Klamath River Hydroelectric Project
FERC No. 2082

Flows and Recreation
Phase I Report for Upper River Segments

PacifiCorp
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1.0 INTRODUCTION

The Klamath River flows southwest out of Oregon's Upper Klamath Lake (UKL) approximately 220 miles to the Pacific Ocean near Klamath, California. The upper 64 miles of the river (from the outlet of UKL to Iron Gate Dam) are generally considered the Upper Klamath River; it features five distinct river segments defined by the location of various hydroelectric facilities (dams, reservoirs, or powerhouses). The facilities are operated by PacifiCorp as the Klamath River Project (FERC 2082); PacifiCorp is applying to the Federal Energy Regulatory Commission (FERC) for a license to continue to operate them. As part of the "relicensing" process, PacifiCorp has contracted recreation consultants (EDAW and Confluence Research and Consulting [CRC]) to assess river recreation opportunities and determine how flows may affect them.

1.1 STUDY GOALS

This study will identify river-based recreation opportunities on the upper reaches in the vicinity of the Klamath Hydroelectric Project (Project), develop relationships between flows and the quality of those opportunities, and assess the possible effects of existing and potential Project operations. Information is organized for five river segments in the study area:

- Link River Bypass Reach (from Link River Dam on Upper Klamath Lake to Lake Ewauna/Keno Reservoir)
- Keno Reach (from Keno Dam to J. C. Boyle Reservoir)
- J. C. Boyle Bypass Reach (from J. C. Boyle Dam to J. C. Boyle Powerhouse)
- Hell's Corner Reach (from the J. C. Boyle powerhouse to Copco No. 1 Reservoir)
- Copco No. 2 Bypass Reach (from Copco No. 2 dam to Iron Gate Reservoir, including Fall Creek)

A study plan (PacifiCorp, 2002a) guiding this research was developed in collaboration with land managing agencies and recreation stakeholders. The study was designed to be conducted in two phases. Phase I included a review of existing information, interviews with resource managers and experienced river users, and on-site reconnaissance (see methods below). This report is the output from that research, and provides sufficient information for some segments and opportunities. For other segments and opportunities, additional information appears necessary to meet overall study goals and objectives, and this report discusses options for collecting that information in Phase II.

Note: This report does not cover flow and recreation issues on the Klamath River below Iron Gate Dam, although this segment was added to the study plan in February 2002. A Phase I report on this segment will be provided separately in Fall 2002.

1.2 STUDY OBJECTIVES

Overall objectives for this two-phased study are stated below. The level of detail for each objective differs by segment or type of recreation opportunity.

- Identify recreation opportunities on the different segments. Boating opportunities may vary by craft, skill level, or preferences for different types of whitewater conditions. Other opportunities may include fishing, swimming, or other general river recreation.

- Identify flow-related attributes for each of those opportunities, including a description and classification of key rapids or other important recreation features.

- Develop relationships between flow levels and experience quality for each opportunity. The resulting "flow evaluation curves" will help identify acceptable and optimal flow ranges for each opportunity, as well as potential threshold "minimum" and "optimum" flows.

- Assess relative impacts of providing flows for specific opportunities on other river recreation opportunities.

- Assess potential effects of different flow regimes on recreation use levels. Integrate that information with recreation impact and carrying capacity information being developed by BLM as part of its ongoing planning effort for the draft Upper Klamath River Management Plan (includes Upper Klamath W&SR/OSSW segment).

1.3 REPORT ORGANIZATION

The report begins with a review of the methods and sources of information in the report, and is followed by results and discussion. Results begin with a description of the resource and Project (including an overview of the recreation-relevant hydrology of the system), and then provide findings by segment. For each segment, this report provides a brief description of the reach, identify available or potential recreation opportunities, associate flow requirements for each opportunity, and discuss Project effects on those opportunities. Also assessed is the level of Phase I information for relicensing needs and, when appropriate, outline options for additional study during Phase II.

2.0 METHODS

Information in this report is based on several sources: 1) existing literature about the Klamath River (reports and other documents, including hydrology information); 2) structured interviews with people who know about recreation and flows on the river; and 3) on-site reconnaissance of recreation areas along the river. Additional information about each is given below, along with a discussion of how this information was integrated and used to draw conclusions in the report.

2.1 EXISTING LITERATURE

An examination of existing reports and other documents is a useful first step for understanding recreation opportunities and the ways that flows may affect them. Key management reports included the Final Wild and Scenic Study Report for the Upper Klamath (USDI, 1990) and the Klamath Falls Resource Area Resource Management Plan (BLM, 1994). Two research efforts with useful information included a comparative analysis of whitewater boating resources in Oregon (Shelby, Johnson, and Brunson, 1990) and a recreation analysis of the Upper Klamath by Oregon State Parks (1990).

Guidebooks describing various boating opportunities on the river were an additional source of information. The following five boating guidebooks were examined for this study; Handbook to the Klamath River Canyon (Quinn and Quinn, 1983); Paddling Oregon (Keller, 1998); Soggy Sneakers Guide to Oregon Rivers (Willamette Kayak and Canoe Club, 1994); California Whitewater (Cassady and Calhoun, 1995) and the Best Whitewater in California (Holbek and Stanley, 1998).

Internet web pages sometimes offer interesting information about recreation uses on a river, or allow researchers to understand how recreation users retrieve information about flows. For this study we examined several outfitter/guide, agency, utility, and user web sites with information about the Upper Klamath River (see references).

Hydrology information was critical in assessing potential effects on recreation from the Project. This information was often complex and was developed from several sources including USGS gage data, PacifiCorp operations data, a PacifiCorp report on Operational Issues (PacifiCorp, 2002b) and the Final Upper Klamath Wild and Scenic River Study Report (USDI, 1990). Details about data sources and their limitations are provided when data is presented for each segment.

2.2 INTERVIEWS

Interviews with knowledgeable resource users are a useful method for learning about recreation and flow-recreation relationships (Whittaker et al., 1993). For this report, researchers conducted a total of 33 phone interviews with boaters, anglers, resource mangers, and others who may know about flows and recreation on the river. A list of interviewees is provided in Appendix A.

The boating interviews followed a structured format organized by segment (see Appendix B for the interview format). One focus was user characteristics and information about the recreation opportunities they pursue (which segments and boats they use, when they take trips, and so on). For commercial users, researchers also were interested in customer costs, proportion of business on the Klamath relative to other rivers, and the types of trips they offer). A second focus was on

evaluations of different flow levels for various opportunities. This included rating different flows for certain types of opportunities and specifying acceptable and optimum ranges of flows for those opportunities. A third focus was on timing issues (how long trips take at certain flows and when trips would start and end under certain timing scenarios). Final sections asked respondents about preferences for facility development (e.g., road improvements, trails, launches, and restrooms) or other recreation management issues. In all, 34 interviewees offered information about boating on the upper five segments of the Klamath River, with 33 offering information on the Hells Corner Reach. When qualitative information from specific boaters is used in the report, the name of the source is provided in parentheses.

Interviews with anglers focused on several issues. Anglers were asked to identify target species for each reach, describe typical size of caught fish, and evaluate the fisheries on a 1 to 5 scale (from poor to excellent) in comparison to other regional opportunities. Interviewees were also asked to describe when and where they fish, and which type of tackle they use (e.g., spinners, plugs, bait, or flies). Finally, they were asked to identify acceptable and optimal flow ranges for fishing for each reach, and provide comments about how they perceive irrigation or hydropower operations may be affecting fishing quality. In all cases, researchers attempted to have anglers separate evaluations about biophysical issues from fishability issues. The former are the subject of biological studies that are part of the relicensing process; here study is focused on how flows affect the ability to fish (assuming there was a good fishery). In all, 17 interviewees offered information about fishing on various reaches. In addition, researchers requested and received a letter summarizing similar information from board members of the Klamath Country Fly Casters, a local fishing club. When qualitative information from specific anglers is used in the report, the name of the source is provided in parentheses.

2.3 RESOURCE RECONNAISSANCE

Targeted fieldwork and systematic flow need evaluations are other useful methods for conducting flow-recreation studies (Whittaker et al., 1993). On-site work focused on a week-long site visit in September 2001. Dates and flows observed during the field work are summarized below. CRC researchers and PacifiCorp staff were present for all fieldwork; agency staff, EDAW consultants, and stakeholders were also present during much of the fieldwork and boated or hiked along several reaches.

Fieldwork involved assessing various recreation environments along the river, identifying areas and features discussed by interviewees or existing documents, evaluating the observed flow level for various opportunities, and estimating how alternative flow levels are likely to affect those opportunities.

Table 1
Summary of September 2001 Fieldwork

Segment	Date	Observed Flow	Mode of Transport
Link River	Sept. 9-10	350-390	Kayak, on foot
Keno Reach	Sept. 9	698	Kayaks, rafts, inflatable kayaks (Iks), & catarafts
J. C. Boyle Bypass Reach	Sept. 8	366	Kayaks, IK, on foot
Hells Corner Reach	Sept. 7	1,570	Kayaks, rafts, catarafts
Copco No. 2 Reach	Sept. 10	<10	On foot

2.4 INTEGRATING INFORMATION

The final steps in the study process were to 1) integrate information from multiple sources and develop flow evaluation curves (when possible) for each flow-dependent recreation opportunity, and 2) assess whether current flow management regimes are likely to affect those opportunities.

2.4.1 Developing Flow Evaluation Curves

Flow evaluation curves are a key output for flow-recreation studies, showing how incremental changes in flows are related to recreation quality. The curves are drawn on a graph that shows flow along the horizontal axis (in cfs at the relevant gage) and recreation quality along the vertical axis (the evaluation scale runs from totally unacceptable to totally acceptable with a mid-point at "marginal"). Based on previous research, flow evaluation curves often have a bell shape that identifies marginal threshold flows at both the low and high end (defining an acceptable range for that opportunity), as well as an optimal flow or range of flows where the curve peaks (Shelby et al., 1992; Whittaker et al., 1993).

Opportunities examined on the Upper Klamath River include boating, angling, and general river recreation (hiking, camping, day use, and so on along the river's banks). General information about flow evaluation curves for these opportunities is provided below. In all cases, curves should be considered preliminary, as additional Phase II information may help improve them.

2.4.1.1 Boating Opportunities

Curves for boating opportunities were generally developed from professional judgments that considered all available information (existing literature, interviews, and site reconnaissance). The exception was for Hells Corner whitewater boating, where more extensive quantitative interview data were the primary source. For the Hells Corner whitewater opportunities, researchers also have additional quantitative information about preferred flow ranges for various opportunities and other flow-recreation issues.

On the Hells Corner and J. C. Boyle bypass reaches, separate curves were developed for "standard" and "high challenge" boating opportunities as well as for rafts and kayaks. While both standard and high challenge trips on those segments provide Class IV rapids, standard trips feature less intimidating flows, while high challenge trips feature the higher flows with stronger hydraulics of interest to skilled challenge-oriented boaters. Differences between standard and high challenge trips and between craft types were not considered significant on the Link River, Keno Reach, or Copco No. 2 Bypass Reach.

For the Hells Corner Reach, a flow evaluation curve for lower flow "technical" trips was developed. Technical trips differ from standard trips by offering more "rock-dodging," tighter lines through rapids, greater boatability problems, and less powerful hydraulics. They are generally less desirable than standard trips, but some boaters take them when higher flows are not available because they offer access to the canyon.

On the Link River and Keno Reach, flow evaluation curves were also developed for "locational playboating" (where kayakers utilize a wave or hydraulic to practice "rodeo" or "freestyle" skills). These differ from other trips in their dependence on a specific play feature (a wave or hydraulic). Additional information about playboating and the specific play features on those segments are presented in the findings.

2.4.1.2 Angling Opportunities

Curves for angling opportunities were developed from professional judgments that considered all available information, with particular attention to interview information (when available for a segment). In general, they follow from previous research that suggests that lower flows tend to provide the best quality fishing conditions on most rivers, as long as low flows do not stress fish or lead to lowered feeding activity. Although there are differences for different types of "angling habitat" (pools, runs, or pocket water), trout fishing on western rivers is generally best when there is better wadeable access; lower velocities in riffles, runs, and pools; and less turbulence in the rapids.

While previous research suggests there may be substantive differences between flow requirements for quality fly, spin, and bait fishing (with the latter two types available for a wider range and slightly higher flows than fly angling), Phase I information for the Upper Klamath River does not offer enough information to make these judgments. Accordingly, a single fishing flow evaluation curve for each segment is provided.

Previous research also suggests that anglers often have concerns about biological impacts from various flow regimes (Whittaker and Shelby, 2002a), some of which may confound evaluations of the best flows for fishing (as opposed to the best flows for fish). It is obvious that good fishing opportunities begin with quality fisheries, but biological studies are designed to provide information about the latter. In this study, the focus is on the flows that are considered good for fishing, not fish. However, when anglers have remarked upon biological conditions or their perceptions of how flow regimes affect a fishery, that information is included.

2.4.1.3 General Riverside Recreation

Camping, hiking, picnicking, and similar forms of general riverside recreation occur at several defined locations on the Upper Klamath River. These recreation activities are generally flow-enhanced rather than flow-dependent, so flow levels tend to have smaller and indirect effects on quality compared to effects on boating and angling (Whittaker et al., 1993). The exception is the potential impacts associated with aesthetics.

Many riverside recreation activities are enhanced by the river's aesthetics, which in turn may be related to flows in the channel. Many riverside recreational opportunities focus on the aesthetics of moving water (Moore et al., 1990), although other opportunities may focus on other features of the environment (e.g., forests and other plant life, wildlife). Similarly, while flows may be only one important factor in people's evaluations of scenic quality in a riverscape (topographic relief, vegetation, color, and weather conditions are also likely to play important roles), research shows that many recreation users can specify their evaluations of flow levels (Land and Water Associates, 1992; Shelby, Whittaker and Ellingham, 1995). Research also shows that flows have significant effects on overall scenic evaluations (Brown and Daniel, 1991).

While a review of river aesthetics research is beyond the scope of this report, findings show that aesthetic ratings vary on the same river in locations with different channel features, but that very low and very high flows are generally rated lower than medium flows (Shelby et al., 1992). Two studies also indicate that ratings improve more dramatically when flow increases cover the bottom of the channel rather than simply increasing depths and velocities after that is covered (Whittaker and Shelby, 2002b).

General riverside flow evaluation curves were developed from professional judgments while considering this previous research. In general, this meant drawing a curve that begins in the unacceptable range at very low flows and crosses the "marginal line" at the flow that would cover most of the bottom of the channel and reaches optimal levels soon after. It remains at optimal levels until flows reach "bankfull" levels, when turbidity and lack of definition are likely to lower aesthetic quality.

2.4.2 Assessing Project Impacts

Project impacts on recreation opportunities were assessed in two ways. The initial focus was on whether Project-induced changes in flows were likely to be noticeable by recreation users for a certain opportunity. Hydrologists generally acknowledge a 10% margin of error with single discharge measurements, so we have assumed that twice as much change (20%) is necessary for recreation users to notice differences for most of their activities.

Assuming this 20% rule, the second issue is whether Project-induced changes in flows would cause opportunities to change from optimal to sub-optimal, or from acceptable to sub-marginal, and if so for how long. In general, researchers have analyzed hydrology data to illustrate the relative frequency of days when these conditions would have changed with and without the Project effect under discussion. Because the hydrology for some segments is complex (with variation by day, type of year, and over the operating history of the project), additional

discussion of how hydrology information was used to assess Project effects is presented as segment results are provided.

2.4.3 Information Limitations

For some opportunities, sufficient information is not available to develop accurate flow evaluation curves because it is too difficult to estimate how flows would affect opportunities until those flows have been observed. In these cases, a curve is not provided.

Similarly, for some Project effects, it is difficult to assess impacts until an operating scenario is specified with greater accuracy than past hydrology. In these cases, discussion is organized around options for developing better information during Phase II, or specifying the operating scenario information that is needed to more accurately describe potential Project effects on recreation.

3.0 STUDY AREA

3.1 RIVER AND RESERVOIR SEGMENTS

Figure 1 shows a map with segment and reservoir locations on the Upper Klamath River. Additional maps are provided in the results and discussion section for each segment; those maps include more detailed information such as launches, key rapids, and other recreation facilities.

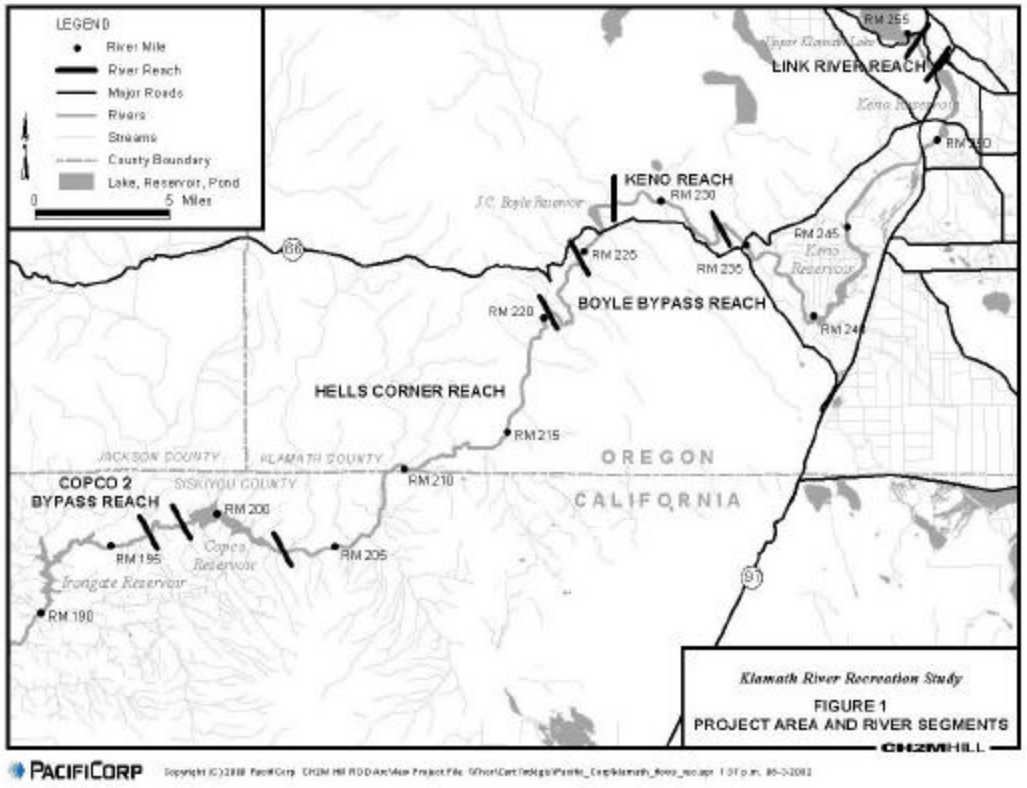


Figure 1. Project Area and River Segments

The Upper Klamath River is divided into five distinct river segments (Table 2) and six reservoirs (Table 3). Table 2 includes basic information about segment length, typical flow ranges (more detailed hydrology information will be provided below), and how the segment is currently used for recreation. Table 3 shows reservoir size (in acre-feet) and provides additional comments about reservoir surface area (at full pool) or other features.

Table 2
Summary of River Segments on Upper Klamath River

Segment	Length (miles)	Typical flow ranges (in cfs)	Current recreation opportunities
Link River	1.5	250 to 2,500+	Hiking, angling, whitewater kayaking wildlife viewing
Keno Reach	5.0	400 to 4,000+	Angling, whitewater boating, wildlife viewing
J. C. Boyle Bypass	4.3	320 base; spills up to 5,000+	Angling, whitewater boating (rare)
Hells Corner	16.4	320 base; up to 3,000 daily peaks; spills up to 5,000+	Whitewater boating, angling, camping
Copco No. 2 Bypass	1.3	10 base; rare spills	Hiking (rare)

Table 3
Summary of Lakes and Reservoirs on Upper Klamath River

Reservoir	Total storage (acre-feet)	Size at full pool (acres)	Comments
Upper Klamath Lake	629,780	90,000	Relatively shallow but large lake (controlled by Link River Dam). 486,830 acre-feet of active storage.
Lake Ewauna/ Keno Reservoir	18,500	2,475	Long large reservoir with several narrow sections. Contract with USBR allows fluctuations up to 1.5 feet but it is generally held flat at 1.5 feet below full pool for irrigation purposes – no active storage.
J. C. Boyle Reservoir	3,495	420	Small, narrow reservoir. Possible fluctuation up to 3.5 feet; daily fluctuation is 2.0 feet or less. 1,724 acre-feet of active storage.
Copco 1	46,867	1,000	Medium size reservoir. Possible fluctuation up to 5 feet, daily fluctuation is usually under 0.5 feet. 6,235 acre-feet of active storage.
Copco No. 2	73	40	Small, narrow reservoir tied to Copco No. 1 operations. Daily fluctuation is less than 0.5 feet per day.
Iron Gate	58,794	944	Medium size reservoir; fluctuates of up to 8 feet seasonally. Daily fluctuation is 1 foot or less. 3,790 acre-feet of active storage.

3.2 PROJECT DESCRIPTION AND BASIC HYDROLOGY

3.2.1 Project Facilities

The Upper Klamath Project consists of six generating facilities (between river mile (RM) 190 and RM 254), and a re-regulation dam with no generation facilities along the main stem of the Upper Klamath River. It also includes one generating facility on Fall Creek, a tributary to the Klamath River at about RM 196. The eight major Project developments are listed in Table 4; the table gives their location, size, and comments about how they operate. Figure 2 shows a not-to-scale schematic of the project facilities.

Table 4
Summary of Hydroelectric Facilities on Upper Klamath River

Facility	River Mile	Size (MW)	Comments
Link River Dam/ East Side Powerhouse	254.0 (dam) 252.7 (ph)	3.2	Associated with Link River Dam (owned by USBR); water diverted through a wooden and steel pipe (diversion varies up to 1,200 cfs).
Link River Dam/ West Side Powerhouse	254.0 (dam) 252.5 (ph)	0.6	Associated with Link River Dam (owned by USBR); water diverted through canal and penstock (diversion is either 0 or 250 cfs).
Keno Dam	233.0	None	Non-generating – operates as a re-regulating facility; buffers inflow and outflow changes from USBR irrigation diversions and East side/West side discharge.
J. C. Boyle Dam and Powerhouse	225.0 (dam) 220.4 (ph)	80.0	Storage for daily peaking operations at J. C. Boyle Powerhouse (two turbines). Turbines can produce up to 1,100 and 1,425 cfs outflow each (2,525 cfs total). This does not include 320 cfs in J. C. Boyle Bypass (100 cfs fish release + 220 from springs).
Copco No. 1 Dam and Powerhouse	198.8	20.0	No bypass reach; water flows from dam through penstock to powerhouse. Total capacity is 3,200 cfs.
Copco No. 2 Dam and Powerhouse	198.6 (dam) 197.3 (ph)	27.0	Water diverted through a tunnel to a powerhouse 1.3 miles down river. Total capacity is 3,200 cfs. Operated in concert with Copco No. 1.
Fall Creek	196.0	2.2	Facility on tributary to the Klamath; water also diverted for fish hatchery & water supply in Yreka, CA. Total capacity is 50 cfs.
Iron Gate Dam and Powerhouse	190.0	18.0	Operated as re-regulation facility; outflows specified by USBR (750 to 1,100 base flows in recent years). No bypass reach. Total hydraulic capacity is 1,750 cfs.

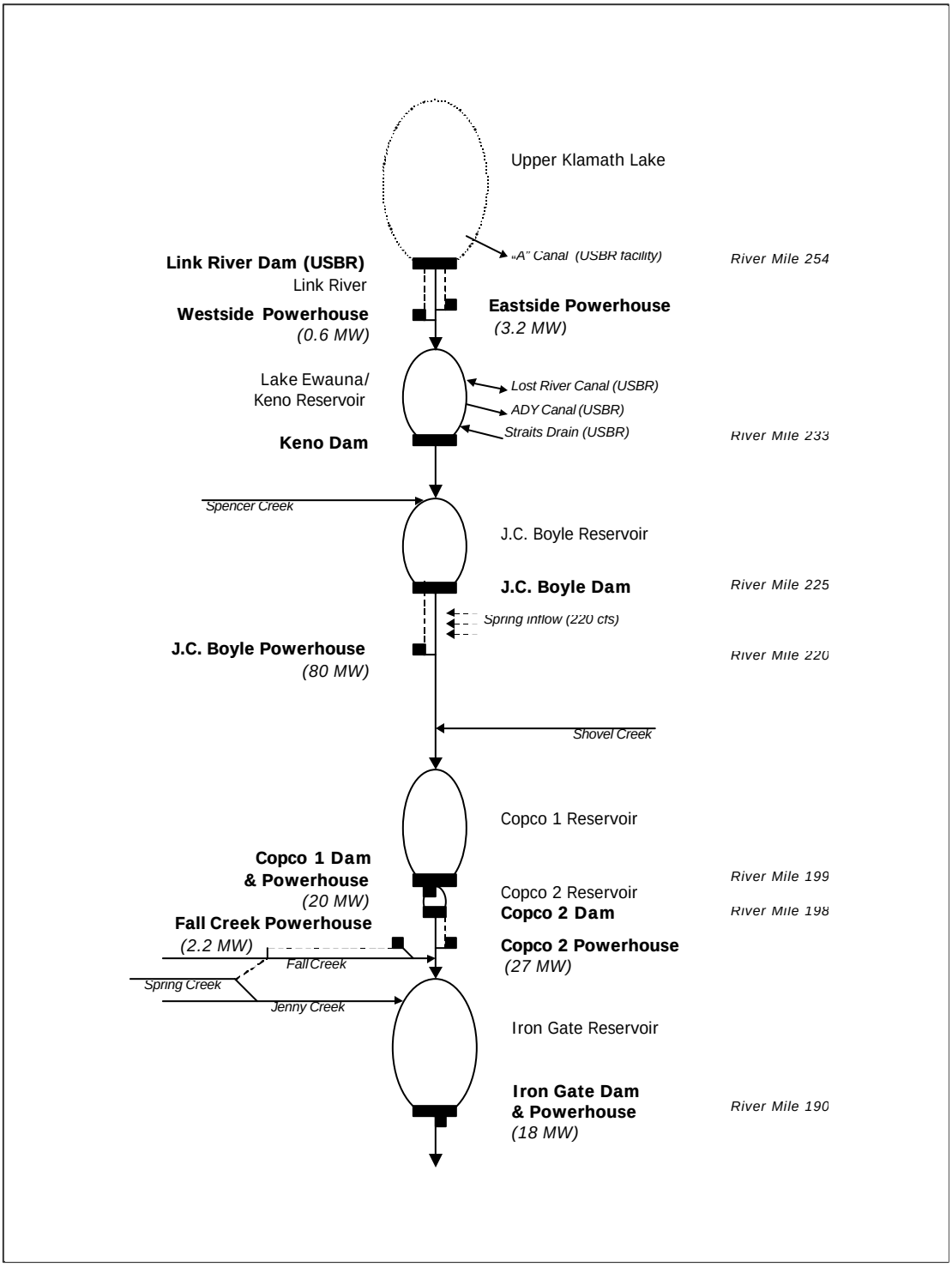


Figure 2. Schematic Drawing of Upper Klamath Hydroelectric Facilities (Not To Scale; Schematic Provided by PacifiCorp)

3.2.2 Basic Hydrology of the Upper Klamath Project

The operation of the PacifiCorp Hydroelectric and USBR Irrigation projects on the Upper Klamath is very complex. The following summary is designed to provide an overview of the system and suggest how it affects specific flows in the reaches covered in this report. For more detailed information about the Projects and river hydrology, please review PacifiCorp's report on Project Facilities and Operations (PacifiCorp, 2002b).

3.2.2.1 Overview of Project Operations

Historically the Upper Klamath system was operated primarily to provide irrigation, power generation, and meet minimum flow needs for various river and lake/reservoir resources (e.g., fish, and to a lesser extent whitewater boating flows). It also provides some flood control. However, due to Endangered Species Act listing of two species of sucker fish in Upper Klamath Lake (UKL) and Coho Salmon below Iron Gate Dam, in recent years operational priorities have shifted with the highest priorities being managing UKL levels for suckers, and flows below Iron Gate for Coho.

Given this fact, four major factors influence operations of the system and drive hydrology of the reservoirs and river reaches; 1) seasonal storage in UKL; 2) irrigation diversions and return flows from the Upper Klamath basin; 3) minimum flow needs below Iron Gate for endangered Coho; and 4) short-term storage and peaking operations through J. C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate.

The only significant storage in the system is in UKL. In wet or above average water-years, the Project operates as a run-of-the-river system from mid-winter through spring. Once UKL is full, facilities are generally operated as a run-of-the-river system. The short Link, J. C. Boyle and Copco No. 2 by-pass reaches do not receive this spill water unless the hydraulic capacity of power diversions are exceeded. Spills into the J. C. Boyle and Copco No. 2 bypass reaches only occur during peak runoff in above average water years.

When spill at Link River Dam is not occurring, UKL is drawn down for irrigation diversions and to pass water through the PacifiCorp power generation facilities (meeting minimum flow needs in the reaches and below Iron Gate for Coho). Active storage in UKL is estimated at about 97 days at 1,000 cfs, although this does not consider USBR changes in its minimum lake levels to protect endangered suckers.

Irrigation diversions from UKL and Keno Reservoir provide water for approximately 240,000 acres of farmland as well as some wildlife refuge lakes and marshes. Irrigation diversions can exceed 1,200 cfs from UKL and Keno Reservoir, although return flows to Keno Reservoir may exceed 400 cfs. Irrigation diversions are highest in spring and during the summer growing season. Many farmers also flood their fields in winter to control nematodes or other pest problems. In recent dry years, summer irrigation diversions have been reduced because of USBR requirements to maintain higher UKL levels for suckers.

At times when no spill is occurring at UKL, minimum flow needs below Iron Gate Dam for Coho salmon dictate minimum flows be passed through the PacifiCorp facilities and associated

reaches and reservoirs. Although required minimum flows below Iron Gate have varied over the years from 710 to 1,300 cfs, the current minimum flow is set at 1,000 cfs.

Within these general parameters (dictated by run-of-the-river spill in wet periods; minimum pass through water and irrigation return flows during drier periods), PacifiCorp operates its facilities to maximize power generation. Short-term storage in J. C. Boyle Reservoir is the driving factor here, and it allows J. C. Boyle Powerhouse to follow power demand (peaking during the day or early evening). This water, in turn, then continues through Copco No. 1 and 2 (which also are operated as peaking facilities), and into Iron Gate Reservoir, where it is re-regulated to provide the sustained minimum salmon flows. There are also peaking opportunities at Eastside powerhouse, although this is a much smaller plant and has other constraints (see below).

3.2.2.2 Link River Hydrology

There is a USGS gage (No. 11507500) located in the Link River segment between the Eastside and Westside hydropower facilities, but this includes Eastside water and thus is a poor indicator of flows in the bypassed segment. For any given time, hydrologists can subtract estimated Eastside flows (based on operations data) from gage information to describe what is in the bypass reach. They can also add Westside flows to the gage amount to describe the total amount of water being released from UKL to irrigation and downstream reservoirs/ hydroelectric facilities. However, developing this information on a daily basis (or for shorter time units) over the period of record has proven challenging because of inconsistencies in operations data. Additional hydrology work may be necessary to accurately reflect specific historical releases from UKL or flows in the bypass reach, although this could still prove impossible given the status of operations data. The following discussion is thus provided at a general level based on preliminary data (Kelly, Pers. Comm.); it may be revised if additional hydrology information for the segment is developed.

During high run-off periods when inflows to the upper basin exceed the hydraulic capacity of Project turbines (a spill condition) the Klamath Hydroelectric Project operates as a “run of the river” system. While operational constraints leave relatively stable base flows in the Link River (spill gates on Link River Dam must be operated manually and are changed as infrequently as possible), flows through the Eastside diversion are modified frequently to maintain Keno Reservoir / Lake Ewauna at a stable level (see discussion about that reservoir below). However, once UKL is full and power diversions are at full capacity, excess water from rain/run-off events are typically spilled through the Link River channel.

During the summer, fall, and early winter (or at other times when the Project is not spilling), UKL to Iron Gate reaches are no longer operated as a “run of the river” system. During these times, available active storage in UKL is managed for ESA listed suckers, and then used to provide irrigation withdrawals, (the A-1 Canal takes up to 1,100 cfs) and finally partially meet minimum flow needs below Iron Gate (after considering the amount that springs, tributaries, and irrigation return flows are likely to provide). During these periods, total flows through the Link River component of the system (including the two power diversions, and minimum flow released into the bypass reach) exceed inflow into the system (i.e. active storage is being used).

Of course, the total in-flow to the system does not equate with the flow in the bypass channel, the focus here. Eastside and Westside hydropower diversions have the potential to diminish flows in the bypass channel, and do so to varying degrees both daily and seasonally. The Westside facility is either on or off and draws 250 cfs when it is operating. The Eastside facility, in contrast, can vary its diversion, taking as much as 1,200 cfs. The A-1 Canal may also reduce available water for downstream purposes during the irrigation season (although return flows from irrigation into Keno Reservoir can exceed 400 cfs). The key to assessing hydropower or irrigation effects on recreation in the Link River is thus tied to understanding when these diversions occur and whether those noticeably change the type or quality of opportunities.

There are minimum flow requirements for the Link River bypass reach. Flows must be at least 90 cfs year-round (ODFW agreement) and recent year-by-year agreements with USBR require 250 cfs during the summer as per USFWS 2001 Biological Opinion (BO). Below Eastside powerhouse, a USFWS 1996 BO stipulates minimum flows of 450 cfs, although this requirement applies only to the last .25 miles of the Link River.

PacifiCorp modified operations at the Eastside and Westside facilities to minimize the number of sucker fry drawn into diversion intakes (neither of which are screened). During late summer and early fall, Westside was not operated at all and Eastside only operated during the day. Outside that period PacifiCorp operates both Eastside and Westside facilities to maintain relatively stable flows in the Link River (to avoid stranding fish) and to keep Lake Ewauna / Keno Reservoir at stable levels throughout the year (although the FERC license allows Keno Reservoir fluctuations up to 1.5 feet).

In general, minimum flows in the Link River bypass have been higher than 90 cfs in even the driest periods, and they are often in the 250 to 600 cfs range from May through December. During the winter and spring, “typical” outflow from UKL ranges from 1,500 to 3,000 cfs, with the bypass generally receiving about 500 to 1,500 cfs and the power diversions receiving up to 1,450 cfs (full capacity). During higher spill periods that typically last a week or more at a time (but which may occur several times from January through May during wetter years), outflows from UKL may approach or even exceed 5,000 cfs, with the bypass channel receiving about 3,000 to 4,000 cfs of this water.

3.2.2.3 Keno Reach Hydrology

There are no power generation facilities associated with Keno Dam, and all flows are passed through this segment (it is not a bypass reach). However, Upper Klamath Lake storage, USBR irrigation withdrawals and returns, and minimum flow requirements below Iron Gate Dam for endangered Coho salmon all affect the amount and timing of water available in the Keno Reach compared to “natural regimes” (if there were no dams or diversions on the river). PacifiCorp has little influence over these variables (PacifiCorp, 2002b).

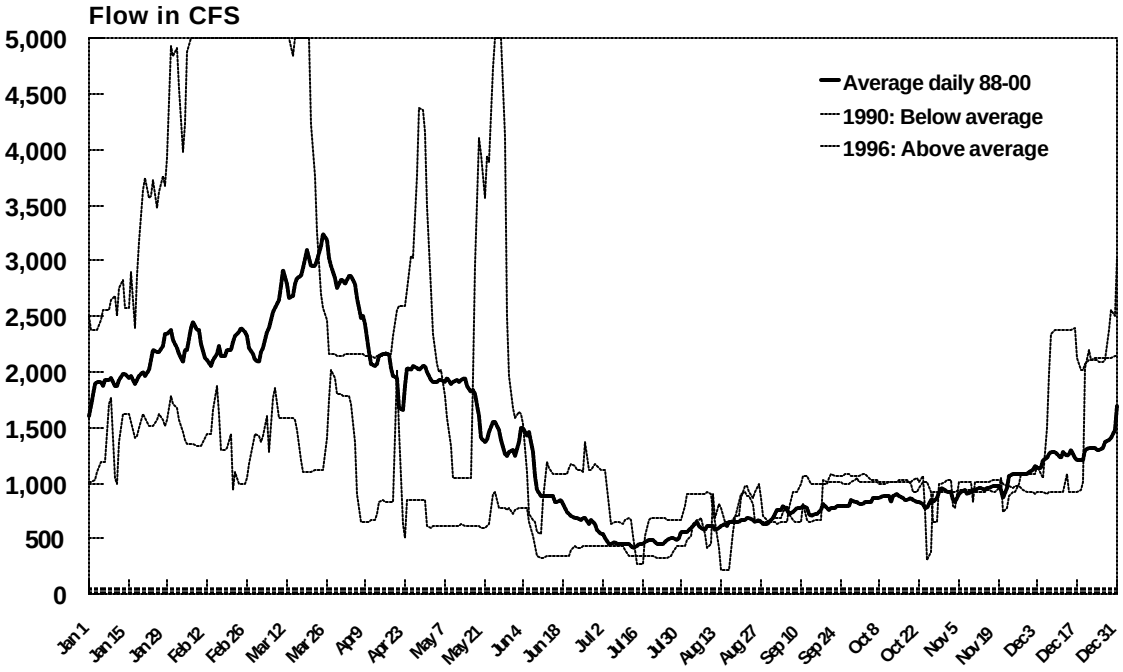
Minimum instream flows in the reach are 250 cfs, as per an agreement with ODFW, but base flows are often much higher. Three additional factors help determine how Keno can be operated. First, much of the water provided to meet minimum requirements below Iron Gate (minus downstream accretion) has to pass through the reach. Second, a PacifiCorp/USBR contract requires that Lake Ewauna / Keno Reservoir remain within 1.5 feet of full pool. Third,

PacifiCorp has informal agreements with irrigators and a wildlife refuge to maintain Keno Reservoir at a steady elevation (+ or - 0.1 ft) at 1.5 feet below full pool (so intakes for pumps remain submerged). Taken together, these factors cause Keno Dam to be operated as if it has no active storage, and flows in the river are varied to re-regulate fluctuating releases from UKL, Eastside and Westside facilities, and USBR irrigation return flows. Without Keno Dam, Klamath River flows would fluctuate as much as Reclamation diversions vary, and the current planned, steady source of water for J. C. Boyle power generation would be compromised (PacifiCorp, 2002b). Resultant flows in the Keno Reach thus vary both seasonally and daily/hourly, as discussed below.

3.2.2.4 Seasonal Variation

Average daily flows in the Keno Reach from 1988 to 2000 are given in Figure 3, along with daily flows from example wet (1996) and dry (1990) years. Data come from the USGS gage (No. 11509500) which is located about one mile downstream of Keno Dam. This hydrograph provides a general understanding of seasonal flow variation on the river, and demonstrates how differences can be substantial from year to year.

Data show that winter and spring flows are commonly between 1,000 and 3,000 cfs, but that peaks approaching over 5,000 cfs are possible. In drier years, of course, higher peaks are rare, and base flows during wet months rarely exceed 2,000 cfs. In summer and fall months, differences between wet and dry years narrow, as UKL storage is sent through the system to meet minimum flows below Iron Gate. Flows during these periods typically range between 500 and 1,000 cfs – well above the required minimum 250 cfs.



Note: Flows above 5,000 cfs not shown; peaks in 1996 approached 9,000 cfs.

Figure 3. Average Daily Flows on the Keno Reach From 1988-2000 and for an Example Wet (1996) And Dry (1990) Year

In contrast, during summer and fall months, average daily flows released by the USBR and PacifiCorp projects are generally higher than those that would exist without them, primarily because of storage capacity in UKL, the irrigation return flows (about 400 cfs in summer), and the minimum flows to be provided below Iron Gate.

3.2.2.5 Daily or Hourly Variation

Seasonal variation is not the only effect on Keno flows from PacifiCorp and USBR projects. A second effect is associated with daily or hourly changes to keep Keno Reservoir levels flat, while re-regulating USBR diversion return flows for use through the J. C. Boyle Reservoir and Powerhouse. The average daily flows shown in Figure 3 mask this variation, requiring a closer examination of the frequency and rate of daily and hourly fluctuations.

During high flow periods (January through May), flow changes in the Keno Reach may exceed 500 cfs per hour, although that is the PacifiCorp self-imposed maximum hourly change during medium to low flow periods (PacifiCorp, 2002b). Data from water years 1995 through 2001 suggest that hourly changes average about 20 to 30 cfs, but there may be 30 to 40 times per year when flows change at rates between 100 and 350 cfs per hour, while there are 7 to 12 times per year when flows change over 350 cfs per hour. In drier months (June through December), the average hourly change is 5 to 9 cfs, but hourly flow changes between 100 and 350 cfs occurred about 20 times per year, and hourly flow changes greater than 350 cfs occurred about five times per year. This substantial hourly variation, for example, may mean that an average daily flow of 750 cfs produces flows that may be 100 to 200 cfs higher or lower for parts of any given day (although the fluctuation is likely to be smaller during summer and fall).

3.2.2.6 J. C. Boyle Bypass Hydrology

Hydrology in the J. C. Boyle Bypass is relatively simple compared to other Upper Klamath River segments, although there is no gage in the segment (base flows are known and spill flows are calculated by subtracting estimated outflows from the powerhouse from changes in storage at J. C. Boyle Reservoir). Power generation associated with the J. C. Boyle facilities generally diverts all but minimum flows from the J. C. Boyle Bypass Reach, with spills only occurring when upstream storage capacity is full (J. C. Boyle Reservoir, Keno Reservoir, and UKL) and the hydraulic capacity of the Powerhouse (about 2,500 cfs) is exceeded.

Minimum instream flows in the reach are 100 cfs, as per the current FERC license, and the springs add about 220 cfs (starting about a half-mile below the dam). Total base flows in the reach are thus about 320 cfs. Spill amounts in the reach have ranged from a few hundred cfs to over 10,000 cfs, but most spill periods have flows of about 1,000 to 5,000 cfs. When they do occur (usually in the period from January to April), they are likely to last for several days (and sometimes several weeks).

In all but wet years, spills in the J. C. Boyle Bypass do not occur at all. In very wet years, spills may occur on over 100 days. Before the mid-1990s, J. C. Boyle Bypass spills may have occurred less often because UKL was typically drawn down to handle run-off events as high as 10,000 cfs. However, since UKL sucker recovery efforts have begun, UKL drawdowns are likely to be smaller and essentially eliminate UKL storage for spring run-off flood control (PacifiCorp,

2002b). Accordingly, spill events in J. C. Boyle Bypass during wet and average years in the future are likely to become more frequent and higher than they were prior to the mid-1990's. Additional analysis is being conducted to quantify spill amounts in the J. C. Boyle Bypass Reach over the period of record, and to characterize likely spill amounts in future average, dry, and wet years.

3.2.2.7 Hells Corner Hydrology

Hydrology in the Hells Corner Reach is complex, and varies seasonally and daily. Flows in the segment are equal to J. C. Boyle Bypass base and spill flows (see above), plus the outflows from J. C. Boyle Powerhouse. The Powerhouse is operated to follow power demand when not in a UKL spill situation (using J. C. Boyle Reservoir to store water at night and drawing from it during the day).

The J. C. Boyle Powerhouse has two turbines with a maximum flow capacity of 2,525 cfs. Unit 1 can generate more power and produces 1,200 to 1,425 cfs outflow at capacity, depending upon the level of J. C. Boyle Reservoir; Unit 2 only generates 800 to 1,100 cfs at capacity. Unit 1 offers greater efficiency and it is generally used first. Neither unit works as efficiently below the outflow ranges given here, so operators try to ramp up to those levels if they are going to use a unit at all. It takes about three hours to ramp from base flows to one turbine, and an additional hour and a half to ramp to two turbines given the current FERC ramp rate of 9 inches per hour..

During wet times of the year (winter and spring), flows in the Hells Corner reach often are at approximately 2, 850 cfs (320 cfs from J. C. Boyle Bypass plus 2,525 cfs from J. C. Boyle dam outflows). This is commonly known among boaters and anglers as the “two turbine” flow. If there are additional spill flows in J. C. Boyle Bypass, flows in the Hells Corner Reach may range from 3,000 to 4,000 cfs. Peak spill amounts may approach 10,000 cfs, but more often peak at about half that amount. Additional analysis is being conducted to quantify the frequency, duration, and magnitude of spill amounts in the J. C. Boyle Bypass and Hells Corner reaches over the period of record.

When not in a spill situation (summer and fall), flows in the Hells Corner Reach vary through the day from base flows (320 cfs from J. C. Boyle Bypass) up to 2,900 cfs (two turbines plus base flows). During much of the summer and fall, there may not be sufficient water from UKL or irrigation return flows to run both turbines, so a single unit is operated. This typically provides peaking flows about 1,500 to 1,750 cfs in the reach, which is commonly known by boaters and anglers as the “one turbine” flow.

A preliminary analysis of 1995-2001 flow data examining the number of days that Hells Corner has flows 1) less than one turbine; 2) one turbine or more; and 3) two turbines or more is given in Figures 4, 5, and 6, respectively. Results characterize the frequency of days with different flows.

In most years, most days provide at least one turbine of flow (at least 1,400 cfs) for several hours at some point in the day, but the timing of those peaking flows has changed in recent years. Figure 4 shows the number of days with flows ***below 1,400 cfs*** at 11 am and 2 pm during the May to September period when these “no turbine” days are likely to occur. Data suggest that prior to 2000, there were relatively few days (always less than 20 and usually less than 10) when

no turbines were operated during the middle of the day (from 11 am to 2 pm). However, there were nearly 40 days in 2000 and over 90 days in 2001 when one turbine was not provided by 11 am. On all but 15-20 of those days in each year, one turbine was provided by 2 pm. However, the data support the notion that peaking at J. C. Boyle has shifted to later in the day in recent years, when power demand costs of offsetting power are higher.

On most days in the winter and spring, more than one full turbine (over 1,700 cfs) is often provided, and in wetter years these higher flows are common for significant proportions of the May to September period as well. Figure 5 shows the number of days per year from 1995-2000 when flows at 11 am and 2 pm ***exceeded 1,700 cfs*** (over one turbine). In wetter years (e.g., 1996 to 1999), there may be 200 to 300 days a year when more than one turbine is operated during the middle of the day. In drier years (e.g., 1995, 2000, and 2001), less than 100 days offer flows over 1,700 cfs and less than 50 of those days occur from May to September.

While much of the year offers flows in excess of one full turbine, relatively fewer days offer flows at or over two full turbines (2,800 cfs). Figure 6 shows the number of days per year from 1995-2000 when flows at 11 am and 2 pm ***exceeded 2,800 cfs*** (near or above two turbines). In most wet years (e.g., 1996 to 1998), there are about 150 days when two turbines are operated during the middle of the day, although they were operated over 200 days in 1999. In drier years such as 1995 and 2001, there were about 50 or less days with two turbines, although in another dry year (2000), two turbines were provided over 140 days.

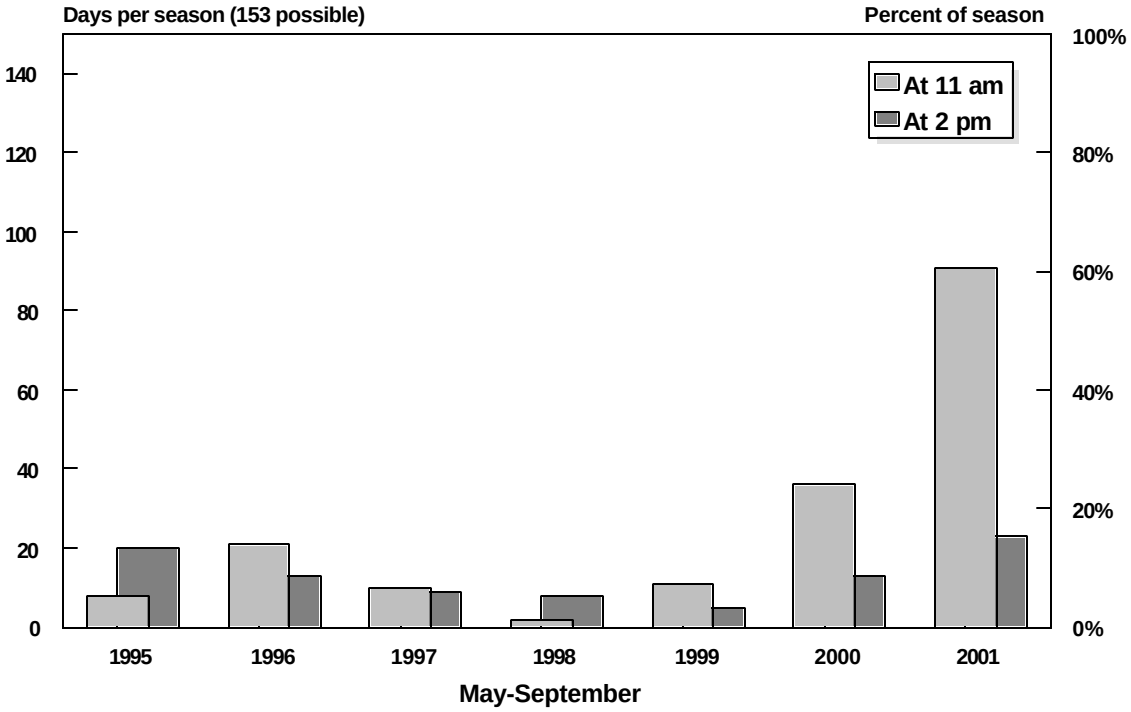


Figure 4. Number of Days With Flows (At 11 Am And 2 Pm) Lower Than 1,400 Cfs (Less Than One Turbine) for May-September Seasons, 1995-2001

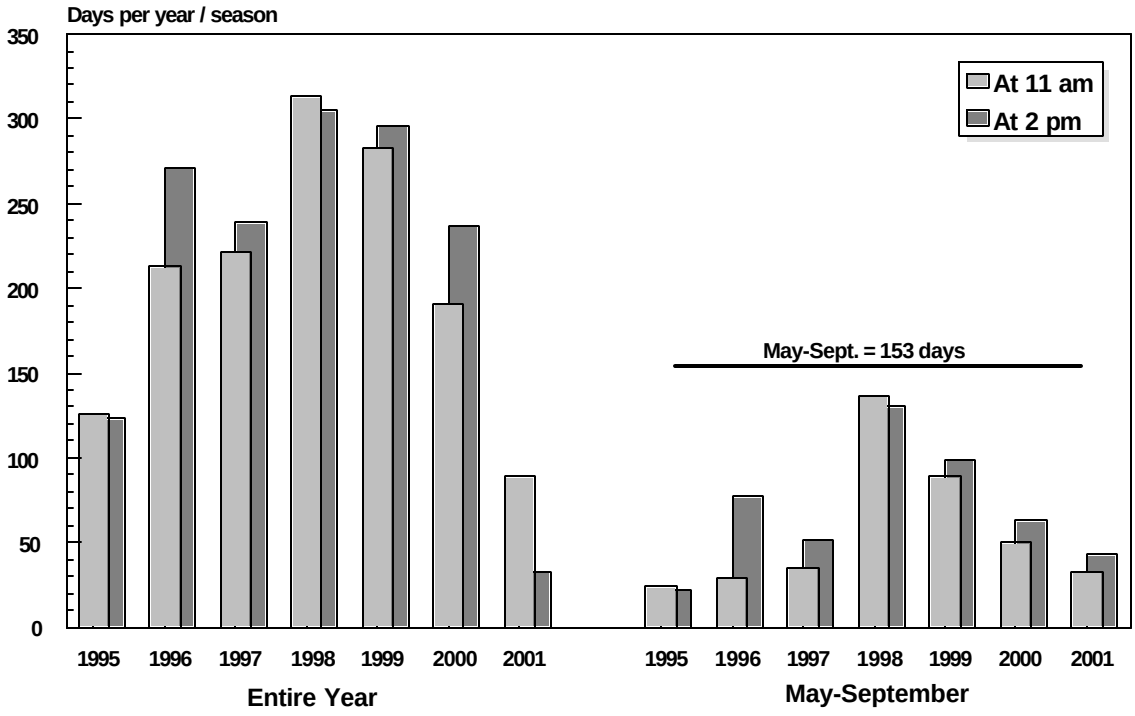


Figure 5. Number of Days With Flows (At 11 Am Or 2 Pm) Higher Than 1,700 Cfs (Over One Full Turbine) For Each Year And May-September Season, 1995-2001

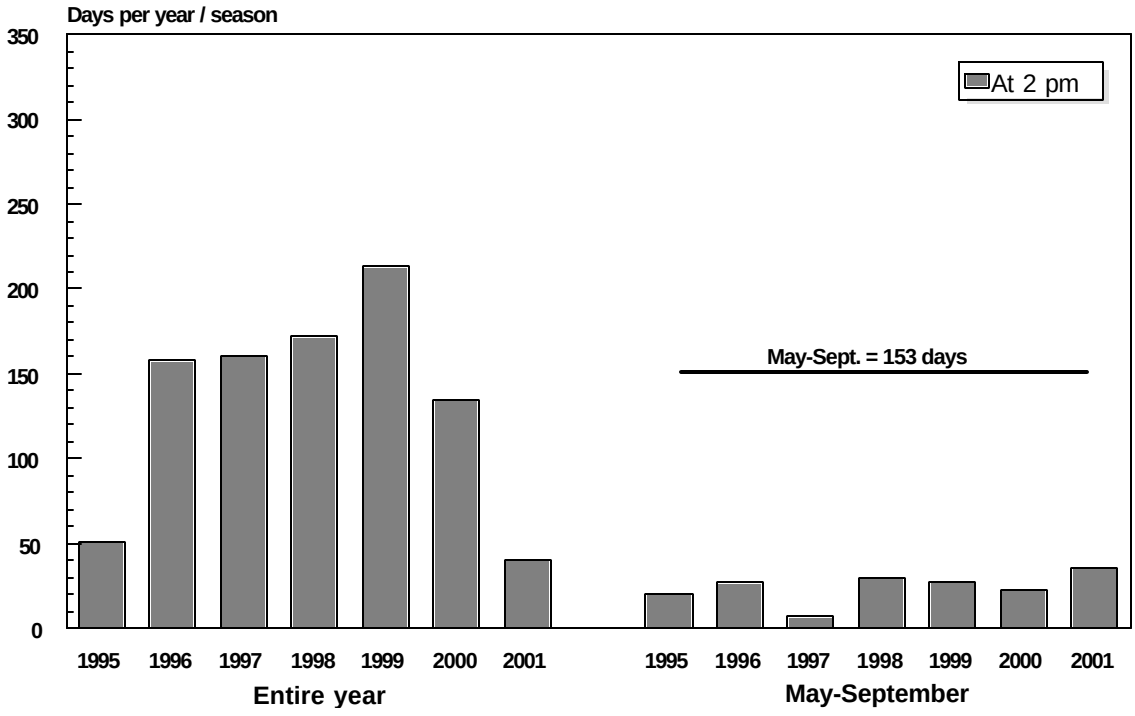


Figure 6. Number of Days With Flows (At 2 Pm) Higher Than 2,800 Cfs (Near Two Full Turbines or Higher) for Each Year and May-September Season, 1995-2001

3.2.2.8 Copco No. 2 Bypass Hydrology

A minimum flow of 10 cfs is commonly provided in the Copco No. 2 Bypass Reach, although this is not part of the FERC license. Spills do occur in the reach, but they are infrequent except in very wet years or when maintenance is required. The frequency, duration, and magnitude of spill events are currently being summarized as part of the re-licensing hydrology study, but is not yet available.

4.0 RESULTS AND DISCUSSION BY SEGMENT

4.1 LINK RIVER

This river segment is about 1.5 miles long, and flows from the Link River Dam (the outlet of Upper Klamath Lake) to Keno Reservoir (also known as Lake Ewauna). Figure 7 shows the river and various recreation features. The river drops approximately 40 feet per mile and the steepest part of the segment occurs in a single rapid at the upstream end. There is also a ledge about halfway down the river which forms a large standing wave at higher flows. The river has multiple channels near the dam, but forms a single channel below an island halfway through the reach. Most of the river corridor is on PacifiCorp land, although there are some private homes on river left (the east side).

The segment's landscape is dominated by a large wooden pipe on river left, which delivers water to the Eastside hydroelectric facility. The pipe diverts up to 1,200 cfs, depending upon power needs. On river right, a diversion canal leads from the dam to a penstock above the Westside hydropower facility; a service road parallel to the canal is open to public use as a designated greenway trail. It is gated to allow only service vehicles and foot traffic (no bikes, horses, or motorized use allowed).

Vegetation is relatively thick along the riparian zone and up the valley slopes. Some vegetation is impassable blackberries or other thorny species. Recreationists (probably anglers and children/teenagers) use several informal, un-maintained trails to the river from this service road; most of these are steep, have low overhanging vegetation, and end in small riverside clearings with noticeable litter. However, at least two spur trails appear to have received some management attention. These are toward the downstream end of the segment and lead to larger clearings on the river's edge; they are also slightly easier to recognize as river access options (one even has metal stairs down a steep part at the top of the trail).

4.1.1 Recreation Opportunities

Recreation opportunities in the Link River corridor include locational trout angling, playboating, and general recreation along the service road trail.

4.1.1.1 Fishing

The Link River segment has a wild Redband rainbow trout fishery, which attracts mostly local Klamath Falls anglers. Although there are significant water quality issues associated with Upper Klamath Lake, as well as less-than-natural aesthetics along this segment (hydroelectric facilities and homes are visible from most places in the corridor), the river has a fair fishery and is close to town. Fishing on this reach is most popular from January into March, when larger migrants (up to 15 to 20 pounds) from the Keno Reach make their spawning run (Smith, ODFW pers. comm). However, smaller (usually 10 to 14 inches) non-migratory fish are also available and fished through the rest of the year, particularly in the fall. Anglers may use a variety of tackle, including spinners, plugs, flies, or bait. Bank angling access appears to be easiest from the service road and spur trails on the west side. Boat anglers also row or motor up river from Keno Reservoir (Lake Ewuana) to the bottom of the first riffle above the Westside powerhouse.

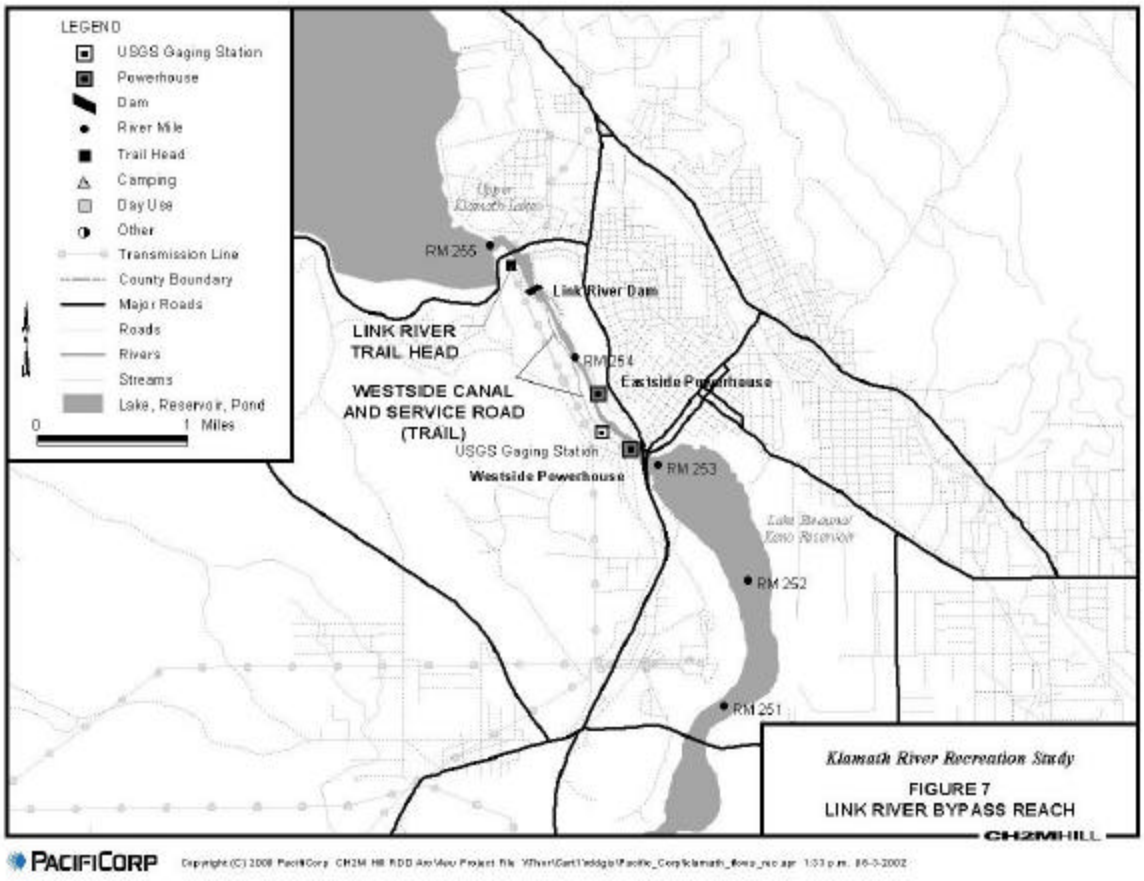


Figure 7. Map of the Link River Bypass Reach

4.1.1.2 Locational Playboating

Boating use is generally limited to kayaks and inflatable kayaks, although boating in small rafts and catarafts appears possible at higher flows (see below). The short reach has only one short Class III/IV rapid and another Class II/III ledge drop; these would not typically attract many whitewater boaters, except that the latter creates a well-known playboating feature (a large breaking wave) at higher flows. The popularity of locational playboating (also known as "park and surf," rodeo, or freestyle boating) has increased dramatically in the past decade (Bennett, 1999), and play waves close to urban areas have the potential to attract substantial use. In this case, use appears relatively low and limited to local kayakers. They gain access to the wave by paddling downstream from the dam, or by carrying their boats upstream from the Westside powerhouse and using one of the informal spur trails to get to the play area, floating out when they are finished.

4.1.1.3 General Recreation

The service road on the west side of the Link River appears popular among local Klamath Falls residents for hiking, walking, jogging, bird watching, dog walking, berry picking, and so on. While the road offers relatively distant views and no close access to the river, spur trails allow

visitors to get to the water, particularly at the two ends of the segment. There is a bird watching blind located on the lake accessible from the service road trail. Based on the site visit and limited discussions with people using the area, most people appear to stay on the road. However, neighborhood children appear to have good knowledge of the spur trails and the informal, dispersed recreation opportunities they provide.

4.1.2 Flow Requirements

4.1.2.1 Fishing

Bank anglers appear to use Link River at a few well defined sites leading from spur trails, while boat-based anglers use the last quarter-mile of the segment below the swifter water. Based on reconnaissance and limited interviews with Link River anglers (particularly Smith, Fortune, Pers. Comm.), these opportunities are best from January to March because of the availability of larger Keno migrants. At these times, flows in the river generally range between 500 and 1,500 cfs, although there may be several short periods (usually less than a week at a time) where spills reach 3,000 to 4,000 cfs. Occasional large spills over 4,000 cfs are also possible, although these tend to occur for very short periods (a day or two at a time).

Higher winter flows over about 1,500 cfs are probably less than optimal (and possibly unacceptable) for both types of angling. These flows would make wading hazardous for bank anglers, and increase the difficulty of rowing or motoring against the current from Lake Ewauna for boat-based anglers. While fishing from boats at the edge of the river and reservoir is probably possible at even the highest flows, turbidity and swift currents might also make conditions less acceptable at levels above 1,500 cfs.

For bank fishing, lower summer and fall flows also offer much more bank and wading access to the river, while improving water clarity and providing higher concentrations of fish in deeper pools and runs. However, if flows are too low, fish may be under stress from higher water temperatures and fish concentration in those pools, which may lower their feeding activity (and thus fishing success). The summer/fall fishery (which does not feature the larger Keno migrants) also has fewer fish than the winter / spring fishery in this segment.

A flow evaluation curve for fishing is provided in Figure 4; it is preliminary and based on limited interviews, the shapes of curves from other studies, and professional judgments about when flow levels are likely to inundate the thicker vegetation and make wading more difficult. It shows acceptable flows from about 100 to 1,500 cfs, with optimum flows at the lower end from about 200 to 1,000 cfs.

4.1.2.2 Locational Playboating

The Link River is boatable in kayaks at about 350 to 400 cfs (Shelby kayaked the river at an estimated 350 to 390 cfs during reconnaissance), but the steep drop at the top of the run presents some pinning hazards at that level. The river also does not offer any playboating features at those flows. Only four interviewees had specific knowledge of the Link River reach (Wiedenbach, Lehman, Gutermuth, and Pribble, Pers. Comm.), although four others reported having heard of the wave and intended to use it in the future. Of the four with Link River experience, three use

the river for playboating in kayaks, while Pribble reported a single trip in a raft at very high flows.

Among the kayakers, one boater (Lehman, Pers. Comm.) reports that the wave begins to provide playboating at flows as low as 600 to 800 cfs (there are apparently two smaller merging waves at those levels). However, there was general consensus that the wave provides higher quality play at about 1,500 to 2,000 cfs. The wave appears to increase in size and quality as flows increase beyond those levels, but information is less available about flows over 3,000 cfs. Pribble's rafting trip may have been at flows in the 4,000 to 5,000 cfs range, and he reported that the breaking wave was quite large and could easily have flipped his boat if he did not aggressively hit its weakest point. All flows are estimates from the boaters themselves; accurate flow information for the reach is generally not available (see below).

A preliminary flow evaluation curve for playboating is provided in Figure 8; it is based on interview and reconnaissance information. It shows acceptable playboating beginning around 700 cfs, and optimal flows are from 1,500 cfs to 3,000 cfs. This curve declines only slightly at flows higher than 3,000 cfs. Additional information is necessary to better define this end of the curve, but it may be less important than improving accuracy of the curve from acceptable to optimal levels (700 to 2,000 cfs).

Note: No curve is developed for "standard" boating trips, because few boaters appear to use the river for point to point boating.

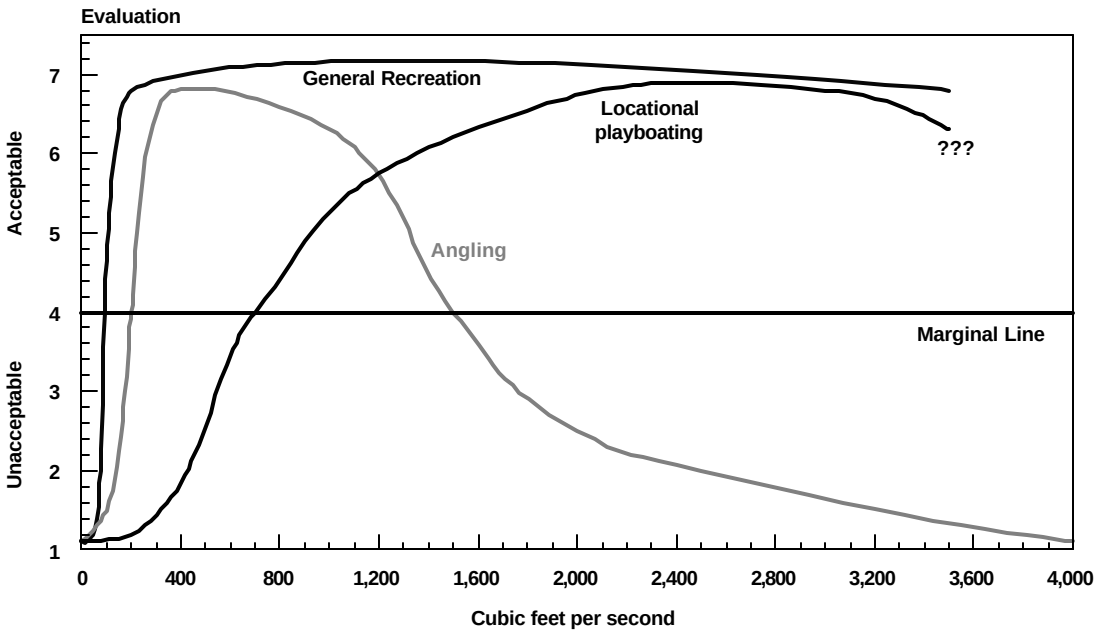


Figure 8. Flow Evaluation Curves for Recreation Opportunities on the Link River

4.1.2.3 General Riverside Recreation

As discussed in the methods section, general riverside recreation is often enhanced by certain flows rather than dependent upon them. People using the Link River service road for walking,

running their dogs, bird watching, picking berries, or other similar day use activities are unlikely to consider flows unacceptable as long as the river appears to have some water covering the bottom of the channel and appears to be moving. Based on reconnaissance at 350 to 390 cfs, this is likely to occur at flows as low as 100 cfs. A flow evaluation curve for general riverside recreation is also given in Figure 4, and shows dramatic improvement from 100 to 200 cfs, with ratings remaining high through estimated "bank full" levels. At that point, aesthetics might decrease marginally as the river is likely to become more turbid, inundate vegetation, or lose definition in the rapids.

4.1.3 Project Effects

In general, minimum flows in the Link River bypass have been higher than 90 cfs in even the driest periods, and they are often in the 250 to 600 cfs range from May through December. While these flows do not provide acceptable locational playboating, they are in the optimal ranges for both fishing and general recreation. Accordingly, Project power diversions appear to be having few if any negative effects on those opportunities during summer and fall.

During the winter and spring, higher "base" flows in the bypass (500 to 1,500 cfs) provide optimal general recreation and optimal or near-optimal fishing; power diversion effects are thus beneficial because the Project generally prevents even higher flows. For example, if 1,450 cfs from Eastside power diversions were added to a typical winter base level of 1,000 cfs, flows would probably be too high for good fishing. When higher spills occur during winter and spring, however, fishing conditions are probably unacceptable even if the power diversions remove 1,450 cfs.

In contrast, effects on locational playboating from power diversions are likely to be both noticeable and detrimental during the winter and spring. For example, if 2,000 cfs is released through the system from UKL and 1,450 cfs of that flow is diverted for power, only 550 remains in the channel and no playboating opportunity is provided. Similarly, if 2,500 cfs is to be released from UKL and 1,450 cfs is diverted, Link River receives only 1,050 cfs -- acceptable but probably sub-optimal for playboating. If Eastside and Westside are taking their full diversions, UKL must be releasing over 3,000 cfs into the system to provide near-optimal playboating in the Link River.

In general, high quality locational playboating is only ***assured*** during higher flow periods when UKL outflow exceeds about 3,000 cfs. Based on preliminary available hydrology information, this could happen up to 70 or 90 days in an average year, but it may not occur at all during dry winters (e.g., 2001). It may occur over 120 days in a wet winter (e.g., 1998 and 1999). If power diversions never took 1,450 cfs from January to May period, an additional 10 to 40 days of playboating (up to 150 total days) might occur in an average year.

This discussion implies there may be opportunities to purposely provide flows for playboating in the future by diminishing power diversions and sending the water down Link River as spill. This would be most effective when 2,000 cfs or more is to be released from UKL during the winter or spring. If these "enhanced" Link River spills were to occur for whitewater boating, the spike flows would probably only need to be provided occasionally and for a few hours at a time (e.g., for a three hour "session" on a weekday evening or weekend afternoon each week) to meet

boater demand. Purposeful whitewater flows would result in lost power generation, may be difficult to provide because of operational constraints (manually-operated dam gates), and would need to be considered in light of potential impacts on Link River fisheries. As more information about potential operating scenarios of these facilities becomes available, it will be possible to assess specific impacts on the frequency and quality of locational playboating opportunities on the segment.

4.1.4 Future Study Needs and Options

It is possible to develop more precise flow evaluation curves for all three Link River opportunities, but there does not appear to be a compelling need for that additional precision, particularly for fishing or general recreation. Project effects on these two opportunities are unlikely to be noticeable (and may be beneficial); additional precision is unlikely to modify that conclusion or help in developing PME flow scenarios.

Additional precision for locational playboating is also possible, and it may make sense to determine a threshold level for quality playboating if purposely-provided bypass flows are considered for this opportunity. However, existing information suggests that playboating improvement is gradual on the Link River as flows increase, so defining a specific threshold may be difficult in any case.

More importantly, one efficient method for gaining this precision would be a controlled flow study (where boaters evaluate several flows in a short period of time). But conducting this study could be very challenging because of 1) operational constraints (little controllable upstream storage during periods of the year when UKL outflows are available as well as the problematic manually-operated spill gates) and 2) concerns regarding potential fisheries impacts.

A less difficult and cost effective approach might focus on interviewing more boaters who use the wave, although this would only be helpful if they had an accurate way to gage flows. Boaters currently have to guess what they are observing by getting Link River USGS flows and subtracting estimated Eastside flows. With relatively little effort, a staff gage could be placed near the play wave to allow boaters to calibrate acceptable and optimal conditions with a knowable gage. Similarly, with a relatively small effort, PacifiCorp could calibrate actual flows in the reach with the new staff gage (although this will require improved recordkeeping for Eastside and Westside diversions). Assuming that a gage can be placed on the river before winter 2002-2003, and that spills provide variable flows during that season, interviews conducted in summer 2003 are likely to substantially improve the accuracy of the playboating flow evaluation curve.

A final option is to have recreation researchers conduct additional reconnaissance trips on the river when playboating flows are available. Link River flows in the crux range of 1,000 to 2,000 cfs may occur when other recreation work is being conducted in the area, so it would be relatively easy and efficient to run this short reach and assess characteristics of the play wave at those flows.

Regardless of whether these additional study options are pursued, improved historical flow data for the reach would help understand specific Project effects on recreation. Because development

of this information is likely to be time and labor intensive, a focus on the past two or three years is sufficient to help characterize current operations.

4.2 KENO REACH

This river segment is about 5 miles long, extending from Keno Dam (outlet of Keno Reservoir / Lake Ewauna) to J. C. Boyle Reservoir (Figure 9). The river has a gradient of approximately 50 feet per mile, most of which is concentrated in a series of six to seven drops in the upper third of the reach (including the largest one, known as "Cotton Gin"), and at a single large rapid at the downstream end (suggested name, "Teetering Rock Rapid"). The river spreads out into a wider channel for about a mile and a half in the middle of the reach, but otherwise features a relatively narrow single thread channel with a pool/drop character. The river has relatively steep banks and cliffs with a few sheer walls, but the canyon is generally less than about 200 feet above the river. The cliffs, river, and associated riparian areas appear to offer superlative shorebird habitat, and the abundance of birds (e.g., cormorants, pelicans, herons, and eagles) can be remarkable. According to local anglers and fish biologists (Ostenson, Hale, Fortune, Smith Pers. Comm.), the reach also features an excellent wild Redband rainbow trout fishery. Some of the river corridor is on PacifiCorp land with the remainder being private lands, although there are some county public lands as well.

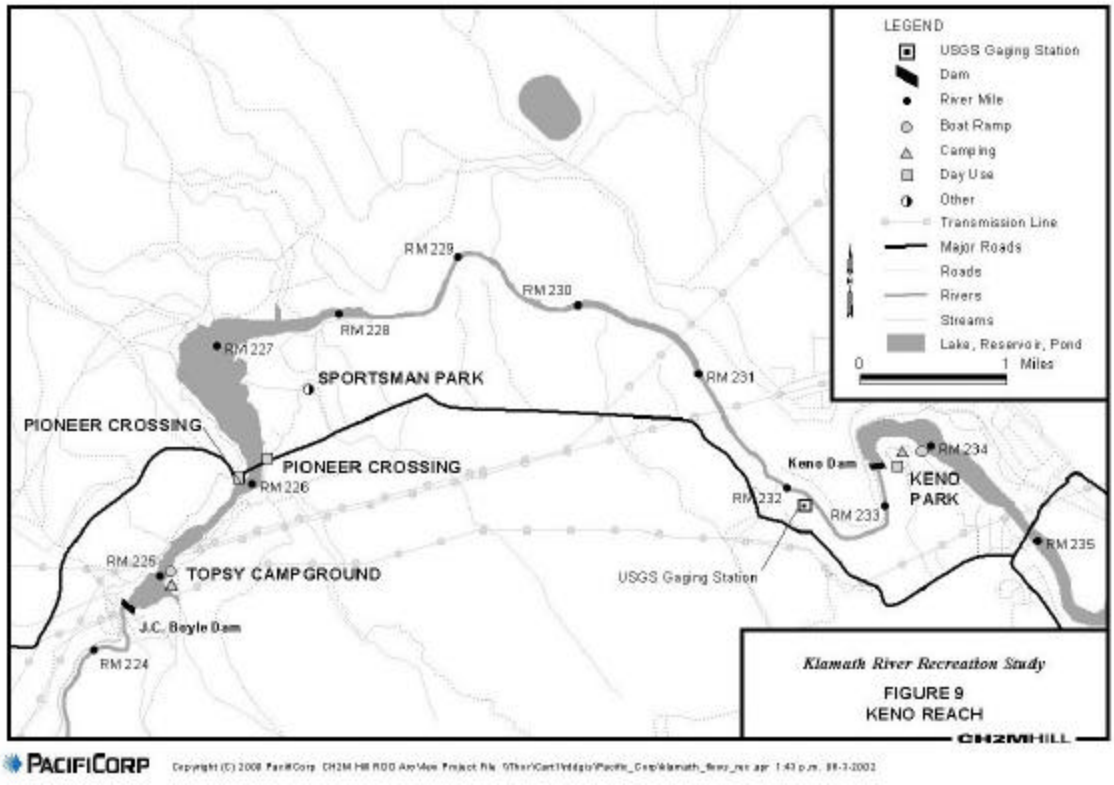


Figure 9. Map of the Keno Reach and Associated Recreation Features

The segment's landscape features few signs of development except for the dam and associated service road (which only travels a few hundred yards downstream from the dam on the river right side). Two power lines cross the reach at approximately RM 230.5 and RM 231.5 (about one to two miles down the reach); these appear to be two of the key access points for bank anglers. There are no obvious user trails visible from the river, although anglers report several informal, un-maintained trails and 4 wheel drive roads that approach the river (one at the downstream power line crossing may allow vehicles to reach the immediate river vicinity). At the end of the segment there is gravel road access from Sportsman Park on J. C. Boyle Reservoir, including one road that travels close to an obvious boat take-out area (although there is no developed ramp).

4.2.1 Recreation Opportunities

Recreation opportunities in the Keno Reach corridor include fishing, standard boating, locational playboating, and general riverside recreation.

4.2.1.1 Fishing

The Keno Reach offers high quality trout angling opportunities, apparently among the best in the Klamath Falls region (Ostenson, Hale, Smith, Fortune, Pers. Comm.). Although the reach has difficult access (limited to small boats or the informal trails) and significant water quality issues associated with Upper Klamath Lake, the canyon features high quality scenery, solitude, good variety of fishing water, and trophy-sized redband rainbows. Fish that exceed 20 inches are occasionally caught, although the average size is apparently closer to 15 to 17 inches (Smith, Pers. Comm.). From January to March, some spawning fish migrate upstream into Lake Ewauna and the Link River Reach (Keno Dam has a fish ladder).

Fishing regulations allow anglers to keep one fish per day in fall, winter, and spring, but the river is closed during the summer (June 15 to Sept. 30). No bait is allowed, and anglers appear to use both flies and spinners in roughly similar proportions. Some anglers wade in the river while fishing (particularly fly anglers and particularly in the wider/shallower middle part of the river), but many others fish from the shore (Smith, Pers. Comm.).

The most common access points are from the road near the dam (it runs for about a half mile along the river), the trails to the power line crossings, and from Sportsman Park. Some boat-based anglers may also fish the river tail-out by motoring up from J. C. Boyle Reservoir, while others may take rafts or pontoon catarafts down the reach. The periods of highest fishing use are apparently from April through early June, and again in the fall.

4.2.1.2 Standard Boating

The Keno reach offers a short Class II/III whitewater run that is boatable at medium to high flows. It appears to attract occasional use from local boaters, including boat-based anglers looking for access to a segment with limited, informal trails. Two outfitters (Lee, Noah Hague, Pers. Comm.) reported taking or contemplating commercial trips on this segment as an alternative to the more challenging whitewater run on Hells Corner, or as part of a two or three day "package" that included runs on Hells Corner. Both noted that the canyon is undeveloped and has good wildlife viewing, with less challenging whitewater. Most boaters are likely to run

the river as a day trip, although camping might be possible at several upland locations (there are few beaches).

4.2.1.3 Locational Playboating

There is a well known playboating wave/hydraulic (the "Keno Wave") at the start of the segment, allowing kayakers to "park and surf" without running the entire segment. The popularity of playboating has increased significantly in the past decade (Bennett, 1999), and play waves of this type have the potential to attract significant use. In this case, use appears relatively low and limited to local kayakers from the Klamath Falls and Ashland area. They gain access to the wave from the end of the road that goes to the dam.

4.2.1.4 General Recreation

Although there is access at the top and bottom of the segment, as well as at the power line crossing, few people appear to use the Keno Reach for general riverside recreation (walking, hiking, mountain biking, berry picking), this may be due to the absence of formal trails. However, there is probably good off-trail hiking along some parts of the river and superlative bird viewing for interested users.

4.2.2 Flow Requirements

4.2.2.1 Fishing

Nine interviewees reported about fishing on the Keno reach, including three (Ostenson, Smith, and Fortune, Pers. Comm.) who provided detailed information. The KCFC also provided information about this reach. Based on interviews, many anglers appear to use the Keno Reach from a few sites leading from un-maintained trails (particularly those from the power line crossing or the road that ends just downstream of the dam). A few may also take boat-based fishing trips (Hale, Ostenson, Pers. Comm.), while others may have fished incidentally while on standard boating trips (Munroe, Lee, Noah Hague, Pers. Comm.).

Interviewees suggest that bank-based fishing is generally best at lower flows when water is below riparian vegetation, and there is better access for bank or wading anglers (Swisher, Ostenson, Smith). Bank anglers also generally prefer lower flows for improved clarity and higher concentrations of fish in deeper pools and runs (Ostenson, Smith, Pers. Comm.).

On the Keno reach, Ostenson reports that flows between 300 and 600 cfs are "spectacular" and that conditions remain good as high as 1,000 cfs. At that level and higher, he reports that fishing quality declines steadily until about 2,000 cfs, when he would not fish because the current is too fast. Smith noted that anglers can adapt their fishing techniques to these higher flows, but agreed that wading angling in all but the wider, middle part of the river is difficult to impossible once flows exceed 900 cfs; his optimal range for the Keno Reach was in the 600 to 900 cfs range. The KCFC letter identifies flows up to 1,200 cfs as acceptable, with an optimal flow of 800 cfs. Other interviewees had less specific information about when fishing was best, but concurred that lower flows under 1,000 cfs offered good conditions (Hague, Hale, Fortune, Pers. Comm.). A flow evaluation curve for fishing is provided in Figure 10 and generally follows from these

recommendations. It shows acceptable flows from about 200 to 1,500 cfs, with optimum flows from about 300 to 900 cfs.

Flow evaluations for boat-based angling have not been explicitly shown, but can be inferred by "combining" the angling and standard boating curves. Boat-based anglers may be willing to tolerate some boatability problems at lower flows (i.e., from 500 to 800 cfs) in order to gain access to the river at good fishing flows, but the best combination of boating and fishing is likely to occur from 800 to 1,000 cfs. At flows less than about 800 cfs, small "sport-cats" (9 to 12 foot catarafts designed for a single person which are becoming popular among some anglers) would be a better choice than standard 13 and 14 foot rafts. Flows below 500 cfs probably require considerable boat dragging in any craft except kayaks.

4.2.2.2 Standard Boating

Based on study reconnaissance, the segment is boatable in kayaks or lightly loaded small rafts (under 15 feet) at about 600 to 700 cfs, but these flows offer little whitewater challenge or "play." At these flows, the middle section of the river with its wider, shallower channel causes several boatability problems such as "hits" (where boats make contact with rocks but continue downstream), "stops" (where rocks stop forward momentum and boaters have to push off to continue moving) and "boat drags" (where boaters get out of their boats to pull them off rocks).

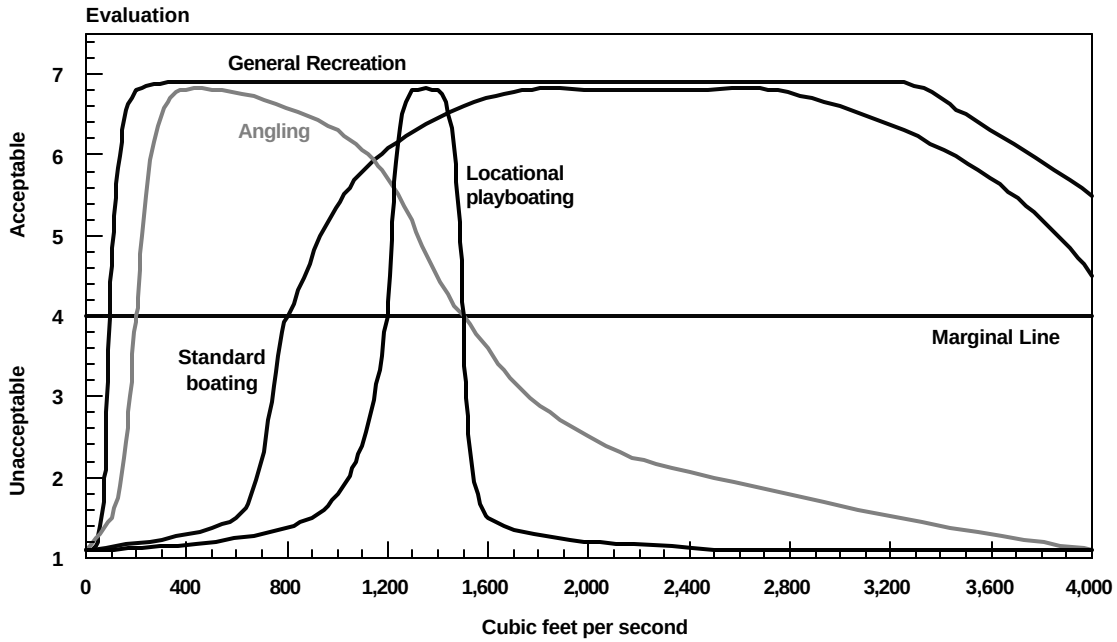


Figure 10. Flow Evaluation Curves For Recreation Opportunities on the Keno Reach

A few of the steeper rapids at the beginning and end of the run appear to have enough gradient and constriction to offer Class III challenge and play opportunities at medium to high flows (about 1,200 to 3,000 cfs). At these flows, there are likely to be relatively strong hydraulics at several steeper rapids near the start of the run, a rapid that careens into a wall about a third of the way down the segment, and at the final rapid where the river reaches J. C. Boyle Reservoir. At very high flows (over 3,000 cfs), only the final rapid (which features large bus-sized mid-channel

rocks and more constriction from canyon walls) is likely to have very powerful hydraulics and perhaps approach Class IV difficulty. Most of the other rapids are short, steep chutes with smaller rocks that are unlikely to significantly change difficulty at higher flows (they may even wash-out and become easier).

Interview information from five rafters who have run the segment suggests similar conclusions. Below 1,000 cfs, the wider and shallow middle section of the river is "boney," can hang up rafts, and prevent driftboat use. However, some respondents report "clean runs" (no boatability problems) at flows above 1,000 cfs and good whitewater at flows in the 2,000 to 4,000 cfs range (Pribble, Noah Hague, Pers. Comm).

A flow evaluation curve for standard boating opportunities is provided in Figure 10. It suggests that flows below about 800 cfs are marginal, with little whitewater challenge and noticeable boatability problems. Conditions improve steadily with additional flow above 1,000 cfs, with optimal conditions appearing from about 1,200 to 3,000 cfs. After this level, ratings decline as the river is likely to become more "pushy" for Class III boaters and the length of the trip is likely to be very short (the trip takes two to three hours at lower flows, but may take less than an hour of river time at higher flows). By 4,000 cfs (the typical peak flows likely to occur on the reach except in extreme flood), conditions for standard trips probably approach marginal levels.

4.2.2.3 Locational Playboating

The Keno wave is a well known play feature among Southern Oregon kayakers. When the wave is "in," it may rival the quality of other Oregon play areas such as Bob's Hole (Clackamas River). At optimum levels, the wave is apparently 3 to 4 feet high, has a 6 foot face, and is about 10 feet wide with a surging pile that has some "retention" for hole-based maneuvers. There are eddies on either side of the wave, and a "friendly" deep pool immediately below the wave for rolling if kayakers are capsized during their maneuvers. Six interviewees had specific knowledge of the Keno wave (Wiedenbach, Lehman, Gutermuth, Stokesberry, Kirwin, and Ellis, Pers. Comm.), although two others reported knowing about the wave and intended to use it in the future.

There was considerable consensus among the interviewees about when the wave first appears (from 1,000 to 1,200 cfs), when it is optimal (1,250 / 1,300 to 1,400 cfs), and when it begins to "wash out" or becomes too fast for most rodeo maneuvers (1,450 to 1,500 cfs). All flows refer to the Keno USGS gage, which is available on the web.

A flow evaluation curve for playboating, based primarily on interview information, is provided in Figure 10. It shows that flows less than 1,000 cfs are clearly sub-marginal, that acceptable playboating begins around 1,100 cfs, and optimal flows are from 1,300 cfs to 1,400 cfs. The curve then declines sharply from 1,400 cfs, becoming unacceptable at 1,500 cfs.

4.2.2.4 General Riverside Recreation

Based on reconnaissance, flows as low as 200 cfs are likely to cover the bottom of the Keno Reach channel (except in the wider shallow section) and provide adequate aesthetics for general recreation. A flow evaluation curve for general riverside recreation is also given in Figure 6, and shows dramatic improvement from 100 to 200 cfs, with ratings remaining high through estimated

bank full levels. At that point, aesthetics might decrease as the river becomes more turbid, inundates vegetation, or loses some definition in rapids.

4.2.3 Project Effects

Project effects can be categorized as either seasonal or short-term variation issues. Seasonal flow variation caused by PacifiCorp and USBR projects is unlikely to significantly affect recreation opportunities on the reach during winter and spring months. Once UKL is full, water sent through Keno is very similar to what would occur without the irrigation and power projects. These flows may sometimes be too high for optimal fishing, but they provide acceptable to optimal standard boating opportunities and they are optimal for general recreation as well. Locational playboating also would occur within its narrow range (1,200 to 1,500 cfs) at about the same frequency.

In contrast, during summer and fall months, average daily flows created by the projects are generally higher than those that would exist without them, primarily because of storage capacity in UKL, the irrigation return flows (about 400 cfs in summer), and the minimum flows to be provided below Iron Gate. These higher flows may slightly diminish fishing opportunities (because 300 to 900 appears better than higher flows), but they are still near optimal for both fishing and general recreation (and fishing is closed from June 15 to October 1 in any case). For these two opportunities, Project effects may therefore be noticeable but not substantial.

For boating, project-enhanced summer and fall flows are also unlikely to have substantial effects. The higher flows during these periods are generally not enough to provide better quality standard boating than would otherwise occur, and locational play boating opportunities during this period are rare in any case. For example, because springs and accretion provide about 250 cfs below J. C. Boyle Dam, even during dry months in dry years about 300 to 500 cfs from UKL plus 300 to 400 cfs in irrigation return flows is sufficient to produce 1,000 cfs minimum flows below Iron Gate. If this 600 to 900 cfs were provided in the Keno Reach on a constant basis, it would still produce only marginal standard boating (although these flows are better than if UKL storage was not providing minimum flows for Iron Gate).

In addition to seasonal variation effects, short-term variation in Keno flows may also affect the frequency or quality of recreation opportunities. During high flow periods (January through May), flow changes in the Keno Reach may exceed 500 cfs per hour, although that is the maximum hourly change allowed during medium to low flow periods (PacifiCorp, 2002b). This substantial hourly variation, for example, may mean that an average daily flow of 750 cfs produces flows that may be 100 to 200 cfs higher or lower for parts of any given day (although the fluctuation level is less likely to be that large during summer and fall).

During winter months, this substantial short-term variation is unlikely to have important effects on recreation aside from locational playboating. Flows are typically too high for fishing when this variation is likely to occur, and changes are likely to be noticeable but within the optimal range for standard boating. With the narrow range applicable to playboating on the Keno Wave, however, daily and hourly variation of even 100 cfs per hour may frequently, and unpredictably, move flows in and out of the optimal range.

During summer and fall months, daily and hourly variation is unlikely to have substantial effects on fishing and general recreation because those would likely remain within optimal ranges even with 100 to 200 cfs of variation per day. However, this variation could produce acceptable flows for standard boating that otherwise would not exist if boaters knew about them and could plan to be on the water at those times. For example, a 750 cfs average daily flow could include periods of five to six hours with flows as high as 950 cfs, balanced by flows around 550 cfs. If boaters had a schedule of these changes and the higher flows were provided during the day, they might be able to take advantage of the opportunity. At present, however, predicting daily variation for Keno is virtually impossible. Predictability is tied to understanding substantial USBR irrigation return flows to Keno Reservoir, which are a function of hundreds of individual irrigation decisions by farmers. Gages on return flow canals could serve as better indicators of those return flows.

4.2.4 Future Study Needs and Options

It is possible to develop more precise flow evaluation curves for all four Keno Reach opportunities, but there does not appear to be a compelling need for that additional precision, for fishing, general recreation, or locational play boating. For fishing and general recreation, Project effects on these opportunities are unlikely to be substantial; for fishing and locational playboating, information is already relatively precise.

Additional precision for standard boating is also possible, and may make sense if more proactive management of flows for this opportunity is contemplated. For example, if PacifiCorp considers using the 1.5 feet of Keno Reservoir fluctuation allowed by USBR in the current contract to modify fluctuations in the Keno Reach, more information about acceptable flows for boating might be useful. Similarly, if information about Keno Reach flows becomes more predictable, PacifiCorp might assist boaters in taking advantage of those flows by providing the information.

Options for developing additional information about boating flows focus on 1) conducting a controlled flow study, 2) conducting more interviews with boaters who use the segment, or 3) having recreation researchers conduct additional reconnaissance trips on the river at higher flows than the 2001 field work.

The most precise information would be developed from a controlled flow study, but operational constraints make this choice logistically challenging. During the time of year when boating flows of interest are likely to be available, control over those flows is limited and one would have to be lucky to observe a desired range of flows in a short period. Additional interviews are likely to help further define a flow evaluation curve for boating, but current boating use on the reach appears low. It is also unlikely that we could develop a sufficiently large interview sample with information about flows and boating on the reach to substantively improve the precision of the existing curve. Flows in the 1,000 to 2,000 cfs range, however, may occur when other recreation work is being conducted in the area, so it is relatively easy and efficient to run this short reach and assess standard boating quality to document characteristics at those flows. We recommend that this step be taken if flows are in this range during future fieldwork.

Regardless of whether any of these additional study options are pursued, improved historical flow data for the reach seems to be necessary to fully understand Project effects on recreation. In

particular, it seems appropriate to examine daily and hourly variation in Keno Reach flows when daily averages are in the 700 to 1,000 cfs range. At these levels, it seems important to quantify the frequency and duration that short periods of higher flows may be providing standard boating opportunities. Similarly, if PacifiCorp considers using some of the potential active storage in Keno Reservoir in the future (by fluctuating reservoir levels), additional analysis of these regimes will be necessary to assess whether they will add or subtract days of various recreation opportunities.

4.3 J. C. BOYLE BYPASS REACH

This river segment is approximately 4.3 miles long, extending from J. C. Boyle Dam (outlet of the Reservoir) to J. C. Boyle Powerhouse (Figure 11). The river has a gradient of approximately 96 feet per mile, with slightly steeper sections at the end of the reach. At base flows (100 cfs is released from the dam and springs add about 220 cfs), the upper mile of the river has some small braided channels, but otherwise is a narrow single thread channel with a pool/drop character. The rapids are quite steep, with large car- to house-sized boulders that sometimes create sieves. The river has steep banks and cliffs with a few sheer walls, some of which rise a few hundred feet above the river.

The segment's landscape features considerable development associated with the hydroelectric project, including the dam and its adjacent service road bridge across the river; a concrete diversion canal and a second service road; a tunnel and penstock; an emergency spillway from the canal, a service road to the powerhouse, and the powerhouse itself. Aside from the dam and bridge, all facilities are on the river right (west) side.

Despite the development, the corridor offers good scenery featuring steep canyon walls, large basaltic boulder fields, some thick pine forests, a natural-appearing riparian zone (with reaches of grasses and sedges as well as thicker forest and brush), clear spring-fed water, and several rapids. According to local anglers and a fish biologist (Ostenson, Hale, KCFC, Smith Pers. Comms.), the reach also features a good wild rainbow trout fishery (but not Redband rainbow). Most of the river corridor is on BLM land, although there are some PacifiCorp lands as well near the top of the reach.

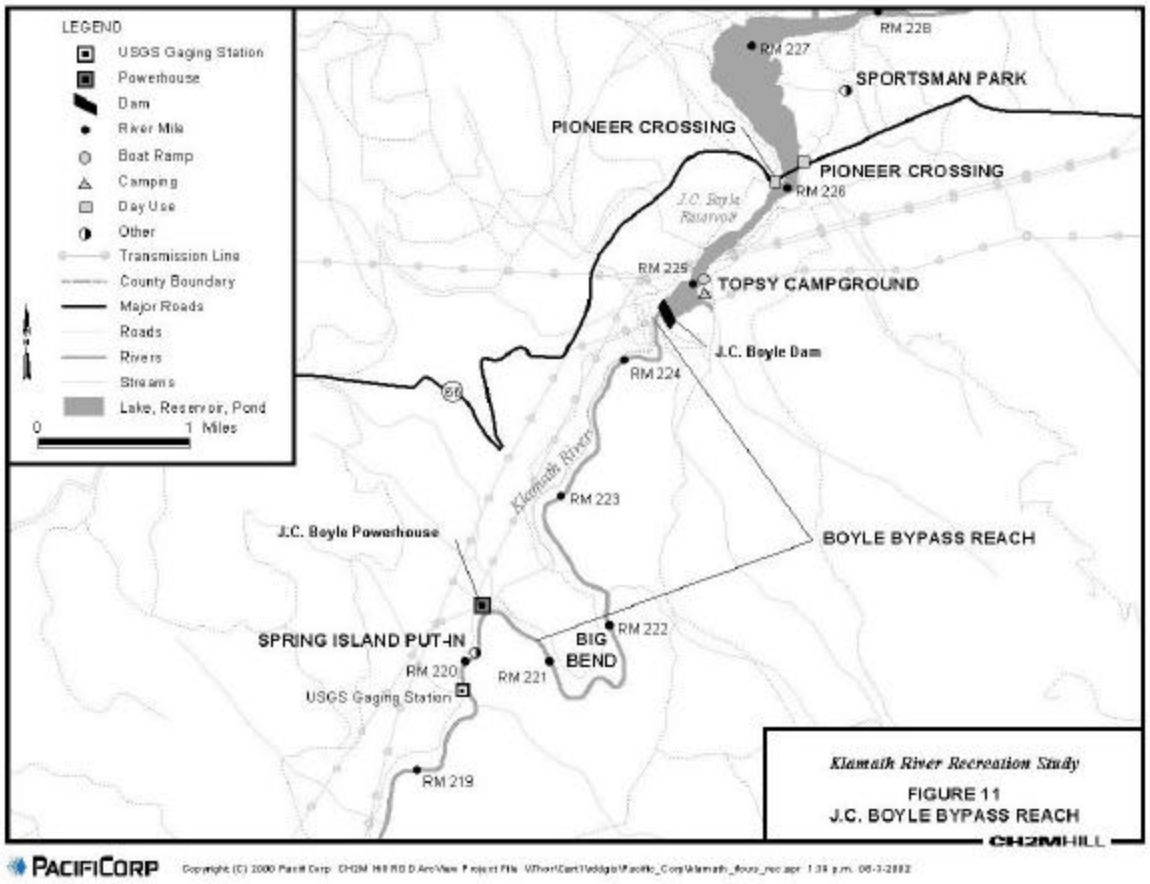


Figure 11. Map of the J. C. Boyle Bypass Reach

4.3.1 Recreation Opportunities

Recreation opportunities in the J. C. Boyle Bypass Reach include trout angling, standard and high challenge boating, and general riverside recreation.

4.3.1.1 Fishing

The J. C. Boyle Bypass Reach offers good trout angling opportunities, but the size of the average fish appears to be smaller than below J. C. Boyle Powerhouse, and much smaller than the trophy-sized fish available in the Keno Reach (Pers. Comm., Smith, KCFC). According to KCFC, there are abundant fish in the 5 to 14 inch range (these same anglers noted that Keno Reach fish may reach up to 10 pounds, while trout below the powerhouse may reach 20 inches, but are usually 8 to 14 inches). Fisheries studies as part of relicensing are likely to better quantify these differences.

Fishing regulations allow anglers to keep one fish per day in fall, winter, and spring, but the river is catch and release during the summer (June 15 to Sept. 30). No bait is allowed, and anglers

appear to use both flies and spinners in roughly equal proportions. Some anglers may wade in the river while fishing (particularly fly anglers), but most fish from the bank (Pers. Comm., Smith).

The reach generally has difficult access except near the dam and at the powerhouse. According to Smith, the majority of anglers fish close to the powerhouse, using the network of informal trails that run up the river for about a half mile. To access the middle part of the river, there are some informal steep routes down from the service road to the Powerhouse (particularly near the canal tunnel and after the emergency spillway), as well as sporadic informal trails along the river right bank. Based on field reconnaissance, use of this area appears light, probably due to its difficulty (i.e., considerable brush and large boulders to bushwhack through or over).

4.3.1.2 Standard And High Challenge Whitewater Boating

The J. C. Boyle Bypass Reach appears to offer a short Class III to V whitewater run that is probably boatable at medium to high flows, and is similar to the "gorge" section on the Hells Corner Reach (see below). Several rapids appear to have enough gradient and constriction to offer Class IV/V challenge at higher flows, while other rapids and lower flows appear to offer Class III/IV difficulty. Because flow needs for these two opportunities are likely to differ, separate curves for each have been developed. A standard trip does not feature the large and powerful hydraulics that might occur at higher flows; this trip is generally the choice for boaters with appropriate skills (Class IV boaters), but who are not necessarily interested in greater difficulty. High challenge trips occur when higher flows raise the difficulty of the reach; these are the focus for highly skilled boaters (with solid Class V skills) who are interested in greater difficulty.

Boating flows are rarely available except during spill periods, so relatively few boaters have run the reach. Most appear to have used the short reach as a day trip, although it could be linked with the Hells Corner Reach for a longer day or overnight trip. There are a few forested benches that could provide good camping (particularly around Big Bend), but no obvious beaches.

4.3.1.3 General Riverside Recreation

Few people appear to use the J. C. Boyle Bypass for general riverside recreation (walking, hiking, berry picking), although there is access at the top and bottom of the segment. However, there is some good off-trail hiking along parts of the river and a few benches and other clearings in the riparian zone that offer places to enjoy the river. The springs that provide the bulk of the water in the reach are relatively cold, so swimming is unlikely to be an attraction (except during extremely hot parts of the summer). However, the water clarity at base flows is excellent in this reach, and there are a few inviting pools and runs.

4.3.2 Flow Requirements

4.3.2.1 Fishing

Three interviewees reported about fishing on the J. C. Boyle Bypass Reach (Pers. Comm., Ostenson, Smith, and Fortune), and the KCFC letter provided additional information. Interviews suggest that fishing is generally best at 320 cfs base flows (100 cfs from the dam and 220 cfs from springs), which occurs most of the time (see below). These flows provide opportunities to

wade in the river and good pocket water in the swifter runs and rapids. They also provide excellent water clarity below the springs, as well as higher concentrations of fish in deeper pools and runs (Pers. Comm., Ostenson, Smith). As Smith noted, anglers are used to this level, but it does not mean that higher flows might not improve the fishery from a biological perspective. He also suggested that higher flows may provide good fishability conditions after anglers have adapted to the new conditions (i.e., learned how to fish them). The KCFC appear to concur with this concept, noting that flows up to 500 cfs would be acceptable (although they reported that 350 cfs was optimal).

A fishing flow evaluation curve is given in Figure 12. It shows acceptable fishing dramatically improving from about 200 cfs, with optimal flow levels about 300 to 400 cfs (current base flows). The curve then declines steadily toward marginal levels around 700 cfs, with question marks to indicate that flows for this part of the curve are more difficult to evaluate (although flows over 1,000 cfs are probably unacceptable).

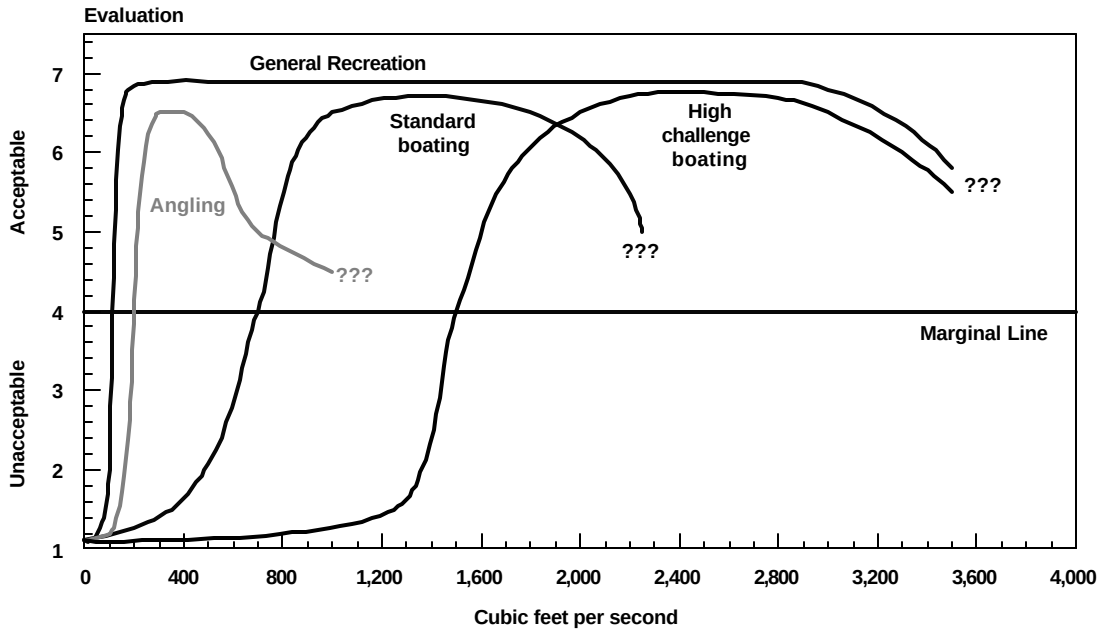


Figure 12. Flow Evaluation Curves for Recreation Opportunities on the J. C. Boyle Bypass Reach

4.3.2.2 Standard and High Challenge Boating

The J. C. Boyle Bypass Reach is boatable in kayaks and inflatable kayaks at about 320 cfs (base flows). However, during the September 2001 reconnaissance trip, kayakers occasionally were grounded and had to exit their boats in the first mile of the run (until the springs provided more water). The boaters also had numerous hits and stops in boulder-choked rapids toward the end of the run, and the rapids had very little power or quality play. This was clearly a marginal trip, even if one were willing to define it as a technical opportunity. Our reconnaissance-based assessment is that flows of 600 to 800 cfs are necessary to provide acceptable quality whitewater boating.

Nine boaters reported having taken previous trips on the reach (two at base flow levels, five at flows from 1,000 to 2,500 cfs, one at flows over 3,000 cfs, and one who has taken several trips at flows from 1,500 to 5,500 cfs). Seven other boaters reported hearing about trips or having scouted the reach at base flows and expressed a desire to run the river if higher flows were available. Only four boaters offered specific estimates of acceptable ranges for standard and high challenge trips (Pers. Comm., Wiedenbach, Kauffman, Ellis, and N. Hague)

Based on these reports, it appears that quality standard trips are available by 1,000 cfs, and they continue to about 2,000 to 2,500 cfs, offering mostly Class IV rapids (few boaters had knowledge of flows between base levels and 1,000 cfs). These trips have been taken by both kayakers and rafts (although the latter were taken by highly skilled guides). At flows around 2,000 cfs and higher, the hydraulics appear to become more powerful, and the trip may require Class V skill (a higher challenge trip). These flows may be more suited to kayakers than rafts, although rafts have taken them as well. It is unclear how high boaters can run the river, but one skilled kayaker (Pers. Comm., Gutermuth) aborted a run at flows estimated to be over 3,000 cfs because of its difficulty, and Noah Hague apparently took a raft trip at flows that may have exceeded 5,500 cfs (8,000 cfs below the powerhouse with both turbines running); he described the trip as “life-threatening” and noted that he would not go at that level again.

Flow evaluation curves for standard and high challenge boating are provided in Figure 12. The standard curve suggests that acceptable boating begins about 600 to 800 cfs, with steady improvement until flows reach about 1,000 cfs; optimal standard trips are from about 1,000 to 2,000 cfs, with ratings declining above that level. The question marks suggest that additional information may be necessary to develop this curve with greater accuracy, particularly at higher flows. The high challenge curve shows those trips become acceptable about 1,500 cfs, with optimal levels from about 2,250 cfs to 3,000 cfs. More information would help better define the top end of this curve, although the “epic” high flow trips reported by some interviewees suggest that 3,000 to 4,000 cfs may be the limit for most boaters. For both opportunities, there may be some differences for rafts and kayaks that could probably be represented in separate curves, but existing reconnaissance and interview information is insufficient for this level of precision.

4.3.2.3 General Riverside Recreation

Based on reconnaissance, flows as low as 200 cfs are likely to cover the bottom of the J. C. Boyle Bypass Reach channel and provide adequate aesthetics for general recreation. The 100 cfs dam release above the springs, in contrast, does not provide the quality aesthetics associated with the flows below the springs. A flow evaluation curve for general riverside recreation is given in Figure 12, and shows dramatic improvement from 100 to 300 cfs, with ratings remaining high through estimated bank full levels. At that point, aesthetics might decrease as the river becomes more turbid and inundates vegetation.

4.3.3 Project Effects

Project effects have generally enhanced fishing in the reach by providing stable base flows (about 100 cfs at the start and 320 cfs at the end of the reach). While fish habitat might be improved with higher base flows (to be determined by fisheries studies), and anglers are likely to be able to adapt their fishing tackle and techniques to those higher levels, it is clear that anglers

enjoy the current low levels, and most spill flows are considered too high. The KCFC letter suggests that the J. C. Boyle Reach is particularly popular when other reaches on the river have flows that are too high.

Project-provided base flows in combination with spring flows are within the optimal range for general recreation, providing more than adequate aesthetics. Without Project diversions, higher flows would probably lower water quality in the segment as higher proportions of the water would be from UKL than the springs. However, pre-Project flows were probably also within the optimal range for general recreation through most of the year.

In distinct contrast, Project effects on boating have been substantial. Base flows are clearly too low for quality boating opportunities, and taking advantage of spill events is difficult because spill flows are 1) unpredictable, 2) usually too high, and 3) often during the colder winter or early spring months. In some years, no spills providing boatable flows occur. Additional analysis of spill flows may be needed to quantify the frequency of spill amounts in different ranges. That analysis could also be compared with pre-project estimates of flows in the J. C. Boyle Bypass Reach, which are likely to have been between 1,000 cfs and 3,000 cfs for several months each year (probably from late spring to mid-summer, and then again from late fall to early winter).

4.3.4 Future Study Needs and Options

It is possible to develop more precise flow evaluation curves for all four J. C. Boyle Bypass opportunities. This additional precision makes sense for fishing and boating. For general recreation, Project effects on these opportunities are unlikely to be substantial, but boating and fishing information is relatively sparse and comes from evaluations of a flow regime that offers base flows or very high spill flows that recreation users generally do not observe (because they occur in winter and early spring).

Options for developing additional information about boating and fishing focus on 1) conducting a controlled flow study, or 2) having recreation researchers conduct additional reconnaissance trips on the river at higher flows than the 2001 field work. The most precise information would be developed from a controlled flow study, but operational constraints may make this choice logistically challenging.

In order to minimize lost power generation, the study should be conducted when some spill flows are available. However, during those times, control over spills may be limited (due to little upstream storage). In addition, there are operational concerns about the ability to open gates on the J. C. Boyle Dam to provide specific flow amounts for such a study. Finally, substantial concern has been voiced by anglers and fishery biologists about the potential impacts of releasing spill flows into the J. C. Boyle Bypass, particularly if it were to occur during the summer or fall.

Assuming that these constraints can be addressed, Shelby and Whittaker recommend conducting a controlled flow study for both boating and fishing. The study could be conducted concurrently with fish, water quality, or other biophysical studies that may also require additional flow in the channel, and it offers the best way to understand how changes in flow regimes in the reach would affect various resources. Whitewater advocates (AW) and resource agencies (NPS and BLM)

have also requested such a study, and similar studies have been commonly requested and conducted on bypass reaches for other re-licensing efforts.

Planned maintenance on the J. C. Boyle diversion canal in September 2002 offers an opportunity to conduct a controlled flow study in the Bypass Reach without forgoing power generation. Assuming that flows of about 750 cfs will be spilled into J. C. Boyle Bypass during such a period to meet Iron Gate minimum flows (because the springs and downstream accretion will add another 250 to 350 cfs), it may be possible to provide three or four flows between 500 and 1,500 cfs for short periods (2 to 4 hours each); these are the key flows for developing more precise curves for fishing and standard boating. While it would be helpful from a scientific perspective to also rate flows higher than 1,500 cfs, information about those flows is probably less useful because they are 1) only likely to help define the upper end of high challenge trips, and 2) high challenge trips in that range are likely to occur because of spill events regardless of license measures. More importantly, there is not likely to be enough water in the system in September to provide those flows.

If a controlled flow study in September or at some other time cannot occur, opportunistic reconnaissance by recreation researchers and local anglers and boaters might improve flow evaluation information. This type of reconnaissance also has logistical challenges (particularly ensuring participation by researchers and users when spills of the desired size occur unpredictably). However, this option would at least provide systematically collected information about fishing and boating at flows higher than base levels.

Regardless of whether a controlled flow study or additional reconnaissance is pursued, models of future operating scenarios and their likely effects on hydrology in the reach will need to be analyzed to fully describe future Project effects on recreation. Similarly, more extensive analysis of existing J. C. Boyle spill data might prove helpful for characterizing the flows that have been available in the reach.

4.4 HELLS CORNER

The Hells Corner segment is about 16 miles long, extending from J. C. Boyle Powerhouse to Copco No. 1 Reservoir (Figure 13). The river has a gradient of 51 feet per mile, with a steeper six mile reach (sometimes called “the gorge”) that averages about 77 feet per mile. The river is mostly a single thread channel, although there are some islands and wider areas with boulder gardens or braids (particularly at lower flows). The river has some steep banks and cliff walls, but generally flows through a more open canyon than the J. C. Boyle Bypass Reach, particularly downstream of the California-Oregon border.

The 11-mile segment of the Hells Corner Reach from J. C. Boyle Powerhouse to the Oregon border was designated an Oregon State Scenic Waterway in 1988 and designated a National Scenic River (part of the federal Wild and Scenic River System) in 1994; the designations came in response to various Salt Cave Hydroelectric Project proposals and a formal Wild and Scenic river study (USDI, 1990). Designation assigned federal management responsibilities to BLM, which has considerable land in the corridor (along with PacifiCorp), although the segment was designated under the 2a (ii) section of the Act and calls for cooperative state/federal management.

The river was designated for its “outstandingly remarkable” recreation, fish, wildlife, historical, prehistoric, scenic, and traditional Native American values. Descriptions of these values are extensively cataloged in the Wild and Scenic River Study. Relevant resources for flow and recreation focus on fishing, whitewater boating, and the aesthetics of the river, as briefly summarized below.

The fishery on the Hells Corner Reach is considered excellent; the Wild and Scenic River Report describes it as “one of the better fly fishing rivers in Oregon” (USDI, 1990). Fish are generally larger rainbow trout than in the J. C. Boyle Bypass Reach, but smaller than the trophy-sized fish in the Keno Reach. The largest fish may run 16 to 18 inches, with an average closer to 12 to 14 inches (Pers. Comm., Smith). Mid-1980s studies completed by the City of Klamath Falls as part of the Salt Caves proposals suggest that densities of rainbow over 7.8 inches between J. C. Boyle Powerhouse and Frain Ranch were 890 fish per mile, with populations in the gorge estimated at over 1,900 fish per mile (USDI, 1990). These compare with densities of 1,500 fish per mile on the Lower Deschutes, widely recognized as among the most productive wild rainbow fisheries in Oregon (USDI, 1990).

The rapids on the reach can be quite steep, with boulders that generally range in size from beach balls to small cars. The rocks are basaltic, notoriously angular, and are generally resistant to erosion. Resultant rapids can create chaotic hydraulics and unusual rock placements in the drops. According to the Wild and Scenic River Study report (USDI, 1990), there are 25 Class II, 16 Class III, 3 Class IV, and 2 Class V rapids on the river. Rapids are generally continuous in the gorge (all of the harder rapids except for three Class III drops are in the gorge), but they are more pool/drop in character outside of the gorge. Most of the rapids on the river have been named, described, and rated in various guidebooks (Quinn and Quinn, 1983; Keller, 1998; Willamette Kayak and Canoe Club, 1994; Cassady and Calhoun, 1995; and Holbek and Stanley, 1998).

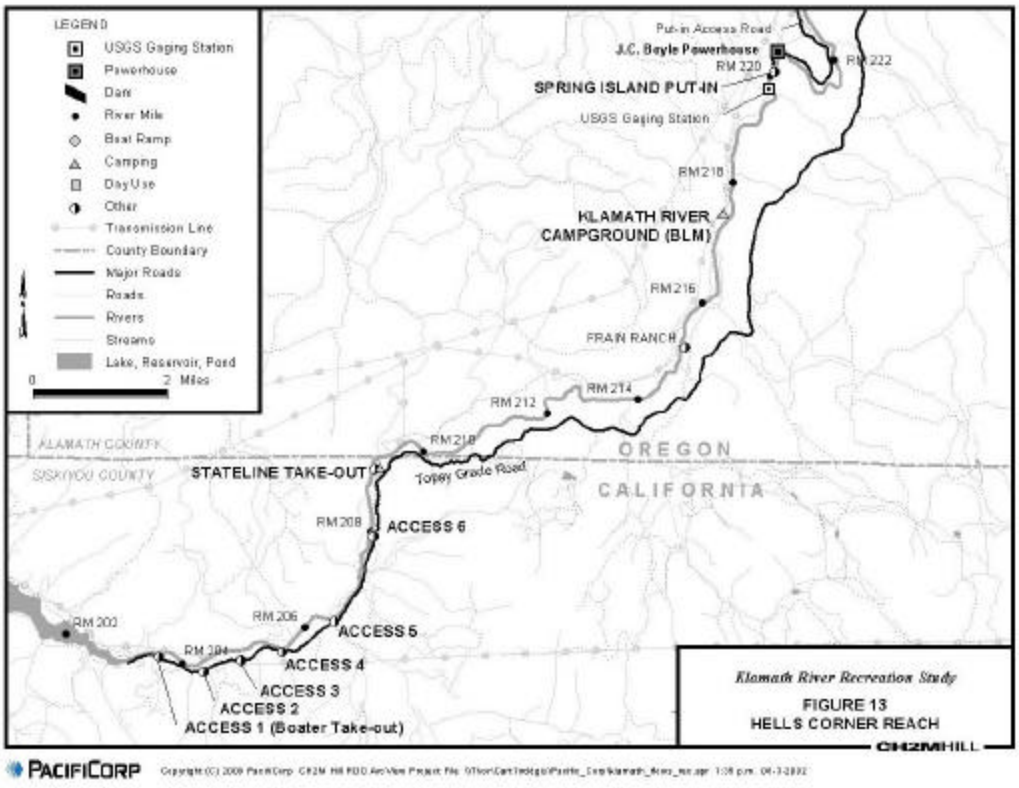


Figure 13. Map of the Hells Corner Reach

The segment's landscape features limited development associated with the hydroelectric project and some ranching activity. Below the vicinity of the powerhouse, the only signs of development are gravel roads, ranching buildings or fences (some active; others historical), and a few remnant bridge pilings or low head diversion weirs on the lower river. There are also several recreation facilities at boater and angler access sites on the river (e.g., toilets, informal parking and camping areas, fire rings, etc.).

BLM has actively managed the river since the advent of increased recreation use about 25 years ago. Facilities include the boater put-in downstream of J. C. Boyle powerhouse (at Spring Island), which features paved parking, associated picnic sites, changing rooms, and toilets. Camping is not permitted at this location. BLM also operates the Klamath River Campground, a 3-unit developed campground downstream from the put-in. BLM is currently involved in developing a River Management Plan and EIS for the Upper Klamath River, including the designated reach. Information collected for this study about management issues is being shared with BLM and has been included in Appendix C.

Dispersed camping and day use occurs on property owned by the BLM and PacifiCorp along the river. BLM and PacifiCorp are working collaboratively to manage these dispersed camping and day use areas. PacifiCorp also has developed six public fishing access points along the south side of the river, adjacent to a county-maintained gravel access road (Ager-Beswick; Topsy Grade). All of these access points were provided through a voluntary agreement with California

Department of Fish and Game by PacifiCorp and are not currently associated with the Project license.

4.4.1 Interview Sample Profile

Interviews with 33 recreation users provided information on the Hells Corner Reach; 30 reported about boating and 17 reported about fishing. Brief summary information about the boating and fishing samples is provided below. Information from these interviews provided the basis for most of the findings presented for Hells Corner.

4.4.1.1 Profile of Boating Sample

- Of the 30 boaters who provided Hells Corner information, 21 were guides or outfitters (hereafter labeled simply "guides"), 7 were private boaters, and 2 were from agencies (Forest Service and BLM).
- Of the 30 boaters, 22 used rafts most often on their Hells Corner trips, while 8 most often used kayaks.
- The median number of total trips on Hells Corner (ever) was 30 for private boaters and 100 for guides. Four guides reported 1,000 or more trips on the river.
- The median number of trips per year on the reach was 8.5 for private boaters and 28 for guides.
- The median number of years of experience boating on any river was 18.5 for private boaters and 20 for guides. The median number of days boating each year was 40 for private boaters and 100 for guides.
- 75% of the private boaters reported having Class V skill levels, with the remainder reporting Class IV skills. Among guides, 89% reported Class V skill levels.
- About half of the sample reported familiarity with multiple types of craft on Hells Corner (4 of the 8 private boaters, 9 of the 20 guides, and both agency staff). Craft types included kayaks, rafts, inflatable kayaks, and driftboats (used above the gorge only).
- Among guides, 15% reported that they typically operate paddle rafts with a stern drive rowing frame, 15% reported that they typically run paddle trips only, and the remaining 70% run both types of rafts.
- Among guides, about 62% also reported guiding trips on other rivers in California, Oregon, or Idaho. Of those, the median percentage of business associated with the Hells Corner Reach was 29%. However, this ranged from about 3% (Pers. Comm., Welch) to 98% (Pers. Comm., Pribble), and readers should note that the sample was not focused on representing all Upper Klamath outfitting businesses (we targeted guides from the higher use companies because we assumed they would have more experience on the river). Other rivers commonly guided by Upper Klamath commercial outfitters include: Rogue, Lower Klamath, California Salmon, Smith, Scott, Upper Sacramento, Owyhee, Idaho's Main Salmon and Middle Fork Salmon, and the South Fork American.

- The median age of boating interviewees was 45 (youngest was 22; oldest was 66).
- The median number of miles from home/headquarters to the Hells Corner put-in was 60, although the range was from 3 to 150. About 84% of the sample lived or worked within 100 miles of the put-in.

Taken together, this information suggests that the interview sample has considerable experience boating on rivers and particularly the Hells Corner Reach, with most boaters coming from the local area (within a two hour drive).

4.4.1.2 Profile of Fishing Sample

- Of the 17 interviewees who provided fishing information, 13 also take whitewater boating trips on the segment, while 4 were focused more specifically on fishing (Pers. Comm., Swisher, Fortune, Smith, and Ostenson).
- Among those four, Swisher is a guide and fly shop operator from Ashland; Smith is a biologist with ODFW; Ostenson operates a fly shop in Klamath Falls; and Fortune is on the board of directors of the KCFC. With help from Fortune, we also received consensus information from seven board members of the KCFC about Hells Corner fishing.
- Among the boating anglers (those who fish but also take whitewater trips), 2 were private boaters, 9 were guides, and 2 were agency personnel.
- Among the boating anglers, the median number of trips on Hells Corner was 300, and the median number of years boating on rivers was 18.5.
- The median age of fishing interviewees was 46 (the range was from 22 to 59). This does not include age information from Fortune or Smith.
- The median number of miles from home to the river was 50 (slightly closer than for boaters).

The fishing sample is smaller and includes considerable numbers of anglers who also boat (and thus may under-represent anglers who do not), but it also includes some highly experienced anglers, people with considerable contact with other anglers (shop owners, board members of the Klamath Country Fly Casters [KCFC] and the ODFW fish biologist), and several people with considerable experience on the segment.

4.4.2 Recreation Opportunities

4.4.2.1 Fishing

As noted above, the Hells Corner Reach offers excellent trout angling opportunities, although they may not be as superlative as those on the Keno Reach. There are abundant fish in the 7 to 16 inch range, with the most common size around 12 to 14 inches (Pers. Comm., Smith, KCFC board letter, Ostenson, Kauffman). The fish below the J. C. Boyle Powerhouse appear to be generally larger than in the Bypass Reach, although they may not be as abundant (Pers. Comm., Smith, Swisher, Ostenson). Only one angler (Pers. Comm., Pribble) reported his guides preferred

fishing in the Bypass reach over the Hells Corner reach. Fisheries studies as part of relicensing may quantify these potential differences.

Oregon fishing regulations allow anglers to keep one fish per day in fall, winter and spring, but the river is catch and release during the summer (June 15 to Sept. 30). No bait is allowed, and anglers appear to use both flies and spinners in roughly equal proportions (Pers. Comm., Smith). Many anglers wade in the river while fishing (particularly fly anglers), but others fish from the shore (Pers. Comm., Smith, Swisher, Ostenson). A few anglers may fish the reach by boat (Pers. Comm., N. Hague, Swisher), usually from rafts. At least one guide has used a driftboat, but he only ran the section from Spring Island to Frain Ranch (Pers. Comm., Swisher).

Access to the upper part of the reach can occur along gravel roads on both sides of the river. The majority of Oregon anglers fish the two to three miles of river in the vicinity of the Frain Ranch, which is at the top of the gorge about five miles below the powerhouse (Pers. Comm., Smith, Fortune, Swisher, Kauffman, Walters). A few anglers may also fish in the gorge (usually gaining access by walking, or via mountain bikes or ATVs, although some may fish while taking whitewater trips). There are informal angler trails to the river from the Topsy Grade Road, which deteriorates into a rugged four wheel drive road between Frain Ranch and the Stateline Access turnoff in California. Access to the California parts of the reach are from Topsy Grade road, and include the six access points developed by PacifiCorp; of these, one guide reports that more use occurs at Access 6 and 5 than the others (Pers. Comm., Kauffman). In general, more use appears to occur on the Oregon segment (Pers. Comm., Ostenson).

4.4.2.2 Boating

The Hells Corner Reach offers well known Class III to V rafting and kayaking whitewater opportunities that are boatable at medium to high flows provided by peaking flows from J. C. Boyle Powerhouse. Different flows from the Powerhouse appear to create at least two distinct types of boating trips. A “standard” trip is available at medium flows (1500-1750 cfs total in channel) and does not feature the large and powerful hydraulics that occur at higher flows. This trip is generally the choice for boaters with appropriate skills (Class IV-V boaters), who are not necessarily interested in testing beyond those skills. At these flows, runs feature more rock-dodging and “technical” routes through the rapids.

High challenge trips occur when additional flows raise the power of the river by an order of magnitude; these are the focus for highly skilled boaters (solid Class V boaters) who are interested in more challenging water. At these flows, rapids are more continuous and the major challenges are associated with powerful hydraulics and large waves rather than rock-dodging.

A third type of opportunity might be labeled a “technical” or low flow trip. This type of trip occurs at distinctly lower flows than standard trips, and has even more rock-dodging and technical routes. These trips may increase pinning/wrapping hazards, and include some level of boatability problems (hits, stops, and boat drags). Most boaters would prefer standard or high challenge trips, but might take these low flow trips to gain access to the canyon if higher flows aren’t available. They also may take smaller craft (kayaks, inflatable kayaks, and small rafts or catarafts [under 13 feet]), or rig their boats differently to facilitate this type of trip (e.g., run

paddle trips only, load more lightly). Additional discussion of this trip and its flow needs are given in the next section.

Boating generally can occur year round, and some interviewees reported taking at least some trips in every month of the year. However, most trips occur in the warmer times of the year from March/April through October. The median reported earliest and latest months for guided trips was April to September, while the median reported "prime season" for guided trips was from June through August. Among private boaters, the median earliest and latest months for trips was March through October, while the median reported "prime season" was from July through September. In general, these data suggest that the private season may be slightly longer and later than the guiding season.

Private use probably comprises less than 10% of the total use on the river (when asked, 12 of the 30 boaters offered estimates of the percentage of private use, and all but one reported 15% or less; the median response was 10%). One guide (Pers. Comm., Kauffman) noted that weekend use might be as high as 20% private, but that weekday use was 90 to 95% guided. BLM annual use statistics are discussed in greater detail below.

Most boating trips on Hells Corner over the years have been day trips, although there was slightly more overnight than day use in the past. About 54 percent of all trips from 1982 to 1988 were overnighters, compared to about 12% in the past seven years and only 7% in 2001.

The most common day trip for rafters is from Spring Island to Access Number 1, the full 17 mile trip. However, shorter trips are offered by many guides when power generation schedules limit the time higher flows will be available; these trips may end at Stateline (an 11 mile trip) or Access Number 6 (a 12 mile trip). Additional information about flow effects on trip timing is discussed in greater detail later in the report.

When commercial overnight trips are offered, boaters typically run from Spring Island through the gorge to Stateline on the first day, and then camp there or travel back upstream on the Topsy Grade and camp at Frain Ranch. On the second day, they re-run the gorge and continue to the end of the segment. These "double run" trips provide passengers two runs through the most exciting whitewater, and allow outfitters to leave camping gear in vehicles rather than having to carry it on rafts (lightening boats and providing more room for clients). In the past, a few outfitters offered three or four day trips on this schedule (but only 2% of all trips).

A few outfitters have also offered more traditional overnight trips where they carry all camping gear and food, and thus do not take two runs through the gorge (Pers. Comm., Lee, Munroe). These trips typically run from Spring Island to Access Number 1, and they camp in the gorge, usually just below Hells Corner rapid. Gear boats are often used on these trips to allow clients to travel in paddle rafts.

Private boaters (particularly kayakers) often run only the gorge section of the river from Frain Ranch to Stateline, accessing the river from the Iron Gate road and using Topsy Grade to do their shuttle (sometimes by mountain bike). This is roughly a five to six mile trip.

Most commercial trips are taken in rafts, usually 13 to 14 foot models with self-bailing floors (although the trip was pioneered in the late 1970s and early 1980s in non-self bailing "bucket

boats"). At higher flows, some commercial outfits offer trips in 15 to 16 foot rafts. Rafts are typically rigged as paddle boats (5 to 6 paddling passengers and a guide) or as "stern-drives" (5 to 6 paddling passengers and a guide in a stern rowing frame). The latter set-up allows guides to have slightly more control over the boat, particularly in high flows, although most guides acknowledge that an experienced paddle captain can usually negotiate a paddle boat as well as a stern-drive. Relatively few commercial trips offer trips in boats with standard rowing rigs (where passengers do not paddle and guides control the boat from a central rowing station). It is very rare for commercial trips to offer inflatable kayaks in the Hells Corner Reach.

Private use occurs in both rafts and kayaks, and rarely in inflatable kayaks. Rafts are typically 13 to 15 foot self-bailers, sometimes rigged for paddling but more commonly with a central rowing station. Small catarafts (up to 16 feet) are also common. A variety of kayaks are used on the river, with lower volume play boats becoming increasingly popular, especially at lower flows. At higher flows, larger volume kayaks are more common.

BLM has collected use data for the river since at least 1982; Figure 14 shows private, commercial, and total annual use on the river from 1982 to 1988 (from USDI, 1990) and again from 1995 to 2001 (provided by BLM). Data show that use increased significantly in the late 1980s, peaked in the mid-1990s around 6,000 visitor-days per year, and has fluctuated between about 4,000 and 5,000 user-days per year in the recent past. 2001 use was about 30% lower than 2000 levels, and average use levels over the past four years (4,590) are about 25% less than the average use levels from 1995 to 1997 (6,122). Additional discussion about potential Project effects on these use levels is provided below.

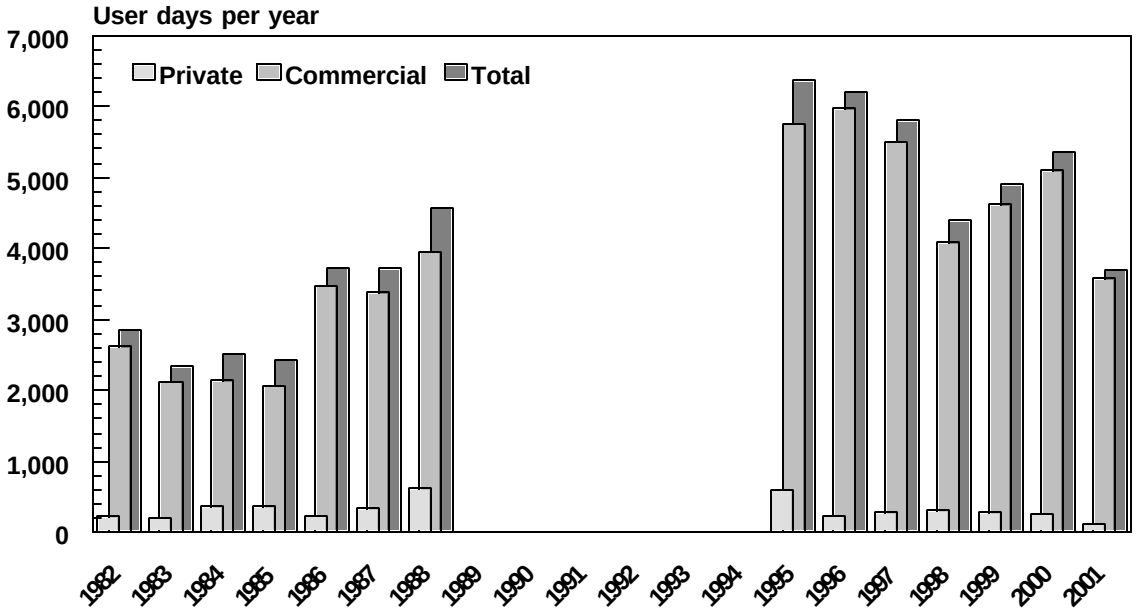


Figure 14. Annual Boating Use on Hells Corner from 1982-1988 and 1995-2001

General Riverside Recreation. Some people use the Hells Corner reach for general riverside recreation rather than for boating or fishing (e.g., walking, hiking, camping, mountain biking, hunting, berry picking). There is access on both sides of the river, and several informal trails as

well as some good off-trail hiking along parts of the river. Camping and ATV use in the Frain Ranch area appear to be common on summer weekends, and again during the fall hunting season. Water quality from UKL and irrigation run-off does not encourage swimming, but there are some inviting pools and runs for cooling off during hot summer days.

4.4.3 Flow Requirements

4.4.3.1 Fishing

Seventeen interviewees reported about fishing on the Hells Corner Reach, with four providing information focused primarily on fishing. The KCFC letter provided additional information. Interviews suggest that fishing is generally best at 320 to 350 cfs base flows (320 cfs from the J. C. Boyle Bypass Reach + accretion and tributary inflows). These flows provide opportunities to wade in the river and good pocket water in the swifter runs and rapids. They also provide better water clarity and appear to concentrate fish in deeper pools and runs (Pers. Comm., Ostenson, Smith).

Two whitewater guides who also fish (Pers. Comm., Lee, N. Hague) indicated that fishing remains good or even improves as base flows are increased by J. C. Boyle Powerhouse outflow, up to about one turbine, which may be total flows of about 1,500 to 1,700 cfs. While these flows are probably more difficult for wading anglers, the anglers who like them note that rising flows may increase nutrients in the river and stimulate feeding. Flows of this size are also needed for improved boatability for boat-based anglers.

Most interviewees indicated that flows above one turbine provide lower quality angling, although three noted that if base flows were at higher levels, both fish and people would probably adapt (Pers. Comm., Smith, N. Hague, Hale). Smith also noted that somewhat higher flows might improve the fishery from a biological perspective, and that it was the ramping from peaking flows that might be a more significant limiting factor (noting that fish studies for relicensing will hopefully sort that out). Complaints about ramping effects on fish were echoed by the KCFC board and other anglers (Pers. Comm., Ostenson, Fortune), including some whitewater guides (Pers. Comm., Lee, Munroe, Hale).

The KCFC letter reported that acceptable flows were from 350 to 1,000 cfs, with an optimal flow around 500 cfs. Averages of four whitewater boaters that provided specific acceptable ranges defined that range from base flows to 1,188 cfs. A fishing flow evaluation curve based on all information is given in Figure 12. It shows acceptable fishing dramatically improving from about 200 cfs to 400 cfs, with optimal flows between about 300 and 500 cfs. The curve then declines to marginal levels about 1,500 cfs; ratings reach totally unacceptable levels by about 2,000 cfs.

The timing of peaking flows was also an issue for several anglers and the KCFC. Some noted that evening was the best time for fishing on the Klamath (Pers. Comm., Ellis, Lee), and therefore tolerated the mid-day peaking more common in the 1980s and early 1990’s than in recent years, when peaking flows occur later in the day (and sometimes into dark). In contrast, morning anglers noted that recent later peaks allowed them to fish longer (Pers. Comm., Hale, Ostenson). Whitewater guides who also fish obviously have conflicting interests in the flows (preferring lower flows for fishing and higher flows for boating), but it appears that on some

trips (especially overnight trips) they get both and they enjoy that (Pers. Comm., Lee, Munroe, N. Hague).

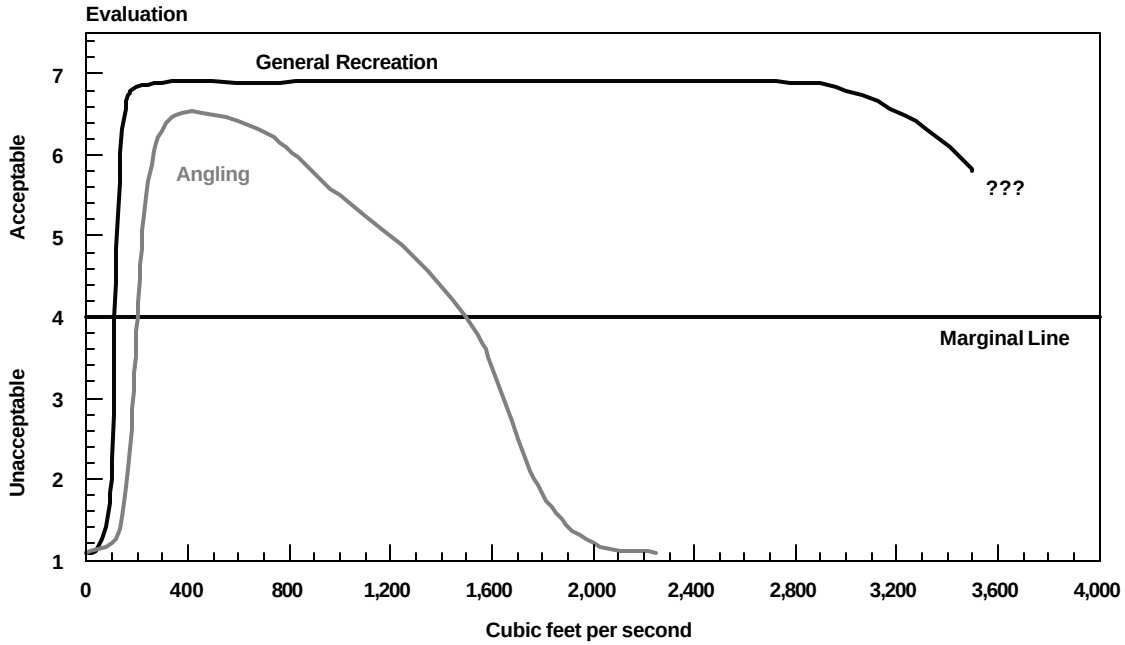


Figure 15. Flow Evaluation Curves for Fishing and General Riverside Recreation on the Hells Corner Reach

4.4.3.2 General Riverside Recreation

Based on reconnaissance, base flows about 320 cfs are likely to cover the bottom of the Hells Corner Reach channel and provide adequate aesthetics for general recreation, although slightly higher flows (about 500 cfs) might be required to provide better aesthetics. A flow evaluation curve for general riverside recreation is given in Figure 12, and shows dramatic improvement from 200 to 350 cfs, with ratings remaining high through estimated bank full levels. At that point, aesthetics might decrease marginally as the river becomes more turbid and inundates vegetation.

4.4.3.3 Whitewater Boating

Thirty whitewater boaters provided information about flow needs for boating Hells Corner. This sample size allowed for more extensive statistical analysis than for other segments and opportunities, including the development of quantifiable flow evaluation curves. The following section of the report presents results from those interviews and analyses, organized by type of question. The section also summarizes information from guidebooks and other reports.

Guidebook Flow Recommendations. Five guidebooks provide information about the Hells Corner run, as summarized in Table 5. Except for the Quinn & Quinn book, which is of older vintage (before the advent of self-bailing rafts and a dramatic evolution in skills and river running equipment), the rest of the guidebooks acknowledge the acceptability of runs at both one or two turbines (about 1,300 to 3,000 cfs). The guide most focused on kayaking notes that the

trip may be acceptable for those craft as low as 600 cfs, all the others note a starting flow of 1,200 cfs or higher. Note: the traditional cfs level equated with one turbine in all books is about 1,500 cfs, which may be an imprecise assumption (see additional discussion below).

At the upper end of the acceptable range, most books recommend flows around 3,000 cfs as a cut-off. Some guidebook authors are obviously more conservative than others about recommending higher flows, but it is notable that most of the guidebooks rate the reach Class IV+ rather than Class V, except at very high flows. This provides support for our distinction between "standard" and "high challenge" trips.

None of the guidebooks discuss the availability of low flow technical trips, even though Holbek and Stanley report that 600 cfs is boatable (although they recommend going at two turbines). Boaters clearly prefer flows higher than minimum boatable levels in Hells Corner, and several guidebooks highlight the safety issues and equipment wear-and-tear that can result from encounters with the river's sharp, angular volcanic rocks.

Table 5
Summary of Guidebook Flow Recommendations for Hells Corner

Guidebook	Acceptable Range	Optimal Range	Notes
Keller (1998)	1,500 to 3,000	1,500	Recommends late summer use. Rates rapids Class IV+ except at high water.
Soggy Sneakers (2001)	1,200 to 3,400	1,500	Class V at two turbines.
Holbek & Stanley (1998)	600 to 3,000	3,000	Rates rapids Class IV+. Notes poor clarity, sharp volcanic rocks, oddly-placed rocks.
Cassady & Calhoun (1995)	1,400 to 3,000	1,500 to 2,700	Rates rapids Class IV+.
Quinn & Quinn (1983)	~1,650		Provides extensive historical and natural history information. Suggests two turbines is "too dangerous to run."

Flow Recommendations/Requirements from Reports. The Oregon Water Resources Department conducted a Scenic Waterway Recreation Analysis for the Upper Klamath in 1990, part of the Salt Caves proposals and subsequent studies (Oregon State Parks and Recreation Department, 1990). The study included an assessment for recreation stream flow, the fundamental task in this present report. In general, however, their primary sources were other reports and letters from the BLM and six rafting outfitters.

This document notes that 380 cfs is necessary to run rafts from Spring Island to the top of the gorge (based on City of Klamath Falls Salt Caves report, 1988), and that 1,500 cfs is the minimum raftable flow for the reach in general (quoting a BLM letter, 1989). Guide information ranged from minimum levels of 1,200 cfs to 1,800 cfs, often with accompanying descriptions of those flows. In general, excerpts from these sources suggest that flows less than 1,500 cfs are less exciting and have greater navigation hazards for rafts, and that higher quality trips occur at

flows above 1,500 cfs. The high end of the range (5,900 cfs) was determined from a single high flow trip taken by Noah Hague.

Final recommended flow needs for boating in Hells Corner in this report were 1,500 to 3,200 cfs for "general" boating, and 3,200 to 5,900 cfs for "expert" boating. Season of use for general boating was from May to September; expert boating was described as potentially occurring year-round.

The report also offers information about required flows for fish and fishing, including summaries of ODFW responses to Salt Caves proposals regarding minimum flows. These note that best fishing flows may occur during periodic maintenance periods for J. C. Boyle Powerhouse, which typically result in flows about 650 cfs. A Tennant (1976) analysis also showed that flows about 570 cfs would be a minimum continuous flow for the reach. Fisheries studies conducted for this re-licensing are likely to offer more precise information about these issues. The final flow recommendation for fishing was 550 to 3,000 cfs.

Gage Use. Every boating respondent reported that they pay attention to flows on the river, and over 70% reported that they know flows in terms of both turbines and cfs. Another 23% say they only know flows in terms of turbines, while the remaining 7% know only cfs.

Most boaters (84%) get their flow information from PacifiCorp's flow phone (56%), web page (12%), or both (16%). Only one reported consulting USGS flow information from web pages (e.g., USGS, Pat Welch's Oregon flows page). However, others (12%) hear about flows by word of mouth or after arriving at the put-in and looking at the staff gage (which crudely registers 1 and 2 turbines only).

PacifiCorp currently reports J. C. Boyle outflows for three days in advance during the main recreation season. When asked, 67% of respondents thought this provided an acceptable time frame for forecasting flows. However about 17% reported that they would prefer forecasts for a week in advance, and one outfitter noted that he needed to know flows nearly four months in advance to use the information for scheduling tips.

In contrast to PacifiCorp data, USGS-based information focuses on instantaneous information from the recent past and does not forecast any future flows. As flow information sources, both have potential problems for boaters or flow researchers trying to determine what flows have been or are going to be.

First, not all boaters may understand that PacifiCorp outflow amounts do not equate with total flow in the channel (which is what the USGS gage provides). An additional 320 cfs base flow is already in the river from J. C. Boyle Bypass Reach throughout the year, spill levels through that reach may be even higher, and there is some accretion in the segment before the major rapids. The PacifiCorp flow phone and the webpage both note this additional base flow amount, but it is unclear if all boaters add this. Some interviewees reported flows around 1,200 or 1,250 cfs in various contexts, and we suspect at least some were confusing 1,200 cfs outflows from J. C. Boyle Powerhouse (a common amount) with the total flow in the river (which is rarely at 1,200 cfs for long, generally occurring for short periods on the way up or down from one turbine; see below).

A second problem is that guidebooks and convention suggest that each turbine has a maximum flow capacity of 1,250 cfs (total 2,500 cfs), while the reality is more complex. As discussed in the hydrology section of this report, Unit 1 can generate more power and produces 1,200 to 1,425 cfs outflows, depending upon the level of J. C. Boyle Reservoir; Unit 2, in contrast, can only generate 800 to 1,100 cfs. Unit 1 offers greater efficiency and it is generally used first. This means that one turbine does not always provide 1,250 cfs, and commonly will provide 100 to 200 cfs more. Conversely, when Unit 2 is added, total outflows may be less than 2,500 cfs. This may confuse some boaters who think largely in terms of turbines alone, as "one turbine flows" typically range from 1,200 to 1,425 cfs (1,520 to 1,745 cfs in channel), and two may range between 2,000 and 2,525 cfs (2,320 to 2,845 cfs in channel). Some guides appear sensitive to this and distinguished between a "skinny turbine" (at or below about 1,500 cfs in channel) vs. a "fat" or "juiced" turbine (over about 1,600 cfs in channel).

Finally, during winter and spring spill periods, estimates of Hells Corner flow based on turbine outflows is likely to be imprecise because there may be more than 320 cfs coming down the Bypass channel. In these cases, USGS data is probably more accurate, although they do not project into the future for trip planning.

Knowledge of Flow Levels. Despite these potential problems, boaters appear very confident of their ability to calibrate conditions on the river with flows they receive from gages or power forecasts. We asked boaters to estimate their accuracy at guessing the flow after taking a trip without knowing flows ahead of time. Of the 82% who answered this question, 74% reported that they would know cfs within 20% of the actual amount, and 44% reported they would know it within 10%. Of the remainder, 7% reported that they might not know the cfs, but they could describe whether the flow was from one or two turbines, and another 11% reported that they probably could identify whether it was one or two.

Highest and Lowest Flows Boated. The Hells Corner Reach has been boated at or near base flows (about 350 cfs) in kayaks (Pers. Comm., Kauffman) and rafts (Pers. Comm., Lee, Hale), but no one suggested that these flows provided a quality whitewater experience. The median "lowest flow" seen by all boaters was 1,200 cfs, suggesting that most boaters have relatively little familiarity with flows below one turbine. Several other boaters reported that they have run the top of the reach to Frain Ranch at base flows, or have finished the trip from Stateline to Access 1 as flows were dropping substantially below one turbine, but most wait for better flows or try to "ride" better flows when in the gorge.

The highest flow reported by any boater was 7,000 cfs (Pers. Comm., Munroe) with several other boaters reporting trips between 5,000 cfs and 6,700 cfs (Pers. Comm., Lee, N. Hague, Pribble, Ellis). Most of these were guides on private trips. The median "highest flow" reported was 3,400 cfs, which indicates two turbines plus some spill from J. C. Boyle Bypass.

Minimum Boatable Flows. Boaters were asked to specify the lowest flow that would allow a boater to use the river for transportation, a level we have labeled "the minimum boatable flow." This type of trip may be arduous and involve some boatability problems, but still provides access to the canyon. The median response to this question for all boaters was 1,100 cfs, although some boaters reported flows as low as base flows and others were as high as 1,500 cfs; the inter-quartile range of responses was between 900 and 1,200 cfs, a likely range for identifying this

threshold. Variance in these results was not attributable to craft types (rafts vs. kayaks) or type of boater (commercial vs. private). It appears that some respondents simply believe it is possible to get down the river at lower flows than others.

Notably, 75% of the respondents reported that they would not take a trip in Hells Corner at these minimum boatable flows, with another 4% reporting that they might take a trip and 21% saying they would. Flows that simply provide access to the canyon do not provide the same kind of whitewater experience that most boaters are seeking.

Flow Evaluation Curves for Standard and High Challenge Trips. Boaters were asked to rate six specific flows on the Hells Corner Reach for two different types of opportunities (standard, high challenge) on a scale of 1 (totally unacceptable) to 7 (totally acceptable), with a "marginal" mid-point. The six flows given were:

- Base fish flows (about 350 to 400 cfs in the channel, 0 cfs from powerhouse)
- Half a turbine (about 900 cfs in the channel, 600 cfs from powerhouse)
- A full turbine (about 1,500 cfs in the channel, 1,200 cfs from powerhouse)
- A turbine and a half (about 2,100 cfs in the channel, 1,800 cfs from powerhouse)
- Two turbines (about 2,900 cfs in the channel, 2,500 cfs from powerhouse)
- Over two turbines (about 3,500 cfs in channel, 2,500 cfs from powerhouse + spill)

Flow evaluation curves for all boaters for standard and high challenge trips are given in Figure 16. These curves show a classic bell-shape, and help identify when flows are acceptable and optimal for two opportunities that appear to have slightly different flow needs.

Based on these data, standard trips are sub-marginal until flows reach about 1,100 cfs, but small amounts of water at those levels may substantially improve quality (the curve rises steeply). By about 1,500 cfs (one turbine), flows are near optimal, but quality still improves slightly with more flow until about 2,500 cfs. Above this flow, standard trips begin to decline toward marginal levels, but even 3,500 cfs was rated acceptable. For high challenge trips, the flow evaluation curve essentially shifts to the right about 200 to 300 cfs at low to medium flows, and peaks at flows about 500 cfs higher than standard trips. As expected, high challenge trips require more water.

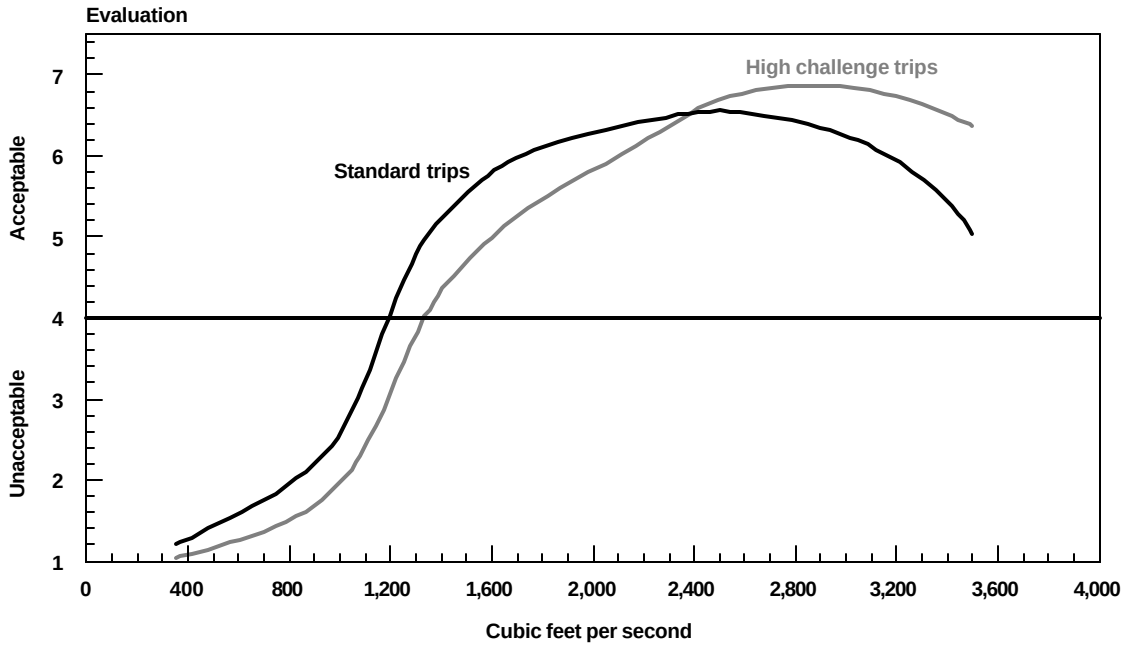


Figure 16. Flow Evaluation Curves for Standard and High Challenge Trips for All Boaters on Hells Corner Reach

Specified Flows for Standard, High Challenge, and Technical Opportunities. For various opportunities, boaters were also asked to specify the flows that define acceptable ranges, optimal ranges, or single optimal flows. Figure 17 shows "range bars" defined by median specified flows for technical, standard, and high challenge trips. The figure also shows the flow evaluation curves given in Figure 16 for comparison purposes.

Specified flow information shows that "range bars" are slightly more compressed than ranges implied by flow evaluation curves. For example, while curves suggest that standard trips are acceptable from 1,100 cfs to 3,500 cfs (ratings above the marginal line), specified flow information suggests that a standard acceptable range is from 1,400 to 3,000 cfs. Similarly, curve ratings for high challenge trips were acceptable as low as about 1,300 cfs, while specified flows suggest that 1,700 cfs is necessary for an acceptable high challenge trip.

These are relatively subtle differences, and the general pattern of responses is similar in the standard and high challenge opportunities. Both kinds of data show there is considerable overlap between these two opportunities, implying that there is a range of flows (from about 1,700 to 3,000 cfs based on specified data) that are acceptable for both, as well as a more narrow range (from about 2,300 to 2,800 cfs) when both are near optimal. Having noted this, the median best flow for high challenge trips (2,800 cfs) is 700 cfs more than the best flow for standard trips (2,100 cfs).

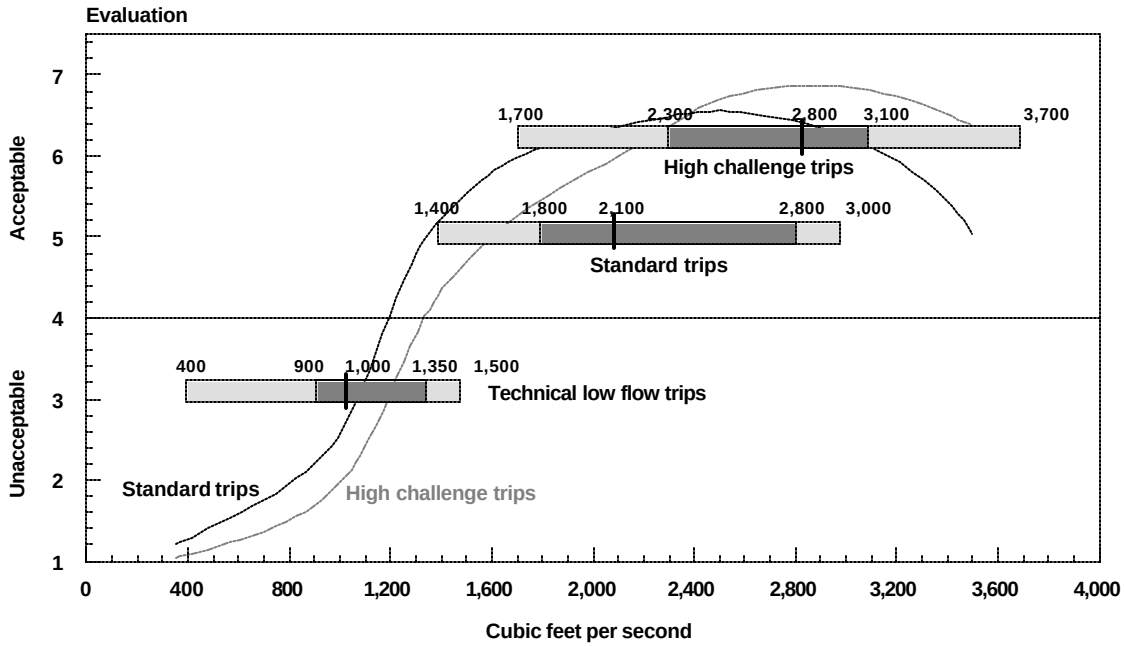


Figure 17. Flow Evaluation Curves and "Range Bars" Defined by Median Specified Flows for Technical, Standard, and High Challenge Boating on The Hells Corner Reach

Range bar results for "technical trips" illustrate the flow ranges associated with lower flow trips. The low end of the acceptable range for technical trips (400 cfs) is actually lower than the median minimum boatable flow (1,100 cfs). This is partly due to smaller sample sizes for the technical trip questions (n=5; Lee, Kauffman, Lewis, Cochran & Wiedenbach), which were only asked if boaters reported interest in those types of opportunities. Because most people prefer the higher flow standard or high challenge opportunities (and 75% wouldn't go at minimum navigable flows), the technical opportunity data is somewhat limited.

Having noted these caveats, these data support our conceptualization of technical trips as a second-best choice if standard flows are not available. The acceptable range for technical trips ends as standard trips become acceptable, and the optimal range for technical trips is in the higher end of the acceptable range. Some people may still take these trips if flows are low and unlikely to increase, but they would clearly prefer a standard trip.

Differences between Rafts and Kayaks. There were few important differences between commercial and private rafters for flow evaluation curves or specified flow results. However, there were interesting differences between rafters and kayakers, as illustrated in Figure 18 (shows flow evaluation curves and range bars for standard trips for both craft types). In general, results suggest that optimal flows ranges for kayakers are slightly higher than for rafters, and the single best flow for kayakers (2,500 cfs) is about 500 cfs more than the single best for rafters (2,000 cfs). One possible explanation focuses on the continuous nature of the gorge rapids at higher flows, which may be more difficult for rafts than kayaks (kayakers are more adept at catching smaller eddies along the banks at higher flows).

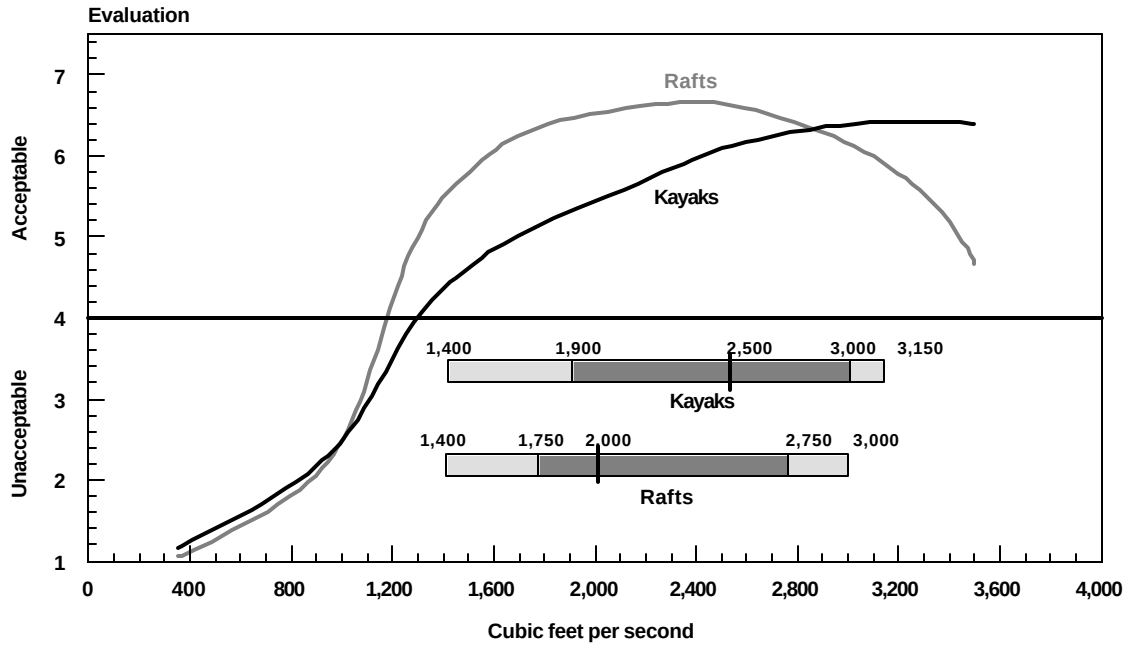


Figure 18. Flow Evaluation Curves and "Range Bars" Defined by Median Specified Flows for Standard Trips for Rafts and Kayaks

Trips Under One Turbine. Possible changes in Project operations could substantially limit the number of days when one "full" turbine or more is provided (e.g., if fisheries enhancements require less peaking, lower peaks, and/or higher base flows). Accordingly, researchers asked boaters whether they currently took trips down the Hells Corner reach at flows below one turbine, and if not, could they do so in the future if that was all that was available some of the time.

Only 18 out of 30 were willing to answer these questions (the remaining 12 (40%) simply were not interested in considering these types of trips). Responses reflected answers given to the specified flow questions for technical trips and minimum boatable flows, but with more qualitative information about what types of boats and trips that could be offered at flows under one turbine (1,400 cfs).

Of the 18 who answered these questions, 13 were outfitters, 3 were private boaters, and 2 were agency personnel. Among the commercial outfitters, 38% reported that they had been on trips of this sort or could take them in the future, 38% said they could take these types of trips but would not offer them commercially, 15% reported that they might be able to take them but they would need to see the precise flow levels, and 8% flatly stated that they would not be commercially viable. Among the private boaters, two reported they might take such trips, and one said he would not. The two agency staff reported they could take these types of trips.

Among those who said trips under a turbine were possible, comments focused on the need to use different craft and take less people. One outfitter noted that "we've been spoiled having [1,500 cfs] for 13 and 14 foot boats, which are safer and carry more," and suggesting that 10 to 12 foot boats with two to four passengers might make lower flows boatable. Another rigging suggestion for "under one turbine" trips included having clients wear wetsuits for protection from rocks in

case of a swim even in summer (several guides reported that lower flows increased the risk of passengers falling out of the boat as rafts hit exposed rocks).

Among those who reported that "under one" trips were not possible or commercially viable, comments focused on 1) safety and liability issues (passengers falling out of boats, less water for missing rocks if a passenger swims); 2) equipment damage (from more contact with the sharp rocks); 3) the lack of powerful hydraulics and bigger waves; and 4) the change in profitability from having fewer passengers per raft as necessitated by lighter or smaller boats.

Flow Timing Issues. A final flow issue focused on the timing of peaking flows, which has been the major complaint of outfitters following the 2000 and 2001 seasons. In those years, peaking flows were generally provided later in the day, particularly in July and August, the prime boating season (see previous hydrology section for details). To help understand this issue, boaters were asked questions about common lengths of trips at one and two turbines, the time commercial boaters take for hiking or lunch breaks, the preferred time of day for taking out, and whether they would be willing to take shorter trips if flows were not available for longer ones. Researchers also asked boaters the earliest they might start their trips before one full turbine was provided (assuming ramping from base flows to 1,500 cfs takes three hours), noting that some outfitters do not require a full turbine to run the five mile reach before Frain Ranch (they can have lunch or hike in that area while waiting for the water to arrive). Results for these questions are given in Table 6.

Results suggest that most day trips from Spring Island to Access 1 take about four to five hours (not including lunch), with "one turbine" trips taking about a half hour more than "two turbine" trips. Most commercial outfitters take about an hour for lunch or hiking, making the entire put-in to take-out time about five to six hours. Private boaters (particularly kayakers) often run only from Frain Ranch to Stateline (the gorge segment) and typically take about two hours to make this shorter run.

Preferred take-out times ranged from 2:30 p.m. to 6:00 p.m., but 4:30 p.m. was the median response. The earliest time was for a Klamath Falls outfitter who reported that his return from the take-out is substantially longer than for Ashland outfitters. Ashland outfitters were also specifically asked what time they had to take-out to return clients to Ashland in time for Shakespeare Festival theatre obligations; responses ranged from 4:30 p.m. to 5:00 p.m., but were accompanied by reports that these late take-out times constrain the time clients spend at the Copco Store or to order photographs from WOA (an agency that photographs boaters as they run through a rapid in the gorge and then offers them for sale).

Table 6
Responses to Trip Timing Questions for Hells Corner Reach

Question	Median (hrs:mins)	Range (hrs:mins)	Comments
Length of trip at 1,500 cfs	4:30	3:45 to 6:30	Spring Island to Access 1
Length of trip at 3,000 cfs	4:00	3:25 to 5:00	Spring Island to Access 1
Typical break time	1:00	0:45 to 1:30	Includes lunch, hiking (not short scouts)
Length of trip at 1,500 cfs (kayakers)	2:12	1:30 to 2:30	Frain Ranch to Stateline
Preferred latest take-out time	4:30	2:30 to 6:00	Assumes day trips.
Latest take-out to return clients to Ashland for theatre	4:30	4:30 to 5:00	Relevant for Ashland area outfitters only. May not allow preferred time at Copco Store or to order photos from WOA.
Hours before flow peak you are willing to start trips	0:55	0:00 to 2:00	Boaters putting in at Spring Island only.
Percent has taken / willing to take shorter trip if necessary	47%	--	Assumes take-out at Stateline or Access 6.

Because it is possible to run to the top of Caldera Rapid (the start of the gorge) on less than one turbine, some boaters put-in at Spring Island in front of the peak to 1) avoid crowding, 2) simply start their trips earlier, or 3) be the first trip on the river and thus receive the best wildlife viewing. The median time that boaters were willing to leave in front of the peak was just under an hour and no boater was willing to go more than two hours before.

A parallel question focused on the latest hour that boaters would be willing to put-in if they knew that flows were about to ramp down to base flows by 5 p.m. Most boaters had difficulty expressing quantifiable answers to this question, with some reporting that they just “stay on the wave.” Among boaters providing more quantifiable responses, most indicated that few problems occur as long as boaters start through the gorge about an hour before down-ramping occurs (assuming they have no rescue situations or other delays).

Taken together, timing information suggests that boatable flows provided from about 10 a.m. through 4:00 p.m. would be ideal for most boaters. This would allow staggered put-ins starting as early as about 9 a.m. (thus ameliorating crowding), and ensure that most trips started before noon could take-out by 5 p.m. For private boaters taking trips through the gorge only, trips could probably start as late as 4 or 5 p.m. With later peaking flows in recent years, the 10 a.m. peak is less frequently provided than in the past; in general, this is the most common complaint by commercial outfitters about PacifiCorp operations.

Based on these data, providing 1,500 cfs by 10 a.m. would be ideal. However, flows that peaked by 1 p.m. would probably still allow most outfitters to provide day trips on an acceptable schedule (because they could start up to an hour before the peak, lunch or hike at Caldera while waiting for higher flows, and still take out about 4 or 5 p.m.). If peaks do not appear by 2 p.m., outfitters warn clients that they will not be able to make evening plans and take-out times shift

into the early evening (5 to 7 p.m.). A few outfitters reported that these schedules also increase safety risks, as delays in the gorge for rescues could mean boating in the dark.

Overnight Camping Issues. Later peaking flows during recent years also potentially affect overnight trips, particularly since most overnight boaters take "double runs" through the gorge (see recreation opportunities above for a description). People camping at Frain Ranch have to wait about an hour after peak flows are provided at J. C. Boyle Powerhouse to begin running the gorge, so post-noon peaks mean overnight boaters do not start boating on their second day until the middle of the afternoon. Some outfitters reported that this provides a lot of "down-time" in camp for most boaters interested in a whitewater trip.

Use data support the notion that later peaks may be affecting the numbers of overnight trips. BLM commercial use data from 1982-1988 (from USDI, 1990) and from 1995-2001 (provided by BLM) helps characterize the proportion of single-day versus multi-day trips (Figure 19). In the 1980s, the number of outfitted overnight trips approached about 100 per year, while by the mid-1990s that number rarely exceeded 50 trips. In 2001, there were only 21 commercial overnight trips. Comparable data for private boaters from 1982-1988 is not available, but records from 1995-2001 suggest that only 11% of all private trips were overnight trips (and none in 2001).

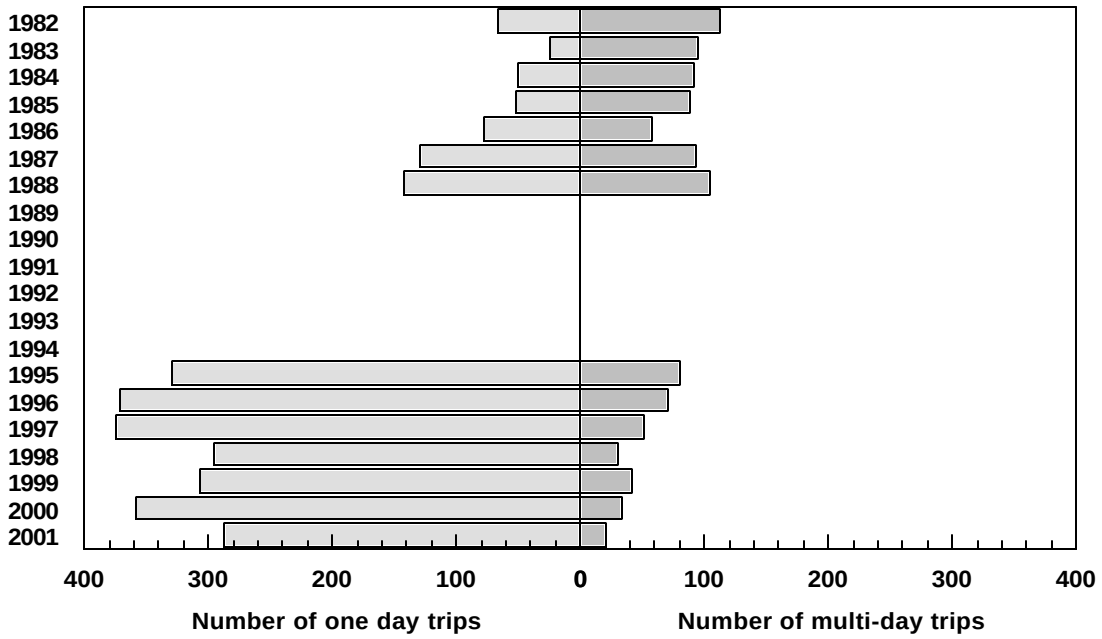


Figure 19. Number of One-Day and Multi-Day Commercial Boating Trips on the Hells Corner Reach from 1982-1988 and 1995-2001

Over two-thirds (68%) of the Hells Corner interviewees reported having taken camping trips and most reported they might take such trips in the future. Nearly all expressed preferences for the "double run" trips through the gorge, and most avoid scheduling trips if they expect peaks to be unavailable until the afternoon. A few outfitters, in contrast, report that it is possible to take

overnight trips regardless of when peaking flows will be available by simply planning more non-boating activities (Pers. Comm., Lee, Munroe)

4.4.4 Project Effects

As discussed in the hydrology section, flows in the Hells Corner reach are strongly influenced by Project effects. While flows during wet periods in winter and spring are probably similar to those that would exist without the Project, flows in dry year winters and springs and during summer/fall are enhanced by peaking flows through J. C. Boyle Powerhouse. Because of UKL storage, the Hells Corner reach has periods of higher flows in summer and fall than would be provided without the PacifiCorp and USBR projects. Because of PacifiCorp peaking operations, however, these periods of high flows are balanced by periods of base flows that are probably lower than would occur without the projects.

These daily peaking events during drier periods generally have small effects on general recreation, but substantially determine the frequency and quality of boating and fishing. In general, peaking flows of one turbine or higher provide high quality boating opportunities, while those same flows preclude quality fishing.

Predictable daily boating flows on the reach has led to the development of a substantial commercial boating industry on the river. As shown in the hydrology section of the report, there are usually less than 20 days from May through September when one turbine flows are not available, as well as many days with flows over a full turbine (above 1,700 cfs; usually in May and early June). If the Project did not exist, the Upper Klamath River would probably provide only technical boating opportunities after early summer (similar to other unregulated rivers in the general region such as the Scott, California Salmon, and Illinois).

Recent changes in the timing of peaking flows in 2000 and 2001 have also had substantial impacts on that industry. Total use levels were down almost a third from peak levels in the late 1990s, and the number of overnight trips also dropped substantially. While the shift to peaking releases later in the day certainly is a factor in decreasing use levels, other contributing factors may include the public perception that the basin-wide drought of 2001 resulted in insufficient flows, and a generally declining economy in the past year. The quality and timing of trips has also changed as peaking flows shifted until later in the day, requiring outfitters to take shorter trips, make their trips shorter, or return clients to town much later than in the past.

Effects on fishing are the converse of those for boating. Summer and fall peaking flows in the middle of the day makes fishing a morning or evening activity, and they may affect the overall health of the fishery too. As peaking flows shifted to later times in the day, anglers received more time with better conditions during the morning base flows, but less time during the evening.

4.4.5 Future Study Needs and Options

It is possible to develop more precise flow evaluation curves for all five Hells Corner recreation opportunities. This additional precision makes sense for fishing and boating, particularly for flows between base levels and one turbine. Boaters and anglers generally only observe flows

between 350 cfs and 1,500 cfs as flows are being ramped up or down, so their evaluations of those levels is very limited.

The best option for developing additional information about boating and fishing is a controlled flow study. Operational constraints on conducting such a study focus on 1) the inefficiencies associated with running a turbine at less than full capacity or 2) providing spill flows through J. C. Boyle Dam in order to provide stable flows during such a study. Assuming either can be addressed, the study could be conducted concurrently with fish, water quality, or other biophysical studies that may also require variable flows in the channel. This type of study offers the best way to understand how changes in flow regimes in the reach would affect various resources. Whitewater advocates (AW) and resource agencies (NPS and BLM) have also requested such a study, and similar studies have been commonly requested and conducted on similar reaches for other re-licensing efforts.

Planned maintenance on the J. C. Boyle diversion canal in September 2002 offers an opportunity to conduct a controlled flow study in the Hells Corner Reach concurrent to a similar study in the Bypass Reach; neither appear likely to require PacifiCorp to forgo power generation during the study. Assuming that flows of about 600 to 750 cfs will be spilled into J. C. Boyle Bypass during such a period to meet Iron Gate minimum flows (because the springs and downstream accretion will add another 250 to 350 cfs), it may be possible to provide three or four flows between 500 and 1,500 cfs for short periods; these are the key flows for developing more precise curves for fishing, technical boating, and determining the low end of the acceptable range for standard boating.

From a scientific perspective, it would also be helpful to have boaters and anglers rate flows higher than 1,500 cfs during the study, and to assess a full turbine (1,500 cfs), 1.5 turbines (about 2,100 cfs), and two turbines (2,900 cfs) just before or after the September maintenance period. It may be difficult to provide 1.5 and 2.0 turbine flows due to operational constraints (insufficient water in active storage at that time of the year), and it is less important to rate them compared to flows under 2,000 cfs. Existing data from interviews suggests that flows above 2,000 are probably within the optimal range and greater precision is unlikely to change that conclusion. However, there is still uncertainty about evaluations of 1.5 and 2 turbine flows, particularly compared to lower flows. A controlled flow study is the most cost efficient way to settle the issue, particularly if the sample and researchers are on-site and the flows can be provided in a short period of time.

Regardless of whether a controlled flow study is conducted, future operating scenarios and their likely effects on hydrology in the reach will need to be analyzed to fully describe future Project effects on recreation.

4.5 COPCO NO. 2 BYPASS REACH

This river segment is about 1.5 miles long, extending from Copco No. 2 Dam to the Copco No. 2 Powerhouse (Figure 20). The river has a gradient of approximately 67 feet per mile. At base flows (about 10 cfs is released from the dam), the river is generally a narrow single thread channel with a pool/drop character. The steeper drops sometimes have channel-wide ledges, but other rapids are created by boulder gardens, and a few may be constricted by steeper canyon

walls at higher flows. The river has relatively steep banks and a thickly forested riparian zone, although one can walk along the river's bank or low benches parallel to the stream at the 10 cfs base flows (these may be part of the channel at higher flows). Canyon walls are generally a few hundred feet above the river; the most prominent wall is at the end of the segment on river left (diverted water from Copco No. 2 runs through a tunnel in this basalt formation).

The segment has some development associated with the hydroelectric project, including the dam, a service road on river left near the top of the reach, and another service road on river right toward the end of the segment. However, the powerhouse and power lines are around the corner from the Bypass Reach, and the riparian vegetation effectively screens other development from the river. Most of the reach is owned by PacifiCorp, with a single block of BLM land.

About a half mile from the river, the Fall Creek area has a fish hatchery, powerhouse, day use area, and a short trail to waterfalls on Fall Creek. There is also a small diversion structure providing domestic water to the city of Yreka, CA. This area also features a number of interesting basalt formations.

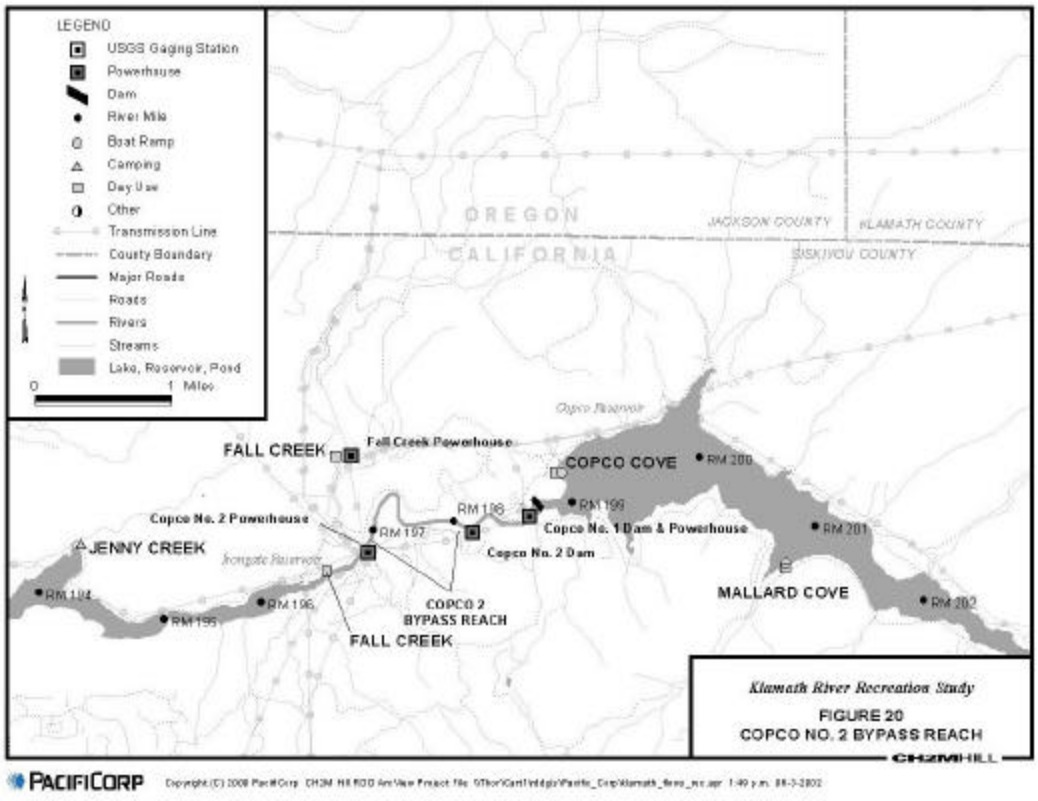


Figure 20. Map of the Copco No. 2 Bypass Reach

4.5.1 Recreation Opportunities

4.5.1.1 Fishing

Current base flows do not appear to support a game fishery in the Bypass Reach, although anglers appear to fish upstream of the dam in the short river-like Copco No. 2 reservoir, which has trophy-sized trout. If a Bypass fishery were developed, the reach would likely offer some opportunities for bank angling in pools and pocket water.

4.5.1.2 Hiking and General Riverside Recreation

There are no developed trails on the Copco No. 2 Reach, but hikers willing to wade the river and bushwhack along the shore can gain access to numerous pools and riffles at base flows (about 10 cfs). There are several places with wider views of the canyon, shade trees, and potentially good swimming holes or picnic areas. With some trail development, hikers could link trips on the Bypass Reach with hiking to the Fall Creek area, which offers interesting basalt formations and waterfalls/cascades with a few short trails.

4.5.1.3 Boating

Current base flows are insufficient for boating, but this opportunity may be available during some (rare) spill events. At least one interviewee (Pers. Comm., Cross) has scouted parts of the river during a spill (April 24, 2000; estimated flow was 1,000 to 1,400 cfs) and thought it might create Class IV opportunities. Reconnaissance suggested a similar conclusion, but this was difficult to assess from base flows. Hazards from riparian vegetation encroachment are a potential constraint on boating opportunities, although the middle of the channel generally appears free of larger trees.

4.5.2 Flow Requirements

It is difficult to evaluate flow needs for recreation on the Copco No. 2 Reach based on a single reconnaissance at 10 cfs, so we have not developed flow evaluation curves for any opportunity. We have, however, identified preliminary ranges for recreation opportunities. These estimates do not specify optimal levels and may be revised with additional information or reconnaissance focused on higher flows.

In general, the 10 cfs base flow begins to suggest opportunities for general river recreation; it is clearly sub-marginal for fishing and whitewater boating. If a fishery existed, wadeability is likely to be a key issue; based on reconnaissance, acceptable wading might exist from about 10 to 300 cfs. At higher spill flows, the rapids are likely to be too swift to negotiate and the pools might be too deep. For boating, flows about 300 cfs might start to be runnable in a kayak, but flows from 500 to 1,500 cfs are probably necessary for acceptable opportunities in kayaks or rafts. It is difficult to determine if there will be good play opportunities at those higher flows, but a couple of the ledge drops may create interesting rapids.

4.5.3 Project Effects

Recreation in this segment is substantially affected by Project operations, which generally provide 10 cfs throughout the year except during rare spill events. The frequency, duration, and magnitude of spill events is currently being summarized as part of the re-licensing hydrology study. In general, the 10 cfs provides acceptable general recreation opportunities only; boating and angling can not occur at these levels.

4.5.4 Future Study Needs and Options

There is obviously room for considerably more precision in defining flow needs for Copco No. 2 recreation opportunities, but this added precision may not be necessary. The short length of the reach diminishes its potential for high quality whitewater boating unless good play features were to appear at higher flows, thus creating a locational playboating attraction. Similarly, unless a game fishery is developed, there seems little reason to focus on a fishing opportunity that is currently absent. In contrast, there appear to be some good opportunities for hiking and associated general riverside recreation, and additional reconnaissance at slightly higher flows may help determine limitations that spill events might impose on those opportunities or trail development.

If additional information is judged important, there are two options: 1) a controlled flow study, and 2) additional reconnaissance at “demonstration” spill flows. A controlled flow study has significant operational constraints associated with dam gate functionality and the lack of upstream storage capability. A less difficult option is to have researchers conduct reconnaissance during planned or predicted spill periods; even a single visit at flows in the 200 to 1,500 cfs range would likely increase the precision of existing information by an order of magnitude.

4.6 SUMMARY OF RECREATION OPPORTUNITIES AND FLOW REQUIREMENTS

Table 7 summarizes acceptable and optimal ranges for recreation opportunities by segment. Flows based on less precise data are shown in italics, and some ranges are not specified (denoted by --) when uncertainty is too high. In all cases, these threshold flows should be considered preliminary, and may be revised based on additional information. Readers should also recognize that recreation quality generally improves incrementally with more or less flow, so thresholds are oversimplifications of the precise point when a trip becomes acceptable or optimal.

Table 7
Summary of Acceptable and Optimal Flow Ranges for Upper Klamath Recreation Opportunities

Segment/Opportunity	Acceptable Range		Optimal Range	
Link River Bypass Reach				
Fishing	100	150	200	1,000
Locational playboating	700	3,000	1,500	3,000
General recreation	100	3,000	--	--
Keno Reach				
Fishing	200	1,500	300	900
Locational playboating	1,100	1,500	1,300	1,400
Standard whitewater boating	800	4,000	1,200	3,000
General recreation	200	3,000	--	--
J. C. Boyle Bypass Reach				
Fishing	200	700	300	400
Standard whitewater boating	700	2,500	1,000	2,000
High challenge whitewater boating	1,500	4,000	2,250	3,000
General recreation	200	3,000	--	--
Hells Corner Reach				
Fishing	200	1,500	300	500
Standard whitewater boating	1,400	3,000	1,800	2,800
High challenge whitewater boating	1,700	3,700	2,300	3,100
Technical whitewater boating	400	1,500	900	1,400
General recreation	200	3,500	--	--
Copco No. 2 Reach				
Fishing	10	300	--	--
Standard whitewater boating	500	1,500	--	--
General recreation	>10	--	--	--

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APPENDIX A: INTERVIEW LIST

First Name	Last Name	Primary type of user/Affiliation
Donna	Boyd	Private boater; Friends of the River
Bob	Claypole	Private boater
Marty	Cochran	Private kayaker
Bill	Cross	Private boater; AW
Rick	Demarest	Rafting guide; Turtle River
Jeff	Ellis	Private kayaker
Joe	Ellis	Rafting guide with Noah/Southern Oregon Outdoor Program
John	Fortune	Angler; Klamath County Fly Casters
Brandt	Gutermuth	Private kayaker
Hugh	Hague	Rafting guide/manager; Noah
Noah	Hague	Rafting guide/owner; Noah
Mike	Hale	Former rafting guide; private boater
Zack	Kauffman	Rafting guide; Adventure Center
Michael	Kirwin	Kayaking guide/instructor; Osprey Kayak School
Roger	Lee	Rafting guide/outfitter; Wilderness Adventures
Jedd	Lehman	Private kayaker
Kevin	Lewis	Private boater; AW; Shasta Paddlers
John	Mcdermott	Rafting guide; River Dancers
Pam	Mclean	Rafting guide; Whitewater Connection
Dean	Munroe	Former rafting guide; Wilderness Adventures
Todd	Ostenson	Angler; Trophy Flies (Klamath Falls fly shop)
Dave	Payne	USFS river ranger (primarily Lower Klamath)
Ron	Pribble	Rafting guide
Willie Joe	Smith	Rafting guide with Rogue Klamath
Roger	Smith	ODFW biologist
Paco	Stewart	Former rafting guide with Noah
Del	Steyaert	Former rafting guide; angler; photographer with WOA Outfitters
Ben	Stokesberry	Private kayaker
Mark	Swisher	Former rafting guide; angling guide Ashland Fly Anglers
Steve	Walters	Rafting guide with Noah
Stephen	Welch	Rafting guide with ARTA River Trips
Grant	Wiedenbach	BLM recreation planner/river manager
Wayne	Zallen	Rogue Klamath owner

APPENDIX B: INTERVIEW FORMAT

The following provides the proposed general format of the interviews. The document outlines the general interview topics and provides a series of specific questions that were asked. While the goal was to ask each of the specific questions in the format, the language used in the interview varied slightly to be more conversational or to respond appropriately to the interviewee. If the respondent did not seem to understand the issue researchers were asking about, additional clarifying comments were provided. If the respondent was primarily an angler, researchers focused on those questions and skipped out of the boating sections.

Quantifiable answers to specific questions were coded directly into a database. Additional comments by respondents were hand-written, and then typed into the database immediately after the interview so they were legible. Those comments were organized by topic area. Analysis focused on the quantifiable information, but was tempered by a review of qualitative information from comments.

Name _____
Phone Number: (_____) _____ - _____
Affiliation _____

Opening

I understand you may be someone who knows about boating on the Upper Klamath/Hells Corner reach of the Klamath. Have boated this river?
0. No. Thanks – I guess I was ill-informed.
1. Yes to continue

We're working on a study for PacifiCorp as part of the relicensing effort to assess how flows affect boating on Upper Klamath. We have about fifteen minutes of questions about how you use the river and which flows you think are best. Do you know enough about the river to be able to help with that?
0. No.
1. Yes to continue.
2. General comments only; doesn't know the flows well but has other information of value.

Boating Experience and Preferences

Let's start with a few easy ones about your boating experience and preferences.
Roughly how many times have you boated the Upper Klamath? (estimates are fine; per year or total is fine)
___ times total
___ time per year

How many years have you been boating?
___ years
In general, how many days per year do you spend whitewater boating?
_____ days per year

What type of boats do you commonly use? (record up to three in table below…)
How would you rate your skill level with each type of craft?
1. hard shell kayaks
2. iks
3. small rafts/cats (under 14 feet)
4. medium cats/rafts (15 to 16 feet)
5. large rafts or cats (over 16 feet)
6. driftboats
7. other _____

Boat type	Intermediate Class III/IV	Advanced Class IV	Advanced Class IV/V	Expert Class V
1.				
2.				
3.				

For HC Outfitters Only:

Season of use: earliest, latest, prime months.

Can you roughly quote me the range of costs per person per day for your day trips?
(Report low and high and comment and on any unusual add-ons that create differences)

Does your company charge more or less depending upon water levels?

Does your firm run other rivers? Which ones?

What percent of your company's business is on the Klamath?

Estimating flows on the Hells Corner Reach

People appear to know flows on the Upper Klamath/Hells Corner reach in terms of turbines and cfs. Which do you know?

0. Neither
1. Turbines
2. CFS
3. Both

Do you find out ahead of time what the river is going to be running?

Where do you get that information?

1. PacifiCorp
2. Web _____
3. Phone _____

How far in advance do you want that flow information?

1. One day
2. One week
3. One month

If you were to run the river without knowing what the gage said, how close do you think you'd be…

1. Just know whether it was high or low in general terms
2. Could probably guess whether it was one or two turbines
3. Would definitely know if one or two
4. Would be within 20% of the cfs
5. Would be within 10% of the cfs

Evaluating Existing Flows on the Hells Corner Reach

Think about four different types of trips:

- Standard commercial trip: 13 to 15 foot paddle rafts with oar support, average skill among passengers
- Standard private trip (your type of craft)
- High challenge commercial trip: 13 to 15 foot paddle rafts with experienced paddlers and oar support
- High challenge private trip (you specify craft of choice)

On a seven point scale from 1=totally unacceptable to 7=totally acceptable (with 4 as the mid-point or marginal evaluation, please rate the following flows:

	Standard commercial	Standard private		HC commercial	HC private	
		score	craft		score	craft
Base flows (about 350 to 400)						
Between base and one (about 900)						
1 turbine (about 1,500)						
1.5 turbines (about 2,100)						
2 turbines (about 3,000)						
Over 2 (about 3,500 – rain/spill input)						

Specified Flows for Hells Corner

The next few questions are the crux of the interview. We are going to ask you about the flows required to provide several different opportunities that may be available on Hells Corner. For each, please tell us the flows in cfs or in terms of turbines; if you don't know about a specific opportunity or flow, we can move on to the next.

Flow in cfs

What is the lowest flow that you have ever run? _____

What is the highest flow you have ever run? _____

Think of the river as a waterway used for transportation. What is the lowest flow you need to simply get down the river? _____

Would you go at this flow?

0. no
1. yes
2. depends/maybe

Standard commercial trips: 13 to 15 paddle raft with oar support
- What is the lowest flow that provides a quality experience for this opportunity? _____
- What is the best or optimal range of flows for this opportunity? _____ to _____
- What is the single best flow for this opportunity? _____
- What is the highest flow that provides a quality experience for this opportunity? _____

High challenge commercial trips: 13 to 15 experienced paddle raft with oar support
- What is the lowest flow that provides a quality experience for this opportunity? _____
- What is the best or optimal range of flows for this opportunity? _____ to _____
- What is the single best flow for this opportunity? _____
- What is the highest flow that provides a quality experience for this opportunity? _____

Standard private trips (specify craft)
- What is the lowest flow that provides a quality experience for this opportunity? _____
- What is the best or optimal range of flows for this opportunity? _____ to _____
- What is the single best flow for this opportunity? _____
- What is the highest flow that provides a quality experience for this opportunity? _____

High challenge private trips (specify craft)
- What is the lowest flow that provides a quality experience for this opportunity? _____
- What is the best or optimal range of flows for this opportunity? _____ to _____
- What is the single best flow for this opportunity? _____
- What is the highest flow that provides a quality experience for this opportunity? _____

Low flow technical trip for smaller craft (kayaks, play cats)
- What is the lowest flow that provides a quality experience for this opportunity? _____
- What is the best or optimal range of flows for this opportunity? _____ to _____
- What is the single best flow for this opportunity? _____
- What is the highest flow that provides a quality experience for this opportunity? _____

What percent of use on Hells Corner do you think is private vs. commercial?

Hells Corner Future Flow Changes

If other resources required flows from the powerhouse to be less than 1 turbine, could you run trips with your current boat set up?

If other resources required flows from the powerhouse to be less than 1 turbine, could you run trips with smaller boats or a different set up?

Describe set-up (boat type, trip time, load); describe minimum flow needed to run a quality version of this trip.

Hells Corner Timing Issues

If the flow schedule for a day is to ramp up to one turbine (1,500 cfs) by noon, what is the earliest time you could start your trip? Note: The ramp up process takes three hours, so they start raising base flows at 9 am.

If the flow schedule for a day is to ramp up to two turbines (3,000 cfs) by noon, what is the earliest time you could start your trip? Note: The ramp up process takes four and a half hours so they start at 7:30 am.

Assuming the flow during a trip is one turbine (about 1,500 cfs) and you plan to take the usual amount of time to get down the river, how much time does it take to complete a trip? Assume your put-in is at Spring Island and your take-out is Access Number 1. Assume you make the usual stops for scouting – but do not factor in time for rescues or extended lunches/sightseeing, etc.)

Making the same assumptions and the flow is two turbines, how long does it take to complete a trip?

On your usual trips at one turbine, how much time do you generally spend out of your boats for lunches, snacks, or hiking/sightseeing (don't include time spent scouting rapids)?

On your usual trips at two turbines, how much time do you generally spend out of your boats for lunches, snacks, or hiking/sightseeing (don't include time spent scouting rapids)?

If the flow schedule had flows ramping down from one turbine (1,500 cfs) to base flows (350 to 400 cfs) starting at 3 pm and ending at 6 pm, what is the latest that you could start your trip?

What time would you have to be off the river (at the take-out)?

Many commercial outfitters run trips designed to fit with their customers' schedules (get them back to their hotels or homes before a certain hour). What is the latest time that you like to be at the take-out in order to get clients back to their origin at a reasonable time?

Hells Corner Trip Type Questions

Do you run overnight trips on the Hells Corner Reach?

How do they work? What do they cost? What percent of your trips are like that?

How do flows affect those types of trips?

If good flows were provided for shorter periods, would you be interested in shortening trips?

Hells Corner Access Questions

Where are you coming from?

Which roads do you use for your shuttle?

Which roads would you improve? To what level (better gravel, sealed, paved)?

Which launch/take-out points would you like to see better developed to allow for shortened trips?

- Spring Island put-in
- Frain Ranch put-in/take-out
- -- Rapids --

- State Line put-in/take-out
- Fishing Access 6 (where 4 commercial outfits have access now)
- Fishing Access 1 (main take-out for privates and other commercial outfitters)

- Currently not legal: Fishing Access 2-5

J. C. Boyle Bypass (J. C. Boyle Dam to Powerhouse – 5 miles)

Ever run it?

Estimate cfs? Other gage information

What craft?

On a seven point scale from 1=totally unacceptable to 7=totally acceptable (with 4 as the mid-point or marginal evaluation, please rate the following flows:

- Base flows (about 350 to 400 cfs)
- Twice base flows (about 800 cfs)

Estimate acceptable range for “standard trip” in that craft

Estimate acceptable range for “high challenge” in that craft

Keno Reach (From Keno Dam to J. C. Boyle or Topsy Reservoir – to Sportsman Park/Pioneer Crossing Bridge, Highway 66 Bridge)

Ever run it?

Estimate cfs? Other gage information

What craft?

On a seven point scale from 1=totally unacceptable to 7=totally acceptable (with 4 as the mid-point or marginal evaluation, please rate the following flows:

- Summer base flows (about 500 to 600 cfs in summer)
- Winter flows (about 1,500 to 2,000 cfs)

Estimate acceptable range for “standard trip” in that craft

Estimate acceptable range for “high challenge” in that craft

There is a lot of birdlife on this reach because of its proximity to the lake. Is there much demand for birdwatching trips by raft? Could you sell that trip?

Link River (in-town surf wave)

Ever run it?

Estimate cfs? Other gage information

What craft?

On a seven point scale from 1=totally unacceptable to 7=totally acceptable (with 4 as the mid-point or marginal evaluation, please rate the following flows:

- Summer base flows (about 500 to 600 cfs in summer)
- Winter flows (about 1,500 to 2,000 cfs)

Estimate acceptable range for “standard trip” in that craft

Estimate acceptable range for “high challenge” in that craft

Fishing

Do you fish any of the segments we've discussed?

Segment	What gage?	Target species?	Acceptable range	Optimum range	Conflicts with boaters

A few more respondent characteristics

What is your age? _____ years

What is your zip code?

Roughly how many miles is it from your HQ/home to the Upper Klamath?

Relicensing Knowledge

Have you heard that PacifiCorp is applying to renew its license?
0. no
1. yes

If yes, please describe what you know?
0. virtually nothing
1. heard of it, no details
2. heard of it, knows some details
3. knows the story, may have attended meetings
4. actively involved

Other

Know any other boaters we should talk to?

Any other comments to pass on to PacifiCorp or BLM?

APPENDIX C: ADDITIONAL INFORMATION FOR HELL'S CORNER PLANNING

Interviewees were asked to report whether various roads and facilities in the Hells Corner and **J. C. Boyle** Bypass reaches should be improved (and to what degree). Results for all interviewees is provided in Table C-1 (below).

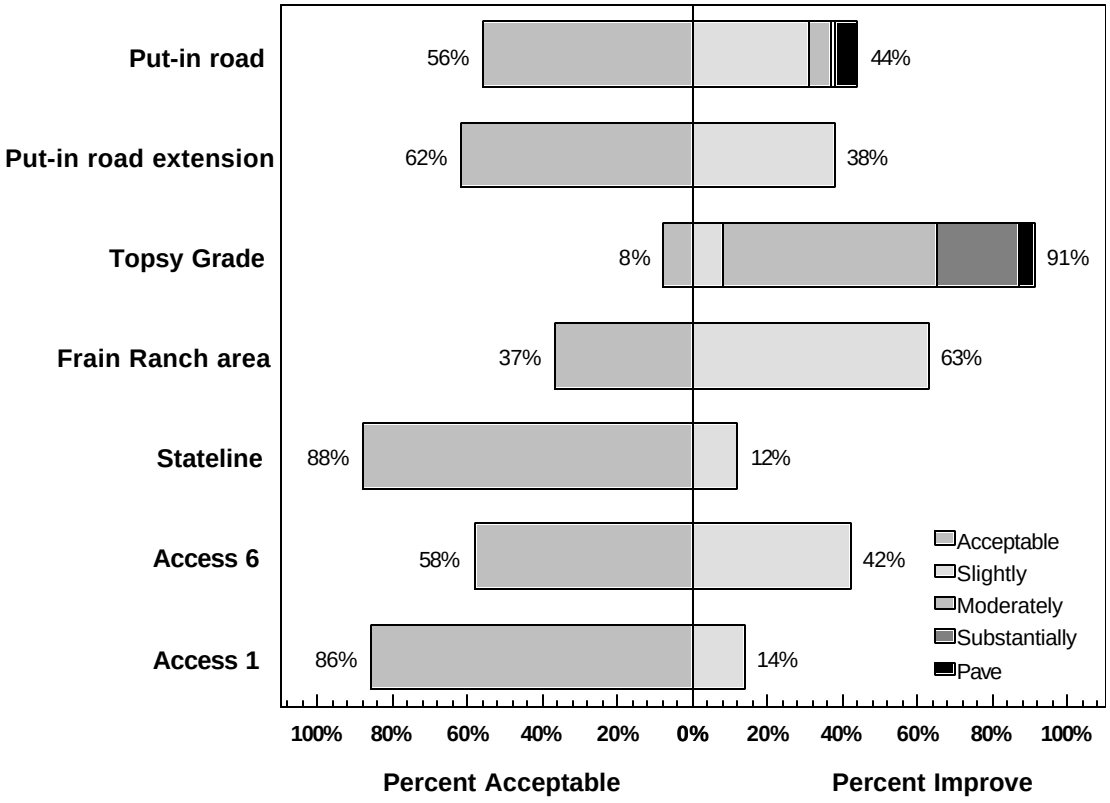

Figure C-1. Percent of interviewees reporting that roads or facilities are in "acceptable" condition or need to be "slightly," "moderately," "substantially" improved (for road options, respondents could also choose "pave."

In general, results suggest that most facilities and roads in the area are acceptable to a majority of respondents. The obvious exceptions are Topsy Grade (where 91% reported the need for improvements) and the Frain Ranch area (where 63% reported the need for improvements). Additional discussion of these results and qualitative comments made by respondents about preferred improvements are summarized below, by facility.

Spring Island Put-in Road. Over half reported this road was in acceptable condition, although about a third thought it could be improved with some periodic grading (one person would like to see a formal schedule for grading). Very few thought substantive improvements were necessary, although one respondent thought it should be paved, and another noted the need to make the turnaround near the put-in a little larger.

Extension of Put-in Road to Frain Ranch (River Right). Similarly, a majority of respondents reported that the road from the put-in downstream on river right was in acceptable condition, although about 4 in 10 noted the need for some grading-level improvements. One respondent

noted that the river left road (Topsy Grade) should be a higher priority, while another respondent commented that it should be bikes only below the put-in, and a third cautioned against making it "too nice," which might encourage more use.

Topsy Grade. Over 90% of respondents felt this road needed some improvements, although there was variation in the level of improvement preferred. Relatively few thought grading alone would be sufficient, and several noted that the road is down to bedrock in many places so grading simply would not help much. Most respondents preferred moderate improvements that might include additional gravel, removal of larger rocks, drainage improvements, and general "clean-up." In general, these respondents wanted to see the worst parts of the road improved and brought to the standard similar from Iron Gate to Stateline (the worst parts are from Stateline to Frain Ranch).

About twenty percent were interested in more substantial improvements that would include widening the road, improved grades, and even more gravel surfacing. However, only one respondent was interested in having the road paved, and at least three others noted that improvements should fall short of sealing or paving the road. Six respondents also reported concerns that road improvements might attract more use and accordingly cautioned against substantial improvements. A common sentiment among these respondents was that the poor existing condition of the road was "the price of admission" for using the area.

Frain Ranch Area. Over 6 in 10 respondents felt that Frain Ranch facilities also needed improvements, with most of those focusing on three areas: restrooms (six respondents), general maintenance (four respondents), and law enforcement/vandalism concerns (four respondents). Other specific concerns identified the need for a better boat ramp and turnaround for vehicles with trailers, minimizing the "spider-web" of de facto roads, and spacing/organizing campsites. At least two respondents were concerned about improvements attracting additional use.

Stateline Access. Nearly 9 in 10 of respondents thought that improvements at Stateline in recent years were acceptable and there is no compelling need for additional work in that area. Of the four respondents who made additional comments, two praised the new improvements, one thought it should remain primitive, and a fourth thought there were still a few larger rocks on the road that should be removed to improve access.

Access 6. Relatively fewer respondents commented about this site (11 out of 33), but among those who use it a majority reported it was in acceptable condition. Complaints focused on the distance to the restroom, and lack of a launch area ("too far to carry rafts") or good turnaround for trailers. There appears to be recognition that if this site is to be used on a more frequent basis because of later flows, some improvements might be necessary.

Access 1. Nearly 9 in 10 respondents felt that this primary access site was in good shape and did not need substantial improvements. Suggestions among the few reporting improvements included the creation of some "changing rooms" or walls, launch leveling, and signs to help organize use during crowded periods.

Other Comments. Respondents had a number of other suggestions for improvements in the general area, or general comments about improvements. These are listed below.

- Okay to do any improvements, no need to do lots except on Topsy Grade
- Footbridge across river for bikes at Frain Ranch
- Bathrooms at Frain Ranch
- Need management presence in canyon
- Doesn't know area well, but roads are in poor shape generally; put-in is okay
- Worried about lack of law enforcement
- Worried about improvements attracting use—just improve a little
- Road control—check on fires, etc. Some management presence needed
- If trash cans at takeout, it might help; worried about too much use
- Vandalism is bad, but don't improve too much; keeps the "sissies" out
- Worried about vandalism
- Prefer more wilderness, lots less use and development
- Turn Klamath Hot Springs into a resort; encourage two day opportunities; like to see a foot trail to bring in a longer trip
- Don't attract more use
- Worried about improvements attracting more use
- Worried about crowding if road improvements are too good
- Bridges are gone, used to be three or more from Stateline to Access 1