N/A	5	–	–	–
Lesser goldfinch	N/A	–	4	–	–
Black-headed grosbeak	N/A	–	5	–	–
Wilson’s warbler	N/A	–	–	4	–
Willow flycatcher	N/A	–	–	5	–
Bird abundance during the fall migration season					
Purple finch	1	1	2	2	1
Song sparrow	2	1	1	1	2
Hermit thrush	3	3	–	3	3
Golden-crowned sparrow	2	5	–	–	4
Fox sparrow	3	–	–	4	5
Warbling vireo	–	1	3	5	–
Pine siskin	–	2	–	–	–
Spotted towhee	–	4	5	–	–
Ruby crowned kinglet/ White-crowned sparrow	4	–	–	–	–
Bushtit	–	–	4	–	–
Oregon junco/ Swainson’s thrush/Stellar’s jay	5	–	–	–	–

***** Relative abundance of the five most common landbird species captured at the Frain Ranch constant effort mist netting site (1997–2000) [1]

[1] Data was collected by the Klamath Bird Observatory and Redwood Sciences Laboratory, USFS, during the breeding/post breeding and fall migration periods. Several species were captured at the same rate and therefore have the same abundance rating.

critical and BLM sensitive species, occurs in the canyon in large numbers, especially during the winter period. Acorn woodpeckers also utilize the planning area and are the only population of this species that nests east of the Cascade Range.

Another species of concern documented in the canyon is the pileated woodpecker. This species is listed as BLM tracking and Oregon State vulnerable. The yellow-billed cuckoo, a riparian obligate species, is a federal candidate for listing as threatened or endangered, and is thought to be extirpated from this area.

Very little suitable habitat for this species is present in the Oregon portion of the study area. A limited amount of habitat consisting of cottonwoods and willows occur in the California section along Shovel Creek. A complete list of all bird species present in the canyon and their federal and state status is listed in Appendix K.

Mammals

The canyon provides the habitat to support a great variety and abundance of mammals. Silver-gray squirrels, an important game species in the canyon, are plentiful, as are other small mammals such as bats, rabbits, chipmunks, ground squirrels, deer mice, shrews, and other small rodents. These species provide an abundant prey base for the many mammalian and avian predators. Beaver and muskrat, two small mammals dependent on aquatic habitat, are commonly found along the river.

Wild pigs have been documented in Segments 2 and 3 of the planning area. These populations are considered feral and pests by both state game agencies, and neither organization plans to manage for these populations in the canyon. Even though some of the proposed habitat projects may encourage use by feral pigs, BLM will not manage specifically to enhance pig habitat.

The Townsend's big-eared bat is found in Segment 2 at Salt Caves. This species is listed as BLM sensitive and as critical by the State of Oregon. A maternity (birthing) colony of Townsend's big-eared bats at Salt Caves was documented by qualified bat biologists from Southern Oregon University during the summer of 1988.

Use of the caves by this species has been studied by Southern Oregon University over several years to determine the season of use, population information, and overall importance of the caves to Townsend's big-eared bats. Salt Caves serve as one of three known maternity sites in south central Oregon (Cross 1998). One of the caves also functions as a transitory roost during intermittent periods near the beginning and end of the maternity season. Due to the importance of Salt Caves to Townsend's big-eared bats, the caves have been designated as significant under the authority of the *Federal Cave Resources Protection Act*.

Hoover Ranch, which has an abandoned ranch house near the Klamath River, is also used by Townsend's big-eared bats during the reproductive season. It is believed this site may serve as a rearing site for a relatively small colony of these bats.

Studies by Southern Oregon University in the early 1990s included attempts to locate alternate roosting sites of the Townsend's big-eared bat, which used the Oregon section of the Klamath River Canyon. Most of the roost sites found were small cavities formed by piles of large boulders, all within the canyon. Most of the roost sites were within two miles of Salt Caves. No sites of large congregations were found (Cross 1992). More information on the Townsend's big-eared bat at Salt Caves is included in the "Environmental Assessment for the Salt Caves Management Plan EA#OR-014-01-07" (BLM 2002).

Several species of predators that are dependent upon riverine habitat and prey range in the canyon, including raccoon, river otter, mink, long- and short-tailed weasel, and ringtail. The ringtail, an Oregon State sensitive species, is a small, slender relative of the raccoon that is rare in southern Oregon and northern California. Klamath County is the eastern limit of their range in Oregon. Larger predatory mammals inhabiting the planning area include coyote, gray fox, bobcat, and mountain lion.

Big game mammals that occur within the planning area include black-tailed deer (mule deer in California), Roosevelt elk, black bear, and cougar (ODFW). Although appearing uncommon in the planning area, black bear and cougar either reside or pass through the canyon. Carnivore studies along the canyon rim in Oregon have shown a frequent use by cougar and bobcat. Black bears forage in the blackberry patches along the river and the irrigation ditches during the late summer. This activity is especially prevalent in Segment 3, and at times the bears are a nuisance.

A migratory herd of 3,100 black-tailed deer (estimated 1988-89 population), known as the Pokegama Herd, inhabits the area on the north side of the canyon (Keno Unit). The summer range of this herd extends from Siskiyou County in California to Crater Lake. The majority of this herd winters in and around the planning area. In California the herd that utilizes the south side of the river is managed as mule deer (see Map 7).

The majority of the planning area lies within a larger area designated by the BLM and ODFW as critical deer winter range. This area mainly consists of low elevations, which gives rise to light to snow-free conditions during severe winters essential for deer survival. The planning area is important to deer by providing accessible forage, easier movement, good thermal cover, and early spring green up that furnishes critically needed forage for deer coming off of a hard winter. Segment 3 is considered winter range for the deer herd in California, especially the lower elevations. A small portion of these deer herds reside year-round in the planning area. Springs and wet areas with riparian cover are important fawning habitat for these resident deer (see Map 7).

The forested areas in the canyon, along with the meadows around the Frain Ranch area, provide suitable habitat for elk, which are occasionally seen in these areas in the spring and early summer. Elk use the area during winter, but usually only during the most severe winters. Recent surveys (2000-2001) estimate up to 700 elk in the Keno Management Unit and this number is predicted to continue to increase. The Keno Management Unit covers all of the planning area in Oregon. In California, elk are beginning to range south of the river. In 2000, a radio-collared elk from northern California moved into Segment 3 and then continued through the planning area. USFS biologists from the Klamath National Forest and local residences have commented on increased elk numbers south of the river in Segment 3.

Herptiles

A herptile (reptiles and amphibians) study (conducted from 2000 through 2001) documented 18 species of reptiles and amphibians in and around the planning area, which is potential habitat for about 34 species (see Appendix K). Talus slopes and rocky hillsides provide good habitat for lizards and den sites for snakes. Historic den sites include the old housing site near the powerhouse. Amphibians inhabit moist sites around seeps and springs and along the river. Snakes found within the canyon include the western rattlesnake, common and western terrestrial garter snake, gopher snake, striped whipsnake, rubber boa, ringneck snake, and yellow-bellied racer. Common lizards include the western fence lizard, southern alligator lizard, sagebrush lizard, and western skink; amphibians of note include western toad and Pacific chorus frog.

Five Oregon State sensitive species found in the planning area are the California mountain king snake, sharptail snake, northern sagebrush lizard, western toad, and western pond turtle. Species that potentially occur but have not been documented in the planning area include the Pacific giant salamander, roughskin newt, ensatina, black salamander (listed as a species of concern in 1989 Oregon Natural Heritage Database), Great Basin spadefoot toad, western aquatic garter snake, northwestern garter snake, and night snake; and three Oregon State sensitive species, tailed frog, Oregon spotted frog, foothill yellow legged frog, and short-horned lizard (St. John 1987).

Watershed Values

Water resources are a key component in shaping the animal and plant communities found within the planning area, and in providing recreation opportunities. Factors discussed in this section include beneficial uses and resource values, energy generation, water rights, stream flows, water quality (including that of Upper Klamath Lake and upstream segments of the Klamath River), and aquatic habitat.

Although the river within the planning area is the primary focus of examination, upstream conditions substantially affect this portion of the river. Additionally, tributary streams contribute streamflow to the river and provide habitat. Where relevant, characteristics of these streams will be discussed in the appropriate sections of this chapter.

Beneficial Uses

The appropriation of surface waters within the Klamath Basin is governed by Oregon and California law, and the "Klamath River Basin Compact" (Oregon Revised Statutes 542.620). The Compact became effective in 1957 upon ratification by Oregon and California and acceptance by the U.S. Congress. Article III of the Compact addresses beneficial uses in the Klamath River Basin.

The Oregon Department of Environmental Quality (ODEQ) has expanded upon these beneficial uses for the purpose of developing water quality management programs for the upper Klamath River (Oregon Administrative Rules 350-41-962). Established beneficial uses include public and private domestic water supply; industrial water supply; irrigation; livestock watering; salmonid rearing and spawning; resident fish and aquatic life; wildlife and hunting; fishing, boating, and water contact recreation; and aesthetic quality.

The North Coast Regional Water Quality Control Board has established beneficial uses for the California portion of the Klamath River. These are broadly categorized as water supply, recreation, fish and wildlife habitat, power generation, and scientific study. Specific existing and potential beneficial uses for the Klamath River between the state line and Iron Gate Dam have also been outlined. Existing beneficial uses include municipal and domestic supply, agricultural supply, groundwater recharge, freshwater replenishment, commercial and sport fishing, hydropower generation, navigation, water contact and noncontact recreation, warm freshwater habitat, cold freshwater habitat, fish migration, fish spawning, and wildlife habitat (North Coast Regional Water Quality Control Board 1994).

Water Rights

Water use upstream from and within the planning area affects streamflows in the Klamath River. The Oregon Water Resources Department (OWRD) is currently conducting an Oregon general stream adjudication for the Oregon portion of the Klamath River Basin. An adjudication is the Oregon statutory process for quantification and determination of all rights to surface water, the use of which was initiated before February 24, 1909 (the date the surface water code in Oregon was established) and federal reserved water rights. The reserved water rights claims submitted by federal agencies and the Klamath Tribes will be determined through this process.

The OWRD process for acquiring water rights under state law has three steps. Prior to receiving a water rights certificate, a water user must first apply for, and then receive, a water rights permit. In order to "prove up" on the permit, a water user must begin putting the water to beneficial use. Following this period, the OWRD determines whether to issue a "perfected" water rights certificate (OWRD, 2001).

Klamath River

Within the Oregon portion of the study area (Segments 1 and 2), PacifiCorp is licensed to divert up to 2,500 cubic feet per second (cfs) of Klamath River water for the operation of the J.C. Boyle hydroelectric project (Hydroelectric Commission of Oregon 1965). The discrepancy between the hydraulic capacity of the powerhouse (3,000 cfs) and the licensed diversion volume (2.500 cfs) will be addressed during the FERC re-licensing process.

In addition, PacifiCorp has other pre-1909 water rights claims that were acquired with the purchase of land adjacent to the river. Two permits allow diversion from the Klamath River for irrigation, stock, and domestic use. The volume of water that could be withdrawn by these permits is an insignificant portion of the total river discharge (less than approximately 10 cfs).

The BLM has filed a claim for instream flows in Segment 2 of the planning area based on the *Wild and Scenic Rivers Act* of 1968. In the Act, Congress expressly reserved water for flow-dependent outstandingly remarkable values. Flows were claimed (Federal Reserve Claim 376, 1999) for two outstandingly remarkable values: fisheries (625 cfs from April 1 through June 15, and 525 cfs for the rest of the year), and recreation (whitewater rafting, 1,500 cfs between Memorial Day and September 30) (see Table 2-12). The BLM water right claim on the Klamath River is pendingin the Klamath Basin Adjudication.

The Oregon Department of Parks and Recreation and the Oregon Department of Fish and Wildlife (ODFW) applied to the Water Resources Department in 1989 for an instream water right on the Klamath Scenic Waterway (Segment 2). Based on the release regime from the J.C. Boyle Powerhouse, the application requests 1,500 cfs for recreation and 550 cfs (not additive) for fish populations and habitat. This application is still pending.

The Bureau of Indian Affairs, on behalf of the Klamath Tribes, has claimed (Federal Reserve Claim 671, 1999) for future use 700 cfs year-round to provide adequate migratory passage of anadromous salmonid fishes into and out of the Upper Klamath River Basin (should the former range of the anadromous fish habitat be restored).

Within the California portion of the planning area (Segment 3), the California State Water Resources Control Board currently does not have any water use applications or claim of rights on file. Private land owners within Segment 3 exercise pre-1914 water rights to divert water from the main stem and from Shovel and Negro Creeks to irrigate pastureland and hay fields.

Table 2-12.—Summary of BLM instream flow claims

Claim		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Recreation	1,500 cfs					■ (late)	■	■	■	■			
Fisheries	625 cfs				■	■	■ (to mid)						
	525 cfs	■	■	■			■ (from mid)	■	■	■	■	■	■

Shading shown under a month indicates the times BLM applied for a water right claim.

The "Klamath River Basin Compact," provides guidance along with other applicable laws for water rights administration in the Klamath Basin. The major purposes of the Compact, as stated in Article I, are:

A. To facilitate and promote the orderly, integrated and comprehensive development, use, conservation and control thereof for various purposes, including, among others: the use of water for domestic purposes; the development of lands by irrigation and other means; the protection and enhancement of fish, wildlife, and recreational resources; the use of water for industrial purposes and hydroelectric power production; and the use and control of water for navigation and flood prevention.

B. To further intergovernmental cooperation and comity with respect to these resources and programs for their use and development and to remove causes of present and future controversies by providing (1) for equitable distribution and use of water among the two states and the federal government, (2) for preferential rights to the use of water after the effective date of this compact for the anticipated ultimate requirements for domestic and irrigation purposes in the upper Klamath River Basin in Oregon and California, and (3) for prescribed relationships between beneficial uses of water as a practicable means of accomplishing such distribution and use.

Tributary Streams

The Oregon State Department of Forestry has a permit to use up to 10,000 gallons of water per day for dust abatement from an unnamed tributary of the Klamath River near the Topsy Road in Segment 2. An irrigation diversion is located on Hayden Creek, but is not currently used.

In Segment 3, water is diverted from the mainstem of Shovel Creek in two locations and from near the mouth of Negro Creek (a tributary of Shovel Creek) in one location. From April 15 to October 15, these diversions supply up to 15 cfs to irrigated meadows along the lower portion of Shovel Creek (Ichisaka 2001, personal communication). This constitutes a relatively large percentage of total stream discharge during the summer baseflow period. Water rights for these diversions are based on California's doctrine of riparian water rights.

Streamflows

Klamath River

General

The Klamath River begins at the outlet of Upper Klamath Lake and flows to the Pacific Ocean. At the upstream end of Segment 2, the river drains approximately 4,080 square miles (not including the Lost River sub-basin, which occasionally overflows into the Klamath River drainage).

Late winter and spring peak flows are derived primarily from snowmelt in the drainage area of Upper Klamath Lake and subsequent releases from Link River Dam. Summer flows in the river are derived from releases at Link River dam, groundwater discharge from volcanic aquifers, and some return flow. Elevated flows in fall and early winter are a result of return flow from irrigated areas south and west of Klamath Falls (BHI 1996).

The Klamath Reclamation Project operated by the Bureau of Reclamation (USBR), supplies water to about 240,000 acres of irrigated land and a smaller area of national wildlife refuge lands. Diversion of water for use by the USBR Project began in 1905. In 1961, the completed USBR Project facilities were fully operational (USBR 2000).

Compared to pre-USBR Project conditions, flow regulation at Upper Klamath Lake results in higher and earlier peak flows in the Klamath River, decreased summer minimum flows, and greater annual flow variability (BHI 1996). In the planning area, these effects commingle with the effects of diversions and releases related to hydropower generation.

Flow Modifications Due to Operation of the J.C. Boyle Facility

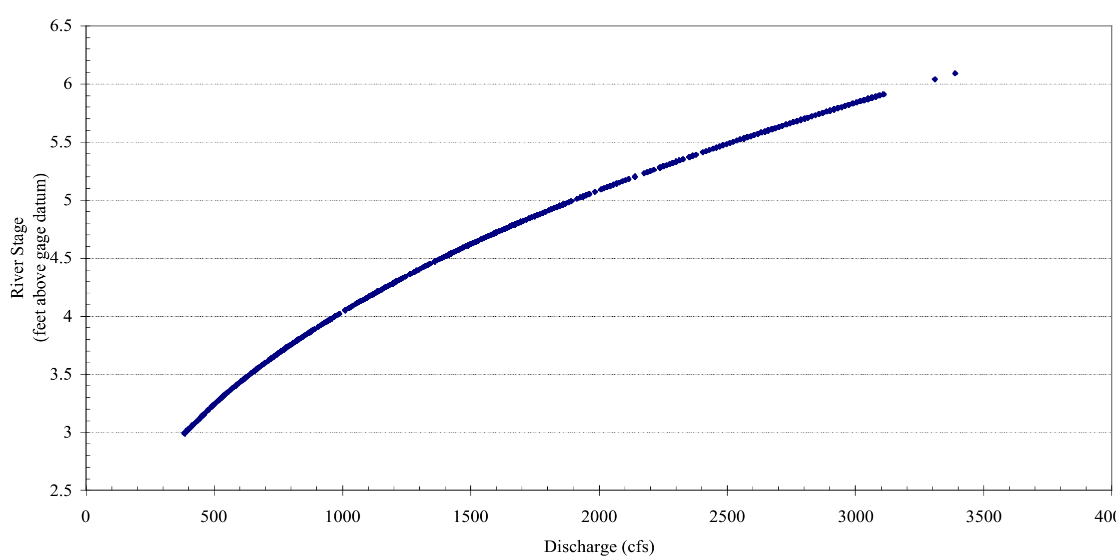
The operation of the J.C. Boyle facility varies according to water availability, instream flow requirements for ESA-listed salmon downstream from Iron Gate Dam (RM 190), and PacifiCorp's FERC license.

A minimum flow of 100 cfs is released at J.C. Boyle Dam to provide instream flow for fish movement through Segment 1. In addition to this continuous outflow at the dam, a series of springs in the riverbed between the dam and the powerhouse (located near RM 223) add another estimated 225 cfs of flow (on average), which maintains a relatively constant flow of approximately 325 cfs during summer (see Map 3). Flows in Segment 1 between the dam and the powerhouse are not subject to the daily fluctuations that occur in Segments 2 and 3 that result from powerhouse operations.

One, both, or neither of the turbines at the J.C. Boyle Powerhouse may be generating electricity at any given moment, depending on energy demand and water availability. When daily average river flows are less than about 3,300 cfs, the J.C. Boyle facility is operated to produce power during periods of peak energy demand (PacifiCorp 2000). This type of operation is referred to as "peaking" or "load following."

When neither turbine is in use, water flowing into J.C. Boyle Reservoir is stored for later use. As a result of peaking operations, streamflow and water surface elevations ("stage") in the river below the powerhouse can fluctuate throughout the day. Stage fluctuations below the dam and powerhouse are limited to a 9 inch per hour ramp rate, as per the 1956 FERC license (PacifiCorp 2000). Depending on flow levels, this equates to changes in discharge that range from 400 cfs per hour, to approximately 950 cfs per hour (see Figure 2-1).

Figure 2-1. Water Level-Discharge Relationship.
Correlation between streamflow and the elevation of the water surface level at the USGS gage downstream from the J.C. Boyle Powerhouse, derived from measurements made between January and September of 2000. Data courtesy of USGS.



Daily Average Streamflows

Streamflows have been measured since January 1959 by the USGS at a gaging station located 0.7 mile below the J.C. Boyle Powerhouse (USGS gage 11510700). The streamflow record at this gage is representative of flows in Segments 2 and 3, although flows through Segment 3 are slightly higher and slightly less variable than flows in Segment 2, due to tributary inflows from Shovel Creek (10 to 100 cfs), Hayden Creek, and minor intermittent tributaries.

For this planning effort the data set has been converted to water years, which are defined by the USGS as beginning on October 1 and ending the following September 30, and are designated by the calendar year in which the water year ends. Data is not available for water years 1972-74, 1980-82, and 1988.

Average daily discharge data from water years 1961 through 2000 show an average annual flow of 1,839 cfs. Mean monthly flow data show that average monthly flows are highest December through April and lowest June through September (Table 2-13). Average daily discharges in the 300 to 400 cfs range can occur any month of the year, as can average daily discharges greater than 1,600 cfs.

Daily Fluctuations in Streamflow and Stage

Peaking operations cause significant daily stage and discharge fluctuations in the river. The effects of daily powerhouse operations on streamflow were analyzed using discharge data collected every 30 minutes at the USGS J.C. Boyle gage. This analysis was limited to January and July 2000, which are representative of average winter and summer flows.

During low flow periods (summer/fall), there is typically only one turbine generating for a portion of any given day. On a daily basis during the low flow season, discharge below the

Table 2-13.— Average Daily Discharge*

	Maximum average daily quantity [2]	10% exceedance [3]	Mean average daily quantity	90% exceedance [3]	Minimum average daily quantity
January	9,860	3,940	2,483	862	318
February	10,200	5,432	2,584	647	316
March	9,630	6,174	2,932	700	313
April	7,810	5,091	2,540	756	306
May	6,790	3,890	1,888	602	317
June	6,740	1,891	1,043	493	321
July	1,890	951	678	385	309
August	1,650	1,180	899	509	302
September	2,290	1,620	1,208	745	309
October	4,170	2,540	1,556	861	320
November	5,100	2,943	1,954	894	361
December	8,260	3,732	2,344	979	342

- Summary statistics for average daily discharge downstream from J.C. Boyle Powerhouse (USGS gage 11510700) for water years 1960–2000 [1]
-

[1] Data is not available for water years 1972–74, 1980–82, and 1988.
[2] All values are in cfs.
[3] The 10% and 90% exceedance flows refer to average daily discharges that are exceeded 10 and 90% of the time, respectively.

powerhouse generally ranges from 300 to 400 cfs (baseflow, composed of outflow from the dam and contributions from springs) to approximately 1,500 cfs (baseflow plus turbine throughflow). When there is sufficient water and consumer demand both turbines may be used, and flows can ramp from baseflow to 3,000 cfs within a few hours (see Figure 2-2). Alternatively, there may be days when no water is released in excess of the minimum bypass flow.

Discharge in Segments 2 and 3 is more variable during the high flow season (late winter/early spring) than during the low flow season (see Figure 2-2). As a consequence of tributary inflows, baseflow increases to approximately 700 cfs. Higher average daily flows allow frequent two-turbine peaking during this period. Depending on how the J.C. Boyle complex is operated, discharge fluctuations within a 24-hour period can range from 50 to more than 2,500 cfs.

Flow ramping causes river levels downstream from the powerhouse to vary widely on a daily basis. These effects persist for the length of Segments 2 and 3. Measurements at the USGS gaging station indicate that daily fluctuations (at this site) during the low flow season may exceed 2.5 feet, though fluctuations on the order of 1.75 feet are more common. Portions of the streambed are dewatered and exposed during intervals when no power is generated. As with discharge, stage fluctuations during the high flow season are more variable. On days when the J.C. Boyle complex is operated for peaking power, stage can be raised or lowered by approximately 2.2 feet over a 6-hour period. Conversely, when the complex generates power at a steady rate there is no appreciable stage variation. Because stage fluctuations vary according to channel geometry, the magnitude of stage fluctuations in Segments 2 and 3 is not constant between different locations; in confined reaches of the river, fluctuations may be higher, while in reaches with low benches, fluctuations may be lower.

Peak Flows

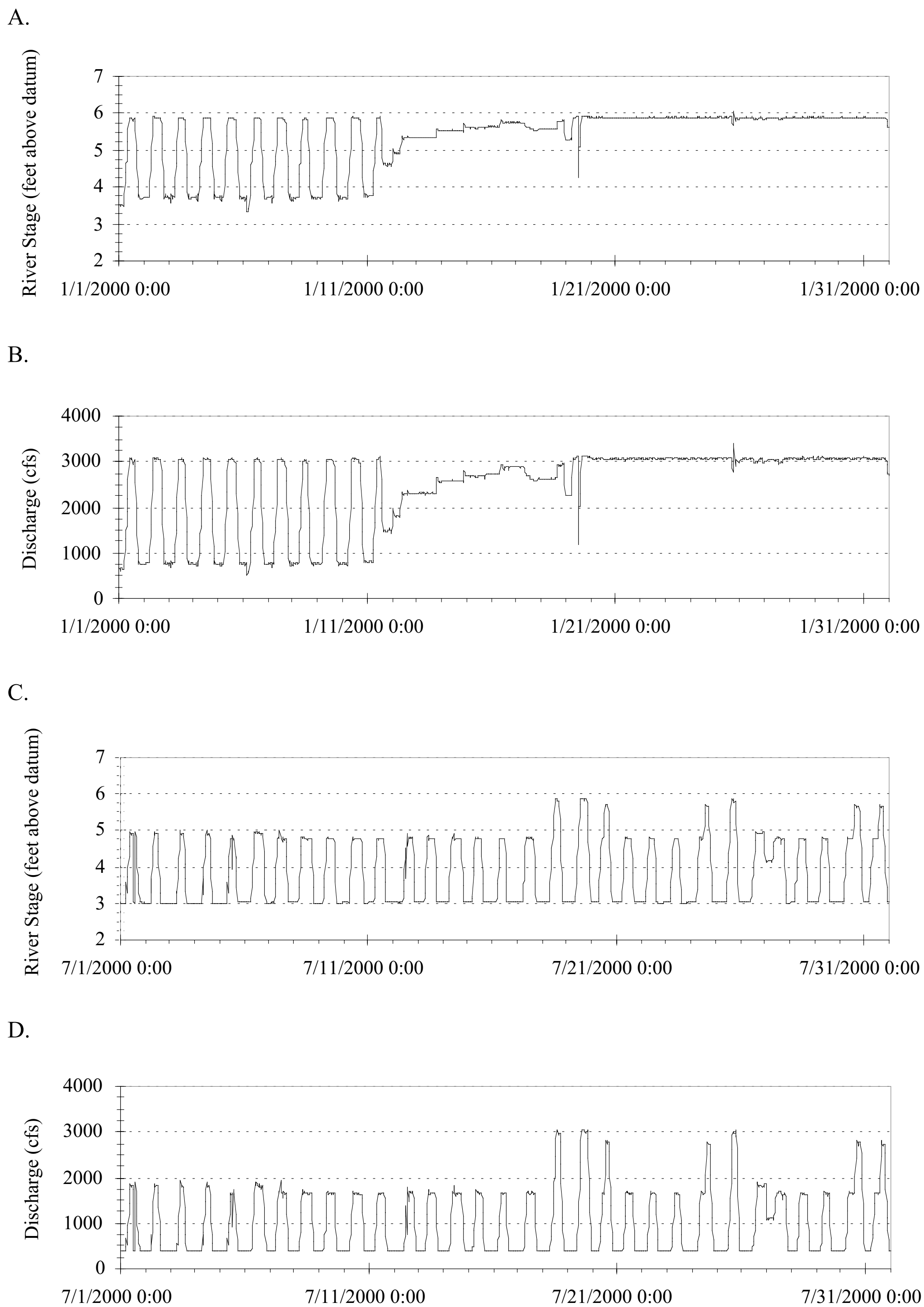
Floods with recurrence intervals of about 1.5 years are generally considered to be the most geomorphically effective (Dunne and Leopold 1978). Analysis of peak flow data from the USGS J.C. Boyle gage suggests that flows of between 3,100 and 4,700 cfs occur about every 1.5 years in Segments 2 and 3. Spills from J.C. Boyle Dam into Segment 1 occur in about two out of every three years. Due to flow regulation and diversions, peak flows in Segment 1 are currently of lower magnitude and shorter duration than would occur were the river unregulated. The largest peak flow recorded at the J.C. Boyle gage occurred in February 1996. Discharge during this flood exceeded 11,500 cfs.

Tributary Streams within the Planning Area

One large seep complex and two relatively large perennial streams enter the river in the planning area, as well as numerous smaller streams and springs. Depending on the season, total accretions between J.C. Boyle Dam and the slackwater of Copco Reservoir range approximately from 230 to 700 cfs. The greatest portion of this inflow occurs in Segment 1, where an extensive zone of seepage into the riverbed contributes, on average, about 225 cfs to the river (Hanel and Gerlach 1964; PacifiCorp 2000). Except for this seepage zone, the magnitude of tributary inflows are relatively minor and of much more importance locally (as coldwater refugia, for example) than on the scale of the Klamath River as a whole.

Shovel Creek enters the Klamath River near RM 206. Although Shovel Creek drains a large watershed (51 square miles), most summer flow is derived from springs in the Negro Creek and Bear Canyon drainages. As discussed above, a substantial portion of summer baseflow is diverted for irrigation use near the mouth of Shovel Creek. Winter peak flows are on the order of 100 cfs (PacifiCorp 2000). The summer base flows are about 20 cfs when irrigation diversions are not in use (Beyer 1984).

Figure 2-2. Daily Hydrographs Below J.C. Boyle Powerhouse
Daily stage and discharge data for the Klamath River below J.C. Boyle Powerhouse (USGS gage 11510700), collected at 30 minute intervals, including stage (A) and discharge (B) for January 2000, and stage (C) and discharge (D) for July 2000. Data courtesy of USGS.



Hayden Creek drains approximately 28 square miles and has fewer large springs than the Shovel Creek drainage. Measured summer discharges about two miles upstream from its mouth are on the order of 0.5 cfs. There are no active diversions from Hayden Creek within the planning area, although the stream intersects an irrigation ditch (diverted from the river) at its mouth.

Peak flows from Hayden Creek and Edge Creek have been estimated using a variety of methods - refer to the "Topsy Pokegama Landscape Analysis" (BLM 1996) for this information.

The hydrologic cycle in tributary watersheds within the planning area has likely been affected by the extensive road network. Roads can change infiltration rates, intercept and divert subsurface flow, change the drainage area of small streams, and decrease the time it takes for runoff to reach streams. This can cause peak flows to increase (Furniss et al. 1991). Incision of streams into their floodplains has also affected baseflows, due to the loss of the "sponge effect" of the floodplains.

Water Quality

Klamath River

Water Quality Standards

Water quality standards have been set by the ODEQ for Klamath Basin waters and specifically for the Klamath River from Upper Klamath Lake to the state line (Oregon Administrative Rules 340-41-965). In California, the North Coast Regional Water Quality Control Board (1994) has established water quality objectives for the upper Klamath River from the state line to Iron Gate Dam (see Table 2-14).

303(d)-Listed Segments of the Klamath River

The mainstem Klamath River upstream from, within, and downstream from the planning area is included on lists of water quality limited water bodies (referred to as 303[d] lists) prepared in 1998 by the ODEQ and California North Coast Regional Water Quality Control Board. In each listed segment, state standards are regularly exceeded for numerous water quality parameters (Table 2-15). For some water quality parameters, data is not available to assess compliance with state standards.

Water quality of the Klamath River within the planning area is affected by upstream point and nonpoint sources of pollutants:

- The source of the Klamath River, Upper Klamath Lake, is a hyper-eutrophic lake that supports an abundant algal population. Lake water quality varies according to season and the annual amount of runoff entering the lake. Recent studies have pointed out that the nutrient-enriched condition of the lake, though natural, has likely been accentuated as a result of agricultural activities, livestock production, logging, urban development, and reclamation of wetlands for agriculture (Eilers et al. 2001, Snyder and Morace 1997). Massive blooms of blue-green algae typically occur in the lake in the summer. Daily cycles of respiration and decomposition result in extremely high pH levels and wide fluctuations in levels of dissolved oxygen and carbonic acid.

- The Link River, which is that portion of the Klamath River flowing between the outlet of Upper Klamath Lake and the upstream end of Lake Ewauna, is included on the 1998 Oregon 303(d) list for temperature, pH, and chlorophyll-a.

Table 2-14.—Oregon and California water quality standards for key parameters within the planning area

Parameter	Oregon standard or criteria	California standard or criteria
Temperature	No measurable increase when ambient temperature exceeds 64 degrees Fahrenheit. During the period from salmonid spawning to fry emergence, no measurable increase when ambient temperature exceeds 55 degrees Fahrenheit.	Shall not be altered unless demonstrated that such alteration does not adversely affect beneficial uses. At no time shall temperature be increased by more than 5 degrees Fahrenheit above natural receiving water temperature.
Dissolved oxygen	Absolute minimum of 8.0 mg/L or 90 percent saturation. At ODEQ discretion, 30 day mean minimum of 8.0 mg/L, seven day mean minimum of 6.5 mg/L, and absolute minimum of 6.0 mg/L. During the period from salmonid spawning to fry emergence, 95 percent saturation.	Minimum 7.0 mg/L. In the Klamath River, 50 percent of monthly means greater than 10.0 mg/L; in other streams 50 percent of monthly means greater than 9.0 mg/L
pH	Values shall not fall outside the range of 6.5–9.0.	Values shall not fall outside the range of 7.0–8.5.
Turbidity	No more than a 10 percent increase above natural background levels (except for certain limited duration activities).	No more than a 20 percent increase above natural background levels (except as otherwise allowed by permit).

- Drainage water from portions of the USBR Klamath Project is conveyed back into the Klamath River via the Klamath Straits Drain, which enters the river upstream from Keno, Oregon. Water quality standards for dissolved oxygen, fecal coliform, temperature, pH, chlorophyll-a, and ammonia are not being met for this water body (ODEQ 1998). Effects to water quality in the river depend on the proportions of return flow to river water and vary by constituent (Mayer 2000).

- The Klamath River upstream from Keno Dam to the upper end of Lake Ewauna is included on the 1998 303(d) list due to high temperatures, low dissolved oxygen levels, high pH levels, and high chlorophyll-a abundance. Additionally, measured concentrations of un-ionized ammonia in this reach are above criteria set by the ODEQ and the Environmental Protection Agency (ODEQ 1998).

The Klamath River between Keno Dam and the California border (which includes Segments 1 and 2) is included on the 1998 303(d) list for exceedance of Oregon temperature standards. Though generally within the range of standards, other water quality parameters, such as dissolved oxygen and pH, may detrimentally affect beneficial uses and outstandingly remarkable values (including fisheries, recreation, and wildlife) in Segment 2 during certain flow conditions.

The Klamath River between the state line and Iron Gate Dam is listed for high nutrient levels, organic enrichment, low dissolved oxygen, and high temperatures (California State Water Resources Conservation Board 1999).

Table 2-15.—Segments of the Klamath River included on state 303(d) lists of water quality limited streams

Parameter for Listing	Klamath River			Link River (Lake Ewauna to Klamath Lake)	Upper Klamath Lake
	(Iron Gate Dam to Oregon border)	(California border to Keno Dam)	(Keno Dam to Link River)		
Temperature	1998 303(d) List	1998 303(d) List	1998 303(d) List	1998 303(d) List	Need Data
Dissolved oxygen	1998 303(d) List		1998 303(d) List		1998 303(d) List
pH			1998 303(d) List	1998 303(d) List	1998 303(d) List
Chlorophyll a			1998 303(d) List	1998 303(d) List	1998 303(d) List
Toxics (ammonia)			1998 303(d) List		
Nutrients	1998 303(d) List	Need data[1]	Need data[1]	Need data[1]	Need data[1]
Sedimentation		Need data[1]	Need data[1]	Need data[1]	Need data[1]
Habitat modification		Need data[1]	Need data[1]		
Flow modification			Need data[1]	Need data[1]	
Toxics			Need data[1]		

[1] More data collection and analysis is required for these parameters before a conclusive determination of compliance with water quality standards can be made.

Water Quality Trends

Water quality within the planning area is monitored monthly by the ODEQ at several locations above Keno Dam and at the USGS J.C. Boyle gage. The City of Klamath Falls (1986) monitored water quality at several locations between Keno Dam and Copco Reservoir during 1984 and 1985, in relation to the proposed Salt Caves project (Table 2-16).

Additionally, PacifiCorp monitored temperature, dissolved oxygen, pH, total dissolved gas, and specific conductivity at several sites between the Link River Dam and the Iron Gate Powerhouse between 1994 and 1995 (PacifiCorp Environmental Services 1996).

Within the planning area, dissolved oxygen (DO) levels increase between the upstream and downstream end of Segment 1, are reduced when flows are released at the powerhouse, and then increase between the powerhouse and the downstream end of Segment 3 (PacifiCorp 1996; PacifiCorp 1998).

This longitudinal pattern reflects two primary influences on DO levels: (1) the balance between relatively high quality spring inflows and water from J.C. Boyle Reservoir, and (2) the effect of turbulent aeration caused by rapids. On a daily basis, it is likely that DO levels change as water temperatures respond to solar heat inputs and fluctuating flow levels downstream from the powerhouse.

As discussed above, upstream water quality limitations may be responsible for a substantial portion of water quality problems within the planning area. Water quality downstream from

Table 2-16.—Measured water quality parameters for the Klamath River within the planning area

	Keno Bridge (RM 235.0)		Below J.C. Boyle Powerhouse (RM220.4)		River mile 205.5 [1]	
Parameter	Average	Range of values	Average	Range of values	Average	Range of values
Temperature (degrees Fahrenheit) [2]	57.0	32.0–78.8	55.2	34.7–74.3	54.5	35.1–67.5
Dissolved oxygen (mg/L) [2]	6.7	0.7–15.5	9.4	3.9–12.8	9.2	7.5–11.2
Dissolved oxygen (% saturation) [2]	75.5	14–308	98	49–125	---	---
pH (units) [2]	8.1	6.8–10.0	8.0	7.3–9.0	7.7	7.7–8.7
Laboratory turbidity (NTU) [3]	8	2–47	7	1–35	---	---
Dissolved nitrate/nitrite (mg/L as N) [4]	0.14	<0.02–0.50	0.40	0.07–1.1	---	---
Un-ionized ammonia (mg/L) [5]	0.042	0.0–0.978	0.009	0.0–0.061	---	---
Total phosphorous (mg/L) [3]	0.24	0.09–0.72	0.19	0.08–0.5	0.20	0.12–0.35
5-day undiluted biological oxygen demand (mg/L) [2]	3.6	0.8–10.1	2.6	0.2–10.0	---	---

[1] Station KR-5, City of Klamath Falls, 1984–1985.
[2] 1959–2000, ODEQ.
[3] 1977–2000, ODEQ.
[4] For Keno Bridge, 1980–2000; for below J.C. Boyle Powerhouse, 1986–2000; ODEQ.
[5] 1959–1997, ODEQ.

pollution sources often improves due to dilution and/or mixing. Dissolved oxygen concentrations increase between Keno Bridge and the J. C. Boyle Powerhouse as result of aeration and dilution of organically enriched waters; pH levels decrease between those two sites, likely for similar reasons. Were it not for high quality groundwater entering the river in Segment 1, the effect of dilution within the planning area would be minimal, especially during the low flow season, when water quality problems are most critical.

Water Temperature Measurements

Water temperatures in the planning area vary with season and by segment. Within both the river and tributary streams, temperatures are controlled by interactions between streamflow, channel geomorphology, and riparian vegetation. In the river, altered flows and, to a lesser degree, altered channel geomorphology and riparian vegetation have likely adversely affected water temperature and warming rates.

Highest water temperatures occur June through August, in conjunction with high local air temperatures and low flows. Daily summer temperature fluctuations are lowest in Segment 1 and greatest in Segments 2 and 3. Because of the stable flows and springs, temperatures in Segment 1 remain relatively constant from day to day, and are typically around 70 degrees Fahrenheit in August and 48 to 53 degrees Fahrenheit in early spring. Where the flows from Segment 1 meet the releases from the Powerhouse, an abrupt mixing zone occurs.

Mid-day peaking operations at the J.C. Boyle Powerhouse cause significant daily temperature fluctuations in Segments 2 and 3. Summer temperatures typically range from approximately 70 degrees Fahrenheit in early evening, coincident with the passage of large volumes of reservoir water, to approximately 58 degrees Fahrenheit in early morning hours, a result of nighttime cooling (City of Klamath Falls 1986). An additional cause of temperature fluctuations is the alternating source of water in this reach (i.e., spring-dominated vs. reservoir-dominated flows). Because the springs are much cooler than the reservoir water, higher water temperatures in Segments 2 and 3 correspond to higher releases from the powerhouse (Figure 2-3). At flows near 600 cfs, average water temperatures at the upstream end of Segment 2 are near 61 degrees Fahrenheit, while at flows near 1,800 cfs (one turbine) average water temperatures are near 68 degrees Fahrenheit.

When flows from the powerhouse are stable, water temperatures in Segments 2 and 3 are also relatively stable. During periods when peaking occurs, the daily minimum temperature is reduced and the daily range of temperatures is increased. The rate of temperature change associated with peaking operations is generally faster than the rate at which temperature changes due to changes in ambient air temperature (Figure 2-4).

Figure 2-3. Discharge-Temperature Relationship
Correlation between streamflow and water temperature, measured from 7/18/01 to 9/20/01 at the USGS gaging station downstream from the J.C. Boyle Powerhouse (derived from PacifiCorp water temperature data set). Note that no data is available for flows greater than 1,850 cfs, and that the temperature logger was often exposed during flows less than 600 cfs (rendering the data for those flows unusable). Data courtesy of PacifiCorp and USGS.

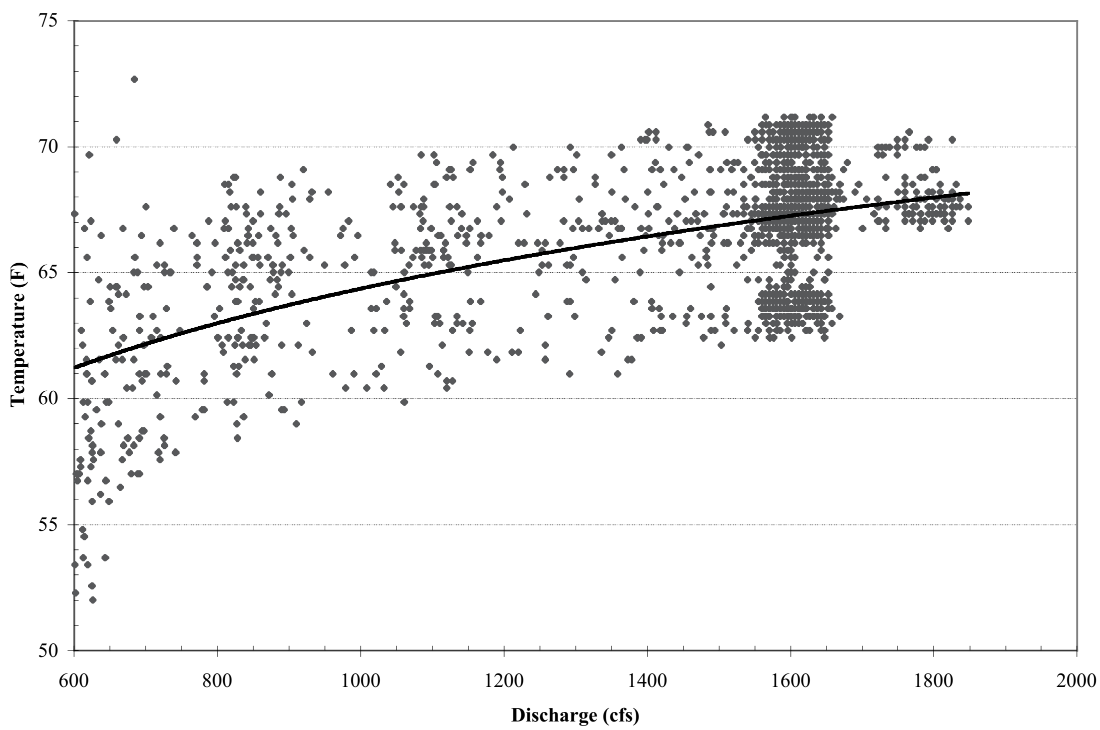
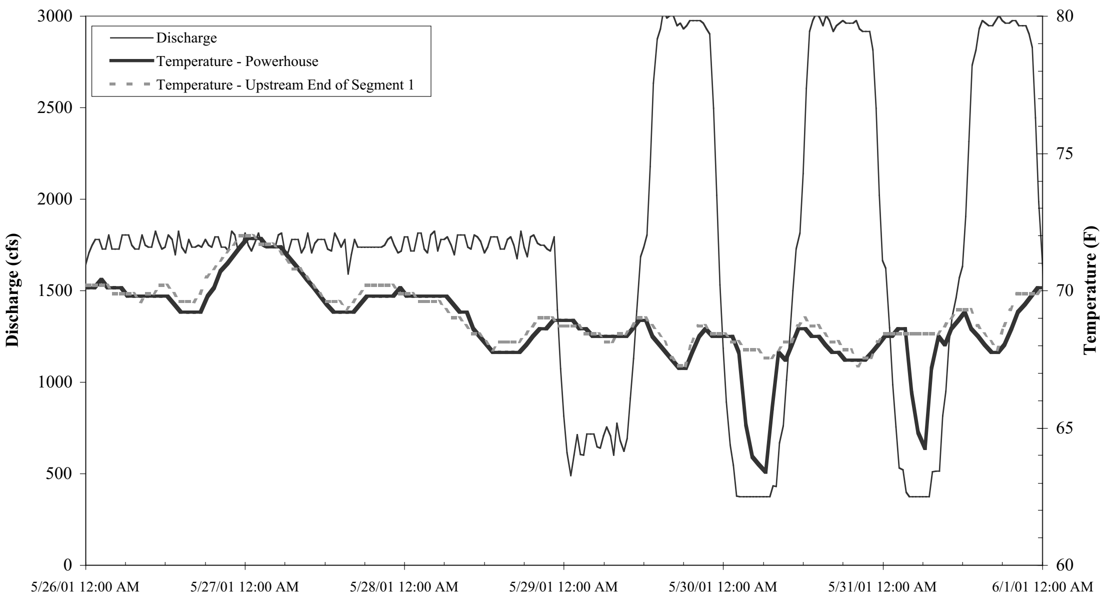


Figure 2-4. Daily Water Temperature Patterns

Daily cycles of discharge and water temperature during two distinct periods of powerhouse operation in spring 2001. From 5/26 to 5/29, flow was stable at about 1,700 cfs; from 5/29 to 6/1, flows fluctuated from about 400 to 3,000 cfs. Note that although the temperature data from the upstream end of Segment 1 is included in order to allow a comparison of quasi-natural rates of temperature change, the flows occurring in that portion of Segment 1 were stable at about 100 cfs during this period, and do not correspond with the discharge measured at the USGS gage. Data courtesy of PacifiCorp and USGS.



Effects of Reservoirs on Water Quality

Instream reservoirs such as J.C. Boyle and Keno can improve or degrade water quality, depending on factors such as reservoir size and shape, reservoir operations, climatic conditions, time of year, and upstream water quality. According to one source (City of Klamath Falls 1986), the presence of instream reservoirs can reduce pH, bacterial counts, nutrients, sediments and turbidity, biological oxygen demand, and settling of algal loads. A more recent analysis of nutrient dynamics in the Klamath River suggests that the series of reservoirs do not function as nutrient sinks, perhaps as a result of nutrient cycling within the reservoirs (Campbell 1999).

Effects of Land Management on Water Quality

Water quality within the planning area is affected primarily by hydroelectric facilities and operations and the character of water flowing into the planning area. Because the Klamath River drains such a large area, it is unlikely that land management activities such as timber harvest or grazing within the planning area have a substantial effect on overall water quality within the river. However, land management actions can affect habitat quality (and beneficial uses) at varying scales within the river, and can profoundly affect water quality within tributary streams. As the land within the river canyon is somewhat inaccessible and generally receives special management attention, the most significant land management effects on water quality and habitat quality in the river are related to the location and condition of the road network.

In all segments, there are roads within the riparian reserves along the river (equivalent to the width of two site potential trees, or 280 feet) and along tributary streams. Segment 1 has a relatively modest length of road within the riparian reserve of the river, although sidecast material from the flume maintenance road severely affects riparian and aquatic habitat features. Segment 2 has the greatest length of roads within the river's riparian reserve (see Table 2-17 for a summary of riparian road features). These roads reduce the recruitment of coarse woody debris, reduce stream shading, and reduce overall riparian habitat quality. The roads along the river in Segment 3, though extensive, are located primarily in areas that would not be expected to have forest cover, so their effect on habitat quality is more limited.

Effects of Water Quality on Beneficial Uses and ORVs

High water temperatures can affect beneficial uses indirectly, principally through the relationships between water temperatures, dissolved oxygen, and fish health. Low dissolved oxygen levels impair fish health. Dissolved oxygen levels decrease as temperature increases. Increased temperature can also enhance algal productivity.

Algae can impart a bad odor to water and a bad taste to game fish. As massive quantities of blue-green algae decay, the biological oxygen demand increases, and dissolved oxygen concentrations decrease to levels that are harmful to fish. This effect can be partially offset by aeration occurring in high gradient reaches of the river. Conditions that favor algal growth include shallow turbulent water, hard water, well-illuminated and warm water, and high phosphorous concentrations (FERC 1990). Such conditions are present in some reaches of the river within the planning area, especially in Segment 1.

Dissolved organic matter within the water contributes to the distinctive coffee color and foam that is often noted about the Klamath River.

Water Quality Management Programs

The federal EPA has delegated primary responsibility for implementation of the *Clean Water Act* to state agencies. In addition, Oregon and California have adopted various pieces of legislation that address water quality (discussed in more detail in Chapter 4).

The ODEQ and the California North Coast Regional Water Quality Control Board are currently developing water quality improvement strategies for those water bodies that are

Table 2-17.—Summary of riparian road lengths (miles) and number of stream crossings

	Segment 1	Segment 2	Segment 3	Total
Fish-bearing streams	2.9	10.3	5.6	18.8
Non-fish-bearing streams	0.2	5.8	3.2	9.2
Wetlands > 1 acre	–	0.8	1.9	2.7
Wetlands < 1 acre	–	–	<0.1	<0.1
Reservoirs	0.2	–	–	0.2
Number of stream crossings[1]	4.0	14.0	14.0	32.0

[1] Does not include bridges across the Klamath River.

either not meeting, or suspected of not meeting water quality standards, and thus, not supporting beneficial uses. The ODEQ (1998) is in the process of establishing total maximum daily loads (TMDLs) for point and nonpoint sources of water quality limitations. A temperature TMDL for the Klamath River and tributary streams between Keno Dam and the state line is scheduled to be complete in December 2004. For the river and tributary streams between the state line and Iron Gate Dam, TMDLs for nutrients and temperatures are scheduled to be complete in April 2004, while a TMDL for organic enrichment and dissolved oxygen is scheduled for completion in December 2004 (California SWRCB 1999).

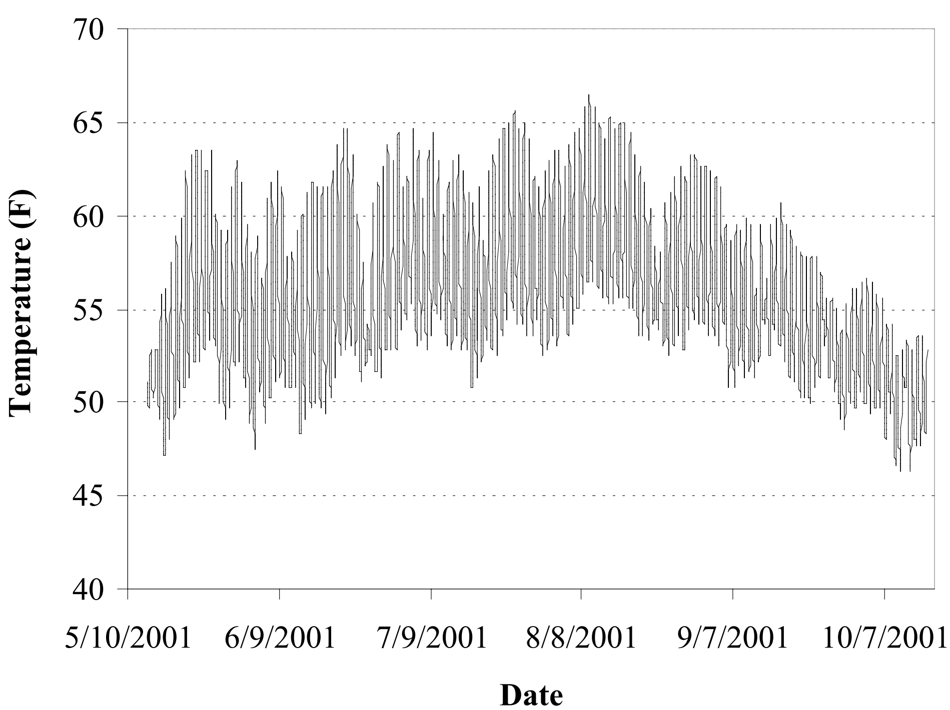
Tributary Streams

Water quality data is generally lacking for tributary streams within the planning area. Water temperature data includes a continuous temperature data set measured at the mouth of Shovel Creek during 2000 and 2001 and a series of “spot” measurements in various streams during the summer of 2001.

Temperature and other water quality parameters, such as dissolved oxygen and pH, may detrimentally affect beneficial uses and outstandingly remarkable values (including fisheries, recreation, and wildlife) during certain flow conditions.

The temperature data set for Shovel Creek is reflective of the springs that comprise summer baseflow in this stream (Figure 2-5). A field survey of instantaneous temperatures conducted in August 2001 suggests that some warming occurs between the mouth of Bear Canyon and the mouth of Shovel Creek (over a distance of about 2.1 miles), but is limited by the contribution of Negro Creek flows, the northern aspect, and the closed canopy riparian forest. The effect of the Shovel and Negro Creek diversions on water temperatures in those streams is uncertain, though other aspects of aquatic habitat may be adversely affected (Beyer 1984).

Figure 2-5. Shovel Creek Water Temperature
Hourly water temperature near the mouth of Shovel Creek. Data courtesy of PacifiCorp



In May 2001, water temperature at three springs adjacent to the river downstream from the J.C. Boyle Powerhouse ranged from 50 to 60 degrees Fahrenheit. Temperatures at the mouths of Chert Creek (near RM 210) and Hayden Creek were 60 and 57 degrees Fahrenheit., respectively. Although both of these streams are spring-fed, warming occurs as they flow across broad meadows and south aspect slopes (BLM field notes).

Riparian roads adjacent to tributary streams may impair water quality, habitat quality, and fluvial processes. In the most severe cases, where roads are located extremely close to streams (such as along Chert Creek), streamflow may be captured by road surfaces. In other situations, riparian roads and stream crossings limit coarse woody debris (CWD) recruitment, stream shading, and fish/herptile passage, and may contribute runoff and fine sediment to stream channels.

The length of roads within riparian reserves of tributary streams (equivalent to the width of one site potential tree, or 140 feet), as well as their effect, varies between segments. Riparian roads adjacent to tributary streams in Segment 1 are short and do not appear to be causing resource damage. Riparian road length is greatest in Segment 2 (see Table 2-17). Of greatest concern in this segment are the roads that parallel portions of Chert and Way Creeks; the remainder cross, rather than parallel, streams. In Segment 3, relatively long road segments parallel Shovel and Hessig Creeks. While the Hessig Creek road likely affects runoff and channel processes in that ephemeral stream, the portions of the Shovel Creek Road (and associated spurs) that pass through forested areas probably have a detrimental effect on stream shading, wood recruitment, and sediment delivery to that stream.

Stream Channel Geomorphology

This section will discuss the characteristics of stream channels within the planning area, as well as the processes that shape them. Before addressing individual streams, general principles of channel geomorphology will be discussed briefly.

Overview

Important attributes of channel morphology include width, depth, substrate, sinuosity, channel gradient, and pool spacing. Stream channel morphology in areas of high topographic relief - such as the planning area - is determined primarily by structural constraints within the channel. Examples of such constraints are bedrock outcrops or stable coarse woody debris (CWD), as well as interactions between sediment and streamflow (Swanston 1991). Limited adjustment of channel features occurs when flow is great enough to entrain and transport sediments and CWD on the streambed and along channel margins.

The movement of bedload sediment (sediment that moves by sliding, rolling, or bouncing along the streambed) is controlled by interactions between streamflow, particle size, and channel hydraulics (Swanston 1991). In general, coarse sediment moves through stream systems discontinuously, being alternately stored and mobilized. Steep streams are typically supply-limited (capable of transporting more sediment than is supplied, with the result that alluvial features are rare). That said, low gradient reaches or local features (such as tributary mouths, side channels, large boulders, or stable CWD jams) may create conditions favorable for sediment deposition. Though spatially and temporally variable, channel storage of coarse material in such settings is common, particularly in the form of riffles and bars (Sullivan et al. 1987).

CWD can be delivered to stream systems from upstream sources or by recruitment of material from adjacent riparian areas and hillslopes. In small streams with low mass wasting potential, such as are common within the planning area, most CWD is derived from adjacent riparian areas (McDade et al. 1990, Lienkamper and Swanson 1987). In the river, wood is contributed from streamside forests as well as from upstream, although the presence of upstream dams limits the delivery of wood from upstream sources. The channel-forming role of CWD is more strongly expressed in tributary streams and secondary channels than in the main stem of the river. In both settings, however, CWD affects sediment storage, pool formation, secondary channel development, bank stability, and riparian vegetation patterns. The role of instream CWD is a function of piece location, size, and stability; in large rivers, jams of CWD pieces are often much more stable and morphologically active than individual pieces.

When the amount of water or sediment delivered to a given stream changes, aspects of channel morphology adjust in response (Furniss et al. 1991). The nature of the adjustment depends on the extent of changes in water or sediment supply, the morphology and condition of the channel, and the extent of constraints limiting the ability of the channel to reshape itself. Hydroelectric developments and land management activities can alter channel morphology by changing the magnitude and timing of water, sediment, and CWD delivery to streams and thereby affecting the capability of the channel to transport and store these materials (Williams and Wolman 1984; TPLA 1996). Potential channel adjustments to altered discharge and sediment load include changes in width, depth, velocity, slope, roughness, and sediment size. Increased discharge, decreased sediment supply, or a combination of both can cause channel widening, incision, and bed armoring (Williams and Wolman 1984; Montgomery and Buffington 1993).

The bank materials of natural streams influence channel patterns and processes, and also provide a boundary between aquatic and terrestrial habitats (BLM 1996). The resistance of streambanks to erosion influences channel width, sinuosity, and sediment supply. The root systems of riparian vegetation contribute substantial cohesion to streambanks. As such, changes in streamside vegetation can have dramatic impacts on channel morphology and processes (BLM 1996).

Secondary channels (comprised of floodplain high flow channels and chute-cutoffs) occur throughout the planning area. High flow channels function as important refugial areas and could potentially function as spawning habitat (City of Klamath Falls 1986). Chute-cutoffs typically result from lateral scour at the upstream end of meander bends, and cause reduced sinuosity, increased local channel gradient, and increased flow velocities. (Knighton 1984). While both types of secondary channels are found on unregulated rivers, the current distribution and function of these channels may be impacted by the hydroelectric project. Decreased bank stability due to impaired riparian vegetation may cause increased secondary channel formation. A lack of gravel may reduce the rate at which they recover, or fill back in. Perhaps most importantly, flow fluctuations create conditions in these channels that lead to fish stranding (Hunter 1992; Marcus et al 1990).

Klamath River

Stream channel types in the planning area can be generally classified as Rosgen (1994) B and C type systems (Table 2-18). Currently the Klamath River is a very stable system, with well developed (though rarely inundated) floodplains in the Rosgen C type segments (BLM 1996). The cobble and boulder substrate is resistant to scouring, and provides the majority of channel roughness (except during periods when floodplains are inundated).

As a whole, channel complexity in the river has likely been reduced, due to activities associated with historic log drives, construction, and operation of the J.C. Boyle development. Altered flow regimes and changes in sediment supply have resulted in excessive fine sediment deposition in some reaches and reduced gravel availability in others. Currently, coarse sediment is supplied to the river only from tributary streams and eroding banks. Historically, upper watershed sources (i.e., upstream from J.C. Boyle Dam) were likely important sources of coarse sediment. Due to frequent flow fluctuations, the channel may never achieve equilibrium with the increased duration of high flows (due to peaking operations at the powerhouse) and the reduced supply of coarse sediment.

Table 2-18—Summary of habitat information for Segments 1-3 of the Klamath River planning area

	Segment 1	Segment 2	Segment 3
Habitat features [1]			
Reach length (meters)	7,155	18,122	9,359
Gradient (%)	1.3	0.9	0.4
Average active channel width (meters)	36.9	61	41.2
Width:depth ratio	15.3	27.4	No Data
Entrenchment ratio [2]	1.2	1.3	No Data
Rosgen (1994) channel types	B and C	B and C	B and C
Secondary Channels			
% of Area in secondary channels	1.7	6.8	No Data
Number of secondary channels	6	16	11
Secondary channels/kilometer	0.8	0.9	1.2
Pools			
Number of pools	33	53	No Data
Pool area (% of channel area)	45	43	No Data
Residual pool depth	1.38	1.68	No Data
Pool spacing (channel widths/pool)	6.1	7	No Data
Pools >/= 1 meter deep (pools/kilometer)	4.3	2.2	No Data
Coarse Woody Debris [3]			
Number of pieces/100 meters	0.9	1.3	No Data
Volume (m^3)/100 meters	1.3	1.2	No Data
Substrate			
Fines in riffles (%)	2	4	No Data
Gravel in riffles (%)	5	7	No Data
Riparian Vegetation [4]			
Number of hardwoods/100 meters	150	391	No Data
Number of conifers/100 meters	45	74	No Data
50 cm conifers DBH/100 meters	15	13	No Data
90 cm conifers DBH/100 meters	10	4	No Data

[1] Data for Segments 1 and 2 were derived from ODFW Physical Habitat Surveys (1998), data for Segment 3 was based on BLM geographic information system spatial databases.
[2] Entrenchment ratio is defined as the ratio of floodprone width to active channel width, and is an index of the degree to which stream channels are confined by valley walls.
[3] In these surveys, all rootwads and pieces with diameter > 15 cm and length > 3 m were considered as coarse woody debris.
[4] In these surveys, vegetation within one channel width of streambanks was considered to be riparian.

Segment 1 (J.C. Boyle Dam to J.C. Boyle Powerhouse)

Segment 1 aquatic habitat is comprised primarily of pools and riffles (ODFW 1998). No stream banks were found to be actively eroding or undercut. Boulders and cobbles dominate stream substrate, and CWD volume is low. The average residual pool depth is 4.5 feet. Gravel is in short supply and is restricted primarily to small pockets behind large boulders (City of Klamath Falls 1986). Recruitment of gravel to this area (as is the case in the majority of the planning area) is limited due to the presence of J.C. Boyle Dam and the small number of tributary streams.

The river channel in Segment 1 is narrow, averaging 100 feet in width, and is steep, with an average gradient of 75 feet per mile (City of Klamath Falls 1986). Highly regulated flows in this segment provide consistent aquatic habitat through most of the year. Historic flow regimes (i.e., increased summer flows, seasonally varying hydrographs with a gradual recession to baseflow) likely provided additional habitats within this reach that are no longer available due to flow regulation and hydropower diversions.

Instream cover for aquatic species in the diversion reach is provided by an ample supply of large boulders (City of Klamath Falls 1986). Bank cover is sparse due to the steep, rocky walls of the canyon and the presence along the north bank of extensive rock spoils areas created during the construction of the power project's flume and road. In addition, bank development has likely been impaired due to the sparse sediment supply. Banks are predominately a mixture of cobble/boulder and reed canary grass.

Based on field reconnaissance and air photo interpretation, it has been determined that at least six secondary channels (either high flow channels or chute-cutoffs) occur within Segment 1. Currently, side channels in this segment are only inundated when spill from the dam occurs during periodic high flows that cause water to be spilled from J.C. Boyle Dam. There have likely been substantial changes in the timing, frequency, duration, and magnitude of high flow channel inundations as compared to probable historic conditions, as a consequence of both altered flow regimes and altered river morphology.

Upper Portion of Segment 2 (J.C. Boyle Powerhouse to Caldera)

Between the powerhouse and RM 214.3 the river continues through a deep, steep-walled canyon (City of Klamath Falls 1986). The width of the canyon floor increases to about º mile towards the downstream end of this section. Physical characteristics of this section vary somewhat over its length due to the widening of the canyon floor and a gradual reduction in gradient to 27 feet per mile (City of Klamath Falls 1986). The river channel in the upper half of this section is confined by steep canyon walls and averages about 150 feet in width. The lower half is somewhat wider, averaging about 200 feet in width, with some areas over 300 feet in width. Aquatic habitat in Segment 2 is comprised primarily of pools and riffles (ODFW 1998). The bed is generally heavily armored with boulders and cobble, and instream CWD volumes are low. A few small gravel pockets are present in the main channel behind boulders, although most gravels are embedded in fine sediments. The average residual pool depth is 5.5 feet. No stream banks were found to be actively eroding or undercut.

Instream cover in Segment 2 is largely made up of large boulders (City of Klamath Falls 1986). Deep pools in many parts of this section may also provide instream cover. Bank cover is relatively sparse and dominated by reed canary grass. Large expanses of the bed are exposed and inundated on a daily basis throughout varying lengths of the year (particularly during the summer) due to the water level fluctuations associated with hydropower generation.

The exposure of river substrate on a daily basis potentially contributes to reductions in productivity of aquatic vegetation and macro-invertebrates. Additionally, daily flow fluctuations limit the development of near-stream riparian vegetation, thereby limiting the availability of vegetated edge habitat, especially during low flow periods.

Two bridge sites crossing the Klamath River are present in this reach. One site was a single span, which was blown out during the mid-1960s. Abutments at this site have restricted channel width and increase water depths locally. The second bridge site was a multiple-arch span that was demolished at an unknown date. Channel widening is evident at this siteæan apparent result of multiple buttress footings located within the stream channel. Historic irrigation diversions present in this reach have caused the channel to widen in some locales.

Based on field reconnaissance and air photo interpretation, it has been determined that at least nine secondary channels are present within the upper section of Segment 2. As noted above, side channels likely function as important refugial areas during high flows, but their habitat value has potentially been impaired due to hydropower operations. Summer load-following operations at the powerhouse result in most side channels being inundated and dewatered on a daily basis. This contributes to an increased potential for stranding of fish species as well as limiting the habitat available to macroinvertebrate species. Chute-cutoff formation has had similar impacts as those described for Segment 1, as well as providing additional potential stranding habitats due to daily peaking operations.

Lower Portion of Segment 2 (Caldera Rapids to State line)

The river flows through a constricted canyon in this section, and the channel averages about 90 feet in width (City of Klamath Falls 1986). The gradient is 77 feet per mile. Substrate throughout this reach of the river is predominately boulders and large cobble, though a few gravel pockets occur, and instream CWD volume is low. The high velocities that occur in the reach have resulted in a heavily armored streambed. No appreciable gravel recruitment is apparent downstream from Rock Creek, a tributary that enters the river near RM 214. No stream banks were found to be actively eroding or undercut. At least seven secondary channels are present within the lower portion of Segment 2.

Cover in this section is described as good in terms of both instream object cover and bank vegetation (City of Klamath Falls 1986). Cover is similar to that present in the upper portion of Segment 2, with much of the cover habitat being boulder-dominated. Channel edges are vegetated primarily by reed canary grass. Instream diversions for upland meadow irrigation are present in the lower part of this segment. These diversions have resulted in channel widening along several hundred feet of river channel above and below the diversion points. One historic bridge site is present at the lower end of the segment, the abutments of which are currently affecting floodplain function and channel width-to-depth ratios.

Segment 3 (State line to Copco 1 Reservoir)

In this segment, the valley floor begins to widen and the river gradient decreases (City of Klamath Falls 1986). The average gradient through this segment of the study area is approximately 23 feet per mile. Width of the river is uniform, averaging 135 feet. Expansive alluvial deposits of gravel, sand, silt, and clay form floodplains along large portions of the river in this segment.

Cover in this segment is described as good, with both instream and bank cover being plentiful (City of Klamath Falls 1986). Boulders, undercut banks, and rooted aquatic vegetation provide most of the instream cover. Field review of river morphology indicates some lateral erosion of banks is occurring; however, active erosion is limited to the outside of a few meanders. Instream diversions for irrigation have resulted in channel widening along several hundred feet of river channel above and below the diversion. Two bridges are currently present in this segment. Both sites are likely impairing floodplain access during high flows and reducing width to depth ratios over short lengths of the river.

Based on field reconnaissance and air photo interpretation, it has been determined that at least 11 secondary channels exist within Segment 3. As noted above, side channels likely function as important refugial areas during high flows, but their habitat value has likely been impaired by frequent flow fluctuations. Chute-cutoff formation has had similar impacts as those described for other segments, though these features appear to be more common in Segment 3.

Major Tributaries of the Klamath River Planning Area

Tributaries within the canyon function as conduits for sediment and organic debris (BLM 1996). These materials originate on hillslopes and move through stream channels. These watershed products (sediment, course woody debris, and organics) are especially important for gravel bar and floodplain development, pool formation, and aquatic resource productivity in the Klamath River system. The mouths of tributary streams may also serve as important aquatic habitat refugial areas during flood events. Where tributary waters mix with the Klamath River, areas of relatively good water quality may persist through the year.

Four important tributaries enter the river within the planning area: Rock, Hayden, Shovel, and Edge Creeks.

Rock Creek is a small tributary that meets the river at approximately RM 214. Rock Creek provides supplemental flows during spring and winter; its natural flow is supplemented by water pumped from Meiss Lake during wetter years. Increased suspended sediments have been noted in the river during periods of pumping (City of Klamath Falls 1986). The entrance to the creek from the river is steep and limits fish passage upstream of the mouth.

Portions of Rock Creek have been affected by road construction and maintenance. The channel has apparently been bulldozed and straightened to protect the bridge where Topsy Road crosses the stream. The stream in this area is no longer connected to its floodplain, channel form has been simplified, and as a result the extent of riparian communities has been reduced.

Hayden Creek enters the river approximately one river mile above the state line. Hayden Creek flows perennially, though during summer the flow near its mouth is restricted to subsurface pathways and perennial pools. As it enters the planning area, Hayden Creek flows in a step-pool channel (alternating between boulder cascades and plunge pools) through a narrow canyon that widens somewhat in two locations. As it nears the river, Hayden Creek enters a wide valley into which the stream has entrenched and formed a new floodplain. The channel assumes a pool-riffle morphology in this reach, with some side channel development. Riparian vegetation is moderately abundant and consists of Oregon ash, willow species, ponderosa pine, and sedge species. The relic floodplain is now a dry meadow, the low parts of which may be seasonally inundated. Some gully development is apparent in portions of the relic floodplain.

Downstream from Hoover Ranch, the stream briefly flows through a steep canyon before opening up again at its mouth. An irrigation canal (from the Klamath River) diverts flow at the mouth of Hayden Creek and prevents full connectivity of the stream to the river. A small irrigation diversion had been developed on Hayden Creek approximately 0.25-mile upstream from the mouth, likely to irrigate the lower field of Hoover Ranch. The irrigation diversion point has subsequently blown out. Two wet meadows are adjacent to the mouth of Hayden Creek, one to the east and one to the northwest

Shovel Creek is the most significant tributary within the planning area. It enters the river upstream from RM 206. A major tributary to this stream is Negro Creek, which joins Shovel Creek less than a mile from the river. Both of these are small streams, averaging not more than 15 feet wide. As they enter the planning area, these streams flow through moderately steep and confined valleys. Shovel Creek enters a wider valley approximately 1.6 miles upstream from the river, while Negro Creek remains moderately confined for all but the lower 0.3 miles of its length.

The unconfined portions of both streams are responsive to changes in watershed and riparian conditions, and thus show some evidence of past and recent land management. Stream channels have incised by perhaps one to three feet, partly as a result of increased runoff and partly as a result of reduced instream CWD. The active channels have widened and contain few deep pools. Loss of gravel storage areas and increased fine sediment contributions could also be impairing habitat quality (Beyer 1984). Currently, the streams are cobble-dominated systems that have fairly low sinuosity and sparse functional CWD. A few pockets of gravel were noted during stream surveys in the river below the mouth of Shovel Creek. Shovel Creek is a primary a source of gravel for the mainstem river in the lower portion of Segment 3.

In the vicinity of the bridge near its mouth, Shovel Creek has been channelized in the past to prevent bridge failure during peak flows. Coarse sediment and CWD accumulate upstream from the bridge during these events and restrict the conveyance of floods. The bridge and associated structures have been threatened during such events at least three times in the past 40 years (Miller 2002, personal communication). These occurrences suggest that the volume of sediment moving through the stream is not in balance with the ability of the stream to transport it, the size of the bridge is not adequate, or both.

Riparian communities change along the length of Shovel Creek, with the amount of stream cover increasing with distance from the mouth (Beyer 1984). Towards the mouth, grass is the dominant vegetation, with a narrow fringe of hardwoods and blackberry along the stream. Upstream, a closed canopy forest is present along the stream, the composition of which shifts from hardwood dominated to conifer dominated as the stream gains elevation. Portions of the riparian area have been logged in the past, though there are no extensive anthropogenic openings in the forest. Similar patterns exist in Negro Creek, though portions of its drainage have been harvested recently.

The diversion of Shovel and Negro Creek waters for irrigation (and the maintenance of instream irrigation diversions) has had adverse affects on fish habitat (Beyer 1984). The irrigation diversions lower stream flow from late spring through early autumn.

Edge Creek enters the river less than a mile downstream from Shovel Creek. Only a very short length of Edge Creek is within the planning area. This consists primarily of a steep drainage flowing down from the canyon rim, though the stream gradient decreases substantially near its mouth. Edge Creek flows under an irrigation ditch near its mouth. During high flow periods, runoff from Edge Creek is captured by the irrigation ditch (Miller, personal communication, 2002).

Other minor tributaries within the planning area include Chert, Way, and Frain Creeks. These streams enter the river at steep inclinations. Each of these streams is spring-fed and provides habitat for aquatic invertebrates and herptiles. Instream and riparian conditions within and along these streams vary, although an array of potential problems have been identified. These include poorly functioning stream crossings, riparian roads, grazing impacts, and conversion of riparian vegetation to upland types.

Aquatic Conservation Strategy

The Aquatic Conservation Strategy (ACS) was developed (as part of the Northwest Forest Plan) to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The ACS is designed to meet the following objectives:

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.

The components of the ACS are Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration.

Riparian Reserves

The riparian reserve system on federal land was created as a land use allocation under the Northwest Forest Plan. Riparian reserves are designated on federal lands adjacent to streams and potentially unstable areas where special standards and guidelines direct land use. These reserves include those portions of the watershed that are required to maintain the hydrologic, geomorphic, and ecologic processes that directly affect fish habitat and standing and flowing water.

Riparian reserves are used to maintain and restore riparian structures and functions, confer benefits to riparian-dependent and associated species, 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.

Riparian reserve widths for various types of waterbodies are based on the height of a site potential tree (see Table 2-19). Within the planning area, about 1,600 acres of riparian reserves occur on BLM land and 40 acres on Forest Service land. (Table 2-20). The majority of the riparian reserves on BLM land are adjacent to the Klamath River.

The riparian reserve land use allocation applies only to federally managed land. The areas adjacent to streams, springs, and wetlands on private land provide similar resource values as

Table 2-19.—Riparian reserve and riparian corridor widths for various types of water bodies

Riparian feature	Reserve width
Fish-bearing streams, including the Klamath River	280 feet (the height of two site potential trees)
Perennial non-fish-bearing streams	140 feet (the height of one site potential tree)
Seasonal non-fish-bearing streams ***and*** wetlands less than 1 acre ***and*** unstable or potentially unstable areas	*At a minimum, the corridor will include:* • The stream channel and the area extending to the top of the inner gorge; • The wetland and the area extending to the outer edges of riparian vegetation; • The area extending from the stream channel to a distance equal to the height of one site potential tree, or 100 feet slope distance, whichever is greatest; and, • The extent of stable or potentially unstable areas.
Constructed ponds and reservoirs ***and*** wetlands greater than one acre	*At a minimum, the corridor will include:* • The body of water or wetland and the area to the edges of riparian • vegetation; • The extent of seasonally saturated soil; • The extent of unstable or potentially unstable areas; • To a distance equal to the height of one site potential tree; and, • To 140 feet slope distance from the edge of the wetland or the maximum pool elevation of constructed reservoirs.
Lakes and natural ponds	*At a minimum, the corridor will include:* • The body of water or wetland and the area to the edges of riparian vegetation; • The extent of seasonally saturated soil; • The extent of unstable or potentially unstable areas; • To a distance equal to the height of two site potential trees; and, • To 280 feet slope distance from the edge of the body of water.
Springs	*Corridor* widths vary according to the size of the associated wetland (see above).

federal riparian reserves. "Riparian corridors" on private land were mapped in order to assess watershed functions and quantify the relative extent of actions proposed within federally managed riparian reserves. About 1,700 acres are within riparian corridors on PacifiCorp land, and an additional 460 acres occur on private land (Table 2-20). No state lands are near waterbodies.

Key Watersheds

Key watersheds serve as the cornerstones of aquatic species recovery, and special guidelines apply to federal lands within key watersheds.

No key watersheds exist within the planning area. Spencer Creek, which is tributary to the Klamath River at J.C. Boyle reservoir, is a Tier 1 key watershed outside of the planning area, which plays an important role in the protection of at-risk fish populations within the Klamath River. Jenny Creek, which is tributary to the Klamath River at Iron Gate reservoir, is also a Tier 1 key watershed. Connectivity between the planning area and the Jenny Creek watershed is currently disrupted by the Copco 1 hydroelectric facility, which prevents emigrant species from Jenny Creek from accessing the planning area.

Watershed Analysis

Watershed analysis is required in key watersheds and non-key watersheds containing inventoried roadless areas, prior to determining how proposed land management activities meet ACS objectives. Additionally, watershed analysis is required prior to implementing proposed actions within riparian reserves.

The Topsy-Pokegama Landscape Analysis (TPLA; BLM 1996) includes all but the most southern portion of the planning area, and does not include any key watersheds or inventoried roadless areas. The Affected Environment chapter of this River Management Plan serves as an update and extension of the TPLA.

Watershed Restoration

As part of the ACS, watershed restoration will be an integral part of a program to aid recovery of fish habitat, riparian habitat, and water quality. In general, the most important components of watershed restoration are control and prevention of road-related runoff and sediment

Table 2-20.—Estimated extent of riparian reserves (on federal land) and riparian corridors (on private land) within the planning area, in acres.

Feature	Segment 1			Segment 2			Segment 3			Total
	BLM	PC	Other	BLM	PC	Other	BLM	PC	Other	
Fish-bearing	253	47	10	753	150	4	16	519	33	1,785
Non-fish-bearing	23	8	17	478	87	127	59	568	258	1,625
Wetlands > 1 acre				19	20	20	1	270	29	359
Wetlands < 1 acre				1	1	1		1	1	5
Reservoirs	4	9								13
Total	280	64	27	1,251	258	152	76	1,358	321	3,787

production, restoration of the condition of riparian vegetation, and restoration of in-stream habitat complexity. Monitoring is an important component of restoration projects.

Aquatic Species/Habitat

The dams on the Klamath River have affected fish species distribution throughout the Klamath Basin. Historically, the Klamath River was a passageway for anadromous fish, salmon, steelhead, and Pacific lamprey as they migrated to various tributaries of the Klamath River and Upper Klamath Lake (ODFW 1997). These fish runs were halted as early as 1910 by the construction of Copco I Dam, completed in 1917, which permanently blocked fish passage (City of Klamath Falls 1986). Five more dams were built on the upper Klamath River-Copco II and lrongate are located in California, and Link River, Keno, and J.C. Boyle Dams are located in Oregon (PacifiCorp 2000). J.C. Boyle, Keno, and Link River Dams have fish ladders intended for trout migration. Only J.C. Boyle Dam has a screening facility to prevent entrainment of fish into the power diversion canal.

Connectivity of the planning area segments to the upper and lower portions of the Klamath River has been impaired by alterations in water quality and development of the river for commercial purposes including dams, diversions, and dikes.

The major human impact to aquatic habitat over the last 150 years has been the fragmentation and loss of components of the marsh, lake, and stream system in Klamath Basin (ODFW 1995). The basin floor was developed for agriculture, which included extensive diking, channeling, draining, and loss of marshlands. Diversions were constructed on many streams and rivers in the Klamath system, causing dewatering and physical blockages for both upstream and downstream migrating trout. Cattle grazing also contributed to channel degradation in some locations.

Alteration in lake alkalinity and water quality limited outflow may have increased contributions as a result of the loss of adjacent marshlands in the upper basin. Lake, marsh, and riparian rearing habitat and functioning migration corridors have been lost as a result. Much of the impacts have occurred on private lands and are affecting the aquatic condition of the planning area.

The wild and scenic river segment of the upper Klamath River is inhabited by a diverse assemblage of fish species; at least 10 known native species occur (Table 2-21). Three species of note occur in the wild and scenic river segment (redband trout, Lost River sucker, and shortnose sucker) and shall be addressed independently. The other native species found in the river include Klamath smallscale sucker, blue and tui chub, Klamath speckled dace, sculpin species, and lamprey species (City of Klamath Falls 1986). The Klamath largescale sucker, a federal species of concern, has been found in J.C. Boyle Reservoir and potentially occurs in the planning area (USDI-BLM 1990).

Lost River (*Deltistes luxatus*) and shortnose (*Chasmistes brevirostris*) sucker are large, long-lived and omnivorous lake-dwelling species that generally spawn in rivers, streams, or springs (Beuttner and Scoppettone 1990). These two species likely occur in the wild and scenic river segment of the upper Klamath River. Although utilization has not been documented, both species have been documented in upstream and downstream reservoirs (City of Klamath Falls 1987; Beuttner and Scoppettone 1991). Both species were federally listed as endangered in 1988, and state listed as endangered 1991 (ODFW 1995). The U.S. Fish and Wildlife Service (USFWS) completed a federal recovery plan in 1993. The planning area was listed as proposed critical habitat (unit 3) for both Lost River and shortnose suckers in 1994 (*Federal Register* Vol. 59, No. 230).

Klamath redband trout are currently the primary game fish inhabiting the river. The upper Klamath River from Keno Dam to slackwater of Copco I Reservoir has been identified as

Table 2-21. Common and scientific names of fish known or suspected to occur with the planning area

Common name [1]	Scientific name
Native species	
Klamath smallscale sucker	*Catostomus rimiculus*
Klamath largescale sucker	*Catostomus snyderi*
Shortnose sucker	*Chasmistes brevirostris*
Sculpin sp.	*Cottus* sp.
Lost River sucker	*Deltistes luxatus*
Tui chub	*Gila bicolor*
Blue chub	Gila coerulea
Lamprey sp.	*Lampetra* sp.
Redband trout	*Onchorynchus mykiss* sp.
Klamath speckled dace	*Rhinichthys osculus*
Introduced species	
Bullhead sp.	*Amerius* sp.
Sacramento perch	*Archoplites interruptas*
Green sunfish	*Lepomus cyanellus*
Pumpkinseed	*Lepomus gibbosus*
Bluegill	*Lepomus macrochirus*
Largemouth bass	*Micropterus salmoides*
Golden shiner	*Notemigonus chysoleucas*
Yellow perch	*Perca flavescens*
Fathead minnow	*Pimephales promelas*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Brown trout	*Salmo trutta*

[1] Where species level identification has not occurred or where multiple species may be present the fish names were listed to genus only.

wild trout managed fisheries (ODFW 1997; CDFG 2000). The Klamath River from the Keno Dam downstream to the state line was one of the first three rivers designated in 1978 by the ODFW as a wild trout stream. From the state line to Copco Reservoir, the Klamath River has been managed by the California Department of Fish and Game as a wild trout area since 1974 (CDFG 2000).

No nonnative hatchery trout have been stocked in the Oregon reach of the Klamath River since 1978, or in the California reach since 1974. The California Department of Fish and Game and a private organization cooperated to raise and plant native stocks of trout into Shovel Creek between 1985-1990.

The concern for and importance of this wild rainbow trout fishery has been acknowledged not only by state designation, but by public and private concerns and also by state and federal government agencies as evidenced by the following:

- The National Park Service, in its 1982 nationwide rivers inventory, recognized the “excellent trout fishery” of the Klamath River.

- The Northwest Power Planning Council designated the upper Klamath River as a protected area in 1988, to protect the resident rainbow trout population.

- The 1986 Pacific Northwest rivers study for Oregon gave their highest resource value rating to the Klamath River based on the wild trout population.

- The ODFW chose the wild rainbow populations of the Klamath Basin, specifically those of the Klamath River, as the first of many in the state to be studied, to better understand how stocks of wild trout have adapted to their particular environments.

The Klamath system produces an immense quantity of aquatic invertebrates such as caddisflies, mayflies, midges, and stoneflies, which provide a primary food source for trout (USDI-BLM 1990). Crayfish are considered abundant and would be an important part of the trout's diet.

Redband of the Klamath River

The Oregon Basin redband trout occupies remnant streams in seven Pleistocene lakebeds in Oregon (ODFW 1995). Populations in each of these basins are completely isolated by natural geological features, except for those in the Klamath Basin. After Lake Modoc cut an outlet to the Pacific Ocean via the Klamath River, the lake became smaller as the outlet trenched down (Behnke 1992). After the connection to the ocean was made with the Klamath River, steelhead were known to migrate from the ocean to the Klamath Lake area. The novel traits in the Upper Klamath Basin group may have resulted from the interbreeding of the newly invading *O. mykiss* with the original resident fish of the basin (ODFW 1995; Behnke 1992).

Thousands of years of adapting to a drying environment have enabled populations of Klamath Basin redband trout to feed at higher temperatures than most other western trout, which typically are affected by increases in temperature (Behnke 1992). Native stocks of redband in the Klamath Watershed have also evolved resistance to an endemic bacterial disease, (*Ceratomyxa shasta*), which is highly lethal to nonnative trout (ODFW 1997).

Klamath River redband confront many environmental constraints, including low summer base flows and concurrent decreasing water quality, lack of spawning gravel, cyclic water fluctuations from power generation, and potential competition from nonnative warm water fish (City of Klamath Falls 1986). Despite these problems, Klamath River redband in the planning area have been able to sustain a sport fishery (ODFW 1997).

The loss of access between lakes, marshes, and streams has interfered with the migratory life histories of Klamath Basin redband trout (ODFW 1995). Population productivity has been compromised because of the loss of the important rearing areas. Gene flow among the Klamath Basin populations has ceased or is reduced and many of its populations are seriously fragmented. Some populations have likely been completely lost.

The trout population that persists in the wild and scenic river segment of the upper Klamath River could be described as locally productive; however, due to passage limitation above and below the wild and scenic river segment, this population is very restricted in distribution. Potentially, the life history options that carried this population through natural drought cycles, or provided for recolonization in the event of die off, are no longer available.

Close genetic similarity of rainbow trout exists between multiple stream populations in areas above Upper Klamath Lake including Spring Creek and Trout Creek, and areas below including Spencer Creek and Bogus Creek (Buchanan et. al. 1994). This genetic similarity suggests that the upper Klamath River trout, including fish within the wild and scenic river segment, are closely related. In addition, ODFW noted genetic uniqueness of the populations of trout in the basin as evidence of a history of isolation from other evolutionary lines of trout (Buchanan et al. 1994).

Based on the genetic analysis of upper Klamath native trout indicating uniqueness and isolation from other trout populations, support exists for the classification as a separate subspecies (Klamath redband trout) scientific name *Onchorhynchus mykiss newberri* of the trout of the upper basin including the affected wild and scenic river segment of the upper Klamath River. This classification nomenclature was originally derived from early collection of specimens from the 1850s (Behnke 1992). While this classification has not been formally accepted, protection of genetically distinct stocks is an important management goal (USDI-BLM 1995; ODFW 1997). The redband, including those within the wild and scenic river segment, are included in ODFW Klamath Lake gene conservation group of the Oregon Basin redband trout complex that is listed as a State sensitive species (ODFW 1997).

The "Upper Klamath River Wild Trout Management Plan 2000-2004" (CDFG 2000) makes no distinction between these Klamath River trout stocks and other rainbow trout. The purity of the wild and scenic river segment of the upper Klamath River strain comes under question as a result of Iron Gate hatchery supplementation from 1970-1981 into Copco Reservoir.

Iron Gate Hatchery steelhead stocks were founded on native fish, but some eggs were imported from Trinity River hatchery and Cowlitz River Hatchery in Washington (Klamath River Basin Fisheries Task Force 1991). The introduced nonnative strains of rainbow trout into the Klamath Basin probably have not been able to reproduce due to their susceptibility to the endemic disease, *C. Shasta* .It is hoped that the genetics of the native trout in the affected reach would endure only minimal negative effects. (ODFW 1997).

Informally, California Department of Fish and Game biologists support ODFW classification of the Klamath redband trout as a separate subspecies of rainbow trout (Rode 2002, personal communication).

In high-gradient systems trout production can be greatly affected by limited habitat features rather than food supply (Behnke 1992). Trout require four kinds of habitat during the various stages of their life history: spawning habitat, nursery or rearing habitat, adult habitat, and overwintering habitat. Deficiencies in any one of the four will limit the potential production.

Spawning Habitats/Occurrence: All western trout spawn during the spring, stimulated by the rising water temperatures (Behnke 1992). However, specific spawning time varies greatly depending on temperature and flow regimes. Klamath River redband trout spawn from late February through May (City of Klamath Falls 1986).

Although some spawning habitat is found in the bypass reach, the wild and scenic river segment of the upper Klamath River and the California reach have little or no spawning habitat for trout (ODFW 1997; City of Klamath Falls 1986). Recruitment of spawning gravel to the wild and scenic river segment, as well as the Bypass and California reaches, is very limited, due to the presence of the J.C. Boyle Dam and the small number of tributary streams (City of Klamath Falls 1986).

Of the spawning habitat that is present in the wild and scenic river segment of the upper Klamath River, much would be exposed during low flows, as a result of peaking operations, making these areas unsuitable for incubation of trout embryos during most years. The abnormal flow fluctuations, associated with peaking operation below the powerhouse, may also interfere with normal spawning behavior (Marcus et al. 1990).

Adult trout from the analysis area are assumed to migrate to either Spencer Creek or Shovel Creek to spawn due to the general lack of spawning habitat in the Klamath River. Spencer Creek, the primary spawning tributary in the Keno reach of the river, empties into J.C. Boyle Reservoir. The spawning population in Spencer Creek has been monitored in Spencer Creek and robust spawning recruitment is evident (ODFW 1995).

However, most of the spawners in Spencer Creek appear to come from the Keno reach above J.C. Boyle Dam.

The number of fish below J.C. Boyle Dam attempting to migrate to Spencer Creek apparently has decreased by about 99 percent since the construction of the J.C. Boyle facility (Hemmingsen et al. 1992). Monitoring migration over J.C. Boyle Dam in 1959 indicated 5,529 adult redband passing the facility, while counts in 1991 (a drought year) were only 70. River flow in the mainstem reach used by this population is highly regulated (ODFW 1995) and may be affecting fishery ecology (Marcus et al. 1990). Inadequate upstream fish passage facilities at J.C. Boyle Dam are also a possible cause of this decline.

Shovel Creek, located three miles downstream from the state line, is the primary tributary to the Klamath River reach below the wild and scenic river segment of the upper Klamath River. The lower 2.77 miles of this tributary are an important spawning area for the Klamath River wild redband trout (CDFG 2000). However, insufficient spawning gravel was found to be a limiting factor in Shovel Creek. Loss of gravel storage areas, increased fine sediment contributions, and diversions for irrigation delivery may also be impairing spawning habitat quality. Adults were documented to be moving upstream into Shovel Creek to spawn from March-June (Beyer 1984). Most downstream movement of spawned out adults (kelts) occurred from mid-May until June.

Rearing Habitats/Occurrence: Important rearing habitat for trout would include habitat with protective cover and low velocity water (Behnke 1992). Such habitats occur along the margins of streams and in spring seeps, side channels, and small tributaries. The bypass reach of the river is potentially an important rearing area for young trout during their first year of life (City of Klamath Falls 1986). After the high winter/spring flows drop off, the flow is relatively stable in bypass reach from summer through winter and the water temperatures of the lower part of the reach is improved by spring inflow (USDI-BLM 1990).

Little information exists on the condition of rearing habitat in upper wild and scenic river segment of the upper Klamath River, however the milder gradient of the upper reach should provide more rearing habitat than the lower segment. In the lower wild and scenic river segment of the upper Klamath River very few pools or backwater habitats suitable for rearing of juvenile fishes were found under summer low flow conditionsæeven less would be available at higher flows due to increased water velocities in the narrow, constricted river valley (City of Klamath Falls 1986).

Some rearing habitat for trout fry and juveniles is available in the California section of the Klamath River. Shovel creek is considered an important rearing tributary to the Klamath River in California (CDFG 2000). Shovel Creek rearing capacity could be limited as a result of water withdrawal (Beyer 1984). However, the effect of diversions on age-0 fish rearing habitat is uncertain.

In the wild and scenic river segment of the upper Klamath River and California reach, large expanses of riverbed are exposed and inundated on a daily basis throughout varying lengths of the year (particularly during the summer) due to the water level fluctuations associated with hydropower generation. The dewatering of river habitat on a daily basis contributes to reductions in the availability of rearing habitat (Marcus et. al. 1990). In addition, stranding of rearing fish may also occur in the wild and scenic river segment of the upper Klamath River as a result swift exposure of riverbed. Stranding has been documented in the California reach, below wild and scenic river segment (City of Klamath Falls 1987). The target species for this stranding study was larval suckers, however the exact species classification of stranded animals was not noted as all fish were classified as larvae.

Fry and juvenile redband trout inhabit the wild and scenic river segment of the upper Klamath River. Monitoring by PacifiCorp, snorkeling of the J.C. Boyle reach in 1996, indicated the presence of young of the year (less than three inches) redband trout (ODFW 1997). Juvenile trout appear to rear as a relatively larger percentage of the population in the Bypass reach versus the portions of the wild and scenic river segment of the upper Klamath River and California reach (City of Klamath Falls 1986). Trout fry and juveniles were observed in the Klamath River below Shovel Creek during electro-fishing surveys in September 1984. In Shovel Creek fry emergence occurred in June. Fish averaged 29 mm long and grew about 15.7 mm every month until November (Beyer 1984). Most trout emigrated from Shovel Creek to the Klamath River as young of the year (CDFG 2000).

Fry and juvenile trout appear to exhibit a late summer to early fall downstream movement at the J.C. Boyle Dam (City of Klamath Falls 1986). Observed downstream movement of fry to the J.C. Boyle Reservoir of the Klamath River from Spencer Creek occurred during October and November (Hemmingsen et al. 1992).

Some fry movement occurred as early as May and June. Research monitoring downstream fish movement below J.C. Boyle Dam to measure possible recruitment from Spencer Creek concluded that the low numbers of juvenile redband collected suggests inadequate recruitment was occurring to maintain the population in the river between the J.C. Boyle Dam and the California state line (Hemmingsen et al. 1992).

Other sources of recruitment for trout may contribute to the present fishery, including the upper basin sources, mainstem sources, and tributaries sources such as Shovel Creek. In Shovel Creek, movement of fry (0+) occurred in late summer with the peak in late August, and juveniles (1+) migrated out of Shovel Creek to the river from April to June (Beyer 1984).

Adult Habitats/Occurrence: At adulthood, stream species generally live at a depth of 0.3 meters or greater, in areas where slow waters for resting are juxtaposed with fast waters that carry food, and where protective cover is provided by boulders, logs, overhanging vegetation, or undercut banks (Behnke 1992).

Cover for adult habitat in the Klamath River is primarily derived from instream sources such as boulders and water depths (City of Klamath Falls 1986). The riparian vegetation contribution to cover varies in along the length of the river. Large expanses of riverbed in the wild and scenic river segment of the upper Klamath River are exposed and inundated on a daily basis throughout varying lengths of the year (particularly during the summer) due to the water level fluctuations associated with hydropower generation.

ODFW's monitoring of downstream fish movement below J.C. Boyle Dam indicated that Spencer Creek did not have adequate recruitment of juvenile redband to maintain the adult population in the river between the J.C. Boyle Dam and the California state line (Hemmingsen et al. 1992). Regardless, the existing trout population appears to support a sustainable fishery (ODFW 1997). Estimates of adult trout (197 mm or larger) populations between J.C. Boyle Powerhouse and the Frain Ranch (upper reach), and Frain Ranch to Salt Caves (lower reach) were conducted in August 1984 (City of Klamath Falls 1986). Population estimates ranged from 890 fish/mile in the upper reach (95 percent confidence interval of 763-1,069), to 1,911 fish/mile in the lower reach (95 percent confidence interval of 475-7,936). The highest number of adult trout would probably have occurred late in January or early February.

Shovel Creek appears to support a healthy population of spawning rainbow trout (CDFG 2000). The age of the Shovel Creek fish at maturity was similar to rainbow trout in other studies (Beyer 1984). Most trout mature in their second or third year. Minimum size at maturity 140 mm (males) to 163 mm (females) was smaller when compared to other studies but within the range of normal variation. The back calculated mean fork-length for each age of fish taken in Shovel Creek was; 102 mm age 1, 191 mm age 2, 293 mm age 3, and 357 mm at age 4.

Redband management: The planning area portion of the Klamath River in Oregon is managed as a catch-and-release fishery from June to September, and is open to a limited catch the remainder of the year (ODFW 2002). The palatability of the trout meat decreases during the summer/fall seasons, potentially as a result of the poor water quality conditions (ODFW 1997). ODFW noted that in the lower river reach downstream of the J.C. Boyle Powerhouse the hydroelectric peaking operation seriously hampered angler use and catch rates. Low angler use was noted during power peaking periods due to added difficulty and poor success during those conditions.

In the California reach of the planning area, Shovel Creek is closed to fishing year-round to protect important wild trout spawning areas, and a portion of the Klamath River, 250 feet upstream and downstream from the mouth of Shovel Creek, is closed from November through June (CDFG 2000). Otherwise the California segment is open to a limited catch from April to November. When compared to other wild trout rivers monitored by California Department of Fish and Game, the Upper Klamath River Wild Trout Area had the highest overall catch rate (CDFG 2000).

Lost River and Shortnose Suckers

The Lost River sucker, or "mullet," once an important food staple for local Native Americans, was at one time abundant in Klamath Basin lakes and streams, migrating by the thousands to spawn in tributaries of Upper Klamath Lake. Lost River and shortnose suckers typically inhabit lakes and migrate into tributaries to spawn. Adult suckers are long-lived with late sexual maturity (ages 5-7). There is extremely poor recruitment to adult size and age classes in the Klamath Basin. Recruitment failure is attributed to poor survival of larval and juvenile life history stages due to water quality changes, habitat availability, and exotic predation (ODFW 1995; Desjardins and Markle 2000).

Spawning Habitat/Occurrence: For stream spawning populations, suckers begin their spawning migration in late February, March, or early April, depending on peak flows, with spawning activity continuing well into May (USDI-USFWS 1993). Suckers spawn in a range of water temperatures (9-17 degrees Celsius), water depths (1-170 centimeters), and water velocities (42-132 centimeters/second) (Beuttner and Scoppettone 1990). Spawning occurs near the bottom, and when gravel is available eggs are dispersed within the top several centimeters. Spawning over cobbles and armored substrate, eggs fall between the crevices or are swept downstream. Spawning preference appears to be more related to flow than to substrate type. However, reproductive success may not be tightly linked to spawning habitat preference.

Spawning runs of listed sucker species has been documented in the California reach above Copco Reservoir (Beuttner and Scoppettone 1991

Tagged suckers have been documented appearing to prepare for spawning near the slackwater of Copco Reservoir (City of Klamath Falls 1987). Suckers have not been observed spawning in Shovel Creek. Age class analysis has indicated that successful recruitment is not occurring among the two sucker species in these segments of the river (Beuttner and Scoppettone 1991). The scouring and dewatering associate with the hydroelectric operations were thought to reduce survival of eggs and larvae, and predation may also be impairing recruitment.

Rearing Fry/Juvenile Habitat/Occurrence: Larval suckers usually spend relatively little time in tributary streams but migrate back to the reservoir shortly after swim-up (the emergence of larvae from spawn substrate, which typically occurs soon after hatching in suckers) (USDI-USFWS 1993). Larval suckers appear to exhibit a diel migratory behavior and typically migrate during the evening hours. Most larvae would likely migrate to the reservoir between May and June. Larvae prefer slow water areas surrounded by rooted aquatic vegetation, and the larvae appear to avoid areas devoid of vegetation. Gently sloping, unvegetated shorelines are common today lining the lakes and larger streams of the Klamath.

This type of habitat was probably nonexistent historically and created as a result of dams. This type of habitat does not provide nursery habitats of the same quality as a marsh/mature riparian edge habitat.

Little is known of juvenile sucker habitat in the wild and scenic river segment of the upper Klamath River, the adjacent river reaches, and the slackwater of Copco Reservoir. However, juvenile habitat could be affected by water level fluctuation from power peaking operations, which can disturb littoral zone cover and substrate, and can also affect nutrient concentrations, light, temperature, phytoplankton and zooplankton abundance, and macroinvertebrates (Desjardins and Markle 1999).

Loss or alteration of any of these components could be harmful to sucker population stability. Introduction of exotic fish species and hybridization have also been suggested as mechanisms for decline. Recent genetic work suggests hybridization does not occur frequently. Surveys for larval suckers in the California reach indicated that the majority (98 percent) of larvae occurred near the lower most portion of the reach (City of Klamath Falls 1987). Larval presence declined substantially progressing upstream.

Adult Habitat/Occurrence Copco Reservoir:
Lost River and shortnose sucker extended their range into the upper Klamath River system following the creation of lacustrine habitat by construction of Copco reservoir (City of Klamath Falls 1987). Adult suckers spend relatively little time in the riverine spawning reaches, migrating back to the reservoirs after spawning (USDI-USFWS 1993).

The Klamath River reservoirs may be acting as catch basins for expatriated suckers from Upper Klamath Lake (Desjardins and Markle 2000). Juveniles and subadult survive in J.C. Boyle Reservoir, while older individuals move downstream through the Bypass reach, the wild and scenic river segment of the upper Klamath River, and the California reach to Copco and Iron Gate Reservoirs.

Introduced Species

At least fourteen exotic species occur in the river and reservoirs (Table 2-21). Yellow perch, fathead minnows, Sacramento perch, and golden shiner typically favor slower water habitats including slackwater shoals close to Copco Reservoir, and generally are not found in swift flowing portions of the river (USDI-BLM 1990). Although not documented by fisheries specialists, there have been at least two reports of white sturgeon in the planning area. White sturgeon was planted in Upper Klamath Lake in 1956 (ODFW 1997). Brown trout, planted in Copco Reservoir, inhabit and migrate through the California reach to spawn in Shovel Creek (CDFG 2000). Steelhead, planted into Copco Reservoir 1971-1981 (excepting 1975, 1977, and 1978) has been reported from the California portion of the Klamath in the past.

Limitation to Aquatic Species in the Wild and Scenic River

Habitat: Abnormal fluctuation in daily and seasonal flow patterns created below the hydroelectric power operations can lead to low flow dewatering of spawning beds, and both low flow and high flow induced spawning interference, incubation mortality, and rearing mortality of resident fish (Marcus et al. 1990).

Downstream dewatering and desiccation of spawning habitat is a documented occurrence in the wild and scenic river segment of the upper Klamath River (City of Klamath Falls 1986). Downstream dewatering and desiccation are undoubtedly the worst of the possible adverse impacts on the stream (Marcus et al. 1990). In addition, in regulated streams where natural peak flushing flows are greatly reduced, fine sediment can accumulate in the deeper layers, clogging the free flow of water (Marcus et al 1990).

The quality of the spawning habitat present in the wild and scenic river segment of the upper Klamath River was impaired, as result of being heavily embedded and interspersed with large cobble (City of Klamath Falls 1986). Embedded sediments can adversely affect the intragravel habitat important to the survival of benthic insects, incubating eggs, and rearing larvae (Marcus et al. 1990).

The wild and scenic river segment of the upper Klamath River is probably poor rearing habitat. This can be attributed to high gradient and a wide range of flow velocities as a result of peaking operations by the J.C. Boyle Powerhouse. Downstream dewatering of habitat resulting from hydroelectric impoundments would eliminate access to cover habitat and potentially degrade the quality of the existing habitat (Marcus et al. 1990).

Alteration of instream flows from power operation and changes in sediment regimes due to reservoirs can result in decreased bank stability and loss of riparian vegetation (Marcus et al. 1990), which would decrease the cover habitat important to rearing fish (Behnke 1992). Rearing habitat in the California reaches would be affected similarly by peaking operations.

The extent and cumulative impacts of stranding has not been studied in the wild and scenic river segment of the upper Klamath River (CDFG 2000), but the occurrence of larval stranding has been documented (City of Klamath Falls 1987). In the wild and scenic river segment of the upper Klamath River and California reach, large expanses of riverbed are exposed and inundated on a daily basis throughout varying lengths of the year (particularly during the summer) due to the water level fluctuations associated with hydropower generation (City of Klamath Falls 1986).

The predominate habitat types, from the lower segment of the upper reach within the wild and scenic river segment of the upper Klamath River, are shallow rapids, riffles, and runs. Channels with an abundance of shallow habitat are more likely to have larger areas exposed during down-ramping where fish could become separated from the main river flow due to declines in stage (Stillwater 1999). The large flow fluctuations associated with the J.C. Boyle Powerhouse can cause high mortality to young fish through stranding (City of Klamath Falls 1990).

Daily temperature fluctuations of up to 12 degrees Celsius occur in this full flow reach of the river during the middle of the summer (City of Klamath Falls 1986). The effects of these large diurnal temperature fluctuations on the existing cold water fish populations has not been studied specifically for the wild and scenic river segment of the upper Klamath River.

It can be assumed that water temperature fluctuation impacts to fisheries may include elevation of temperatures beyond the range preferred for rearing, inhibition of upstream migration of adults, increased susceptibility to disease, reduced metabolic efficiency, and shifts in competitive advantage (Hicks et al. 1991).

Impacts to other aquatic resources may also be occurring as a result of hydroelectric power operations, including water level fluctuation associated with J.C. Boyle Powerhouse, and poor passage. The distribution of benthic organisms appears to be limited by power peaking operations (City of Klamath Falls 1986). The production of benthic invertebrates' appears to be limited to locations in the riverbed that remained wet during the low flow period of the daily flow cycle.

The impact of J.C. Boyle Dam impairing downstream movement of fish to the wild and scenic river segment of the upper Klamath River has not been studied. Studies of trout food habits in the Bypass reach and wild and scenic river segment of the upper Klamath River did not note the occurrence of prey fish species in stomach contents analysis (City of Klamath Falls 1990). Downstream passage concerns have been noted, including poor passage hydraulics and predation exposure in the forebay of J.C. Boyle Reservoir (FishPro 2000), which may limit the downstream movement of prey species.

Redband Trout: ODFW fisheries biologists have noted that redband in the wild and scenic river segment of the upper Klamath River and Bypass reach appear to be smaller in size on average than fish observed in the Keno reach of the river above J.C. Boyle Reservoir (Smith 2000, personal communication). The physical structures of Keno Dam are more conducive to fish passage than J.C. Boyle (FishPro 2000). Lake elevation and flow rates are regulated at Keno Dam to maintain near constant conditions in Lake Ewauna (FishPro 2000) and instream flows for the reach generally are governed by Bureau of Reclamation directives in meeting their instream flow requirements downstream from Iron Gate Dam (PacifiCorp 2000). This results in fairly unimpaired flows in the Keno reach.

Adult habitat limits the population biomass of resident trout in most streams (Behnke 1992). Spawning and rearing habitat are adequate, and the food supply would support a greater biomass of trout if more adult habitat were present. Excessive recruitment into the population, where young and adult fish are competing for a common food supply, results in short-lived slow-growing individuals and a population whose biomass is tied up in small, young fish.

Based on the population estimates and length frequency distribution (City of Klamath Falls 1986) and the existing conditions of poor upstream passage at J. C. Boyle Dam (Hemmingsen et al. 1992) and power operations which provides suitable habitat to only individuals which can escape the daily dewatering, the trout population could be exceeding carrying capacity and the additive recruitment of trout to these segments could then affect the trout size/age structure.

Genetics may be playing a part in the differences in size and age between the Keno stretch and the wild and scenic river segment of the upper Klamath River reach. The populations of Upper Klamath Basin trout exhibit older ages at maturity and large maximum size (Behnke 1992). Fish passage facilities at J.C. Boyle Dam have been described as inadequate (FishPro 2000; Hemmingsen et al. 1992). Recruitment to the wild and scenic river segment of the upper Klamath River may be limited from these upper populations. Movement between Keno and the upper basin may not be similarly affected. Selection of smaller, earlier maturing fish may be occurring in the wild and scenic river segment of the upper Klamath River.

Food supply may also be impairing size and age structures. Trout restricted to small food items form populations characterized by small maximum individual sizes and young maximum ages (Behnke 1992). Only when trout have adequate access to larger prey, such as crayfish and fish, can they avoid feeding competition with smaller trout and sustain growth.

Truncated population structures, particularly in the Bypass reach where older age classes were missing, has been documented (City of Klamath Falls 1990). Downstream passage concerns have been noted, including poor passage hydraulics and predation exposure in the forebay of J.C. Boyle Reservoir (FishPro 2000), which may limit the downstream movement of larger prey species. Lack of this larger fish prey base could be limiting the size classes present in the wild and scenic river segment of the upper Klamath River, which would not occur in Keno Reservoir (which has better passage).

Historic Anadromous Species

The steelhead life history morphology was historically present in this group, but is now considered extinct (ODFW 1995). This life history probably was introduced into the Upper Klamath Basin after the Pleistocene Lake Modoc opened to the Pacific Ocean (Behnke 1992). The novel traits in the Upper Klamath Basin group may have resulted from the interbreeding of the new invading *O. mykiss* with the original resident fish of the basin (ODFW 1995; Behnke 1992). Steelhead were documented as far up as the Link River (ODFW 1997).

Fall chinook and spring chinook salmon potentially spawned within the Sprague River (Klamath River Basin Fisheries Task Force 1992). Runs were seen as far up the Sprague

River as Beatty, Oregon, and spawning was reported in the North and South Forks of the Sprague. Historically, entry timing for spring chinook appeared to occur in March to upper Klamath River area. Fall chinook entry to the Sprague River was noted in September and October.

The Coho adapted to the Upper Klamath Basin had been lost sometime prior to the earliest documented fisheries assessment and collections, and prior to fish collections between 1914-1918 at Klamathon Racks (Klamath River Basin Fisheries Task Force 1992).

Currently the Southern Oregon Northern California Coastal Coho salmon ESU, in which the Klamath River populations downstream of Iron Gate Dam are included, was listed as threatened under the *Endangered Species Act* in 1997 (62 FR 24588). An ESU or Evolutionarily Sensitive Unit, is a designation that defines a distinctive group of Pacific salmon, steelhead, or sea-run cut-throat trout (NOAA and National Marine Fisheries Service 2000).

Designated critical habitat for Southern Oregon Northern California Coastal Coho salmon occurs downstream of Iron Gate Dam (May 5, 1999; 64 FR 24049).

Reintroduction of anadromous fisheries to the Upper Klamath Basin has been addressed more than once (Fortune et al. 1966; Klamath River Basin Fisheries Task Force 1992). Conditions of the Upper Basin and anticipated relative costs versus relative benefits negated implementation of reintroduction of anadromous fisheries at the time based on these reviews.

The hydroelectric project on the upper Klamath River (FERC Project No. 2082), including five of the six mainstem dams currently blocking or impairing fish passage, will be assessed for reintroduction of anadromous species through the hydroelectric facilities as part of the relicensing process.

Management of the Fishery Resources

The BLM has committed to fisheries management goals from the 1994 “Northwest Forest Plan” and included Aquatic Conservation Strategy objectives, “Bring Back The Natives,” and “Fish and Wildlife 2000.” These plans/initiatives are guidance to the BLM for fisheries habitat management.

“Bring Back The Natives” is a national effort by the BLM, the USFS, and National Oceanic and Atmospheric Administration-Native Marine Fisheries Service to restore the health of entire riverine systems and their native species (NFWF et al. 1992).

Public land management initiatives, such as “Fish and Wildlife 2000,” target key habitats and animal and plant species as well as water quality. “Fish and Wildlife 2000” is a plan to improve management of fish, wildlife, and their habitats on BLM-administered lands.

It is the objective of the BLM to manage and maintain habitat in the planning area and, where feasible, restore those habitats that are now in degraded condition. The 1994 “Northwest Forest Plan” provides for protection of areas that could contribute to the recovery of fish and improve aquatic habitat and water quality through out the basin. The 1994 “Northwest Forest Plan” also provides general guidance on implementation and effectiveness monitoring.

Federal aquatic habitat within western Oregon, Washington, and northern California falls under the 1994 “Northwest Forest Plan” guidance and aquatic conservation strategy objectives, which include:

- Establish watershed and riparian goals and objectives to maintain and restore fish habitat;

- Delineate riparian management areas and a system of key watersheds to protect fish habitat;
- Provide standards and guides for management in riparian areas; and
- Calls for watershed analysis and sub basin reviews to set priorities and provide guidance on priorities for watershed restoration.

Range Resources

Livestock Grazing

Homesteaders have grazed cattle, sheep, and horses within the Klamath River Canyon since the late 1800s. Cattle, and a few domestic horses inside fenced pastures, are currently the only domestic stock that graze within the canyon. Although no figures are available on historic livestock use in the canyon, grazing use has been intense as evidenced by a change from native perennial grasses to invading nonnative annual grasses currently dominating the rangeland. Cattle, wildlife, and a small herd of wild horses (see the following Wild Horses section), currently compete for forage. U.S. Timberlands, PacifiCorp, and BLM-administered lands are used for grazing in and around the planning area. Hay production is also common on privately-owned meadows in the planning area in California.

Riparian vegetation has also been impacted by grazing. Typically, areas that have retained their natural vegetative composition are primarily in steep topography that are inaccessible to livestock. Native grasses that were typical of the once dominant perennial range but are now limited, include Idaho fescue, blue bunch wheatgrass, pine bluegrass, few-flowered wild oatgrass, melic (onion) grass, and needle grass. Cheatgrass, medusa head wildrye, two-flowered fescue, bulbous bluegrass, foxtail barley, thistle, and dandelion are presently found, indicating an annual rangeland and poor range condition. All of these annuals are generally unpalatable and provide little or no nutrient value to both livestock and wildlife (Stoddardt, Laurence A., et. al. *Range Management, Third Edition*, McGraw-Hill Book Company, 1975). Factors causing this change include early spring grazing, historical burning, natural erosion, trampling and soil compaction by livestock, and repeated livestock use. These conditions favor the weedy annual species that easily take over the native perennial plants and grasses (see the Noxious Weeds section for more information).

Two studies have been done in the Klamath River Canyon in relation to vegetation and range condition, one by the Medford District BLM in 1981 and the other for the proposed Salt Caves Hydroelectric Project by the City Of Klamath Falls in 1984 and 1986. Both studies determined the rangelands to be in poor condition. The BLM range study included 5,580 acres in the proposed Salt Caves Hydroelectric Project area, most of this within the river study boundary. It rated ecological range condition based on the seral stage present and determined 64 percent of these acres to be rated poor (early seral stage), 28 percent fair, 8 percent good, and 0 percent excellent condition (late seral stage).

The "Edge Creek Rangeland Health Standards Assessment" came to the following conclusion relative to "Standard 1 – Watershed Function – Uplands," the standard which most addresses upland ecological conditions: "Though this standard is currently not being totally met, BLM management (grazing and nongrazing) is making significant progress toward meeting it on the public portions of the Edge Creek Allotment. Current BLM leased/licensed livestock is not considered a factor…" this points to the fact that though ecological conditions are not optimum, current livestock use was not determined to be a significant factor in the suppressed conditions or was slowing down the gradual improvements.

BLM-Administered Lands

The first known grazing lease on Oregon BLM lands in the canyon was issued in 1960, although it is believed that grazing was occurring long before that. Current grazing use on BLM-administered lands in the planning area is licensed under two different leases covering portions of two different grazing allotments (see Map 8). The recognized base properties for both BLM leases are owned by PacifiCorp. Since the mid-1990s, these base properties (and thus, the attached BLM grazing privileges) have been leased to Bob Miller, a long-term grazing user in the area. Specific grazing allotment and lease information is as follows:

Edge Creek Allotment (0102): The majority of this allotment is outside the Klamath River Canyon, and thus, outside the planning area. The portions in the canyon are licensed as part of the Ward Pasture of the Edge Creek Allotment. It has never been clear exactly how the canyon was adjudicated for grazing use; the common assumption has been and still is, that the canyon is a portion of the Ward Pasture.

The current BLM lease allows for 43 cattle from May 1 to July 15 (107 animal unit months), which includes use in the Ward Pasture on top of the rim (and out of the planning area) as well as the canyon area from the Hoover Ranch (mouth of Hayden Creek) up to the Frain Ranch area (near RM 216). An animal unit month (AUM) is a unit of measurement indicating how much forage is eaten by a cow/calf pair in one month.

Since 1997, the Frain Ranch area has been effectively fenced off from the grazing areas downstream by the Rock Creek fence. The majority of the current grazing use within this allotment (inside the planning area) is in the vicinity of the Hoover Ranch. This grazing use is confined by the power line fence, which is located about 2 miles north and east of the Hoover Ranch and appears to effectively limit the upstream movement of cattle. Cattle ingress/egress is also limited by the Klamath River rim itself and intermittent gap fencing located along low spots in the canyon rim, from just east of the Hayden Creek canyon to near the California/Oregon border.

It should be noted that both the Frain Ranch and Hoover Ranch areas have large quantities of private lands intermingled with BLM-administered lands. Thus, grazing use is not totally within BLM control.

More information on the Edge Creek Allotment can be found in the "Topsy/Pokegama Landscape Analysis" (1996); and Edge Creek Allotment's rangeland health standards assessment (1999).

Laubacher Lease Allotment (0155): This small allotment is located fully within the planning area. It is also entirely within the jurisdiction of California's Redding Field Office and is administered only for grazing use by the Klamath Falls Resource Area. All other management is out of the Redding Field Office.

The grazing lease allows for 32 cattle from April 15 to June 14 yearly (64 animal unit months). The grazing use in this small allotment is limited somewhat by fencing that keeps livestock out of BLM portions of the canyon near the rafting take-out. Cattle use on much of the BLM uplands is limited by steep slopes; thus, most of the grazing use occurs on the gentler-sloping, leased private lands owned by PacifiCorp and others.

In 1998, over one-third of the allotment was sold into private ownership and most of the remaining acreage (everything outside of the 0.25-mile river corridor buffer) is identified for disposal by sale or exchange in the "Redding Resource Management Plan and Record of Decision" (1993).

Private Lands

The majority of the grazing use within the planning area takes place on privately-owned lands—primarily PacifiCorp lands leased to Bob Miller. The most important and highest capacity lands for vegetation production are the irrigated meadows between Copco Reservoir and the Oregon/California state line.

Within the planning area, about 95 percent of the grazing use takes place on private lands, though some of the private landsæmost notably in the Frain Ranch areaæare not grazed for various reasons. The private lands have a long and rich history (and prehistory), with grazing generally beginning around the time of the Civil War, though some cattle trailing was done through the western portions of the region (west of Iron Gate Reservoir) as early as 1837.

From 1993 to 1995, PacifiCorp contracted with rangeland management consultant Ed Korpela for the preparation of a grazing management plan. This was consummated in the August 1995 “Livestock Grazing on PacifiCorp’s Klamath River Rangelands: Inventory, GIS Model Development, and Grazing Management Plan–Working Draft.”

This plan provided a comprehensive overview of estimated forage quantities and related grazing capacities for both normal and drought years; suggested various rotational grazing systems and seasons of use by pastures; comprehensively listed current and proposed rangeland improvements; stated rangeland objectives and monitoring; and provided other information pertinent to livestock operations on the PacifiCorp properties.

The plan included the BLM-administered lands that are attached to PacifiCorp’s private base properties (see previous section). Approximately 50 percent of the normal year grazing capacities outlined in the PacifiCorp management plan are located within the planning area analyzed in this document.

This grazing management plan forms the basis for the current basic management system on the private lands (and to a much more limited degree, the public lands). The plan allows for up to 400 head of cattle to be run year-round throughout the plan in defined operational areas. The cattle are variously rotated through a myriad of separate irrigated and upland pastures and units throughout the year. However, the actual yearly use is largely dependent on the needs and desires of the lessee.

Wild Horses

A very small portion (<5 percent) of the Pokegama Wild Horse Herd Management Area is located within the planning area north of the Klamath River. The total herd management area is bounded by Copco Lake and the Klamath River on the south and east, Jenny Creek on the west, and State Highway 66 on the north. With the exception of State Highway 66, these natural boundaries appear to be physical barriers to movement of wild horses and therefore to habitat expansion. These horses are not in a designated herd management area but drift occasionally from the adjacent Gavin Peak Herd Management Area, which lies to the south and east of the planning area. The Gavin Herd Management Area is administered by the USFS Goosenest Ranger District, which has been trying to remove the horses due to the small amount of federal land in the herd management area. As the herd management area only touches the river planning area in a few locations, it will be minimally considered in this document (see Map 8).

Wild horses have been reported in the Klamath River Canyon area since the early 1900s in numbers that have widely varied depending on many factors. In 1972, 25 horses were counted during BLM’s first inventory. Since then, the Pokegama herd has been inventoried frequently with the counts ranging from 25 to a high of 55 in 2000. Actual horse numbers were probably 25–50 percent higher due to the difficulty of accurately counting animals on a forested landscape.

The primary objective for wild horses is the "…management of wild horses and burros as an integral part of the natural system of the public lands under the principle of multiple use…" (43 Code of Federal Regulations [CFR] 4700.0-2). A primary aspect of this management is ensuring that wild horse grazing use is in harmony with the resource capacities of the public lands and other legal uses. In part, this entails ascertaining the conditions of the rangelands relative to the total numbers of grazing animals using those lands.

An analysis of range conditions was prepared in 1983 by the Medford District ("Medford Grazing Management Program EIS"), allocated 250 animal unit months of forage from BLM lands for the Pokegama Wild Horse Herd within the herd management area (the Dixie and Edge Creek Allotments). The bulk of the forage was (and is) expected to be provided by the dominant private lands, which make up over 80 percent of the herd management area. Part of the herd management area is within critical deer winter range, which was considered in allocating animal unit months. Studies conducted for the original 1978 wild horse herd management plan showed that the horses feed primarily on grass, and therefore do not appear to compete with deer for browse on critical winter range; however, there may be direct competition for grass during green up periods when deer feed heavily on grasses and forbs. Horses will compete directly with elk and cattle since these species have almost complete dietary overlap.

The above AUM figure and the appropriate management level of 30–50 head was affirmed in the 1995 "Klamath Falls Resource Area Final RMP/EIS Record of Decision." This appropriate management level was also documented in the 1995 "Lakeview District Wild Horse Gather Environmental Assessment," 1996 "Topsy/Pokegama Landscape Analysis," and the Dixie (2001) and Edge Creek (1999) Allotments rangeland health standards assessments.

In 1996, the actual wild horse numbers were found to exceed 50 head and resulted in the first ever government removal of horses from this herd management area. During the late spring, summer, and early fall of 1996, 20 horses were removed from the herd management area via a bait trapping method. In 2000, the horses were found to again be above the appropriate management level maximum of 50 head. Because of this, 18 more horses were removed (using the same trapping method) during May and June of 2000. All of the horses captured in 2000 were captured north of State Highway 66—out of the designated herd management area. Captured horses have been taken to the Burns, Oregon, wild horse facility where they were made available for public adoption as required under the regulations (43 CFR part 4700). There are currently (2002) estimated to be 35–45 horses residing in the herd management area.

Wildland Fire and Fuels Management

The Klamath River Canyon vegetation is a very diverse assemblage of plant communities. The major plant communities identified are conifer forest and woodland, dense oak woodland, open oak woodland, juniper woodland, mixed shrubs, rabbitbrush-sagebrush, dry meadow, riparian, and irrigated meadow.

Lightning occurrence was 20 lightning ignitions from 1990 through 1999 (Oregon Department of Forestry). The fire return interval for the conifer forest/woodland type is every 10 to 20 years. The estimated fire return interval for oak woodlands in this type of canyon terrain is 5 to 15 years.

Since European settlement, several factors have allowed changes in the vegetation to occur. Native American subsistence burning has been eliminated, heavy grazing has occurred in certain areas, and active fire suppression has occurred in the planning area.

Beginning early in the 20th century, fire prevention and suppression efforts greatly intensified in order to protect public resources and private property from perceived risk of wildfire (Oliver et al. 1994). These efforts became increasingly successful, and by the 1930s nearly all fires were successfully suppressed (Oliver et al. 1994; Agee 1994, 1990, 1993).

Throughout much of the 20th Century, the success of these efforts effectively eliminated fire from these landscapes, leading to conditions favorable for the establishment of numerous small (often shade tolerant) trees, shrubs, and other vegetation (Hessburg et al. 1999; Lehmkuhl et al. 1994).

The resulting additional biomass has caused an increase in crown and ladder fuels, which contribute directly to the lethal effects of recent fires on these landscapes (Huff et al. 1995).

The three main vegetation types considered for fuels treatment are conifer forest and woodlands (41 percent), oak woodlands (21 percent), and mixed shrub (16 percent) within the total planning area. Both mechanical thinning and prescribed burning are options being considered to achieve reduction of fuel loadings.

The conifer forest overstory consists mainly of Douglas fir, sugar pine, ponderosa pine, and incense cedar. The developing ladder fuels in this type targeted to receive fuels reduction treatments are Douglas fir, incense cedar, and white fir.

The oak woodland overstory consists mainly of the dominant Oregon white oak and lesser amounts of California black oak. The developing ladder fuels in this type targeted to receive fuels treatment are scattered junipers, pines, wedgeleaf ceanothus, manzanita, and other brush species (depending upon site conditions).

The mixed shrub type is quite variable and species composition and density is tied to local site conditions. Common shrubs include birchleaf and curlleaf mountain mahogany, wedgeleaf ceanothus, manzanita, poison oak, and serviceberry. Oregon white oak can also be found in its shrubby form class. Fuels treatment in this type will be in the form of fuel loading reduction and lowering the height structure of the shrubs.

A prescribed burning program began in 1996 on BLM land on the Oregon side of the planning area. Burn units were created based on fuel type, fuel loads, topography, and access. Units were selected for burning on a random basis to more closely mimic natural burn patterns at a landscape level. The objective of these burns is to reduce fuel loads to lower, more natural levels, reducing the risk of stand-replacing wildfires (for more details, see "Environmental Assessment No. OR- 014-94-09, Klamath Falls Resource Area – Fire Management, June 1994). To date, 300 acres have been burned, and 200 acres have been contracted for burning when conditions fall within prescription. These prescribed burn projects are limited to areas not seen from the Klamath River. The Final River Plan will determine the locations of treatment areas where prescribe burning can be used.

Air Quality

Air quality is a sensitive issue in the Upper Klamath Basin primarily because of the existing relatively clean air. Potential air quality consequences of the range of alternatives are important for the preservation of high quality visual values for the region. Clean (clear) air is also an important quality with respect to this plan, because of the role it plays in maintaining the Scenic values attributed to the Klamath River Canyon.

Air pollutants are emitted from a variety of sources in the Basin including industrial plants, highways, and urban areas. Agriculture operations contribute greatly to air pollutants (dust) especially in the spring when fields are tilled and planted before irrigation begins. With the emphasis on reducing risk of wildfire on federal, state, and private lands, fuels reduction projects using prescribed fire are also becoming a more common source of pollutants that can contribute to reduced air quality.

The incised nature of the river canyon results in restrictive topography that can trap air until winds can move it out. Because of the lower elevation, smoke and dust generated outside the planning area can contribute to poorer air quality within the canyon and be evidenced as a haze. This typically could occur in the mornings after cooler downdrafts carry the smoke or dust particles down into the canyon over night. Pollutants introduced locally within the inversion layer may follow the drainage flow, but will likely stay within the stable inversion layer. During the daylight hours, when the sun warms the local topography, air adjacent to the surface warms and rises and can break down the surface inversion and ultimately results in an upslope flow. Predominant winds are westerly to northwesterly, however, wind direction fluctuates greatly from the north, south and more rarely from the east as weather “fronts” move through the area.

Air Quality Standards

National Ambient Air Quality Standards (NAAQS) were established by the 1963 *Clean Air Act* and subsequent Amendments to protect the public health (primary standards) and public welfare (secondary standards) from any known or anticipated adverse effects associated with the presence of pollutants in the ambient air.

On May 15, 1998, the EPA issued the *Interim Air Quality Policy on Wildland and Prescribed Fires (Air Quality Policy)* (EPA, 1998) to integrate the public policy goals of, 1) using fire to restore healthy ecosystems, and 2) mitigating the impacts of air pollutant emissions on air quality and visibility. The Air Quality Policy was written to help air quality managers to ensure that plans by Federal Land Managers to conduct more prescribed burns would not result in exceedances of NAAQS.

Enforcement of the *Clean Air Act* in Oregon has been delegated, by the U.S. Environmental Protection Agency (EPA), to the Oregon Department of Environmental Quality (ODEQ) - Air Quality Division. The state, in turn, is required to develop and administer air pollution prevention and control programs approved by EPA. State ambient air standards must either be the same as or more stringent than the federal NAAQS. The State of Oregon has established its own ambient air quality standards (Division 31, Oregon Administrative Rules).

California’s Smoke Management Program addresses potentially harmful smoke impacts from agricultural, forest and rangeland management burning operations. The legal basis of the program is found in the *Smoke Management Guidelines for Agricultural and Prescribed Burning* (California, 2001) adopted by the California Air Resources Board at its meeting on March 23, 2000. These Guidelines were filed with the Secretary of State and became effective on March 14, 2001. The California Air Resources Board and the State’s 35 air districts are responsible for administration of the program.

The biggest health risk arising from prescribed fires is from smoke, which contains multiple chemical compounds and particulate matter, one of the six pollutants for which EPA has set NAAQS. If the particulate matter for NAAQS is exceeded, the EPA is required to designate the area as a “nonattainment” area. This designation then imposes on the state certain legal requirements to bring the area back into attainment.

Visibility is an important air quality value in the western United States, particularly for scenic and recreational areas. *Clean Air Act* Section 169A requires EPA to develop regulations for the "prevention of any future and remedying of any existing impairment of visibility in mandatory Class°I federal areas which impairment results from man-made air pollution." EPA has prepared a list of 156 mandatory Class I areas in which visibility is an important value.

Generally, Class I is the designation for clean pristine airsheds. Class I areas include national parks larger than 6,000°acres, most national wilderness areas greater than 5,000 acres, and international parks and national memorial parks that exceed 5,000°acres. The nearest Class I airshed is Mountain Lakes Wilderness located 12 miles directly north of the northern end of the planning area.

The River Plan will propose fuel treatments to enhance wildlife habitat, maintain scenic resources, and reduce the potential for catastrophic wildfires. Planned prescribed fires need to be consistent with the *Clean Air Act*. Klamath Falls Resource Area will be developing a Smoke Management/Air Quality Plan in 2003. This smoke management plan would analyze the river planning area and should identify what affect actions proposed would have on air quality. The final river plan will meet the requirements of the Smoke Management Plan currently under development.

Land Tenure

Land ownership within the planning area boundary is as follows (see Map 3):

- Segment 1: 70 percent BLM and 30 percent private
- Segment 2: 75 percent BLM, 2 percent state, and 23 percent private
- Segment 3: 11 percent BLM, 2 percent U.S. Forest Service (USFS), and 87 percent private ownership

Table 2-22 shows land ownership by segment in both acres and percent.

Existing Rights

Rights-of-way for three power lines and four roads totaling 27.3 miles in the planning area affect 259 acres of federal land. Table 2-23 summarizes the rights-of way by segment. There are no existing mining claims. PacifiCorp has three water right claims for power generation and irrigation and the Oregon Department of Forestry has one water permit for fire suppression. Native American rights, which include access to religious sites and the freedom to worship through ceremonies and traditional rites, are protected and preserved within the planning area by the *American Indian Religious Freedom Act* of 1978.

Hydroelectric Facilities

The planning area includes the portion of the Klamath River between two hydroelectric facilities: J.C. Boyle Dam in Oregon and Copco 1 Reservoir in California. The J.C. Boyle 80-megawatt power generation plant is 4.3 river miles below J.C. Boyle Dam. This facility has two turbine generators that provide power during high use (peak) periods. Up to 3,000 cfs of flow can be diverted at J.C. Boyle Dam.

This water passes through a 14-foot-diameter pipe into an above ground concrete flume for two miles, flows into a concrete forebay, and then enters a tunnel, which passes a short distance through the canyon wall before entering the penstocks and turbines (PacifiCorp 2000). At the entrance of the tunnel an emergency overflow spillway can discharge water from the canal to the river. Additional facilities associated with the J.C. Boyle Powerhouse in Segment 2 include a surge tank, substation, and storage building at the powerhouse site, and a

Table 2-22.—Upper Klamath River planning area land ownership

Landowner	Acres	Percent
Public		
Bureau of Land Management	947	67
Private		
PacifiCorp	169	12
U.S. Timberlands	276	20
JELD-WEN, Inc.	18	1
Segment 1 Total	1,410	100
Segment 2		
Public		
Bureau of Land Management	5,152	71
State		
Oregon	118	2
Private		
PacifiCorp	1,100	15
U.S. Timberlands	545	7
Other Private	391	5
Segment 2 Total	7,306	100
Segment 3		
Public		
Bureau of Land Management	1,472	14
Klamath National Forest	601	6
Private		
PacifiCorp	5,830	55
Boise Cascade	754	7
Other Private	2,029	18
Segment 3 Total	10,686	100
Total Acres for all Segments	19,402	

U.S. Geological Survey (USGS) gaging station downstream from the powerhouse. Roads and power lines associated with energy transmission are found in all three segments.

The Klamath Hydroelectric Project is comprised of the J.C. Boyle and Copco 1 facilities, four other dams (Keno, Copco 2, Iron Gate, and Fall Creek), and the powerhouses associated with the Link River Dam (PacifiCorp 2000). The hydroelectric project, which is operated by PacifiCorp, was licensed by FERC in 1956. That license expires in 2006.

In 2000, PacifiCorp formally initiated the relicensing process. The BLM is working with numerous federal, state, and tribal agencies to ensure that resource management concerns are addressed in the new licensing process. A new license would probably have a life of 30 to 50 years.

Table 2-23.— Upper Klamath River planning area rights-of-way

Right-of-way	Width (feet)	Length (miles)	
		Private	Bureau of Land Management
Segment 1			
Power lines			
OR 24416	100	0.5	1.5
OR 17364	50	0.4	0.0
ORE 013482	N/A	0.0	<0.1
Roads			
OR 200608	60	0.0	1.8
Power Project #2082	100	2.0	4.3
Segment 2			
Power lines			
OR 17364	50	1.1	5.7
OR 24416	100	0.0	0.5
Roads			
Power Project #2082	100	1.0	6.2
Access Road [1]	60	4.4	4.9
Segment 3			
Power line	50	4.8	0.5
Topsy Road	100	4.9	1.8

[1] Includes portions of the Topsy Road and the J.C. Boyle Powerhouse Access Road.

Socioeconomics

Three counties, Jackson and Klamath Counties in Oregon and Siskiyou County in California, would most likely be affected by changes in management or reallocation of resources associated with the upper Klamath River. The population of this area during the 2000 Census totaled 289,345. Populations in the individual counties were: Jackson, 181,269 (up 23.8 percent since the 1990 census); Klamath, 63,775 (up10.5 percent since the 1990 census); and Siskiyou, 44,301 (up 1.8 percent since the 1990 census). Major population centers are Ashland, 20,085; Klamath Falls, 19,365; Medford, 62,030; and Yreka, 7,500.

The Oregon Employment Department in its 1999 annual employment report, estimated civilian labor force in Jackson County to be 89,160 and 28,760 in Klamath County. The California Employment Development Department estimated civilian labor force in Siskiyou County to be 17,760. In Jackson County the three largest sectors were trade (20,800), services (19,840), and government (11,280). In Klamath County the three largest sectors were services (5,580), trade (5,510), and government (5,400). In Siskiyou County the three largest sectors were government (3,820), services (3,370), and trade (3,280). Unemployment rates in the individual counties were: Jackson, 6.6 percent; Klamath, 8.7 percent; and Siskiyou, 9.5 percent.

Personal income in 1998, as reported by the U.S. Department of Commerce, Bureau of Economic Analysis, was $6.17 billion for the tri-county region. County totals were as follows: Jackson, $4,021,718,000; Klamath, $1,250,550,000; and Siskiyou, $901,367,000. Jackson County had the highest per capita income ($23,214) followed by Siskiyou ($20,474) and Klamath ($19,800).

Agricultural products/crops in the area include cattle, forage and hays, nursery products, and in Siskiyou County only potatoes and potato seed. Total agricultural sales for each county in 2000 were Jackson, $58,847,000; and Klamath, $132,815,000. Total agricultural sales for Siskiyou County in 1999 were $116,598,000. Farm income is a very small portion of total personal income in the area. During 1998, farm income represented just 0.23 percent of the total personal income in Jackson County. Farm income represented 0.73 and 2.16 percent to total personal income in Klamath and Siskiyou Counties, respectively.

The lumber and wood products industry also contributes to the local economy. In Jackson County, 3,870 people were employed in the lumber and wood products industry, representing 5.4 percent of all wage and salary employment in the county. In Klamath County, 2,470 people were employed in the lumber and wood products industry, representing 10.6 percent of all wage and salary employment. In Siskiyou County, 770 people were employed in the lumber and wood products industry, representing 5.3 percent of all wage and salary employment. The industry also contributed to personal income in the region. In Jackson County, earnings in the lumber and wood products sector totaled $196,287,000, or 4.9 percent of total personal income. In Klamath County, earnings in the lumber and wood products sector totaled $109,677,000 or 8.8 percent of total personal income. In Siskiyou County, earnings in the lumber and wood products sector totaled $31,795,000, or 3.5 percent of total personal income.

Employment and income statistical references do not specifically track recreation and tourism as a sector. Instead recreation and tourism contributes to several sectorsætransportation, services, retail trade, and even government. The Oregon Tourism Commission publishes an annual report with estimates to total travel-related spending in each county. Estimates for 1999 were $224.1 million in total travel spending in Jackson County and 99.7 million in Klamath County. The same researcher made estimates for Siskiyou County for 1998 of 171.0 million.

Description of Potential Area of Critical Environmental Concern Values

An ACEC designation highlights an area where BLM special management attention is needed to protect and prevent irreparable damage to important historic, cultural, and scenic values; fish or wildlife resources; or other natural systems or processes; or to protect human life and safety from natural hazards (BLM Regulations, 43 CFR 1610).

The ACEC designation indicates to the public that the BLM not only recognizes the area possesses significant values, but has also established special management measures to protect those values. Designation serves as a reminder that the significant values or resources must be accommodated during the BLM's consideration of subsequent management actions and land use proposals within an ACEC.

To be considered as a potential ACEC, and further analyzed in resource management plan alternatives, inventory data for the area must be analyzed to determine whether there are areas containing significant resources, values, systems or processes, or hazards. To be a potential ACEC, an area must meet both relevance and importance criteria, as established and defined in BLM Regulations, 43 CFR 1610.7-2:

Relevance. There shall be present significant historic, cultural, or scenic values; a fish or wildlife resource or other natural system or process; or natural hazard.

Importance. The above described value, resource, system, process, or hazard shall have substantial significance and values. This generally requires qualities of more than local significance and special worth, consequence, meaning, distinctiveness, or cause for concern. A natural hazard can be important if it is a significant threat to human life or property."

Upper Klamath River Area of Critical Environmental Concern Designation

The "Klamath Falls Resource Area Record of Decision and Resource Area Management Plan" (1995) designated an ACEC in the Klamath River Canyon from rim to rim extending from J.C. Boyle Powerhouse to the Oregon/California state line (see Map 2). The presence of cultural (both prehistoric and Native American traditional use) values, scenic values, fish and wildlife (both populations and habitat) resources, and a natural process or system (both priority plant species and vegetation) were found to be both relevant and important. Management guidance outlined in the 1995 resource management plan specified that this area is not available for planned timber harvest, limited off-highway vehicle use to designated roads, allowed no developments to enhance the potential for grazing, limited mineral leasing to no surface occupancy, and allowed no hydroelectric development. The area was to be managed for semi-primitive motorized recreation opportunities. A site-specific management plan for this ACEC will be developed as part of the final river plan.

Potential Areas of Critical Environmental Concern

This plan will also evaluate extending the existing ACEC to Segment 1 (below J.C. Boyle Dam to the powerhouse) of the planning area. To be considered as a potential ACEC, an analysis and evaluation report must consider the relevance and importance of resource values identified within the area which has be nominated as an ACEC. This report is found in Appendix I.