FINDING OF NO SIGNIFICANT IMPACT
&
ENVIRONMENTAL ASSESSMENT

Link River Fish Passage Project

Link River Dam – Proposed Project Site

January 9, 2003

Klamath County, Oregon

Prepared by:
Bureau of Reclamation
Mid-Pacific Region
Klamath Basin Area Office
(Reference No. KBAO-FONSI-03-002)
(Reference No. KBAO-05-002)

LINK RIVER FISH PASSAGE PROJECT
Finding of No Significant Impact (FONSI)
FONSI No.: KBAO-FONSI-03-002

Reclamation considered the context and intensity of the proposal's effects in determining if the action would result in significant impacts on the quality of the human environment. The effects are summarized as follows:

- The endangered Lost River sucker, endangered shortnose sucker and the threatened bald eagle would not be adversely affected by the action.
- There would be no significant effect on the Link River Dam.
- There would be no significant effect on the recreational uses of the Link River Nature Trail.

Based upon the analysis of effects in the EA, Reclamation finds that the proposal does not constitute a major Federal action significantly affecting the quality of the human environment thus an environmental impact statement is not required and will not be prepared. Implementation of the proposal may take place immediately.

EA and FONSI Prepared By:	Jennie M. Hoblit	Date: January 9, 2003
FONSI Recommended:	[signature] Daniel S. Fritz, Environmental Specialist	Date: 01-13-03
FONSI Approved:	[signature] Dave Sabo, Area Manager	Date: 01/13/03

ENVIRONMENTAL ASSESSMENT

Link River Fish Passage Project

Link River Dam – Proposed Project Site

January 8, 2003

Klamath County, Oregon

Prepared by:
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Mid-Pacific Region
Klamath Basin Area Office
(Reference No. KBAO-05-002)

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CHAPTER 1 – INTRODUCTION AND DESCRIPTION OF THE PROPOSAL

INTRODUCTION

The Bureau of Reclamation (Reclamation) proposes to construct a fish ladder at the Link River Dam, a feature of the Klamath Project. This Environmental Assessment (EA) includes brief discussions of the need for the proposal, alternatives, environmental impacts of the proposed action and alternatives, and a listing of agencies and persons consulted (40 CFR §1508.9).

PURPOSE OF THIS EA

Reclamation is preparing this EA to describe the environmental effects of a proposal to construct a fish ladder at the Link River Dam. This EA was prepared to satisfy the procedural requirements of the National Environmental Policy Act (P.L. 91-190, as amended) and to determine if an Environmental Impact Statement or Finding of No Significant Impact should be prepared for this project.

PURPOSE AND NEED STATEMENT

The purpose of this project is to allow fish passage from the Klamath River system to Upper Klamath Lake. The ladder is needed because the existing fish ladder does not meet the requirements for passage, and it does not function correctly and is not used by the target fishes. The ladder is also required as a term and condition in the 2001 Biological Opinion for operations of the Klamath Project issued by the U.S. Fish and Wildlife Service (Service).

BACKGROUND

The Link River controls the level of Upper Klamath Lake and is considered a barrier to upstream passage of native fish species of Klamath Lake and the Klamath River System. Upstream passage for the endangered shortnose and Lost River suckers (*Chasmistes brevirostris & Delistes luxatus*) is primarily needed to allow fish access back to Upper Klamath Lake should they be carried downstream in the spillway, outlet works, or diversion flows.

Current conditions in Lake Ewauna, which is located south of the Link River Dam, are not considered suitable for fish populations; therefore it is important to survival that fish are allowed a form of passage back into Upper Klamath Lake. A fish ladder currently occupies spill bay 24, on the east side of the dam. However, this ladder was constructed in 1926 and was designed for red band trout (*Oncorhynchus mykiss*). The downstream end of the ladder is located 220 feet from the river outlet releases and fish seem to have difficulty finding the ladder. In addition, the endangered suckers have difficulty navigating the ladder if they do find it, and the ladder has been shown to be a barrier to suckers.

LOCATION AND GENERAL DESCRIPTION OF THE LINK RIVER DAM

General Description

The Link River Dam was constructed in 1921 and is located in Section 30, Township 38 South, Range 9 East, WM (Figure 1 & 2). This concrete reinforced dam is owned by Reclamation and is operated pursuant to contract with PacifiCorp. Reclamation provides the power company irrigation diversion requirements and minimum lake levels and flows below Keno and Irongate

Reservoir, and the power company adjusts the outflow at the Link River Dam to balance the system. (Klamath Project Historic Operation, USDI, BOR, November 2000)

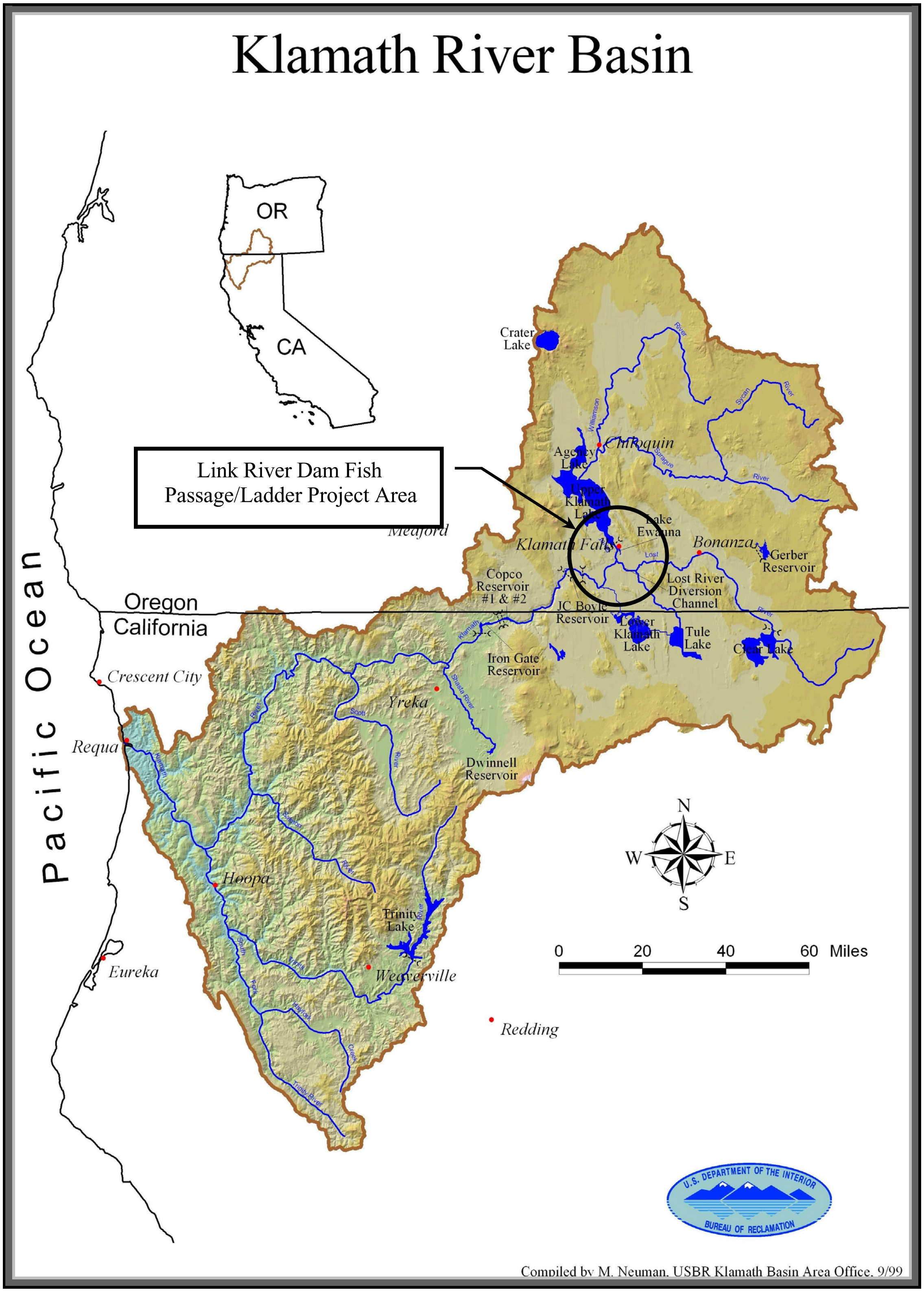

Figure 1: General Location of Link River Fish Passage Project

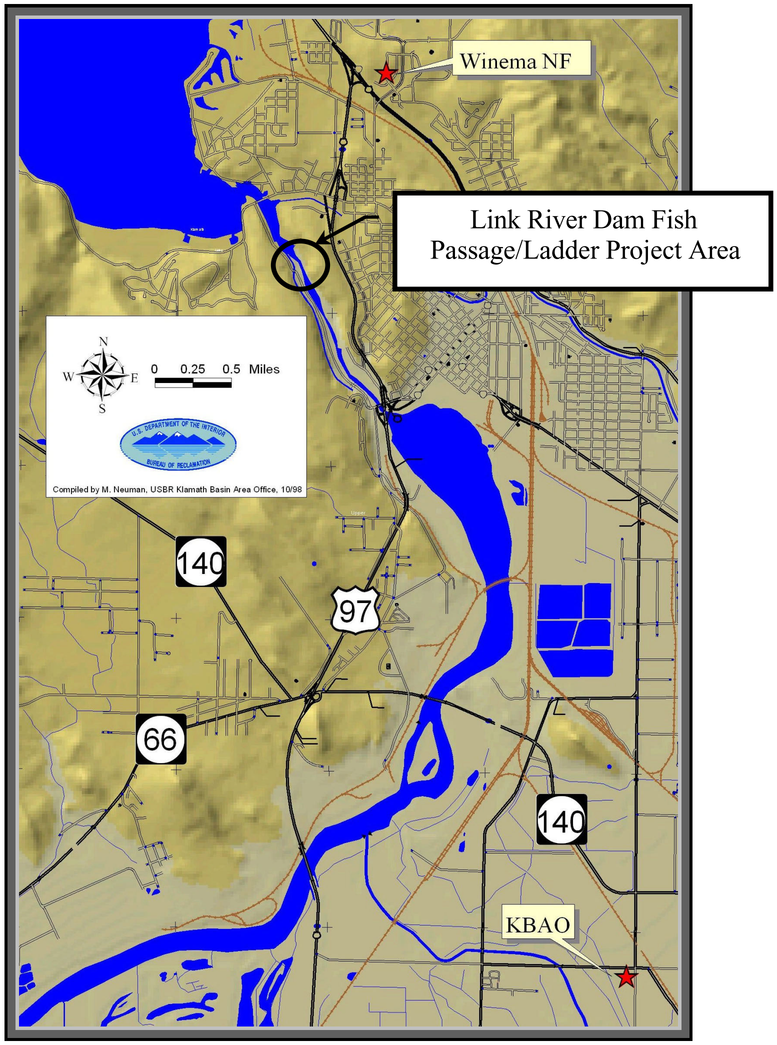

Figure 2: Location of Link River Fish Passage Project

There are no fish screens on the outflows from Link River Dam. Reclamation owns the dam and PacifiCorp owns two power canals that carry water from the lake to two small power plants on either side of the Link River.

DECISIONS TO BE MADE

Reclamation will use this EA and other relevant information to make the following decisions regarding the construction of a fish ladder at Link River Dam: (1) Should Reclamation install a ladder?; (2) How should Reclamation install the ladder?; and (3) Does the proposed action constitute a major federal action significantly affecting the quality of the human environment necessitating preparation of an environmental impact statement?

PERMITS AND AUTHORIZATIONS NEEDED

Reclamation would obtain the following permits and authorizations to implement the proposed action as displayed in Table 1.

Table 1 – Permits and Authorizations Needed Link River Fish Passage Project		
Authority	**Permit/Authorization Needed**	**Responsible Agency**
Clean Water Act	Section 401-Water Quality Certification	Oregon Department of Environmental Quality
Clean Water Act	Section 402-National Pollutant Discharge Elimination System Permit	Oregon Department of Environmental Quality
Clean Water Act	Section 402-Stormwater Discharge Permit	Oregon Department of Environmental Quality
Clean Water Act	Section 404-Permit to Discharge Dredged or Fill Material into the Waters of the United States	U.S. Army Corps of Engineers
ORS 196.800-990	Removal-Fill Permit	State of Oregon Division of State Lands

SIGNIFICANT RESOURCE ISSUES

The following resource issues have been identified as the significant issues that should be analyzed in detail in this EA. They were identified through scoping activities conducted by Reclamation, and will be used to guide analysis of environmental consequences.

The resource issues are briefly summarized in the following analysis questions:

1. Cultural Resources – How would the proposed action and alternatives affect cultural resources and the historic properties of the dam?

2. Threatened and Endangered Species – How would the proposed action and alternatives affect any federally listed threatened or endangered species in the proposed areas?

3. Wetland and Riparian Areas – How would the proposed action and alternatives affect the vegetation (wetland and riparian) and wildlife habitats/populations within the proposed areas?

4. Recreational Uses (Nature Trail, boating, etc.) – How would the proposed action and alternatives affect recreational use/facilities within the area? How would the proposed action and alternatives affect visitor experiences within the area?

5. Other Resources and Issues – How would the proposed action and alternatives affect these resources and issues? (Indian Trust Assets, Environmental Justice, etc.)

CHAPTER 2 – PROPOSED ACTION AND ALTERNATIVE

ALTERNATIVE DEVELOPMENT

In addition to not implementing the proposal (or "no action"), Reclamation briefly considered other alternative courses of action which could meet the need for the proposal and be technically, economically and environmentally feasible. Taking "no action" would not meet the purpose and need for the proposal and was eliminated from further consideration. Other courses of action such as alternative locations of the proposed ladder with reference to the dam were eliminated from further consideration. More information regarding these alternatives may be found in the Link River Dam Fishway Replacement Feasibility Study prepared by the Bureau of Reclamation on May 2001 (Appendix A).

PROPOSED ALTERNATIVE

The proposal involves the installation of a fish ladder at the Link River Dam near the west side of the dam. It would be located between the Keno Canal and the outlet works stilling basin guide wall (See Figure 3, 4, 5, 6, & 7). The fishway exit would connect to an existing gate opening in the dam between the Keno Canal headworks and the outlet works. To minimize the risk of re-entrainment of fish exiting the fishway, the canal gate adjacent to the fishway exit would be closed during normal operation.

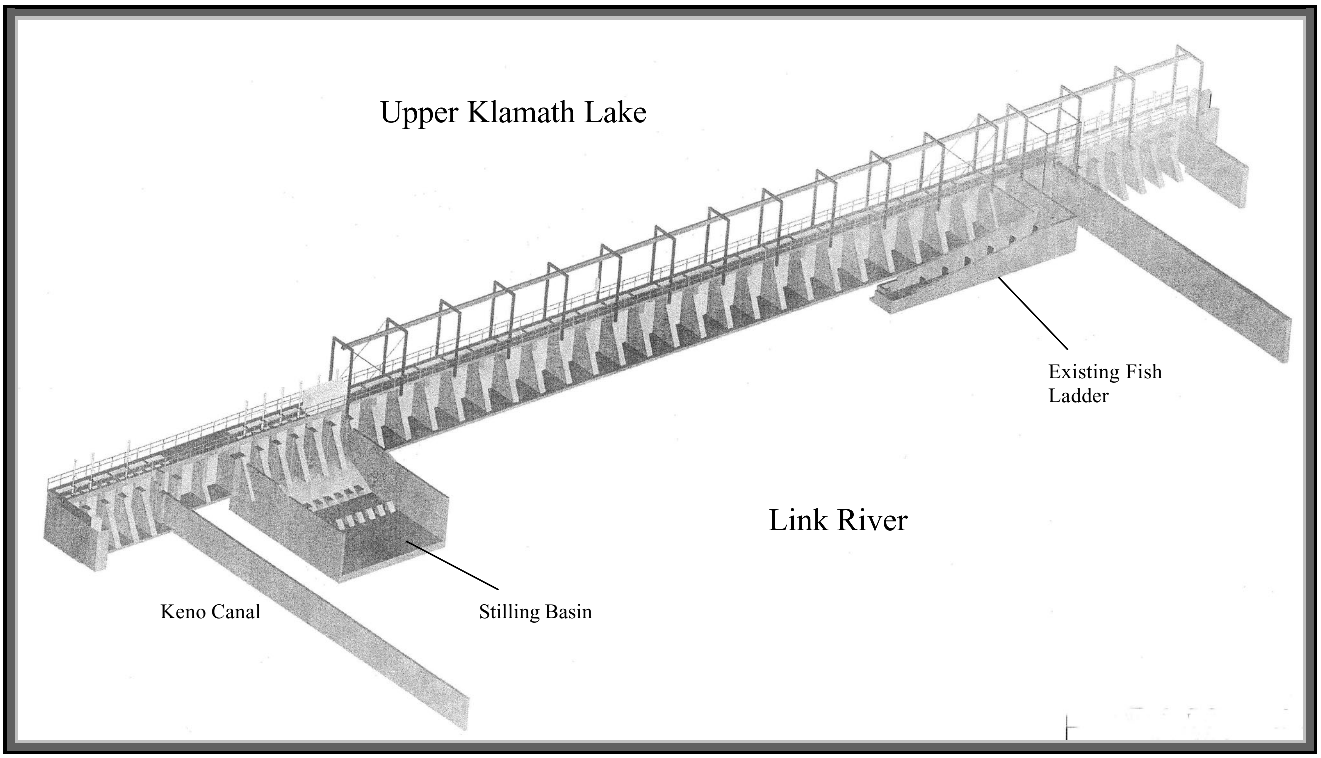

Figure 3: Existing Link River Dam and Ladder.

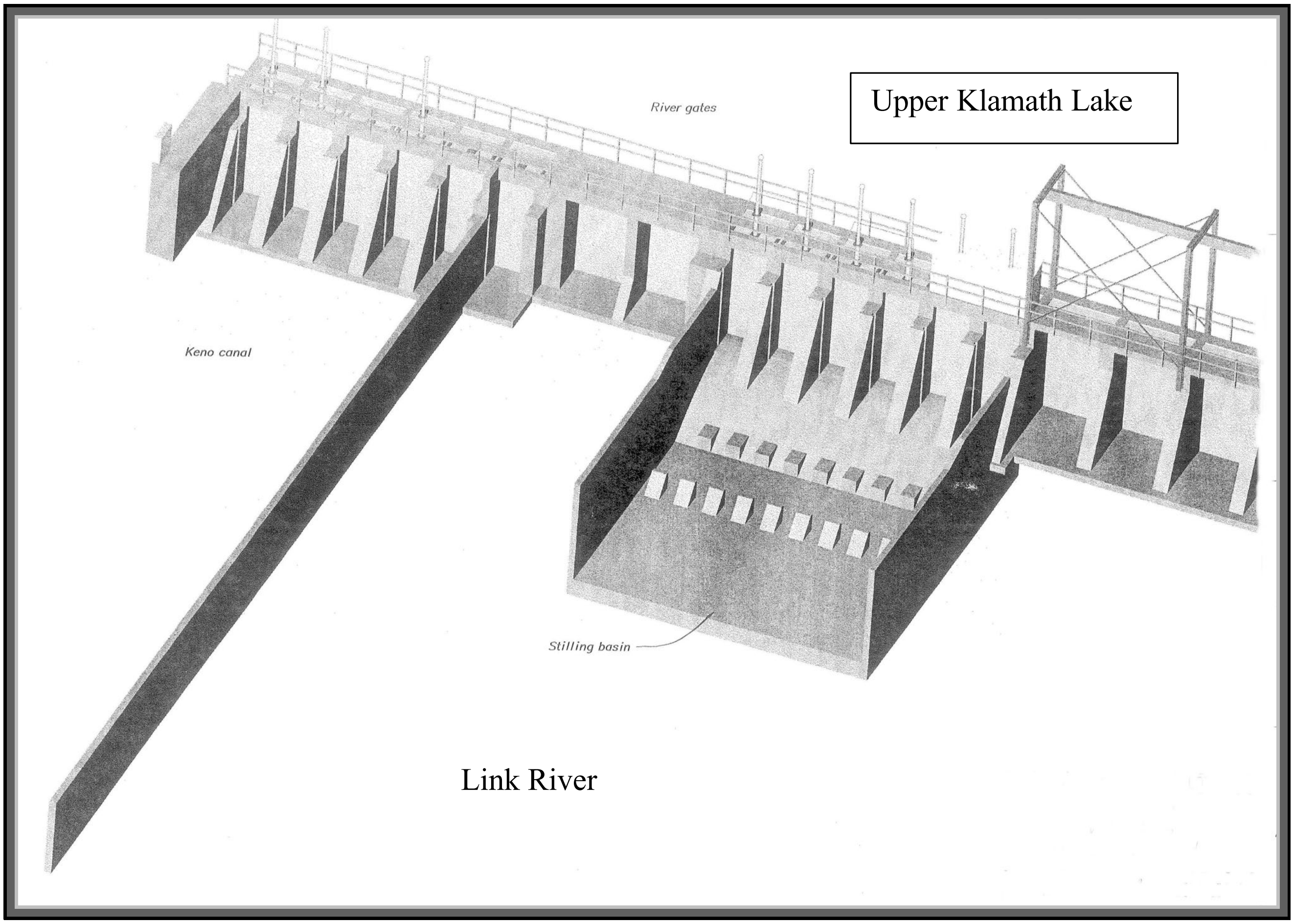

Figure 4: View of Existing Stilling Basin and Keno Canal.

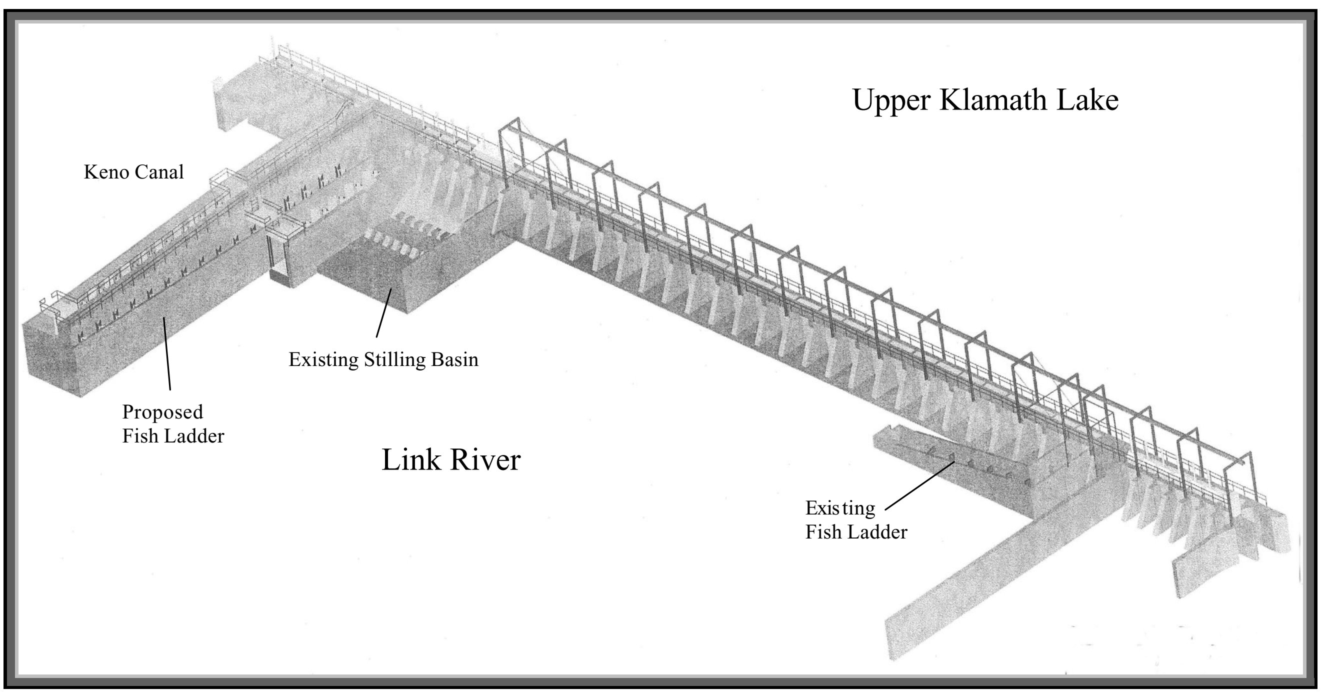

Figure 5: Link River Dam Fish Ladder Project Layout.

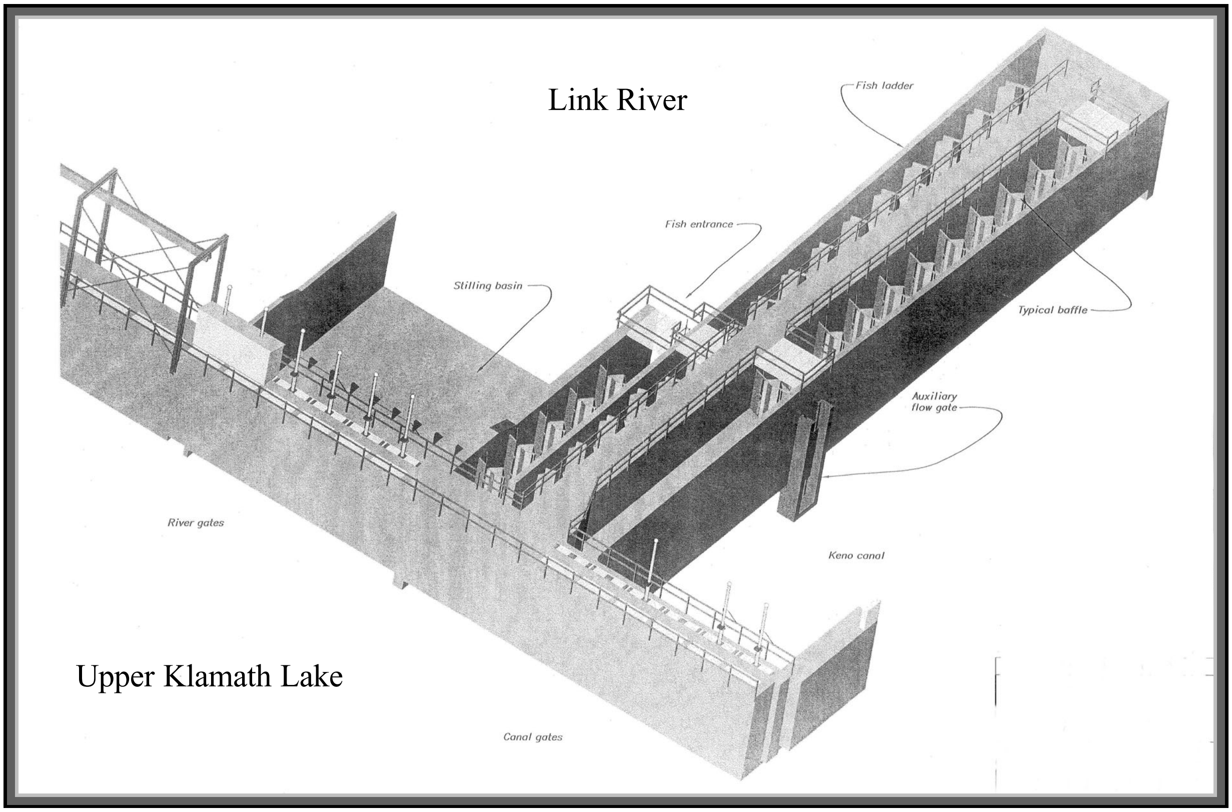

Figure 6: View from UKL Side of Proposed Fish Ladder.

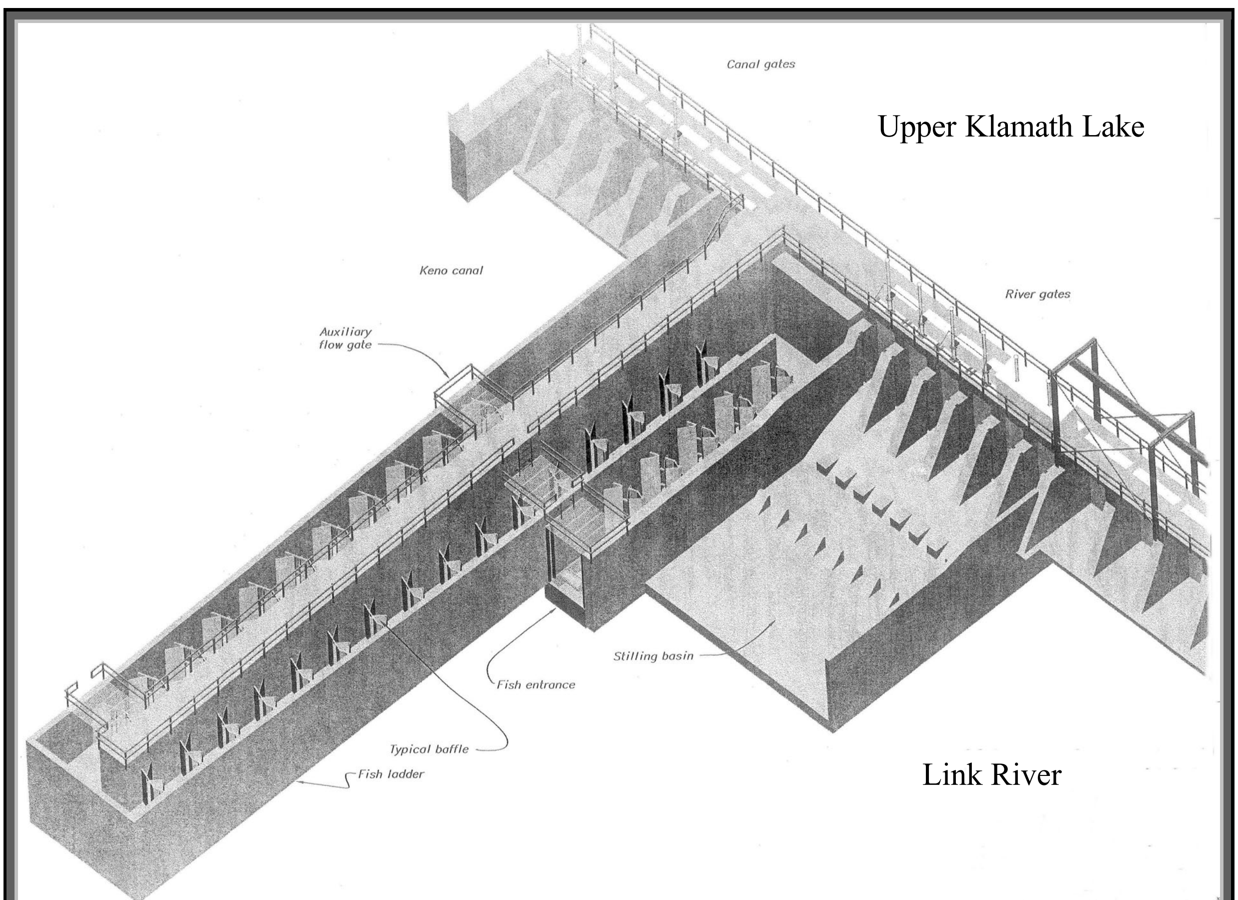

Figure 7: View from Link River Side of Proposed Fish Ladder.

CONSTRUCTION ACTIVITIES

A cofferdam would be constructed adjacent to the proposed fish ladder site on the east side (See Figure 8). The cofferdam would be constructed of clean gravel (suitable for fish spawning), and have a volume of 850 cubic yards, and cover roughly 0.15 acre. This cofferdam would be removed at completion of construction activities. The dimensions of the cofferdam would be approximately 9' wide x 12' high x 200' long.

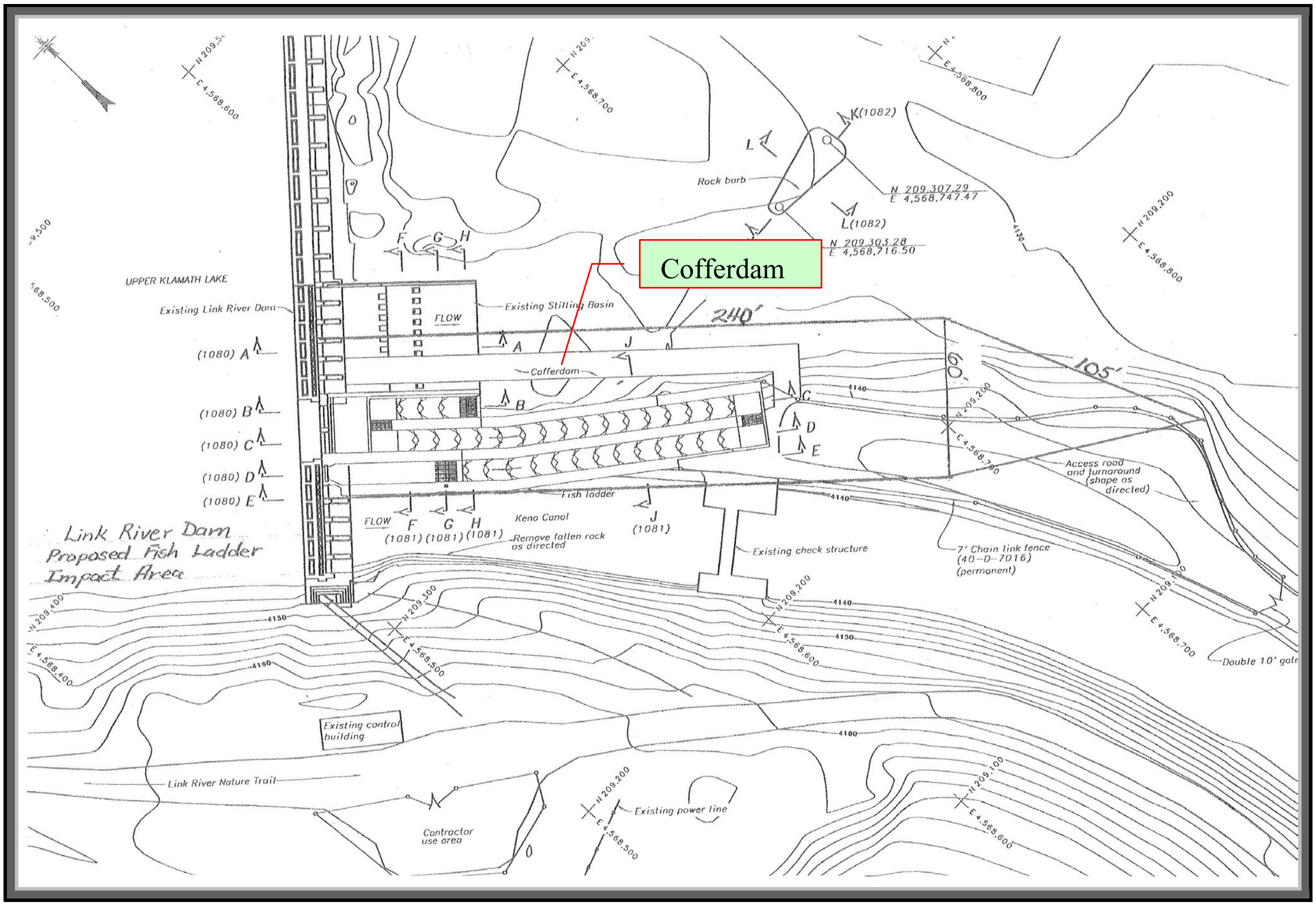

Figure 8: Link River Fish Passage Project Cofferdam.

MITIGATION MEASURES INCORPORATED INTO THE PROPOSED ACTION

The following mitigation measures are incorporated into the proposed action to mitigate adverse effects of the project:

1. Management practices will be employed during construction activities to minimize environmental effects and will be implemented by Reclamation construction forces or included in construction specifications. Those practices or specifications include sections on public safety, dust abatement, air pollution, noise abatement, water pollution abatement, waste material disposal, erosion control, archaeological and historical resources, vegetation and wildlife.

2. Additional environmental analyses and compliance may be necessary if the proposed action changes significantly from that described in the EA because of additional or new information. For example, if the estimate of spoil material increases or if different spoil, borrow or work areas are required, environmental as well as cost considerations will be included in determining the final location of these areas.

3. Construction of the project would require a Clean Water Act-Section 404 Permit, Section 401 state water quality certification and a State of Oregon removal/fill permit for discharges of dredged or fill material into

the waters of the United States. Such activities associated with this project could include the cofferdam, outfall structures/pipelines for the primary and secondary fish bypass pipelines disposal sites for excavated material or construction material sources. The necessary permits and authorizations would be acquired by Reclamation prior to initiation of construction activities. The conditions and requirements of these permits will be strictly adhered to by Reclamation. Reclamation would fully mitigate any loss of jurisdictional wetland with appropriate in-basin, in-kind mitigation as determined in consultation with the U.S. Army Corps of Engineers and the State of Oregon, and required as a condition of a 404/fill-removal permit. Reclamation will implement adequate wetland mitigation to fully compensate for any impacts to the waters of the United States.

4. A Clean Water Act-Section 402 National Pollutant Discharge Elimination System (NPDES) permit would be required and obtained from the State of Oregon prior to any discharges of water resulting from activities associated with the project and appurtenant facilities, if such water is to be discharged as a point source into Upper Klamath Lake or the Link River. A NPDES permit would also be required and secured for stormwater discharges associated with project construction activities.

5. In the event that any cultural and/or paleontological site (historic or prehistoric) is discovered, it shall be immediately reported to the Area Manager of the Klamath Basin Area Office. An evaluation of the significance of the discovery will be made by the archaeologist to determine appropriate actions to be taken to prevent loss of significant cultural or scientific value and; (2) Any person who knows, or has reason to know, that they have inadvertently discovered human remains on Federal or Tribal lands must provide immediate telephone notification of the inadvertent discovery to the Area Manager at (541)883-6935. Work will stop until archaeologists are able to assess the situation onsite. Follow-up actions will comply with the Native American Graves Protection and Repatriation Act (P.L.101-60) of November 1990.

6. Documentation efforts will be performed at the existing Link River Dam to mitigate adverse effects to this property that is eligible for inclusion in the National Register of Historic Property. A Memorandum of Agreement will be completed between SHPO and Reclamation to guide this effort.

7. All construction activities and appurtenant work (such as borrow sources, waste areas, staging and storage areas, and vehicle and equipment parking areas) will be on previously-disturbed areas, to the extent practicable.

8. Existing roads will be used for project activities.

9. Construction sites will be closed to public access. Signs or temporary fencing may be installed to prevent public access. Reclamation will coordinate with landowners, homeowners, local residents and the City of Klamath Falls regarding access to, or through the project area.

10. All disturbed areas resulting from the project shall be smoothed, shaped, recontoured and rehabilitated to as near their pre-project construction condition, as practicable. Disturbed areas shall be reseeded with appropriate native seed mixes and at times suitable for successful revegetation after completion of construction and restoration activities. The composition of seed mixes shall be coordinated with the U.S. Fish and Wildlife Service and Oregon Department of Fish and Wildlife.

11. An Environmental Commitment Plan (ECP) and Checklist (ECC) will be prepared and used by the Klamath Basin Area Office to ensure compliance with the environmental commitments and the environmental quality protection requirements. A post-construction environmental summary (PCES) shall be prepared within one year after completion of the project to assess the effectiveness of the mitigation measures.

12. Permits required pursuant to compliance with federal, state, local and tribal environmental protection laws and regulation shall be acquired before initiation of ground-disturbing activities. Conditions of such permits shall be fully complied with by Reclamation and/or its designated representative.

CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

INTRODUCTION

Reclamation analyzed the effects of the proposal on the following resources or issues that are relevant to the proposal. These include:

Cultural Resources

These resources are defined as properties listed, or eligible to be listed, in the National Register of Historic Places. The Link River Dam is being considered for inclusion on the National Register of Historic Places. Implementation of this project would involve minor additions to the existing Link River Dam. Reclamation will consult with the Oregon State Historic Preservation Office (SHPO) prior to any construction activities to insure compliance with Section 106 of the National Historic preservation Act. Currently, Reclamation is in consultation with the SHPO concerning the Link River Dam and a nearby lithic scatter. Reclamation believes that the project will have no adverse effect on these sites. Reclamation has also consulted with the Klamath Tribes and conducted site visits to reduce or eliminate effect to the above mentioned lithic scatter.

Cultural Resources have been located in some areas where the proposed mitigation trail (see Recreation Uses; Mitigation) that would pass from the Link River Nature Trail, over the adjacent bluff (east to west), into Moore Park, could be located.

Mitigation

Mitigation for impacts to cultural resources is incorporated into the proposed action described in Chapter 2 – Proposed Action and Alternative. Mitigation for impacts to cultural resources located in near the proposed mitigation trail will be developed and implemented with the Klamath Tribe. The Klamath Tribes and City of Klamath Falls Recreation & Parks Department will coordinate with the cultural and environmental staff of Reclamation in development of the proposed mitigation trail.

Threatened and Endangered Species

Federally-listed threatened and endangered species that could be found near the proposed action are the Lost River sucker (endangered), the shortnose sucker (endangered), and the bald eagle (threatened). The spotted frog (candidate for listing) may also be found in the area.

This proposed action is not likely to adversely affect threatened and endangered species found in the vicinity. The effects of activities related to this action are addressed in the Biological/Conference Opinion Regarding the Effects of Construction of the A Canal Fish Screen and Link River Fish Ladder issued by the U.S. Fish and Wildlife Service (Appendix B). The ladder is also required as a term and condition in the 2001 Biological Opinion for operations of the Klamath Project issued by the U.S. Fish and Wildlife Service.

Mitigation

Mitigation is incorporated into the proposed action described in Chapter 2 – Proposed Action and Alternative.

Wetland Area

The wetland area would be changed from the present condition as a result of this action. A Wetland Delineation (Appendix C) of the proposed construction area was conducted by Michelle Prowse, Environmental Specialist for Reclamation, on March 4-8, 2002. The project area is an area that has been significantly disturbed. The soils are comprised of imported fill and rocks used to create maintenance roads and access to the dam in the late 1800's and again in the 1920's. These soils are not hydric, but there are other wetland indicators present such as, wetland vegetation and hydrology. The wetland hydrology exists primarily because the Link River Dam releases water during the growing season.

Table 2 describes the area of impact in more detail. The table provides information regarding what type and how much of each wetland is impacted from different activities, whether the effects are permanent or temporary, and the total amount of impacted wetlands. These figures were determined using the measuring tools in ESRI® ArcMap™ 8.2. See Figures 9, 10, and 11.

Table 2 – Summary of Wetlands Affected by Link River Fish Passage Project

No.	Description of Activity	Total Size/Area	Wetland Type & Size		Temporary Effect	Permanent Effect
			Open Water	Riparian		
1.	Temporary cofferdam for installation of new ladder.	0.06 acre	0.06 acre	0.00 acre	✓	
2.	Installation of Fish Ladder.	0.17 acre	0.01 acre	0.16 acre		✓
						✓
3.	Miscellaneous Activities; Road enhancement, equipment traffic, etc.	0.23 acre	0.00 acre	0.23 acre		✓
	Total Amount of Impacted Wetlands	**0.46 acre**	***0.07 acre***	***0.39 acre***		

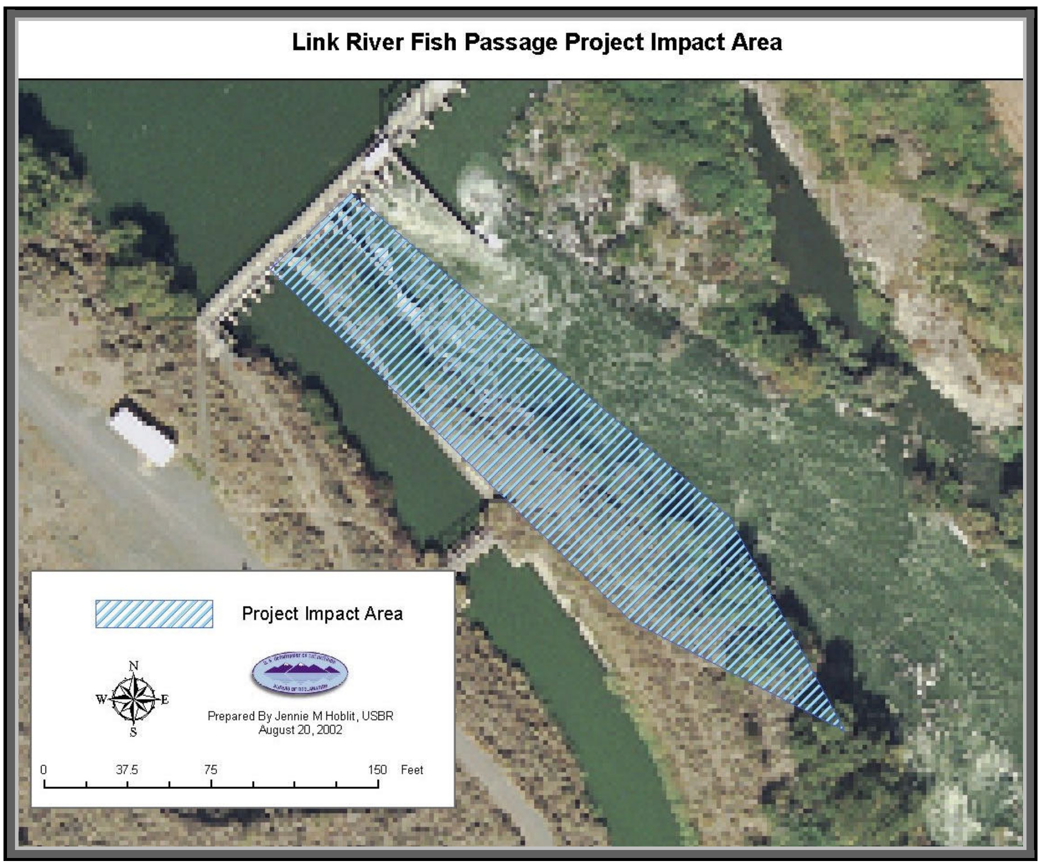

Figure 9: Link River Fish Passage Project Total Area of Impact.

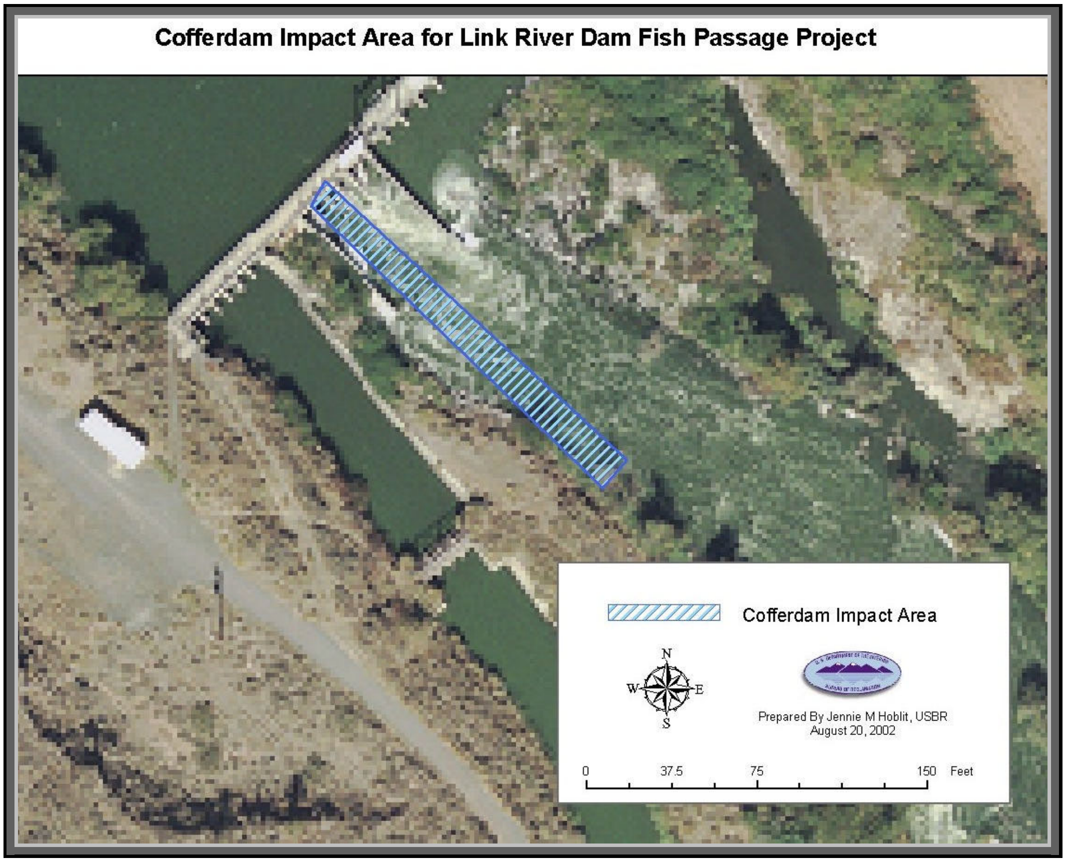

Figure 10: Area of Impact from Cofferdam.

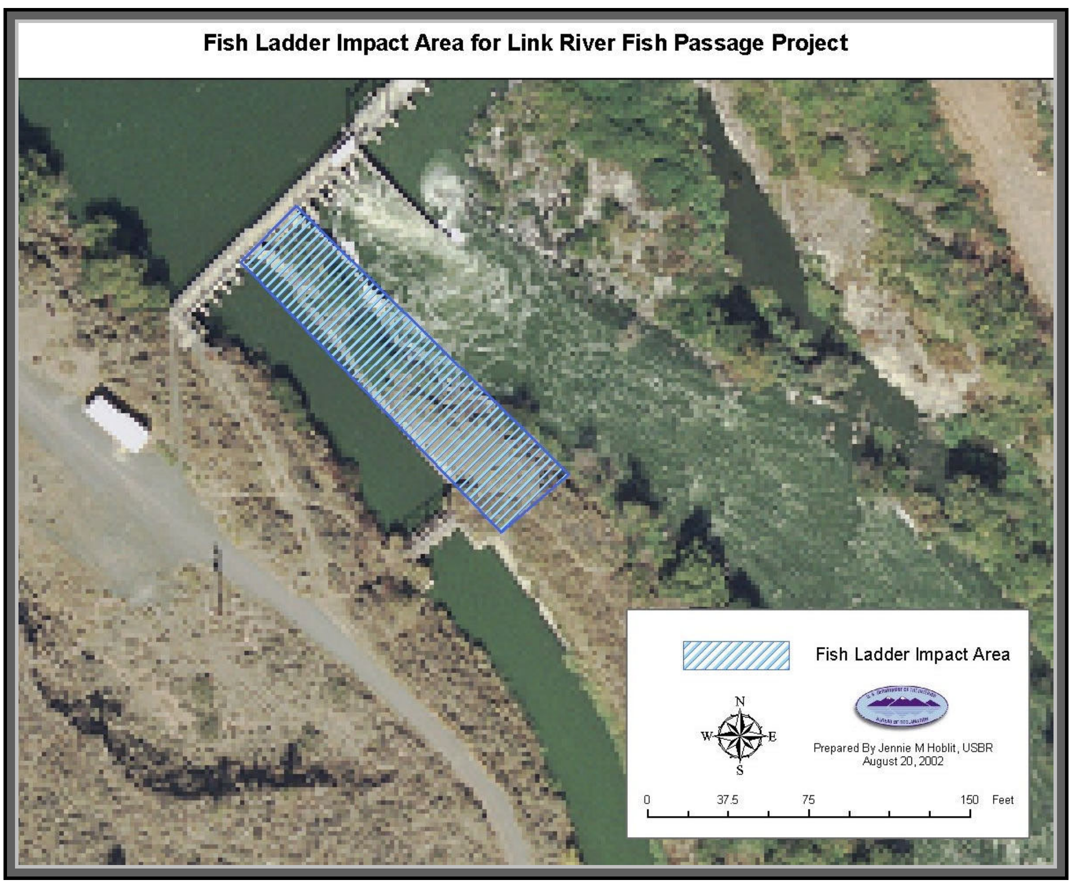

Figure 11: Area of Impact from Proposed Fish Ladder.

Mitigation
Mitigation is incorporated into the proposed action described in Chapter 2 – Proposed Action and Alternative. Mitigation would be implemented to avoid any net loss of wetlands.

Recreational Uses (Nature Trail, boating, etc.)
The Link River Nature Trail is located along the west bank of the Link River and the portion of UKL from Fremont Bridge to Link River Dam. Constructed by Pacific Power and Light Company, this scenic trail starts at the Fremont Bridge and runs 1½ mile down to the Favell Museum of Western Art and Indian Artifacts. The trail is affiliated with the USA National Trails System and is part of the Link River Bird Sanctuary and Small Game Refuge. At the north end of the trail is a quarter-mile paved path with two observation pads overlooking the A Canal Headworks. (Pacific Power 2002)

Visitors often walk or jog the mile stretch to view the wildlife and the Link River Dam. There are also several places to fish along the one-mile stretch. Boaters using small motor or rowboats infrequently use the stretch of UKL from the Fremont Bridge to Link River Dam.

The Link River Nature Trail, or a portion of it, would be closed to public access for public safety concerns during the construction of the proposed fish ladder because it would be used for construction access. The period of closure would only be temporary and be for approximately 6 months, from July to December 2003. The project would affect recreational usage during this period. There would be no impact on boating activities in the area.

Mitigation
Reclamation proposes to construct an alternative trail, to the west, from the Link River Nature Trail, over the adjacent bluff, into Moore Park (See Figure 12). This trail would give the public an alternative hiking trail while the north half of the existing trail is closed to public use. The trail would become a permanent addition to Link River Nature Trail and Moore Park. Reclamation has requested assistance from the Klamath Tribes, City Recreation and Parks Department, and any other interested parties in planning, designing, and constructing the alternative trail. The trail will be completed by May 2003.

In addition to the new trail to be installed crossing from the Link River Nature Trail to Moore Park, a foot bridge would be installed in the same area as the beginning of the new trail (on Link River side) that will cross over the Keno Canal to allow public access down to the Link River. (See Figure 12).

Reclamation is also coordinating with the City of Klamath Falls, Recreation and Parks Department to develop a plan to improve the south entrance to the Link River Nature Trail.

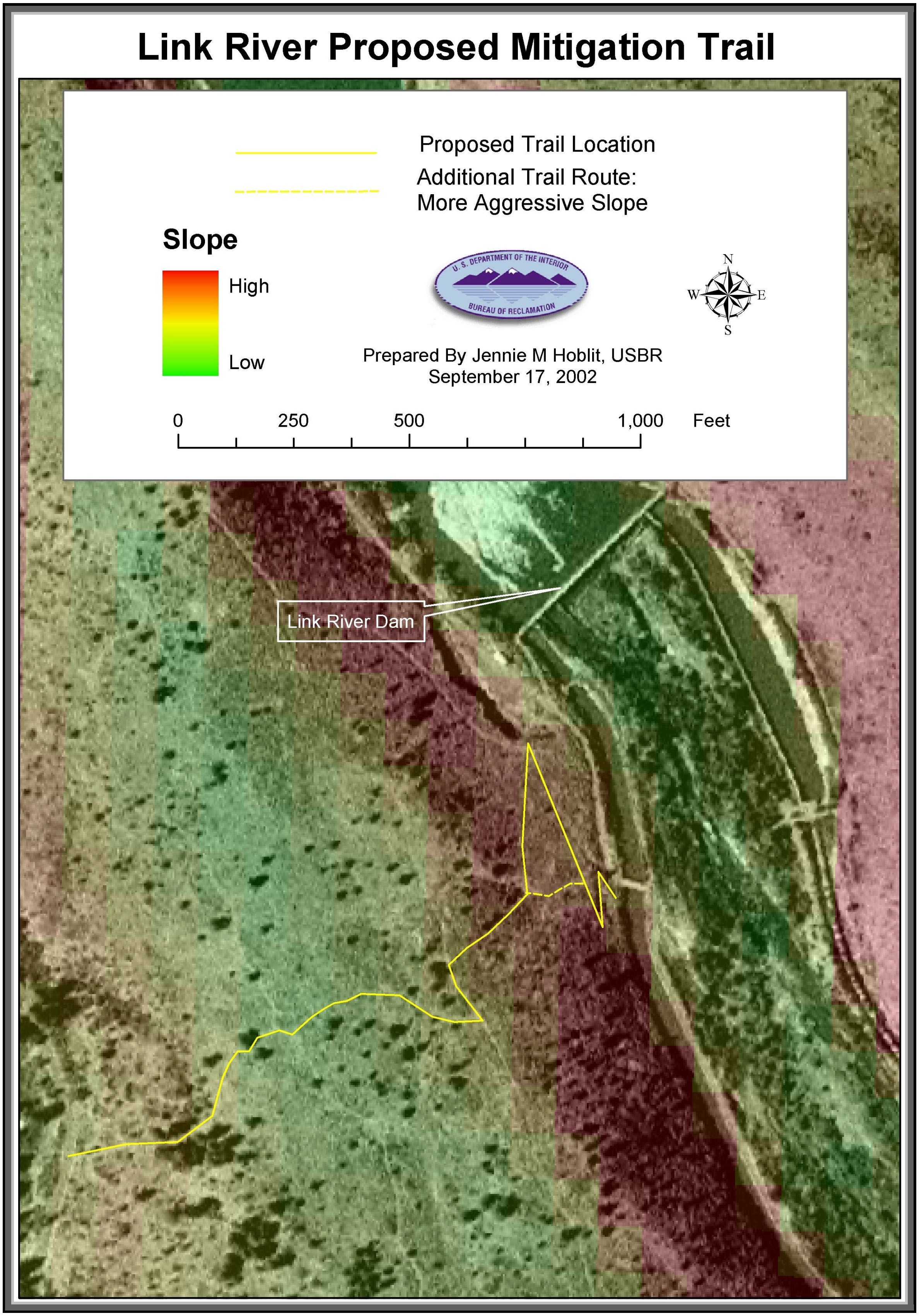

Figure 12: Proposed Mitigation Trail for the Closure of the Link River Nature Trail

Other Resources and Issues

Indian Trust Assets - Reclamation is required to consult with affected or involved tribes regarding impacts from Reclamation's activities on Indian trust assets. Indian trust assets are defined as legal interests in property held in trust by the United States for Indian tribes or individuals, or property that the United States is otherwise charged by law to protect. The United States has a trust responsibility to protect and maintain rights reserved by or granted to American Indians or Indian individuals by treaties, statutes and executive orders. These rights are sometimes further interpreted through court decisions and regulations. This trust responsibility requires that all federal agencies take all actions reasonably necessary to protect this trust. As a federal agency, Reclamation will carry out its activities in a manner that protects these assets and avoids adverse impacts when possible. When impacts to such assets cannot be avoided, Reclamation will provide appropriate mitigation or compensation. The proposal would have no effect on any identified Indian trust assets.

Environmental Justice - Pursuant to Executive Order 12898 (dated February 11, 1994), Reclamation is required to consider any potential effects to minority or low-income populations resulting from its actions. The Project would not result in a disproportionate effect upon those populations resulting from this action.

SUMMARY OF ENVIRONMENTAL EFFECTS

The environmental effects of the proposed alternative are summarized in Table 3.

Table 3 - Summary of Environmental Effects
Link River Fish Passage Project

Resource/Issue	Predicted Effects
Cultural resources	The project would have little or no adverse effect on the existing Link River Dam. Construction of the fish ladder would not have an adverse effect on cultural resources.
Threatened and Endangered Species	Construction-related activities may temporarily affect endangered Lost River and shortnose suckers. Operation of the fish ladder would have a long-term beneficial effect on the endangered suckers. There would be short-term displacement of foraging/roosting bald eagles away from the project site during construction activities.
Wetland and Riparian Areas	0.06 acre of wetland/riparian area would be temporarily affected and 0.40 acre of permanent loss; mitigation would be implemented to avoid any net loss of wetlands.
Recreation Use	Recreation use in the vicinity of the project site would be affected; temporary (roughly six months) closures or restrictions on the Link River Nature Trail during construction.

CHAPTER 4 – CONSULTATION AND COORDINATION

Reclamation consulted Federal agencies, Tribes, state agencies, and other interested parties during preparation of this EA. A Biological Opinion Regarding the Link River Fish Passage Project has been completed and can be found in Appendix B of this document.

PUBLIC INVOLVEMENT

The Draft EA was distributed for a 30 day public review to approximately 50 individuals/entities. Copies were also made available through the internet and were posted at the Oregon Institute of Technology and Klamath County Libraries. Comments received were utilized in developing this final EA. Two Comments were received from outside entities which can be found in Appendix D. Responses, if appropriate, can also be found in Appendix D.

COORDINATION WITH OTHER AGENCIES

Section 7 Consultation – Endangered Species Act

The effects of activities related to this action are addressed in the Biological/Conference Opinion Regarding the Effects of Construction of the A Canal Fish Screen and Link River Fish Ladder issued by the U.S. Fish and Wildlife Service (Appendix B). The ladder is also required as a term and condition in the 2001 Biological Opinion for operations of the Klamath Project issued by the U.S. Fish and Wildlife Service (Service).

Reclamation utilized an interdisciplinary approach to prepare the EA to comply with the mandate of the National Environmental Policy Act (NEPA) to "…utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man's environment" (40 CFR 1501.2(a)). The principal disciplines involved with preparation of the EA were the following resource specialists:

Prepared By:

Jennie Hoblit, Environmental Specialist; Reclamation
Dan Fritz, Senior Environmental Specialist; Reclamation
Archaeologist – Patrick Welch, Reclamation
Fisheries Biologist –Mark Buettner, Reclamation
Civil Engineer – Bud Cook, Reclamation

Representatives of other agencies were also included in the preparation of the EA to provide resource expertise, technical assistance and provide ongoing review and input to the environmental analysis. These agencies include:

Bureau of Reclamation
US Fish and Wildlife Service
State Historic Preservation Office
State of Oregon
Oregon Department of Fish and Wildlife
City of Klamath Falls
US Army Corps of Engineers
Oregon Division of State Lands
Klamath Tribes

CHAPTER 5 – REFERENCES CITED

U.S. Bureau of Reclamation. 2000. Klamath Project Historic Operation. November 2000. U.S. Department of the Interior, Mid-Pacific Region Klamath Basin Area Office, Klamath Falls, Oregon.

U.S. Fish and Wildlife Service. 2001. Biological Opinion of Klamath Project Operations. April 2001. U.S. Department of the Interior, U.S. Fish and Wildlife Service.

U.S. Bureau of Reclamation. 2001. Link River Dam Fishway Replacement Feasibility Study. May 2001. . U.S. Department of the Interior, Mid-Pacific Region Klamath Basin Area Office, Klamath Falls, Oregon.

Appendix A

Link River Dam Fishway Replacement Feasibility Study

May, 2001

Link River Dam Fishway Replacement Feasibility Study

Prepared for
Bureau of Reclamation
Klamath Area Office

By

Bureau of Reclamation
Technical Service Center

May, 2001

Link River Dam Fishway Replacement Feasibility Study

Submitted to:
Bureau of Reclamation Klamath Area Office
Klamath Falls, Oregon

Investigations by:

Brent Mefford
Arthur Glickman
Rudy Campbell

United States Department of Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado 80225

March, 2001

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Link River Dam Fishway Concept Study

Study Objective

The Klamath Basin Area Office (KBAO) requested the Water Resources Research Laboratory (WRRL), Denver, Colorado conduct a study to investigate improving fish passage at Link River Dam. Link River Dam is located at the terminus of Upper Klamath Lake near Klamath Falls, Oregon, figure 1. The dam controls the elevation of Upper Klamath Lake and flow releases to Link River. The dam is considered a barrier to upstream passage of native fish species of Klamath Lake and the Klamath River system. This study proposes several fish passage concepts for improving upstream fish passage from Link River to Upper Klamath Lake.

Background

Link River extends for less than a mile between Upper Klamath Lake and Lake Ewauna. Link River Dam was constructed across a rock outcropping that formed part of a natural falls at the outlet of Upper Klamath Lake. About 600 ft downstream of the dam a series of falls still exist.

<u>Link River Dam (USBR, 2000)</u> Link river Dam was completed in 1921 and is operated by the Pacific Power and Light (PP&L) Company to provide hydroelectric power production and diversion of irrigation water. The reservoir, Upper Klamath Lake, is for the most part a natural lake that covers an area of 85,000 acres at reservoir water surface elevation 4143.3. It has an active storage capacity of 523,700 acre-feet between elevations 4143.3 and 4136 and an inactive storage capacity of 211,300 acre-feet between elevations 4136 and 4126. The dead storage volume below elevation 4126 has not been determined.

An unusual condition exists at Link River Dam in that hydraulic control of large outflows from Upper Klamath Lake is established at a reef located at the south end of the lake, approximately 0.4 miles upstream from the dam. A 100-foot-wide channel was cut through the reef to an invert elevation of 4131 feet when the dam was constructed; the remaining portion of the reef is at approximate invert elevation 4138. Because of the controlling influence of this reef, it is possible during large flood events to have reservoir water surface elevations in Upper Klamath Lake higher than the top of dam elevation of 4145.0, while water surface elevations between the dam and the reef are below the top of dam, provided that the dam gates are opened sufficiently to pass the water that flows over the reef. At maximum reservoir water surface elevation of 4143.3 feet, the maximum reef discharge is 8,500 ft3/s.

Link River Dam is a reinforced concrete buttress and slab diversion structure consisting of multiple slide gate and stoplog bays with a common operating deck at elevation 4145.0, see figure 2. It has a structural height of 22.0 feet, a hydraulic height of 8.0 feet, and a crest length of 435.0 feet. There is a total of 44gates in the Link River Dam and canal headworks structure, see appendix drawing A-1.

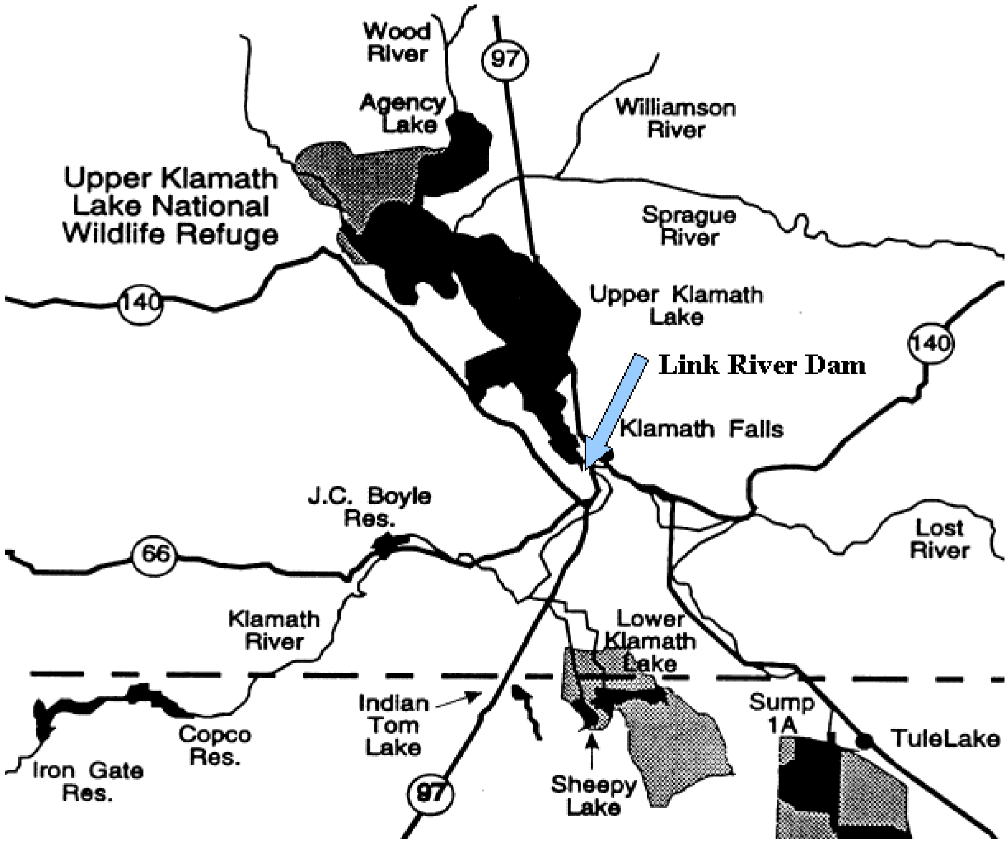


Figure 1 - Location of Link River Dam, Oregon.

Figure 2 - Link River Dam looking east from Keno Canal.

On the west abutment of the dam is the headworks for the Keno (West) Canal. This canal headworks consists of six gate bays, each bay with a 5.0-foot wide by 7.0-foot-high slide gate. The sill elevation of each gate bay is 4129 feet. The slide gates are operated by screw-lift hoists that are driven by an electric-motor driven chain-and-sprocket assembly, that is mounted on a gantry. The Keno Canal delivers water to the West Powerplant; the discharge from the west canal-outlet structure is limited to 290 ft^3/s by the capacity of the Keno Canal. Only two of the Keno Canal slide gates (the second and fourth gates from the right end of the dam) are routinely used to make releases into the canal.

East of the Keno Canal headworks are six river outlet gates. The river-outlet gate section consists of six bays, each with a 5.0-foot-wide by 7.0-foot high slidegate. The sill elevation of each gate is 4130 feet. The four gates on the right side of the river-outlet section are identical to the gates within the adjacent west canal outlet section, and are operated with the same gantry-mounted chain-and-sprocket assembly. The two left-most river-outlet gates have their own individual electric motor drive hoists. A stilling basin was constructed for the river-outlet section in 1952, see appendix figure A2. The design discharge capacity of the river-outlet section is 3,000 ft^3/s.

Continuing east across the dam are 24 stoplogged spillway bays numbered from west to east. A fish ladder occupies bay 24, the east most bay. Spillway bays are equipped with 8-foot-wide timber or concrete stoplogs. The 10 right-most spillway bays are equipped with steel-framed concrete panel stoplogs; the remaining spillway stoplogs are timber. The fish-ladder bay is not stoplogged. Stoplogs are removed and installed with an overhead monorail electric hoist and trolley. The crest elevation of each of the spillway bays is 4135 feet. The combined design discharge capacity of the spillway section is 13,000 ft^3/s. Only bays 1 through 10 are normally used to pass spillway flows.

The fish ladder that passes though spillway bay 24 was constructed in 1926, figure 3. The ladder is a pool and weir design originally constructed with 10 pools along its length, see appendix drawing A-3. Each weir was designed to provide about one foot of drop. In 1988 an additional pool was added at the downstream end to reduce an excessive water surface drop at the ladder entrance. The ladder is eight feet wide with weirs spaced eight feet apart. Weirs have four-feet long crests that can be stoplogged to adjust weir height. The fish ladder is laid out in an "L" shape that runs parallel to the spillway axis 25 feet downstream of spillway bays 17 through 24.

At the east (left) end of the dam is the headworks of the Ankeny (East) Canal, figure 4. The Ankeny canal-outlet headworks is composed of seven bays, each with a 5.0-foot-wide by 7.0-foot-high slide gate; each of the slide gates has its own electric-motor driven hoist. The Ankeny Canal headworks supplies water to a 12-foot diameter wood stave pipe that leads to the East Powerplant. The sill elevation of each gate bay is 4130 feet. The capacity of the pipe limits the discharge from the gate structure to 1,000 ft^3/s.

Figure 3 - View of existing Link River fishway.

Figure 4 - View of the Ankeny canal and headworks.

Major Fish Species of Concern (Perkins 2000) - Link river and Upper Klamath Lake support many fish species. Passage between Link River and Upper Klamath Lake is especially important for two native sucker species. The Lost River sucker *Deltistes luxatus* and shortnose sucker *Chasmistes brevirostris* are large, long-lived suckers endemic to the upper Klamath Basin of Oregon and California. Both species are typically lake dwelling but migrate to tributaries or shoreline springs to spawn. Once extremely abundant, both species have experienced severe population declines and were federally listed as endangered in 1988.

Shortnose Lake Sucker (FWS 1993) - Lakesuckers (genus *Chasmistes*) are differentiated from other members of the family Catostomidae by thin lips, the lobes of which are separated and may lack papillae, and by a large terminal, oblique mouth. The four recognized species are residents of three distinct drainage basins: cui-ui (*C. cujus*) in the Truckee River basin of western Nevada (Pyramid Lake); shortnose sucker (*C. brevirostris*) in the Klamath River basin of Oregon and California; June sucker (*C. liorus*) in Utah Lake; and the recently extinct Snake River sucker (*C. muriei*) of the upper Snake River in Wyoming.

The Lost River Sucker (FWS 1993) - The Lost River sucker was first classified as a member of genus *Chasmistes*. It was later reclassified into a new monotypic genus *Deltistes*. Lost River suckers are one of the largest sucker species growing to 3 ft in length. The Lost River sucker is distinguished by its long snout and a wide medium notch in the lower lip that has one or two large papillae between the notch and the edge of the lower lip.

Fish Passage Requirements at Link River Dam

Sucker passage - The shortnose sucker and Lost River sucker spawn in the spring. During spawning they move from the lake into tributaries or lake areas where springs are found. There is no evidence suckers migrate downstream into Link River during spawning. Upstream passage for suckers is primarily needed to allow fish access back to Upper Klamath Lake should they be carried downstream in spillway, outlet works or diversion flows. Three large water diversions are located on Upper Klamath Lake near the dam. The Keno and Ankeny power canals divert water adjacent to the dam. Both canals are unscreened and carry water to hydro-power plants located about one mile downstream. Fish survival after passing through the power plants is not well documented. However, both powerplants are low head facilities and likely pass significant numbers of entrained fish uninjured. Power plant flows reenter Link River near the confluence of Link River and Lake Ewauna. Fish carried downstream by power plant diversions must move upstream past Klamath Falls and Link River Dam to reenter Upper Klamath Lake.

Reclamation's A-Canal is located about 2,500 ft up-lake from the dam. The A-Canal diverts about 1,150 ft^3/s for irrigation. The canal is currently unscreened, however construction of fish screens in the canal is planned in the near future. Preliminary fish screen designs include an in-canal fish screen and fish bypass to the river downstream of Link River Dam. For this screen concept, lake resident fish entrained in the canal would be screened and reintroduced into Link River below the dam.

Rainbow Trout Passage - Passage for rainbow trout is also important at the dam. Trout migrate from Link River to Upper Klamath Lake in the fall when water temperatures drop.

Fishway Options

Power canals located on either abutment of the dam restrict fish passage alternatives to those that can pass through the dam. The types of fishpasses considered in the concept study were: flumes with vertical slot style baffles, flumes with denil style baffles, fish locks and fish trap/lift systems. Natural style rock fishways were not considered due to site constrictions and flumes with orifice or weir style baffles were not considered due to Fish and Wildlife Service experience with poor cui-ui passage through similar fishways. Fish locks and fish traps/lift systems were dropped from concept design because, compared to baffle fishways, the greater complexity and higher operation and maintenance costs of this type of passage system were not warranted for a low head dam.

Vertical Slot Fishway - A vertical slot fishway uses a series of baffles with vertical slots in each baffle, figure 5. The baffles are designed to create backwater pools between baffles and higher velocity flow through the baffle slots. The vertical slots allow passage at nearly all depths within the water column and can operate over a relatively large range of flows and river stage.

Denil Fishway - A Denil fishway uses closely spaced baffles to create strong turbulence and rapid energy dissipation to control flow velocity, figure 6. At a given depth, flow velocity is nearly constant along the chute while varying sharply with depth. Lowest velocities occur near the chute invert. The Denil design requires fish pass by swimming the length of the chute in a single burst. For long ladders, intermediate resting areas are used.

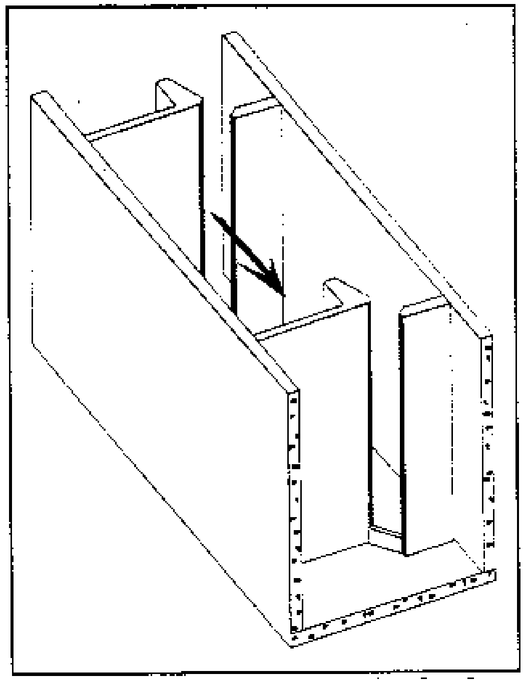


Figure 5 - Vertical slot baffled fishway, FWS, 1997.

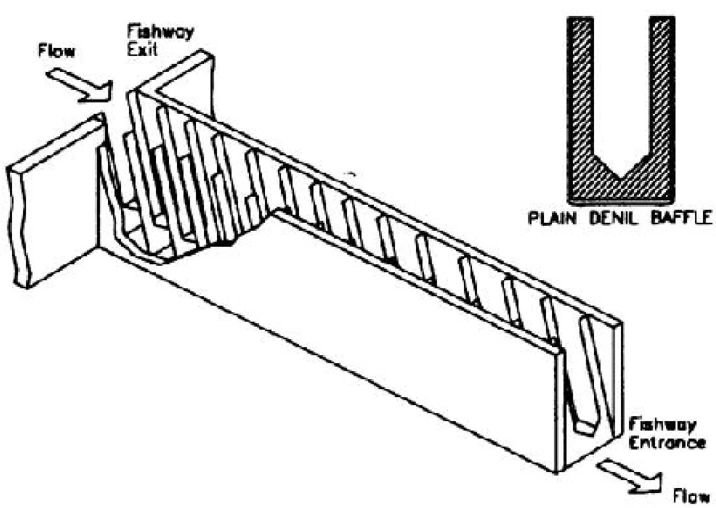


Figure 6 - Schematic of a Ďenil Fishway, FWS 1997.

Experience with Sucker Passage Through Baffled Fishways

Chiloquin Dam Fishway - Chiloquin Dam is located on the Sprague River near Chiloquin, Oregon. The dam creates about 10 ft of hydraulic head. An orifice and pool fishway is located on the right bank. The fishway has a 1:10 slope with nine pools. The original fishway was constructed with weir baffles which were found to be ineffective for passing Lost River and shortnose suckers. Weirs were replaced with baffles containing 12 inch by 16 inch orifices located about one foot below the surface. Each orifice creates a water surface change of about 1.1 ft with average passage velocities of about 6 ft/s. From the mid-1960's to the early 1980's Lost River and shortnose suckers were documented moving through the fishway (FWS Recovery Plan, 1993). However, the fishway is not thought to provide effective sucker passage. There are observations of fish moving into the ladder and dropping back (CH2M-Hill, 1996) and accounts of the ladder being a favorite spot of tribal members when snag fishery existed. A new vertical slot ladder at a 1:20 slope was proposed for the dam in 1996.

Pyramid Lake Fishway - Significant experience with lake sucker passage has been gained at Marble Bluff Dam, near Reno, Nevada. U.S. Fish and Wildlife Service (FWS), Reclamation and the Pyramid Lake Paiute Nation have worked with passage of cui-ui lake suckers since the early 1970's, Mefford 1998. Cui-ui migrate from Pyramid Lake upstream into the lower Truckee River to spawn in the spring. In 1970 Marble Bluff Dam was constructed to halt severe degredation of the Truckee River above Pyramid Lake. In conjunction with constructing the dam a 3 mile long fishway channel with a series of five weir and orifice style fish ladders was constructed for upstream passage. The fishway design was based on then-typical salmonid style fishways and available biological studies (Koch 1972, 1973, 1976; Ringo and Sonnevil 1977) of the cui-ui physical attributes. The baffled fishways were constructed on a 10 percent slope with combination weir/orifice baffles spaced every 10 ft of run, figure 7. The original water surface drop over each baffle was one foot. The fish ladders quickly proved to be nearly total barriers to cui-ui passage. Cui-ui which are bottom oriented fish native to lakes and low gradient stream environments failed to negotiate flow over weirs. Many cui-ui entering the fishway ladders stayed near the bottom avoiding the strong vertical turbulence of flow plunging over the weirs. Intermediate baffle walls were installed to reduce the water surface drop per pool

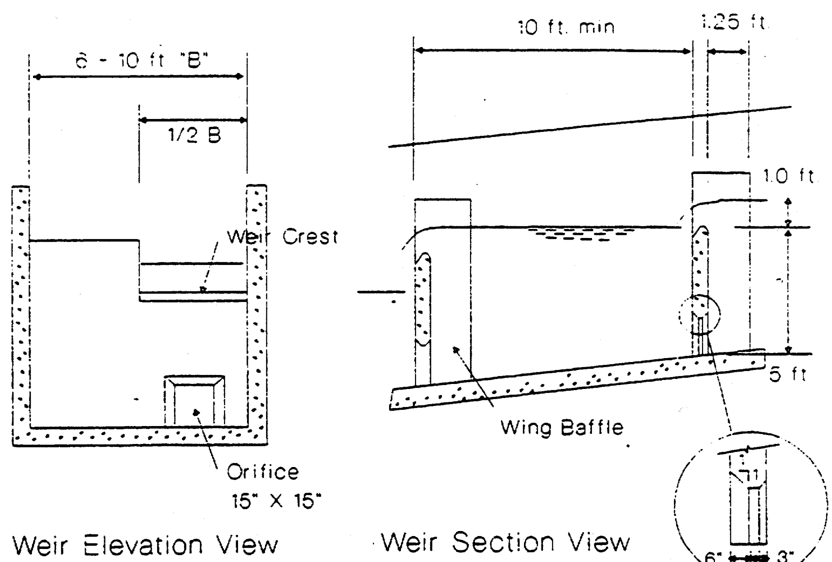


Figure 7 - Schematic of a Half-Ice Harbor fishway design, FWS 1997.

Figure 8 - Pyramid Lake fishway ladder. Shown, with temporary intermediate baffles.

to 0.5 feet, figure 8. Cui-ui passage improved; however crowding of weaker swimmers at ladder entrances continued to be a major problem. Fish and Wildlife Service sampling of fish that passed the ladders found a high percentage were young male cui-ui. This data indicated the pool and weir ladders were creating a degree of selective passage based on age and sex.

Pyramid Lake Fishway Exit Ladder - In 1995, Reclamation working with FWS, started investigating fish ladder designs for improving cui-ui passage. A number of ladder baffle designs and gradients were studied using laboratory models and numeric simulations. The design objectives for the project were; hold passage water velocity to about 4.5 ft/s and design baffles that maximize downstream flow within pools between baffles. Maximizing downstream flow in fishway pools resulted from field observations that indicated cui-ui tend to school densely and hold for long periods in large horizontal eddies. Holding may be due to fish disorientation due to poor visibility in turbid water coupled with the complex velocity field within a large eddy. The Pyramid Lake fishway exit ladder was replaced with a unique dual vertical slot baffle design in 1998. The fishway is 8 ft wide, 6 ft deep, with baffles placed every 8 ft of length, figure 9. The fishway gradient is 3.1 percent. Dual-slot-chevron shaped baffles were designed to maximize upstream passage attraction between baffles.

Figure 9 - Pyramid Lake Fishway exit ladder designed with chevron shaped vertical slot baffles (looking downstream).

Numana Fishway - The Numana Dam fishway, figure 10, is located on the Truckee River about 10 miles upstream of Pyramid Lake. The fishway is a typical vertical slot baffle design. The Numana fishway provides about 10 ft of elevation rise at a 5-percent slope with about 0.5 ft of drop per baffle. In 1998, FWS estimated about 60,000 cui-ui passed through the fishway. However, observations of fish crowding below the dam and in the fishway suggest many cui-ui are significantly delayed or prevented from passing the dam each year.

Figure 10 - View of Numana Dam vertical slot fishway.

Redlands Fishway - Redlands Fishway is located adjacent to Redlands Diversion Dam on the Gunnison River near Grand Junction, Colorado. The fishway was constructed to assist in the recovery of Colorado pikeminnow (Ptychocheilus lucius) and razorback suckers (Xyrauchen texanus) native to the Colorado River system. The fishway was designed on a 3.75 percent grade with vertical slot and orifice baffles spaced every 6 ft, figure 11. The total elevation difference across the ladder is about 10 ft. The ladder has been operating since 1996. A fish trap is operated at the top of the fishway to monitor fish passage and control upstream passage of some non-native species. Trap results from 1996 through 1998 show between 7,000 and 11,500 native fish including bluehead suckers (Catostomus discobolus), flannel mouth suckers (Catostomus latipinnis), roundtail chub (Gila robusta) and Colorado pikeminnow passed through the fishway each year (Burdick,1999). The predominant fish species passing through the fishway have been bluehead and flannel mouth suckers.

Figure 11 - View of the Redlands Fishway (looking downstream).

Fairford and Cowan Lake Fishways - Prototype studies of two Denil ladders on the Fairford River, Manitoba and Cowan Lake, Saskatchewan (Katopodis et al.,1991) found the ladders provided effective passage for sauger, walleys, white suckers, and other resident fish spieces. The Denil ladders at Fairford and Cowan slope at 12% with run lengths of between 15 and 30 ft, figure 12. The ladders have a total elevation drop of about 7 ft. At Fairford, velocities in the weir chutes varied from about 4.5 ft/s at 0.6 depth to about 2.3 ft/s at 0.2 depth. Slightly higher velocities were measured at Cowan. The velocities are above reported sustained swimming velocities of many species using the ladders. However, velocities were below burst swimming speeds. Weak swimmers were assumed to pass up the Denil ladders by holding close to the bottom in the lowest velocity zone. Nearly all documented fish using the ladders were adults. Katapodis’s study did not compare ladder usage to downstream fish populations. Therefore, the study results do not clearly show the overall effectiveness of the ladders. A previous Canadian study by Schwalme and Mackay (1985), of two Denil ladders and a vertical slot ladder found similar results to Katopodis's. The Schwalme and Mackay study also found juveniles and weaker swimmers appeared to prefer the vertical slot ladder.

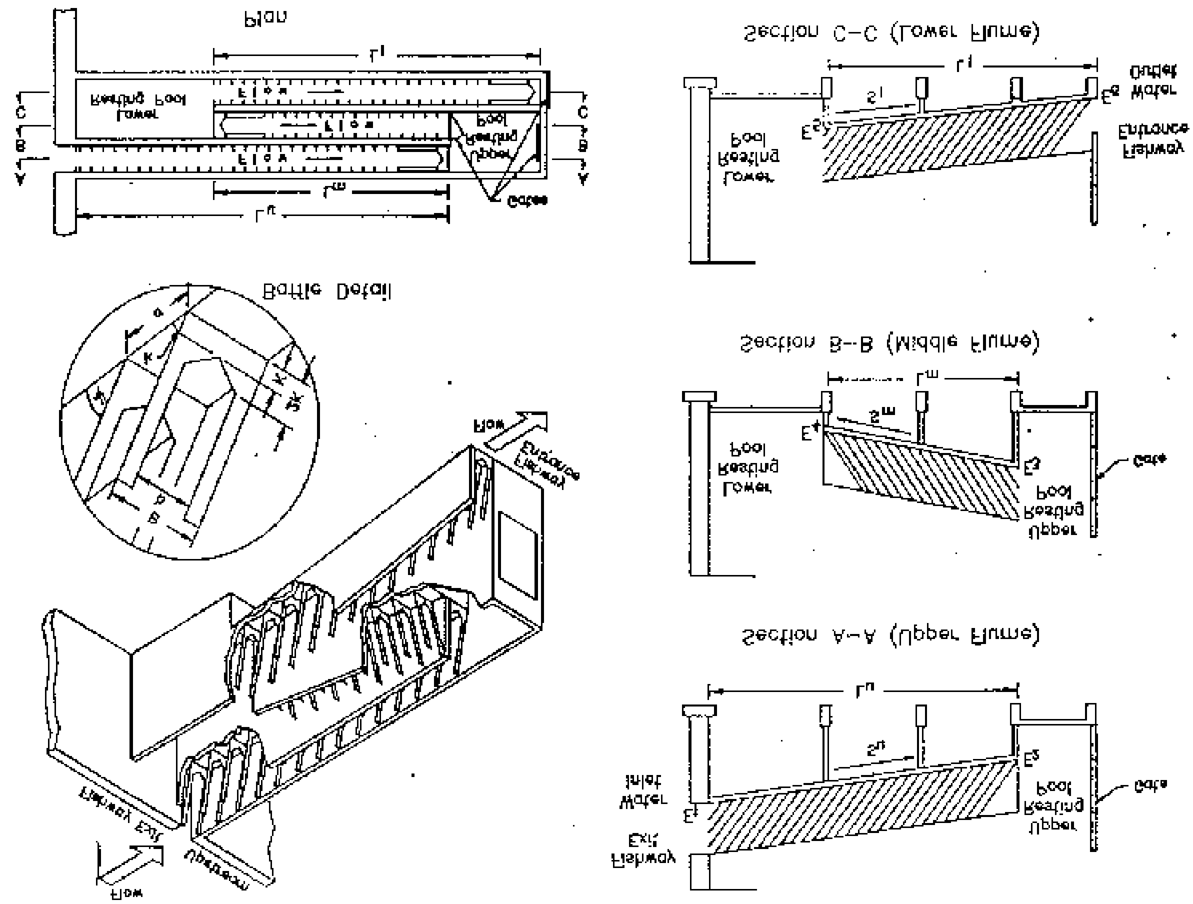


Figure 12 - Fairfield Denil fishway, Katapodis 1991.

WRRL Laboratory Tests - In 1998, a limited series of sucker passage tests were conducted in the Water Resources Research Laboratory using a Denil fishway set at a 5 percent slope. The laboratory flume tests investigated passage of 6 to 8 inch long razorback suckers through a 20 ft long Denil fishway. Observations of fish attempting to pass through the Denil fishway revealed passage was accompanied by a high rate of fall back within the fishway. Most suckers attempted to pass up the Denil fishway staying close to the fishway invert. Many of the fish observed became entrained in the strong vertical eddies that form near the floor behind each baffle. These fish would then loss swimming orientation and tumbled back down the fishway.

Previous Link River Dam Fish Passage Studies

Pacific Power and Light Company commissioned Link River Dam fish passage concept studies in 1986 (Orsborn) and 1990 (Ott). Both studies identify many problems with the existing pool and weir fish ladder. The main problems cited are poor attraction conditions and ladder hydraulics. Poor attraction conditions are largely caused by the ladders left bank location. To find the entrance of the existing ladder requires fish leave the main outlet works flow and follow what is referred to as the downstream cross channel toward the left abutment. The cross channel is an excavated channel that runs parallel to the dam downstream of the spillway gates. Fishway discharge flows behind the spillway gates to the left outlet works stilling basin wall then downstream to the main river channel. During non-spillway flows, only gate leakage and fishway flows (normally < 10 ft^3/s) provide attraction to the existing fishway entrance. During spillway operation high velocity jets issuing from the spillway gates into the cross channel impede attraction. Spillway operation creates a highly turbulent and chaotic flow condition in the cross channel.

The existing fish ladder is a weir and pool design with a horizontal bottom. Weirs control the fishway hydraulic slope. Weirs are the highest at the upstream end and successively decrease in one foot steps. The height of the fishway weirs must be manually adjusted to accommodate changes in lake and tailwater levels to maintain uniform flow conditions across each weir. If weirs are not properly adjusted for lake and tailwater elevations, the water surface drop through the entrance weir can be much greater than the upstream weirs. For example, Ott cites fishway pool elevations measured during a 1989 survey of the ladder. The survey shows a water surface drop of 2.0 ft across the entrance weir with less than one foot drop for upstream weirs. This flow pattern occurs whenever the fishway entrance depth is less than the exit depth.

The Osborn study proposed several modifications for the existing fishway and cross channel to improve attraction and passage. The main recommendations were:

1. The lower cross channel outlet should be revised with a concrete weir and slot structure to provide better attraction.
2. A removable, diagonal, barrier should be installed upstream of the fishway entrance to keep fish from swimming upstream of the fishway entrance.
3. The entrance to the fishway should be reconstructed with two chambers and a slotted entrance to improve attraction over a wide range of flows.
4. The fishway should be modified to a series of three Denil fishway sections within the existing structure, (see appendix figure A3).

The Ott Engineering study presents on two alternatives for modifying the existing fishway and reference to other alternatives that require the construction of new fishways. The main fishway alternatives proposed are:

1. Modify the existing ladder weirs to vertical slot baffles and reduce the water surface elevation of the existing fishway by using the cross channel as part of the ladder. The proposal adds five slotted baffles and pools along the cross channel, (see appendix figure A4). The baffles would each provide a water surface drop of about 0.8 ft.
2. Reconstruct the existing fishway to a vertical slot fishway. Lengthen the fishway by adding six additional pools downstream of the existing fishway entrance, (see appendix figure A5). Similar to Alternative 1, the baffles would each provide a water surface drop of about 0.8 ft.

Link River Dam Hydraulics

Upper Klamath Lake - The top of active conservation for Upper Klamath Lake is elevation 4143.3 feet. Average, minimum and maximum lake elevation for Upper Klamath Lake based on monthly data for the years 1921 to 2000 are given in figure 13. Lake elevations typically peak in March and April then drop through October . On average lake elevations decline about 2.5 ft from March through October. The maximum decline of lake elevation recorded during the March through October period was 5.8 ft. Figure 14 shows monthly lake elevation data in percent exceedance. There is a 95 percent probability that lake elevation will be between elevation 4138.0 and 4143.3 during the main fish migration period of March through November.

Link River Flow - Link River flows are totally derived from releases from Link River Dam. Daily average river flow for the period September 1989 through September 1999 is given in figure 15. River flow was calculated by subtracting daily East Canal flows provided by Pacificorp from flow measured at US Geological Survey river gauge 11507500. The data plotted is considered approximate. Figure 15 shows outlet works releases increased from about mid-1994 to 1999 over the previous 5 years. Pacificorp indicated higher outlet works flows in recent years were due to changes in dam operation to increase fishery flows below the dam (personal communication). Figure 16 gives calculated river flow data in percent exceedance for the yearly period of March through November. For the ten year period of record, flow through the river outlets occurred about 60 percent of the time and 49 percent of the time exceeded 100 ft^3/s. River outlet flows from 1995 to 1999 were significantly higher than the previous five years. Outlet flow occurred about 88 percent of the time and 82 percent of the time exceeded 100 ft^3/s. During both the 1989-1999 and 1995-1999 periods five percent of the time flows exceeded outlet works capacity (3,000 ft^3/s).

Tailwater Elevation at the Dam - Tailwater data is not available for the area just downstream of the dam. The only tailwater data available is presented by Ott (1990). Ott cites the tailwater elevation at the end of the outlet works training wall as 4130.5 with gates closed, minimal gate leakage and the fishway operating. He made observations of highwater marks left by then recent high flows and estimated the tailwater rises below the dam about six to eight feet for a flow of 4,000 ft^3/s. For the purposes of this concept report, the tailwater elevation for 100 ft^3/s river flow was estimated by assuming the river immediately downstream of the outlet stilling basin acts like a broad crested weir with a crest length of about 50 ft. This approach gives an estimated tailwater elevation 0.75 ft above the gates closed condition given by Ott. Herein the tailwater elevation for a flow of 3,000 ft^3/s is assumed to be 6 ft higher than the gates closed elevation. Therefore, tailwater elevations at the outlet works training wall for flows of 100 ft^3/s and 3,000 ft^3/s are estimated as 4131.5 and 4136.5, respectively.

Operating procedure for flow releases - Flow is normally released through the outlet works. When flow release requirements exceed outlet works capacity, spillway gates are progressively opened starting adjacent to the outlet works and proceeding toward the left bank.

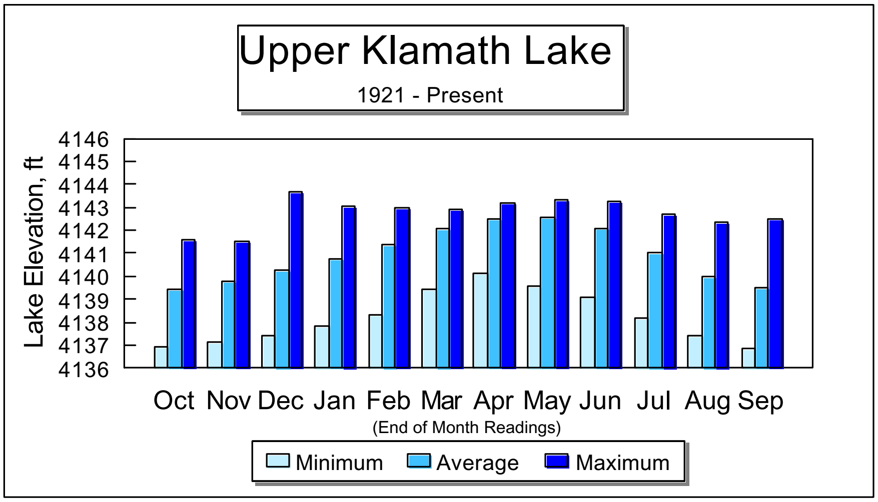


Figure 13 - Monthly minimum, average and maximum lake elevation based on historic data.

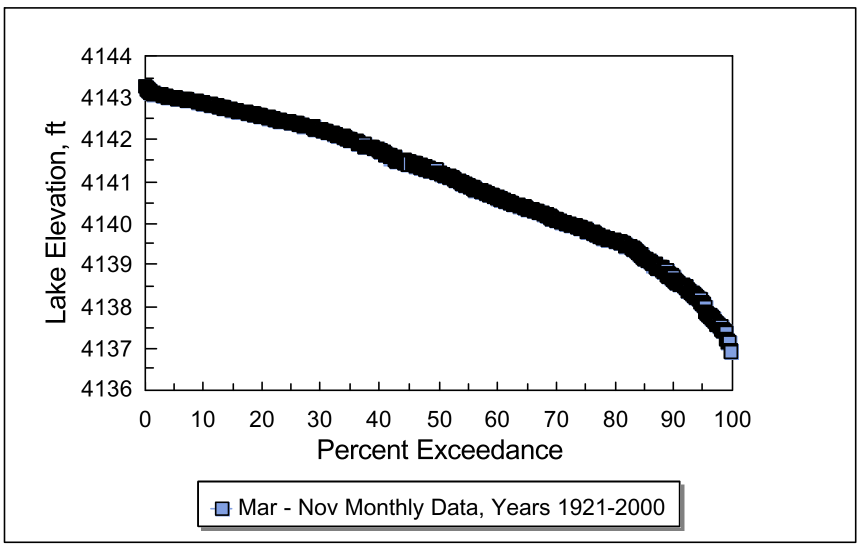


Figure 14 - Klamath Lake Elevation data in percent exceedance.

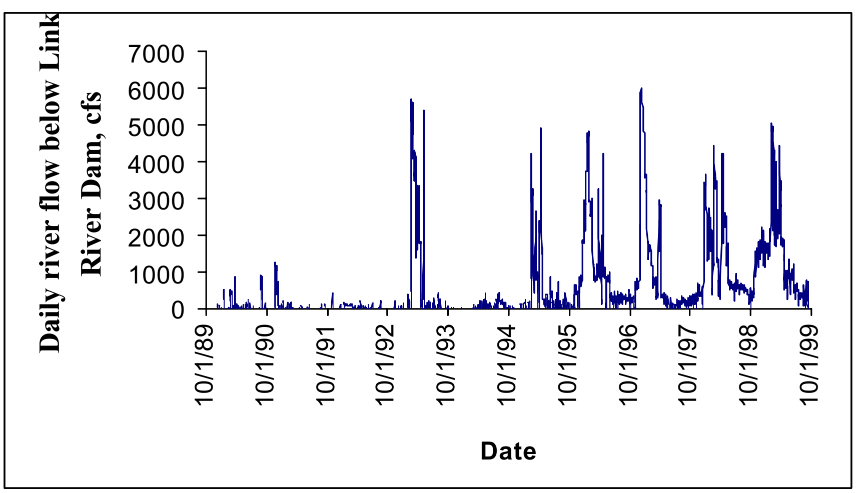


Figure 15 - Daily river flow below Link River Dam.

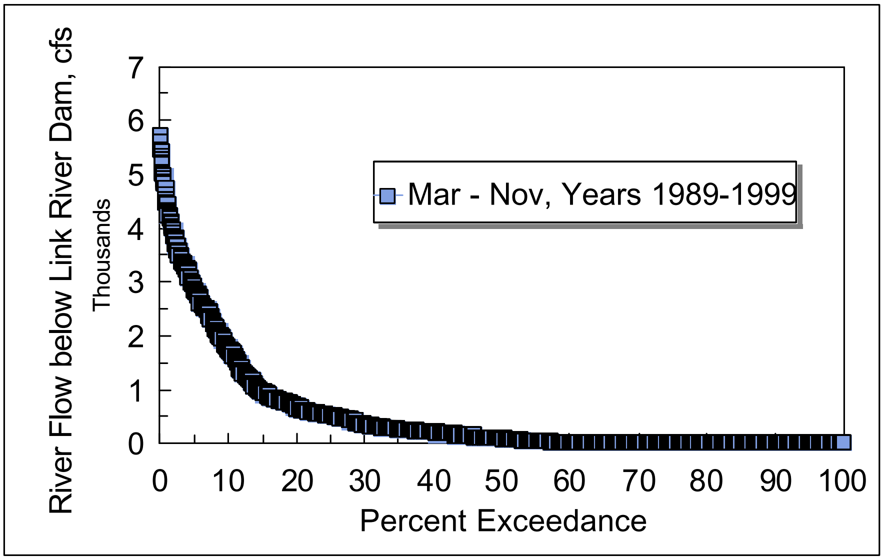


Figure 16 - River flow below Link River Dam in percent exceedance.

Summary of Fishway Hydraulic Design Conditions

Table 1 - Fishway hydraulic design limits (local USBR datum, for NAV 88 add 2.2 ft)

	Lake Elevation, ft	Tailwater Elevation, ft	River Flow, ft^3/s
Maximum	4143.3	4136.5	3,000.0
Minimum	4138.0	4131.25	100.0

Based on these conditions a maximum difference in hydraulic height of 12 ft occurs for maximum reservoir and minimum flow release for passage. The range of lake elevation and tailwater elevation for fishway design are 5.3 ft and 5.25.0 ft, respectively. Figure 17 gives 1989 through 1999 historic data for Link River flow and Klamath Lake elevation. The data shows low river releases frequently occurred at high lake elevations. Also during the period, when lake elevations were below 4140 river releases were usually less than 1,000 ft^3/s.

Design objectives for the fishway used for the concept study are based largely on experience with passage of lake sucker species and other river suckers in the western United States. Options for a new Link River Dam Fishway were considered that provide for:

- A differential head range between the entrance and exit of between 12 ft and 6.0 ft,
- a minimum fishway depth of 2 ft,
- a minimum fishway attraction velocity of 1 ft/s,
- flow depth fluctuations of up to 5.3 ft above minimum,
- fish passage at any flow depth,
- a maximum passage velocity of 5.0 ft/s and
- strong attraction flows to the fishway entrance.

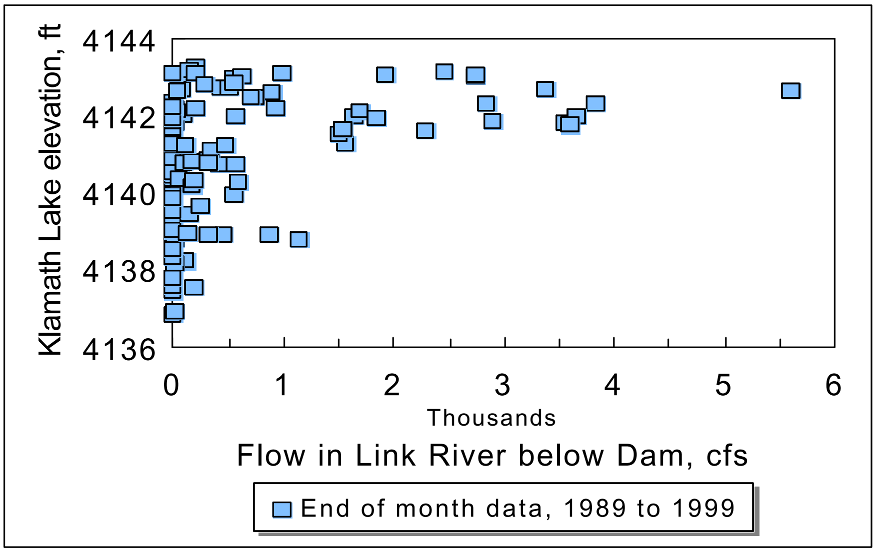


Figure 17 - Klamath Lake elevation versus Link River flow for the years 1989 to 1999.

Fishway Alternatives

Fish passage experiences at Chiloquin Dam, Marble Bluff Dam, Numana Dam, Redlands Dam and the WRRL indicate a general trend of declining sucker passage efficiency as ladder slope, flow velocity and flow turbulence increase. Based on these case studies three fishway alternatives were developed for Link River Dam. All proposed alternatives are similar in hydraulic design. A vertical slot fishway design is proposed consisting of a chute sloping at 4.75 percent containing 33 vertical slot baffles designed for a water surface drop of 0.36 ft per baffle. A comparison of hydraulic design parameters to those of other fishways referenced in the study are summarized in Table 2. The proposed design would provide passage velocities about 0.8 ft/s lower than Numana Fishway and about 0.3 ft/s greater than the new Pyramid Lake exit ladder.

Table 2 - Comparison of proposed fishway hydraulic design to other fishways where sucker species are present.

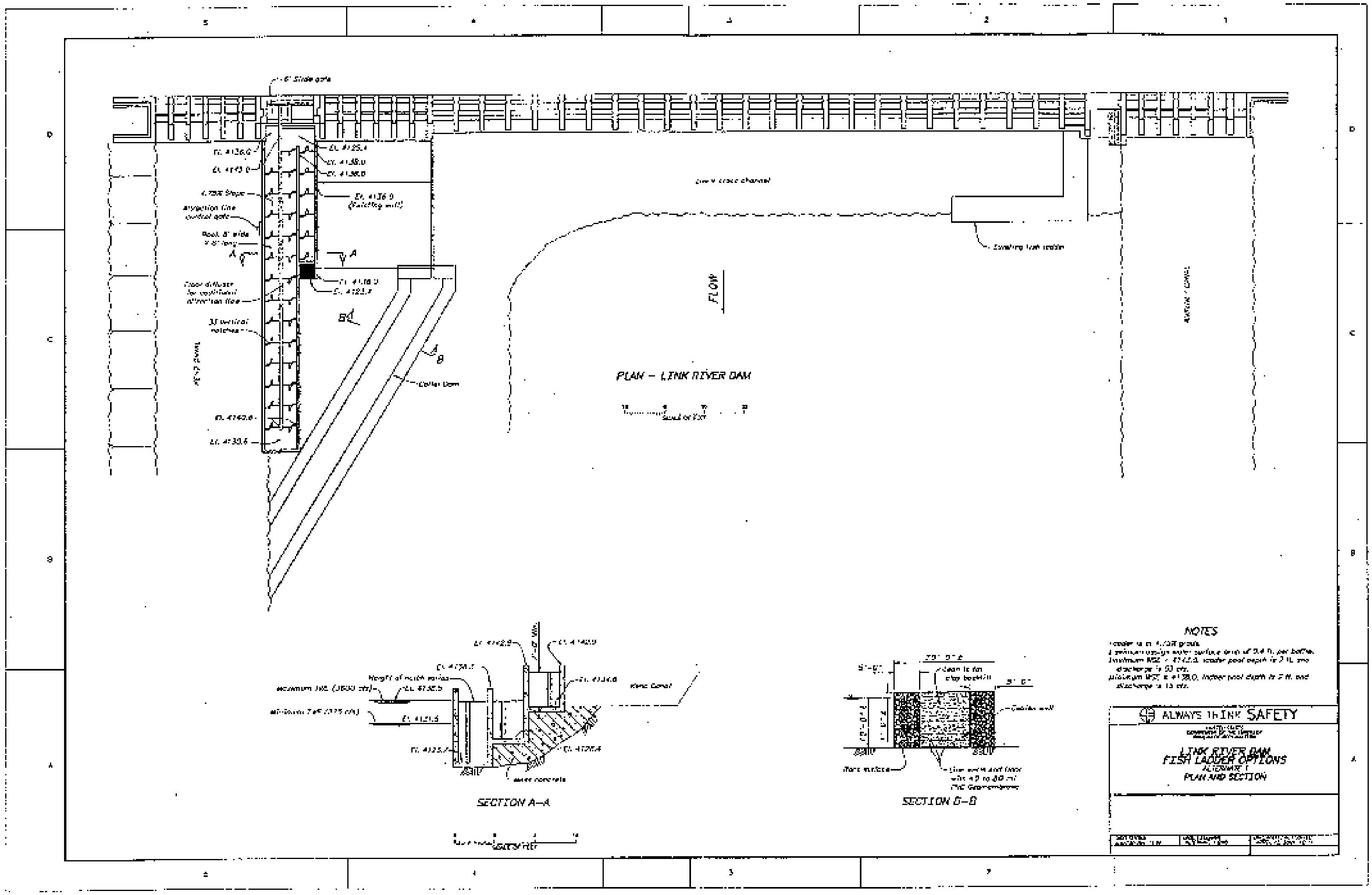
Fishway	Location	Sucker species present	Baffle type	WS drop per baffle, (ft)	Peak velocity across baffle, (ft/s)	Channel slope, (%)
Proposed design	Link River	Lost river and short nose suckers	Vertical slot single or dual	0.36	4.8	4.75
Chiloquin Dam	Lost River Oregon	Lost river and short nose suckers	12"x16" orifice 1 foot below water surface	1.1	8.4	10.0
Pyramid Lake (modified with intermediate baffles)	Truckee River, Nv	Cui-ui	Weir and pool	0.5	5.7	10.0
Numana	Truckee River, Nv	Cui-ui	Vertical slot	0.5	5.6	5.0
Pyramid Lake (Exit ladder)	Truckee River, Nv	Cui-ui	Vertical dual slot chevron shape	0.3	4.5	3.1

Redlands	Gunnison River, Co.	Razorback, bluehead and flannel mouth suckers	Vertical slot	0.23	3.8	3.75
Fairford and Cowan Lake Fishways	Fairfield River Manitoba, Canada	White suckers	Denil	NA	(Measured Vel.) 4.5 at .6 depth, and 2.3 at .2 depth	12.0

Single or dual vertical slot fishway baffle designs similar to Redlands or the Pyramid Lake fishway exit ladder could be used in each fishway alternative presented. The fishway concept alternatives developed vary mainly in location and need for supplemental attraction flow. When ever possible, locating a fishway entrance adjacent to a dam's main flow release structure is preferred. The old saying "go with the flow" is especially true for upstream migrating fish. Studies by Pavlov, (1989) indicates fish move upstream seeking flow at a velocity of between 0.6 and 0.8 times their maximum cruising velocity. If flow velocity is lower than about 0.3 times the fish's cruising speed, fish lose orientation to the flow direction and often hold or drift downstream. Based on studies of cui-ui by Ringo and Sonnevil (1977) and Koch and Contreras (1972) the maximum cruising speed of cui-ui is about 4 to 5 ft/s. A similar velocity range is assumed for the Lost River and shortnose sucker. Following Pavlov's study, attraction flow velocity for lake suckers should be between about 1.0 to 3.0 ft/s. This criteria was followed in selecting fishway location. This concept study presents two fishway concepts located adjacent to the river outlet works and an east bank fishway. Fishway concepts located adjacent to the river outlets offer the best attraction flow conditions while the east bank fishway offers the least effect on existing structures, but will require larger auxiliary attraction flow releases. All fishway designs present in this report are concept level. Prior to final design, additional field data needs to be collected on the Link River Dam and tailwater elevation versus Link River flow releases.

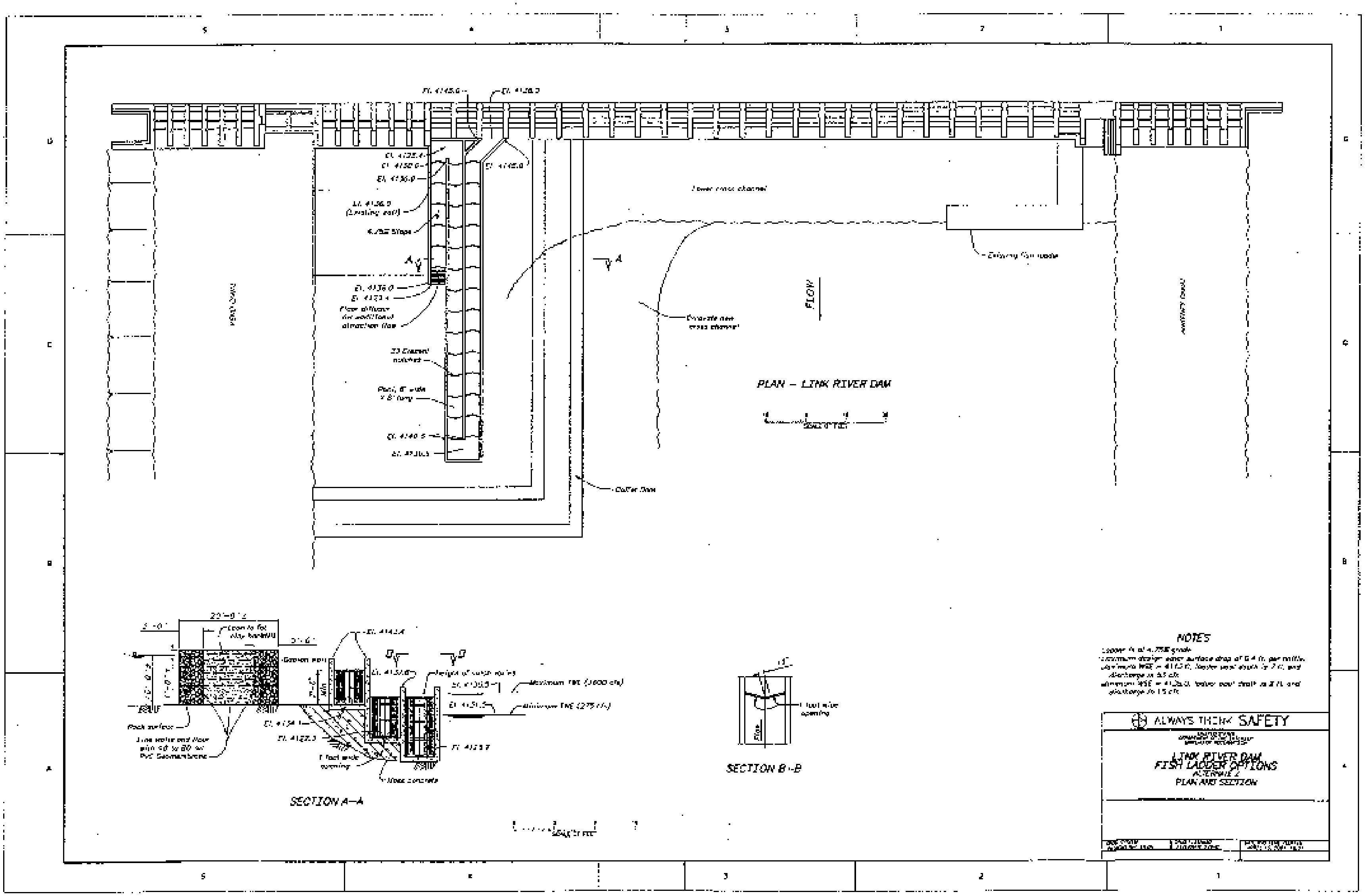
Alternative No.1 - A west bank ladder is proposed lying between the Keno Canal and the outlet works stilling basin guide wall, figure 18. The fishway exit would penetrate the dam between the Keno Canal headworks and the outlet works, figure 19. The fishway would slope at about 4.75 percent with 33 six-ft-wide by eight-ft-long pools separated by vertical slot baffles. A water surface change of about 0.36 ft would occur across each baffle for lake elevation 4143.3 and a downstream river flow of 275 ft^3/s. During periods of large river releases, auxiliary attraction flow would be supplied through floor diffusers near the fishway entrance to maintain a minimum attraction velocity of 1.0 ft/s. To minimize the risk of re-entrainment of fish exiting the fishway the canal gate adjacent to the fishway exit would be closed during normal operation.

Figure 18 - View looking upstream at Keno Canal and the west outlet works stilling basin wall.


PLAN – LINK RIVER DAM
FLOW
SECTION A–A
SECTION B–B
NOTES
ALWAYS THINK SAFETY
LINK RIVER DAM
FISH LADDER OPTIONS
PLAN AND SECTION

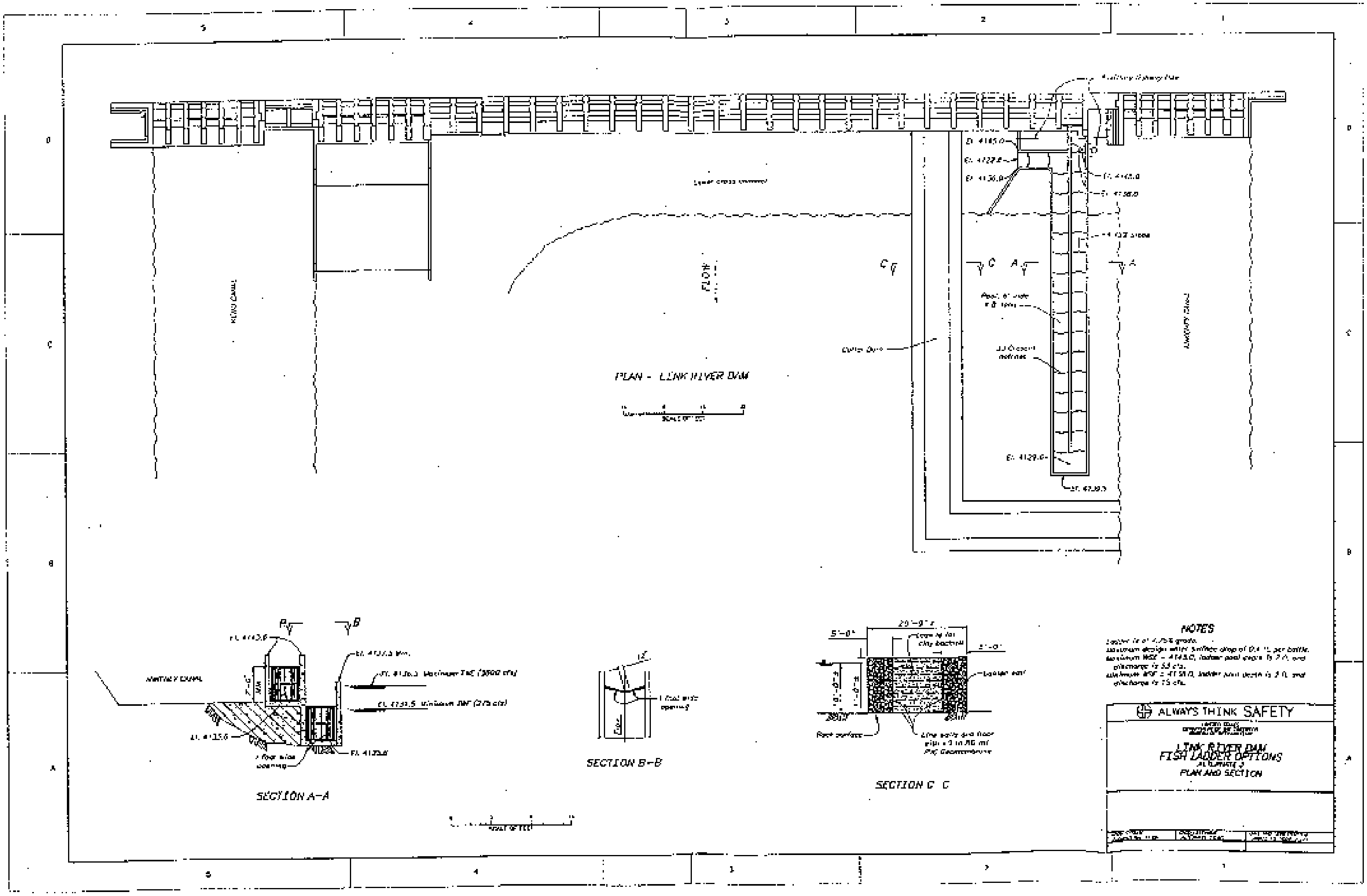
Alternative No.2 - Alternative No. 2 places the fishway ladder adjacent to the east wall of the outlet works stilling basin, figure 20. The fishway would exit through an existing spillway gate opening. The fishway would slope at about 4.75 percent with 33 six-ft-wide by eight-ft-long pools separated by vertical slot baffles, figure 21. A water surface change of about 0.36 ft would occur across each baffle for lake elevation 4143.3 and a downstream river flow of 275 ft^3/s. During periods of large river releases, auxiliary attraction flow would be supplied through floor diffusers near the fishway entrance to maintain a minimum attraction velocity of 1.0 ft/s. This concept would require spillway gates 1, 2 and 3 be removed from service. Operation of gate four would increase the risk of fish re-entrainment and would only be operated when necessary to pass flood flows.

Figure 20 - View looking downstream along the east wall of the outlet works stilling basin.


PLAN – LINK RIVER DAM
FLOW
SECTION A–A
SECTION B–B
NOTES
ALWAYS THINK SAFETY
LINK RIVER DAM
FISH LADDER OPTIONS
PLAN AND SECTION

Alternative No.3 - Construction of a east bank ladder is proposed adjacent to the Ankeny Canal, figure 22. The proposed fishway would use the existing fishway exit. The fishway would slope at about 4.75 percent with 33 six-ft-wide by eight-ft-long pools separated by vertical slot baffles, figure 23. A water surface change of about 0.36 ft would occur across each baffle for lake elevation 4143.3 and a downstream river flow of 275 ft^3/s. Auxiliary attraction flow would be required to increase flow velocity in the cross channel to about 1 ft/s minimum. Three options for attraction flow are possible. First, an existing spillway bulkhead gate located near the fishway exit could be replaced with a bulkhead and 30 inch gate valve. Second, a 30 inch pipe and gated flow control structure could be constructed to provide water from the Ankeny Canal downstream of the headworks. Third, the A-Canal fish bypass could enter the river adjacent to the fishway entrance. This option for increasing fishway attraction flow is similar to Fish Screen Bypass Option 2 presented in the A-Canal fish screening feasibility report, (Montgomery Watson, 2001). This option would require larger attraction flow releases than Alternatives 1 or 2, but would not effect operation of the dam or diversion canals. Fishway attraction would be poor during spillway operation.

Figure 22 - View looking west along the cross channel from the existing fishway.


PLAN - LINK RIVER DAM
FLOW
SECTION A-A
SECTION B-B
SECTION C-C
NOTES
ALWAYS THINK SAFETY
LINK RIVER DAM
FISH LADDER OPTIONS
PLAN AND SECTION

Fishway Construction

Alternative No.1 - Several site conditions effect construction of a west bank fishway at Link River Dam. First, construction access is restricted by the power canals that divert flow on each abutment and run p arallel to the river channel. The Keno Canal lies adjacent to the proposed fishway. Fishway construction would likely require shutting down the canal during the construction period. Construction access would be achieved from the west abutment across the canal. The dam is constructed on a large rock outcropping that forms Klamath Falls. Exposed surface rock extends well upstream and downstream of the dam. The exposed foundation rock requires site dewatering be achieved by constructing an earth cofferdam. An earth and rock gabion structure with a membrane lining is proposed from the east wall of the outlet works stilling basin to the Keno canal, see figure 19. River flows would be passed downstream using the spillway gates. Coffer damming upstream of the dam was assumed not necessary to penetrate the dam at the fishway exit. This assumption would be reviewed following collection of additional field data.

Alternative No.2 - Construction access would be from the west abutment. Depending on cost, the Keno Canal could be shut down or temporary bridging installed during fishway construction. Bridging the canal is assumed in the concept level cost estimate. The cost of shutting off the canal was not estimated for this study. Dewatering would require constructing a coffer dam from spillway bays five and six downstream and across the river, see figure 22. An earth and rock gabion coffer dam similar to Alternative 1 is proposed. River flows would be released using spillway gates seven through 10. No upstream coffer dam is necessary. Spillway gate No. 3 would be used as a bulk head during construction. Following fishway construction, gate hoists one, two and three could be removed and placed in spillway bays 11, 12 and 13. The new fishway would require rock excavation downstream of spillway gates four, five and six to re-established a channel between the downstream cross channel and the low river channel.

Alternative No.3 - Construction access would be from the east abutment. Access would have to be provided across the Ankeny Canal and a temporary road constructed downstream of the cross channel. Bridging the canal to provide construction access is assumed in the concept level cost estimate. A cost evaluation of shutting down the canal or bridging was not conducted. Dewatering would require constructing a coffer dam from Spillway Bay 18 to the Ankeny canal downstream of the proposed fishladder, see figure 23. An earth and rock gabion coffer dam similar to Alternative 1 is proposed. During construction river flows would be released using the outlet works. Spillway gates 1 through 10 could be used if required. No upstream coffer dam is assumed necessary.

Construction Period - Figure 24 gives the occurrence of historic river flows that exceeded a total flow of 3,000 ft^3/s at the Link River USGS gage for the years from 1969 to 1988. During this period river flows exceeded the capacity of the river outlets in most years requiring spillway gates to be opened. Link River Dam releases for the years 1989 to 1999 versus time of year given in figure 25 show lowest river flows occur from July through August. Figure 26 presents July through August flow data in percent exceedance. During this period, river flow releases occurred about 50 percent of the time and exceeded 1000 ft^3/s less than one percent of the time.

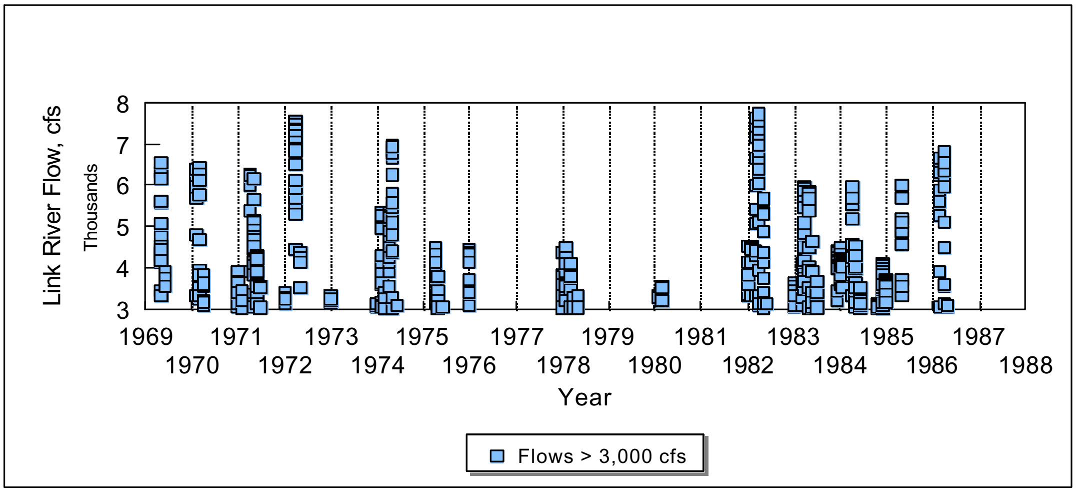


Figure 24 - River flows requiring operation of Link River Dam spillway bays during the period 1969 to 1988.

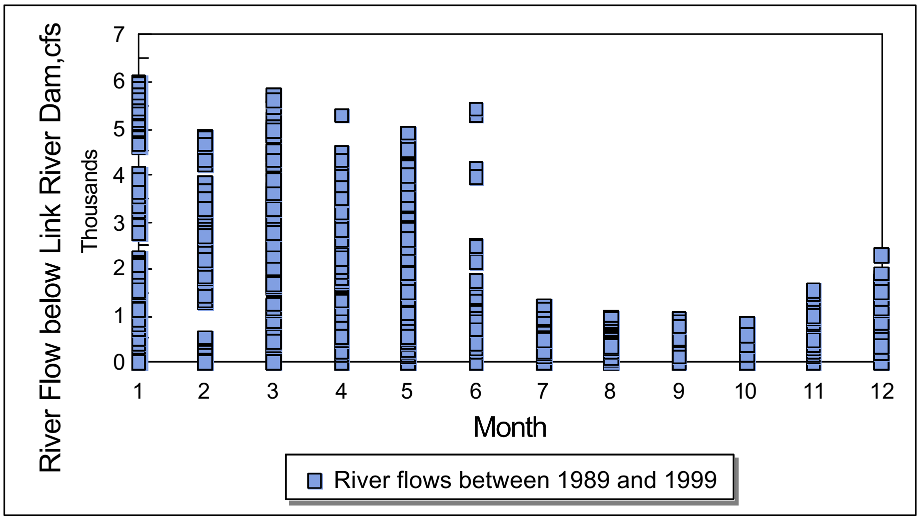


Figure 25 - Link River flows by month for the period 1989 to 1999.

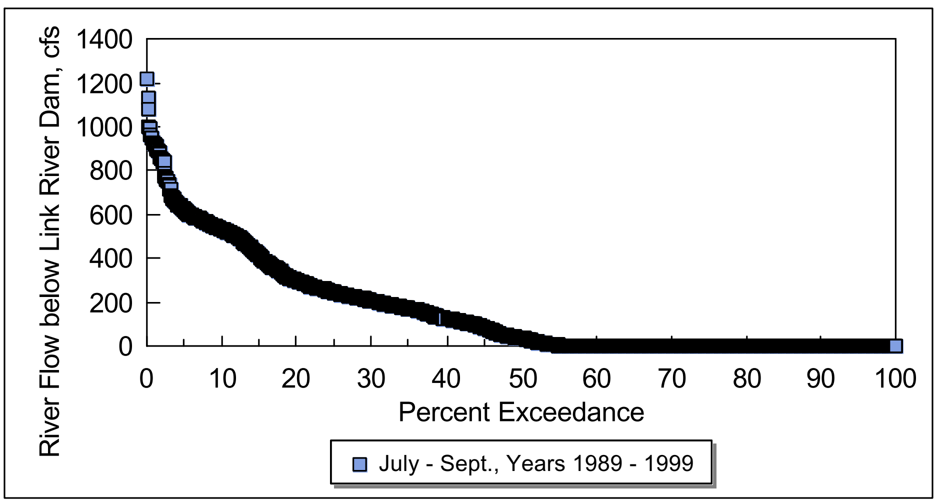


Figure 26 - Link river flow percent exceedance for the months July through August, 1989 to 1999.

Construction Cost Estimates

Concept level cost estimates for each fishway alternative are given in tables 2-4. The estimates are based on limited available data of existing structures and site conditions. The estimated cost of Alternative 1 is $725,000 plus the cost of shutting down the Keno Canal for about 1 month. The estimated cost of Alternative 2 is $730,000. Alternative 2 would not require the Keno Canal to be shut down. The estimated cost of Alternative 3 is $670,000. Alternative 3 would not require the Ankeny Canal to be shut down.

Recommended Alternative

Fishway Alternatives 1 or 2 offer the best fish attraction conditions for river outlet operation and spillway operation at a similar construction cost. Re-entrainment concerns for fish existing fishway Alternatives 1 or 2 would likely require future changes in management of release gates to minimize use of gates adjacent to the fishway exit. For all fishway alternatives, dual vertical slot fishway baffles are recommended. This baffle design will pass about 25 percent more flow through the fishway and reduce the pool area consumed by large eddies. Fishway Alternative 3 is considered less desirable than Alternatives 1 or 2 due to poor fish attraction that would occur when large flows are released through the outlet gates and or spillway gates. Access for fishway maintenance is a concern for all three fishway alternatives. Sight constraints currently limit maintenance access downstream of the dam. Fishway maintenance access was beyond the scope of this study, but should be addressed in selection of a preferred alternative.

Table 3 - Concept Level Construction Cost Estimate for Fishway Alternative No. 1

CODE:D-3521 **ESTIMATE WORKSHEET** SHEET 1 OF 1

FEATURE: 23-Apr-2001 **PROJECT:** Link River - Fishway

Link River Fishway Concept
East Bank Fishway, Alternative 1

DIVISION:

UNIT:

C:\MYFILES\LINK\LINKEST.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Civil Works					
		Channel					
		Concrete		290	yds	$450.00	$130,500
		Reinforcement		35,000	lbs	$0.65	$22,750
		Cement		70	ton	$110.00	$7,700
		Earthwork (25% of the above)					$40,238
		Cofferdaming (gabion and earth)					
		compacted fill		360	yds	$5.00	$1,800
		rock gabions		360	yds	$25.00	$9,000
		unwatering (furnish and operate 250 gpm pump)		1	ea	$2,000.00	$2,000
		Mechanical					
		Removable Baffles					
		Steel		38,200	lbs	$3.00	$114,600
		Attraction flow structure					
		Steel diffuser panel (72 sf)		2,000	lbs	$2.00	$4,000
		Steel pipe (24 inch, 100 ft)		3,200	lbs	$2.50	$8,000
		24 inch gate valve		1,500	lbs	$4.50	$6,750
		Manually operated, fabricated steel slide gate		2,500	lbs	$8.50	$21,250
		6' wide by 7' high, with pedestral					
		Site access					$55,288
		Earth fill across canal and temporary					
		roads (install and remove)		2,500	yds	$7.50	$18,750
		Mobilization (5 percent of above)					$21,194
		Subtotal					$463,819
		Unlisted items (25 percent)					$115,955
		Subtotal					$579,774
		Contingencies (25 percent)					$144,944
		Total					$724,718

QUANTITIES		PRICES	
BY		BY	CHECKED
DATE PREPARED	APPROVED	DATE	PRICE LEVEL

Table 4 - Concept Level Construction Cost Estimate for Fishway Alternative No. 2

CODE:D-3521 **ESTIMATE WORKSHEET** SHEET 1 OF 1

FEATURE: **23-Apr-2001** **PROJECT:** Link River - Fishway

Link River Fishway Concept
Mid-Channel Fishway, Alternative 2

DIVISION:

UNIT:

C:\MYFILES\LINK\LINKEST.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Civil Works					
		Channel					
		Concrete		270	yds	$450.00	$121,500
		Reinforcement		32,000	lbs	$0.65	$20,800
		Cement		65	ton	$110.00	$7,150
		Earthwork (25% of the above)					$37,363
		Cofferdaming (gabion and earth)					
		compacted fill		720	yds	$5.00	$3,600
		rock gabions		720	yds	$25.00	$18,000
		unwatering (furnish and operate 250 gpm pump)		1	ea	$2,000.00	$2,000
		Mechanical					
		Removable Baffles					
		Steel and guid		38,200	lbs	$3.00	$114,600
		Attraction flow structure					
		Steel diffuser panel (72 sf)		2,000	lbs	$2.00	$4,000
		Steel pipe (24 inch, 50 ft)		1,600	lbs	$2.50	$4,000
		24 inch gate valve		1,500	lbs	$4.50	$6,750
		Site access					$50,964
		Prefabricated bridge		680	sf	$65.00	$44,200
		abutments and temporary roads (25% of bridge)					$11,050
		Mobilization (5 percent of above)					$19,536
		Subtotal					$465,513
		Unlisted items (25 percent)					$116,378
		Subtotal					$581,892
		Contingencies (25 percent)					$145,473
		Total					$727,364

QUANTITIES		PRICES	
BY		BY	CHECKED
DATE PREPARED	APPROVED	DATE	PRICE LEVEL

Table 5 - Concept Level Construction Cost Estimate for Fishway Alternative No. 3

CODE D-3521

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE:	23-Apr-2001 PROJECT: Link River - Fishway
Link River Fishway Concept West Bank Fishway, Alternative 3	DIVISION:
C:\MYFILES\LINK\LINKEST.WK4	UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Civil Works					
		Demolition of existing fishway		150	yds	$150.00	$22,500
		Channel					
		Concrete		270	yds	$450.00	$121,500
		Reinforcement		32,000	lbs	$0.65	$20,800
		Cement		65	ton	$110.00	$7,150
		Earthwork (25% of the above)					$37,363
		Cofferdaming (gabion and earth)					
		compacted fill		720	yds	$5.00	$3,600
		rock gabions		720	yds	$25.00	$18,000
		unwatering (furnish and operate 250 gpm pump)		1	ea	$2,000.00	$2,000
		Mechanical					
		Removable Baffles					
		Steel		38,200	lbs	$3.00	$114,600
		Attraction flow structure					
		Steel diffuser panel (72 sf)		2,000	lbs	$2.00	$4,000
		Steel pipe (24 inch, 100 ft)		3,200	lbs	$2.50	$8,000
		24 inch gate valve		1,500	lbs	$4.50	$6,750
		Site access					
		Prefabricated bridge		816	sf	$65.00	$53,040
		abutments and temporary roads (25% of bridge)					$13,260
		Mobilization (5 percent of above)					$17,188
		Subtotal					$427,251
		Unlisted items (25 percent)					$106,813
		Subtotal					$534,063
		Contingencies (25 percent)					$133,516
		Total					$667,579

QUANTITIES		PRICES	
BY		BY	CHECKED
DATE PREPARED	APPROVED	DATE	PRICE LEVEL

References

Buettner M. and Scoppettone G., “Life Histroy and status of Catostomids in upper Klamath Lake, Oregon,” National Fisheries Research Center, Reno Field Station, Nevada, 1990.

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United States Fish and Wildlife Service, “Fish Passageways and Diversion Structures”, National Conservation Training Center Manual, Shepherdstown, WV, 1997.

Appendix - Reference Drawings

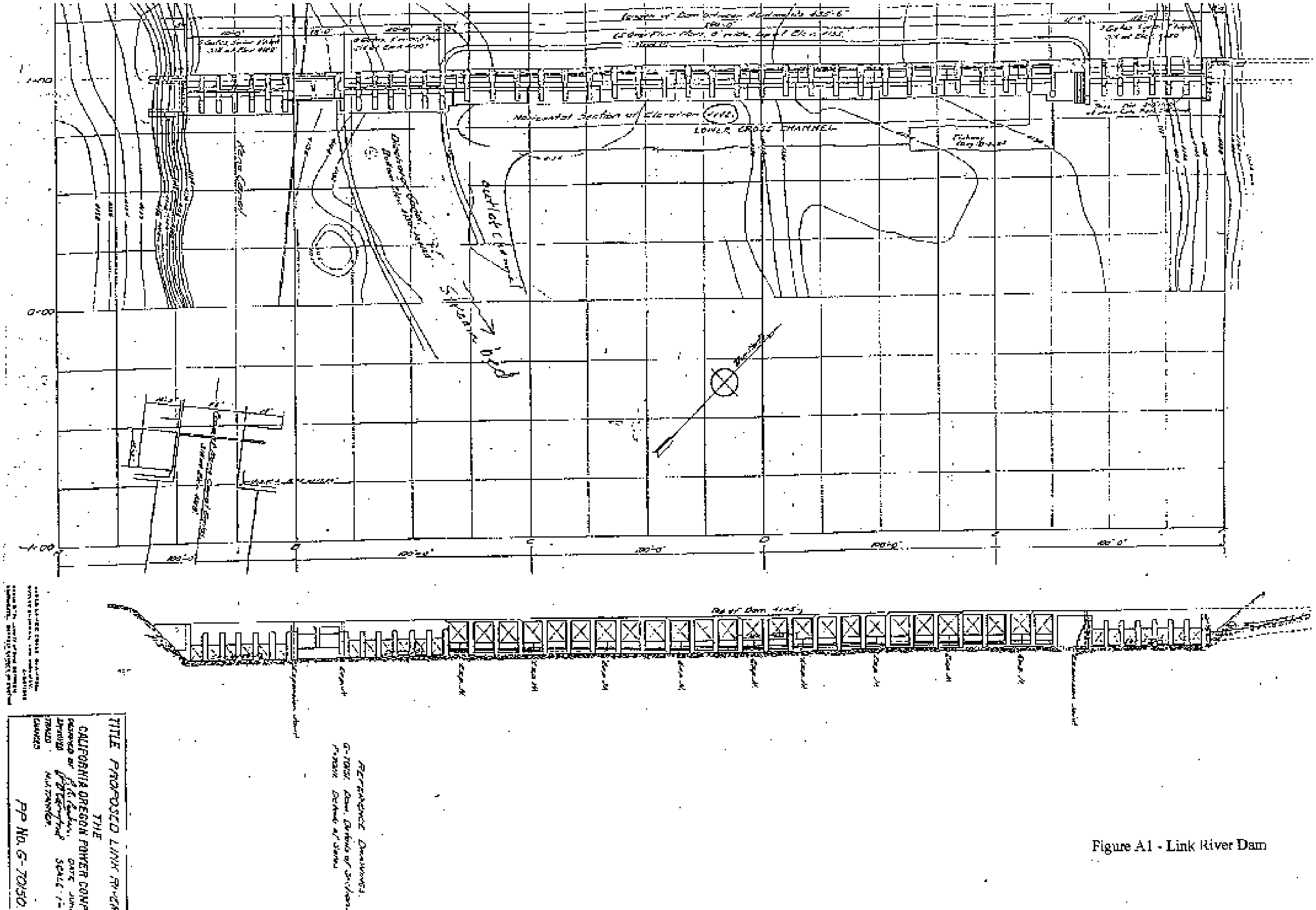


Figure A1 - Link River Dam

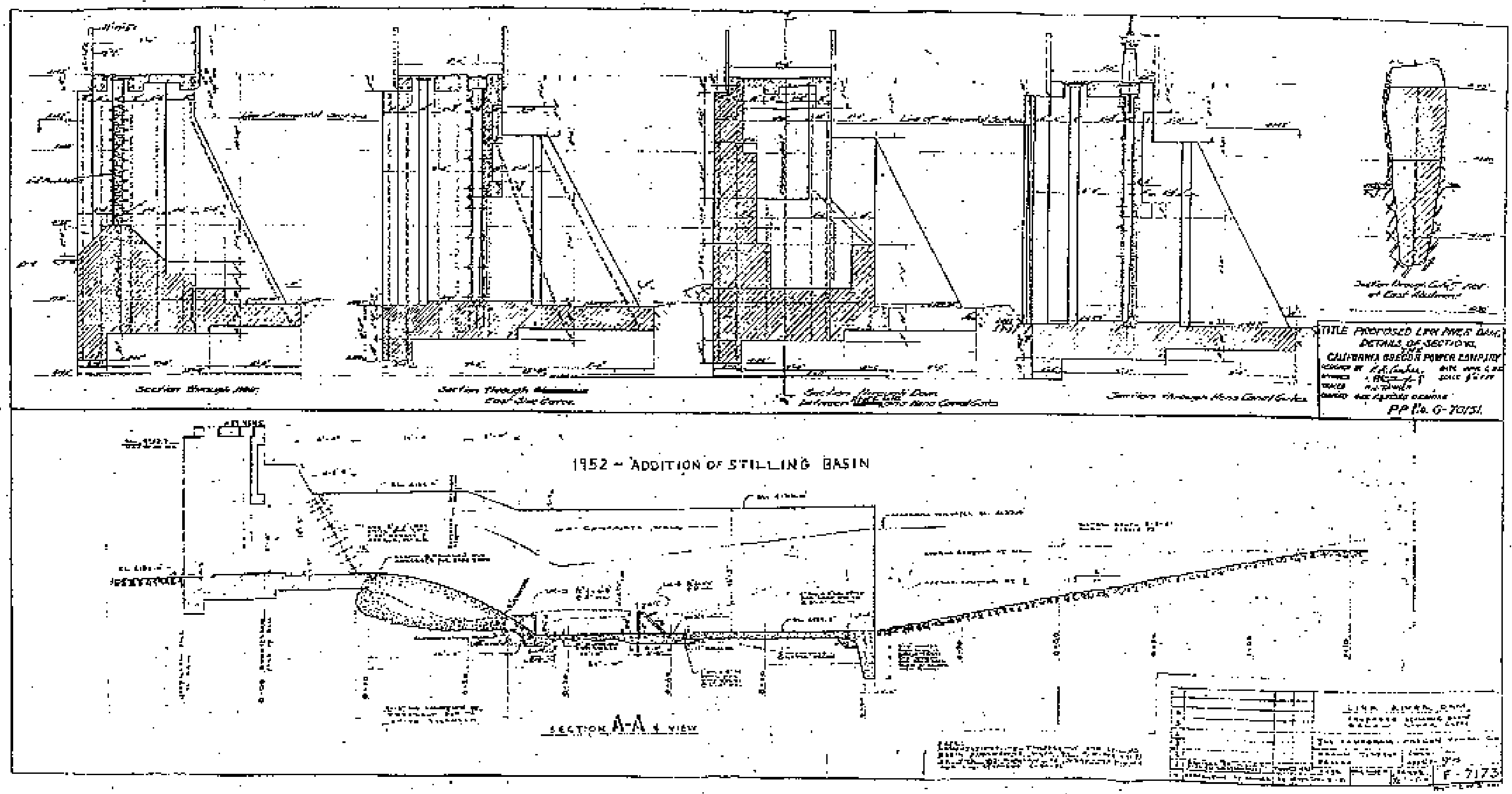


Figure A2 - Link River Dam river outlet stilling basin.

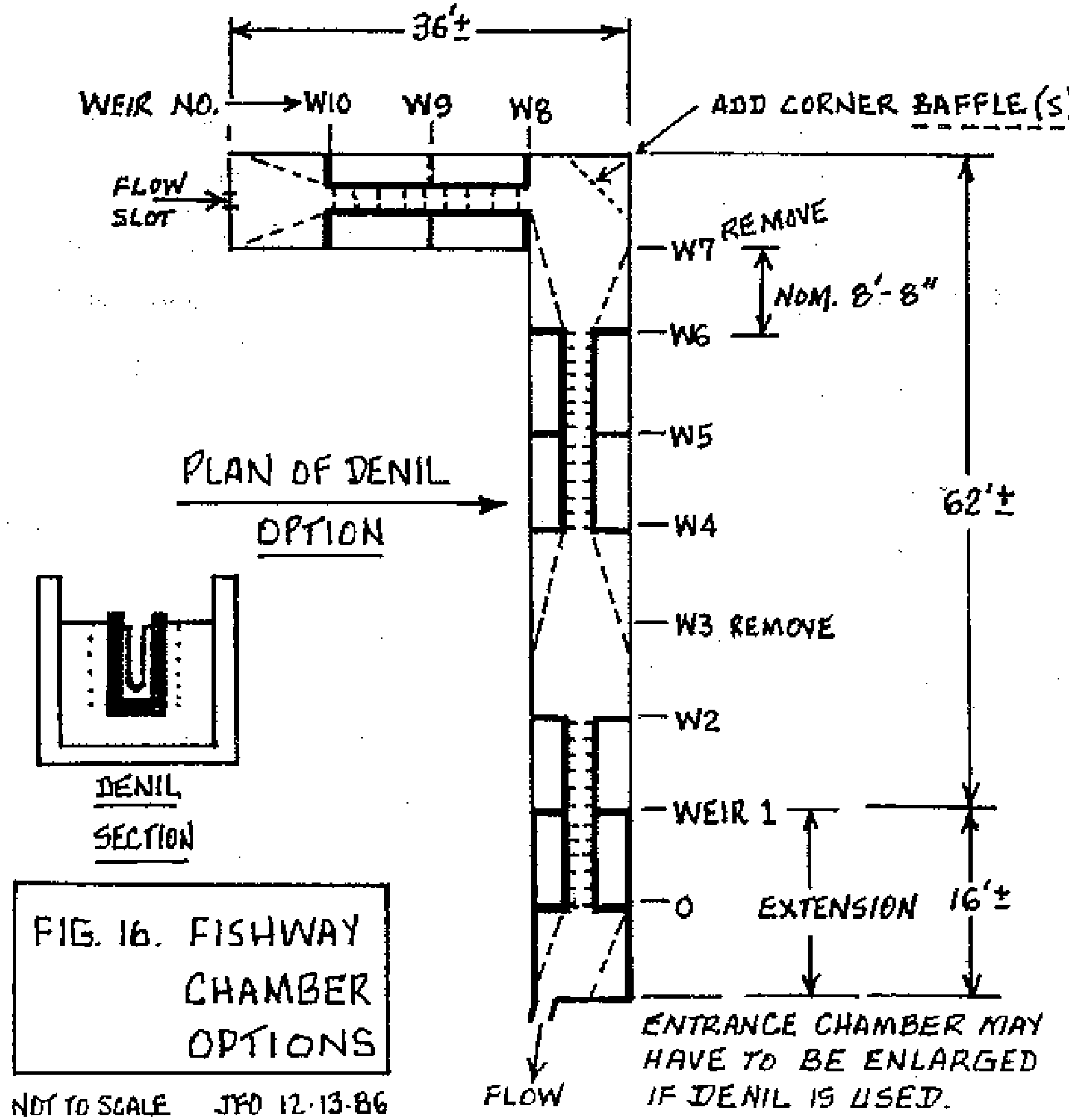


Figure A3 - Link River Dam fishway proposed by Orsborn, 1986.

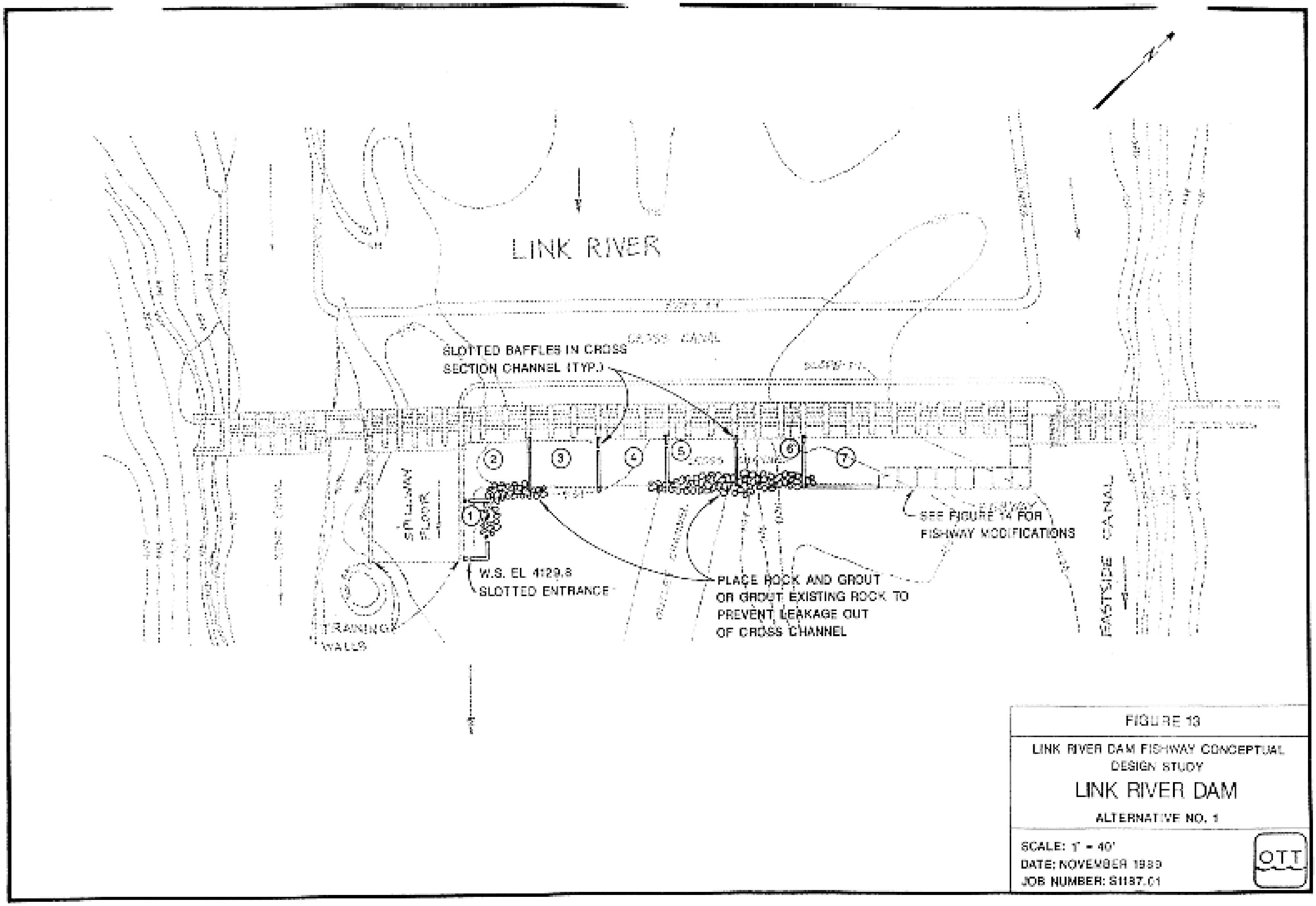


Figure A4 - Alternative 1 from the 1990 concept study by Ott Engineering.

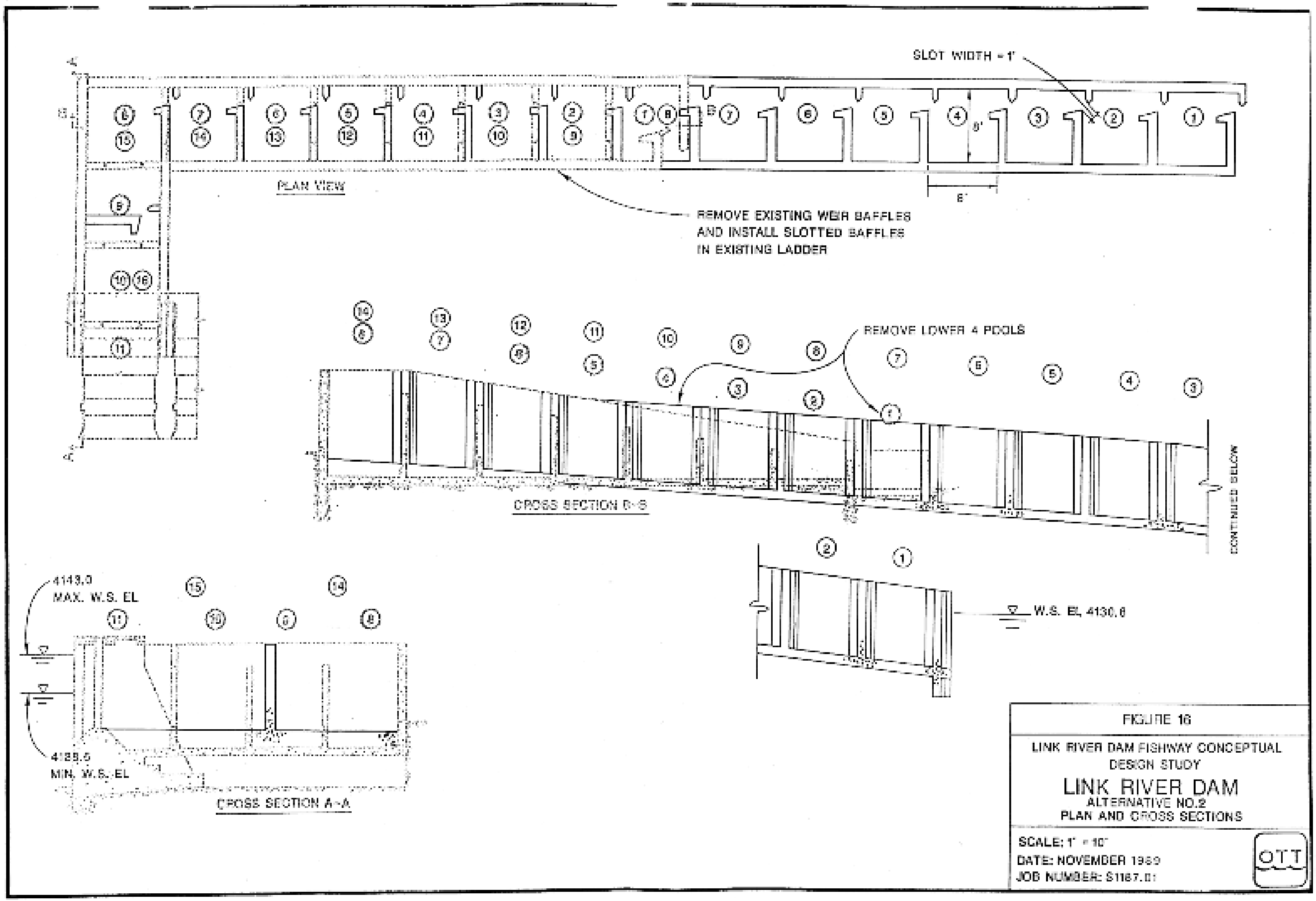
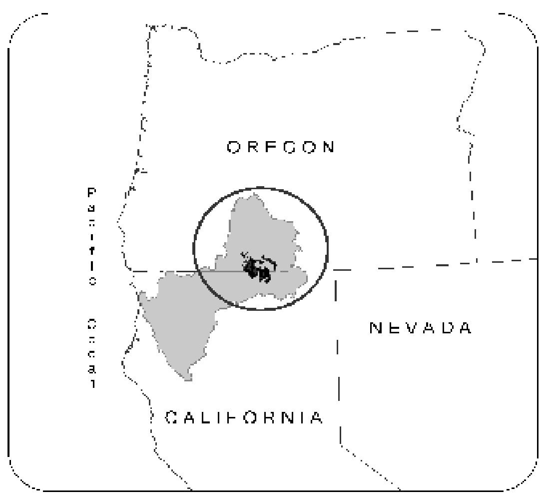


Figure A5 - Alternative 2 Link River Dam fishway concept proposed by Ott Engineering, 1990.

Appendix B

BIOLOGICAL/CONFERENCE OPINION
REGARDING
THE EFFECTS OF CONSTRUCTION OF THE
A-CANAL FISH SCREEN AND LINK RIVER FISH LADDER
U.S. BUREAU OF RECLAMATION - KLAMATH PROJECT
AND ITS EFFECT ON THE
ENDANGERED LOST RIVER SUCKER (*Delistes luxatus*)
ENDANGERED SHORTNOSE SUCKER (*Chasmistes brevirostris*)
AND PROPOSED CRITICAL HABITAT FOR THE
LOST RIVER AND SHORTNOSE SUCKER



Prepared by theU.S. Fish and Wildlife Service
Klamath Falls Fish and Wildlife Office
Klamath Falls, Oregon
July 24, 2002

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Klamath Falls Fish and Wildlife Office
6610 Washburn Way
Klamath Falls, Oregon 97603-9365
(541) 885-8481 FAX: (541) 885-7837

In Reply Refer To:
1-10-02-F-181

July 24, 2002

Memorandum

To: Area Manager, Bureau of Reclamation, Klamath Basin Area Office, Klamath Falls, Oregon

From: Project Leader, Klamath Falls Fish and Wildlife Office, U.S. Fish and Wildlife Service, Klamath Falls, Oregon

Subject: US Bureau of Reclamation, Klamath Project - Biological Opinion and Conference Report for Construction of the A-Canal Fish Screen and the Link River Fish Ladder, Klamath County, Oregon.

This document transmits the Fish and Wildlife Service's (Service or USFWS) biological opinion and conference report (BO) based on our review of the Bureau of Reclamation's (Reclamation or USBR) proposed construction of a fish screen to reduce entrainment into the A-Canal of the Klamath Project (Project) and a fish ladder to provide upstream passage past the Link River Dam, both in Klamath County, Oregon, in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). At issue are the effects of the proposed action on the endangered Lost River sucker (*Deltistes luxatus*; LRS), endangered shortnose sucker (*Chasmistes brevirostris*; SNS), threatened bald eagle *(Haliaeetus leucocephalus)* and proposed critical habitat for the LRS and the SNS (collectively referred to as suckers). Reclamation's request for formal consultation was dated March 27, 2002 and was received on March 29, 2002. Subsequent memoranda providing supplemental and revised project descriptions were dated and received on June 11 and June 14, 2002.

After reviewing the potential impacts to the Lost River sucker, the shortnose sucker, and the bald eagle, Reclamation determined that the proposed action "may affect" and "is likely to adversely affect" the two suckers and is "is not likely to adversely affect" the bald eagle. There is also proposed critical habitat for the Lost River sucker and shortnose sucker in the project area, and Reclamation made a "may affect" determination for that critical habitat. This Biological Opinion (BO) will address effects to both sucker species and their proposed critical habitat.

Due to the lack of nearby eagle nests (the nearest is over a mile away), the low level of foraging in the immediate vicinity of the Project, the availability of alternate foraging areas nearby, and the high levels of background urban activity to which resident eagles are presumably acclimated, the Service concurs with Reclamation's determination that the proposed Project is "not likely to adversely affect" the bald eagle.

Incidental take of listed suckers owing to entrainment and impingment as a result of operation of the A-Canal fish screen is covered by the May 31, 2002 BO for the 10 year operation of the Project. The Service will provide Reclamation with an amendment clarifying the conditions for that coverage.

1.0 INTRODUCTION

This Biological Opinion (BO) is based on: (1) information provided in Reclamation's final Biological Assessment (BA) dated March 27, 2002 (USBR 2002b); (2) design and construction information provided in various documents (USBR 2002d, e, f); (3) supplementary project information received in subsequent memoranda dated June 11 and June 14, 2002 (USBR 2002g,h); (4) information presented in the 2002 BO regarding long-term operations of the Klamath Project (Project) (USFWS 2002); (5) information obtained from Reclamation in meetings regarding operation of the Project, and from the results of ongoing Reclamation field research activities; (6) information, including new information, provided in published and unpublished reports on the biology, distribution, systematics, and status of the affected listed species and the ecosystems upon which they depend; (7) communications with field researchers who have conducted, or are now conducting, research on the biology of affected listed species or the ecosystems upon which they depend; and (8) other available commercial and scientific information. A complete administrative record of this consultation is on file at the Service's Klamath Falls Fish and Wildlife Office in Klamath Falls, Oregon.

1.1 Consultation History

Reclamation has consulted with the Service concerning the effects of operating the Project on federally listed threatened and endangered species on numerous occasions since1989 (USFWS 2002, Table 1.1-1). On February 27, 2002, Reclamation submitted a final BA and on May 31, 2002 the Service issued a final BO on the effects of the proposed actions related to Klamath Project operation, April 1, 2002 - March 31, 2012 (USBR 2002a, USFWS 2002). This consultation considered the effects of entrainment into A-Canal and past the Link River Dam, as well as restricted upstream passage at the Link River Dam. However, it did not address specific effects of construction of the A-Canal Fish Screen or Link River Fish Ladder. On March 29, 2002, Reclamation submitted a BA and a request for formal consultation to address the effects of construction and operation of the A-Canal Fish Screen and the Link River Fish Ladder on the endangered Lost River sucker, the shortnose sucker, and the bald eagle (USBR 2002b). On June 11, Reclamation submitted a memorandum of supplemental information on the final location for the gravity bypass pipe and a revision of the proposed removal process for the Link River Dam cofferdam (USBR 2002g). On June 14, Reclamation submitted a second memorandum clarifying information related to the construction-related effects of the new secondary gravity bypass pipeline alignment (USBR 2002h). Over the past year, Reclamation has convened several meetings of working groups which included the Service, the Klamath Irrigation District, and Oregon Department of Fish and Wildlife, to develop and finalize plans for both projects (USBR 2002d).

2.0 DESCRIPTION OF THE PROPOSED ACTION

2.1 Definition of the Action Area

The "action area" is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" 50 CFR §402.02. Based on information contained in Reclamation's March 29, 2002 BA, as well as information from the two subsequent memoranda, we have determined that the action area for this consultation includes the lower arm of Upper Klamath Lake between Fremont Bridge and Link River Dam, the A-Canal, Link River, and Lake Ewauna. The Project is located in the vicinity of Klamath Falls, Klamath County, Oregon. All construction activities will occur at the forebay and headworks of the A-Canal and at the Link River Dam (T 38 S, R 9 E, Sec 30).

2.2 Reclamation's Proposed Action

2.2.1 <u>A-Canal Fish Screen</u>

Reclamation proposes to remove the current A-Canal headworks. They will then construct a new trash rack structure and V-screen fish bypass structure at the mouth of the A-Canal, a new headworks downstream of the screen in the canal itself, and an onshore pump and gravity bypass facility with fish examination capability on the south side of the A-Canal headwork area (Figure 2.2.1-1). The primary pumped bypass pipe will be extended from the examination station across the bottom of Upper Klamath Lake, just downstream of the A-Canal, to the western channel where bypassed fish will be discharged underwater. A secondary gravity bypass pipe will be placed overland to within about 350 feet of the Link River Dam where it will enter the water, extend about 200 feet across the channel pass through a flood gate, and discharge into the plunge pool, below the dam, in the vicinity of the proposed fish ladder.

All in-water work would occur between October 1, 2002 - April 1, 2003. Prior to in-channel construction, a soil and plastic sheeting cofferdam will be placed just upstream of the headworks at the mouth of the canal in the vicinity of the present log-boom. This will allow dewatering of the canal for construction purposes. A second cofferdam will be placed for about 200 feet along the eastern forebay of the Link River Dam to allow placement of the gravity bypass pipe and its two support piers. Reclamation will carry-out salvage operations in all dewatered areas in accordance with the Service-approved 2002 salvage plan for the Project.

Screen criteria for the A-Canal were jointly developed in June 2000 by Oregon Department of Fish and Wildlife and the Service. Criteria were primarily adopted from those used by the National Marine Fisheries Service in the Pacific Northwest for protection of salmon, with slight modification. These criteria were part of a screening requirement under reasonable and prudent alternative #4 in the April 5, 2001 BO for the Klamath Project, and were included in the BO as Appendix 1.

Additional details on construction are included in the BA provided by Reclamation (USBR 2002b), the A-Canal Fish Screen - Preferred Alternative Selection Technical Memorandum (USBR 2002d), the fish screen construction drawings (USBR 2002e), and two supplemental memoranda (USBR 2002g,h).

2.2.2 Link River Fish Ladder

Reclamation proposes to construct a fish ladder along the western shoreline just below the Link River Dam in the vicinity of gate no. 6 and the entrance to the West-side (Keno) canal. Construction will include modification of the existing headworks and construction of a fish ladder between the existing stilling basin and the canal (Figure 2.2.2-1). A cofferdam will be placed on the shore-side of the existing stilling basin to allow dewatering of the site during construction.

The cofferdam will be built in July 3003 and removed in February 2004; placement will take about 5 days and removal 2 days. During these 7 days, Reclamation has requested that flows through the gates be reduced to 50 cfs. The footprint of the construction site, including cofferdam, will be approximately 9,000 sq ft , with about a third or less in the dewatered Link River channel, depending on water elevation, and the rest onshore or in the dewatered West-side canal.

Specific passage criteria were not developed by the Service; however, as part of a passage requirement under reasonable and prudent alternative #4 in the April 5, 2001 BO for the Klamath

Project, the Service stated that it "...shall be adequate to pass LRS and SNS of all spawning sizes..."

Additional details on construction of the fish ladder are included in the BA provided by Reclamation (USBR 2002b), the Preliminary Designer's Operating Criteria/Design Summary (USBR 2002c), the Link River Fish Ladder SPECD, including construction drawings (USBR 2002f), and a supplemental memorandum (USBR 2002g).

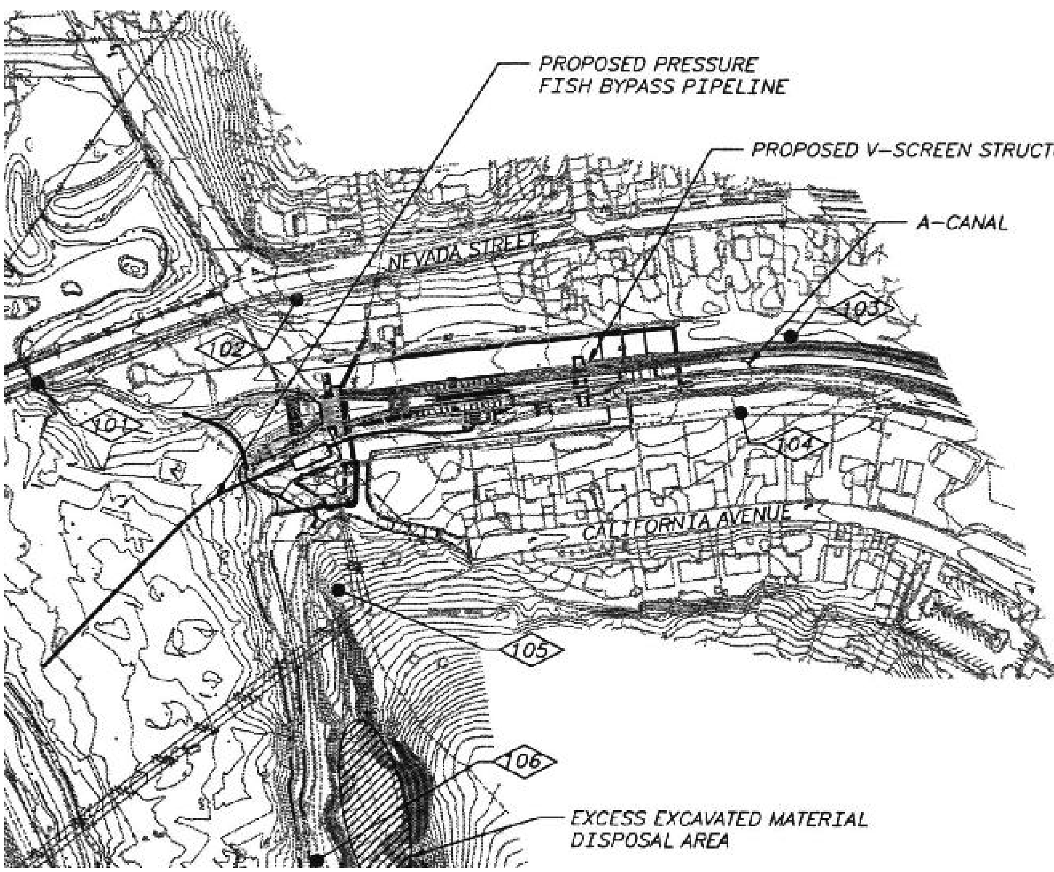


Figure 2.2.1-1. Schematic of the proposed A-Canal fish screen. The cofferdam would be placed during construction in the position marked by the log boom.

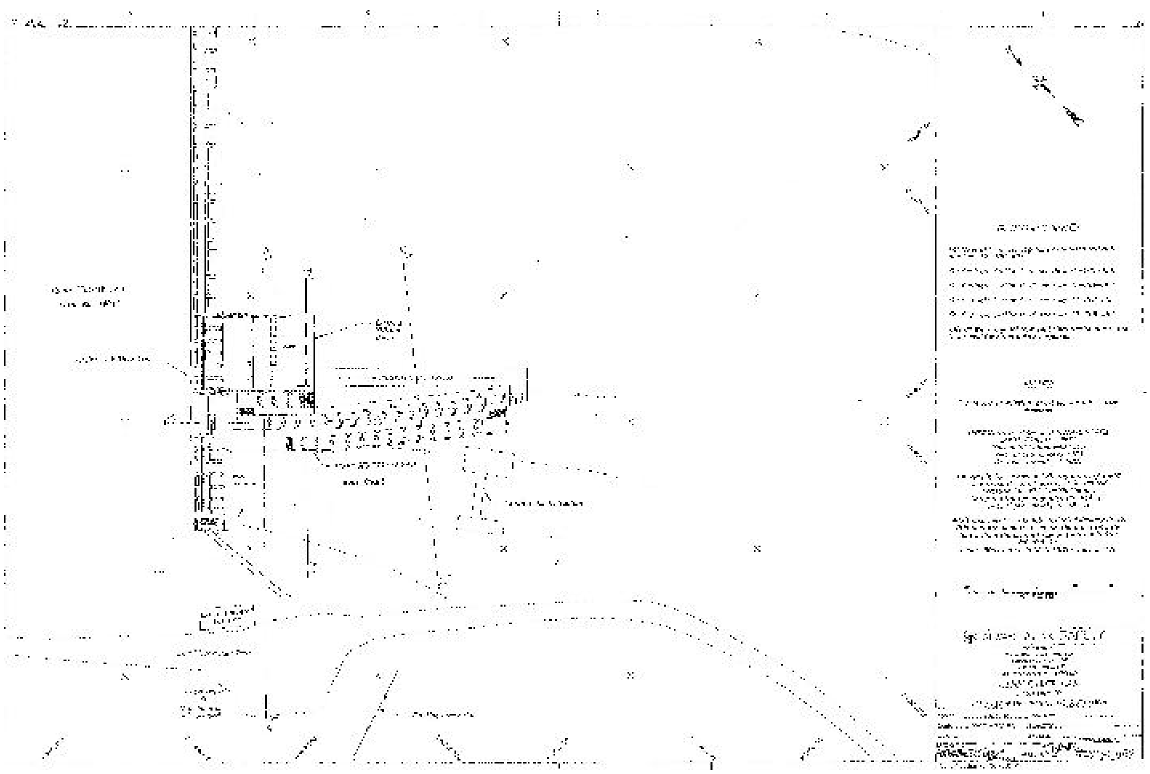


Figure 2.2.2-1. Schematic of the proposed Link River Dam fish ladder.

3.0 STATUS OF THE SPECIES: Shortnose and Lost River Suckers

3.1 Listing History

The LRS and SNS were federally listed as endangered on July 18, 1988 (USFWS 1988). At the time of listing, perceived threats to the species included: 1) loss of historical populations and range; 2) habitat loss, degradation and fragmentation; 3) drastically reduced adult populations; 4) over-harvesting by sport and commercial fishing; 5) large summer fish die-offs caused by declines in water quality; 6) lack of significant recruitment; 7) hybridization with the other two sucker species native to the Klamath Basin; 8) potential competition with introduced exotic fishes; and 9) the inadequacy of existing regulatory mechanisms to provide for the conservation of these species. These threats, and others that have been recognized since these species were listed, are discussed below under "Current Threats and Conservation Needs."

3.2 Current Threats, Conservation Needs and Range-wide Status

The threats to the LRS and SNS are discussed below along with the conservation needs that address each threat and the general status of the species relative to that threat. The term "conservation needs" is defined as those actions or conditions necessary to bring an endangered or threatened species to the point at which protection under the Endangered Species Act (Act) is no longer necessary. In other words, those actions or conditions that adequately provide for the survival and recovery of the listed species. The discussion below addresses the primary threats recognized at the time of listing and two additional threats recognized since listing, lack of passage and entrainment. The range-wide status of the suckers was recently reviewed as part of the Biological Opinion on long-term operation of the Klamath Project (USFWS 2002); the reader is referred to that document for more detailed discussion and for the references cited in this section.

3.2.1 Loss of Historical Populations and Reduction in Range

> ***Conservation Need*** **: Establish a sufficient number of viable, self-sustaining populations of the LRS and SNS in as much of their historical range as possible. Multiple populations provide resiliency in response to localized extirpations caused by adverse conditions such as prolonged drought, contaminant spills, disease and catastrophic water quality declines. Multiple populations also help ensure the genetic**

diversity of the species and improve its ability to adapt to changing environmental conditions.

The historical range of LRS and SNS has been severely reduced by drainage and management of Lower Klamath and Tule Lakes. Lower Klamath Lake no longer supports suckers, and the populations in Tule Lake are reduced to a few hundred adults. Both species were once very abundant and were critical food resources for Native Americans and white settlers in the upper Klamath River Basin (Cope 1879; Gilbert 1898; Howe 1968). It was estimated that the aboriginal harvest at one site on the Lost River may have been 50 tons annually (Stern 1966). Settlers built a cannery on the Lost River and suckers were also processed into oil and salted for shipment. In 1900, the *Klamath Republican* newspaper reported that "mullet," as suckers were referred to, were so thick in the Lost River that a man with a pitch fork could throw out a wagon load in an hour. In 1959, suckers were made a game species under Oregon State law, and snagging suckers in the Williamson and Sprague River was popular with locals and out-of-town sportsmen (Bragg 2001). By 1985, Bienz and Ziller (1987) estimated the harvest had dropped by about 95%. Based on this information, the game fishery was terminated in 1987, just prior to federal listing of these species under the Endangered Species Act.

Historically, both LRS and SNS occurred throughout the Upper Klamath Basin, with the exception of the higher, cooler tributaries dominated by resident trout and the upper Williamson, which is isolated by the Williamson Canyon. At the time of listing, LRS and SNS were reported from UKL, its tributaries, Lost River, Clear Lake Reservoir, the Klamath River, and the three larger Klamath River reservoirs (Copco, Iron Gate, and J.C. Boyle). The general range of LRS and SNS had been substantially reduced from its historic extent by the total loss of major populations in Lower Klamath Lake, including Sheepy Lake, and Tule Lake (USFWS 1988). The Klamath River reservoir populations receive individuals carried downstream from upper reaches of the river, but they are isolated from the Upper Klamath Basin by dams and show no evidence of self-sustaining reproduction (Desjardins and Markle 2000). The current geographic ranges of LRS and SNS have not changed substantially since they were listed and only two additional SNS and one LRS populations have been recognized since 1988. They all occur in isolated sections of the Lost River drainage, within the historical ranges of the species, and include an isolated population of SNS in Gerber Reservoir and a small population (limited to several hundred adults) of each species in Tule Lake.

Currently, there are three major populations of SNS in the Upper Klamath Basin found in UKL, Clear Lake, and Gerber Reservoir. There are two major populations of LRS in the Upper Klamath Basin found in UKL and Clear Lake, along with a very small population in Tule Lake. UKL contains the largest populations of SNS and LRS and these populations are crucial for the long-term survival of both species. However, multiple populations provide resiliency in response to localized extirpations caused by adverse conditions such as prolonged drought, contaminant spills, disease and catastrophic water quality declines. Multiple populations also help ensure the genetic diversity of the species and improve its ability to adapt to changing environmental conditions. Therefore, in addition to sucker populations in UKL, the populations of LRS and SNS in Clear Lake, Gerber, and Tule Lake are essential to ensure the long-term survival of the species.

3.2.2 Habitat Loss, Degradation, and Fragmentation

> *Conservation Need* **: Provide adequate quantity and quality of habitat to meet the needs of all life-history stages of the LRS and SNS. Adequate habitat is crucial to ensure recruitment and support viable populations.**

Aquatic habitat has been substantially altered or destroyed in the Klamath Basin. Many previously occupied areas no longer support suckers, and crucial habitat for larvae and juveniles is often unavailable due to water management in critical rearing areas such as UKL. The Klamath Basin has lost extensive areas of emergent marshes and open lake environments that were previously used by the LRS and SNS. Lower Klamath Lake no longer supports suckers, and available habitat in Tule Lake is now limited to a few hundred acres or less. Conditions in the Lost River have limited suckers to a few primary reaches of the river. In UKL emergent vegetation that provides habitat to larval and juvenile suckers, is greatly reduced in extent and often fragmented into isolated patches along the shoreline or left dry as lake levels drop. Current habitat availability and conditions in the Klamath Basin are greatly dependent on water management. In UKL availability of larval and juvenile sucker habitat is constrained by lake level, with much of the available habitat lost by mid to late summer as water levels decline. Adult sucker habitat is also limited by low summer/fall lake levels.

3.2.3 Small or Isolated Adult Populations [Reproduction]

> *Conservation Need* **: Increase and maintain population sizes of the LRS and SNS.**

> **Populations must be maintained at levels that ensure genetic viability and provide sufficient genetic variability to allow the species to respond to environmental and ecological variability.**

Important portions of the suckers' historical range, including the Lost River, Tule Lake, Clear Lake and Gerber Reservoir, contain populations which are either relatively small or are isolated by dams. LRS and SNS populations in Tule Lake and the Lost River (LRS in particular) appear to have declined substantially below historic levels. The primary threat to these populations is limited habitat due to adverse water quality, sedimentation, impoundment, isolation from spawning areas and lack of significant recruitment. The Clear Lake and Gerber Reservoir populations of the LRS and SNS are isolated by dams from the rest of the Klamath Basin. Although these populations appear to be maintaining themselves, each is at risk by habitat reduction during prolonged drought with no ability to replenish the gene pool through immigration of individuals from neighboring areas.

3.2.4 Isolation of Existing Populations by Dams [Passage]

> ***Conservation Need*: Provide for adequate passage for all life-stages of suckers past dams. Both sucker species are dependent on free-passage along river corridors to ensure genetic exchange between populations, to gain access to spawning areas, and to allow young fish entrained downstream to return to their parent populations.**

There are nine primary dams within the natural range of the LRS and SNS, none of these dams provide suitable passage for suckers. The dams physically isolate sucker populations, prevent genetic exchange, block access to essential habitat, cut off escape from adverse conditions downstream, and prevent the return of entrained suckers to upstream habitat and spawning areas. The proposed fish ladder at the Link River Dam is intended to allow spawning adults and possibly sub-adult suckers to pass the dam, but the smaller juveniles will remain isolated downstream.

3.2.5 Poor Water Quality Leading to Large Fish Die-Offs and Reduced Fitness

> ***Conservation Need*: Improve water quality to a level where adverse effects are not sufficient to threaten the continued persistence of the LRS and SNS. Lethal water quality conditions in UKL are the primary cause of mortality in adult suckers.**

Water quality in UKL consistently reaches levels known to be stressful to suckers and periodically reaches lethal levels in August and September, resulting in catastrophic die-offs. Major fish die-offs have been recorded at UKL since the late 1800's but have increased in frequency in the last few decades. Small, localized fish die-offs have been observed annually on UKL since 1992 when extensive research and monitoring activities began. In 1995, 1996 and 1997 a series of major fish kills in UKL reduced adult sucker populations of LRS and SNS in UKL by an estimated 80-90 percent.

Adverse water quality conditions in Clear Lake and Gerber Reservoirs is primarily determined by shallow reservoir depths, which reduce available habitat and cause declines in dissolved oxygen (DO), resulting in stress to the suckers and reducing their overall fitness. Available habitat in Tule Lake is severely limited by shallow depths and further limited by seasonal declines in water quality. All three water bodies are subject to potential winter fish-kills when poor water quality, especially low DO, is associated with prolonged ice-cover and shallow depths.

3.2.6 Lack of Sufficient Recruitment

> ***Conservation Need*: Increase the frequency and magnitude of recruitment into the spawning populations of both LRS and SNS. For a population to survive, survival and recruitment of young fish into the spawning population must be sufficient to offset adult mortality and allow populations to increase to sustainable levels that provide adequate resiliency against fish kills, disease, infrequent recruitment, and other factors.**

Since listing in 1988, the UKL sucker populations have not maintained recruitment levels sufficient to offset adult mortality caused by catastrophic fish die-offs. Successful recruitment of substantial new cohorts of the LRS and SNS into the UKL spawning populations has only occurred 2-3 times in the last seventeen years (1984-2001). During this time there have been four catastrophic, and many minor fish die-offs, caused by adverse water quality. Size frequency of suckers in Clear Lake and Gerber Reservoirs indicates that these populations have had recent recruitment; however, the overall status of the populations is uncertain. There is no evidence of successful sucker recruitment in the small Tule Lake population or in the Klamath River reservoirs.

3.2.7 Entrainment into Irrigation and Hydropower Diversion Canal

> ***Conservation Need*: Substantially reduce entrainment of larval, juvenile and adult LRS and SNS. Entrainment represents a major cause of mortality in young suckers and adults within the Upper Klamath Basin. For recovery of LRS and SNS it is crucial to increase survival of young life-stages so that they can recruit into the adult spawning population, and reduce mortality of adults; both are necessary for the establishment of viable, self-sustaining, natural populations.**

Entrainment of suckers into Klamath Basin irrigation and hydro-power diversions is documented to account for the loss of millions of larvae, tens of thousands of juveniles, and hundreds to thousands of adult suckers each year (Gutermuth et al. 1997, 1998b, 1999, 2000a, 2000; Harris and Markle 1991; Markle and Simon 1993; Simon and Markle 2001; USBR 2002b). There are currently no fish screens at principal diversions that meet State or Federal screening criteria. This biological opinion addresses construction of a fish screen at the A-Canal, which is scheduled to be operational in 2003. However, the proposed facility will not prevent entrainment of larval fish under about 30 mm, and so larval entrainment of suckers will continue. Suckers prevented from entering A-Canal will still have to contend with entrainment just downstream at the Link River Dam and diversions. The fact that adequate screening has not been provided anywhere within the Project after nearly a century of

operation is considered by the Service to be a major factor imperiling and retarding the recovery of the two endangered suckers.

3.2.8 <u>Hybridization with Other Native Klamath Sucker Species</u>

> ***Conservation Need*: Maintain rates of hybridization appropriate to the evolutionary framework in which the suckers are evolving. Excessive hybridization can result in the loss of genetic diversity, fitness, and loss of evolutionarily unique lineages.**

Hybridization was believed to be widely occurring in Klamath Basin suckers and was considered a threat by the Service at time the LRS and SNS were listed. From 1997-2001 several different laboratories (Oregon State University; University of California, Davis; and Arizona State University) have used independent strategies to identify morphological and genetic characters to address questions regarding reproductive isolation, classification, systematic relationships, and the extent of hybridization among Klamath Basin suckers. The preliminary evidence suggests that some hybridization may be natural within the Klamath

Basin sucker fauna, and hybridization may not represent as great a threat as was thought at the time the LRS and SNS were listed. However, the biological and conservation implications of hybridization, as well as the degree to which recent man-made changes to the Klamath Basin have altered the natural rate of hybridization, are still not completely understood.

3.2.9 Potential Competition with and Predation by Non-Native Fishes

> ***Conservation Need*: Ensure that LRS and SNS populations can withstand the adverse effects of competition and predation from introduced fishes.**

At least eighteen species of non-native fishes have been introduced and have established populations in the Upper Klamath Basin. Little is known about the ecological and competitive interactions of the introduced fishes with the native suckers, and this limits our ability to assess their impact. Many of the introduced fishes, including the fathead minnow, yellow perch and brown bullheads, have successfully established themselves in the Upper Klamath basin and are predators that could prey on larval and juvenile suckers. It is not practical to remove non-native fishes once they have become established. However, habitat management to the benefit of native suckers, especially larvae and juveniles, and recovery of the adult population to a point where reproduction offsets the adverse effects of competition will allow the suckers to sustain viable populations in the face of increased competition and predation.

3.2.10 Over-harvesting by Sport and Commercial Fishing

> ***Conservation Need*: Reduce harvest to levels that allow for viable natural populations to maintain themselves.**

LRS and SNS were once very abundant and were critical seasonal foods of Native Americans and white settlers in the upper Klamath River basin. In 1959, suckers were made a game species under Oregon State law, and snagging suckers was extremely popular with both locals and out-of-town sportsmen. By 1985, the estimated harvest had dropped by about 95%. Based on this information, the fishery was terminated in 1987, just prior to Federal listing. As a result of the regulatory termination of sport and commercial fishing, overharvest is no longer considered a threat to the species.

3.4 Life History

This section provides a brief review of the life history of the two suckers relevant to formulating this BO. Greater detail and citation information is available in USFWS (2002).

LRS and SNS are both large, long-lived, lake-dwelling fish that are found only in the Klamath Basin above Iron Gate Dam. Adult LRS can reach 39 inches in length, while SNS are generally less than 20 inches. LRS naturally live over 43 years, and SNS can live at least 33 years (Scoppettone 1988). Larvae reach about an inch (25-30 mm) in length by July. They are generally considered as young-of-the-year juveniles above that size (Buettner and Scoppettone 1990, Simon and Markle 2001). By October of their first year juveniles reach about 2 - 4 in (5-10 cm). Male LRS begin to enter the spawning population at about age 4 and a size of about 16 in. Female LRS begin to spawn at about age 7 and a size of about 20 in. (Buettner and Scoppettone 1990; Perkins et al. 2000a). Male and female SNS begin to spawn at about age 4-5 when they reach a length of about 11-13 in.

3.4.1 <u>Reproduction</u>

Klamath suckers can be separated into three groups, based on where they spawn. Adult SNS and LRS primarily occupy lake habitats, of these some migrate into tributaries to spawn, while others spawn in suitable near-shore lake habitats, primarily springs. There are also apparently some SNS that both live and spawn in streams, notably in the Clear Lake and Gerber Reservoirs. Stream and lake spawning populations appear to rarely exchange individuals and appear to be reproductively isolated (Perkins et al. 2000a; Shively et al. 2000a; Hayes and Shively 2001).

Currently, most of the stream-spawning LRS and SNS in UKL move up the Williamson and Sprague River to spawn. Small spawning populations of LRS and SNS may also utilize the Wood River (Markle and Simon 1993; Simon and Markle 1997). Both LRS and SNS also spawn at shoreline sites within UKL, especially at eastside springs and areas with a gravel substrate (Buettner and Scopettone 1990). Along the eastern shore of UKL known spawning occurs at Sucker, Silver Building, Ouxy, and Boulder springs, and Cinder Flats (Shively et al.2000; Hayes and Shively 2001). Suckers in the Clear Lake and Gerber Reservoir drainages spawn primarily, if not entirely, in the tributary streams (Buettner and Scoppettone 1991; Koch and Contreras 1973; Perkins and Scoppettone 1996; USBLM 2000).

Spawning generally occurs from February - June and peaks between mid-April and early May. The timing of spawning migration is somewhat variable from year to year and is apparently dependent on age, species, sex, and environmental conditions (Andreasen 1975; Buettner and Scoppettone 1990; Hayes and Shively 2001; Klamath Tribes 1996; Markle 1993; Markle et al. 2000b; Perkins et al. 1997, 2000a; Perkins and Scoppettone1996; Shively et al.2000; USBLM 2000; Ziller 1985).

LRS and SNS typically spawn at night in shallow areas with gravel substrate where eggs are broadcast or slightly buried (Bienz and Ziller 1987; Buettner and Scoppettone 1990, 1991; Klamath Tribes 1995; Perkins and Scoppettone 1996; Perkins et al. 2000a). Water depth for most spawning sites ranges from about 1-4 ft.

In a single spawning season, a single LRS or SNS female can produce 18,000-72,000, and 44,000-236,000 eggs, respectively (Perkins et al 2000a). Larger, older females produce substantially more eggs and therefore can contribute relatively more to recruitment than a recently matured female. However, only a small percentage of the eggs survive to become larvae.

3.4.2 Larvae (<1 Inch in Length)

Soon after hatching, sucker larvae move out of the gravel; they are about a third of an inch (7-9 mm) long and mostly transparent with a small yolk sac (Buettner and Scoppettone 1990). Larval suckers need to begin feeding quickly, before they exhaust their yolk or they starve (Cooperman and Markle 2000; Klamath Tribes 1996). The availability of appropriate habitat, which provides sufficient food soon after hatching, is critical to the survival of larvae.

Larvae apparently spend relatively little time upriver before drifting downstream to the lakes (Buettner and Scoppettone 1990; Cooperman and Markle 2000; Klamath Tribes 1996; Markle et al. 2000b; Perkins and Scoppettone 1996). In the Williamson River, larval sucker out-migration from spawning sites begins by at least May and is generally completed by mid-July. Downstream movement takes place at night and near the water surface. During the day, larvae appear to move to the river margins and to seek cover in the emergent shoreline vegetation.

In UKL, larval suckers are first captured in early April during most years, with peak catches occurring in June, and densities dropping to very low levels by late July (Cooperman and

Markle 2000, Simon et al., 1996, 2000a). Larval suckers are found throughout UKL, with highest concentrations generally at the mouth of the Williamson River and just to the east and west of the mouth, apparently depending on flow patterns. At the Link River, larval suckers have been collected as early as April 28 and as late as July 18 (Gutermuth et al. 1999).

Larval habitat in UKL is generally along the shoreline, in water 4 - 20 in deep and associated with emergent aquatic vegetation, such as bulrush (Buettner and Scoppettone 1990; Cooperman 2002; Cooperman and Markle 2000; Dunsmoor 1993; Dunsmoor et al. 2000; Klamath Tribes 1995; 1996; Markle and Simon 1993; 1994; Reiser et al. 2001; Simon et al. 1995, 1996). Emergent vegetation provides cover from predators, protection from currents and turbulence, and abundant prey (including zooplankton, macroinvertebrates, and periphyton). Larvae generally do not use submerged vegetation (e.g., pondweeds) as an alternative to emergent vegetation (Cooperman 2002, Klamath Tribes 1995). This is apparently due to habitat preferences of the larvae and due to the absence of submerged vegetation, which die back in the winter and do not reappear until mid summer, when larvae are transforming into juveniles. Larvae transform into the juveniles at about an inch in length (25-30 mm). This generally occurs by the end of July.

3.4.3 <u>First Year Juveniles (1 - 4 Inches in Length)</u>

Juvenile sucker habitat is generally in nearshore areas less than 4 ft in depth (Markle and Simon 1993; Reiser et al. 2001; Simon et al. 2000b; Simon and Markle 2001; VanderKooi 2002; Vincent 1968). Juveniles in unvegetated habitats occur primarily over rocky substrates (rock, gravel, and gravel and sand mix) and appear to avoid sandy and softer muddy bottoms. Recent evidence suggests that emergent vegetation also provides important habitat for juvenile suckers (Reiser et al. 2001; VanderKooi 2002). Rocky bottoms occur along the shoreline primarily in the southern portion of UKL while emergent shoreline vegetation occurs primarily in the northern half of the lake, and soft, mucky bottoms occupy the vast majority of the deeper offshore areas.

In mid-summer, juveniles are concentrated in the northern and eastern sections of UKL, near the the mouth of the Williamson River and along the eastern shoreline. In late summer and fall most juveniles are concentrated in the south end of UKL and along the eastern shoreline (Simon et al. 2000b; Simon and Markle 2001; Simon, unpub. data 2002).

Juvenile sucker abundance drops dramatically from late July to October in UKL (Simon and Markle 2001; Simon, unpub. data 2002). Catches of juveniles in emergent vegetation also declined significantly near the end of August in both 2000 and 2001, coinciding with lake levels dropping below 4140 ft (VanderKooi 2002). Near 4140 ft, vegetated *Scirpus* habitat becomes increasingly unavailable as water level drops, and at 4140 ft is essentially unavailable (Dunsmoor et al. 2000, Reiser et al. 2001). The late summer declines in juvenile abundance are associated with substantially increased entrainment of juveniles into the A-canal and Link River diversion channels during the same period (Gutermuth et al.1999, 2000a, 2000b). It is currently uncertain as to whether the increased entrainment is due to a migration of juveniles out of the lake, concentration of juveniles in habitat provided by the south end of UKL after dropping lake levels have reduced available shoreline habitat in the north, or avoidance of poor water quality conditions in UKL.

3.4.4 Sub-adults (>4 Inches in Length) and Adults (>10 Inches in Length)

Adult LRS are generally limited to lake habitats when not spawning, and no large populations are known to occupy stream habitats. SNS, on the other hand, have resident populations in both lake and some riverine habitats, including: Lost River, Miller Creek, Willow Creek, and other tributaries of Clear Lake and Gerber Reservoir.

Cover is a primary habitat feature required by fish. For fish like lake suckers that primarily occupy open water, depth and turbidity provide needed cover. In streams, while deeper pools provide some cover, additional cover is provided by instream and overhanging structure (Buettner and Scoppettone 1991; Perkins and Scoppettone 1996). Adults, and probably subadults, of both species are bottom-oriented, consistently staying within 1 ft of the bottom (Buettner and Scoppettone 1991; Reiser et al. 2001; USBR 2000d). Adults rarely enter water shallower than 3 ft, except to spawn at night, and show a strong preference for water deeper than 4 ft (USBR 2000d; Reiser et al. 2001). In Tule Lake, where most habitat is shallower than three ft, adult suckers are found only in the very limited areas with available habitat over 3 ft in depth (Hicks et al. 2000; USBR 2000c).

In the summer and fall, adult suckers generally occupy the northern third of UKL (Bienz and Ziller 1987; Buettner and Scoppettone 1990; Golden 1969; Perkins 1996; Perkins et al. 2000b; Reiser et al. 2001; Simon 2000a; USBR 1996a, 2000d). However, suckers apparently avoid shallow, clear water in UKL except when showing ill effects of poor water quality (Bienz and Ziller 1987; Buettner and Scoppettone 1990; USBR 1996a). Avoidance of shallow

depths by adult suckers may be related to increased vulnerability to predators, including pelicans, osprey, bald eagles, and man. The need to seek adequate depth in UKL may make suckers more vulnerable to the adverse effects of poor water quality because they appear to avoid inflow areas where the water quality is high, but there is a lack of cover owing to shallow depths and relatively high water clarity, and appear to remain in deeper where water quality is frequently worse.

4.0 ENVIRONMENTAL BASELINE FOR THE SHORTNOSE AND LOST RIVER SUCKERS

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area, but does not include the effects of Federal actions that have not yet undergone section 7 consultation. The environmental baseline does not include the future effects of the proposed action addressed by this opinion. The "action area" is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" 50 CFR §402.02. Based on information contained in Reclamation's Biological Assessment, as well as information from the two subsequent memoranda, we have determined that the action area for this consultation includes the lower arm of Upper Klamath Lake between Fremont Bridge and Link River Dam, the A-Canal, Link River, and Lake Ewauna. All construction activities will occur at the forebay and headworks of the A-Canal and at the Link River Dam.

4.1 Physical Environment

Regulation of water levels in Upper Klamath Lake began in 1921, with completion of the Link River Dam (Boyle 1987). By 1921, the reef at the entrance to Link River was lowered (Figures 4.1-1, 4.1-2). Prior to construction of the dam and channelization of the reef, measured the lowest portion of the reef was at 4137.8 ft and lake levels varied from about 4140 to 4143 ft, with a mean annual variation of about two ft (Boyle 1920, 1987; USBR data). According to Boyle (1976, 1987) the pre-dam minimum, recorded, elevation of UKL was 4140.0 ft in September 1908, and the high was 4143.3 ft on April 1907; average annual variation was about 2 ft. USBR data from 1904-1920 shows an absolute minimum of 4139.9 for June 1918. Since 1921, water levels in UKL have varied from 4136.8 to 4143.3 ft, with a mean September 30 lake elevation of 4139.84 ft during the period of historic record from 1960-2001, based on USBR data.. Water level regulation has also changed the seasonal

timing of high and low elevations by making the highest and lowest elevations occur earlier in the season

as well as prolonging the period of low water levels. This likely has had profound effects on the ecology of the lake.

The configuration of the A-Canal, Link River Dam and the associated intake bays for the hydropower diversion canals, combined with the alteration and channelization of the hydrographic outlet to UKL, results in water being withdrawn from deeper depths than would have occurred prior to these changes (Figure 4.1-2). Withdrawal of water from near the bottom of the channel puts bottom-oriented fish, like juvenile and adult suckers, at significantly higher risk of entrainment (see discussion below under "Entrainment of Larval, Juvenile and Adult Suckers").

The Link River Dam controls the release of water out of UKL and results in the entrainment of suckers to the Link River below the dam. Water release is either through the dam, by way of gates, or through the intake bays leading to the eastside and westside hydropower canals, located on each side of the dam. Entrainment past the dam results in isolation of fish downstream of UKL in the Link River or Keno Impoundment. At this time, the Keno Impoundment does not provide suitable long-term habitat for suckers, due to frequently lethal water quality conditions. Upstream passage is not currently possible at Link River Dam; however, the proposed fish ladder is expected to allow passage of adults and younger suckers in the 15-20 cm size range. Entrainment into the hydropower diversions further threatens fish due to injury and mortality in the turbines, which has been estimated at 10-26% direct mortality, with unquantified losses due to injury (USBR 2002b)

The highly productive condition in UKL known as hypereutrophication, which creates seasonally adverse water quality in affected water bodies, is well documented (U.S. Army Corps of Engineers [USACE] 1982; Kann and Smith 1993; Kann 1993a,b; Martin and Saiki 1999; Perkins et al. 2000b; Welch and Burke 2001; Walker 2001; ODEQ 2001). Hypereutrophic conditions result from excessive nutrients, especially phosphorus from natural and anthropogenic sources, enable massive blooms of the blue-green alga (cyanobacterium) *Aphanizomenon flos-aquae* (*AFA*) to develop in UKL. These blooms cause significant water quality deterioration due to: elevated pH (Kann and Smith 1993); low (hypoxic) DO concentrations, which can be lethal to fish; and elevated levels of un-ionized ammonia, which can be toxic to fish (Perkins et al. 2000b; Welch and Burke 2001; Walker

2001). *AFA* blooms reach such dense concentrations in UKL that the water turns pea-green in color during the summer and fall. As a result, acutely toxic, chronic, and stressful conditions for suckers and other fishes likely occur at some scale on an annual basis in the lake, and three catastrophic fish kills have occurred in the past decade. The outlet and lower arm of Upper Klamath Lake in the action area are subject to the same water quality conditions.

Habitat characteristics in the lower arm of the lake, below Freeman Bridge to the Link River Dam, include considerable rocky substrate, extensive submerged aquatic plants and riparian vegetation, as well as suitable depths, to support suckers of all life-stages.

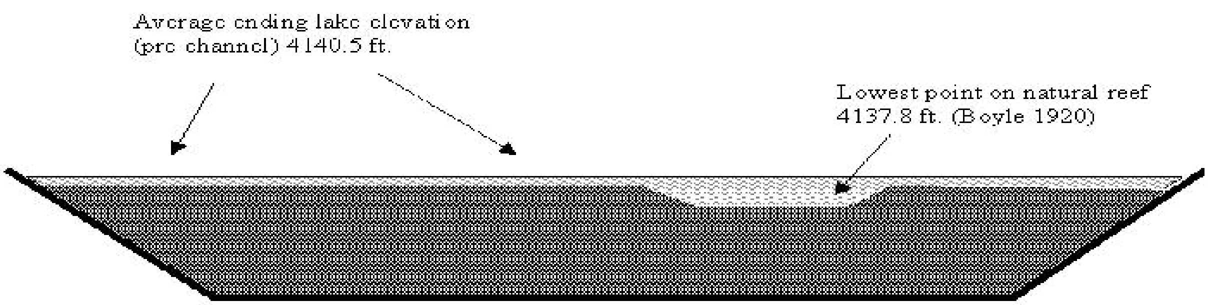
The Link River historically carried the entire surface outflow from Upper Klamath Lake. The head of the river was formed by a basalt sill, near the entrance to A-canal and about one-third of a mile upstream from the present dam. Water flowed over this sill into a low-energy lacustrine reach and then over a second sill at the present dam site. From this sill the water flowed down relatively high-gradient rapids for about 1.7 miles with a drop of approximately 55 ft to Lake Ewauna. The only natural "falls" in the Link River that potentially blocked fish passage are two small drops of 3-4 ft on either side of a bedrock island about 600 ft downstream of the present dam site (USBR 2000). At flows of 2,500 cfs, or greater, the "falls" are completely inundated.

Historically, Lake Ewauna and the upper Klamath River were connected to both the Lost River, at least in years of high water, and to Lower Klamath Lake. In 1890, the paddle-wheeler "Mayflower" was able to navigate up the Lost River Slough and moved down the Lost River to near Merrill. The Lost River Slough was located near the current location of the Lost River Diversion Canal. Steamboats also moved through the Klamath Straits (now Klamath Straits Drain) between the river and Lower Klamath Lake. The Lake Ewauna/ upper Klamath River reach may have formed a critical connectivity corridor for suckers moving between the Upper and Lower Klamath Lakes and the Lost River.

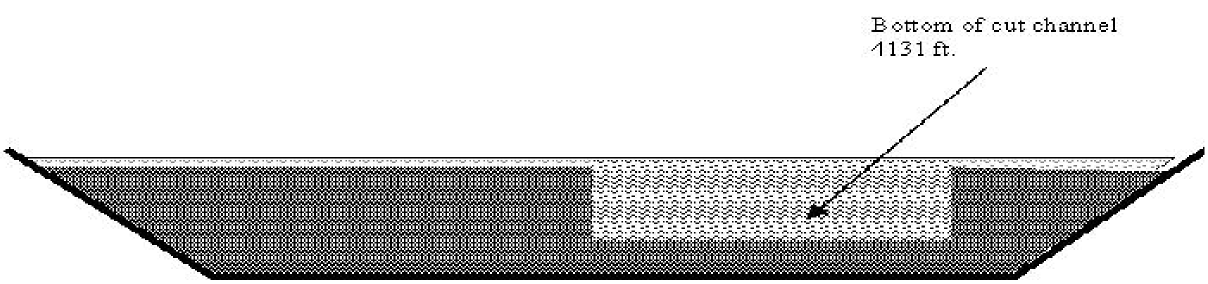
Currently, Lake Ewauna and the upper reach of the Klamath River above the Keno Dam form an impoundment 20 miles-long by 300 to 2600 ft-wide (the Keno Impoundment); depths range from 9 to 20 ft (CH2M Hill 1995). Water surface elevations in this reach are controlled by Keno Dam within 4083 to 4086 ft (USBR datum) to provide sufficient head for irrigation diversions, including the Lost River Diversion Canal and Ady Canal. Water quality in this reach is seasonally poor owing to UKL outflow, a high sediment biochemical oxygen

demand (BOD), and a number of significant discharges with BOD (CH2M Hill 1995; ODEQ 1998). This reach also receives discharges from sewage treatment plants, receives irrigation return flows enter from the Lost River Diversion and the Klamath Straits Drain, and has considerable amounts of of bark and wood debris on the bottom from historic and on-going log storage and mill operations (Oregon State Sanitary Authority 1964). This reach of the Klamath River is 303(d)-listed by Oregon Department of Water Quality (ODEQ) for the following water quality criteria: DO, pH, Chl-a, and ammonia.

Figure 4.1-1. Schematic representation of the natural reef of Upper Klamath Lake and the relationship between the channel and lake elevation. The natural reef was a long, wide sloping sill (not like the vertical wall of a dam). Prior to the cutting of the channel, water passing over the sill was directly related to inflows. The average end-of-summer (August 30) lake elevation was 4140.5 ft. (USBR data). The minimum recorded lake level under normal conditions was 4139.9 ft. (USBR data, Boyle 1987). Occasionally, strong South winds have resulted in a cessation of flows over the sill. The last recorded event was in July 1918 when winds shifted water levels northward for a short time, eliminating outflow from the lake (Spindor 1996, Boyle 1987).

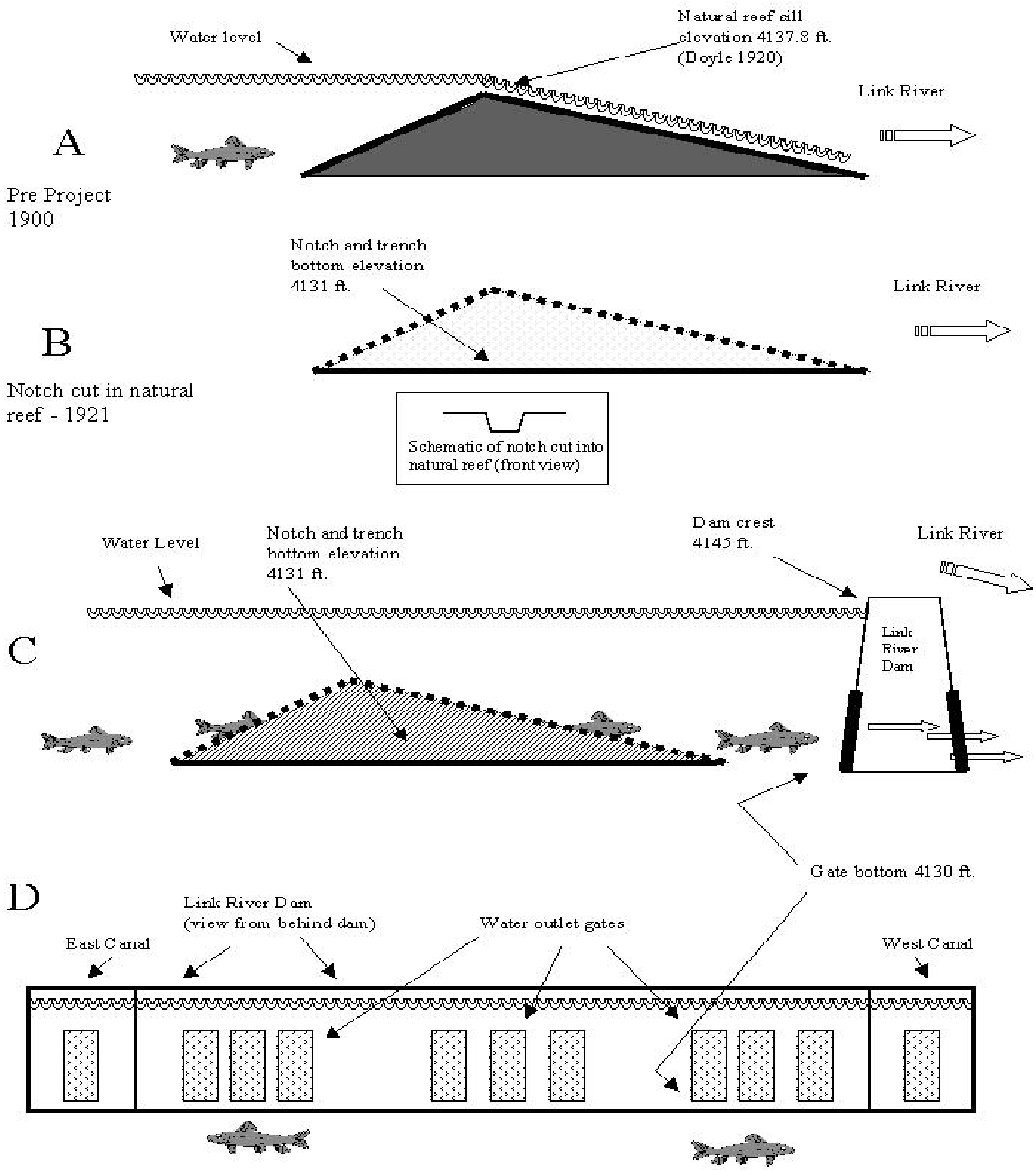


A **Schematic representation of natural reef/sill before channel was excavated**



B **Schematic representation of natural reef after 100 foot wide channel was cut at time of dam construction**

Figure 4.1-2. Schematic of pre-Project natural outlet to Upper Klamath Lake, alterations made by notching and channelization of the natural outlet sill, and construction of dams and diversions (this is only a representative diagram and is not to scale).



Residential development in the Klamath Falls area have likely had some negative effects on the LRS and the SNS through reductions in water quality. However, since the largest concentrations of listed suckers is upstream from urban areas, impacts are limited to Lake Ewauna and adjacent upper reaches of the Klamath River. Improvements to the city of Klamath Fall's wastewater treatment facility are expected to help improve water quality in Lake Ewauna. However, the lake is also adversely affected by nearly a half-century of log storage. Bark deposited on the bottom of the lake has a significant biological oxygen demand as it decomposes. Logs are still being stored in rafts downstream from Lake Ewauna and are believed to be contributing to poor water quality in that area (E. Snyder-Conn, USFWS, pers. comm.).

4.2 Status in the Action Area

Prior to construction of the Link River Dam, there were apparently large spawning runs of suckers migrating up the Link River in March, which were described as "immense congregations" of fish weighing two to six pounds (Klamath Republican 1901). The origin of these runs is not recorded; presumably, they came up out of Lower Klamath Lake or the Lake Ewauna/Keno reach, as no suitable lake habitat was available below Keno prior to construction of J.C. Boyle Dam. Suckers apparently occupied the Link River even in summer, as evidenced by accounts of stranded "mullet," when flow to the Link River was cutoff by southerly winds producing a seiche (a wind-drive oscillation of the water surface) in UKL that lowered the level at the outlet to below the sill and the river temporarily stopped flowing (Spindor 1996).

There has been no concerted effort to survey the Link River itself for fish distribution and seasonal use patterns. However, the limited information available demonstrates that adult suckers still make an attempt to migrate upstream in the Link River during the spring, and at least juveniles apparently reside in the river below the dam throughout most of the year. Primarily juvenile suckers are consistently caught during salvage operations conducted at the base of the Link River Dam during maintenance operations and spill termination, which occurs in most seasons except the January-March period (USBR 2000). Small numbers of adult suckers have also been found attempting to utilize the poorly designed fish ladder at the Link River Dam (Fortune unpub. data; Hemmingsen et al. 1992; PacificCorp 1997; Schrier, PacificCorp, pers. com. cited in USBR 2001).

While suckers appear to still occupy habitat throughout the Link River in low numbers, the

lower Link River is probably crucial to suckers and other fish, since it may be the best habitat now available in the reach upstream of Keno. The lower Link River can serve as a critical refuge for fish during periods of low DO. Water quality in Lake Ewauna is frequently very poor and the higher water quality in the Link River may allow fish from the lake to survive. Link River, because of its high gradient and numerous cascades, has a significant potential for oxygenation of water prior to entry into Lake Ewauna where there is a high biochemical oxygen demand. Furthermore, a number of small springs along and in the channel add fresh, high-quality water to the river. In summer, when most of the flow is diverted into the hydroproject, water quality in the Link River itself and the reach's potential to oxygenate water entering Lake Ewauna is greatly compromised by the reduced flow caused by the diversions.

At this time, suckers attempting to move up into UKL, including those that have been entrained from UKL and delivered downstream by diversion channels, are effectively prevented by the Link River Dam. Mature suckers trapped below the Link River Dam are prevented from reaching spawning grounds in UKL or its tributaries and are lost to the population.

Very little is known about the present use of the Keno to Link River reach by suckers or other fishes, and no systematic sampling has been done. There is evidence that some suckers still migrate upstream past the Keno Dam (Hemmingsen et al. 1992; ODFW 1996; PacifiCorp 1997). Their destination and success at reaching it are unknown. The occasional capture of adult suckers in the Keno Impoundment, the presence of suckers both in the Link River itself and at both the Link River and Keno fish ladders, and the apparent out-migration of tens of thousands of juveniles from UKL in the late summer and fall demonstrate that suckers utilize this reach and suggests that improvement of habitat quality, coupled with adequate fish passage at the Link River and Keno Dams, would be a key component to restoring exchange between UKL and downstream populations, as well as allowing the survival and return of the large number of suckers swept downstream of the Link River Dam from UKL.

Very little is known about the present use of lower arm of Upper Klamath Lake, below the Freeman Bridge, by suckers or other fishes, and no systematic sampling has been done. However, entrainment studies carried out at the A-Canal and Link River Dam provide information on the presence, timing, size structure and population numbers of suckers passing through this area (see discussion below under "Entrainment of Larval, Juvenile and Adult Suckers").

4.2.1 Entrainment of Larval, Juvenile and Adult Suckers

Larval sucker entrainment into Project diversions has been extensively studied (Harris and Markle 1991; Markle and Simon 1993; Gutermuth et al. 1997, 1998b, 1999). The seasonal timing of larval drift into the A-Canal and past the Link River Dam is similar, starting as early as late April and continuing into late July, with peak entrainment during June. The highest density of drifting sucker larvae occurs primarily at night and near the surface, which is similar to larval outmigration in the Williamson River (Buettner and Scoppettone 1990; Gutermuth et al. 1998b; Harris and Markle 1991; Klamath Tribes 1996).

Larval entrainment was found to be high in all studies. The lowest estimate was in the 1990 A-Canal entrainment study, when approximately 400,000 larvae were entrained into just the A-Canal (Harris and Markle 1991). Entrainment was likely greatly underestimated in this study, because sampling began too late in the season, after much of the entrainment was suspected to occur, and there was no night-time sampling. In a 1991 study, under similar constraints, it was estimated that 800,000 sucker larvae were entrained into the A-Canal (Markle and Simon 1993). The more complete 1996 and 1997 entrainment estimates (full season and 24-hr sampling) for larval and early juvenile suckers (<74 mm in length) were 3,000,000 in 1996 and 1,700,000 in 1997 (Gutermuth et al. 1998b).

Management of UKL elevations probably contributes to some increase in larval entrainment relative to the hydrologic baseline conditions. During all water-year types, additional water is withdrawn from the lake each summer by the Project because lake levels are higher under the proposed action in spring and they are lower than the baseline by the end of the irrigation season. The greatest withdrawal of water occurs in the May to July period when larvae are present in the lake. Any larvae that are not in emergent marshes would be swept by currents to the south end of the lake where they are entrained in A-Canal or past the Link River Dam.

Studies designed specifically to quantify juvenile and adult sucker entrainment into the A-Canal were conducted in 1997-1998 and for Link River Diversions (eastside and westside hydropower canals) in 1997-1999 (Gutermuth et al. 2000a, b). Juveniles (age 0) make up the majority of the entrained suckers (85-99 %) and most are caught in late July-September. Adult suckers (over 25 cm FL) are generally caught from July through October. A peak of entrainment rates for larger suckers (>15 cm FL) in August-September of 1997 was associated with a drop in DO levels and was considered primarily the result of stressed and

debilitated fish moving from severely degraded water quality conditions in UKL during a fish kill. Entrainment estimates from the Link River hydropower canals studies are considered to represent potential entrainment past the Link River Dam, were that water to go directly through the dam, since diversion structures for the dam gates and intake bays for the hydropower canals are similar. No information is available for direct entrainment through the dam gates.

The total entrainment estimates for A-Canal and the two Link River hydropower canals represent a large percentage of the total population estimates of juvenile suckers in UKL (Table 4.2-1). Increases in entrainment are associated with apparent declines in the lake populations of suckers (Simon and Markle 2001). In both 1997-1998, catches of juvenile sucker in UKL declined precipitously to below the entrainment values in September and October. Differences in gear and uncertainties of sampling efficiencies make it impossible to directly quantify the exact percent of young suckers produced in UKL that are ultimately entrained by the diversions. However, it is clear that entrainment itself accounts for a substantial component of the age 0 juvenile mortality.

Table 4.2-1. Entrainment of juvenile suckers at the A-Canal and Link River Diversions compared to the total UKL, age 0, juvenile population estimate in August (derived from Gutermuth et al. 2000a, 2000b; Simon and Markle 2001).

	YEAR	
	1997	**1998**
Upper Klamath Lake		
UKL Juvenile Population Estimate - August	**82,477**	**665,421**
September	**2,657**	**33,818**
Entrainment into Diversions		
A-Canal Entrainment	**44,974**	**245,642**
Link River Diversions	**19,394**	**82,817**
Total Entrainment	**64,368**	**328,459**
Total Entrainment as a Percent of the UKL August Juvenile Population Estimate	**78 %**	**49 %**

Reclamation has conducted salvage operations from Project canals receiving water from UKL annually since 1991 (USBR 1996a, 2000b, 2002a). Salvage has been considered a stop-gap measure to reduce losses from and obtain information on the magnitude of entrainment. Between 1996 and 1999, the numbers of suckers salvaged increased annually from 11,000-27,000. Sucker salvage in 2001, a year of reduced diversion flows in the A-Canal and reduced salvage effort, captured 587 suckers, with nearly all caught in the two stations nearest the headworks. Age 0 fish dominated the 1996, 1998 and 1999 salvage operations, while age 1+ were more abundant in 1997 and 2001. The canal salvage data should be viewed as a qualitative index, since there are several factors that influence the numbers salvaged. Poor water quality conditions have been documented in several years that likely resulted in high mortality of canal fish (Gutermuth et al. 1998b). Varying levels of success in draining the canals and guiding suckers out of the canals into the Lost and Klamath rivers

may also affect the results. Additionally, only a small percentage of the canal system is sampled and electrofishing is very inefficient in the canals, so large numbers of suckers are undoubtedly missed.

5.0 EFFECTS OF THE ACTION ON THE SHORTNOSE AND LOST RIVER SUCKERS

This section presents an analysis of the beneficial and adverse, direct and indirect effects of the proposed action, together with the effects of other activities that are interrelated or interdependent with that action, on the LRS and the SNS. The discussion below is combined for the LRS and SNS because their status, ecology, life history, distribution, and conservation needs are very similar.

5.1 Beneficial Effects

The construction and long-term operation of the proposed A-Canal fish screen and the proposed Link River Dam fish ladder will beneficially affect the following conservation needs of the suckers:

- **The need to increase population size;**
- **The need to provide adequate passage past dams;**
- **The need to increase recruitment;**
- **The need to prevent entrainment losses.**

The A-Canal fish screen will significantly reduce entrainment of suckers 3-5 cm total length and will eliminate entrainment of larger suckers past the headworks of the canal, and the primary bypass will send them back into Upper Klamath Lake on the far side of the channel, where they will retain the opportunity to remain in the lake and contribute to the Upper Klamath population. During operation of the secondary bypass, suckers will be sent to the Link River near the inlet to the proposed fish ladder, where they will have access to the higher water quality of Link River and the opportunity to either return to the lake through the ladder or move downstream into Lake Ewauna. Due to adverse water quality in Lake Ewauna during the summer, the beneficial effects of bypass downstream of Link River will increase if habitat conditions in Lake Ewauna and the Keno Impoundment are improved through future restoration and management of this reach.

The proposed Link River fish ladder will provide passage past the Link River Dam for adult

suckers and possibly for subadults larger then 15-20cm Standard Length (SL), though it is uncertain whether immature suckers would be inclined to migrate actively upstream. Historically, the Link River passed large spawning migrations in the Spring, and sampling at both the Link River and Keno Dams indicate that remnant populations, or suckers that had been earlier entrained downstream past the dams as juveniles or adults, still attempt passage. By reentering the lake, these mature suckers, that have already survived to adulthood, will contribute to both the absolute numbers and the reproductive potential of the Upper Klamath populations.

5.2 Adverse Effects

The construction of the proposed A-Canal fish screen and the proposed Link River Dam fish ladder will adversely affect the following conservation needs of the suckers:

- **The need to increase population size;**
- **The need to ensure recruitment; and**
- **The need to prevent entrainment mortality.**

During construction there is an expectation of short-term disturbance and possible harm due to placement and removal of cofferdams; dewatering of construction sites; stranding in Link River by reduced flow during cofferdam placement; placement of instream structure (i.e. bypass pipelines and rock deflectors); general construction disturbance (noise, vibration and increased activity); reductions in flow during cofferdam construction and effects on water quality; and fish salvage activities following cofferdam placement.

Sediment inputs due to cofferdam placement/removal and construction activities is expected to be of short duration, and while turbidity and fines may increase, they are not expected to cause significant adverse effects to suckers in the area. There is also the possibility of introducing construction-related contaminants (e.g., fuels and construction materials) into the water, although this will be minimized through best management practices included as part of the proposed project, which include: restrictions and requirements for fuels management, isolation of contaminants from floodplain or near-water areas, separation of vehicle storage and service areas from near-water areas, and field inspections of contractor compliance by Reclamation staff.

During flow reductions, while the cofferdam for the fish ladder is being constructed, suckers

might be stranded below the dam. Adverse effects of stranding will be minimized by salvage actions proposed by Reclamation. Reduced flows in the Link River could result in lower levels of dissolved oxygen (DO) downstream in the lower reach of the river where suckers hold up during the summer when water quality is poor. While this is not likely to be a problem, monitoring would indicate if DO gets below 4 mg/l and if necessary flows could be increased.

The number of suckers that will be directly harmed is difficult to predict, due to uncertainties associated with the distribution of individuals in the water at any time in direct proximity with the construction activities or placement of instream structures (i.e., pipes, piers, rocks, and cofferdams) and uncertainties associated with salvage activities. Nevertheless, an estimate of the number of suckers present in the project area within A-Canal and those present downstream vicinity of the Link River Dam can be obtained from past salvage efforts in the two areas. A-Canal salvage takes place in the Fall, after the end of irrigation season and in the same time period as that for the proposed construction activities.

The number of suckers (including Klamath largescale) salvaged each year by Reclamation from 1991-2000 at the A-Canal headworks and tunnel sampling site varied from 37 to 3,847, with a mean of 1,266 (Peck 2001). Electroshocking salvage activities select for larger fish, and the young juveniles under 15 cm SL are probably underestimated. However, this reach of the A-Canal is considerably longer than the proposed construction area and represents an exaggerated estimate of potential suckers actually in the construction area. Therefore, a maximum estimate for the number of suckers over 15 cm SL that would be affected by the A-Canal construction is 4,000, with only a relatively small, but undeterminable, percentage being injured or killed, due to the low probability of being in direct contact with, and not avoiding, in-water construction work and the salvage operations which will remove most larger fish from the area. Smaller juvenile suckers (<15 cm SL) have substantially declined in abundance throughout the lake by the Fall, and entrainment of juvenile suckers into the A-Canal and Link River Diversions in late September-October is typically less than 1% of the total summer entrainment of about 50-250,000 (Gutermuth et al. 2000a, 2000b; Simon and Markle 2001). Larvae are not present in the canal during the proposed construction period and thus would not be affected.

While little information is available on the distribution of suckers in the Link River, small numbers of suckers have been salvaged immediately below the Link River Dam during inspections and maintenance or during monitoring of the old fish ladder (Hemmingsen et al.

1992, PacificCorp 1997, Peck 2000, USBR 2002b). The number of suckers encountered has been less than 100 at any time. The proposed installation of the fish ladder cofferdam is for July when most larvae would be gone, and the proposed removal would be during February when only adults and sub-adults would be expected to be in the general area and would tend to avoid the immediate area of disturbance.

During operation of the fish screen and bypass system there is an expectation that harm may occur due to entrainment of larvae through the screen, impingement of small or weak fish on the screen, physical passage through bypass pipes and pump, and increased predation at the outfall. The screen is not designed to bypass fish smaller than 3 cm total length, although some percentage will be carried through the bypass flow without passing onto the screen. Estimates of the number of larval fish entrained into the A-Canal range up to 3,000,000 larvae and early juvenile suckers less than 7.5 cm SL (see Environmental Baseline). Pipe and pump mortality is not known at this time, but is estimated to be less than ten percent based on discussions within the screen development group (USBR 2002d). Entrainment of fish larger than about 25 cm SL will be substantially reduced, or eliminated, by the trashrack bar spacing of less than 2" (USBR 2002e). Predation levels at the outfall cannot be estimated at this time; however, adaptive management and monitoring following operation of the bypass is intended to address and minimize predation once it can be assessed.

Operation of the fish ladder is not expected to result in harm to suckers, with the possible exception of increased susceptibility to predation by birds and otters, which cannot be estimated at this time. Adaptive management and monitoring once the ladder is operational is intended to address and minimize predation.

6.0 CUMULATIVE EFFECTS ON THE SHORTNOSE AND LOST RIVER SUCKERS

Cumulative effects are those effects of future non-Federal (State, local governments, or private) activities on endangered and threatened species or critical habitat that are reasonably certain to occur within the action area of the Federal activity subject to consultation. Future Federal actions are subject to the consultation requirements established in section 7 and, therefore are not considered cumulative to the proposed action.

Cumulative effects in the Upper Klamath Basin, but not specific to the action area, are discussed in the BO on longterm operation of the Klamath Project (USFWS 2002). Operation of the A-Canal, Link River Dam, and Link River diversion canals are also addressed in the

BO. The action area itself is located within the urban influence of the city of Klamath Falls and is subject to normal urban activities. No restoration activities are currently planned within the action area itself. However, renewed interest in the fate of suckers entrained past the Link River and into Lake Ewauna is anticipated to result in this habitat improving in the future.

7.0 CONCLUSION

The determination of jeopardy is based upon the effect of the proposed action on the continued existence of the entire population of the listed species, throughout its range (unless population segments are listed separately) (Section 7 Handbook, p. 4-34). Therefore, all LRS and SNS populations were considered in the jeopardy analysis. After reviewing the current status of the LRS and the SNS, the environmental baseline for the action area, effects of the proposed action, and cumulative effects, it is the Service's biological opinion that implementation of the proposed Project is not likely to jeopardize the continued existence of the LRS and the SNS. We reached this conclusion because the A-Canal screen and fish ladder is anticipated to be largely beneficial and will contribute to the conservation needs of the species.

8.0 INCIDENTAL TAKE STATEMENT

This Incidental Take Statement (ITS) applies to incidental take of the LRS and/or the SNS resulting from the construction of the A-Canal Fish Screen and the Link River Fish Ladder. The exemptions provided under this ITS apply to the action agency and its designees. Incidental take for the operation of the fish screen and fish ladder is included, as entrainment, under the ITS for the May 31, 2002 BO for operation of the Klamath Project for the 10-year period June 1, 2002, through March 31, 2012 (USFWS 2002).

Sections 4(d) and 9 of the Act, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harassment is defined as an intentional or negligent act or omission which creates the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or

sheltering. Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this ITS.

The measures described below are non-discretionary, and must be implemented by Reclamation so they become binding conditions of Project implementation for the exemption under 7(o)(2) to apply. Reclamation has a continuing duty to regulate the activity that is covered by this ITS. If Reclamation (1) fails to adhere to the terms and conditions of the ITS through enforceable actions, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of 7(o)(2) may lapse. In order to monitor the impact of incidental take, Reclamation must report the progress of the action and its impact on the species to the Service as specified in the ITS in accordance with 50 CFR §402.14(I)(3).

The Service developed this ITS based on the premise that the Project will be implemented as proposed. The Service anticipates that the LRS and/or the SNS are likely to be taken in the form of capture, kill, harm, and harass.

8.1 Quantification of Incidental Take

The Service anticipates that take of LRS and/or SNS adults, sub-adults, juveniles, and larvae will occur in the form of capture, kill, harm, and pursuit as a result of operating the Project in accordance with the BA and its supporting documentation. We anticipate that such take will likely occur as a result of the following actions related to Project construction.

8.1.1 <u>Construction of the A-Canal Fish Screen</u>

1. **During construction there is an expectation of harm due to placement and removal of cofferdams, dewatering of construction sites, and placement of instream structure (i.e., bypass pipelines). Expected take in the form of harm or kill is less than 2,500 suckers <15cm SL and less than 1,000 suckers >5cm SL.**

2. **During fish salvage activities following cofferdam placement there is an expectation of harm due to electroshocking, netting and transport to relocation sites. Expected**

take in the form of capture, harm, and pursuit is less than 2,500 suckers <15cm SL and less than 4000 suckers >15cm SL. Expected take in the form of kill is less than 250 suckers <15cm SL and less than 400 suckers >15cm SL.

8.1.1 Construction of the Link River Fish Ladder

1. **During construction there is an expectation of harm due to placement and removal of cofferdams, dewatering of construction sites, and placement of instream structure (i.e., rock deflectors). Expected take in the form of harm or kill is less than 1000 suckers <15cm SL and less than 100 suckers >15cm SL.**

2. **During fish salvage activities following cofferdam placement there is an expectation of harm due to electroshocking, netting and transport to relocation sites. Expected take in the form of capture, harm, and pursuit is less than 1,000 suckers <15cm SL and less than 100 suckers >15cm SL. Expected take in the form of kill is less than 100 suckers <15cm SL and less than 10 suckers >15cm SL.**

8.2 Effect of the Take

Take of fewer than 2,500 juveniles, and fewer than 4,000 sub-adult and adult LRSs and SNSs during construction is not likely to have a significant adverse effect on sucker populations because: (1) the majority of take will be in the form of harm, capture (and release), or pursuit and will not necessarily lead to mortality; and (2) non-lethal salvage of suckers in the construction areas will further reduce the anticipated take during actual construction.

8.3 Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impacts of incidental take of the LRS and the SNS as a result of implementing the Project:

1. **Minimize the take of suckers as a result of operation of the trash rack, fish screen and bypass system in the A-Canal.**

2. **Maximize performance of the fish ladder and minimize the take of suckers due to predation.**

3. Minimize adverse water quality effects when the cofferdam is being constructed.

8.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, Reclamation must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. In all of the following terms and conditions, adaptive management is used to provide Reclamation with maximum flexibility while also providing maximum benefit to the suckers.

RPM 1: <u>Develop and implement a monitoring and evaluation plan to reduce fish screen and bypass mortality</u>

Reclamation shall develop and implement a plan to evaluate and monitor performance of the A-Canal fish screen and determine methods to minimize take where practical in the system through adaptive management. A draft evaluation plan shall be provided to the Service for review and comment by May 1, 2003. Reclamation shall begin implementation of the approved plan by August 1, 2003. Reclamation has proposed general goals as part of the proposed Project which can be incorporated with more procedurall detail into the final plan. The Service recognizes that while a preliminary evaluation and study plan, as included in the proposed Project, can be completed before the screen is operational, a complete comprehensive plan may require familiarity with the functioning system.

RPM 2: <u>Develop and implement a monitoring and evaluation plan to maximize fish ladder performance</u>

Reclamation shall develop and implement a plan to monitor and evaluate performance of the Link River Dam Fish Ladder and determine methods to maximize performance and minimize take where practical in the system through adaptive management. A draft evaluation plan shall be provided to the Service for review and comment by February 1, 2004. Reclamation shall begin implementation of the approved plan by June 1, 2004. Reclamation has proposed general goals as part of the proposed Project which can be incorporated with more procedural detail into the final plan. The Service recognizes that while a preliminary evaluation and study plan, as included in

> **the proposed Project, can be completed before the screen is operational, a complete comprehensive plan may require familiarity with the functioning system.**

RPM 3: <u>During cofferdam construction maintain dissolved oxygen in the lower Link River above 4 mg/l</u>

> **Reclamation shall schedule cofferdam construction for the fish ladder early in July, if possible, to minimize adverse effects of low flows during the critical summer period. Reclamation shall also monitor dissolved oxygen (DO) in the lower Link River (upstream of the Main Street bridge) during the cofferdam construction period and if DO gets below 4 mg/l at 1 meter depth in areas used by suckers, shall increase flows down the river to 75 cfs. If the problem is not solved, Reclamation shall notify the Service and be prepared to take other measures to ensure adequate oxygenation.**

8.5 Reporting Requirements

Upon locating a dead, injured, or sick specimen of an endangered or threatened species, initial notification must be made to the nearest Service Law Enforcement Office. In Oregon, contact the U.S. Fish and Wildlife Service, Division of Law Enforcement, 301 Post Office Building, Klamath Falls, Oregon 97601 (phone: 541/883-6900). In California, contact the U.S. Fish and Wildlife Service, Division of Law Enforcement, District 1, 2800 Cottage Way, Room W-2928, Sacramento, California 95825 (phone: 916/414-6660). Care should be taken in handling sick or injured specimens to ensure effective treatment and care and in handling dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

The Service is to be notified within three (3) working days of the finding of any endangered or threatened species found dead or injured in the Project service area. Notification must include the date, time, and precise location of the injured animal or carcass, and any other pertinent information. In California and Oregon, the Service contact person for this information is the Project Leader of the Klamath Falls Fish and Wildlife Office (phone: 541/885-8481). Any LRS or SNS found dead or injured in California shall be provided to the California Department of Fish and Game by calling them at (530) 225-2300.

9.0 CONFERENCE REPORT

Critical habitat for the LRS and the SNS was proposed in 1994, but has not yet been finalized (17 FR 61744). The primary constituent elements identified in the proposal are as follows: (1) water of sufficient quantity and suitable quality; (2) sufficient physical habitat, including water quality refuge areas, and habitat for spawning, feeding, rearing, and travel corridors; and (3) a sufficient biological environment, including adequate food levels, and natural patterns of predation, parasitism, and competition.

9.1 Effects of the Action on Proposed Critical Habitat

All construction activities will occur at the forebay and headworks of the A-Canal and at the Link River Dam (T 38 S, R 9 E, Sec 30), which lie outside proposed Critical Habitat. Based on information contained in Reclamation's Biological Assessment, as well as information from the two subsequent memoranda, we have determined that the action area for this consultation includes the lower arm of Upper Klamath Lake between Fremont Bridge and Link River Dam, the A-Canal, Link River, and Lake Ewauna. Therefore a portion of the action area downstream of Link River Dam lies within CHU #3 (Klamath River). Due to minimal downstream impacts of the Project in the nature of suspended sediments, the primary constituent elements for this unit are not likely to be adversely affected by Reclamation's proposed action.

Based on these effects to the primary constituent elements, we conclude that the action, as proposed, will not result in the adverse modification of proposed critical habitat for the suckers due to the limited nature of short-term impacts to habitat and the long-term benefits to the species as a result of improved passage and reduced entrainment.

We recognize that our findings relative to proposed sucker critical habitat are strictly advisory and are not binding. However, we believe it is in the best interest of both of our agencies to adequately address effects to proposed critical habitat prior to that proposal being finalized.

10.0 REINITIATION NOTICE

This concludes formal consultation on Reclamation's proposed construction and operation of the A-Canal Fish Screen and Link River Dam Fish Ladder. As provided in 50 CFR § 402.16,

reinitiation of formal consultation is required when discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that cause an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If you have any questions regarding this opinion, please contact the Project Leader of the Klamath Falls Fish and Wildlife Office at (541) 885-8481.

11.0 LITERATURE CITED

Full references for most citations in the text are available in the Biological/conference opinion regarding the effects of operation of the U.S. Bureau of Reclamation's proposed 10-year operation plan for the Klamath Project (USFWS 2002).

U.S. Bureau of Reclamation 2002a. Final biological assessment. The effects of the proposed actions related to Klamath Project operation (April 1, 2002 - March 31, 2012) on federally listed threatened and endangered species. U.S. Bureau of Reclamation, Mid-Pacific Region, Klamath Basin Area Office, February 25, 2002.

U.S. Bureau of Reclamation 2002b. Memorandum. Request for formal consultation on the effects of the A-Canal fish screen and Link River Dam fishway facilities construction and operation on endangered Lost River and shortnose suckers (Biological Assessment). Klamath Basin Area Office, Klamath Falls, Oregon. March 27, 2002.

U.S. Bureau of Reclamation 2002c. Preliminary designer's operating criteria/design summary - Fish Ladder Link River Dam. Klamath Basin Area Office, Klamath Falls, Oregon. March 29, 2002.

U.S. Bureau of Reclamation 2002d. A-Canal fish screen facility - Preferred alternative

selection technical memorandum. U.S. Bureau of Reclamation, Mid Pacific Regional Office, Division of Design and Construction. April, 2002.

U.S. Bureau of Reclamation 2002e. Bureau of Reclamation construction documents: A-Canal fish screen, Klamath County, Oregon, Vol. 3 - drawings (Specification # 20-C0569, Solicitation # 02SP202018). U.S. Bureau of Reclamation, Mid Pacific Regional Office, Division of Design and Construction. April, 2002.

U.S. Bureau of Reclamation 2002f. Link River Fish Ladder, Klamath County, Oregon, SPECD. U.S. Bureau of Reclamation, Technical Service Center. April, 2002.

U.S. Bureau of Reclamation 2002g. Memorandum. Supplemental information for formal consultation on the effects of the A-Canal fish screen and Link River Dam fishway facilities construction and operation on endangered Lost River and shortnose suckers. Klamath Basin Area Office, Klamath Falls, Oregon. June 11, 2002.

U.S. Bureau of Reclamation 2002h. Memorandum. Clarifying information for formal consultation on the effects of the A-Canal fish screen and Link River Dam fishway facilities construction and operation on endangered Lost River and shortnose suckers. Klamath Basin Area Office, Klamath Falls, Oregon. June 14, 2002.

U.S. Fish and Wildlife Service 2002. Biological/conference opinion regarding the effects of operation of the U.S. Bureau of Reclamation's proposed 10-year operation plan for the Klamath Project and its effect on the endangered Lost River sucker (*Deltistes luxatus*), endangered shortnose sucker (*Chasmistes brevirostris*), threatened bald eagle (*Haliaeetus leucocephalus*) and proposed critical habitat for the Lost River and shortnose suckers. May 31, 2002.

Appendix C

Link River Fishway Project

Wetland Delineation

Prepared By:

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region
Klamath Falls, Oregon

March 2002

Fish Ladder Project - West Bank of the Link River Dam

Introduction

This wetland verification package addresses identified potential jurisdictional waters of the United States, including wetlands, for the U.S. Bureau of Reclamation (Reclamation) Fish Ladder Project on the west bank of the Link River Dam (Project). The report includes a delineation of a wetland subject to U.S. Corps of Engineers (Corps) jurisdiction under Section 404 of the Clean Water Act.

Study Area

The study area (Figure 1a) is comprised of an area in the Link River west of the dam. The area studied is in Klama th County, Oregon (Figure 2).

The growing season in this area is between June 16 and August 23 (USDA). This makes the average growing season 69 days long. At a minimum, to create the hydrology needed to support a wetland, there needs to be 3.45 days of precipitation or inundation during the growing season.

During the week of the delineation it rained on Wednesday and snowed that night. There were about 2-3 inches of snow on the ground Thursday morning. The snow began to melt around noon Thursday. Not all of the snow melted Thursday, as there was still snow in some areas Friday.

Project Description

The purpose of this Project is to allow fish passage from the Klamath River system to Upper Klamath Lake. The Link River controls the level of Upper Klamath Lake and is considered a barrier to upstream passage of native fish species of Klamath Lake and the Klamath River System. Upstream passage for the endangered shortnose and Lost River suckers is primarily needed to allow fish access back to Upper Klamath Lake should they be carried downstream in a spillway, outlet works, or diversion flows. Current conditions in Lake Euwana, which is located south of the Link River Dam, are not considered suitable for fish populations; therefore it is important to survival that fish are allowed a form of passage back into their native habitat in Upper Klamath Lake. A fish ladder currently occupies spill bay 24, on the east side of the Dam. However, this ladder was constructed in 1926 and was designed for Red Band Trout. The downstream end of the ladder is located 220 feet from the river outlet releases and fish seem to have difficulty finding the ladder. In addition, the endangered suckers have difficulty navigating the ladder if they do find it, and the ladder has been shown to be a barrier to suckers.

The ladder is also required as a term and condition in the 2001 Biological Opinion for operations of the Klamath Project issued by the U.S. Fish and Wildlife Service.

Reclamation proposes to install a ladder in the west bank of the dam, lying between the Keno Canal and the outlet works stilling basin guide wall. The fishway exit would penetrate the dam between the Keno Canal headworks and the outlet works. To minimize the risk of re-entrainment of fish exiting the fishway, the canal gate adjacent to the fishway exit would be closed during normal operation.

The delineation presented in this report will be used to quantify the size of the wetland(s) in order to mitigate.

Wetland Area

The wetlands found in this study area are just below the Link River Dam. This area was built up in the late 1800's with imported fill and rocks. Today this area consists of 2 canals and maintenance roads on either side with inundated areas between these features (Figures 1a to 1c). At the time of the delineation, the obvious plant species included, Hooker's willow and reed canary grass. At the time of the delineation the water was at the high water mark. The aerial photo (Figure 1b) shows where the water level was in the area during September 2001. By looking at the shoreline areas one can see a small light colored band of exposed, unvegetated shoreline. During the delineation these areas were inundated with water. The black areas on Figure 1c indicate the wetland boundaries. For simplicity the Link River is included in the wetland boundary as well.

Jurisdiction and Authority

U.S. Army Corps of Engineers

The Corps regulates impacts to waters of the U.S. under the jurisdictional authority of Section 404 of the Clean Water Act (CWA) (33 U.S.C. 404 et seq.). Jurisdictional waters of the U.S. include all navigable waters, interstate waters, their tributaries, adjacent wetlands, and certain isolated waters (Federal Register 1986).

Delineation Survey and Mapping Methods

Reclamation Regional Office staff conducted a delineation of the Project area on March 4th through the 8th, 2002 using the methodology in the 1987 U.S. Corps of Engineers Wetlands Delineation Manual to determine the extent of wetlands. The delineator was Michelle Prowse, Environmental Specialist, Division of Environmental Affairs (MP-150). The Corps of Engineers, Portland office was contacted for information about the local hydric soils list.

For wetland data points, plants species were identified based on Pojar (1994), Alden (1998), and Sarah Malaby, U.S. Forest Service, Klamath Ranger District.

Soil colors were determined based on the Munsell soil color chart (1998). Assessment of the hydrologic criterion was based on indirect (wetland drainage patterns, high water line, drift lines, sediment deposits, etc.) indicators.

Data sheets used for the Project area are included in Appendix A. Data sheets were completed for 2 different soil pits sampled. The soil pits are represented on the aerial photos (Figures 3a and 3b) by a dot, and are labeled 'A' and 'B'.

Characterizations of the plant communities in the area were made and plotted on aerial photos (Figures 3a and 3b). These aerial photos are at a scale of 1:2303.

For all data points, plant species were identified based on Pojar (1994), Alden (1998), and Sarah Malaby, U.S. Forest Service, Klamath Ranger District. The plant species were then recorded as UPL, FACU, FACW-, FACW+, FACW, OBL, or N/A based on classifications by the Fish and Wildlife Service (1988).

Feature Descriptions

The Project area is an area that has been significantly disturbed. In the late 1800's the dam was built. Imported fill and rocks were used to create maintenance roads for access to the dam.

The area of the Fish Ladder wetland study extends from the base of the Link River Dam down the length of the maintenance road in the west part of the island area of the Link River (Figure 1a).

The dominant species near soil pit A (Figure 3a) included grasses, which were dead and degraded to such an extent that made identification impossible, wild rose (*Rosaceae* sp.), gray rabbitbrush (*Chrysothamnus nauseosus*), and big sagebrush (*Artemisia tridentata*). These plant species range from facultative upland (FACU) and non-indicators and are not wetland plant indicators.

The dominant species found around soil pit B were, wild rose (*Rosaceae* sp.), spotted knapweed (*Centaurea maculosa*), reed canary grass (*Phalaris arundinacea*), and Hooker's willow (*Salix hookeriana*). These plants ranged from non-indicator to facultative wet (FACW).

The different plant communities of the Project area determined sampling points, labeled soil pit A, and B on the aerial photos (Figure 3a).

The soils in soil pit A are dark reddish brown and are (2.5YR 2.5/2). The soils are homogenous throughout the pit. The soils are very fine to very coarse and larger. There is also vesicular basalt and basalt rock (10R 4/8) in about a 20% abundance. The soils are without mottles. The soil was moist but was not saturated. The soil pit was 13 inches deep. There were rocks below this point that made further digging difficult.

The soils in soil pit B are very dark brown and are (5YR 2.5/2). The soils are homogenous throughout the pit. The soils are a clay loam, with high clay content. The soils are without mottles. The soil pit was 16 inches deep. The soils were moist from 0 to 11 inches, it had rained the day before, saturated at 11 to 12 inches and water filled the pit from 12 to 16 inches.

References

Alden, Peter. 1998. “National Audubon Society Field Guide to Pacific Northwest”. Alfred A. Knopf, Inc. New York, New York. 448pp.

Munsell. 1998. Soil Color Charts. Kollmorgen Instruments Corporation. Newburgh, New York.

Pojar, Mackinnon. 1994. “Plants of the Pacific Northwest Coast”. B.C. Ministry of Forests and Lone Pine Publishing. Canada. 527pp.

Wetland Training Institute, Inc. 1995. Field Guide for Wetland Delineation: 1987 Corps of Engineers Manual. Poolesville, Md. WTI 95-3. 143pp.

--------. 1988. “Wetland Plant Indicator List”. U.S. Fish and Wildlife Service. Downloaded from the Internet.

--------. 1976. “Soil Survey of Klamath County, Oregon. U.S. Department of Agriculture.

Figure 1a

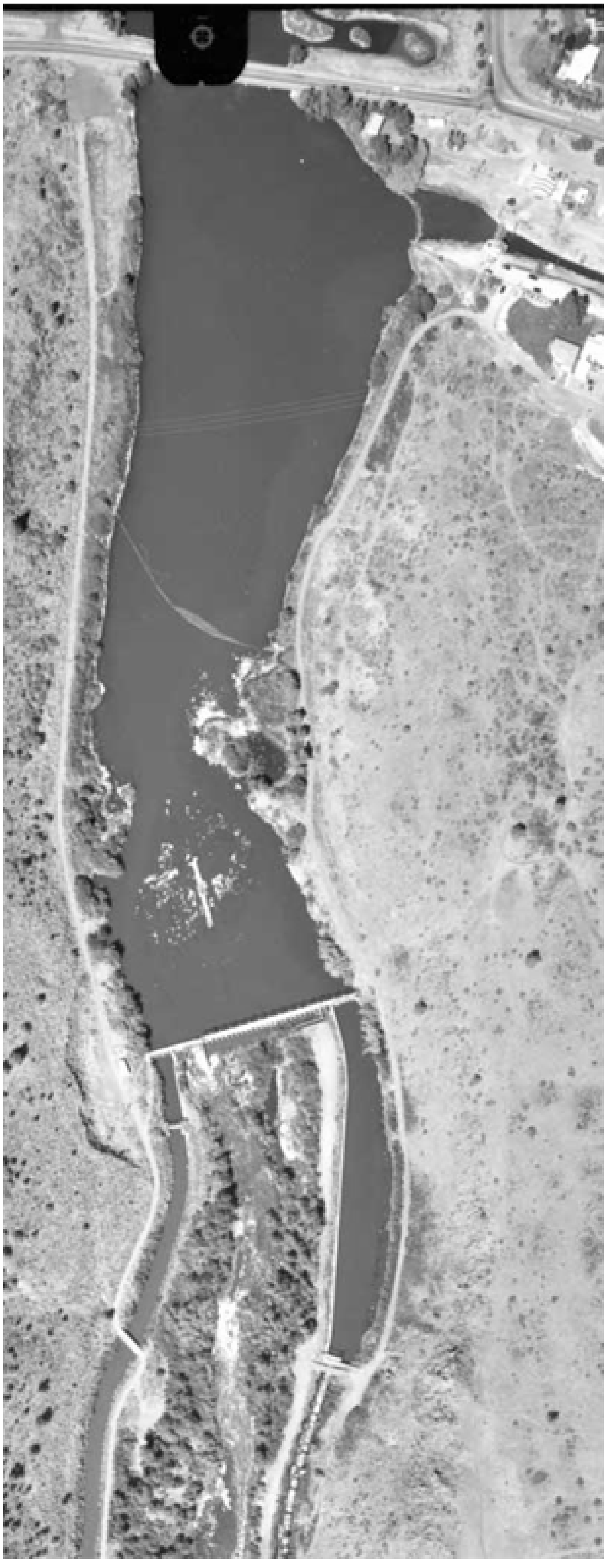


Figure 1b

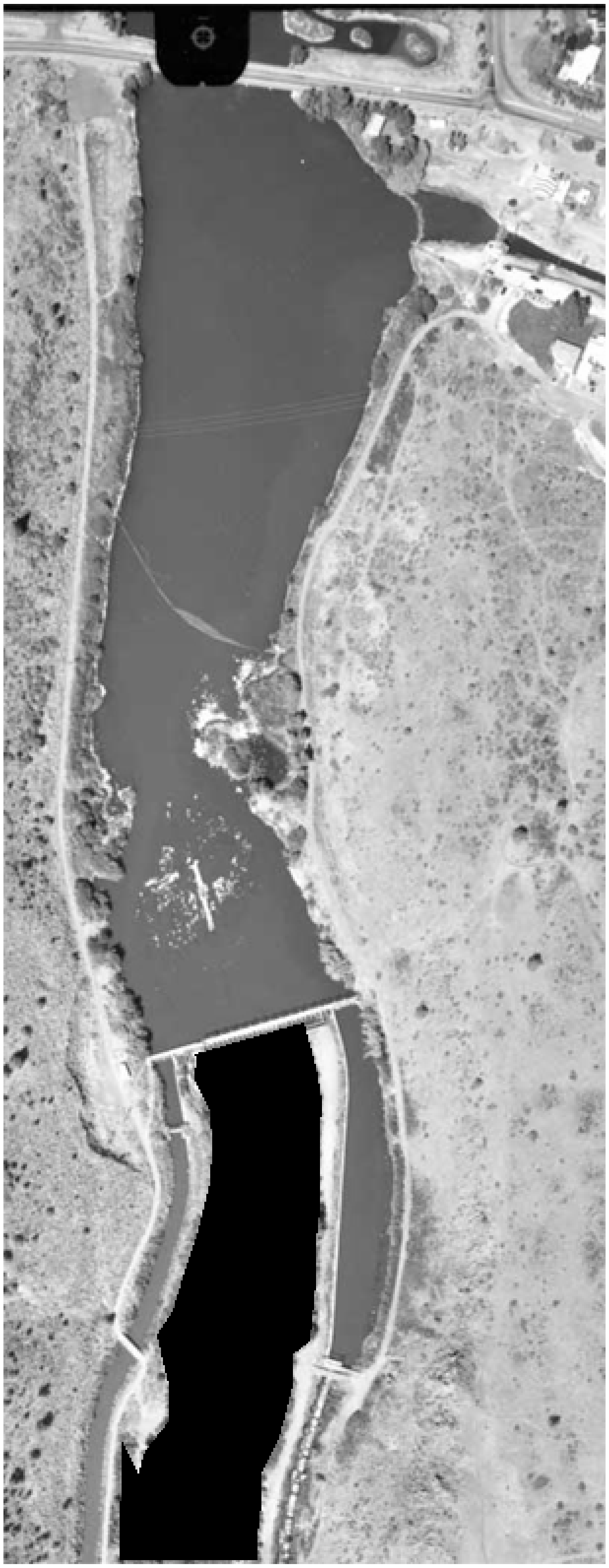


Figure 1c

Appendix D

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825 N. E. Multnomah, Suite 1500
Portland, Oregon 97232
(503) 813-5000

PACIFICORP
PACIFIC POWER UTAH POWER

October 29, 2002

Mr. Dave Sabo
Bureau of Reclamation
6600 Washburn Way
Klamath Falls, Oregon 97603

Dear Mr. Sabo:

Thank you for the opportunity to comment on the Bureau of Reclamation (BOR) Environmental Assessment (EA) for the Link River Passage Project. Listed below are PacifiCorp's comments on the EA. General comments are listed first, followed by specific comments linked to page numbers in the EA.

The proposed ladder construction (including the cofferdam) will occur from July 2003 to February 2004. PacifiCorp has several concerns regarding this construction period.

- Will the existing ladder remain operational? If not, this impact needs to be addressed in the EA.
- Per an agreement with the Oregon Department of Fish and Wildlife (ODFW), PacifiCorp releases a 90 cfs minimum instream flow below Link River Dam. However, PacifiCorp has increased flows to 250 cfs from mid-August to mid-October under the direction of the 2001 and 2002 Biological Opinions (BO) issued by the U. S. Fish and Wildlife Service (USFWS) for endangered suckers. If construction requires deviations from these flow requirements, the BOR needs to coordinate changes with PacifiCorp, ODFW and the USFWS.
- Will it be necessary to dewater the Keno (Westside) canal during construction? If so, the economic impact to PacifiCorp needs to be included in the EA.
- Any flow changes that occur as a result of ladder construction will have to be coordinated to ensure that minimum flow requirements below IronGate Dam are met.
- An alternative hiking trail that includes a footbridge over the Keno Canal is proposed during construction that may eventually become a permanent addition to the Link River Nature Trail. Any footbridge that is constructed over PacifiCorp canals will have to be approved by PacifiCorp.
- The BOR is to maintain dissolved oxygen (DO) levels of at least 4 mg/l during cofferdam construction. Since native trout do occupy this area, Oregon Department of Environmental Quality (ODEQ) requires that DO should not be less than 8 mg/l as an absolute minimum.

- PacifiCorp is assuming that BOR will be responsible for all fish salvage operations associated with proposed ladder construction. Is this assumption correct?
- The cofferdam may contain gravel, sands, etc to act like a temporary earthen dam. Has any assessment been made on downstream effects if this material washes downstream?

Specific comments to the EA are:

1. Page 3 DECISIONS TO BE MADE. The first question (Should Reclamation install a ladder) seems out of place since the ladder is required as a term and condition in the 2001 BO for operations of the BOR project issued by the USFWS.
2. Page 4 Table 1. The table heading should be changed to Permits and Authorization needed for Link Dam Fish Ladder Construction.
3. Page 5 Proposed Alternative. To minimize the risk of re-entrainment of fish exiting the fishway, the canal gate adjacent to the fishway exit would be closed during normal operations. Has any analysis been done to see what impact that would have on BOR or PacifiCorp's project operations?

PacifiCorp believes that the proposed ladder will have a positive benefit for aquatic resources in the Klamath Basin and will continue to work with BOR on this important project. Please direct any questions you might have on the comments provided to Linda Prendergast (503) 813-6625. Thank you.

Sincerely,

Todd Olson

Todd Olson
Licensing Project Manager

PacifiCorp
Response to Comments

Bullet 1: The operation or removal of the existing ladder is unknown at this time. The ladder is owned by the Oregon Department of Fish and Wildlife and the future of the ladder is at their discretion.

Bullet 2: Reclamation notes comment and will coordinate with appropriate entities regarding this matter.

Bullet 3: Reclamation will coordinate with PacifiCorp and address any economic impacts regarding the any need to dewater the Westside Canal.

Bullet 4: Reclamation notes comment and will coordinate with appropriate entities to ensure that proper flow requirements are met.

Bullet 5: Reclamation will coordinate and take lead in agreements with PacifiCorp or any other entities that are needed for the installation of a footbridge over Keno Canal.

Bullet 6: Although Oregon Department of Environmental Quality standards are 8 mg/l for dissolved oxygen, water exiting UKL is usually much less than that during the summer even at the mouth of Link River after it has had time to aerate. This last summer dissolved oxygen levels were less than 8 mg/l throughout July and August in the Link River. We do not expect trout in the Link River during these months. Therefore, maintenance of dissolved oxygen of 4 mg/l or greater is intended to provide adequate conditions for endangered suckers and other native fish that are likely to be in the work impacted area.

Bullet 7: Yes, that assumption is correct, Reclamation will resume fish salvage responsibilities related to the project.

Bullet 8: Materials that will be used for the construction of the cofferdam are required to meet specific specifications that will ensure that the gravel will not have an adverse impact on the aquatic life or water quality in the Link River.

Specific Comments:

1. Yes, however, Reclamation must be identify all impacts from the proposed action and to do that, it is important to entertain all questions, even when they may seem slightly “out of place.”
2. Comment Noted.
3. Thus far, there is no assumption that the gate adjacent to the fish ladder will be closed. Comment Noted.

2 1652

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213
Tel (310) 980-4000; FAX (310) 980-4018

DEC 17 2002

151422SWR02AR8355:MK

Mr. Dave Sabo
Area Manager, Bureau of Reclamation
Klamath Basin Area Office
6600 Washburn Way
Klamath Falls, Oregon 97603

RECEIVE
DEC 23 2002

Dear Mr. Sabo:

Thank you for providing the opportunity for the National Marine Fisheries Service (NOAA Fisheries) to review the October 2, 2002, Environmental Assessment for the Link River Fish Passage Project. NOAA Fisheries reviewed the document to determine whether we could expect adverse effects to anadromous salmon or their habitat from implementation of the proposed alternative.

While anadromous salmonids do not currently have access to the Klamath River at Link River Dam, we are satisfied that, should the need arise, adult and juvenile salmon would be able to successfully negotiate the proposed fish ladder. This determination is based on the fact that the fish ladder is designed to allow upstream passage to relatively weak swimming adult and sub-adult shortnose and Lost River suckers, and to redband trout, which have a similar swimming ability to salmon. Also, we do not expect construction related impacts to anadromous salmonids downstream of Iron Gate Dam during implementation of the project.

Please contact Mr. Mike Kelly at (707) 825-5178 if you have any questions.

Sincerely,

for Jim Lecky (signature)

Rodney R. McInnis
Acting Regional Administrator