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WILLAMETTE RIVER TEMPERATURE CONTROL, McKENZIE SUBBASIN, OREGON

COMMUNICATION

FROM

THE ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS)

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY DATED FEBRUARY 1, 1996, SUBMITTING A REPORT TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS. RECEIVED IN THE UNITED STATES HOUSE OF REPRESENTATIVES NOVEMBER 21, 1996, PURSUANT TO SECTION 204 OF THE 1970 FLOOD CONTROL ACT (PUBLIC LAW 91–611)

January 7, 1997.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

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U.S. GOVERNMENT PRINTING OFFICE

36–591 WASHINGTON : 1997

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LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

REPLY TO
ATTENTION OF

18 NOV 1996

Honorable Newt Gingrich
Speaker of the House
Of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

Section 101(a)(25) of the Water Resources Development Act of 1996, authorized an environmental restoration project for the Willamette River, McKenzie Subbasin, Oregon. The Secretary of the Army supports the authorization and plans to implement the project through the normal budget process.

The authorized project is described in the report of the Chief of Engineers dated February 1, 1996, which includes other pertinent reports and comments. These reports are in partial response to resolutions adopted by the Senate Committee on Public Works and the House Committee on Public Works and Transportation on November 15, 1961, and September 8, 1988, respectively.

The views of the State of Oregon, the Departments of the Interior, Agriculture, Energy, and Transportation, and the Environmental Protection Agency are set forth in the enclosed communications.

The authorized project maximizes net environmental benefits. The project provides for modifying the Cougar Lake and Blue River Lake projects, both located in the McKenzie River Subbasin, by adding one multilevel, ported intake structure at each project. These structures would permit selective withdrawal of water from different elevations within their respective reservoirs to achieve more desirable downstream water temperatures for anadromous and native fish species, especially the bull trout and the endangered Willamette spring chinook. The recommended plan will have no long-term adverse environmental impacts. Construction of the project will have short-term adverse impacts on hydropower use of Cougar Lake and on water-related recreation at both Cougar and Blue River Lakes. Such losses only would be during the construction period and are unavoidable.

Project outputs are for fish habitat values which are not amenable to measurement using monetary values. However, to assure that efficient plans were developed, incremental analysis techniques were utilized to evaluate alternative plans to replicate pre-project river water temperatures and allow for increased fish returns. The authorized project at each site provides for the greatest increase in number of fish returns at the least cost.

Based on October 1995 price levels, the total first cost of the project is estimated at about $38,000,000. This amount is to be repaid based on allocations to the original project purposes of flood control, navigation, and hydropower. Twenty-three percent of the Cougar project costs were allocated to hydropower, therefore, 23 percent of the Cougar project modification costs will be allocated to hydropower and be repaid to the Federal Treasury through rates established by the Bonneville Power Administration. The balance of the costs will be borne by the Federal Government.

The Office of Management and Budget advises that there is no objection to the submission of the report to the Congress. A copy of its letter is enclosed in the report.

Sincerely,

H. Martin Lancaster
Assistant Secretary of the Army
(Civil Works)

Enclosure

COMMENTS OF THE OFFICE OF MANAGEMENT AND BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

OCT 18 1996

The Honorable H. Martin Lancaster
Assistant Secretary of the Army
for Civil Works
Pentagon - Room 2E570
Washington, D.C. 20310-0103

Dear Mr. Lancaster:

As required by Executive Order 12322, the Office of Management and Budget has completed its review of the Willamette River Temperature Control, McKenzie Subbasin.

The Administration supports authorization of this project for construction in accordance with your recommendation of April 15, 1996. The Office of Management and Budget does not object to your submitting this report to Congress.

Sincerely,

T.J. Glauthier
Associate Director
Natural Resources,
Energy, and Science

COMMENTS OF THE STATE OF OREGON

September 5, 1995

Oregon

WATER
RESOURCES
DEPARTMENT

Policy Review Branch
Policy Review and Analysis Division
ATTN: CECW-AR (SA)
7701 Telegraph Road
Alexandria, Virginia 22315-3861

The State of Oregon has completed its review of the Final Feasibility Report and Environmental Impact Statement for the Willamette River Temperature Control Study, McKenzie Subbasin. The state continues to support the Corps of Engineers' efforts to replicate the pre-reservoir temperature regimes in the McKenzie Subbasin. Additionally, the state strongly supports that the costs will be fully paid by federal funds without local cost sharing.

Four agencies, the Departments of Environmental Quality, Fish and Wildlife, Marine Board and Water Resources, along with Oregon's delegates to the Northwest Power Planning Council commented on the draft report. Although the Marine Board did not comment on the final report they still request that low-water access sites be developed as part of the temperature control project.

The Departments of Environmental Quality, Fish and Wildlife and Water Resources also commented on the final report. Their comments are attached. The three primary issues we would like to draw to your attention and see resolved in the final planning or implementation phases of the project are: 1) concern over the turbidity which the project may generate during the construction phase, 2) concern over reducing the cost of the project and keeping impacts on recreation and fish to a minimum, and 3) the need to work closely with the state to respond to any unforeseen problems.

Thank you for the opportunity to comment on the U.S. Army Corps of Engineers Final Report and EIS. We look forward to working with the Corps on this project. If you or your staff have any agency specific questions about the state's coordinated response, they may be directed to the agency which raised the concerns. Issues of broader scope should be directed to the Water Resources Department which is acting as the state coordinating agency.

Sincerely,

Martha O. Pagel
Director

cc: Paula Burgess, Governor's Natural Resource Policy Advisor
Nancy M. MacHugh, Department of Fish and Wildlife
Gregory McMurray, Department of Environmental Quality
Wayne Shuyler, Marine Board
Karen Bahus, COE - Portland

Commerce Building
158 12th Street NE
Salem, OR 97310-0210
(503) 378-3739
FAX (503) 378-8130

STATE AGENCY REVIEWS

of Final Feasibility Report
and Environmental Impact Statement
for the Willamette River Temperature
Control Study, McKenzie Subbasin

Department of Environmental Quality

Department of Fish and Wildlife

Water Resources Department

Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

JUL 1995

July 27, 1995

Mr. Bob Rice
Water Resources Department
158 12th Street NE
Salem, OR 97310-0210

SUBJECT: Cougar and Blue River Water Temperature Control Project

REFERENCE: Final Feasibility Report and Environmental Impact Statement

Dear Mr. Rice:

I have reviewed the referenced document on behalf of the Department of Environmental Quality. As stated in its letter of February 10, 1995, the Department supports the Corps of Engineers' efforts to achieve pre-reservoir temperature regimes in the McKenzie subbasin. The Department believes that natural, historical temperature regimes will best support those beneficial uses related to biological integrity. This concept is the underlying principle embodied in the proposed new temperature standard.

The Department remains concerned with the control of turbidity during the construction phase of the project and expects that all practicable turbidity control techniques will be utilized. The Department appreciates the opportunity to participate on the Interagency Committee described in Section 4.11.1 of the Feasibility Study. This is an important opportunity to allow active participation and coordination of responses to any unforeseen environmental problems. Thank you for the chance to comment.

Sincerely,

Gregory McMurray, Ph.D.
Standards & Assessments Section
Water Quality Division

GM:crw
SA\WC13\WC13611

811 SW Sixth Avenue
Portland, OR 97204-13
(503) 229-5696
TDD (503) 229-6993
DEQ-1

RECEIVED
AUG - 2 1995
WATER RESOURCES DEPT.
SALEM, OREGON

Mr. Bob Rice
Resource Management Division
Water Resources Department
158 12th Street NE
Salem, OR 97319-0210

Dear Bob:

Thank you for your request for comments on the Corps of Engineers Final Feasibility Report and Environmental Impact Statement for Cougar and Blue River Water Temperature Control Project. However, much has changed since this report was written. We are now in the midst of a Value Engineering Study with the purpose of designing a project for less cost and holding project impacts ror recreation and fish to a minimum.

At this time, the brainstorming for the value enginneering study is in the Portland district offices awaiting more review. So, I have no further comments on the final feasibility report than the comments made at the Value Engineering Study.

Thank you.

In harmony with the river,

Nancy

Nancy M. MacHugh
Interagency Fisn & Wildlife Coordinator

Oregon

WATER
RESOURCES
DEPARTMENT

August 4, 1995

Policy Review Branch
Policy Review and Analysis Division
ATTN: CECW-AR (SA)
7701 Telegraph Road
Alexandria, Virginia 22315-3861

Thank you for the opportunity to comment on the Final Feasibility Report and Environmental Impact Statement for the Willamette River Temperature Control Study, McKenzie Subbasin.

The Department reiterates a concern expressed in our comments on the DEIS, that good communication between the Corps and the state is needed to assure that fluctuations in streamflow during the construction period have a minimal impact on the multiple benefits which the project will provide. Since the Water Resources Department has the lead role in coordinating state responses on reservoir operations we believe that the proposed Interagency Committee should include a representative from our Department.

Thank you for the opportunity to comment on the proposal. The Department looks forward to working with you on this project. If you have further questions, please contact Regional Manager Tom Paul at (503) 378-8455, ext. 281 .

Sincerely,

Bob Rice
Resource Management Division

Commerce Building
158 12th Street NE
Salem, OR 97310
(503) 378-3739
FAX (503) 378-8130

COMMENTS OF THE DEPARTMENT OF THE INTERIOR

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

SEP 8 1995

ER 95/431

Mr. David B. Sanford, Jr.
Acting Chief, Policy Review
and Analysis Division
Directorate of Civil Works
Policy Review Branch
ATTN: CECW-AR (SA)
7701 Telegraph Road
Alexandria, Virginia 22315-3861

Dear Mr. Sanford:

The Department of the Interior has completed its review of the proposed Chief of Engineers report and other pertinent reports for the Willamette River Temperature Control, McKenzie Subbasin, Oregon. We have no comments on these documents.

Sincerely,

Willie R. Taylor

Willie R. Taylor
Director, Office of Environmental
Policy and Compliance

COMMENTS OF THE DEPARTMENT OF THE INTERIOR

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

IN REPLY REFER TO:
FWS/MA

APR 11 1996

Arthur E. Williams
Lieutenant General
Office of the Chief of Engineers
Department of the Army
Washington, D.C. 20314-1000

Dear Lt. General Williams:

Thank you for your February 1, 1996, letter advising the Department of the Interior of your agency's intent to proceed with authorization of the Willamette River Temperature Control Project and inviting the Department's comments. The affected reach on the McKenzie River is proposed for inclusion in the National Wild and Scenic Rivers System.

The U.S. Fish and Wildlife Service is working with the Portland District Corps of Engineers to address any construction-related impacts. The Service is also working closely with the Oregon Department of Fish and Wildlife and the Forest Service on these matters and will be coordinating with the Forest Service on its final determination in accordance with section 7(b) of the Wild and Scenic Rivers Act.

The Department recognizes the Willamette Temperature Control Project's potential for providing long-term benefits to the aquatic resources of the McKenzie, South Fork of the McKenzie, the Blue Rivers, and for serving as a critical step in the restoration of bull trout and native spring chinook salmon in the McKenzie system.

We appreciate the Department of the Army's effort to achieve this important restoration goal.

Sincerely,

Acting DIRECTOR

LETTER TO THE SECRETARY OF THE INTERIOR

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO ATTENTION OF:

01 FEB 1996

Planning Division
Western Planning Management Branch

Honorable Bruce Babbitt
Secretary of the Interior
Washington, D.C. 20240

Dear Mr. Secretary:

In accordance with Section 7(a) of the Wild and Scenic Rivers Act (WSRA), I hereby provide the required 60 day notice that the U. S. Army Corps of Engineers (Corps) intends to proceed towards authorization of the Willamette River Temperature Control Project, Oregon. The project has not received a complete determination in accordance with Section 7(b) of the WSRA.

The 90-day period for State and agency review expired on September 7, 1995, with no adverse comments received about the project. However, by letter dated September 6, 1995, the Regional Forester for the U. S. Forest Service (USFS), Pacific Northwest Region, Portland, provided a WSRA Section 7(b) determination to the Corps' Portland District Engineer that withheld making a final determination regarding one aspect of the project. The USFS is concerned about potential construction period impacts to bull trout in stream reaches above the Cougar Dam that are under study for designation into the Wild and Scenic River System. The bull trout, a species of special regional concern, is also being reviewed for listing under the Endangered Species Act of 1973 (Public Law 93-205), as amended. The USFS states that a favorable determination could be made during Planning, Engineering and Design (PED), if certain construction sequence modifications can be made to accommodate their concerns.

Let me assure you that every effort will be made during PED to minimize construction impacts to bull trout populations using the reservoir above Cougar Dam. However, the Corps cannot guarantee the success of any modifications, nor can the Corps assure that such modifications will by acceptable to the USFS. My report fully reflects this possibility.

The Willamette River Temperature Control Project is designed to restore a significant amount of the favorable, historic temperature regime to the McKenzie, South Fork of the McKenzie,

Project outputs are for fish habitat values which are not amenable to measurement using monetary values. However, to assure that efficient plans were developed, incremental analysis techniques were utilized to evaluate alternative plans to replicate pre-project river water temperatures and allow for increased fish returns. The authorized project at each site provides for the greatest increase in number of fish returns at the least cost.

Based on October 1995 price levels, the total first cost of the project is estimated at about $38,000,000. This amount is to be repaid based on allocations to the original project purposes of flood control, navigation, and hydropower. Twenty-three percent of the Cougar project costs were allocated to hydropower, therefore, 23 percent of the Cougar project modification costs will be allocated to hydropower and be repaid to the Federal Treasury through rates established by the Bonneville Power Administration. The balance of the costs will be borne by the Federal Government.

The Office of Management and Budget advises that there is no objection to the submission of the report to the Congress. A copy of its letter is enclosed in the report.

Sincerely,

H. Martin Lancaster
Assistant Secretary of the Army
(Civil Works)

Enclosure

COMMENTS OF THE DEPARTMENT OF AGRICULTURE

United States Department of Agriculture
Forest Service
Pacific Northwest Region
P.O. Box 3623
Portland, OR 97208-3623
333 S.W. First Avenue
Portland, OR 97204

Reply To: 2350

Date: SEP 0 6 1995

Colonel Timothy L. Wood
Commanding Officer
U.S. Army Corps of Engineers
P.O. Box 2946
Portland, OR 97208-2946

Dear Colonel Wood:

Enclosed is our finding regarding the effects of the Willamette River Temperature Control project on the Blue and South Fork McKenzie congressionally-authorized study rivers. This finding is responsive to the Final Feasibility Report and Environmental Impact Statement (FEIS) dated April, 1995. As explained in our March 15 finding, responsive to the Draft Environmental Impact Statement (DEIS), the Wild and Scenic Rivers Act (W&SR's) specifies that developments below or above a potential W&SR "not invade the area or diminish the scenic, recreational, and fish and wildlife values present in the potential wild, scenic, or recreational river area on the date of the designation of the river for study..." The Blue River was determined ineligible (refer to enclosure, page 1). Two segments of the South Fork McKenzie study river, located above Cougar Reservoir, and a 4.5 mile segment located between the Dam and the River's confluence with the mainstem McKenzie have been determined eligible.

The result of our analysis of the FEIS is two-fold. As previously concluded, the project will not invade the eligible river segments of the South Fork McKenzie (SF) nor diminish the scenic, recreational and wildlife values. However, negative short-term, construction-related consequences from this proposal have the potential to affect the fish resource. This resource was determined to be outstandingly remarkable for the SF due to overall diversity within the fish community, presence of anadromous and bull trout populations, and existing and potential habitat. Downstream of the dam, the project will not adversely effect the populations of spring chinook, native rainbow trout, and bull trout because of the ability of these fish to use the mainstem McKenzie to avoid short-term changes in the segment of the study river below the dam. In the two segments upstream of the dam, however, project implementation as proposed in the FEIS will result in a direct adverse effect to the bull trout population.

We appreciate the efforts of Corps of Engineer (COE) staff to provide additional information and develop mitigation measures for concerns identified in our analysis of the DEIS specific to the fish resource. As a result of the interagency bull trout working group, and other efforts of COE staff, mitigation has been proposed for upstream concerns related to food supply, predation, and movement through the sediment wedge.

However, the effects of increased temperature of the residual pool and the river upstream from the pool during project construction results in a high likelihood of the bull trout population being substantially impacted. Current modelling efforts, lim ted empirical data, and recent survey information do not indicate that the population would be extirpated, if the project were not proposed.

The Planning, Engineering, and Design (PED) process, including the Value Engineering (VE) component recently initiated by COE staff, has identified a variety of options to minimize or eliminate the direct adverse effect on bull trout. Given my support for efforts that enhance aquatic ecosystem resources, I look forward to receiving necessary documentation from which I may complete my determination responsive to Section 7 of the W&SR's Act. I will consider the FEIS and PED (which includes the VE), as incorporated in the final project proposal. It is apparent, from the positive efforts evidenced through the interagency bull trout working group and the VE, that the temperature concerns upstream of the dam can be mitigated and project objectives downstream achieved.

Please continue to coordinate this project with Lynn Burditt, Blue River District Ranger (503-822-3317).

Sincerely,

JOHN E. LOWE
Regional Forester

Enclosure

SECTION 7(b) DETERMINATION
WILD AND SCENIC RIVERS ACT

Willamette River Temperature Control Project; Blue River and Cougar Dams
Willamette National Forest

PURPOSE

This report addresses the potential for a water temperature control project to diminish the scenic, recreational, fish and wildlife values of the South Fork McKenzie and Blue Rivers. This determination is responsive to the *Willamette River Temperature Control Final Feasibility Report and Environmental Impact Statement.*

INTRODUCTION

The U.S. Army Corps of Engineers (COE) has completed a Final Environmental Impact Statement (FEIS) for temperature control towers at Cougar and Blue River Dams. The structures will regulate water temperature and volume, returning the downstream temperature regime nearer to pre-construction temperatures. The proposed temperature regulation is designed to improve downstream fish and aquatic habitat.

The South Fork McKenzie (SF) River and Blue River were authorized for study as potential additions to the Wild and Scenic Rivers (W&SR) System via the Omnibus Oregon W&SR Act of 1988. In 1992 the Willamette National Forest completed an eligibility study for both rivers; finding the SF eligible and Blue River ineligible. A suitability study remains to be completed for the SF.

The ineligibility finding for Blue River has been transmitted to the USDA Forest Service Washington Office, though not yet forwarded to Congress. Blue River was found to have no outstandingly remarkable values. Given this current status, Forest staff considered the potential for construction at Blue River Dam to affect scenery, recreational, fish and wildlife values in the upstream study segment. The project was determined to have no upstream effects to any of the values, including fish, as bull trout has not been identified in the system. The remainder of this determination is, consequently, for the SF.

Cougar Reservoir separates eligible segments 2 and 3 of the SF. The upper study segment, segment 1, begins at the river's headwaters, in the Three Sisters Wilderness. It ends 5.2 miles downstream at the wilderness boundary. From the wilderness boundary, 16.0 miles downstream to the slackwater of Cougar reservoir, is segment 2. Study segment 3 begins below Cougar Dam. It is approximately 4.5 miles long, terminating at the SF's confluence with the mainstem McKenzie River. (Refer to enclosed map, last page.)

The USDA Forest Service is responsible for protecting the values identified in the W&SR study process. Under section 7(b) of the W&SR's Act, the administering agency is required to determine if a development below or above a congressionally-authorized study river will:

> "invade the area or diminish the scenic, recreational, fish and wildlife values present in the area at the date of designation of a river for study..."

BACKGROUND: for South Fork McKenzie

Existing Project Description and Operation: Cougar dam and reservoir was constructed by the Corps of Engineers in 1963. The project area is located about 42 miles east of Eugene, Oregon. The dam is an earth and rock-filled embankment about 1,500 feet long and 452 feet high (FEIS, p. 9). The resulting reservoir is about 6 miles long, and 0.7 miles wide, separating study segments 2 and 3.

Cougar dam is used for power generation and flood control in the McKenzie drainage. Starting in the spring, water is held in the reservoir until it is full, around Memorial Day weekend in May. Beginning Labor Day weekend in September, the water in the reservoir starts to be released. By November, the reservoir is at its lowest and provides storage for winter rains. The Cougar dam and reservoir is in the McKenzie drainage which is part of the larger Willamette system.

Based on the current operation of the facility, the temperature of the water released below the dam is either too warm or too cool in relation to the inflow into the reservoir. More specifically, from May to September, the water temperature stratifies in the reservoir and, subsequently, the cooler water drawn from the bottom is released from the reservoir. These temperatures are cooler than what was measured historically, and so delay fish migration upstream.

From late September to early December, water released from the dam is warmer than water entering the reservoir. By this time, the deeper cooler water has already been released from the reservoir, leaving the warmer surface water. These warmer temperatures effect spawning and egg incubation, by advancing emergence and increasing mortality.

Proposed Project Description and Operation: The COE, Portland District, has completed a FEIS on the impacts of the proposed temperature control towers. Construction of the Cougar dam tower would start about May 1998, and last up to 4 years. When construction is underway, flows in the Willamette System will be augmented by drawdown from other reservoirs. Construction will terminate in the fall so flood control operation can be effective during winter months.

During the May to October construction period, the reservoir will be at run-of-river and maintain an 80-acre pool (about 6% of full pool area) above Cougar Dam. This residual pool is to help reduce sediment transport out of the reservoir, reduce turbidity in the water released from the project during construction, and provide refuge habitat for resident fish and aquatic organisms. There will be a turn-over rate of about 4 to 6 days (FEIS, p. 88).

In order to begin construction, the diversion tunnel that was used during the initial construction will be reopened. Reopening this tunnel will occur the year before construction begins. Explosives will be required to reopen the tunnel. A fish barrier screen will be installed at the diversion tunnel once it is opened prior to the initial drawdown. The objective is to prevent fish in the reservoir from passing downstream through the dam. If fish pass through the dam, the potential for mortality is high.

The staging area originally used for dam construction will be used for disposal of rock and sediment. It's estimated that 1,300 cubic yards (cy) of sediment will need to be removed from construction of the exit tunnel.

Sediment will be hauled to the staging area. About 2,600 cy of riprap will need to be hauled to the construction site for erosion protection (FEIS, p. 67). An increase in turbidity below the dam is predicted.

South Fork McKenzie Wild and Scenic Study River: The eligibility determination for the SF found four values outstandingly remarkable (ORV); specifically: recreation, scenery, fish, and pre-historic.

> ***Recreation*** - The river and its corridor are regionally known for diverse recreation opportunities and facilities. There are a number of prime developed campgrounds and undeveloped campsites distributed along study segments 2 and 3, utilized by people from within and outside Oregon. Overnight and day hikes to the Three Sisters Wilderness are within a short distance from the river and Aufderheide Scenic Byway parallels the study river along all of segment 3, and most of segment 2.
>
> ***Scenery*** - The corridor's mature and old growth vegetation, combined with the beauty of the river, offer outstanding scenery to local visitors and many from outside the region. The area's vegetative diversity (e.g., color, size, and texture) creates a highly visual backdrop. The Aufderheide Drive National Scenic Byway, designated in 1988, is recognized outside the region for its scenery. The river and its corridor are predominant features of the Byway.
>
> ***Fish*** - Populations within the South Fork include cutthroat trout, hatchery rainbow trout, bull trout, white fish and non-game species. All species are naturally occurring except the hatchery rainbow trout. Segment 3 below the dam, also contains runs of spring chinook and summer steelhead. Segments 1 and 2, which are above the dam, support populations of all the mentioned species except the anadromous fish.
>
> Numerous tributaries in segments 1 and 2 above the dam provide abundant spawning and rearing habitat. The potential exists to improve bull trout habitat in all segments of the SF.
>
> The river's overall diversity of fish, anadromous and bull trout populations, and existing and potential habitat, are exemplary compared to similar rivers within SCORP region 8.
>
> ***Pre-historic*** - Three sites within the river's corridor are eligible for the National Register of Historic Places. Two undisturbed rock shelters have been found and are excellent examples of long-term, multi-occupancy dwellings. One of the structures represents the only tested and dated rock shelter within the McKenzie Basin. The SF corridor is known to have been extensively used and occupied by aboriginal tribes.

SECTION 7 REQUIREMENTS

Congressionally-authorized study rivers are protected by statute [Section 7(b)]. Specifically:

> Developments below or above a potential wild, scenic or recreational river may occur as long as the project "will not invade the area or diminish the scenic, recreational, and fish and wildlife values present in the potential wild, scenic, or recreational river area on the date of the designation of the river for study as provided in section 5 of this Act."

Portions of the South Fork McKenzie have been designated as a study river above *and* below the dam and reservoir.

The initial question to be addressed is whether or not the proposed project invades the designated river. The term invade is defined as encroachment or intrusion upon.

The remaining portion of the standard has been defined as:

> Does the proposed water temperature control project cause diminution of the scenic, recreational, and fish and wildlife values of the study river (as present at the date of designation of the river for study)? A project with long-term, positive benefits which greatly outweigh very short-term diminishment of stated values may be determined acceptable. However, the river's eligibility; i.e., its identified outstandingly remarkable values, free-flow and water quality, as well as its inventoried classification must be maintained in the short- and long-term.

RATIONALE FOR DETERMINATION

This report was formulated from review of the U.S. Army Corps of Engineers *Willamette River Temperature Control Final Feasibility Report and Environmental Impact Statement*, a recent Watershed Analysis completed by the Forest Service on the South Fork McKenzie, and the *Eligibility Determination for the South Fork McKenzie River* (Willamette NF).

In addition, the Forest Service utilized staff specialists and other available data as described in the accompanying Section 7(b) Report.

DETERMINATION

Invade: The temperature control tower will not be placed directly into the eligible river nor will the project change the reservoir size; therefore, the project will not "invade" the study river area.

This determination accepts the estimated beneficial effects of the proposed project to fish habitat downstream from the dam. The concerns are focused upstream and downstream from the project during the construction phase.

Findings for each of the specifically identified values in Section 7(b) are as follows:

Scenery:

Turbidity below the dam was the only factor identified that may affect scenery. The SF may be seen briefly by vehicle occupants and by river users, mainly during the summer months, when turbidity would be low.

The project will not diminish the scenic resource.

Recreation:

The factors that were identified that could affect diminishment include displacement of users, turbidity, and a change in recreation opportunities.

The displacement of recreation users from the river would be minimal with only short term consequences. Most of the displacement would be people boating and fishing in the reservoir. Their displacement would likely be to other reservoirs outside the study area. Turbidity effects would occur below the dam, where limited fishing and boating occur. The only change in opportunity would occur from reduced flows below the dam which may result in a different boating or fishing experience for the short term.

The project will not diminish the recreation resource.

Wildlife:

The factors identified that could affect wildlife are disturbance and changes to habitat.

During the opening of the diversion tunnel, blasting would create disturbance to wildlife. It is recommended that standardized 4-hour eagle watch protocol be completed before the project begins. 1 year before project implementation we recommend the COE contact the Blue River Ranger District office to see if any TES species are present in the area. Consultation with U.S. Fish and Wildlife Service (USFWS) will be necessary if some are located.

Habitat will be affected by the drawdown of the reservoir. Osprey and other birds could be temporally displaced because of the increase in flight distance to foraging. Big game habitat could see an increase in forage if the reservoir is stabilized with grass seeding. Completion of this project would result in water temperatures below Cougar Dam which would benefit native amphibians and invertebrates.

The effects to disturbance and changes to habitat are primarily short-term throughout the construction period.

The project will not diminish the wildlife resource.

Fish:

The factors identified that could affect the value of fish include temperature, sediment delivery and routing, habitat quantity and quality, and increased mortality. The discussion focused around three key species: spring chinook, rainbow trout, and bull trout. Each species was addressed separately in the analysis. Where appropriate, the species were evaluated for both upstream and downstream effects during construction.

Spring Chinook - Although short-term downstream impacts are anticipated, these effects are reduced because these fish are able to move out of the downstream system and spawn and rear elsewhere in the McKenzie River system.

Native rainbow trout - Rainbow trout above Cougar reservoir are not expected to be affected by the implementation of this project. There will be construction related short-term impacts to the SF rainbow trout population below Cougar Dam; however, the effects are not expected to persist in the long-term and McKenzie River rainbow trout can repopulate this river segment.

Bull Trout (below the dam) - It is speculated that reduced habitat area, warmer summer temperatures, and increased turbidity below the dam during the construction period could discourage sub-adults and adults from using the South Fork below the dam. Long-term effects are minimized because these fish can emigrate to the mainstem McKenzie River.

The project will not adversely effect the populations of spring chinook, native rainbow trout, or bull trout below the dam.

Bull Trout (above the dam) - Project implementation, as proposed in the FEIS, results in a direct adverse effect to the bull trout population above the dam. This is due to expected mortality, and the anticipated significantly decreased reproductive success during the 4-year construction period. These factors will have a significant indirect effect on the small population by increasing demographic and environmental stochastic risks, potentially accelerating a trend toward extinction.

Bull trout was an important contributor to the determination that fish is an outstandingly remarkable value. The W&SR Eligibility Study for the SF (1992) identified fish as an ORV due, in part, to diversity within the fish community and the presence of bull trout. Actions which extinguish or accelerate the extinction of bull trout upstream of the dam affect the diversity of species within the fish community. Extracting the bull trout population from the SF fish community would simplify it, resulting in a community made up of cutthroat trout, rainbow trout, suckers, whitefish, sculpin, and dace populations in Segments 1 and 2 of the river. The resulting fish community would be similar to, or less diverse than, many other rivers in the Columbia River Basin. Bull trout fill a predator niche in the SF that cannot be replaced by the other fish species present.

At this time, I will not complete my determination relative to the fish resource. I will make a final determination, responsive to Section 7 of the W&SR's Act, based on the FEIS and the results of the Planning, Engineering, and Design (PED) process, as documented in the final project proposal. My approach in this case is based on my understanding that the COE is evaluating methods to achieve project objectives while addressing concerns related to temperature problems in the construction pool and exposed 4.7 miles of stream channel (more fully described on pages 14-15 in the attached report). This is being done as part of the current PED process which includes an ongoing Value Engineering component.

Explanation of Temperature Concerns Related to the Fish Resource:

Bull trout in the SF has been identified in an American Fisheries Society (AFS) publication as being at a "moderate risk of extinction." They are also identified in Category 1 status as a candidate species for listing consideration under the Endangered Species Act. "Therefore, additional impacts should be avoided and restoration opportunities identified" (FEIS, Page 3-18).

The population of bull trout above the dam is important for several reasons: it contributes to the diversity of species in the SF fish community and was an important consideration in the determination that fish is an ORV, it is a Category 1 species for listing by the USFWS, and the SF was identified as a Tier 1 Key Watershed in the Northwest Forest Plan due, in part, to its function as refugia for bull trout.

As a result of comments on the DEIS, the COE included mitigation measures which, if successfully implemented, address all but one of the concerns regarding bull trout. Temperature problems in the construction pool and exposed 4.7 miles of stream channel remain a concern for the bull trout population above Cougar dam. These effects result in a high likelihood of the bull trout population being substantially impacted. Current modelling efforts, limited empirical data, and recent survey information do not indicate that the population would be extirpated, if the project were not proposed.

Possible Mitigation of Temperature Concerns

We acknowledge the efforts of the COE during the analysis process to develop mitigation measures for concerns identified in the analysis of the DEIS. The Forest Service participated as part of the interagency bull trout working group in an effort to develop mitigation measures and construction alternatives to eliminate effects on the upstream bull trout population. In addition, the COE has initiated a Value Engineering (VE) process that has identified a variety of options which are being considered in the PED phase.

Passage

Provide upstream and downstream fish passage over Cougar Dam by some means during and after construction of the temperature control tower. This measure will allow fish to migrate out of the system and avoid the warmed water in the reservoir and the 4.7 miles of stream above the reservoir. It will provide refugia habitat for the upstream bull trout populations in the mainstem of the McKenzie River.

Further, following construction of the project, it would reconnect the meta-population of bull trout within the McKenzie River basin.

Residual Pool

Provide a deeper residual pool during the contruction period that emulates current low pool elevation. It is known that the SF adfluvial bull trout population has survived the normal drawdown regime of the reservoir. Therefore, maintaining a residual pool at the elevation of minimum flood control pool during construction should minimimize the effects on bull trout.

Reduced Construction Period

Another potential mitigation to reduce overall effects from project construction is to shorten the construction period. A shortened construction period could be used in concert with other mitigation measures to minimize overall effects, and has the likelihood of impacting fewer year classes of fish.

Planning, Engineering, and Design (PED)

Based upon our understanding of the PED process and the initiation of the VE, it appears that this process has a high likelihood of resulting in design changes which, if implemented, could mitigate the temperature concern.

During the Analysis Phase of the VE, alternative means of temperature control were identified and brought forward to the Development Phase. Many of these alternatives appear to have far less or possibly even no impacts upon bull trout in the SF and Cougar reservoir. The VE process is continuing and the Development Phase should be completed by early November. At this time, it is unknown which ideas may be considered for incorporation into the project design; however, several ideas were discussed which have the potential to mitigate temperature concerns, if they are included in the project design. Alternatives and mitigations developed in the VE process suggest long-term temperature objectives below the reservoir can be met, while reducing or eliminating impacts to the bull trout.

Given my support for efforts that enhance aquatic ecosystem resources, I look forward to receiving necessary documentation from which I may complete my determination responsive to Section 7 of the W&SR's Act. I will consider the FEIS and PED (which includes the VE), as incorporated in the final project proposal. It is apparent, from the positive efforts evidenced through the interagency bull trout working group and the VE, that the temperature concerns upstream of the dam can be mitigated and project objectives downstream achieved.

REGIONAL FORESTER, JOHN E. LOWE
for

9-6-95
(Date)

SECTION 7(b) REPORT
SOUTH FORK MCKENZIE RIVER

for the Willamette River Temperature Control
McKenzie Subbasin, Oregon
August 1995

This Section 7(b) report provides a basis for the determination as to whether the Willamette River temperature control project will invade the South Fork McKenzie (SF) congressionally-authorized study river or diminish its scenic, recreational, fish and wildlife values.

SCENERY

Description: Portions of the river are paralleled by the Aufderheide Scenic Byway, including the study segments below the Dam and above the Reservoir to the Wilderness boundary. The Byway was designated, in part, to highlight the scenic qualities of the SF corridor. The river is part of this attraction with evidence of pools, riffles, and meandering channels. Vegetative diversity (texture, color, etc.) also adds to the scenic qualities of the study segments.

Evaluation Factors: The only factor that was identified to have potential to impact scenery of downstream or upstream study segments was turbidity.

Project Evaluation: Turbidity will not be effected above the Reservoir by project construction. While turbidity will be increased below the dam during project construction, the affect on scenery will be limited. There is only one place below the dam where the river is viewed from the road; also, the several dispersed camping areas adjacent to the river do not receive heavy use. Finally, the season when the turbidity would be most visible, (April-May) is outside the principal recreation season from June to September.

Summary: There will be no long-term diminishment of scenery from completion of the project nor significant short-term consequences during construction.

RECREATION

Description: Recreation opportunities in the study river, above and below the reservoir, include developed and dispersed camping. Segment 1 is within the wilderness. The majority of day and overnight hiking occurs above the reservoir. Other opportunities include boating, driving for pleasure, and fishing. Boating use is by kayakers above the reservoir, and by rafters below the dam. Scenic driving is from Aufderheide Scenic Byway which parallels the SF below the dam and for most of segment 2 above the dam. Fishing is popular both above and below the dam. The Oregon Department of Fish and Wildlife stocks the river with rainbow trout above the reservoir with Aufderheide Scenic Byway creating ready access to a network of user developed trails to the river. Spring chinook and summer steelhead exist below Cougar Dam.

Evaluation Factors: The factors identified to determine if diminishment would occur for recreation include displacement of users, turbidity, and changes in recreation opportunities.

Project Evaluation: The question of displacement, or movement out of an area for recreation users, has resulted in speculation as to where people will, or will not go, during the construction period. Though outside the scope of this W&SR determination which is focused on the study river, most of the displacement will be from those who boat and fish in the reservoir during the summer. It is anticipated that their use will shift to another reservoir.

Below the dam, the majority of fishing use is from the banks. With lower flows, opportunity to access the river may be increased. Displacement of forest visitors below the dam is expected to be low. Similarly, there is not a displacement concern above the reservoir. Those forest visitors who have traditionally used the area are predicted to continue to do so.

The visual effects of the project will only be seen along the reservoir, a small portion of the drive, and not in the study area. Some impacts would be expected to scenic byway users from the increase in truck traffic hauling rock and sediment. There will also be forest visitors who will be curious about the project and may drive Aufderheide because of the construction. This indicates there is an opportunity for interpretation at the dam or along the reservoir during construction. Displacement of Aufderheide Scenic Byway use is expected to be minimal.

Turbidity is expected to be present below the dam during the construction years. If any decrease of fishing or camping occurs from turbidity, it's expected to only be short term, during the life of the project.

Changes in recreation opportunities are minor below the dam and not anticipated above the reservoir.

Summary: Therefore, no long-term diminishment of recreation will occur from the project.

WILDLIFE

Description: Elk, deer, bobcat, coyotes, hawks, stellar jays, Townsend chipmunks, and Douglas squirrels represent a small sample of the fauna using the South Fork corridor.

Above the reservoir, valuable winter range for big game exists. A small portion of the area below the reservoir includes summer elk meadows, which may be calving habitat. Herds of elk and deer spend winter in the South Fork drainage as they seek lower elevation when the winter snows deepen.

Other, less common species that use the corridor include red-legged frogs, northern spotted owls, and bald eagles. Field studies indicate the area below the dam is host to federally-sensitive species, the red-legged frog. The northern spotted owl is listed as a threatened species by the U.S. Fish and Wildlife Service and the State of Oregon. Pairs of owls exist in the vicinity and may forage within the mature and old growth habitat the corridor provides. Though no known nesting sites have been identified, bald eagle sightings at Cougar reservoir have been recorded.

Evaluation Factors: Factors identified that could affect wildlife include disturbance and changes to habitat.

Project Evaluation: The Biological Assessment for northern spotted owls only considers known sites. There is no reference to whether protocol surveys have been conducted and would still be valid at the time of implementation of this project. In a letter to the COE, dated November 29, 1994, it was noted that not all suitable northern spotted owl habitat within 1 mile of the project area had been surveyed to protocol standards. We recommend contacting the Blue River Ranger District 1 year in advance of project implementation for an update on spotted owl surveys. The Biological Assessment implies that the nearest northern spotted owl activity center is located greater than 1.5 miles from Cougar Dam. The current habitat activity center, based on a 1994 location, is located 0.75 miles from the dam. A 1992 location for this same pair was approximately 0.5 miles from the dam. Nesting raptors on the Willamette National Forest are protected based on standards/guidelines in the Forest Plan. For northern spotted owls, seasonal operating restrictions in 1995 are March 1 through June 15 and are recommended for noise disturbance activities until the pair is determined to be non-nesting. For blasting activities, this seasonal restriction would generally extend out 1 mile from the activity.

Cougar Reservoir and the adjacent South Fork McKenzie River are suitable bald eagle habitat, and blasting noise due to this project may affect nesting eagles. In April 1994, an aerial nest survey was conducted which included the project area, and no bald eagles were seen. Three eagle watches have been completed in 1995. Additional ground protocol eagle watches during early June are recommended until this project is implemented.

Harlequin ducks, listed as sensitive on the Regional Forester's List and a federally-listed category 2 species, have been sighted on the SF below Cougar dam. Harlequin ducks and other waterfowl which use the SF below Cougar dam may be indirectly impacted by reduced aquatic insect levels if this project results in increased sedimentation. Macroinvertebrate levels may also fluctuate in quantity or species composition if water temperatures change. Waterfowl, such as mergansers or Canada geese, are occasionally seen on Cougar Reservoir, and may be displaced to other bodies of water during the duration of the drawdown period. This project would not be expected to cause displacement of Harlequin ducks and other waterfowl which use the SF below Cougar Dam if sedimentation problems are minimized by the use of erosion control measures discussed in the FEIS (p. 4-22). It is unknown if the expected 10-fold increase (FEIS, p. 4-16) in turbidity below the dam as a result of drawdown construction, would impact aquatic invertebrates upon which Harlequin ducks feed.

Amphibian habitat in reservoir side channels would be temporarily reduced, but sensitive amphibians have not been documented in the reservoir area. In contrast, side channels of the McKenzie River below the dam would show increased water flows at certain times which may benefit amphibians.

Osprey are protected under the Raptor Protection Act. Eight osprey nest locations are known directly adjacent to Cougar Reservoir. Although initially the reservoir drawdown would concentrate fish and may benefit osprey foraging, over the life of the project the temporary drawdown may cause displacement of some of these nesting osprey. Some of the nests located near the southern portion of the reservoir might still be used, although flight distance to foraging areas would be increased. Displaced osprey would fish the river more intensively.

Summary: All of the above disturbance and habitat effects to wildlife are primarily short-term in duration throughout the construction period of the project. Completion of this project would result in water temperatures below Cougar Dam which would benefit not only native fish, but also native amphibians and invertebrates. Therefore, no long-term diminishment will occur to wildlife from implementation of this project.

FISH

Description: Spring chinook, rainbow trout and bull trout are fish species of interest found within the study river area. All species are found below the dam, while only bull and rainbow trout are within the upper section (in and above the reservoir). These species use the study river segments for all or part of their life history requirements. The completed project proposes to enhance aquatic resource conditions downstream of the reservoir by creating flow releases with temperatures that mimic natural, or pre-project conditions.

Evaluation Factors: Evaluation factors identified to make a determination were changes in temperature, sediment delivery and routing, habitat quantity and quality, and increased mortality. Locally available information, augmented by published literature, was used in addition to that provided in the FEIS to draw conclusions regarding probable cumulative effects upon the key species. Each species was addressed separately in this analysis, and evaluated both on upstream and downstream conditions where applicable.

Project Evaluation:

Spring chinook: Spring chinook currently only occupy habitat downstream of the proposed project. Individual year-classes would be affected by short-term consequences of project implementation and long-term consequences of project operation.

It is predicted for the four-year construction period, the temperatures downstream of the dam will be more typical of what the species endures in other parts of the McKenzie River system, except for summer rearing when elevated water temperatures will occur. This is a result of increased solar radiation and convection on the stream flowing through 4.7 miles of channel in the reservoir drawdown zone upstream of the residual pool and a 3-6 day retention time of that water in the 80-acre residual pool, prior to its release downstream. Results from COE temperature models indicate the warmest daily mean outflow temperature from the residual pool in early August would be 63°F. Daily maximum stream temperatures may reach as high as 70°F. There may be a short-term effect upon invertebrates and juvenile salmonids in the SF below the dam, but it is difficult to quantify. With increased temperature, growth rates would decline and ultimately cease above 68 degrees (Bjornn and Reiser, 1991). Also, above 68 degrees, adult chinook may be discouraged from migrating to spawning areas in the SF.

De-watering the conservation pool to expose the construction site will expose 555 acres of pool bottom to precipitation and wind erosion for the first time in more than 30 years and allow active streamflow over a sediment wedge estimated at 1.4 to 2.9 million cubic yards. As late spring streamflow and rainstorms sort deposited material and mobilize particulate matter, it will move downstream, and heavier particles will deposit in the construction pool. Lighter particles will be swept through the bottom drain and into the channel below the dam where decreased velocity and increased channel roughness will allow sediment to deposit in spawning beds and insect production areas. Most of this will occur in March, April, and May before meaningful erosion control treatments, within the exposed reservoir bed, can become effective. During the month or more that it will take to drain the conservation pool to the construction pool, there will be prolonged periods when juvenile chinook foraging may be disrupted. The extent to which this combination of sedimentation and feeding disruption affects each of the four successive year-classes of juvenile chinook cannot be determined from the available information. In the FEIS, the COE estimates minimal deposition of sediment below the dam.

As late summer flow quantity below the dam approaches pre-dam conditions, area for rearing will be reduced from the amount historically available because of channel down-cutting that has occurred since dam operation. Habitat will include less shallow, peripheral area and significant side-channel habitat will be de-watered, further reducing the quantity and quality of juvenile rearing habitat. Reduction in cover provided by channel-side riparian vegetation will make juvenile fish more vulnerable to predation and reduce the food supply from terrestrial sources (ibid.)

Specific location and quality of spawning habitat in the SF below the dam have not been documented, but potential effects due to project construction are estimated. Adult salmon that attempt to spawn during the years of construction may be forced to select sites more associated with the thalweg (main energy part of the channel) because of the reduced wetted channel area. Over 90 percent of each year's spawning may occur before fall freshets raise the river to the entire low-flow channel. Doing so will expose their redds to higher energy flows during the winter high-flow season, increasing the risk of scour and egg destruction. Superimposition of redds may also reduce spawning success. Use of an Instream Flow Incremental Methodology study would allow these possible consequences to be analyzed and results predicted.

Native rainbow trout: Native rainbow trout are known to inhabit the SF above and below Cougar dam as well as the reservoir itself.

Wild rainbow trout utilize the SF upstream of Cougar Reservoir. Their use of the reservoir is unclear, but not likely extensive. The implementation of the project as described in the FEIS is not likely to affect rainbow trout above the reservoir because they don't appear to extensively utilize the reservoir.

If we assume that native rainbow trout spawn in the SF below Cougar dam, the eggs would be incubating during the pool-draining period and redds would be at risk of sediment deposition. This might preclude emergence and cause reduced fry survival. Newly emerged fry would be exposed to unusually warm water in simplified habitat where avian-induced mortality would likely be higher. Growth would be inhibited and fingerling density would be reduced. The combination of increased temperature, sedimentation and reduced fry prey availability, may decrease the extent of rainbow trout habitat occupancy during the construction phase of this project. However, these fish also occur in the McKenzie River above and below its confluence with the South Fork. In the long-term, there is a probability that rainbow trout will migrate into the South Fork from there. In the FEIS, the COE estimate little deposition of sediment in the South Fork below the dam.

Bull trout: Two known population segments of bull trout occur in the SF. Below the dam, the adult phase exhibits a fluvial life history pattern. The population above Cougar Dam historically exhibited this pattern, but modified to an adfluvial behavior when the dam blocked emigration to the McKenzie Basin. At that point, the reservoir became surrogate habitat for the bull trout in place of the mainstem McKenzie River which had provided foraging area and winter refugia.

Bull Trout (below the dam): Although USFS inventories are not conclusive regarding fish use of the South Fork, the bull trout downstream of the dam appear to be sub-adults or adults of the mainstem McKenzie River population. Average length of the fish reported caught between 1988 and 1993 was 18.3 inches with the smallest fish measuring 13 inches. No juvenile bull trout were observed during habitat surveys completed by Oregon State University in 1988, nor during diving probes of South Fork side channels and tributaries below the dam between 1991 and 1993.

We speculate that reduced habitat area, warmer summer temperatures and increased turbidity below the dam during the construction period could discourage sub-adults and adults from using the area. Long-term consequences are probably not significant because of the extensive foraging habitat of the mainstem McKenzie River.

Bull Trout (above the dam):

Population Status

Available information about the population segment isolated above Cougar Dam is consistent with a fluvial turned adfluvial life-history strategy. Life history strategies may be adaptations to the unstable northern environment (McCart 1985). The population of bull trout isolated above Cougar Dam utilize the reservoir as a "surrogate McKenzie River." The reservoir provides prey concentrations and water temperature/flow refuge which the McKenzie River used to provide. These resources have helped sustain the isolated population for more than 3 decades. Periodic counts of adult bull trout by the Oregon Department of Fish and Wildlife (ODFW) in the SF also indicate an adfluvial population in which adults migrate upstream from the reservoir. Sixteen large pools were snorkeled on 6/21/95 and 7/27/95. On 6/21, 2 adult bull trout were counted and on 7/27, 11 adults were counted (J. Ziller, ODFW pers. comm. 1995). Based upon the bull trout life history pattern (adfluvial) and habitat requirements, the reservoir and the spawning tributaries may be considered critical habitat for the SF population of bull trout.

Based upon volunteer angler reports, an Oregon State University river inventory, ODFW pool surveys, and Forest Service probes for juvenile bull trout, bull trout appear to spawn in SF tributaries and rear in them for [illegible] 3 years. Anglers have reported catching adult bull trout in the reservoir throughout the year, including September and October, indicating the potential for some of the population to be alternate year spawners. Adult bull trout are primarily seen and caught in the river upstream of the reservoir July through September. Most of these fish are likely adults that will spawn in September and early October. There are some bull trout, particularly subadults, that may be more nomadic, migrating between the river and the reservoir throughout the year.

There is no objective information regarding the numbers of bull trout occupying the habitat available within the river, its tributaries, and the reservoir. ODFW speculates the total population size ranges from 100 to 500 adults, while USFWS estimates there are 50 to 100 adult fish. On 7/27/95, ODFW snorkelors observed eleven adult bull trout in a series of 16 pools in the South Fork of the McKenzie River (J. Ziller, pers. comm. 1995). The fish observed can be considered a small proportion of the adult population for the following reasons:

1. Only a small proportion of the total SF habitat was surveyed. This survey did not include the reservoir, pocket pools, and log jams which also provide good adult bull trout habitat,

2. The survey was performed during the day. Bull trout are primarily nocturnal and sampling by snorkeling is more effective at night (Goetz, 1994),

3. Some of the adfluvial population of bull trout in the SF are alternate year spawners. In Flathead Lake, Montana, approximately 50% spawn each year (Fraley 1985) and in Timber Creek, Alberta, 27% spawn each year (Allan, 1980), and

4. There are approximately 2 months between the time of this sampling and the typical McKenzie River bull trout spawning period. Some spawning adults may not have left the reservoir yet.

A population estimate is needed for the SF bull trout population; however, based on the above information it seems reasonable to estimate a population of more than 50 and less than 500 adults. Ratliffe and Howell (1992) document the SF population to be at a moderate risk of extinction.

Concerns Raised in the Section 7(b) Report Responsive to the DEIS

The Section 7(b) Determination Report, responsive to the DEIS (March 15, 1995), identified concerns with the potential to affect the bull trout population upstream of Cougar Dam, based upon the project description in the DEIS. In the FEIS, the COE addressed many of these concerns through proposed mitigation measures. The concerns that have been mitigated in the FEIS are discussed in the following section, titled "DEIS Effects of Project Which Were Mitigated in the FEIS." Concerns regarding water temperature have not, however, been mitigated. These effects are discussed in the section titled "Post-FEIS Project Effects Not Presently Mitigated."

DEIS Effects of Project Which Were Mitigated in the FEIS

Food Supply

We expressed the concern that the food supply available to sustain the bull trout population in the reservoir will be constrained by: ODFW inability to stock fingerling rainbow trout, a 94% reduction in reservoir surface area decreasing phytoplankton/zooplankton production, and colonization and retention of downstream migrating insects and juvenile fish within the 4.7 miles of stream through the exposed reservoir bed.

The FEIS suggests mitigating for this effect by stocking the reservoir with hatchery rainbow trout and chinook salmon to increase the bull trout prey base.

Predation

We expressed the concern that, by concentrating a strongly predatory population of varying size and age classes of bull trout, there is a high likelihood of that population preying upon itself. Regular densities of fish (1 fish per 10 acres), will be increased to one or two fish per acre in the construction pool. This problem may be exacerbated by the large quantity of sediment that will translocate into the residual pool and will reduce its assumed volume of 3,000 acre feet. This will result in higher densities than those identified above. At this increased density, angling can be expected to injure some fish and may possibly lead to increased mortality.

The FEIS lists several mitigation measures to minimize these impacts. They include stocking the reservoir with bull trout prey species, erosion control measures, and providing cover at the bottom of the reservoir in the form of tree bundles. The tree bundles will increase survival by providing smaller fish with escape cover. It should be noted that to minimize impacts upon bull trout in the reservoir, the erosion control measures and tree bundle introduction will be extremely labor intensive.

Movement through the Sediment Wedge

As adult fish prepare to migrate to the spawning area, movement may be impaired by channel conditions within the exposed reservoir bed. A sediment deposit estimated at 1.4 to 2.9 million cubic yards has been deposited in the conservation pool. Most of it, including larger bedload materials are expected to be in the old river channel just below elevation 1,530 feet. Experience at Hills Creek Reservoir demonstrated that the river may flow over, and rework some of the sediment, or it may abandon the old river channel and flow around the deposit. Either way, the mid-summer stream flow may be across insurmountable terrain, or at least over conditions that could cause delays and stress to the migrants.

The FEIS proposes mitigation to provide passage for fish by using excavation to maintain a passage corridor.

Post-FEIS Project Effects Not Presently Mitigated

Temperature

Increased temperature of the river (as it flows through the 4.7 miles of exposed reservoir bed) and of the residual pool during project construction were identified as a concern for the bull trout. The FEIS states that stream temperatures entering the residual pool may rise to as much as 65°F in the summer. The reservoir surface temperature could reach as high as 70°F and the reservoir bottom as high as 62°F. Although the proposed FEIS mitigations include the shading of some pools in the river within the drawdown zone, this does not alleviate the concern of a warmed river section and a warmed reservoir during the construction periods.

The warm reservoir temperatures may impact the SF bull trout population that stay in the reservoir. Bull trout adults and subadults prefer temperatures ranging from 45-53°F when in lakes (Thomas 1992). The 62°F maximum hypolimnion temperature exceeds this range. Although probably not lethal, these temperatures may alter the growth and reproductive development of the fish. These temperatures may combine with high population densities, disease, and sedimentation to kill some fish remaining in the reservoir during the summer construction period. As a thermocline develops in the reservoir, shoreline feeding declines and bull trout move to deeper, cooler water, further concentrating the adult and subadult bull trout population density.

If fish don't leave the reservoir by July or August, it is not likely that they will successfully migrate up the SF, particularly when the river temperatures in the drawdown zone of the reservoir reach 65°F. The bull trout temperature preference range has been documented in some western rivers in the summer to be 48 to 55°F (Willamette National Forest, 1989). Adult bull trout that have not migrated upstream from the reservoir to

spawn by July may encounter this temperature barrier and remain in the reservoir. These fish will likely reabsorb their reproductive tissue and not reproduce that year, decreasing the population's reproductive potential.

The outlet to the residual pool will be located at the bottom, so cooler water will be drawn from the reservoir. A segment of the spawning adult population will likely remain in the reservoir as alternate year spawners and others may be stranded in the reservoir if they have not started their upstream spawning migration by July. The warm reservoir water has the potential to decrease the reproductive success of the 7 year classes of adult bull trout that will inhabit the reservoir during the 4 years of construction activity. This could result in fewer bull trout produced during these years. Because the SF population is small, this reduction in reproduction may be serious over the long term.

The warm water in the reservoir and in the 4.7 miles of river as it flows through the exposed reservoir drawdown zone have the potential to affect bull trout utilizing the reservoir and attempting to migrate upstream. Adult bull trout that leave the reservoir and pass through the 4.7 miles of exposed river prior to maximum water temperatures in July and August will likely be able to spawn but those that do not pass through this migration window may be trapped in the reservoir.

If bull trout attempt to pass upstream through the exposed river within the drawdown zone when the water temperatures are high (COE estimates the river temperatures to reach as much as 65°F and bull trout river temperature preference range is 48 to 55°F) it will likely be at night, when temperatures are cooler (Willamette National Forest, 1989). The maximum distance documented for a bull trout to migrate upstream in a 24-hour period is 2 kilometers (Hanzel 1985). Averages of distances more recently recorded over one and two week periods support the literature (M. Faler, M. Riehle, and S. Thiesfeld, pers. comm. 1995). Fish migrating upstream through the exposed, warmed river will not be able to travel the entire stretch in one night and will be exposed to the elevated temperatures during the day. These temperatures are not likely to be lethal, but may affect the success of the spawning migration by inhibiting upstream movement (see below).

Forest Service personnel on Pine Creek in the Gifford Pinchot National Forest have radio-tracked adult bull trout migrations. They documented upstream migrating bull trout adults suddenly discontinuing migration from Swift Reservoir when they encountered a temperature of 59-61°F in the river. These fish remained nearly stationary in the warm water for about 2 months until cooler temperatures returned. At that time, they turned around and returned to the reservoir. These fish may have reached a semi-dormant state while in the warm water and may have reabsorbed their reproductive tissue (M.Faler pers. comm. 1995).

The exposed river will contain little natural cover and food for the migrating adults. This coupled with potential thermal barriers will likely increase predation upon the fish in the river. If these fish are unable to successfully spawn, the reproductive potential and diversity of bull trout population in the SF above the dam will decrease.

Considering the small size of the population (50-500 spawning adults), the increase in mortality and decrease in reproductive success during the 4 years of construction may have a significant indirect effect on the population by increasing demographic and environmental stochastic risks (Rieman and McIntyre 1993). The demographic stochasticity includes random variation in birth/death rates, sex ratios, or other demographic characteristics, even though the underlying rates may be stable from one year to the next. If a population is reduced enough (to about 20 adults), random variation among individuals can lead to negative growth in the population long enough for the population to go extinct.

Suddenly replacing the reservoir with a residual pool that has less habitat quality and quantity can result in environmental stochasticity. Environmental stochasticity influences survival, birth rate, or population size. Large populations with high amounts of genetic diversity, habitat complexity and refuge areas have a greater capacity to buffer the effects of environmental change (Sedell and others 1990). The small SF bull trout population has less of a capacity to buffer the effects of the change in quality and quantity of rearing habitat (reservoir).

Summary:

Spring Chinook - Short-term impacts on 4 successive year-classes of spring chinook and their habitat cannot be quantified, but are expected to occur. These could jeopardize the productivity of the year-classes present during the construction period, as well as impact post-project habitat of at least one more cycle of full stocking. However, based upon the information provided by COE in the FEIS, severe impacts to this population are not likely. In the short term, these fish have the opportunity to spawn and rear elsewhere in the McKenzie River system if the construction related effects are too severe.

Native rainbow trout - Rainbow trout above Cougar Reservoir are not expected to be affected by the implementation of this project. There will be construction related short term impacts to the South Fork McKenzie rainbow trout population below Cougar Dam; however, the effects are not expected to persist in the long term. If necessary, McKenzie River rainbow trout can repopulate this river segment.

Bull Trout (below the dam) - It is speculated that reduced habitat area, warmer summer temperatures, and increased turbidity below the dam during the construction period could discourage sub-adults and adults from using the area. Long-term consequences are probably not significant because of the extensive foraging habitat of the mainstem McKenzie River.

Bull Trout (above the dam) - Project implementation, as proposed in the FEIS will not likely directly cause the extinction of the population of bull trout upstream of Cougar Dam. However, during the 4 years of project construction, we can expect bull trout mortality and significantly decreased reproductive success directly and indirectly due to warm reservoir and river temperatures. Considering the small size of the population (50-500 spawning adults), the increase in mortality and decrease in reproductive success during the 4 years of construction may have a significant indirect effect on the population by increasing demographic and environmental stochastic risks, potentially accelerating a trend toward extinction.

Bull trout was an important contributor to the determination that fish is an outstandingly remarkable value. The W&SR Eligibility Study for the SF (1992) identified fish as an ORV due, in part, to diversity within the fish community and the presence of bull trout. Actions which extinguish or accelerate the extinction of bull trout upstream of the dam affect the diversity of species within the fish community. Extracting the bull trout population from the SF fish community would simplify it, resulting in a community made up of cutthroat trout, rainbow trout, suckers, whitefish, sculpin, and dace populations in Segments 1 and 2 of the river. The resulting fish community would be similar to, or less diverse than, many other rivers in the Columbia River Basin. Bull trout fill a predator niche in the South Fork that cannot be replaced by the other fish species present.

The importance of the bull trout within this river was recognized through the designation of the SF as a Tier 1 Key Watershed in the Forest Ecosystem Management Assessment Team Report and in the Northwest Forest Plan.

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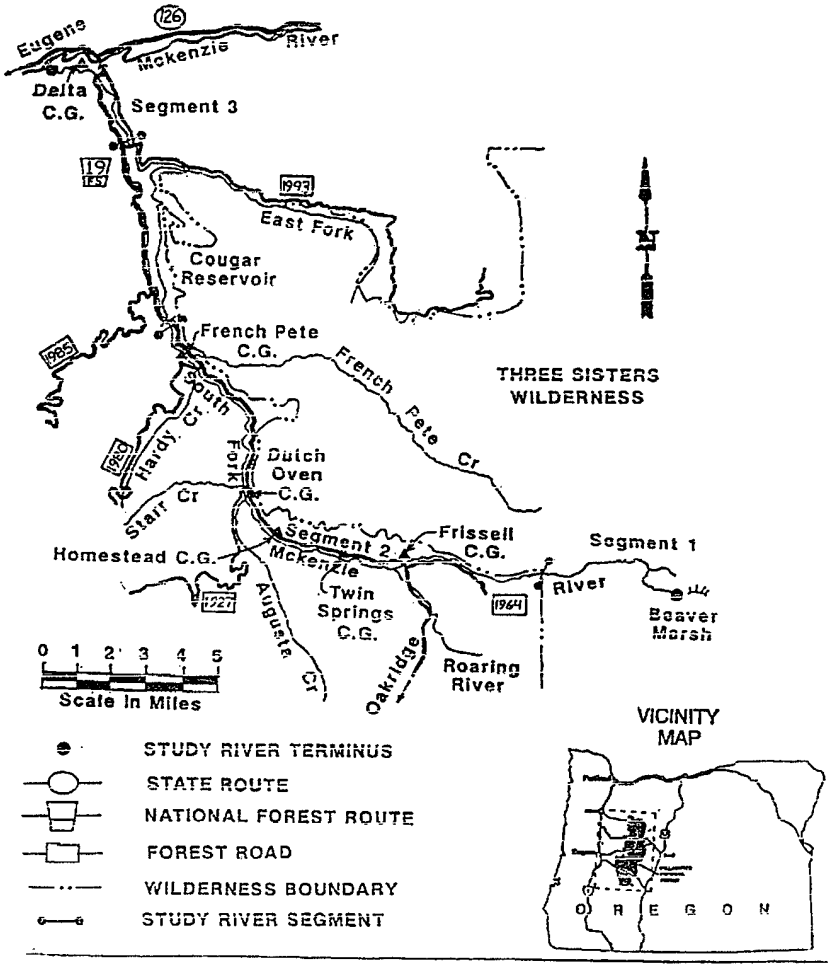
SOUTH FORK McKENZIE RIVER
WILD AND SCENIC STUDY RIVER
WILLAMETTE NATIONAL FOREST



COMMENTS OF THE DEPARTMENT OF AGRICULTURE

United States Department of Agriculture
Forest Service
Pacific Northwest Region
P.O. Box 3623
Portland, OR 97208-3623
333 S.W. First Avenue
Portland, OR 97204

File Code: 2350

Date: March 18, 1996

Lieutenant General Arthur E. Williams
U.S Army Chief of Engineers
Department of the Army
Office of the Chief of Engineers
Washington, DC 20314-1000

Dear General Williams:

This is in response to your February 1 letter providing a 60-day notification period for comments under Section 7(b) of the Wild and Scenic Rivers Act relative to the Willamette River Temperature Control Project. As noted in your letter to the Secretary of Agriculture, I have not completed my determination under Section 7(b) pending completion of your agency's planning, engineering, and design (PED) process. My approach was based on discussions with Colonel Timothy Wood and his staff in your Portland District Office and, specifically, on an understanding that the PED process is the forum in which concerns related to temperature problems in the construction pool and exposed 4.7 miles of stream channel would be addressed.

My September 6, 1995, determination, with its accompanying report, fully details our concerns about project implementation as proposed in FEIS and its potential to have a direct adverse effect to the bull trout population upstream from the reservoir. We appreciate your efforts to work with our agency and other fisheries agencies to seek ways to mitigate identified concerns. The Value Engineering study, conducted as part of the PED process, offered a number of possible options to limit the risk to the upstream bull trout population.

Recent conversations with Portland District staff indicate that proposed mitigations discussed to date may not be possible to implement. However, I understand from Colonel Wood that your agency is still exploring options to address upstream concerns and has not completed the PED process. In the absence of a final project proposal, I will not make a final determination under Section 7(b). I request that both my September 6, 1995, transmittal letter with its accompanying report (which details the upstream fisheries concerns) and the June 22, 1995, letter signed by the Willamette National Forest Supervisor and State Supervisor of the USFWS (copy enclosed) be included in your report to Congress. It is my intention to complete a final determination under Section 7(b) upon completion of your PED process and presentation of a final project proposal unless the project has previously been authorized by Congress.

Sincerely,

for ROBERT W. WILLIAMS
Acting Regional Forester

United States Department of Agriculture	Forest Service	Willamette National Forest	State Supervisor	Fish and Wildlife Service	United States Department of Interior

June 22, 1995

Colonel Timothy L. Wood
Commanding Officer
U.S. Army Corps of Engineers, Portland District
Portland, OR 97208-2946

Dear Colonel Wood:

We sent your office a letter dated June 14, 1995. A paragraph was inadvertently omitted during word processing. Please replace that letter with this document.

Your letter of April 18th responding to the Forest Service's (USFS) draft finding on the impacts of the Willamette River Temperature Control Project on the Wild and Scenic River sections of the South Fork McKenzie River served as a catalyst for a meeting between the Fish and Wildlife Service (FWS) and USFS. Our intent was to develop a common understanding of the fisheries resources potentially affected by this project, and discuss the consistency of the project in meeting the goals and objectives of the Northwest Forest Plan. Our staffs have reached agreement on the following aspects of the project.

The upper part of the South Fork of the McKenzie River Watershed is identified in the FEMAT report and the subsequent Supplemental Environmental Impact Statement and Record of Decision (ROD) as a Tier 1, Key Watershed. It was designated primarily as a refugia watershed for the South Fork McKenzie River bull trout. With the completion of Cougar Dam, the mixing of genetic material between the bull trout populations above and below the dam ceased. Consequently, the South Fork population has been effectively isolated since initial dam operation. Most fishery experts agree that the population of bull trout upstream from the dam are at risk of extinction under existing conditions. The feeling as to the amount of risk varies, but in all cases remains a substantial concern as long as the population remains isolated.

Consequently, it is important to prevent any significant adverse effects on the population above the dam due to construction-related activities for the temperature control project. Addressing potential impacts as a part of the design phase is essential. Reducing these impacts is of paramount significance in maintaining the long-term viability of the bull trout population. Although the magnitude of specific impacts will not be known until actual construction begins, a conservative approach to anticipate problems is warranted.

Currently, the Corps of Engineers (COE) proposal places tremendous responsibility on the effective operation of the "interagency coordinating committee" which will resolve unforeseen problems as they arise. The USFS and FWS believe that the following concerns need to be officially carried into the design phase and that an interagency group should explore practical mitigation which will address these contingencies. Concerns remain with size and temperature of the residual pool, upstream migration through the sediment wedge at the upstream end of the reservoir, and predation upon bull trout that remain within the reservoir. We wish to work closely with the design team to ensure these impacts are negligible.

Reduction of risk to acceptable levels and long-term viability of the bull trout population upstream of the dam will require re-establishing the genetic exchange with the population in the mainstem. Temperature control is a critical first step in this effort because it restores temperature regimes which encourage fish movement and passage between the mainstem and the South Fork up to Cougar Dam. The existing trap-and-haul facility at the dam may allow fish to be moved upstream for this initial exchange. Also, if there were passage of chinook salmon over the dam it would further benefit the South Fork McKenzie bull trout by restoring an important historic prey base. Ultimately, both upstream and downstream passage at the dam will be required to realize long term benefits of the project to the bull trout population AND meet the goals and objectives of the Northwest Forest Plan.

We realize that fish passage issues at Cougar Dam were not within the scope of the temperature control study but are aware that this issue is being examined at other Corps projects within the Willamette River Basin (such as Green Peter Dam). Although the temperature control project is intended to recreate the historic temperature regimes present in the lower system, if upstream and downstream passage is not accomplished, the project may increase the risk of extirpation of the bull trout population above the dam if adverse impacts could not be avoided. This increased risk in a Tier 1, Key Watershed would be inconsistent with the Northwest Forest Plan.

Additionally, the COE should work with the USFS and Oregon Department of Fish and Wildlife to address presently degraded channel conditions below the dam (see USFS letter dated 3/15/95) in order to realize the species enhancement that the EIS projected will occur in the South Fork McKenzie River segment.

As two of the agencies responsible for implementation of the Northwest Forest Plan, we agree that there is some additional risk posed on the population of bull trout above Cougar Dam by the project. We expect the EIS, and subsequent project design studies will continue to identify ways to lower that risk. In light of this risk, and lack of sufficient quantitative information on a number of conditions, we must be cautious in the evaluation and subsequent implementation of this project. This is consistent with the philosophies embodied in the ROD for the Northwest Forest Plan. It is necessary that this be accomplished through close interagency coordination during design and implementation of the project.

If you have questions regarding this letter, please contact either Lynn Burditt, Blue River District Ranger, or Ron Garst, USFWS.

DARREL L. KENOPS
Forest Supervisor

RUSSELL D. PETERSON
State Supervisor

LETTER TO THE SECRETARY OF AGRICULTURE

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

01 FEB 1996

Planning Division
Western Planning Management Branch

Honorable Daniel Glickman
Secretary of Agriculture
Washington, D.C. 20250-2200

Dear Mr. Secretary:

In accordance with Section 7(a) of the Wild and Scenic Rivers Act (WSRA), I hereby provide the required 60 day notice that the U. S. Army Corps of Engineers (Corps) intends to proceed towards authorization of the Willamette River Temperature Control Project, Oregon. The project has not received a complete determination in accordance with Section 7(b) of the WSRA.

The 90-day period for State and agency review expired on September 7, 1995, with no adverse comments received about the project. However, by letter dated September 6, 1995, the Regional Forester for the U. S. Forest Service (USFS), Pacific Northwest Region, Portland, provided a WSRA Section 7(b) determination to the Corps' Portland District Engineer that withheld making a final determination regarding one aspect of the project. The USFS is concerned about potential construction period impacts to bull trout in stream reaches above the Cougar Dam that are under study for designation into the Wild and Scenic River System. The bull trout, a species of special regional concern, is also being reviewed for listing under the Endangered Species Act of 1973 (Public Law 93-205), as amended. The USFS states that a favorable determination could be made during Planning, Engineering and Design (PED), if certain construction sequence modifications can be made to accommodate their concerns.

Let me assure you that every effort will be made during PED to minimize construction impacts to bull trout populations using the reservoir above Cougar Dam. However, the Corps cannot guarantee the success of any modifications, nor can the Corps assure that such modifications will by acceptable to the USFS. My report fully reflects this possibility.

The Willamette River Temperature Control Project is designed to restore a significant amount of the favorable, historic temperature regime to the McKenzie, South Fork of the McKenzie,

and Blue Rivers for the purpose of improving salmonid and other fishery resources within the project area. In fact, the U.S. Fish and Wildlife Service and Oregon Department of Fish and Wildlife, as well as Corps Portland District staff biologists, believe that the completed project will have an overall positive impact on bull trout populations.

Because the Corps views this project as one that will provide significant ecosystem-wide benefits, and because the project has broad support among resource agencies, I believe it is proper to continue with the project authorization process. Therefore, I am forwarding my report to the Office of the Assistant Secretary of the Army (Civil Works) for review, approval, and forwarding to the Congress. Pursuant to Section 7(a) of the WSRA, my report will not be forwarded to the Congress until the required 60-day notification period has expired. Your comments are invited during this period.

The Regional Forester's letter, together with this letter and any comments you choose to offer, will accompany my report to the Congress.

Sincerely,

Arthur E. Williams

Arthur E. Williams
Lieutenant General, U.S. Army
Chief of Engineers

COMMENTS OF THE DEPARTMENT OF ENERGY

Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

October 23, 1995

31 OCT RECD

Mr. David B. Sanford, Jr.
Acting Chief, Policy Review and Analysis Division
Directorate of Civil Works
U.S. Army Corps of Engineers
7701 Telegraph Road
Alexandria, VA 22315-3861

Dear Mr. Sanford:

We have reviewed the Final Feasibility Report and Final Environmental Impact Statement (FEIS) for the Willamette River Temperature Control, McKenzie Subbasin, Oregon. The feasibility study and FEIS examined alternatives for modifying the temperature of water released from the Cougar and Blue River projects to benefit nationally significant anadromous fish species. The recommended plan identified is phased construction of a selective withdrawal system to the existing intake towers at both projects. We are aware that a project to alleviate downstream temperature problems has been a high priority in the Northwest Power Planning Council's Fish and Wildlife Program since the mid-1980's.

We note that the construction schedule for the Cougar project will have an impact on its ability to generate power for several years. We recommend that the U.S. Army Corps of Engineers (COE) focus on reducing the overall construction schedule during the project design and construction to reduce the losses of power supply and revenue from this project. Likewise, we request that the COE re-examine the treatment of Cougar and the other Willamette projects in the Pacific Northwest Coordination Agreement planning process. Up until some years ago, operations for these projects were coordinated with the other major hydro projects in the Basin. In the recent past, the COE has chosen to classify these projects as "hydro independents" which reduces the power benefit they provide the Federal system. Making these projects available again for coordination may help offset the slight reduction in power production imposed by the temperature control facilities.

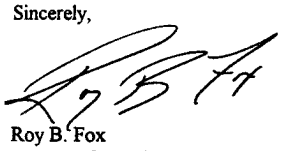
Additionally, Congressional guidance set forth in the Conference Report accompanying the Energy and Water Development Act of 1995 stipulates that the construction costs of this Project be repaid according to the allocations to the original project purposes. For the Cougar project, 23 percent of the original project cost is allocated to the generation of energy and our Agency, through our customers, will eventually have to repay the U.S. Treasury for this pro rata share of project costs, with interest, over 50 years.

The Bonneville Power Administration (BPA) supports this project technically and believes that providing water temperature control facilities at Cougar and Blue River Dams will contribute to improvement of anadromous and resident fish runs in the Willamette River Basin. Based on the estimated benefits of this project as presented in the Final Feasibility Report, the fact that it is included in the Northwest Power Planning Council's Fish and Wildlife Program, and the strong fishery agency support the proposed project appears to represent a high priority item for many parties within the Columbia River Basin.

Congress is presently considering legislation which, if enacted, would specify a multiyear budget for funding that BPA can devote to projects such as these. Until issues surrounding this proposed legislation are resolved and appropriate levels for fish and wildlife programs are determined, we cannot establish the relative priority of water temperature control facilities at Cougar and Blue River Dams. This priority needs to be resolved before the Administration seeks funds to construct the temperature control facilities.

BPA believes that it is vital to work closely with the COE and the rest of the region to resolve priorities for the various competing capital activities. We continue to depend upon all regional interests to help define the activities to be undertaken to enhance mitigation and restoration of fish and wildlife. We appreciate the opportunity to review the feasibility report for this project and will work with the COE in the future to help resolve this regional issue.

Sincerely,



Roy B. Fox
Manager for Federal Hydro Projects

cc:
Mr. Nick Dodge, U.S. Army Corps of Engineers, Portland
Mr. Dave Geiger, U.S. Army Corps of Engineers, Portland

COMMENTS OF THE DEPARTMENT OF TRANSPORTATION

U.S. Department of Transportation
United States Coast Guard

Commandant
U.S. Coast Guard

2100 Second St. S.W.
Washington, DC 20593-0001
Staff Symbol: G-MEP-3
Phone: (202) 267-0500

16452

JUN 27 1995

Mr. David B. Sanford, Jr.
Policy Review Branch
Policy Review and Analysis Division
ATTN: CECW-AR (SA)
7701 Telegraph Road
Alexandria, Virginia 22315-3861

Dear Mr. Sanford:

This is in response to your letter of June 7, 1995, in which you forwarded the proposed report of the Chief of Engineers and the report of the district engineer on Willamette River Temperature Control, McKenzie Subbasin, Oregon, and the final environmental impact statement (FEIS). We have reviewed the reports and the FEIS and have no comments to offer.

Thank you for providing the Coast Guard the opportunity to review the above reports and FEIS.

Sincerely,

M. J. DONOHOE
Captain, U.S. Coast Guard
Chief, Marine Environmental
Protection Division
By direction of the Commandant

COMMENTS OF THE ENVIRONMENTAL PROTECTION AGENCY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

REPLY TO
ATTNOF: WD-126 July 28, 1995

David B. Sanford, Jr.
Acting Chief, Policy Review and Analysis Division
Directorate of Civil Works
U.S. Army Corps of Engineers
7701 Telegraph Road
Alexandria, Virginia 22315-3861

ATTN: CECW-AR (SA)

Dear Mr. Sanford:

The Environmental Protection Agency (EPA) has reviewed the Final Feasibility Report and Final Environmental Impact Statement (FEIS) on Willamette River Temperature Control, McKenzie Subbasin, Oregon. EPA's review is conducted in accordance with the National Environmental Policy Act and EPA's authority under Section 309 of the Clean Air Act to comment on the impacts of federally authorized actions.

The feasibility study and FEIS examine alternatives for modifying the temperature of water releases from the Cougar Lake and Blue River Lake projects in order to replicate pre-project water temperatures and benefit anadromous and native fish species. We support these objectives. The preferred alternative identified in the FEIS is phased construction of multi-level intake structures (i.e. selective withdrawal systems), consecutively at both projects.

EPA provided several comments on the draft EIS. Our principal comment was that the DEIS provided only limited discussion of non-structural, operational temperature modification alternatives. We expressed concern regarding the resource impacts which would occur during the dewatering and construction phases (over a period of several years) and the need for further evaluation of the benefits and costs of operational vs. structural alternatives, and their ability to meet stated temperature modification objectives. The FEIS indicates that operational alternatives were not evaluated in detail because they would not meet the stated temperature modification objectives of the EIS. The FEIS also indicates that the forthcoming Value Engineering study will explore ways of shortening the construction schedule.

We also commented on the adequacy of the 404(b)(1) Evaluation, the need for EPA participation on the interagency

coordinating committee during the construction phases, and the adequacy of the assessment of wetland impacts.

We reiterate our concerns regarding the impact to water quality, and fish habitat and spawning success during the construction phases. The FEIS describes the proposal to develop a monitoring and evaluation plan cooperatively by the District and the resource agencies during the forthcoming preconstruction engineering and design phase. We support that concept. The drawdown plans also need to consider all possible avenues for fish and water quality impact mitigation during construction.

We appreciated the opportunity to review the FEIS. Rick Seaborne in the Environmental Review Section is the lead person for this review and may be contacted if further clarifications regarding the above comments are needed at (206) 553-8510.

Sincerely,

Joan Cabreza, Chief
Environmental Review Section

WILLAMETTE RIVER TEMPERATURE, MCKENZIE SUBBASIN, OREGON

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO ATTENTION OF:

CECW-PW (10-1-7a)

01 FEB 1996

SUBJECT: Willamette River Temperature Control, McKenzie Subbasin, Oregon

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on Willamette River Temperature Control, McKenzie Subbasin, Oregon. It is accompanied by the reports of the district and division engineers. These reports are in partial response to resolutions of the Committee on Public Works of the United States Senate and Committee on Public Works and Transportation of the U.S. House of Representatives, adopted 15 November 1961 and 8 September 1988, respectively. The resolutions requested a review of previously published and other pertinent reports with a view to determining the advisability of modifying existing projects in the Willamette River Basin to meet changed conditions. This interim report relates to water temperature control problems brought about by the construction of the Cougar and Blue River Dams.

2. Currently, cold water released from the Cougar Lake project (through Cougar Dam into the South Fork of the McKenzie River) and the Blue River Lake project (through the Blue River Dam into the Blue River) in the spring and summer, impedes upstream migration of native Willamette spring chinook salmon and the growth of native trout, including bull trout. In addition, warm water released from these projects in the fall and winter accelerates salmon egg incubation and fry emergence, thus subjecting salmon fry to high flows and scarce food, leading to poor survival rates. The Willamette spring chinook salmon is a species of special regional concern being reviewed for listing under the Endangered Species Act (ESA) of 1973 (Public Law 93-205), as amended. Bull trout is also a candidate species for possible listing under the ESA.

3. The reporting officers evaluated various alternative plans to replicate pre-project water temperatures in the South Fork, Blue, and mainstem McKenzie Rivers. Curtain barriers, mixing devices, operational changes, and selective withdrawal systems were analyzed. They recommend a plan which would modify the Cougar

Lake and Blue River Lake projects by adding one multilevel, ported intake structure at each project. These structures would permit selective withdrawal of water from different elevations within their reservoirs to achieve more desirable downstream water temperatures for anadromous and native fish species, especially the Willamette spring chinook salmon and bull trout. Installing selective withdrawal structures would significantly improve water temperature regimes in the South Fork of the McKenzie and Blue Rivers, and would best approximate pre-project conditions on the mainstem McKenzie River. The Cougar and Blue River projects are only a few miles above their respective river's confluence with the McKenzie River, so their influence on the McKenzie River temperature regime is significant. The combined temperature control effect from the two projects is necessary to accomplish the desired temperature regime in the McKenzie River. The recommended plan is expected to produce an additional 16,700 adult spring chinook salmon annually in the McKenzie River subbasin. Although there are no monetary benefits claimed by the project, the environmental benefits justify project costs.

4. On 6 September 1995, the Pacific Northwest Region of the U.S. Forest Service (USFS) provided the Portland District Engineer with an incomplete determination regarding project compliance with the Wild and Scenic Rivers Act(WSRA) of 1968 (Public Law 90-542), as amended. The Regional Forester found that the project would not adversely impact the recreational, scenic, or wildlife potential of the study area, but withheld a USFS determination regarding potential impacts to the fishery resource. Specifically, the USFS is concerned about potential impacts during the construction period to bull trout in stream reaches above the Cougar Dam that are under study for designation into the Wild and Scenic River System. The USFS states that a favorable determination could be made during Planning, Engineering and Design (PED), if certain construction sequence modifications can be made to accommodate their concerns. Because the district, State and Federal fishery resource personnel believe that the project modifications will have an overall positive impact on the local fisheries, including bull trout, and the project would have little impact on bull trout in the area of USFS concern, I believe that project implementation should not be impeded because of this issue. During PED, all

efforts will be made to minimize impacts to fisheries during construction. In accordance with Section 7 of the WSRA, I have notified both the Secretary of the Interior and the Secretary of Agriculture that the U.S. Army Corps of Engineers intends to proceed towards project authorization while we work towards resolution of concerns regarding impacts to fisheries during construction of the new intake structure at Cougar Lake.

5. The estimated first cost of the recommended plan, based on October 1995 price levels, is $38,000,000, to be repaid based on allocations to the original project purposes of flood control, navigation and hydropower. Twenty-three percent of the original Cougar project costs were allocated to hydropower, therefore, 23 percent of the Cougar project modification costs will be allocated to hydropower and be repaid to the Federal Treasury through rates established by the Bonneville Power Administration (BPA). The balance of the costs would be borne by the Federal Government. Project cost sharing is in accordance with the guidance set forth in the Conference Report accompanying the Energy and Water Development Act of 1995 (Public Law 103-316), which supports ". . . installation of these (temperature control) facilities as project modifications which mitigate for the fish and wildlife impacts of the Cougar and Blue River projects. The cost of the facilities would be repaid according to the allocations to the original project purposes."

6. Federal operations and maintenance costs for the two projects will increase by about $147,000 per year. Hydropower use of Cougar Lake, and water-related recreation at Cougar and Blue River Lakes will be adversely impacted during construction. While hydropower losses are significant, they are short-term and unavoidable. Installation of the new intake structure at Cougar Lake would reduce long-term power generation benefits for the project by about $48,000 per year. There are no other adverse impacts to authorized project purposes.

7. In its letter of 23 October 1995, BPA indicates that it supports the project and believes that the project is a high priority item within the Columbia River basin; however, BPA is concerned about the possibility of a funding cap being placed on

its fish and wildlife restoration activities and asked that funding cap issues be resolved prior to seeking construction funds for the project. At this time, it does not appear that a funding cap would have any impact on the financing of this project.

8. Washington level review finds that the proposed plan is technically sound and produces environmental benefits that exceed costs. The proposed project complies with applicable Corps planning procedures and regulations. Also, the views of interested parties, including Federal, State, and local agencies have been considered.

9. I concur in the findings, conclusions, and recommendations of the reporting officers. I recommend that the existing Cougar and Blue River projects be modified to provide temperature control structures generally in accordance with the reporting officers' recommended plan, with such modifications, including possible changes to accommodate USFS concerns, as in the discretion of the Chief of Engineers may be advisable.

10. The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to the Congress, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

ARTHUR E. WILLIAMS
Lieutenant General, USA
Chief of Engineers

REPORT OF THE DISTRICT ENGINEER

EXECUTIVE SUMMARY

This study is in partial response to two Congressional resolutions, which provide authority for the Corps of Engineers to conduct temperature control studies at the Blue River and Cougar lakes projects, located in the McKenzie subbasin of the Willamette River basin. These are the Senate Committee on Public Works resolution adopted November 15, 1961, for the Willamette River Basin Comprehensive study, and the House Committee on Public Works and Transportation resolution adopted September 8, 1988, for the Willamette River Basin Review study. The study area focuses on the mainstem McKenzie upstream from Leaburg Dam to the confluence of the South Fork McKenzie River. It also includes the South Fork and Blue rivers downstream from the Corps dams, as well as the lakes of both projects.

The purpose of the feasibility study is to evaluate the potential for modifying the Cougar and Blue River projects for water temperature control. The projects altered downstream water temperatures which are cooler in the late spring/summer and warmer in the late fall/winter than pre-project conditions. Cooling occurs because flows are released from outlets at the bottom of these deep, stratified reservoirs where water is cooler than at the surface. Warming occurs because drawdown of the lakes for flood control causes warmer water to reach the outlets. Temperature impacts were not anticipated when the projects were constructed in the 1960s.

This study investigated alternatives to modify the temperature of downstream releases to replicate pre-project water temperatures to benefit anadromous and native fish species. Returning to a natural cycle of water temperatures recreates an important component of the ecosystem required by the aquatic community. Replicating the pre-project temperatures throughout the year requires access to and withdrawal of the warmest water available in the pools. Tributary inflows to the Blue River pool are warmer than at Cougar, and it warms more quickly in the spring. About 43 percent of the warm surface water available in both pools is in Blue River.

Three fish species were selected as key indicators to characterize the outputs of the proposed temperature modifications. These include native Willamette spring chinook salmon, a species of special concern being reviewed for listing under the Endangered Species Act (ESA); bull trout, a candidate for listing under the ESA; and native rainbow trout, an important sport fish. All three species have a high degree of public interest and represent good ecological indicators for temperature changes because one or more key life stage is strongly temperature dependant.

Under existing conditions, cooler water temperatures in the late spring/summer impede upstream migration of spring chinook salmon and the growth of native trout, including bull trout. Warmer fall/winter temperatures accelerate egg incubation and fry emergence of spring chinook, and subjects the salmon fry to unfavorable conditions such as high flows and scarce food, which leads to their poor survival.

The alternatives considered included operational changes, a curtain barrier, mixing devices, and a selective withdrawal system. Selective withdrawal was preferred because of its proven

reliability, durability, and operational flexibility for both cooling and warming release temperatures. Alternative scenarios for installing selective withdrawal at Cougar only, at Blue River only, or at both projects were evaluated with respect to their performance in replicating pre-project water temperatures and their environmental outputs for the three indicator species.

Installing selective withdrawal at both projects was found to significantly improve water temperatures in the South Fork and Blue rivers, and provides the best conformance to pre-project water temperatures on the mainstem McKenzie. In order to evaluate the benefits to spring chinook salmon production from each of the scenarios, an analysis was performed using life cycle data and estimates of temperature/survival relationships.

Results show that the Cougar plus Blue River scenario provides the best improvement for salmon fry survival by reducing early emergence and providing better rearing conditions. The Cougar plus Blue River scenario was found to maximize the number of annual adult spring chinook returns a relatively low marginal cost per adult return.

By restoring water temperatures, improved food supplies and growth conditions for resident trout, including bull trout, are expected. As measured by increases in trout growth units, the best improvement is seen in the South Fork, Blue, and mainstem McKenzie rivers when temperature control is installed at both projects. For bull trout, water temperatures particularly for adult migration, spawning, and early egg incubation periods in the fall will be substantially improved.

Based on the results of all analyses, the installation of selective withdrawal at both projects was selected as the final plan. The selective withdrawal system will be added to the existing intake towers and positioned upstream over the regulating outlet works (and power penstock for Cougar). Water will be withdrawn from specific elevations in the reservoirs using temperature control ports. The system has the capacity to operate for temperature control flows of up to 2,000 $ft^3/$ at Cougar and 1,000 $ft^3/$ at Blue River. Beyond these flows, temperature control operations will cease and the largest ports will be opened to pass flood flows. For flows this large, the reservoirs will be well mixed and operation for temperature control not required.

Construction impacts, although major, will last for about 4 years at Cougar and about 3.5 years at Blue River. Construction of each project must be phased to reduce flow and other impacts on the downstream watershed and Willamette system. There are no other projects to use to offset flow impacts on the mainstem McKenzie if both projects were constructed concurrently. Also, impacts to other Willamette reservoirs that would need to be used to meet flow requirements at Albany and Salem, could be severe if both projects were constructed concurrently. Flood control will be maintained during the construction period which may limit the construction season from about June through October, depending upon rainfall.

Summer flows in the mainstem McKenzie may be reduced by about 5 to 20 percent during construction at Cougar or Blue River. There will be times in August and September during

Willamette River Temperature Control
McKenzie River Subbasin, Oregon
Final Feasibility Report

1. INTRODUCTION

1.1 Study Authority

This report is in partial response to two Congressional resolutions, which provide authority for the Corps of Engineers to conduct temperature control studies at the Blue River and Cougar Lakes project, located in the McKenzie subbasin of the Willamette River basin (figure 1). These are the Senate Committee on Public Works resolution adopted November 15, 1961, for the Willamette River Basin Comprehensive study, and the House Committee on Public Works and Transportation resolution adopted September 8, 1988, for the Willamette River Basin Review study. The 1961 study resolution reads as follows:

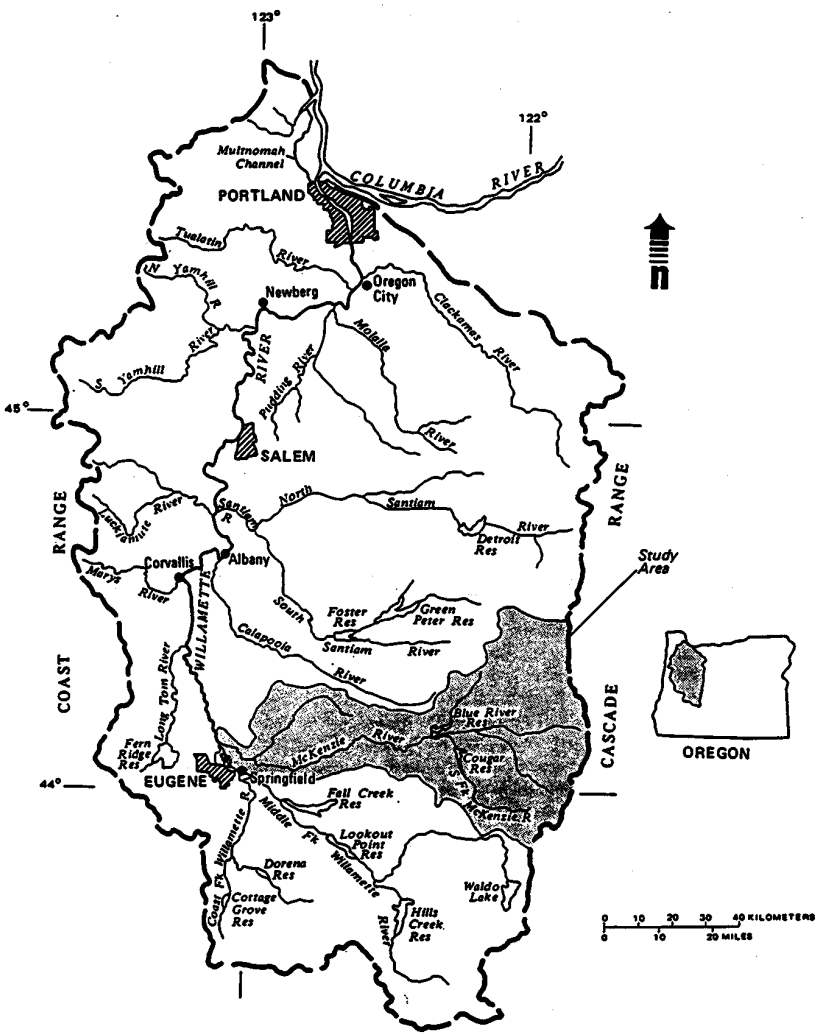
> *... That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the reports of the Chief of Engineers on the Columbia River and tributaries, Northwestern United States, published as House Document Numbered 532, Eighty-first Congress, second session, and other reports, with a view to determining whether any modification of the existing project is advisable at the present time, with particular reference to providing additional improvements for flood control, navigation, hydroelectric power development, and other purposes, coordinated with related land resources, on the Willamette River and tributaries, Oregon.*

In September 1988, the Corps received additional study authority to review the existing 13-project system within Willamette River basin to see if any projects should be modified to meet current, and anticipated future water resources conditions. The text of the House Committee resolution reads:

> *...That the Board of Engineers for Rivers and Harbors is hereby requested to review the reports of the Chief of Engineers, published as House Document numbered 403, Eighty-seventh Congress, Second Session, House Document numbered 531, Eighty-first Congress, Second Session, and House Document numbered 544, Seventy-fifth Congress, Third Session, and any other pertinent reports, with a view to determining whether modifications to the existing projects are warranted and to determine the need for further improvements within the Willamette River Basin in the interest of water resources improvements.*

The current feasibility phase study is being conducted independent of any other study within the basin.

Figure 1 -- *Willamette Basin Location Map*



1.2 Study Purpose

The purpose of the feasibility study is to evaluate the potential for modifying the Cougar and Blue River projects for temperature control. The study identifies specific fishery goals relating to temperature control releases at Blue River and Cougar, and examines the ability of alternative temperature control methods to meet those needs under a range of climatic and hydrologic conditions. The operation of these projects has altered the flow and temperature conditions of the mainstem McKenzie, Blue, and South Fork rivers downstream from the projects. Water temperatures are cooler in the late spring/summer and warmer in the fall/winter than pre-project conditions, which has impacted the fishery and aquatic resources of these streams. Temperature impacts were not anticipated when the projects were constructed.

Alternatives are investigated that modify the temperature of downstream releases from the Corps projects in order to replicate pre-project temperature conditions. The time period prior to 1960, before construction of the first project, Cougar Lake, is considered pre-project for this study. Returning to the natural cycle of water temperatures recreates an important component of the ecosystem required by the aquatic community, and will benefit anadromous and resident fish species, especially the Willamette spring chinook salmon, a species of special concern being reviewed for listing under the Endangered Species Act (ESA) and bull trout, a candidate for listing under the ESA.

1.3 Study Area and Scope

The study area is located in the McKenzie River watershed of western Oregon (figure 2). The McKenzie River originates in the upper elevations of the Cascade Mountains flowing in a general westerly direction to enter the Willamette River at river mile (RM) 171.8 near Eugene, the second largest city in Oregon. The McKenzie subbasin includes about 1,300 square miles (about 12 percent of the Willamette basin) in Lane and Linn counties. There are about 1,040 miles of perennial streams. About 70 percent of the subbasin is federally managed by the Forest Service and the Bureau of Land Management (BLM) for timber production, wilderness areas, and other uses.

The decreased availability of Columbia River spring chinook has resulted in a record high angling effort in the lower Willamette River. Present hatchery production provides from 85 to 95 percent of the Willamette River run. Restoration of natural spawning of this species in key tributaries, such as the McKenzie, is an important goal of regional fishery plans.

Previous Corps studies indicate that the effects of reservoir releases on water temperature are relatively small downstream of the Leaburg Diversion Dam on the mainstem McKenzie River (RM 38.8). This dam diverts a large amount of the McKenzie's flow through a canal to a powerhouse near Walterville, Oregon (RM 20.9). This operation has affected in-stream flow and the ability to alter water temperatures downstream from Leaburg Dam.

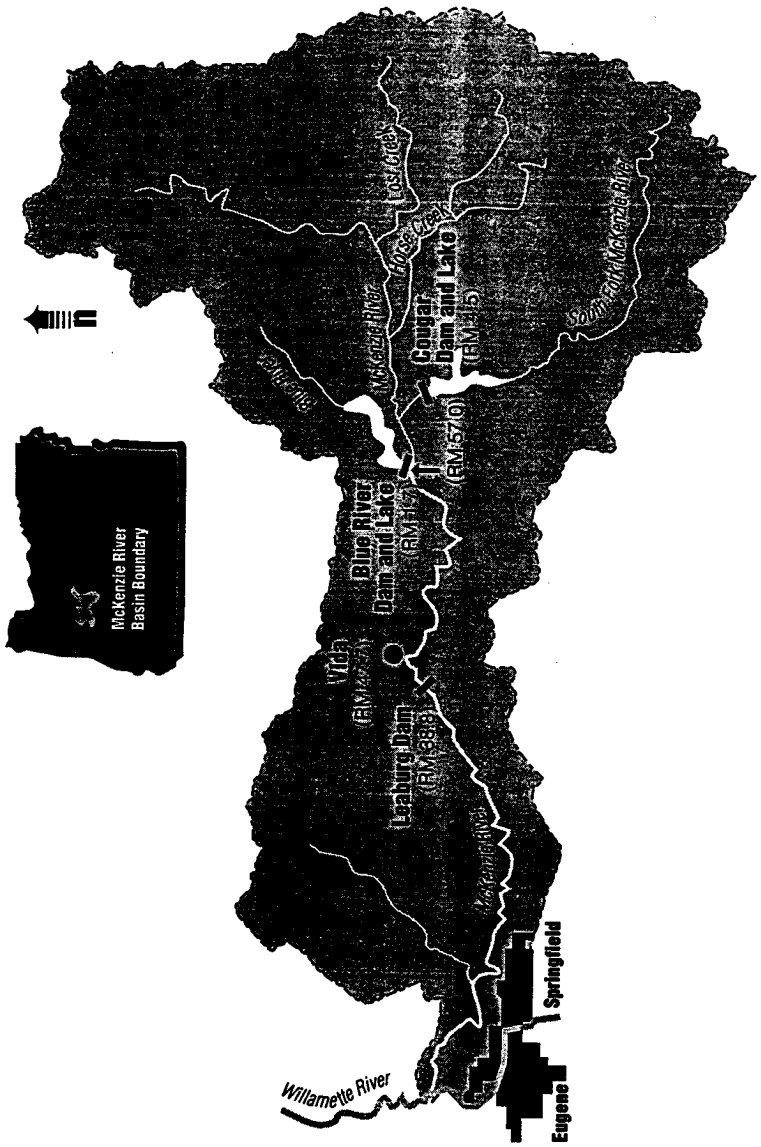


Figure 2 -- *McKenzie River Subbasin Study Area*

Resource agencies including the National Marine Fisheries Service (NMFS), the US Fish and Wildlife Service (FWS) and the Oregon Department of Fish and Wildlife (ODFW) indicate that the primary opportunity for fishery benefits in the McKenzie subbasin is upstream from Leaburg Dam. Leaburg Dam is the only dam in the McKenzie subbasin with upstream and downstream fish passage facilities. The McKenzie River spring chinook run is monitored at Leaburg Dam.

Studies have shown that spring chinook spawning areas downstream from Leaburg Dam are crowded while similar areas upstream are underused, which reduces the natural ability of the McKenzie to produce and sustain this valuable species of salmon. This occurs because of cold water releases from the reservoirs during the early portion of the run (mid to late May). Water temperatures do not warm sufficiently to promote migration of adult salmon above Leaburg Dam. If fish migrate upstream during the early portion of the run, they will migrate further and make use of the high quality spawning habitat available upstream of Leaburg Dam.

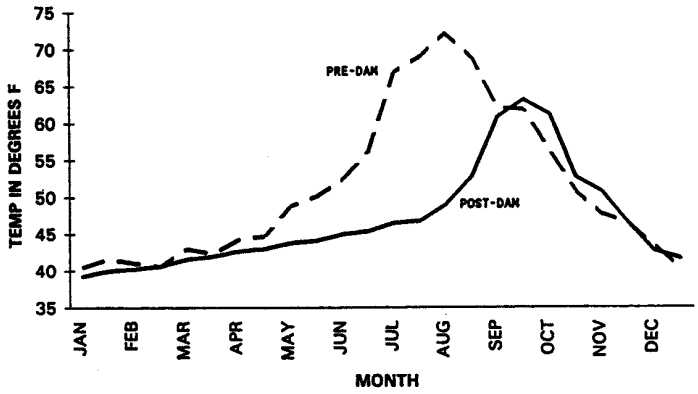
The study area focuses on the mainstem McKenzie upstream from Leaburg Dam to the confluence of the South Fork McKenzie (figure 2). It also includes the lower 1.7 miles of Blue River and the lower 4.5 miles of the South Fork McKenzie River downstream from the Corps dams, as well as the lakes of both projects.

Three fish species were selected as key indicators to represent study objectives and help characterize the outputs of the proposed temperature modifications. These species include the native Willamette spring chinook salmon, bull trout, and native rainbow trout, an important sport fish in the McKenzie subbasin.

These species represent good ecological indicators for temperature changes because one or more key life stage is strongly temperature dependant. Also, there is some existing information describing their use of the study area as well as of their basic life history requirements. These species also provide a good representation of how temperature changes would benefit aquatic ecosystems in the study area.

The operation of the Cougar and Blue River projects has altered the downstream temperature conditions. Existing water temperatures are cooler in the late spring/summer, and warmer in the fall/winter than pre-project conditions. Figure 3, is a general graph showing this shift in temperature below the Blue River project, and represents a similar condition for the South Fork and mainstem McKenzie near Vida. Cooler releases in the late spring and summer impedes upstream migration of spring chinook to their former spawning areas and the growth of resident trout. Cooling occurs because flows are released from outlets located near the bottom of these deep reservoirs where the water is significantly cooler than at the surface.

Figure 3 -- Pre- and Post-Dam Temperatures Below Blue River Dam



Source: USGS temperature data.

In the fall and winter, increased releases during drawdown of the lakes for flood control cause warmer surface water to reach the outlets, leading to elevated downstream water temperatures. This abnormally warm water accelerates egg incubation and fry emergence of spring chinook and subjects the fry to unfavorable conditions such as high flows and scarce food. These factors lead to poor survival of salmon fry.

1.4 Existing Projects

This feasibility study focuses on two Corps lakes in the McKenzie River subbasin. A description of each project is summarized below. Detailed information is found in Technical Appendices B and C in Volume II of this report.

1.4.1 Blue River Lake. The Blue River Lake is located about 38 miles east of the city of Eugene on Blue River at RM 1.7 (figure 2). The project began operation in 1968. Its authorized purposes include flood control, power generation, navigation, water supply for irrigation and domestic use, low flow augmentation for pollution abatement, improved conditions for fish, and improved recreational conditions. Pertinent data for Blue River project is summarized on table 1 and its general plan and principal features are shown on figure 4.

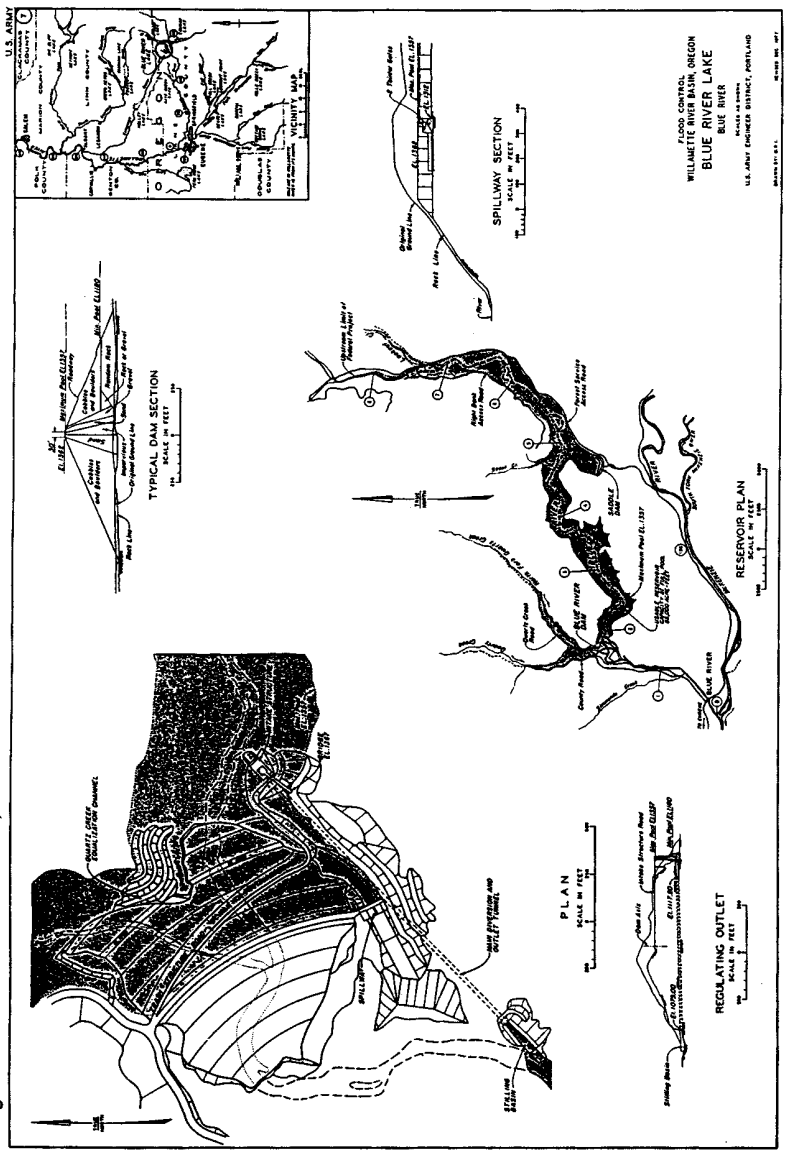


Figure 4 -- *General Plan and Features, Blue River Lake*

Table 1 -- Pertinent Data, Blue River Lake

Drainage Area (sq. miles)	88
Reservoir Elevations (feet mean sea level, MSL)	
Minimum Flood Control Pool	1,180
Maximum Conservation Pool	1,350
Maximum Pool	1,357
Minimum Tailwater Elevation (Q=50 ft^3/s)	1,079
Spillway	
Design Discharge, ft^3/s	53,220
Crest Length - Net, feet	70
Crest Elevation, feet MSL	1,321
Number, Size and Type Gates	Two tainter, 35' x 38'
Outlets	
Type	Concrete Lined Tunnel
Operating Gates	Two, 4'9" x 8'0"
Emergency Gates	Two, 4'9" x 8'0"
Design Discharge at Min. Pool, ft^3/s	3,710
Design Discharge at Max. Pool, ft^3/s	8,400
Main Dam	
Type of Embankment	Compacted gravel fill
Elevation Top of Dam, feet MSL	1,362
Length, feet	1,250
Embankment Volume, cubic yards	4,873,000
Maximum Height, streambed to top, feet	270
Auxiliary Dam	
Type of Embankment	Compacted gravel fill
Elevation Top of Dam, feet MSL	1,362
Length, feet	1,535
Embankment Volume, cubic yards	671,000
Maximum Height above Foundation, feet	72

The main dam is an earth-and-rockfill embankment with a gated spillway in the left abutment. The dam is about 1,250 feet long with a maximum height of 270 feet and a gated spillway about 70 feet long. Diversion and outlets are located in the left abutment. The spillway has a discharge capacity of 53,220 cfs at maximum pool, elevation 1,357 feet, with the gates fully open. An embankment dam about 1,535 feet long and 70 feet high is constructed in a low saddle between the Blue and McKenzie rivers on the left side of the lake, about 3 miles upstream from the main dam. At maximum pool, Blue River Lake is about 6.4 miles long, 0.5 miles wide at maximum width, has 975 surface acres, and a total volume of 89,520 acre-feet.

Below minimum pool (elevation 1,180 feet), there is 3,970 acre-feet of inactive storage. Between elevations 1,180 feet and 1,357 feet, a total of 85,550 acre-feet of storage space is reserved for flood regulation during the flood season. During the summer, 6,700 acre-feet of storage space between elevations 1,350 feet and 1,357 feet is reserved for control of summer floods; the remaining storage is for conservation uses.

The outlet works, located in the left abutment, consists of an intake tower and a regulating outlet tunnel with a stilling basin at the downstream end. The two outlets are controlled by slide gates at the upstream end. Each outlet has two slide gates, one for normal operation and the other for emergency operation. The outlets can discharge 3,710 cfs when the pool is at minimum flood control pool, and 8,400 cfs at full pool. Two low-flow by-passes are provided to allow low-flow releases to be made without using the regulating slide gates.

1.4.2 Cougar Lake. Cougar Lake is located about 42 miles east of Eugene on the South Fork of the McKenzie River at RM 4.5 (figure 2). Project operations began in 1963. Cougar lake has the same authorized purposes as for Blue River. Pertinent data for Cougar Lake are summarized on table 2, and its general plan and principal features are shown on figure 5.

The dam is a rock-fill embankment about 1,500 feet long and 452 feet high from average tailwater to crest of dam. The gated spillway is 89 feet long, is located in the right abutment, and has a design capacity of 76,140 cfs which discharges into a 90-foot long chute. There is no stilling basin. The service outlet and power tunnels are located in the left abutment and have a common intake structure. The outlet capacity is 5,920 cfs at minimum flood control pool, elevation 1,532 feet. The power plant is located at the toe of the rock-fill dam and consists of two 12,500 kilowatt units.

At full pool, Cougar Lake is about 6.5 miles long, 0.7 miles wide at maximum width, and has 1,280 surface acres. At this level, the volume of the reservoir is 219,300 acre-feet, of which 165,130 acre-feet are usable. Of the usable storage, 155,230 acre-feet are assigned to flood control during the winter months, and 9,900 acre-feet to exclusive power storage. Following the flood season, 143,930 acre-feet of the space reserved for floods is filled and this stored water is released during the low water season for conservation uses. There are 54,150 acre-feet of inactive storage below minimum conservation pool, whose primary function is to provide a head for power production.

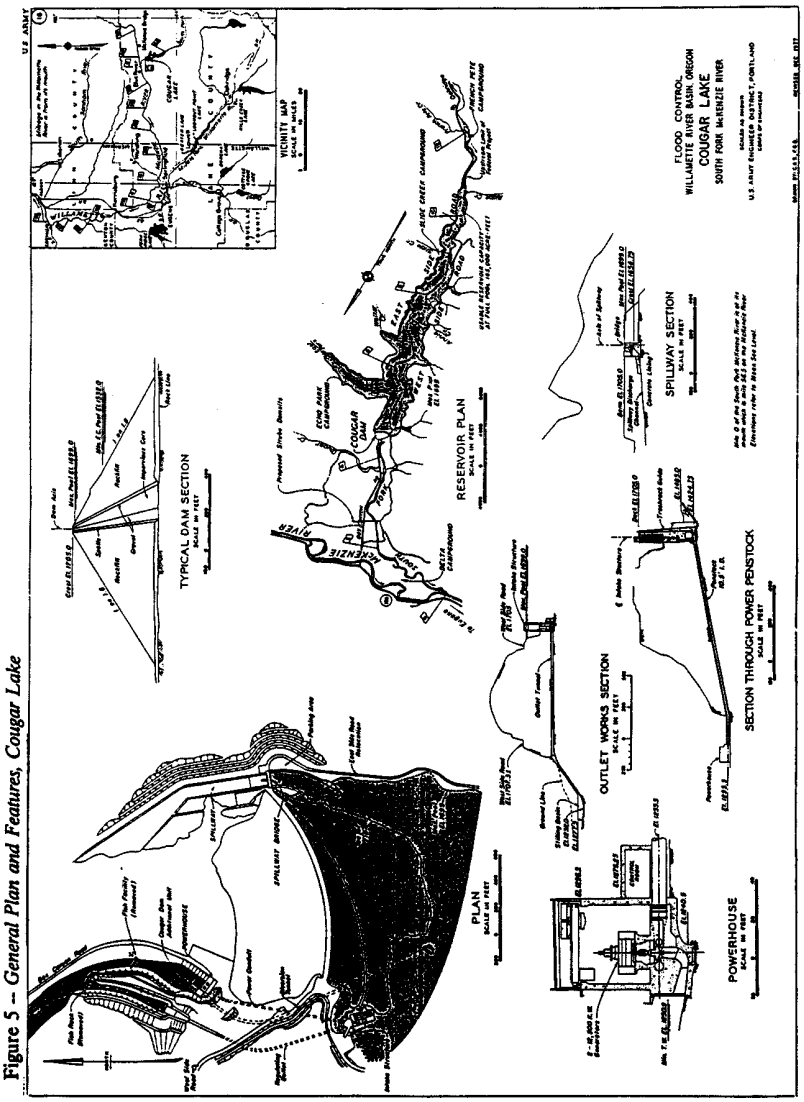


Figure 5 -- *General Plan and Features, Cougar Lake*

Table 2 -- Pertinent Data, Cougar Lake

Drainage Area (sq. miles)	210
Reservoir Elevations (feet mean sea level, MSL)	
Minimum Power Pool	1,516
Minimum Flood Control Pool	1,532
Maximum Conservation Pool	1,690
Maximum Pool	1,699
Spillway	
Design discharge, ft^3/sec	76,140
Crest Length - Net, feet	89
Crest Elevation, feet MSL	1656.75
Number, Size and Type Gates	Two tainter, 40' x 43.3'
Outlets	
Type	13.5' tunnel
Operating Gate	Two slide gates, 6.5' x 12.5'
Emergency Gate	Two slide gates, 6.5' x 12.5'
Design Discharge at Min. Pool, ft^3/s	5,920
Design Discharge at Max. Pool, ft^3/s	12,050
Main Dam	
Type of Embankment	Rockfill
Elevation Top of Dam, feet MSL	1,705
Length, feet	1,600
Maximum Height (above lowest foundation), feet	519
Power Plant	
Penstock	One 10.5' dia.
Number of Generating Unit	Two
Rated Capacity, Total Kilowatts	25,000
Completion Date	1964

The existing regulating outlets, including the intake structure and upstream control, are located in the left abutment. The overall length of the regulating tunnel, including the intake, is 993 feet. Each of the two entrances to the existing intake tower is equipped with two identical slide gates. One serves as an operating gate while the other serves as an emergency gate. The existing outlets discharge 5,920 cfs when the pool is at minimum flood control level and 12,050 cfs at full pool level.

The South Fork watershed above Cougar is forested and logging operations create a source of debris which accumulates in the lake. Debris control is achieved by a floating boom anchored across the lake upstream from the dam. Periodic disposal of the floating debris is accomplished by beaching and burning.

1.4.3 Fishery Mitigation Aspects. Both Corps projects blocked the passage of salmon and reduced stream habitat for salmon and resident trout. Fish collection facilities were built at Cougar dam for spring chinook but these proved unsuccessful and are not used. Mitigation for fish losses was provided by hatcheries. The Leaburg trout hatchery was built to mitigate the loss of resident trout spawning and rearing areas from all Corps managed Willamette reservoirs. The annual operating budget is funded by the Federal Government. The McKenzie salmon hatchery was built as mitigation for the loss of salmon spawning habitat above Cougar and Blue River dams. The Corps funds 50 percent of the annual operating budget. The run eliminated by Cougar was estimated to be 3,860 adult chinook salmon, with an additional 200 adults spawning above Blue River.

Corps mitigation provided at the McKenzie hatchery is for the return of 4,060 adult chinook salmon. The state contributes the balance to provide an additional 4,000 fish for a total facility goal of 8,000 spring chinook returning to the river annually. Both hatcheries are operated by ODFW.

1.5 Related Studies, Reports, and Existing Water Projects

Many related studies and activities have been undertaken or are on-going by federal, state, and local agencies in the Willamette basin. Several key studies and plans for the McKenzie subbasin that form the basis for this feasibility study are summarized here.

1.5.1 Willamette River Basin Reservoir System. The original authorization for the projects in the Willamette River basin was provided by the Flood Control Act of 1938 (Public Law 75-761). The act approved the "...general comprehensive plan for flood control, navigation, and other purposes. . ." as set forth in House Document 544, Seventy-fifth Congress, third session. Subsequent Congressional acts include the Flood Control Act of 1950 (Public Law 81-516), which authorized the plans contained in House Document 531, Eighty-first Congress, second session) and the Flood Control Act of 1960 (Public Law 86-645), which authorized plans contained in Senate Document 104, Eighty-sixth Congress, second session. Eleven storage reservoirs and two re-regulation reservoirs authorized for the basin were completed. Four authorized projects were never constructed and Cascadia, Gate Creek

and Holley were deauthorized by the Water Resources Development Act of 1986 (PL 99-662). The project for Strube Lake includes a dam, spillway, and power plant at RM 1.2 on the South Fork McKenzie River below Cougar dam. No funds have been expended on the project for about 8 years and there are no plans to do so. It will be eligible for deauthorization in about 2 years.

The Willamette projects are operated as a system to serve multiple purposes. The primary purposes include flood control, power generation, navigation, and irrigation. Subsequent "secondary" purposes added by legislation and policy include recreation, fish and wildlife conservation, and pollution abatement. Conservation operation during the summer supplies water for meeting minimum flows, power generation, irrigation, navigation, recreation, instream flows for fish, water quality, and municipal and industrial needs. Water stored in Cougar, Blue River, and Lookout Point is drafted out of these reservoirs first to meet conservation needs.

1.5.2 Pacific Northwest Power Planning and Conservation Act. Since the late 1960s, state and federal resource agencies have routinely requested that the Portland District correct for the adverse temperature effects downstream of the Corps projects in the Willamette basin. These requests were formalized into Fish and Wildlife Program Measures 704(c) (1 and 2) adopted by the NWPPC in 1983 pursuant to Section 4(h) of the Pacific Northwest Power Planning and Conservation Act of 1980 (PL 96-501). The measures called for the Corps to continue investigations for installing devices to control temperatures at Blue River and Cougar, and at Detroit Lake in the Santiam subbasin.

1.5.3 McKenzie Subbasin, Fish Management Plan (1988). This plan was jointly developed by ODFW and an advisory committee. The plan directs the management of fish resources in the McKenzie subbasin, including spring chinook salmon, resident trout, summer and winter steelhead, and other species. This plan recognizes that the McKenzie drainage is the most important remaining area for potential natural production of spring chinook in the Willamette basin. A major objective of the plan is to increase the average annual run of spring chinook entering the McKenzie River to 18,000 adult fish. Also, this plan was adopted for use in the *McKenzie River, Salmon and Steelhead Production Plan* (1990) prepared for the NWPPC.

1.5.4 Willamette System Temperature Control Study (WSTCS). Investigation of temperature control at the McKenzie projects began in 1982 as part of this Corps operation and maintenance study. The WSTCS effort in the McKenzie subbasin continued intermittently as funds were available. Primary work was directed toward collection of field data on temperatures and evaluation of that information.

1.5.5 Willamette River Basin Review. In the mid 1980s, temperature control activities under the WSTCS were integrated into the Corps on-going Willamette River Basin Comprehensive study authorized by Congress in 1961. In 1989, as this study was reaching its final stages, it was decided to combine the temperature control investigations into the

Willamette Basin Review reconnaissance study initiated in December 1989. Congress authorized this reconnaissance study to determine the federal interest in modifying the existing Willamette projects to better serve current and future water resources needs in the basin. Subsequent Congressional action removed the temperature control investigations from this reconnaissance study, resulting in this feasibility study.

The basin review reconnaissance report (June 1991) tentatively concluded that net economic benefits would result from modifying some reservoir operations to increase minimum flows and maintain a longer conservation pool season. For Cougar, no change in operation was proposed. For Blue River, its drawdown priority was changed from first to second for some minor improvement to late summer recreation conditions. Discussions are underway with the Oregon Water Resources Department (OWRD) for cost-sharing a feasibility phase study that may begin in the summer of 1995.

1.5.6 Oregon Water Management Plan. This plan was approved by the Oregon Water Resources Commission in January 1992. Its purpose is to guide the Commission and the OWRD in setting priorities for developing programs and conducting activities in the Willamette basin. One of the six major water resource issues identified in the plan deals with reservoir operations and the management of stored water. Two actions identified under this issue deal with the state promoting the Corps, " . . . to make the structural modifications to the reservoirs necessary to mitigate project impacts on water temperature and fish passage," and for the Corps to ". . . control the temperature of released water as part of its responsibility to mitigate the impacts of dam construction."

1.5.7 Blue River Hydropower. Initial temperature control consideration in the McKenzie subbasin began in the late 1970s during a Corps study for providing hydropower at Blue River Lake. The Corps feasibility report (June 1982) recommended that temperature control be evaluated during subsequent post-authorization studies. The hydropower project was authorized in the 1986 Water Resources Development Act (PL 99-662), and included a provision that non-federal agencies could develop the hydropower project if licensed by the Federal Energy Regulatory Commission (FERC).

The Eugene Water and Electric Board (EWEB) was issued license No. 3109 for a hydroelectric power project by FERC on November 16, 1989. Significant coordination with the NMFS, ODFW, and the FWS on several issues resulted in a settlement agreement between EWEB and NMFS dated June 1992. Since July 1992, the Corps has been involved in design review until EWEB put the project on hold in April 1994. The project has been an on-again/off-again situation since EWEB began planning in 1978. The future of this project is not clear at this time. Unfavorable economic conditions may make the project questionable. The temperature control modifications being considered in this study will not preclude EWEB's option to resume the power project. The power project is not allowed to interfere with temperature control according to the settlement agreement with NMFS.

1.5.8 Forest Service and BLM Activities for the Northern Spotted Owl. The supplemental EIS for federal forest lands within the range of the northern spotted owl identifies restoration plans for key watersheds, emphasizing ecosystem management for all forest species, and especially opportunities to deal with the decline of many stocks of anadromous fish, including bull trout and Willamette spring chinook salmon. The upper mainstem McKenzie, its upstream tributaries of Horse and Lost creeks, and the South Fork McKenzie have been identified as key watersheds in the plan.

1.5.9 National Wild and Scenic River System (NWSRS). In 1988, the South Fork McKenzie, excluding Cougar Lake and Dam, and the Blue River, from its headwaters to Blue River Lake, were designated as Wild and Scenic Study rivers by Congress. The Forest Service conducted studies to determine their eligibility for inclusion into the NWSRS. Only the South Fork was found to be eligible for possible inclusion. Section 7 of the Wild and Scenic Rivers Act mandates federal agencies to insure the values and free-flowing condition of listed streams are maintained. A suitability study remains to be completed for the South Fork by the Forest Service. Congress will ultimately decide whether the South Fork is designated for inclusion in the NWSRS.

1.5.10 Oregon Scenic Waterway Program. The South Fork McKenzie is a designated river in the Oregon Scenic Waterway program. This program is administered by the Oregon State Parks and Recreation Department. Its goals are to protect the free-flowing character of designated rivers for fish, wildlife, and recreation; protect and enhance scenic, aesthetic, natural recreation, scientific, and fish and wildlife values; and encourage other agencies to act consistently with the goals of the program.

2. DESCRIPTION OF THE STUDY AREA

2.1 Overview

This section summarizes the existing physical, economic, social, and environmental conditions in the study area. Pre-project conditions also are discussed, where data is available. The time period prior to 1960, before construction of the first project, Cougar Lake, is considered pre-project for this study. More information can be found in the pertinent technical appendix (Volume II) or the Environmental Impact Statement (EIS) accompanying the main report.

2.2 Topography and Geology

The topography of the study area is rugged, with many deeply incised canyons and steep, heavily timbered slopes. The McKenzie subbasin is a product of stream erosion, glaciation, and alluvial deposition. The underlying rock units consist primarily of pyroclastics, andesitic intrusives, and contact breccias. The rock is transected northwesterly by numerous, high-angled faults and joints.

At Cougar dam, the river has cut a canyon and a narrow channel through the rock sequence. The river channel is bouldery with an average width of 350 feet and a gradient of 64.5 feet per mile. The river valley trends north-south. The foundation rock at the project site is primarily basalt.

Blue River was diverted to its present course by glacial blockage during the last glacial age. Subsequent stream erosion produced a narrow canyon with steep side slopes in the main dam area, and a somewhat wider canyon with steep side slopes in the middle and upper lake areas. A mixture of gravel, talus, and slide debris is common along the valley floor and canyon walls. The foundation rock at the project site is primarily andesite.

2.3 Hydrologic Conditions

2.3.1 General Characteristics. The McKenzie River originates at Clear Lake at RM 89.6 in the northeast corner of the basin. It flows southward for about 15 miles and then turns westward for 75 miles to its confluence with the Willamette River. About 8 miles south of Clear Lake (RM 81.9), the McKenzie is joined from the north by the Smith River. About 17 miles south of Clear Lake, it is joined from the south by Lost Creek. It is joined from the south by Horse Creek 6 miles farther downstream. Six miles downstream from this confluence, the South Fork joins the McKenzie. About 2.5 miles farther downstream, the McKenzie is joined from the north by the Blue River. The next major junction is with Gate Creek at Vida, 14.2 miles downstream from Blue River. The final tributary is the Mohawk River at RM 13.7. The length, elevation drop, and average gradient of the McKenzie and its major tributaries are shown in table 3.

Table 3 -- Length, Elevation, and Average Gradient of the McKenzie and Tributaries

STREAM	LENGTH (miles)	ELEVATION DROP (feet)	AV. GRADIENT (ft per mi)
McKenzie River above McKenzie Bridge	22	1,800	82
McKenzie River from McKenzie Br. to mouth	68	850	13
Horse Creek	26	3,300	130
South Fork McKenzie	32	3,500	110
Blue River	17	1,400	83
Gate Creek w/ North Fork	11	1,650	150
Mohawk River	26	800	31

2.3.2 Climate. Elevation extremes in the McKenzie subbasin influence the distribution of precipitation. Normal annual precipitation varies from 40 inches near Eugene to 110 inches on ridge tops of the Blue River drainage and 100 inches near Mt. Washington on the Cascade Range. The annual weather pattern of hot, dry summers and cool, wet winters is similar to other basins in the Willamette Valley. Seventy to eighty percent of the precipitation in the subbasin occurs during October through April, and 20 to 30 percent during May through September. About one-third of the precipitation is snowfall and snowmelt which contributes cool waters and sustained flows in the McKenzie and upper tributaries during summer. The mean daily air temperature in summer is about 65° F and in winter is about 40° F.

2.3.3 Flow Conditions. Mean annual flows and extremes for the periods of record of gaging stations at selected locations of the McKenzie River are shown in table 4. Average annual discharge from Lost Creek is estimated at 713 cfs (there is no permanent gaging station). The average annual flow of the McKenzie increases about 70 percent at this junction. A large portion of the flow in Lost Creek comes from springs draining through porous lavas. Water temperatures of Lost Creek and the McKenzie are similar.

Flows at McKenzie Bridge are reported before and after completion of Smith River and Trail Bridge dams, which are operated by EWEB. The average annual flow of Horse Creek is about 500 cfs and since the period of record is short, no extremes are estimated. The average annual flow of the McKenzie increases by about 22 percent at this confluence.

Table 4 -- Recorded and Estimated Mean Annual Flows of the McKenzie and Tributaries

Location and Station Number	Period	Min (cfs)	Max (cfs)	Mean (cfs)	Std Dev (cfs)	Coeff Var
Clear Lake (14158500)	1973-82	--	--	469	104	0.22
Trail Bridge (14158850)	1964-82	--	--	1026	184	0.18
Lost Creek	1964-82	--	--	713	--	--
McKenzie Br.	1911-62	--	--	1662	264	0.16
(14159000)	1964-82	--	--	1739	315	0.18
Horse Creek	1962-69	--	--	504	--	--
South Fork	1948-62	749	1300	927	134	0.15
(14159500)	1964-82	453	1243	818	225	0.28
Blue River						
(14162000)	1936-64	218	589	393	87	0.22
(14162200)	1969-82	192	727	481	147	0.31
McKenzie u/s Vida	1925-62	2476	6211	4001	843	0.21
(14162500)	1964-82	2447	5823	4115	910	0.22
Gate Creek (14163000)	1952-82	92	318	214	59	0.27
Leaburg Dam	--	--	--	4329	--	--
Mohawk River (14165000)	1938-82	164	847	535	157	0.29
Coburg (14165500)	1945-63	4575	8275	6018	836	0.14

u/s: up stream

Source: USGS open file report 89-454, 1984

Flows from the South Fork, Blue River, and mainstem McKenzie are reported before and after construction of the Corps projects. The average annual flow of the mainstem McKenzie is increased by about 24 percent by flow from the South Fork. Since the South Fork is fed by snowmelt reaching the river by way of porous lava beds, flows are sustained throughout the summer months. The average annual flow of the mainstem McKenzie is increased about 12

percent by flow from Blue River. A relatively large portion of the annual yield of Blue River occurs in April and May due to snowmelt. A lack of ground water releases is evident in the low base flow in late summer.

The Leaburg Canal withdraws water from the McKenzie at Leaburg Dam and returns it about 6 miles downstream near Cogswell Creek. Water is also withdrawn from the McKenzie via the Walterville Canal (RM 28.5) and returns at RM 20.9. The average annual withdrawal/return at both these canals is about 2,000 cfs. This decreases and increases the flow in the McKenzie by about 50 percent. The mean annual discharge from the McKenzie into the Willamette was 6,018 cfs before construction of the projects, and 4,864 cfs after their completion.

2.3.4 Effects of the Corps Projects on the McKenzie System. Blue River and Cougar lakes are unique because of their contribution to low flow augmentation of the Willamette system during the conservation season. Their augmentation releases generally exceed those from all other Willamette projects during July and August. Rates of discharge from Blue River and Cougar during the filling and conservation periods are normally 50 and 300 cfs, respectively. When Willamette flows are to be augmented, discharge is increased first at Blue River until a maximum of 500 cfs is released. Discharge from Cougar is then increased up to 800 cfs for additional augmentation.

Without Cougar, South Fork flows fluctuated around 1,000 cfs during the winter months and then dropped to a low of about 235 cfs from August through October. With Cougar, the months in which flows have changed most are March through May, and August through November. The most significant flow effect of Cougar has been to increase flows in the mainstem McKenzie from August through October. Without the Blue River project, Blue River flows showed seasonal fluctuations in flow rates of 33 cfs in September to 743 cfs in February. With project data show a range of flows from a low of 196 cfs in June to a high of 1,170 cfs in December.

Blue River Lake has had a significant effect on flows during the summer months in contrast to Cougar Lake whose effects are during the fall. The Blue River project has increased the summer discharges from 20 to 60 cfs (pre-project inflow rates) to 200 to 300 cfs (post-project outflow rates). The winter months are characterized by large variations in flows because of winter storms and precipitation patterns.

The effect of construction and operation of the Blue River and Cougar projects on mainstem McKenzie flows has been a reduction in the 10-day mean flow from February through June and a measurable increase in flow during August through October. Ten-day mean flows of the pre-project period (1925-1962) ranged from a high of about 5,500 cfs during winter to a low of 1,750 to 2,300 cfs during summer. Flows of the post-project period (1969-1984) ranged from a high of 7,500 to 8,000 cfs in December and January to a low of 2,600 to 3,000 cfs during summer. This change represents flow increases of 30 to 50 percent during summer and corresponding decreases in late winter and spring.

Blue River is drawn down first, then Cougar Lake. The main discharge effect of Blue River on the mainstem occurs in mid-August, in contrast to the main effect of Cougar occurring in October. The result of this difference in drawdown schedules is a high, stable flow in the summer for the mainstem McKenzie between the confluence of Blue River and Leaburg Dam. The seasonal pattern of high deviations in winter (4,000 to 5,000 cfs) and low in late summer (500 to 600 cfs) for the McKenzie follows the same pattern as for Blue River and the South Fork.

Figure 6 depicts the contributions of the South Fork and Blue rivers to the mainstem McKenzie before and after the projects were constructed and operated. Flow contributed by each tributary is presented as a percentage of the mainstem flow. The South Fork essentially reversed its seasonal input pattern to the mainstem McKenzie. Under pre-project conditions, the high contribution months occurred in winter whereas under post-project conditions, late summer and fall are the periods of greatest contribution. Blue River also shows a similar but more mild reversal in contribution pattern. The average summer/fall contribution of the South Fork has resulted in an increase in the corresponding flows of the mainstem by about 22 percent. The average increase in summer/fall flows of the McKenzie due to contributions from Blue River is about 15 percent. The total increase from both projects for the McKenzie during summer/fall is more than 35 percent.

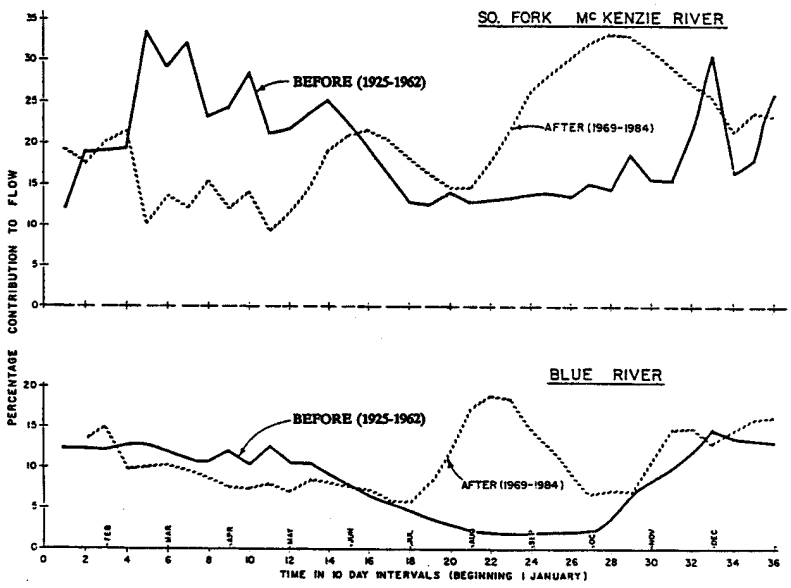
2.4 Existing Thermal Conditions

The Pacific Ocean moderates the weather of the prevailing westerlies yielding a rather mild climate in the study area. Arctic cold is diverted inland by the westerlies off the ocean which brings the temperature-moderated, moisture-laden air to the Cascade mountains of Oregon. Winters are wet and cool. The westerlies bring the moisture off the Pacific Ocean causing increased precipitation and stream flows. Winter water temperatures approach air temperatures.

In summer, a ridge of high pressure builds over Oregon diverting the jet stream north. This directs the summer storm track and moisture north. With the summer sun directly overhead, the ground dries and the humidity falls. Precipitation largely ceases, stream flow drops to a minimum, and solar radiation causes stream temperatures to rise.

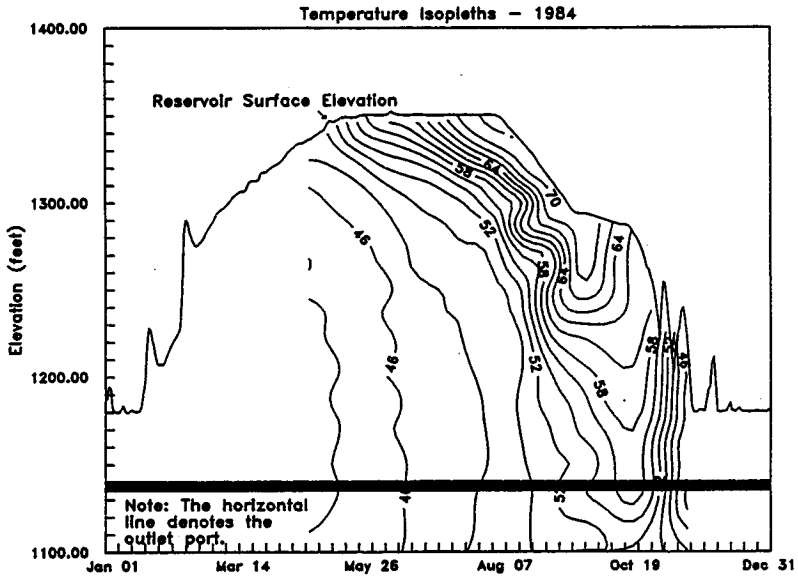
In figure 7, the lower graph shows the 1984 mean daily water temperature in Tidbits Creek, a main tributary entering Blue River Lake ("inflow" on the graph). Temperatures are at minimum levels beginning in late November through March. In April, stream temperature begins to rise and reaches a peak in late July/early August. By mid-August, stream temperatures begin to decline and do so through November. A similar pattern is shown in figure 8 for Cougar Lake. This generalization holds for most mountain streams in the Pacific Northwest.

Figure 6 -- Percentage Contribution of Blue and South Fork McKenzie Rivers to the Main Stem McKenzie Before and After Construction



Source: USGS gage near Vida

Figure 7 -- *Existing Thermal Conditions at Blue River Lake*



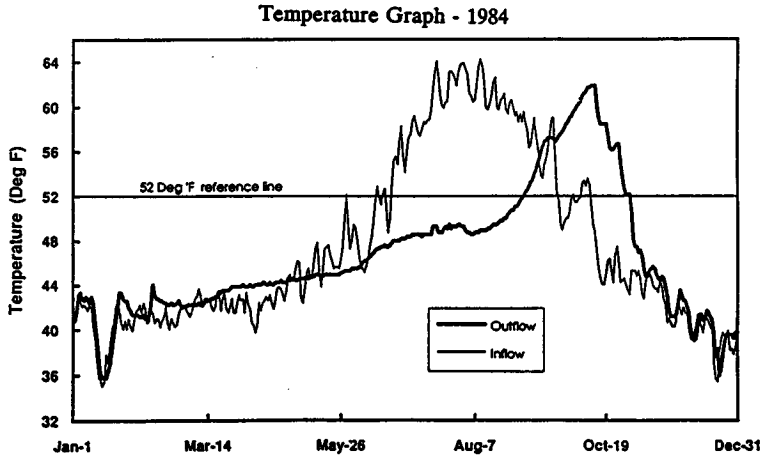
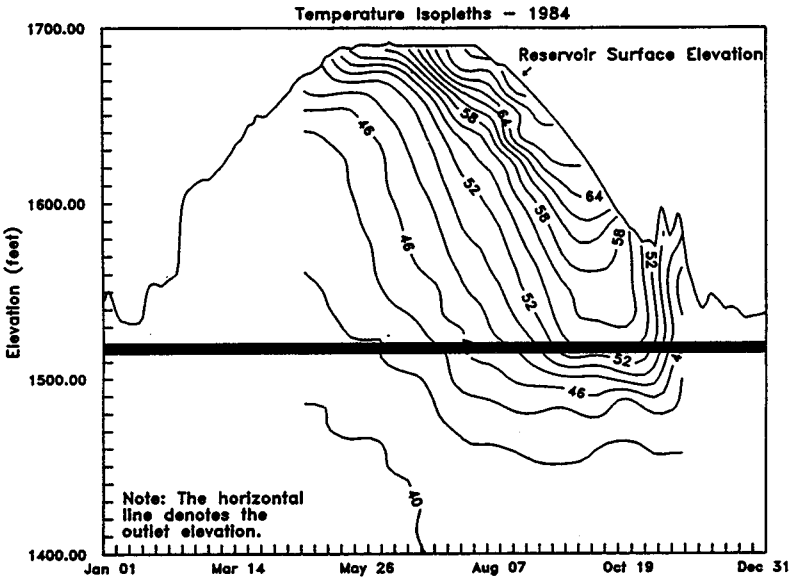
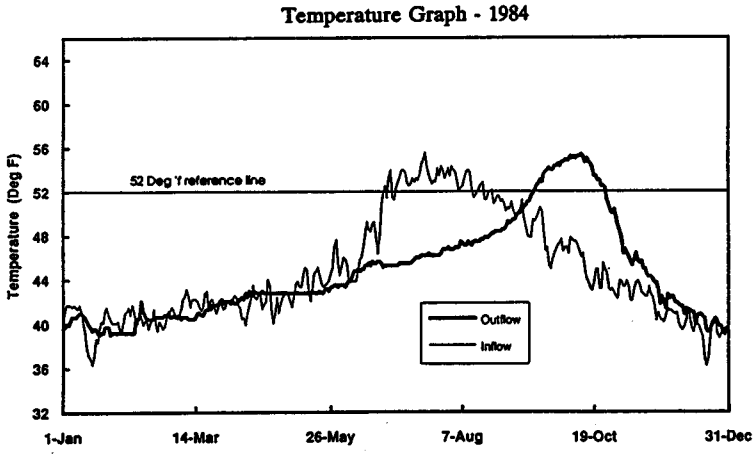


Figure 8 -- *Existing Thermal Conditions at Cougar Lake*





On the other hand, river temperatures measured immediately below Blue River and Cougar dams exhibit a dramatically different pattern. In figure 7, the lower graph shows the temperature below Blue River ("outflow" on the graph) gradually warming until August, although this water is 10° to 20° F cooler than that flowing from Tidbits Creek into the lake. In September, the inflow and outflow temperatures are nearly the same. Later in September and early October, Blue River below the dam is 10 to 15° F warmer than Tidbits Creek. This fall peak temperature in the Blue River below the dam comes 2 months later than the peak temperature in Tidbits Creek. By November, water temperatures in Tidbits Creek and Blue River are the same and remain that way through April. A similar pattern is shown in figure 8 for Cougar. Fishery biologists have been aware of this pattern below the reservoirs, and declining fish resources stimulated research into the consequences of these changing temperature regimes.

An understanding and description of the causes of these changes in temperature regime is basic to formulating solutions that reduce or minimize these changes below both Blue River and Cougar lakes. Four factors contribute to this shift in the temperature cycle:

- The mountain streams flow through a lake/reservoir.
- Warmer water is less dense and floats on top of cooler water in deep lakes.
- The level of Blue River and Cougar lakes varies over 150 feet seasonally.
- The dam outlets are deeply submerged most of the year.

The upper graphs in figures 7 and 8 show the lakes' surface elevation at midnight each day for 1984. Temperature isopleths (in °F) interpolated from the periodic measurements taken at various depths during the year, and the level of the outlet from the lakes also are shown. The isopleths of temperature are lines which represent the elevation and time that a specified temperature occurs. The interval between the isopleths represents a 2° F change in water temperature. The surface water temperature is found where the isopleth lines intersect surface elevation. Following the lines downward yields the temperature at various elevations in the reservoir on the specified date. These figures depict the temporal (time) distribution of heat in the reservoirs. The heavy horizontal line across the graphs represents the outlet level in the reservoirs.

The top and bottom graphs in figures 7 and 8 show the difference in the temperature of the water released from the reservoirs when compared to the natural temperature regime of the streams flowing into the reservoir. In the upper graph, the intersection of the heavy line (representing the level of the outlet) intersects with the 52° F isopleth (52° F is being used as a reference temperature for inflow). In the lower graph on the same date, the outflow temperature also is 52° F. These figures show that the warm water in the lakes, which matches the water temperature flowing into the lakes, is floating high above the outlet (warm water floats on top of cooler water). As the reservoirs are drawn down, the cooler water is depleted and the remaining water is warmer than the water flowing into the reservoirs (which is seasonally cooling because of the shorter, cooler days).

Mountain streams are very turbulent due to rough stream beds. In spring, increasing air temperature and more hours of direct sunlight causes stream warming, and turbulence keeps the water mixed. The temperature of the swiftly flowing water is uniform. Temperatures in several cross sections along the McKenzie were measured in 1984 by the US Geological Survey (USGS), and temperatures were found to be uniform. The density of water in streams also is uniform, mixed through the mechanism of turbulence.

When freely flowing water enters lakes or reservoirs, the currents are slow and spread out, and the surface flattens. Turbulence is reduced and density currents govern movements of water. As the sunlight of spring intensifies, its radiant energy warms the surface waters of the lake. Some of the sunlight penetrates below the surface also warming the water. In the same way that gravity helps create a nearly flat level surface on the lake, so layers of water of the same temperature (density) form in the lake beneath the surface. Similar temperatures will be found throughout the reservoir at similar elevations.

In 1984, water temperature was measured at intervals of increasing depth every few weeks in Cougar and Blue River lakes. Figure 9 shows the typical temperature profile at the reservoirs and figure 10 shows the temperatures recorded at intervals of depth (elevation). On April 19, the surface water temperature was 48° to 49° F at about elevation 1,335 feet and the underlying deeper levels in the lake were cooler, decreasing to about 43° F at elevation 1,270 (65 feet deep). The water from about elevation 1,270 to about elevation 1,170 (165 feet deep) also is 43° F. This layer of deep cooler water is termed the hypolimnion (figure 9).

By June 14, the surface water temperature had increased to 60° F. This layer of warmer water had increased in depth to 12 to 15 feet. This warmer surface layer is termed the epilimnion. The nearly uniform temperature (density) of this surface layer allows the surface wind and waves to mix the water. Below the epilimnion, the water temperature drops rapidly with increasing depth. The depth at which the water temperature changes most rapidly is termed the thermocline. The 50-foot transition from the warm surface layer to the deep cooler water layer is termed the metalimnion (between the epilimnion to the hypolimnion). By mid-August, the hypolimnion warms to about 3° (from 56° to 57° F) with surface water temperature reaching a maximum of 73° F.

In late summer, the reservoirs begin to cool. They also are being drawn down for flood control. Initially, the deep water is released. As the deep water is depleted, warmer water of the metalimnion (mid-depth) begins limited mixing and also is depleted. Finally, by late October or mid-November, the early seasonal storms cause the reservoirs to mix completely. Water temperature continues to fall through January, but then a slow warming begins toward spring. Stratification of the reservoir begins again in April.

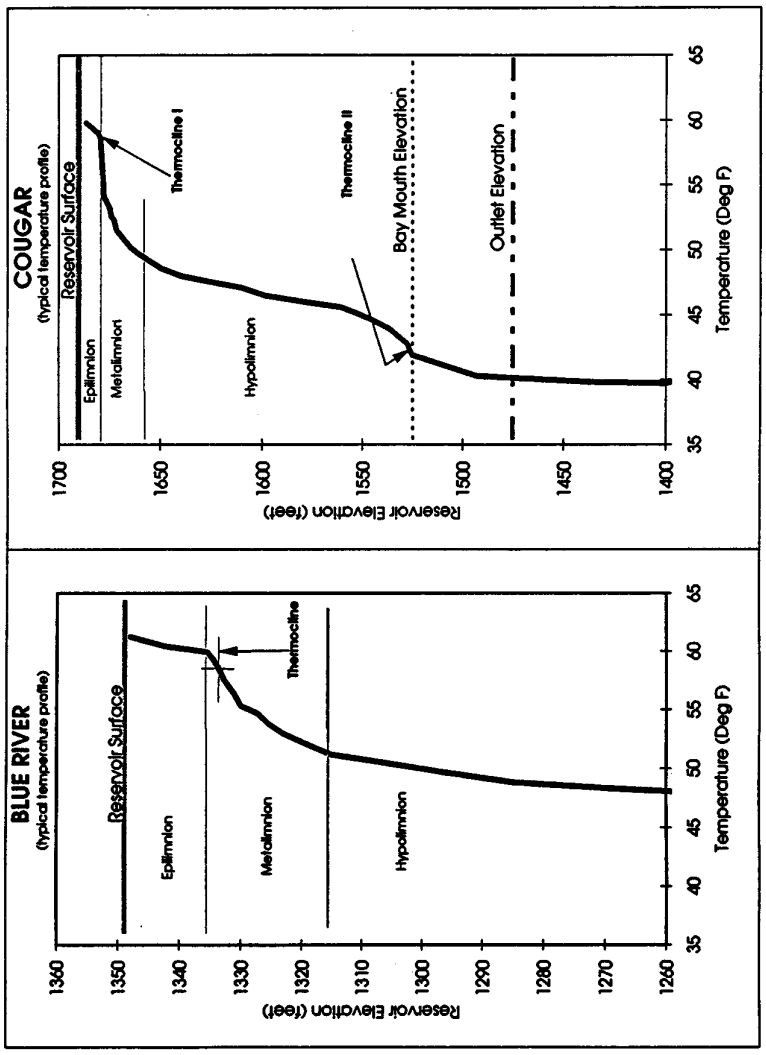


Figure 9 -- *Typical Temperature Profiles at Blue River and Cougar Lakes*

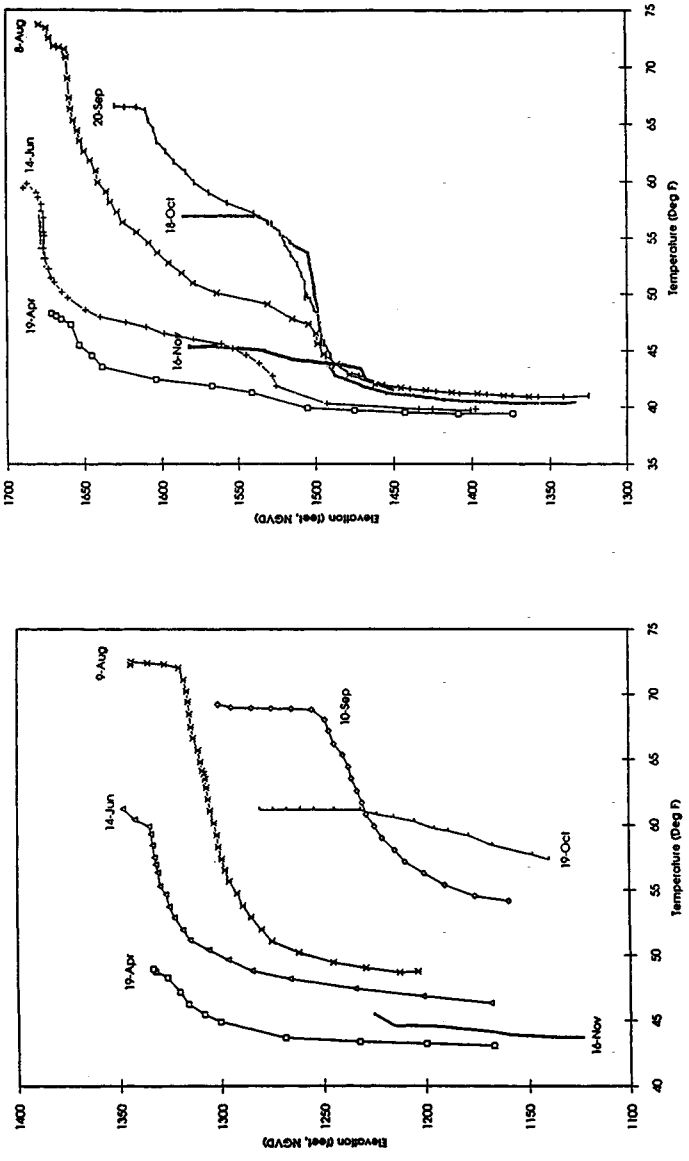


Figure 10 -- *Temperature Profiles for Blue River and Cougar Lakes*

The water temperature profiles in figure 10 for Blue River and Cougar lakes look quite different. While Blue River has two layers, Cougar appears to have three. At Blue River, the outlet is near the bottom of the reservoir (elevation 1,132 to 1,140) whereas the Cougar outlet is located about halfway up on the abutment at elevation 1,512 (elevation 1,275 is the bottom of the reservoir). In addition, Cougar's outlet is in a bay connected to the main reservoir through a gap at elevation 1,500 feet. This feature limits the depth to which reservoir withdrawals can affect the mixing and temperature of Cougar Lake. The mid-range temperature water extends to the level of the outlet while the colder water extends to the bottom of the reservoir.

Cougar and Blue River lakes are unlike natural lakes where lake levels vary only a few feet between winter and summer. Blue River varies 170 feet and Cougar varies 258 feet. These reservoirs were constructed mainly to provide flood control. The threat of floods is confined to winter and early spring. To provide flood control storage space, the reservoirs are drawn down to their lowest flood control level by mid-November and held at that level through January. In the spring, as snow melts, rainfall increases, and the risk of flooding decreases, the reservoirs are allowed to refill with this cool water. As the reservoir nears filling, thermal stratification becomes noticeable and continues to grow throughout the summer.

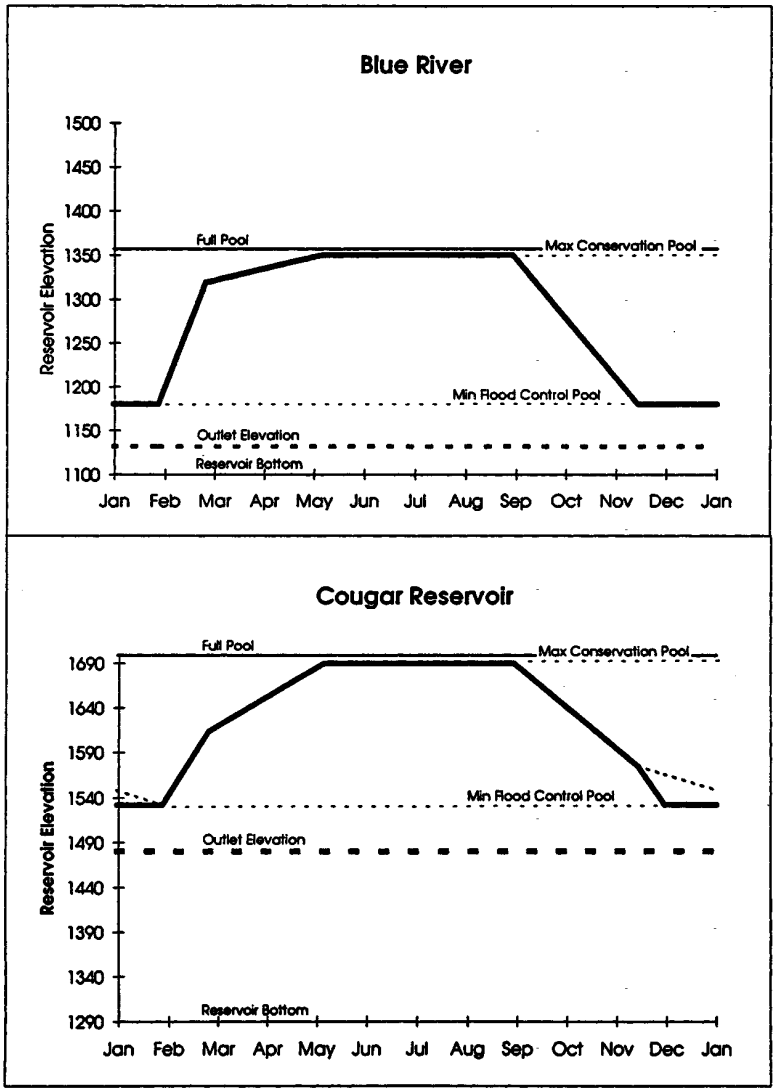
By late July and August, augmentation of instream flows in the Willamette system has started. Water is released from Blue River first because of limited recreation use and lack of power generation. The lake levels are maintained until the end of the camping season, usually Labor Day weekend. Reservoir schedule diagrams for Blue River and Cougar are shown in figure 11. These schedule diagrams show reservoir levels used to achieve flood control and balance the refill rate with the risk of flooding. Special reservoir operating rules apply under flood situations when reservoir levels exceed the schedule diagram.

The existing outlets, being deep in the reservoirs, do not allow for access to the warmer water floating high above the outlets. Access to this warmer water would better replicate summer inflow (natural) temperatures. The warm water pool would be depleted and the cooler water preserved for use in the fall when the inflow temperatures are cooling. The thermal stratification of the lakes would be reduced earlier and at cooler temperatures.

2.5 Water Quality

2.5.1 Cougar and Blue River Lakes. Blue River and Cougar lakes are similar in their water quality characteristics and are typical of surface waters in western Oregon. Mineral content is low and the water is soft and poorly buffered. Dissolved oxygen levels are consistently high. Because the reservoirs are situated in remote, forested areas, urban contributions to nutrient loading are minimal. The phytoplankton composition of the Willamette reservoirs resemble that of many oligotrophic lakes (those poor in nutrients) in the Oregon Cascade Range. Concentrations of nitrate-nitrogen, orthophosphate, and other algal nutrients are not large and are derived primarily from rainfall, watershed soils, and other natural sources.

Figure 11 -- *Reservoir Schedule Diagrams for Blue River and Cougar Lakes*



Because Cougar and Blue River lakes are nitrogen limited, they support a healthy population of *Anabaena circinalis* (a common filamentous algae) from late March to July. Every year the population density is different depending on varying factors that are not well understood. Algal blooms have been known to occur when conditions are right (water temperature, day length, seasonal weather patterns, and proportion of nutrients). These algal blooms appear to occur at the surface and density drops proportionately with depth. The population density takes a sharp drop within a few days as the species dies.

Winter storm events produce the highest turbidities in watershed streams that enter the reservoir pools. Generally, turbid inflows reaching the reservoirs tend to sink into deepwaters and move toward the dam, which are then passed downstream through low elevation outlets. Turbidity levels sampled in 1992 and 1994 show a range of 0.6 to 2.9 NTUs for both lakes.

In 1983 the Portland District investigated the potential for contaminants in the Willamette reservoirs. A water quality constituent was considered a contaminant if it resulted in impaired project purposes, violated federal or state water quality standards, or threatened humans, fish or wildlife. Cougar and Blue River reservoirs were not identified as having potential contaminants in this investigation.

2.5.2 McKenzie Subbasin. The water quality of the mainstem McKenzie, South Fork, and Blue rivers is of high quality, which is essential to maintaining the anadromous fish habitat in the study area. There are few pollution discharges into these streams above Vida. The major pollution impact on the McKenzie comes from industrial waste discharges lower in the subbasin. Dissolved oxygen levels are consistently high and there do not appear to be any limitations to anadromous fish resources. The pH levels also are consistently within desirable limits. Turbidity levels are generally low and these streams are known for their aesthetically pleasing water clarity. However, increases in turbidity levels have occurred with flood water discharges from Cougar and Blue River.

2.6 Biological Environment

The streams in the McKenzie subbasin support diverse populations of fish and aquatic organisms. Anadromous species include Willamette spring chinook salmon, winter steelhead trout, and Pacific lamprey. Native cold water species include rainbow, cutthroat, and bull trout. Warm water resident species include a variety of native and non-native species. The McKenzie subbasin streams likely contain an abundance of invertebrate species as well as a variety of micro- and macro-algae species. Rooted aquatic macrophytes also are present. These groups provide the nutrients and cover for the higher organisms and are important to the well being of the aquatic ecosystem.

Cougar and Blue River provide habitat that supports a variety of aquatic species typical of a lake environment. Both contain resident trout populations, and Cougar has a small resident bull trout population. Cougar is stocked annually with rainbow trout and Blue River with spring chinook fry for an experimental reservoir rearing program being conducted by ODFW.

Blue and Cougar do not contain any large populations of resident warm water fish species.

Coniferous forest, grassland, clearcut/replanted clearcuts, and riparian areas occur in the study area. Conifers dominate the terrestrial ecosystem, and major tree species include western hemlock, Douglas fir, and western red cedar. Riparian and grassland areas are minimal. Clearcuts are scattered throughout the study area.

Wildlife species are typical of those commonly found on the west slope of the Cascades. Big-game species include Roosevelt elk, black-tailed deer, and black bear. Upland game birds include blue and ruffed grouse, mountain quail and band-tailed pigeon. Furbearers include beaver, raccoon, and less commonly river otter, bobcat and mink. A variety of small mammals occur in different habitats in the area. Waterfowl inhabit the river, reservoir and riparian areas.

Federally listed wildlife species under the ESA include the bald eagle, northern spotted owl and the peregrine falcon. Bald eagles occasionally occur during winter in the study area. Only a few individuals are recorded along the McKenzie River each winter. No nesting pairs are associated near the Corps projects. Northern spotted owls use late successional forests in the study area for nesting, roosting and foraging. Owls have been documented within 1.5 miles from Blue River dam and within 0.75 mile from Cougar dam. Although peregrine falcons have been sighted in the Willamette National Forest, no nesting pairs have been identified in the immediate vicinity of the dams.

2.7 Fisheries and Aquatic Species

Three McKenzie subbasin fish species were chosen as key indicators for potential changes associated with temperature modification. These are the Willamette spring chinook salmon, resident rainbow trout, and bull trout.

2.7.1 Willamette Spring Chinook Salmon. The Willamette spring chinook salmon is one of six stocks in the lower Columbia River below Bonneville Dam. These fish use the major tributaries of the Columbia and Willamette rivers, and are native to the McKenzie River. Their historic distribution of spawning and rearing areas includes the mainstem McKenzie up to about RM 85 (Tamolitch Falls), tributaries including Gate, Horse, and Lost creeks, and the South Fork and Blue rivers. The McKenzie is considered the most important remaining area for natural production of spring chinook in the Willamette basin (ODFW 1988)[1].

[1] *McKenzie Subbasin Fish Management Plan.* 1988. Oregon Department of Fish and Wildlife.

Historical data shows that the McKenzie River produced an estimated 40 percent of the run of spring chinook above Willamette Falls, and in 1959, it accounted for about 50 percent of the run (ODFW 1988). Spring chinook have been managed primarily as hatchery stocks with natural production comprising only 5 to 15 percent of total population. Hatchery spring chinook have been stocked in the McKenzie since 1902.

Adult spring chinook enter the Columbia River in late winter and reach the Willamette River as early as February. The run generally peaks in April with the migration complete in late May. In the spring, migration of spring chinook appears to be temperature dependent with the fish moving upstream as the water warms. The NMFS investigated the number of spring chinook passing Leaburg Dam versus water temperature, and most upstream migration was found to occur when water temperatures reached or exceeded 52° F. Upstream migration continues until the water temperature becomes too warm. Delays in spring migration results in fish not reaching spawning areas, with the fish holding in deep pools in the mainstem and tributaries before making a final migration to spawning areas in the fall.

Spawning normally begins in early September, peaks in mid- to late September, and ends by mid-October. Eggs incubate for 65 to 80 days with most fry emerging in February to March under normal conditions. In the South Fork, however, fry emergence occurs as early as December because the warmer water released in fall from Cougar and Blue River accelerates egg incubation. Juvenile spring chinook reside in freshwater from 3 to 18 months with three periods of migration. A movement can occur in late winter to spring soon after emergence, in late fall and early winter, and in the following spring. Fry migrate soon after emergence based on data collected at Leaburg Dam by ODFW.

Data is available that shows that spring chinook numbers have been reduced since completion of Cougar and Blue River (ODFW 1988). The estimated average run size during the period 1945-1960 (pre-project) was about 18,000 spring chinook (total estimated return including hatchery fish, escapement, and catch). Since completion of the dams, the average run size has been only about 6,700 fish, a decrease of about 60 percent from pre-project conditions, with only about 2,900 passing upstream of Leaburg Dam.

Temperature changes in the river from releases out of Cougar and Blue River reservoirs were suspected in the late 60s as a possible cause of reduced returns (Korn and Ingram, 1969)[2]. Spring chinook were found to be delayed at the mouth of the South Fork apparently because of cold water temperatures. When warmer waters were experimentally released from the surface of Cougar Lake, fish migrated into the South Fork. Delay of migrating adults at Leaburg Dam also was suspected to be the result of the cold water released during the early portion of the run (mid to late May). Delaying upstream migration results in shifting the distribution of spawning from above to below Leaburg Dam. This results in significantly

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[2] Korn L. and P. Ingram. 1969. *Evaluation of Fish Passage Facilities at Cougar Dam on the South Fork McKenzie River in Oregon - Final Report.* Fish Commission of Oregon.

underused spawning habitat upstream of Leaburg and particularly in the upper reaches of the McKenzie River. In a recent survey, the quantity and quality of existing spawning habitat in the study area was found to be good, with little change from what was available historically (Sedell et al. 1992)[3]. Although good quality spawning habitat is available upstream of Leaburg Dam, adult chinook salmon are not migrating into the study area or upper McKenzie subbasin because of water temperature constraints.

Spawning above Leaburg occurs primarily during September, with about 95 percent completion by September 30. Distribution of spawning is estimated to be 60 percent above the South Fork (represents natural conditions), 10 percent in the South Fork, and 30 percent in the mainstem McKenzie to Leaburg. Prespawning mortality is estimated at 5 percent above the South Fork, 23 percent in the South Fork, and 18 percent in the mainstem. Water temperature constraints below the Corps projects appear to lower the distribution of spawning and increase prespawning mortality for chinook salmon.

Fry were sampled above, below (mainstem McKenzie), and in the South Fork to determine emergence timing. Fry emerged above the South Fork (represents natural conditions) in Horse and Lost creeks in mid-February and in mid-March in the Carmen Smith spawning channel. In contrast, fry emerged as early as the first week of December in the South Fork, with substantial numbers observed in December and January below and in the South Fork. The number of days to emergence was estimated for each stream reach. Under natural conditions (above the South Fork), 180 days were needed for emergence in contrast to 86 days in the South Fork and 131 days below the South Fork.

In summary, warm water releases from Cougar and Blue River in late summer and fall accelerate egg incubation which results in earlier than normal fry emergence. Early emergence reduces fry survival because conditions in the winter are not favorable for fry growth and food is not readily available. This, in combination with cooler spring releases delaying adult migration and the significant underutilization of available spawning habitat upstream of Leaburg Dam, decreases the natural production of Willamette spring chinook salmon in the McKenzie subbasin.

2.7.2 Native Rainbow Trout. The native rainbow trout was chosen as an indicator species because of its widespread distribution in the area and importance as a sport fish. Its distribution occurs in the McKenzie up to Tamolitch Falls (RM 85), and in the larger tributaries above Leaburg Dam, including the South Fork and Blue rivers. The McKenzie is one of the most popular rivers for trout fishing Both native and hatchery fish contribute to angler catch. Since the 1950s, the mainstem and tributaries have been closed to harvest of rainbow 14 inches and longer.

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[3] Sedell, J.R., B.A. McIntosh, and P. Minear. 1992. *Evaluation of Past and Present Stream Habitat Conditions for the McKenzie River Temperature Control Study.* Pacific Northwest Research Station.

Cougar and Blue River reservoirs have impacted rainbow trout in the McKenzie system by inundating productive stream habitats, blocking migratory routes, and changing water quality conditions, including downstream water temperatures. At the same time, the reservoirs have provided habitat for trout.

Limited information exists on the distribution and abundance of native rainbow trout in the McKenzie subbasin. Catch and other data indicate substantial numbers are still present. Creel survey data from the 1950s to the 1970s shows a decline in the percentage of native to hatchery fish. This does not necessarily reflect a decline in the abundance of native trout because it may be the result of hatchery fish being easier to catch, more available to anglers, or anglers targeting hatchery fish. In both 1974 and 1983, native fish represented about 10 percent of the catch (ODFW 1988).

It is likely that native trout populations in the mainstem McKenzie, South Fork, and Blue rivers are at depressed levels. Blue River downstream to Leaburg has been the most heavily stocked in the past. Stocking also occurs in the tributaries, but stream flow and temperatures are not suitable until June for the South Fork and April to July for the Blue River (ODFW 1988). Native trout have been protected from harvest in the South Fork since 1992 to protect their populations.

Empirical data do not exist for the McKenzie that demonstrates relationships between temperature changes downstream of the projects and changes to native rainbow trout populations. However, these relationships have been developed for other river systems using trout growth units (TGUs), an index of water temperatures favorable for trout growth. TGUs are determined by the number of temperature degree-days between 42° F and 63° F, the range at which trout growth can occur in the wild. One day at 42° F equals one TGU.

This methodology was applied to the mainstem McKenzie, South Fork, and Blue rivers for existing conditions. In general, the South Fork and Blue rivers show lower TGUs for existing conditions (1095 and 1383 TGUs, respectively) than does the mainstem (1460 TGUs). This difference is more pronounced during low flow conditions and less so during high flows.

Because trout growth is a function of both water temperature and food availability, research has been conducted on aquatic insect production in dam tailwaters. This research includes reservoirs with hypolimnial releases similar to Cougar and Blue River. In general, aquatic insect populations are much less diverse when conditions have been altered such that temperatures are uniformly colder, daily and/or seasonal fluctuations are lacking, and waters are enriched with nutrients. This restricted insect fauna, in combination with cold waters and variable flows, was found to strongly influence trout populations and their ability to assimilate food organisms (Ward and Stanford 1982)[4].

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[4] Ward, J.V. and Stanford, J.A. 1982. *Thermal Responses in the Evolutionary Ecology of Aquatic Insects*. Annual Review of Entomology, 27, 97-117.

These conditions likely exist in the South Fork and Blue rivers downstream of the projects, and to a lesser extent in the mainstem below the South Fork. Native rainbow trout are most affected since they are present for their complete life cycle in contrast to hatchery fish which are in the system only for a short period of time (75 percent of catchable trout are caught within 2 weeks of stocking).

2.7.3 Bull Trout. Bull trout distribution includes the mainstem McKenzie upstream of Leaburg Dam to Tamolitch Falls, and the South Fork including Cougar reservoir. In the study area, the main population areas include the South Fork and mainstem McKenzie. Occasionally, bull trout are counted in the ladder at Leaburg Dam moving upstream. A 1983 creel survey conducted by ODFW from Armitage Park to just above Blue River (mainstem only) showed that bull trout represent less than 5 percent of the native trout caught by anglers. Bull trout were selected for evaluation because they are an Oregon state species of concern and a candidate for listing under the ESA.

The FWS completed a survey and status report on bull trout in June 1994 that included the McKenzie subbasin. They decided that although the bull trout is warranted for listing under the ESA, there are other higher priority species in the region that precluded listing at this time. Bull trout have been elevated to a category one status as a candidate species. Therefore, additional impacts should be avoided and restoration opportunities identified.

Over two-thirds of bull trout populations state-wide are considered to have at least moderate risk of extinction, including the South Fork population (Ratliff and Howell 1992)[5]. Populations in the McKenzie subbasin are at risk because of overharvest, passage barriers, habitat degradation, and hybridization with brook trout. Data on temperature requirements for bull trout suggests very narrow temperature ranges are needed for its life stages. For the South Fork and mainstem McKenzie, the spawning and egg incubation periods begin in the fall and are the most impacted by existing water temperatures. Under natural conditions, spawning and egg incubation begin at a time when water temperatures would be naturally cooling. However, in the mainstem and South Fork, temperatures are warming because of reservoir releases. The range of existing water temperatures is 12° to 20° F warmer than optimal for bull trout.

Bull trout also have specific habitat needs for many of their life stages. They spawn in areas with groundwater influence. Juveniles and adults are associated with complex cover consisting of in-channel woody debris, undercut banks, and pools. Young-of-the year are associated with side channels, stream margins, or other low velocity areas. Bull trout feed on terrestrial and aquatic insects, macro-zooplankton, mysids, and fish. Bull trout 8 inches and longer may feed exclusively on fish. Food availability for bull trout is probably limited in the South Fork for reasons similar to that for native rainbow trout.

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[5] Ratliff, D.E. and P.J. Howell. 1992. *The Status of Bull Trout Populations in Oregon.* Pages 10-17 *in* Howell, P.J. and D.V. Buchanan, eds. Proceedings of the Gearhart Mountain Bull Trout Workshop. Oregon Chapter of the American Fisheries Society, Corvallis.

2.8 Social and Economic Conditions

The McKenzie River, from its mouth to Cougar and Blue River lakes, is within Linn and Lane Counties. The Eugene/Springfield area is Lane County's population center, the second most populous city in Oregon. Lane County has exhibited a capacity for a strong population growth. From 1910 to 1990, population in Lane County grew at an average rate of over 30 percent each decade. According to the Bureau of Census, the population of Lane County was about 293,700 in 1992. The population of Linn County was about 95,000 in 1992.

Although lumber and wood products is the dominant manufacturing industry in the area, its role has been steadily diminishing. Non-timber manufacturing has steadily gained in importance over the last 12 years. Manufacturing industries, such as electrical equipment and transportation equipment, have grown to play a large role in the local economy. Expansion also has occurred in industries such as printing and publishing, and food processing.

Employment in Lane and Linn counties is greatly affected by the timber industry. In 1978, the unemployment rate in Eugene/Springfield was at 6.8 percent, and in Linn County at 7.4 percent. During the recession in the early 1980s, the unemployment rate in the Eugene area rose to 12.5 percent. Employment levels fluctuated and with diversification, gradually improved over the next few years. The Eugene area rebounded and grew dramatically. In 1990, the unemployment rate dropped to 5.8 percent. Linn County, however, retains a higher unemployment rate (10.3 percent in 1992) reflecting its dependence on the timber industry.

2.9 Recreation

Cougar Lake has several day-use and camping facilities managed by the Corps and the Forest Service. The Forest Service operates Delta, Echo, Slide Creek, Sunnyside, and French Pete campgrounds on the north side of the lake. Echo and Slide Creek are used by anglers, water skiers, and picnickers, while Slide Creek provides camping facilities. Sunnyside and French Pete are used primarily by anglers. Sunnyside provides limited camping facilities. Boat ramps are located at Echo, Slide Creek, and Sunnyside, and are usable at water surface elevations above elevation 1,635 feet. The Corps provides two viewpoints, one on each side of the dam, and a downstream sight-seeing area.

Visitors are attracted primarily for fishing and desire more and/or larger fish. Reservoir operations, limited facilities and other constraints limit recreational use. Between 1985 and 1989, Cougar Lake received an annual average of about 60,000 visitors, ranking it twelfth out of 13 reservoirs in the Willamette reservoir system. Cougar Lake is third in drawdown priority for meeting downstream flow requirements, reflecting its relatively low use for recreation. Its trout fishery is not dependent on high lake levels. However, users want boat ramps to stay usable through Labor Day. Because early drawdown exposes large areas for off-road vehicle use and impact, the Forest Service has undertaken a long-term effort to revegetate drawdown zones in the lake.

Blue River Lake has several small day-use and camping facilities managed by either the Corps and the Forest Service. Mona campground, at the upper end of the lake, is operated by the Forest Service and includes a limited number of overnight campsites, piped water, and sanitary facilities. Lookout Creek boat ramp is located adjacent to Mona campground and is usable above elevation 1,330 feet. Another boat ramp is located near Saddle Dam, and is usable at elevations above 1,295 feet.

The Forest Service is planning to upgrade and expand Lookout Campground in the near future. Recreation trends for Blue Lake are similar to Cougar. From 1985 to 1989, Blue River received an average of 66,500 visitor days of use, ranking it eleventh in popularity. In order to meet downstream flow requirements, Blue River Lake is drafted first among the 13 Willamette lakes. Consequently, it experiences severe drawdown during mid-summer which affects recreation. Under current operations, boaters are unable to launch by mid-July via the Lookout boat ramp.

The McKenzie River downstream from the Corps projects is a very important regional recreation resource, supporting blue ribbon fishery for trout, salmon and steelhead. A recent increase of raft and boating has been noted on the McKenzie, Blue, and South Fork rivers. Fluctuations in flows can affect boating safety, fishing, and other recreational activities.

2.10 Cultural Resources

The McKenzie subbasin was inhabited by Kalapuyan Speakers. Archaeological evidence indicates that these people occupied the foothill and valley areas of the McKenzie drainage, and their eastern settlements extended to the eastern slopes of the Cascades around 1750 A.D. The various pressures on populations from the Euro-American migrations westward probably caused the abandonment of the villages in the foothills of the western Cascades during early historic times. The Kalapuyans practiced a seasonal subsistence pattern of hunting, fishing, and gathering. Winter villages were established, and several seasonal camps were used throughout the year.

There have been few concentrated archaeological efforts to define the prehistory of this region. The population was greatly affected in the late 1700's and early 1800's by contagious diseases introduced by the Euro-Americans. Probably less that one-tenth of the Kalapuyan people survived. The few survivors relinquished their claims to the McKenzie area under the Dayton Treaty of 1855, and were removed to the Grande Ronde Reservation. They are now thought to be extinct as a separate entity.

Most of the historic events in the McKenzie region were associated with mining. The gold fields in Idaho were linked to the Eugene area with the construction of the McKenzie Fork Wagon Road. Begun in the 1860's, the toll road was opened in the fall of 1872. The town of Blue River was closely associated with mining. Several other settlements, such as Foley Springs and Belknap Springs, became the focus for development within the region.

3. PLAN FORMULATION

3.1 Overview

Plan formulation involves a systematic process of identifying and analyzing water resource needs and problems, establishing objectives, and developing and evaluating alternatives to meet those needs and problems. Plan formulation is guided by the Corps of Engineers' policy on multi-objective planning in accordance with legislative and executive authorities.

3.2 Problems and Opportunities

This discussion provides the background, origin, description and explanation of the temperature effects and objectives used in this study to formulate, design, and evaluate alternative plans for modifying the temperature of the water released from the Cougar and Blue River projects.

3.2.1 Study Objectives. The objective of this feasibility study is to replicate the documented pre-project water temperatures in the South Fork, Blue, and mainstem McKenzie rivers downstream of the Cougar and Blue River projects.

Listed below is a characterization of five different years of hydrometerological data selected for this study to represent a wide variety of climatic conditions to demonstrate the range of effects of temperature control.

1977 - DRY Year: the driest year in the period of record (1954-1984).
1979 - WARM Year: warm spring and summer with near average precipitation.
1982 - COOL Year: cool spring and summer with near average precipitation.
1983 - WET Year: the wettest year in the period of record.
1984 - NORMAL Year: wet spring and a dry summer with above average precipitation, but most characteristic of a normal weather pattern.

For earlier Corps studies on temperature control, the resource agencies (USFWS, ODFW, NMFS) were asked to establish specific temperature and flow objectives so that alternatives could be evaluated in terms of their ability to meet these objectives. Copies of the resource agency correspondence are located in Exhibit C of the main report. Because of a lack of data relating temperatures and flows to habitat use and availability for the fish species of interest, it was not possible to establish specific objectives. Instead, it was agreed that temperature objectives (target temperatures) would replicate documented pre-project water temperatures, and that flows would be based on the existing regulation schedules for the Cougar and Blue River projects. These average monthly minimum and maximum water temperature ranges are shown in table 5.

Table 5 -- Recommended Water Temperature Ranges (in degrees Fahrenheit)

Location	Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SFMR	Max	41	41	41	43	48	55	63	64	58	51	45	41
	Min	39	40	40	41	44	51	57	59	54	49	44	40
BR	Max	41	41	41	43	48	55	63	64	58	51	45	41
	Min	39	40	40	41	44	51	57	59	54	49	44	40
MR	Max	40	43	43	45	48	52	56	56	53	47	45	43
	Min	40	43	42	44	47	49	52	53	51	47	45	43

SFMR - South Fork McKenzie River, RM 3.9 (Rainbow gage), temperature data Oct 1955 - Sep 1963
BR - Blue River, RM 8.5, temperature data Oct 1963 - Sep 1967.
MR - McKenzie River, RM 47.7 (near Vida), temperature data Oct 1961 - Sep 1963.

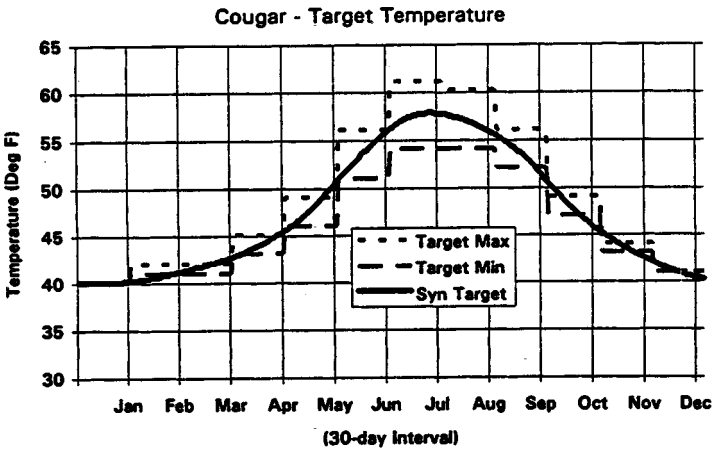
Source: USFWS, ODFW, and NMFS joint letters dated 14 Sep 1984 and 13 Mar 1985.

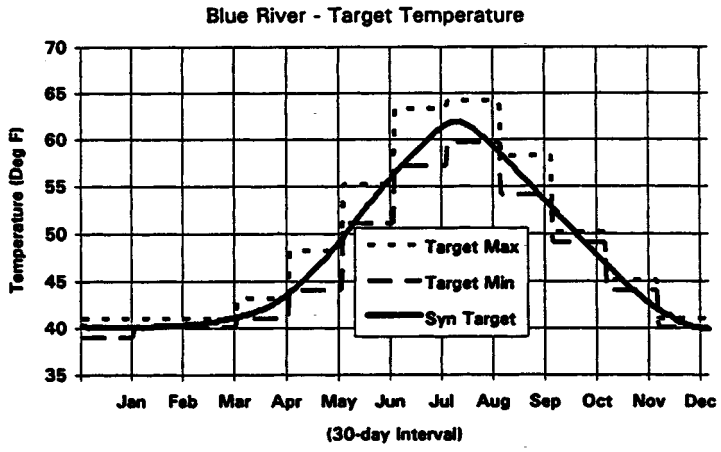
Under existing conditions, the target temperatures are missed on an average annual basis by 5.6° F on the South Fork, 5.3° F on the Blue River, and 1.5° F on the mainstem McKenzie near Vida. Meeting these target temperatures throughout the year requires access to and withdrawal of the warmest water available in the pools. Tributary inflows to Blue River Lake are warmer than at Cougar Lake. Since there is little cold water carryover in Blue River Lake, it warms in the spring more quickly than Cougar Lake. About 43 percent of warm surface water available in both projects (defined as within 16 feet of the surface at maximum conservation pool) is associated with Blue River Lake.

The influence of releases from Cougar and/or Blue River lakes on thermal conditions in the mainstem McKenzie will depend upon the ratio of the amount of heat released from the project(s) to the total amount of heat in the mainstem McKenzie River. The amount of heat is a function of the product of release temperature and flow. The total project inflow to Cougar Lake is about 66 percent larger than at Blue River Lake. Thermal impacts can be managed by either increasing the release temperatures and/or increasing the flow from the project(s). For this study, actual release schedules were used. This model required the use of a discrete, daily value for target temperatures instead of a range of values to measure the with- and without-project outflow temperatures from the Corps projects. A "smooth sine curve" through the mid-month, mid-value between the minimum and maximum provided a more "natural" representation of the temperature goals for the South Fork and Blue rivers (figure 12). The response of the model to the smooth sine curve provided an acceptable interpretation of changes in the daily mean temperatures.

3.2.2 Biological Objectives. Given the goal of being able to replicate pre-project temperature conditions, these biological objectives were developed for the study.

Figure 12 -- *Modelled Temperature Targets*





• Increase the annual spring chinook salmon run in the McKenzie subbasin. The carrying capacity of the habitat in the subbasin for spring chinook has been estimated at 38,000 adult fish. The average estimated run of spring chinook was about 18,000 adult fish prior to construction of the Corps projects. ODFW has identified an average annual run of 10,000 adult salmon as a management goal upstream of Leaburg Dam.

• Reestablish required temperature ranges for bull trout. Currently, the spawning and egg incubation periods for bull trout begin in the fall and are most impacted by existing water temperatures in the South Fork and mainstem McKenzie rivers. In the fall, water temperatures would be naturally cooling, but because of the Corps projects, releases are warming the stream temperatures. Bull trout is a candidate for listing under the ESA. Modifying water temperatures would complement other bull trout actions planned or underway, and aid in recovery of the population in the McKenzie subbasin.

• Reestablish habitat conditions for favorable native trout growth. Returning stream temperatures to replicate pre-project conditions is targeted to produce an increase in trout growth units in the McKenzie subbasin. Attainment of this objective would improve habitat conditions for native trout and the recreational experience of visitors to the subbasin.

• Support other state, federal, and regional objectives. Numerous studies and plans have been undertaken or are on-going in the McKenzie subbasin (see section 1.5). The Corps can play a significant role in the region's comprehensive and synergistic plans by restoring thermal regimes below the Cougar and Blue River dams to benefit Willamette spring chinook salmon, native trout including bull trout, and the overall aquatic habitat in the subbasin.

3.3 Planning Constraints

The study must recognize that the Blue River and Cougar projects are operated as part of a system of reservoirs to meet authorized purposes within the Willamette basin (see section 1.5.1). For example, Blue River and Cougar lakes are operated in conjunction with the other Willamette reservoirs to reduce flood damages for communities including Springfield, Junction City, Harrisburg, Corvallis, Albany, and Salem. The average annual damages prevented are about $10 million for Blue River Lake and about $13 million for Cougar Lake (October 1993 price level). Also, Blue River and Cougar are drafted first and third, respectively, during the conservation season, to supply water to meet established minimum flows. Special emphasis should be given to developing alternative plans for temperature control that do not significantly affect the authorized purposes or that may preclude future changes in release schedules of each project and/or the Willamette system.

3.4 Formulation and Screening of Alternatives

Meeting the target water temperatures for the study area requires warm water in the late spring/summer and cool water in the fall/winter. Currently, Blue River and Cougar reservoirs stratify in the late spring/summer, so only cool water is available for release through their

regulating outlets located deep in the reservoirs. The warm water remains near the surface until the pool is drawn down for flood control in the fall, which depletes the cool water layer and allows the warm surface water to reach the regulating outlets.

Nonstructural alternatives address operational manipulation of reservoir levels. Structural alternatives address mechanical means of either lowering the warm water to the regulating outlets or direct access to the warm water. The following alternatives including the no action alternative were considered to address the problems and opportunities identified for the study.

3.4.1 Without-Project Condition. A without-project condition is based on the most probable future conditions expected to prevail in the absence of further Corps involvement in temperature control modification at Blue River and Cougar. It is considered the no action alternative and is used as the basis for comparing the merits of the potential alternatives.

Determining the expected future conditions within the study area is complex. It involves predicting economic, social, and institutional changes; how programs and policies of water resource agencies may be used; and how the Corps' Willamette reservoirs may be operated in the future. The base year for construction for temperature control is estimated to be 1998. However, the period of analysis starts in 2002 when benefits begin to accrue resulting in a without-project planning horizon from 2002 to 2052 (50 years).

Existing water temperatures downstream of the Blue River and Cougar projects are cooler in the late spring/summer and warmer in the fall/winter than pre-project conditions. Cooler spring water delays upstream fish migration and warmer fall water causes prespawning mortality, accelerated incubation, and premature fry emergence for spring chinook, and decreased growth for native trout, including bull trout. This scenario assumes there will be no significant changes to the projects that would modify their release temperatures. Also, the Strube Lake project would not be constructed on the South Fork. It is uncertain whether hydropower will be installed at Blue River Lake.

Flood control will likely remain the primary purpose for the Corps' Willamette reservoirs. However, state and local governments and the public would like to see the conservation needs in the basin (recreation, water supply, fishery needs) receive the same priority as flood control. These issues will likely intensify with overall growth to the region.

Reauthorization discussions are currently underway between the Corps and the Oregon Water Resources Department for a future study to reexamine the allocation of storage and operation of the Willamette reservoirs to meet current and future water needs. Although such modifications could mean different flow scenarios at some of the Willamette reservoirs, flow augmentation will likely remain as an important purpose at the Blue River and Cougar projects. Since the reallocation of storage would not alter the location of the warm water layer or the regulating outlets, release temperatures would continue to impact the fishery and aquatic resources in the McKenzie subbasin.

Without the installation of temperature control devices at Blue River and Cougar Lakes, it is anticipated that hatchery production will likely continue to sustain the majority of the Willamette spring chinook and rainbow trout runs. Wild stocks of these species will continue to decline. Bull trout populations will continue to be at risk of extinction.

President Clinton's Forest Plan for the northern spotted owl identifies restoration plans for key watersheds to address at-risk fish stocks, including bull trout and Willamette spring chinook salmon. The upper mainstem McKenzie, its upstream tributaries of Horse and Lost creeks, and the South Fork McKenzie have been identified as key watersheds in the plan. Significant levels of watershed restoration are expected for at least the next 5 years under this plan. Also, habitat improvement projects being completed by the Forest Service for fisheries restoration in the South Fork may provide some of the specialized habitat used by native trout including bull trout.

Although there are plans by others to improve the overall aquatic habitat conditions in the study area, it is unlikely that adult returns of spring chinook salmon could be restored without modifying temperature regimes below Cougar and Blue River dams. A run of 10,000 adults upstream of Leaburg (ODFW goal) is an increase of 7,000 fish over the average escapement (3,000 fish) above Leaburg since the Corps projects were completed. Also, the growth of native trout including bull trout would continue to show a declining trend.

3.4.2 Nonstructural Alternatives.

Operational Changes. Modification of the operation of the Cougar and Blue River projects has been suggested as a method of modifying release temperatures. One scenario for modifying operation would be to keep Blue River and Cougar at or near minimum flood control pool (no conservation pool in the summer) and to hold reservoir releases at inflow levels. The goal is to duplicate pre-project flow and temperature conditions except during flood control operation. Another operational scenario may be to modify the reservoir release schedules at Blue River and Cougar during those periods critical for fish life (possibly spring/early summer and late summer/fall) to provide more suitable release temperatures at these times. Also, since reallocation of storage does not alter the location of the warm water layer or the regulating outlets, release temperatures would not be modified.

The inherent constraints with operational scenarios include the adverse effects on the non-flood control authorized purposes (flow augmentation, power production, recreation) at each project and on the Willamette system. Any evaluation of the system-wide impacts from flow variations would require extensive modeling, economic, and environmental studies. Data and evaluation techniques to analyze the effects from variations in reservoir releases on fishery resources are not available and it may not be possible to determine fishery effects. Although some partial improvement in release temperatures may be possible using the existing reservoir outlets, it is unlikely that release temperatures could be improved by the 5.3° to 5.6° F needed to replicate pre-project temperatures which is the objective of this study. Accordingly, both operational scenarios were not considered further.

3.4.3 Structural Alternatives. Earlier Corps temperature control studies evaluated a number of different structural methods for modifying release temperatures.

Curtain Barriers. This is an innovative, unique design concept with the potential for providing temperature control and could consist of installing a nylon-reinforced, hypalon rubber barrier across a lake upstream of its outlet works. Curtain barriers have been designed for some small applications to skim warmer water or underdraw cooler water depending on whether the curtain is in a lowered or raised position. Curtain barriers may be less expensive and may cause less environmental impact during construction than other structural methods such as towers. However, there are many unknowns associated with the design, construction, operation and maintenance of a large, deep-water curtain. Curtains may provide a less accurate withdrawal of water in order to change release temperatures by the 5.3° to 5.6° F needed to replicate target temperatures. Operational flexibility is needed at these projects in order to warm releases in the spring/summer and then cool them in the fall/winter. Also, the large fluctuations in reservoir elevations at Cougar and Blue River may be difficult to operate and maintain the curtain barriers. Accordingly, this method was not considered further.

Mixing Devices. Two types of mixing devices were considered to modify the water temperature of releases from the Blue River and Cougar projects: localized mixers and deep tube mixers (figure 13). Using mixing devices to modify release water temperatures may be less expensive and cause less construction impacts than other structural methods.

Localized mixers consist of a pump or motorized propeller mounted on a free-floating surface platform which generates a vertical jet of surface water. The jet forces surface water downward into the withdrawal zone of a mid- to low-level intake with the purpose of improving the water quality of the reservoir releases. The jet entrains water throughout the water column resulting in a significant dilution of the original water quality properties of the jet. The Corps has researched the processes and design associated with localized mixers as summarized in Holland (1984) and Punnett (1991).[6] These studies concluded that localized mixers are most appropriate for low head projects with small discharges. Also, commercially available mixing pumps range in size from 3 to 40 horsepower (hp).

The depth of destratification for a 40 hp mixer is about 90 to 100 feet. Since reservoir depth from maximum conservation pool to the outlet is about 200 feet at Blue River and 180 feet at Cougar, localized mixers would not be effective at these river because of their depth.

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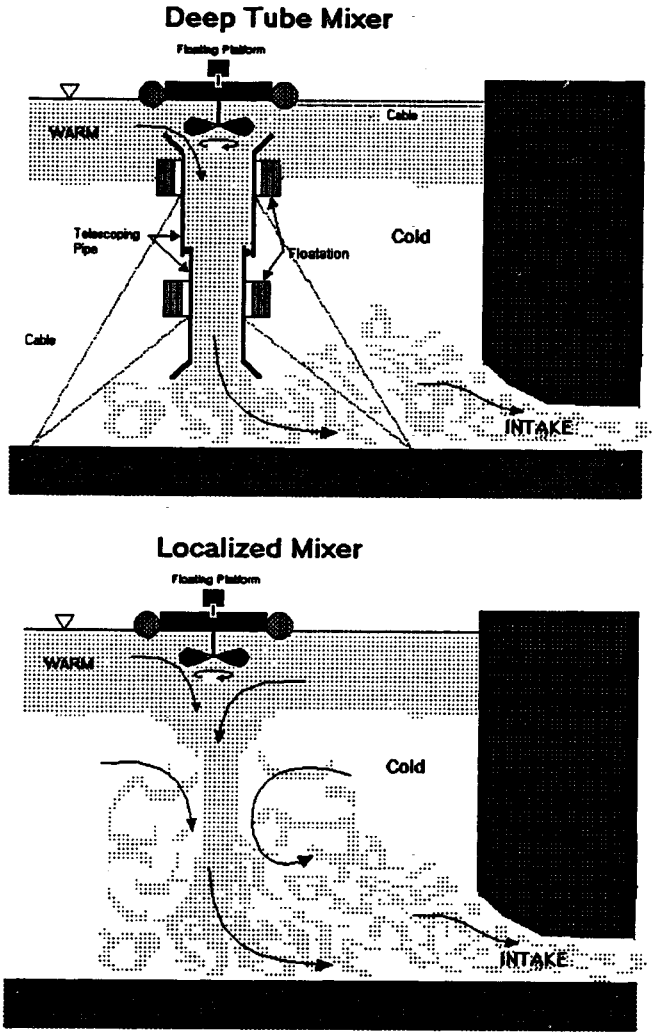
[6] Holland, J.P. *Parametric Investigation of Localized Mixing in Reservoirs.* Technical Report E-84-7. US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Punnett, R. *Design and Operation of Axial Flow Pumps for Reservoir Destratification.* Instructional Report W-91-1. US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Figure 13 – ***Schematic Diagrams of Localized and Deep Tube Mixers***



Deep tube mixers are similar to localized mixers, but water is delivered to the level of the intake through a vertical series of telescoping pipes. The service platform and accompanying delivery piping is anchored in place via a network of cables with the bottom discharge position fixed. The piping will lengthen and contract as the water surface elevation fluctuates. The pump or mixing device should be capable of delivering a range of discharges.

Deep tube mixers would allow access to warm surface water throughout the year. The release temperature targets at both Cougar and Blue River requires access to the warmest water available in the pool for withdrawal. The surface intakes to the deep tube mixers would provide access to this water as the water surface elevation changes. The deep tube mixers could be removed from the lake during the flood control season for maintenance and servicing. This should eliminate safety concerns during high discharge events. The modular nature of a deep tube mixer allows for additional capacity to be added. The deep tube mixer could be fabricated on shore with little disruption of the water control plan for Blue River and Cougar lakes. Anchoring of this device could be completed during minimum pool conditions.

The major concern of using a deep tube mixer involves its ability to manage release water temperature throughout the stratification season. Its discharge end is not physically connected to the regulating outlet. Therefore, warm surface water delivered by the deep tube mixer and cold hypolimnetic water will be withdrawn through the intakes. This may induce substantial mixing of surface and hypolimnetic water. The cumulative influence of this mixing will be some level of destratification and lake warming. This internal mixing of in-lake thermal resources is likely to reduce the effectiveness in warming water temperatures during the spring and cooling water temperatures in the fall. Operational flexibility is needed at the McKenzie projects to meet these seasonal release water temperature objectives. A high level of control over the quantity and thermal characteristics of releases must be maintained. This operational flexibility has been important in accommodating seasonal variability in thermal conditions of native fisheries. A deep tube mixer would not provide a high level of operational flexibility.

Also, the need to control the temperature of discharges up to 2,000 cfs at Cougar Lake has been identified as an objective for temperature control alternatives. This includes flow from the regulating outlets and penstock. Under these conditions, multiple deep tube mixers would be needed to inject warm surface water into the withdrawal zone from both intakes. The 80 feet width of the regulating outlet raises additional concerns regarding the degree of dilution and need for multiple deep tube mixers at this intake.

This alternative is still in the conceptual stage and has not been tested in the laboratory or applied in the field. This lack of experience with deep tube mixers raises serious questions of the structural feasibility and design. The maximum depth of the penstock intake at Cougar Dam is over 250 feet with almost 170 feet between the flood control pool and the maximum conservation pool. This raises a number of engineering challenges such as maintaining positioning and deployment of the deep tube mixer during pool level changes and varying discharges. Based on this evaluation, deep tube mixers were not considered further.

Selective Withdrawal System (SWS). The most common method for selective withdrawal is by using multilevel intake towers with ports or weirs at a number of different elevations. The Portland District has three projects with a SWS -- Applegate and Lost Creek in the Rogue Basin in southern Oregon, and Willow Creek in north-central Oregon. The SWS at Lost Creek has been effective in providing downstream fishery needs. Following impoundment of Lost Creek, a reduction in spring chinook production was observed. Reasons for the reduction were attributed to a 1.5° to 2.0° F increase in water temperatures during the fall spawning and incubation periods for spring chinook. This resulted in spring chinook emerging about 50 days earlier than under pre-project conditions, which decreased fry survival rates. In addition, smolts entered the ocean several weeks earlier resulting in younger age fish at adult return and higher mortality. The flexibility provided with a SWS allowed for the variance of fall temperature releases to offset the early emergence such that emergence times are now within one week of pre-project conditions. Temperature control at Lost Creek also provides better conditions for migrating spring and fall chinook. Targeting specific water temperatures at downstream locations and releasing additional water within this temperature range has decreased adult mortality.

Temperature control at Applegate also has provided fishery benefits. Although downstream water temperatures in winter are warmer since construction of the dam, no decrease in fall chinook production was observed as was the case with spring chinook at Lost Creek. Since construction of Applegate, however, the population of fall chinook generally increased and their spawning distribution is more widespread.

The design differences for a SWS are largely a question of a single or dual wetwell, the use of ports and/or weirs, and withdrawal from one or more ports/weirs at the same time (blending). The advantages of a SWS are reliability, durability, and a high level of operational flexibility for both cooling and warming release temperatures. Selective withdrawal is a proven method that could provide the release temperatures needed to replicate target temperatures on the South Fork and Blue rivers. Disadvantages of selective withdrawal include its expense and the possibility for adverse construction impacts during a retrofit situation.

The selective withdrawal alternative was chosen for further evaluation for the Blue River and Cougar projects. Two types of selective withdrawal structures were considered:

- Intake Tower with Ports. A tower is constructed with several ports which can be operated to selectively withdraw water from the desired temperature stratification level within the reservoir. Ported towers can simultaneously withdraw water from different elevations.

- Intake Tower with Weirs. A tower is constructed with selector gates which can be individually moved up or down in order to skim water from various elevations. This type of facility can only withdraw water from above the gate slot. The slots can be moved in order to withdraw water from different elevations.

Alternative scenarios for installing a SWS at Cougar only, at Blue River only, or at Cougar plus Blue River (where Cougar is constructed first) are evaluated further with respect to their performance in replicating target temperatures, and their environmental outputs for the three indicator species. Construction of a SWS at both projects must be phased in order to reduce flow and other impacts on the downstream watershed and Willamette system. A Blue River plus Cougar scenario, where Cougar is constructed second, was not included because early in the study it was recognized that modifying water temperatures in the South Fork would restore more habitat than available in Blue River, and would take advantage of these benefits in the South Fork as early as possible. Also, the fishery agencies prefer a SWS be constructed at Cougar first.

3.5 Performance of Selective Withdrawal Systems

3.5.1 Overview. Evaluating the performance of a SWS retrofitted at Blue River and/or Cougar was done through the use of the reservoir regulation model, HEC-5, in combination with the water quality subroutines which estimate temperature effects. The without-project condition and the alternative scenarios for installing a SWS at Blue River only, at Cougar only, and at both projects were evaluated. For explanatory purposes only, the evaluation of performance as discussed here is based on the results obtained by using 1984 data, which is representative of a normal weather pattern condition, and the average for all 5 years combined. Results for each alternative scenario are expressed in terms of average temperature differences and the demand for warming or cooling as measured in degree-days. A summary discussion and table also are provided that presents the results for the full range of hydrometerological conditions. Also see Exhibit A to the main report.

3.5.2 Results as Measured by Average Temperature Differences. Table 6 shows the results of SWS performance, as measured by average temperature differences, between the without-project condition and each alternative scenario. Model results were compared to the target temperatures by computing the difference between the temperature resulting from the without-project condition (or alternative scenario) and the target temperature. Minimizing the average annual difference from the target temperatures was the goal for each alternative scenario (this value would be ± 0 for perfect conformance). The measure of improvement results from the change in the average temperature difference between the without-project condition and the alternative scenario evaluated.

For example, the average temperature difference in the South Fork between the without-project condition and the target temperatures was found to be ± 5.2° F (1984 data). Installing a selective withdrawal system at Cougar reduces the average temperature difference to ± 1.6° F, for a 3.6° F reduction from the without-project condition.

Table 6 -- SWS Performance as Measured by Average Temperature Differences

Location	Scenario	Without-Project vs Target Temperatures[1]	With-Project vs Target Temperatures[2]	Reduction (Improvement)[3]
South Fork	Cougar Only - 1984	± 5.2° F	± 1.6° F	3.6° F
	5-year Average	± 5.6° F	± 1.4° F	4.2° F
Blue River	Blue R. Only - 1984	± 4.8° F	± 1.0° F	3.8° F
	5-year Average	± 5.3° F	± 1.2° F	4.1° F
Vida	Cougar Only - 1984	± 1.5° F	± 0.9° F	0.6° F
	5-year Average	± 1.4° F	± 1.0° F	0.4° F
Vida	Blue R. Only - 1984	± 1.5° F	± 1.1° F	0.4° F
	5-year Average	± 1.4° F	± 1.2° F	0.2° F
Vida	Cougar & Blue R - 1984	± 1.5° F	± 0.8° F	0.7° F
	5-year Average	± 1.4° F	± 0.8° F	0.6° F

[1] The average temperature difference between without–project condition and the target temperatures.
[2] The average temperature difference between with–project condition and target temperatures.
[3] The reduction in average temperature difference between the with– and without–project conditions.

3.5.3 Results as Measured by Degree-Days of Warming and Cooling. The demand for warming or cooling the release water to meet target temperatures can be expressed in degree-days. Degree-days represent the temperature differences summed over time between the various conditions as compared to the target temperatures. Table 7 shows the results of SWS performance, as measured by degree-days, between the without-project condition and each alternative scenario. For example, for the South Fork in the late spring/summer, there are 1,078 degree-days of temperature difference between the without-project condition and the target temperatures, which represents the demand for warming. With a SWS in place at Cougar, this warming demand is reduced to 184 degree-days (83 percent reduction) for 1984 data.

Table 7 -- SWS Performance as Measured by Degree-Days of Warming and Cooling

Location	Scenario	Warming Demand (deg-days)[1]	Reduction with SWS (deg-days & percent)[2]	Cooling Demand (deg-days)[3]	Reduction with SWS (deg-days & percent)[4]
South Fork	Cougar Only - 1984	1,078	184 (83%)	664	193 (71%)
	5-year Average	982	195 (80%)	943	256 (73%)
Blue River	Blue River Only - 1984	991	100 (90%)	530	62 (88%)
	5-year Average	789	102 (88%)	884	109 (87%)
Vida	Cougar Only - 1984	230	108 (53%)	120	39 (67%)
	5-year Average	172	82 (51%)	170	90 (51%)
Vida	Blue River Only - 1984	230	158 (31%)	120	73 (39%)
	5-year Average	172	116 (35%)	170	133 (25%)
Vida	Blue R. & Cougar - 1984	230	100 (56%)	120	7 (95%)
	5-year Average	172	62 (65%)	170	56 (73%)

[1] The number of degree–days of temperature difference between the without–project condition and target temperatures, which represents the demand for warming in late spring/summer.
[2] The reduction in the number of degree–days and percent reduction in warming demand between the with– and without–project conditions.
[3] The number of degree–days of temperature difference between the without–project condition and target temperatures, which represents the demand for cooling in fall/winter.
[4] The reduction in the number of degree–days and percent reduction in cooling demand between the with– and without–project conditions.

In the fall/winter, there are 664 degree-days of temperature difference between the without-project condition and the target temperatures, which represents the demand for cooling. With a SWS in place, this cooling demand is reduced to 193 degree-days (71 percent reduction).

3.5.4 Summary of Results. An evaluation similar to the one described above for the 1984 condition was performed for each of the 5 years representing the full range of hydrometeorological conditions. The achievement of target temperatures for the spring/summer warming and fall/winter cooling periods for each alternative scenario is summarized in table 8. Results show a significant improvement in water temperatures in the South Fork and Blue rivers under the full range of hydrometeorological conditions. The percentage of time target temperatures are met range from 84 to 91 percent for spring warming and 83 to 95 percent for fall cooling for the Blue River, and from 71 to 85 percent for spring warming and 63 to 88 percent for fall cooling for the South Fork McKenzie River.

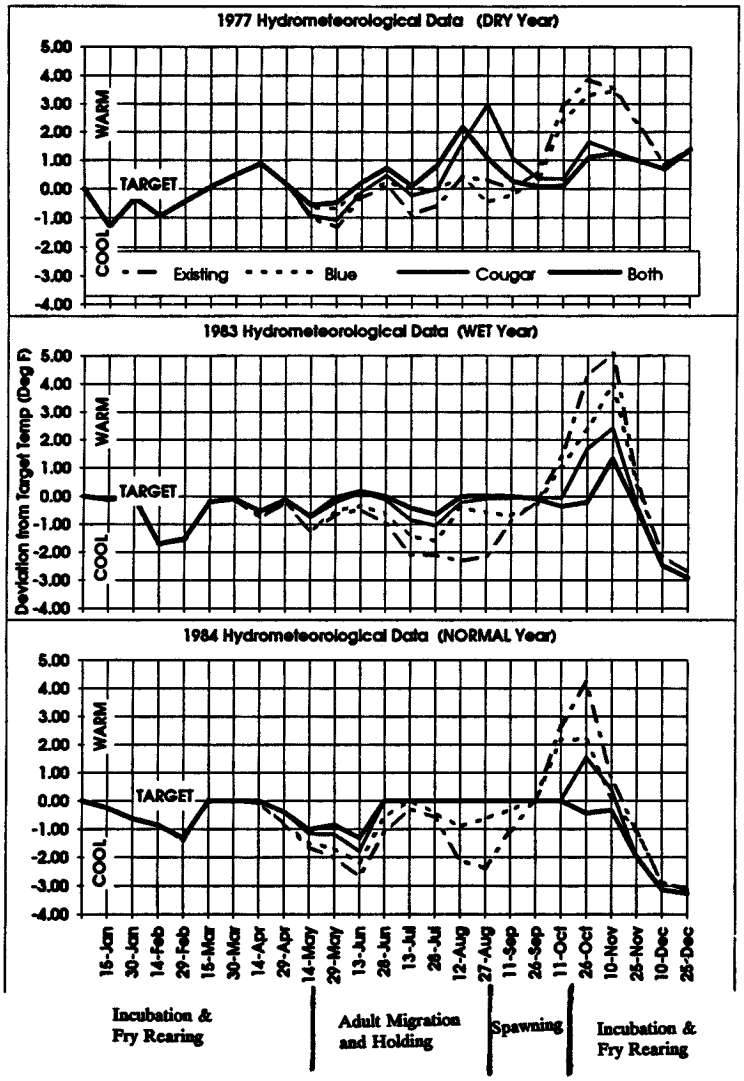
Table 8 -- SWS Achievement of Target Temperatures (in percent of the time)

Location	SWS @	1977 (Dry)	1979 (warm, avg precip)	1982 (cool, avg precip)	1983 (Wet)	1984 (normal)	5-Year Average
For Spring/Summer Warming							
Blue River	Blue River	87%	84%	88%	91%	90%	88%
S Fork	Cougar	81%	71%	78%	85%	83%	80%
Vida	Blue River	50%	28%	26%	40%	31%	35%
Vida	Cougar	39%	50%	44%	68%	53%	51%
Vida	Both	72%	60%	62%	74%	56%	65%
For Fall/Winter Cooling							
Blue River	Blue River	87%	83%	95%	80%	88%	87%
S Fork	Cougar	66%	78%	88%	63%	71%	73%
Vida	Blue River	12%	11%	33%	30%	39%	25%
Vida	Cougar	22%	44%	62%	58%	67%	51%
Vida	Both	36%	56%	95%	82%	95%	73%

Performance results for spring/summer warming on the mainstem McKenzie near Vida show that for most data years and the 5 year average, the best conformance to target temperatures occurs when a SWS is installed at both Blue River and Cougar. This is especially significant in average to low flow years (1977, 1979, 1982). Performance results for fall/winter cooling on the mainstem McKenzie near Vida show that for all data years and the 5 year average, the best conformance to target temperatures also occurs when a SWS is installed at both projects. If the Cougar only and both scenarios are compared, significant increases are seen for 1982, 1983, 1984, and the 5 year average between these two scenarios. In summary, meeting the target temperatures under the full range of hydrometeorological conditions requires access to and withdrawal of the warmest water available in both Blue River and Cougar lakes.

The temperature control effects on the mainstem McKenzie for 1977 (dry year), 1983 (wet year) and 1984 (normal year) are graphically summarized in figure 14. The success of operating the SWSs to replicate the target (pre-project) temperatures becomes especially important when related to the life stages associated with spring chinook. This relationship also is shown on figure 14. Modifying both projects gives the best fit to the target temperatures especially during the life stages in the spring and fall which are significantly impacted by the existing temperature conditions.

Figure 14 – *Temperature Control Effects on the mainstem McKenzie from Selective Withdrawal Systems* (with corresponding life stages for salmon)



The SWSs are described here as achieving less than 100 percent of the warming or cooling demand. Design improvements to the system were under development by the Waterways Experiment Station (WES) at the same time that the system evaluation was being performed by HEC. Consequently, WES's design improvements were not incorporated into the HEC evaluation. HEC's results for the analysis of the performance of the various alternative scenarios gives sufficient information to display the effects and to provide a basis for quantifying the benefits. However, WES design studies do indicate a higher level of performance than is discussed in this section (a higher percentage achievement of the target temperatures).

3.6 Ports vs Weirs

WESTEX is a computer model for thermally stratified reservoirs with the capability to simulate operation of a SWS. This model simulates the performance of a selective withdrawal using a ported system or a weir system. The resulting release temperatures from the throttled ports and from the weir system were found to be equivalent in performance (see Exhibit A for more information). Preliminary costs developed for a SWS with ports or weirs revealed that a weir system results in a 31 percent higher cost at Blue River, and a 42 percent higher cost at Cougar than a ported system. Since performance was found to be equivalent between the two systems, a ported withdrawal system was selected for design.

The number and location of ports was studied using a model called WESMIN, which optimally locates a specific number of ports to minimize the deviation from target temperatures. Although the model found that 5 ports yielded the smallest deviation, it also showed that additional ports are required to optimally meet the target temperatures for the full range of hydrometeorological conditions. Three additional ports at Cougar and two at Blue River are necessary to minimize deviation from target temperatures as the reservoirs are drawn down in the fall/winter.

3.7 Environmental Outputs of the Alternative Scenarios

This section discusses an evaluation of alternative scenarios for installing a selective withdrawal system at Cougar only, at Blue River only, or at both projects with respect to their environmental outputs for the three indicator species. In order to evaluate the expected benefits to spring chinook production from temperature modification, an analysis is performed using life cycle data and estimates of temperature/survival relationships. The assumptions used in the analysis will be described, followed by results for fry emergence timing and adult returns. Benefits are expressed as an increase in production of spring chinook adults in the McKenzie subbasin. An incremental analysis is then performed to compare the costs and benefits of the alternative scenarios as related to increases in adult spring chinook returns.

Other environmental outputs for spring chinook, native rainbow trout, and bull trout also are qualitatively evaluated and compared, if applicable, for each scenario. The results from all analyses are then summarized in a matrix to facilitate selection of a final plan.

3.7.1 Assumptions for the Spring Chinook Analysis. Survival of spring chinook salmon eggs to fry emergence is based on literature research which indicates that early emergence is detrimental to fry survival. Under normal conditions, most fry would emerge from February to March. Early emergence, as early as December on the South Fork, can decrease survival of fry since conditions are not favorable for growth and food availability.

Emergence timing of spring chinook in the McKenzie subbasin is dependent upon the accrual of 1800 temperature units (TUs) or the cumulative number of degrees above 32° F per day. Using this information, survival from the egg to fry stages was estimated for stream reaches above the South Fork, in the South Fork, and below the South Fork. Fish survival from smolt to adult was kept constant since this part of the life cycle is not affected by temperature. Varying survival rates were established for fry assuming early emergence is detrimental to fry survival. Survival of egg to fry was estimated to be 25 percent for fish emerging in mid-March (the best condition), and zero for fish emerging in mid-September (the worst condition). A straight line relationship was assumed between these two dates to give a percent survival per day. Emergence date (time to reach 1800 TUs) was calculated from the date of spawning and using the temperature modeling data. A survival rate could then be associated with fry emerging on that date.

Spawning and emergence dates were estimated using September 15 to represent early spawning fish and September 30 for late spawning fish. The proportion of fish spawning prior to and after September 15 was estimated using redd counts and carcass surveys. Fish spawning prior to September 15 was estimated to be 35 percent.

Prior to the construction of the Cougar and Blue River projects, about 65 percent of the spring chinook production occurred above Leaburg Dam. Under existing conditions, this distribution appears reversed with about 35 percent of spring chinook production occurring above Leaburg Dam. Modifying release temperatures at both projects is expected to restore the production distribution back to pre-project conditions.

ODFW has identified an average annual run of 10,000 adult spring chinook salmon as a management goal upstream of Leaburg Dam. It is recognized that this goal is not representative of the full potential of the McKenzie subbasin, which has been estimated as supporting about 38,000 adult spring chinook salmon. Consequently, it was decided by the fishery agencies that 65 percent of this estimate, or 24,700 fish, is a more reasonable assumption for the maximum number of fish that could be supported above Leaburg Dam. This assumption also is supported by the 1992 survey of available spawning habitat upstream of Leaburg Dam.

The distribution of the benefits to adult spring chinook between the scenarios was evaluated using the relative amount of warm water in the two reservoirs. Meeting the target temperatures requires access to and withdrawal of the warmest water available in the pools. There is little cold water carryover in Blue River Lake, so it warms more quickly in the spring. About 43 percent of warm surface water available in both projects is associated with

Blue River Lake. Applying the percentages of available warm water between the two pools gives a more reasonable assumption of the potential of each project to warm water temperatures in late spring and summer to promote migration into the study area.

3.7.2 Results for Fry Emergence. Results show that with all alternative scenarios, the modified water temperatures will emulate conditions that occurred naturally before the projects were built and will improve in spring chinook production. For the Cougar only scenario, a significant improvement in fry emergence timing (later emergence by 44 to 48 days) occurs in the South Fork. This is also true for the Blue River only scenario, with later emergence occurring by 26 to 47 days in the Blue River.

Fry emergence timing is somewhat improved for mainstem McKenzie. The Blue River only scenario shows a 1 to 5 day difference (improvement) in fry emergence timing at Vida. For Cougar only, a 9 to 12 day improvement is shown. By adding temperature control to both projects, a 13 to 17 day improvement is shown. These results show that by providing temperature control, the ecosystem will be returned to a more natural condition which will improve fry survival by reducing early emergence. Fry hatched later will have better rearing conditions. These improvements in fry emergence timing were used to predict adult returns.

3.7.3 Incremental Analysis for Spring Chinook Adult Returns. For an incremental analysis, increments of costs and benefits associated with the alternative scenarios are identified to display the incremental costs associated with increased output. For this study, the increments being analyzed are the no action alternative and the alternative scenarios dealing with construction of a ported SWS at Blue River only, Cougar only, and Cougar plus Blue River, where Cougar is constructed first.

A Blue River plus Cougar scenario, where Cougar is constructed second, was not included in the incremental analysis because early in the study it was recognized that modifying water temperatures in the South Fork would restore more habitat than available in Blue River, and would take advantage of these benefits in the South Fork as early as possible. Also, the fishery agencies prefer a SWS be constructed at Cougar first.

The average annual National Economic Development (NED) costs associated with each scenario is provided in table 9. These NED costs, along with the estimates of spring chinook adult returns (output) for hydrometerological conditions representing a normal (1984), wet (1983), and dry (1977) year form the basis of the incremental analysis. The incremental analysis results in a display of the incremental benefits and incremental costs associated with each scenario. This information facilitates a decision-making process that looks at the marginal gains, in adult spring chinook returns, associated with the scenarios and their marginal costs.

The marginal costs of each scenario in relation to the others are calculated by dividing the incremental costs associated with one scenario over another by the incremental benefits, in terms of spring chinook adult returns, obtained with that same scenario as opposed to another.

Table 9 -- Average Annual NED Costs for Alternative Scenarios[1]

Category	Blue River Only	Cougar Only	Cougar + Blue River
Construction Costs[2]	$1,383,100	$2,034,800	$3,095,100
O, M, R, & R Costs[3]	$ 70,200	$ 94,400	$ 147,100
Monitoring Costs	$ 26,900	$ 26,900	$ 20,000
Foregone Recreation	$ 13,700	$ 8,500	$ 16,000
Foregone Hydropower	$ 43,800	$1,762,100	$1,798,700
TOTALS	$1,537,700	$3,926,700	$5,076,900

[1] 50-year project life, Federal discount rate of 7.75 percent, numbers rounded.
[2] Construction costs include interest during construction.
[3] Operation, maintenance, repair, and replacement costs.

Note: The scope of an SWS at Cougar and/or Blue River is identical in all scenarios.

The formula is:

$MC = (C_{alt2} - C_{alt1})/(Q_{alt2} - Q_{alt1})$ where

MC = marginal cost
C = average annual cost of the scenario
Q = average annual adult returns

$C_{alt2} > C_{alt1}$ and $Q_{alt2} > Q_{alt1}$

Table 10 displays the average annual adult spring chinook returns and the marginal costs associated with the scenarios.

Table 12 -- Marginal Costs for Scenarios (all numbers rounded)

1977 (Dry Year)

Scenario	Avg. AAR[1]	Change in Avg. AAR	Avg. AC[2]	Change in Avg. AC	Marginal Cost
Without Project	0	--	0	--	--
	--	+ 4,400	--	+$1,537,700	$350
Blue Only	4,400		$1,537,700		
	--	+ 5,500	--	+$2,389,000	$440
Cougar Only	9,900	--	$3,926,700	--	--
	--	+ 8,600	--	+$1,150,200	$135
Cougar + Blue	18,500		$5,076,900		

[1] AAR = Annual Adult Spring Chinook Returns
[2] AC = Annual Cost

1983 (Wet Year) and 1984 (Normal Year)

Scenario	Avg. AAR	Change in Avg. AAR	Avg. AC	Change in Avg. AC	Marginal Cost
Without Project	0	--	0	--	--
	--	+ 4,400	--	+$1,537,700	$350
Blue Only	4,400		$1,537,700		
	--	+ 3,700	--	+$2,389,000	$640
Cougar Only	8,100	--	$3,926,700	--	--
	--	+ 8,600	--	+$1,150,200	$135
Cougar + Blue	16,700		$5,076,900		

The following discussion on the results of the incremental analysis is based on the 1983/1984 conditions. For the Blue River only scenario, about 4,400 more spring chinook returns are expected to occur than under the without-project condition. This increase in spring chinook returns is achieved at an average annual cost of about $1.5 million. This represents a marginal cost of about $350 per adult return.

For the Cougar only scenario, about 8,100 more spring chinook returns are expected to occur than under the without-project condition. This increase in spring chinook returns is achieved at an average annual cost of about $4 million. This increase in spring chinook returns is about 3,700 more than can be achieved with the Blue River only scenario. Since the cost difference between the Blue River only and Cougar only scenarios is about $2 million, the additional 3,700 fish are achieved at a marginal cost of about $640 per adult return.

For the Cougar plus Blue River scenario, about 16,700 more spring chinook returns are expected to occur than under the without-project condition. This increase in spring chinook returns is achieved at an average annual cost of about $5 million. This increase in adult returns is about 8,600 more fish than can be achieved with the Cougar only scenario. Since the cost difference between the Cougar plus Blue River and Cougar only scenarios is about $1 million, the additional 8,600 fish are achieved at a marginal cost of about $135 per adult return. Therefore, the Cougar plus Blue River scenario nearly doubles the expected number of adult spring chinook returns at a relatively low marginal cost.

3.7.4 Thermal Potential for Spring Chinook Movement. Numerous studies have identified the importance of temperature to spring chinook migration. A water temperature of 52° F has been identified as optimal for spring chinook to begin passing Willamette Falls and Leaburg Dam. Migration timing has been shifted later by several weeks at Leaburg Dam as compared to pre-project conditions. A NMFS study (1991-1992) found that passage at Leaburg occurred during the day when peak temperatures were reached (late afternoon/early evening), and that modifying operations to warm temperatures during the early migration period produced increased numbers of salmon passing Leaburg Dam. In the Rogue River basin, ODFW documented the importance of the early portion of the spring chinook run because these are larger, older fish, generally destined to the upper portion of the basin. Similar fish in the McKenzie would be destined to the upper mainstem (Carmen Smith Spawning Channel, Horse Creek and Lost Creek), which contain significantly underutilized habitat for spring chinook.

The potential for temperature modifications to advance the thermal potential for fish movement was investigated for the alternative scenarios. As shown on figure 15, modifying both Cougar and Blue River advances the date exceeding 52° F from about 24 June (existing condition) to 16 June for the 1984 condition. Also, the number of hours above 52° F is significantly increased from 35 hours (existing condition) to 89 hours.

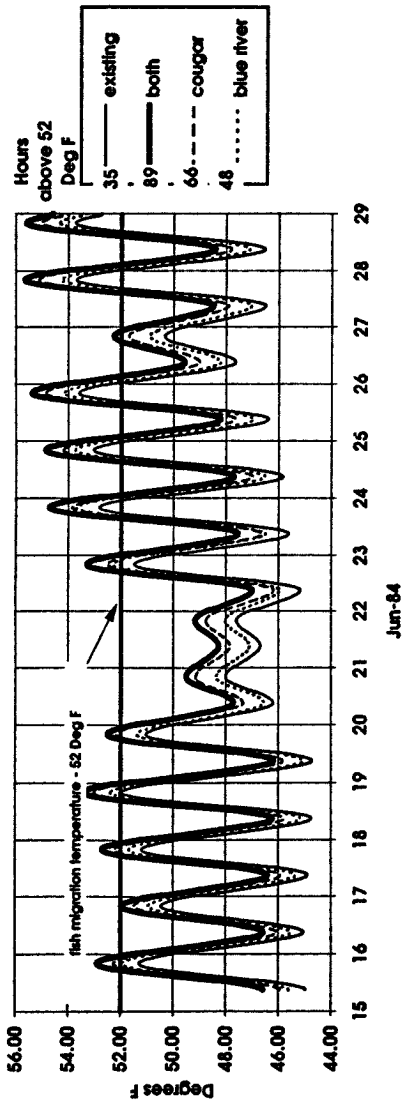


Figure 15 -- Thermal Potential for Fish Movement[1]

[1] Represents the thermal potential for fish movement in the McKenzie River near Vida as a result of retrofitting a SWS at the Blue River or Cougar projects, or at both.

3.7.5 Resident Trout Outputs. Restoring water temperature conditions to replicate pre-project conditions primarily benefits native trout since they are in the river during all stages of their life cycle. Hatchery fish are managed primarily as a put and take fishery and are present for only a short period of time.

Restoring stream temperatures to near normal (pre-project) conditions in other rivers has returned the natural timing of insect life cycle events and insect community structure to normal conditions. This has increased diversity of insect species and provided greater availability of food supply to all life stages of trout (fry, juvenile and adults). Additionally, increased food supplies in warmer waters increases the ability of fish to assimilate food and increase their biomass (size) which can increase survival.

Native trout populations in the South Fork and Blue rivers affected by temperature control would respond to the significantly improved growth conditions. Population levels would increase towards their full potential within the limits of habitat or other factors. It is difficult to quantify this change in numbers of fish because no baseline population information exists for these stream reaches.

Changes would be more subtle in the mainstem McKenzie. While there may not be changes in the overall numbers of resident trout, existing native trout are likely to respond to more natural water temperature conditions and food availability, and probably increase in size. This will likely result in increased angling and harvest.

Changes in trout growth units can be shown for each alternative scenario. The Blue River only scenario shows significant improvements of 34 to 53 percent in the Blue River as compared to existing conditions, and an improvement in the mainstem at Vida (2 to 3 percent). The Cougar only scenario shows significant improvements of 38 to 46 percent in the South Fork, and 5 to 8 percent at Vida. With temperature control at both projects, an improvement of 7 to 10 percent occurs at Vida.

3.7.6 Bull Trout Outputs. Bull trout populations in the South Fork and mainstem McKenzie rivers would respond to water temperature changes similarly to the resident trout. Improved food supplies and growth conditions for resident trout, and improved fry survival for chinook fry, would mean improved food sources for adult bull trout, which are known to prey on these fish. There also may be more exchange of adult bull trout between the South Fork and mainstem populations as habitat conditions (temperature ranges) become more favorable in the South Fork downstream of Cougar Dam.

It is unknown if the specialized habitat conditions for spawning or fry and juvenile rearing for bull trout exist in the South Fork. If they do, the changes associated with temperature control would favor their use as compared to existing conditions. For the period of September through November, which includes adult migration, spawning, and early egg incubation, temperatures are reduced by 5 to 12°F with the project, which would be more suitable temperatures for those life stages.

A habitat improvement project being completed by the Forest Service for fisheries restoration in the South Fork may provide some of the specialized habitat areas used by bull trout. This project involves reconnection of some side channels with the South Fork to create permanent aquatic habitats and in-stream habitat work to create large woody debris and other structure. Modified temperature conditions in the South Fork would improve habitat conditions by native trout including bull trout.

3.8 Selection of the Final Plan

The results from all the analyses concerning the environmental outputs of the alternative scenarios are summarized on table 11. All scenarios show that installing selective withdrawal replicates pre-project downstream water temperatures to benefit spring chinook salmon and bull trout, both species of National and regional significance, other important trout species, and the overall aquatic ecosystem. Based on the results of all the analyses, the installation of a selective withdrawal system at both the Cougar and Blue River projects was selected as the final plan.

Table 11 -- Summary of Environmental Outputs by Alternative Scenario (comparisons based on 1984 representing a normal weather pattern)

ENVIRONMENTAL OUTPUTS (Units)	ALTERNATIVE SCENARIOS			
	WITHOUT PROJECT	SELECTIVE WITHDRAWAL SYSTEM AT		
		BLUE RIVER ONLY	COUGAR ONLY	COUGAR & BLUE RIVER
ABILITY TO MEET TARGET TEMPS FOR MAINSTEM (VIDA)				
Spring warming (degree-days and percent achievement of target)	-230 (too cold)	-151 (31%)	-108 (53%)	-101 (56%)
Fall cooling (degree-days and percent achievement of target)	+120 (too warm)	+73 (39%)	+39 (67%)	+7 (95%)
ABILITY TO MEET TARGET TEMPS FOR BLUE RIVER				
Spring warming (degree-days and percent achievement of target)	-991 (too cold)	-100 (90%)	N/A	-100 (90%)
Fall cooling (degree-days and percent achievement of target)	+530 (too warm)	+62 (88%)	N/A	+62 (88%)
ABILITY TO MEET TARGET TEMPS FOR SOUTH FORK				
Spring warming (degree-days and percent achievement of target)	-1,078 (too cold)	N/A	-184 (83%)	-184 (83%)
Fall cooling (degree-days and percent achievement of target)	+663 (too warm)	N/A	+ 193 (71%)	+193 (71%)
SPRING CHINOOK SALMON OUTPUTS				
Fry emergence timing in Blue River (Number days improvement)	None	26 to 47	N/A	26 to 47
Fry emergence timing in South Fork (Number days improvement)	None	N/A	44 to 48	44 to 48
Fry emergence timing at Vida River (Number days improvement)	None	1 to 5	9 to 12	13 to 17
Incremental avg. annual adult returns and marginal cost	0	4,400 more than without-project at $350 per fish	3,700 more than Blue only at $640 per fish	8,600 more than Cougar only at $135 per fish
Thermal potential for fish movement (hours > 52°F)	35	48	66	89
NATIVE RAINBOW TROUT OUTPUTS				
Trout growth units at Vida and percent improvement	1,460 (0%)	1,492 (+2%)	1,572 (+8%)	1,604 (+10%)
Trout growth units in Blue River and percent improvement	1,383 (0%)	2,229 (+61%)	N/A	2,229 (+61%)
Trout growth units in South Fork and percent improvement	1,095 (0%)	N/A	1,758 (+60%)	1,758 (+60%)
BULL TROUT OUTPUTS (South Fork and Mainstem only)				
Improvement in life stage temperatures	12 to 20°F higher than optimum	N/A	5 to 12°F reduction	5 to 12°F reduction

4. DESCRIPTION OF THE SELECTED PLAN

This section describes the selected plan and construction/diversion considerations for modifying release temperatures at the Cougar and Blue River projects by retrofitting the existing intake towers with a SWS. Detailed design information can be found in Volume II, Appendices B and C, Engineering Analysis for Blue River and Cougar lakes, respectively.

4.1 Cougar Selective Withdrawal System

The ported SWS will be added directly to the existing intake tower and positioned upstream over the regulating outlet works and the power penstock (figure 16). Water will be withdrawn from specific elevations in the reservoir using eight water temperature control ports (7 by 14.5 feet) and two bypass ports (11 by 20 feet) flowing into a wet well within the new tower. All ports will be throttled with slide gates within the wet well to control the outflow temperatures. The water temperature control ports have a 9 inch radius entrance behind a trash screen and are flush mounted to the face of the tower. Each port has the capacity when fully open to pass 1,000 ft^3/s with velocities under 10 feet per second (fps). The gates are designed to operate up to a maximum differential head of 20 feet.

The bypass ports are positioned directly upstream of the existing regulating outlet works entrance. Each bypass port has elliptical curves on all sides of the openings. These ports will be operated to pass temperature control flows during temperature control operations. For flows beyond the capacity of the control system, the gates on these ports will be fully opened.

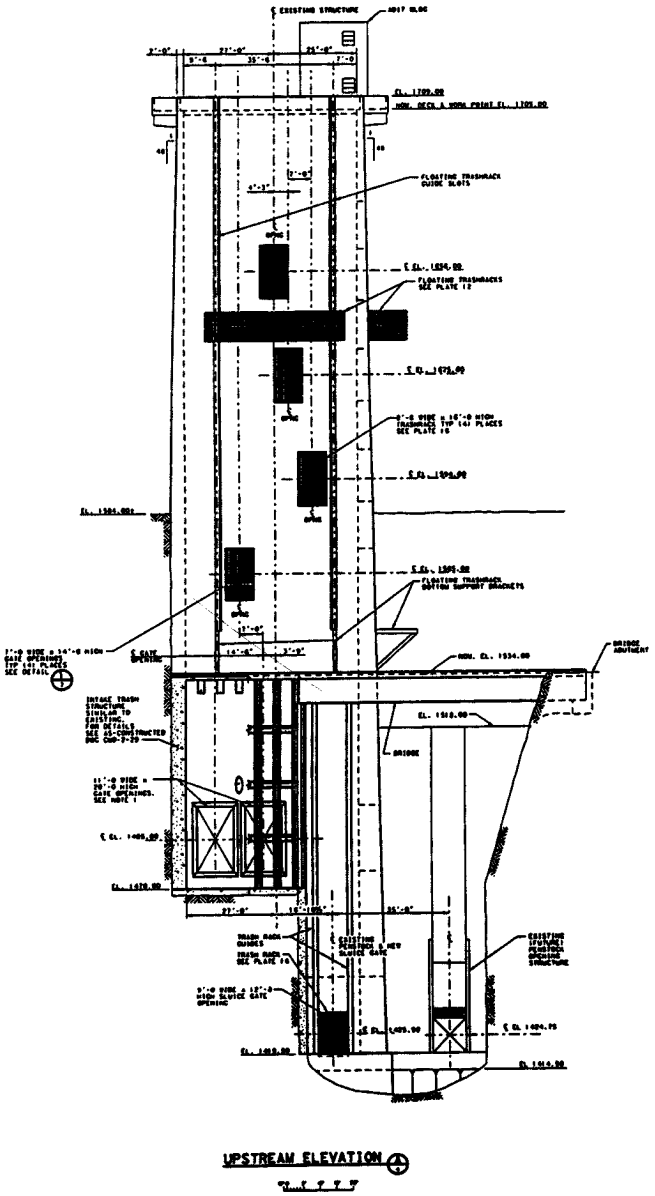
The penstock is located to the right and below the regulating outlet entrances. Flow from the wet well to the penstock entrance must pass through a screened opening. This opening was designed to pass a maximum penstock flow of 1,350 ft^3/s at a velocity of 3.5 fps. A penstock bypass port located directly upstream of the existing penstock entrance will be used to bypass the SWS as needed.

The new trash facilities for the SWS are designed to produce the same level of protection to the penstock and regulating outlet as provided by the existing facilities. The water temperature control ports will have trash racks mounted flush to the face of the tower. There also will be floating trash racks attached to each face of tower containing water temperature control ports. The floating trashracks will extend 5 feet below the fluctuating water surface.

The bypass ports have a trash structure identical to the existing regulating outlet trash structure. The bypass ports do not have trash racks to screen the flow to the penstock. Sumps, which collect sinking trash upstream of the intake structure, will be excavated just upstream of the auxiliary penstock port and the bypass port trash structure.

The flow to the power penstock will be screened by a trash rack on the penstock entrance within the wet well. This trash rack is required due to the unscreened flow from the bypass gates. A trash rack is also provided for the penstock bypass port.

Figure 16 – *Ported SWS for Cougar Lake*



4.2 Blue River Selective Withdrawal System

The ported SWS will be added directly to the existing intake tower and positioned upstream over the regulating outlet works (figure 17). Water will be withdrawn from specific elevations in the reservoir using seven water temperature control ports (6 feet by 9 feet) and two bypass ports (11 by 20 feet) flowing into a wet well within the new tower. All ports will be throttled with slide gates within the wet well to control the outflow temperatures. The gates are designed to operate up to a maximum differential head of 20 feet.

The water temperature control ports have a 1.5 foot radius entrance and are flush mounted to the face of the tower. Each port has the capacity when fully open to pass 500 ft^3/s with velocities under 10 fps. The bypass ports are positioned directly upstream of the existing regulating outlet works entrance. Each port has elliptical curves on all four sides of the openings. These ports will be operated to pass temperature control flows during temperature control operations. For flows beyond the capacity of the temperature control system, the gates on these ports will be fully opened.

New trash facilities are designed to produce the same level of protection to the regulating outlet as provided by the existing facilities. The water temperature control ports will have a grid of concrete filled steel pipe flush mounted to the face of the tower. The bypass ports will have a trash structure identical to the existing regulating outlet trash structure.

4.3 Temperature Control Operations

The multilevel, ported towers will regulate temperature control flows to 2,000 ft^3/s for Cougar and 1,000 ft^3/s for Blue River. The gates are designed to operate up to a maximum differential head of 20 feet. For safety reasons, a fuse plug will be built into the tower. If the differential head exceeds 20 feet, the pins at the bottom will shear. Gate settings for temperature control will be made based on information collected from instrumentation. For flows beyond 2,000 ft^3/s for Cougar and 1,000 ft^3/s for Blue River, the project will not operate for temperature control and would begin operating for flood control. During operation for flood control, the gates on the bypass ports will be fully opened. This allows the existing regulating outlets to operate to the full capacity of the structure. For flows this large, the pools will be well mixed and operation for temperature control not required. Hydraulic control will always be maintained at the existing turbines (only for Cougar) or the regulating outlet gates.

Operation for temperature control will require selectively withdrawing the water from different elevations in the pools to meet target outflow temperatures. A general operation trend during the time of year when the pool is stratified is to withdraw the warmer water in the upper portion of the pool. The flow will be withdrawn from one to three specific ports at a time. The flow at a specific port or a set of ports will be controlled by throttling each of the gates to achieve the appropriate mix of different temperatures. Decisions on the flow distribution will be based on the outflow and data from temperature instrumentation on the face of the structures.

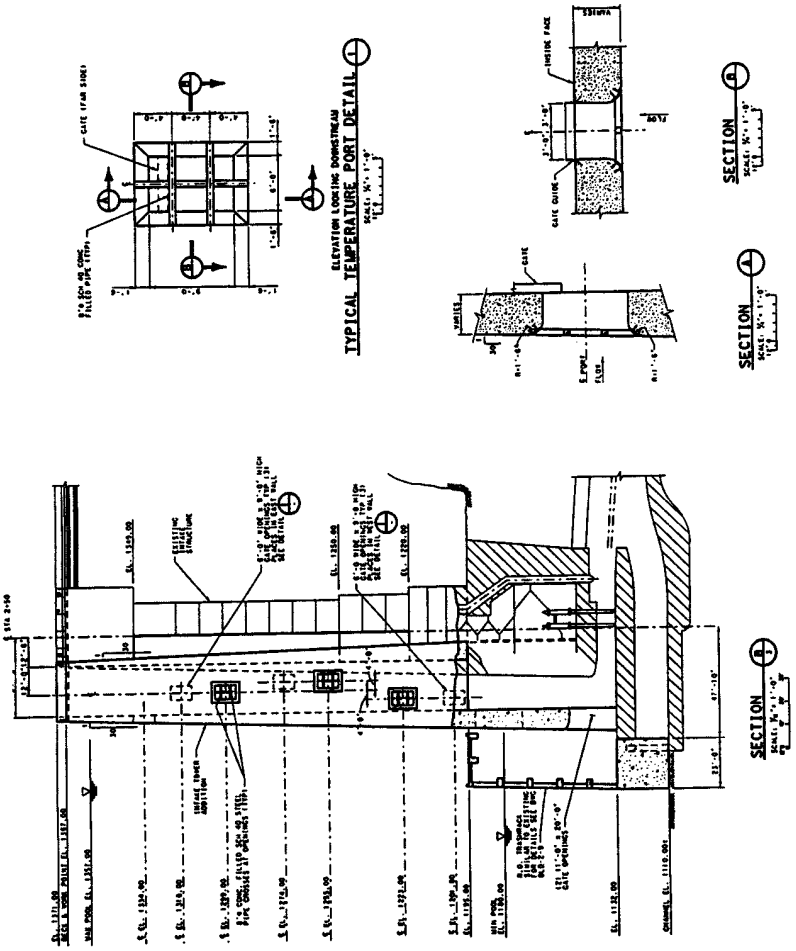


Figure 17 -- *Ported SWS for Blue River Lake*

4.4 Construction Considerations

4.4.1 General. Construction of a SWS at the two projects must be phased (Cougar constructed first followed by Blue River) to reduce flow and other impacts on the downstream watershed and Willamette system. There are no other Corps' storage reservoirs to use to offset flow impacts on the mainstem McKenzie if both projects were constructed concurrently. Also, impacts to the other Willamette reservoirs, that would need to be used to meet flow requirements at Albany and Salem, could be severe if both projects were constructed concurrently. Flood control will be maintained during the construction period which may limit the construction season from about June through October, depending upon rainfall. Also, construction activities may need to be suspended if unusually high rainfall occurs during the construction period.

4.4.2 Construction at Cougar Lake. A 300-foot-radius around the existing intake structure and existing diversion tunnel intake portal, areas of about 280,000 square feet each, will be used as construction areas. A staging area about 250,000 square feet, used originally during the construction of Cougar Dam, will be used for disposal of rock, exit channel sediment, and other construction materials. In-water disposal will be used to dispose of all lake sediment material moved.

Construction access will be via Highway 126, Box Canyon Road, and West Side Road. Once the lake level has been lowered, an existing gravel access road will be refurbished for access to the construction areas. The staging area is about 3.25 miles downstream of the Cougar site, about 1 mile from Highway 126, and is accessible via Aufderheide Drive (FS 19).

The diversion tunnel used in the original construction of Cougar dam will be reopened to drawdown the lake for construction. Construction of the exit channel of the diversion tunnel, beside the powerhouse, will require an estimated 1,300 yd^3 of sediment to be removed and about 2,600 yd^3 of riprap (rock) added for erosion protection. At the upstream portal of the diversion tunnel, it is estimated that 500 yd^3 of lake sediment and debris will require removal. About 4,750 yd^3 of rock around the base of the intake structure will require explosives.

4.4.3 Diversion Considerations at Cougar. The existing intake structure is isolated by the surrounding topography which provides very few options for diversion. The lowest elevation the reservoir enters into this area is about 1,495 feet. The invert elevations of the power penstock and the regulating outlet are 1,419 feet and 1,478.75 feet, respectively. This leaves the intake structure isolated and about 200 feet of dead storage in the reservoir. Another limiting factor for diversion during construction is the amount of flow required to be diverted. A minimum capacity of 2,000 ft^3/s is needed to draw down the pool below elevation 1,495 feet in time to begin placing the foundation.

The options for diversion are pumping, a cofferdam, and utilizing the existing diversion tunnel. The cost of using pumps to draw the reservoir down and divert the flow could possibly be more than half of the project cost. The limiting factors for using a cofferdam are the location, capacity, control and timing for the diversion and drawdown. The cofferdam and two conduits 8 feet in

diameter and about 800 feet long would have to be placed underwater. Using a cofferdam also requires closure of the Rush Creek diversion tunnel and a separate diversion for Rush Creek. After analyzing each option, only the existing diversion tunnel provides the capacity, control, and flexibility needed to divert water from the project.

During previous construction, the river was diverted via a horseshoe-shaped tunnel about 1,850 feet in length (figure 18). The upstream portal of the main diversion tunnel is at elevation 1,290 on the south side above Rush Creek, and the exit is at elevation 1,250 adjacent to the powerhouse. Another diversion tunnel was constructed to divert Rush Creek at elevation 1,457 and exits adjacent to the upstream portal of the main diversion tunnel. When the regulating outlet was ready to be used, steel bulkheads were placed in the upstream portal of the main diversion tunnel. Once the reservoir reached the regulating outlet, the valves in the bulkheads were closed and a concrete plug was installed in the middle of the tunnel.

The main diversion tunnel will be reopened in order to draw down Cougar Lake for construction of the SWS. This will be accomplished in late summer and early fall of the year prior to the start of construction to use minimum pool elevations and to ensure timely drawdown of the lake when construction begins. Reopening of the tunnel will include:

- Excavate and install slope protection for the exit channel of the diversion tunnel beside the powerhouse.

- Mine or drill two 6-foot diameter circular conduits side by side through the existing concrete diversion tunnel plug. Excavate a rubble trap the length of the tunnel plug below the invert of each conduit.

- Enlarge the crown of the existing tunnel downstream of the plug and install a concrete plug extension, incorporating the two conduits through the extension. Provide two gate valves near the downstream end. Locate the operators for the gate valves in the enlarged tunnel crown space above the plug extension.

- Explosives will be used in the upstream end of the two conduits in the tunnel plug to open the tunnel for passage of water. The gate valves should be fully open at the time of blasting and may be closed when the flow has stabilized.

- Remove the upstream portal bulkhead stop logs. Debris and silt may have to be excavated to expose the stop logs for mechanical removal. This operation must be barge supported since the tunnel entrance is at elevation 1,290 and lake surface is at or above elevation 1,532. If the upstream portal can be opened by mechanically removing the stop logs, the new control gate at mid-tunnel must be fully closed to equalize pressure on both sides of the stop logs.

- Begin drafting the pool and regulating the flow from the new gates in the diversion tunnel.

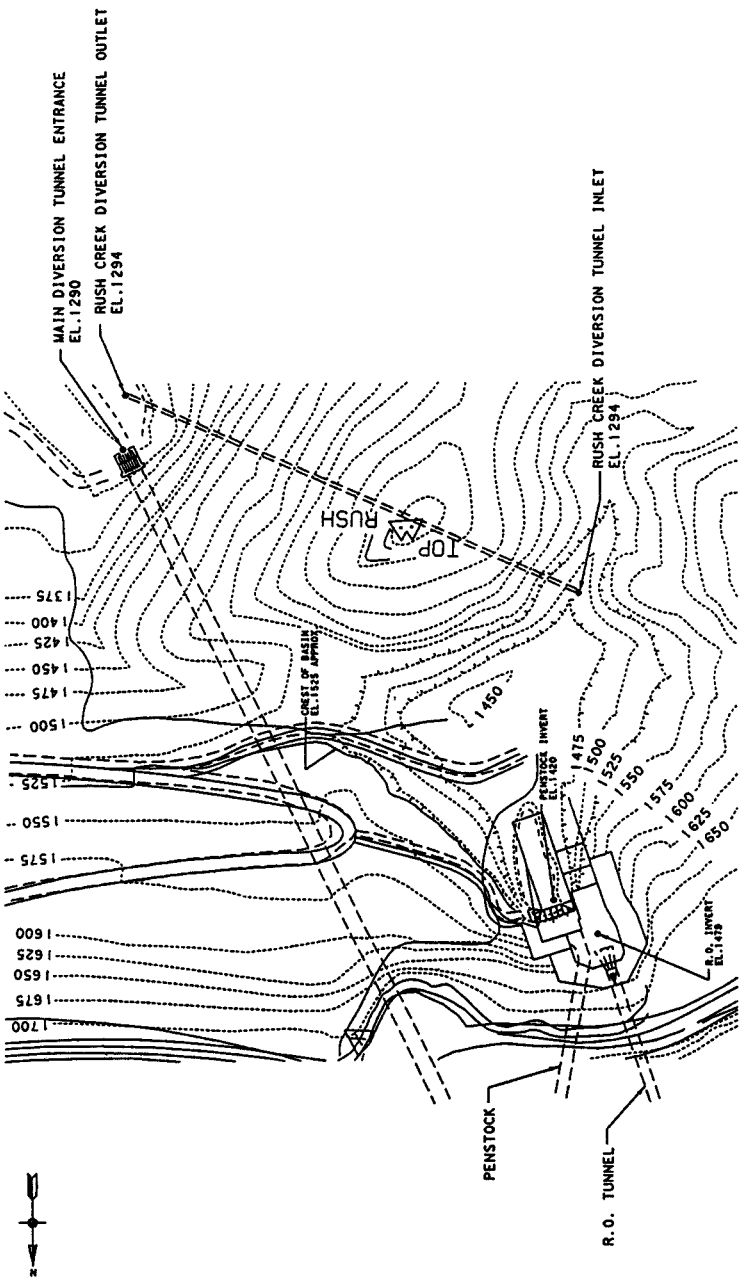


Figure 18 -- *Diversion Plan for Cougar Lake*

Construction of the diversion will occur one year prior to the tower construction. Initial construction is to take place below elevation 1,407. Mean monthly river flow is 1,400 ft^3/s in May, 900 ft^3/s in June, and less that 400 ft^3/s from July through September. However, most of the flow is concentrated in a few storm events. The design of this diversion scheme will operate for flows to 2,000 ft^3/s. A flow of 2,000 ft^3/s provides sufficient capacity to operate the project with the diversion tunnel. During diversion, the pool will be regulated between the entrance of the Rush Creek diversion tunnel at elevation 1,450 and the upstream portal to the main diversion tunnel at elevation 1,290. The storage between these elevations should provide protection for the construction site, depending upon rainfall. Large storm events exceeding the capacity and storage during diversion will be controlled with the regulating outlet.

Also, a residual pool will be maintained that will essentially eliminate sediment transport out of the reservoir, reduce turbidity in the water released from the project, and provide refuge habitat for aquatic species in the reservoir. The residual pool will be about 80 surface acres and about 76 feet deep with about 3,000 acre-feet of volume.

4.4.4 Construction at Blue River Lake. A 400-foot-radius around the existing intake structure, an area of about 500,000 square feet, will be used as the construction area for the intake structure modification. A paved laydown area, 7,500 square feet, is provided near the intake structure access bridge. A staging area, about 60,000 square feet, is located about 1,500 feet downstream and is proposed for disposal of rock and other non-sediment type construction materials. In-water disposal will be used to dispose of all sediment moved.

Access to the construction area will use Highway 126 to County Road 591 on the west side of the project. A paved road exists to the laydown area and an existing gravel road will provide access to the staging area. Once the lake level has been lowered, an existing gravel access road will be refurbished for access to the construction area.

A temporary rockfill cofferdam, 42 feet tall (elevation 1110 at the bottom of channel to elevation 1152) and 60 feet in length will be placed upstream of the existing intake structure. Geotextile fabric will be placed on the upstream face of the cofferdam. Two diversion conduits, 72 inches in diameter, will run through the cofferdam into the regulating outlet in order to dewater the channel floor (about 8,000 square feet) outside of the existing intake tower. It is estimated that about 500 yd^3 of sediment will need to be removed from the channel floor during foundation preparation. No explosives will be used at Blue River Lake.

4.4.5 Diversion Considerations at Blue River. Diversion during the original construction was accomplished by passing the flow through two sluices in the foundation of the intake tower. The sluices bypassed the construction area of the intake tower to the existing tunnel. The invert of the diversion sluices was 1,110 feet and were designed to pass 1,850 ft^3/s at a pool elevation of 1,132 feet. After diversion became unnecessary the sluices were plugged with concrete. Diversion was also used to pass Quartz Creek through a ridge adjoining the right abutment and used an unlined rock tunnel through the ridge.

Construction of the diversion will occur during the low flow season one year prior to SWS construction (figure 19). An earthfill cofferdam with crest elevation 1,152 feet will be placed upstream of the intake tower in the approach channel. Two 72-inch conduits will be used to divert water and will pass through the cofferdam and connect to two circular conduits in the existing foundation. The conduits in the existing foundation must be constructed by mining or drilling. The conduits enter at the base of the tower foundation and exit on the floor of the existing regulating outlet sluices downstream of the bulkhead slot and upstream of the gates. The cofferdam can be flooded using valves on the diversion conduits. The hydraulic control for the diversion is the existing regulating outlet gates. Gates on the diversion conduits downstream of the cofferdam will be used during the construction and demolition of the diversion.

The diversion will pass inflow to 800 ft^3/s at 16 feet of head. When the diversion cannot safely maintain the pool below the level of construction, construction work will stop and the project will begin flood control operations. Construction will resume when the diversion is able to safely maintain the pool below the level of construction. The transition from diversion to flood control is accomplished by first flooding the cofferdam with valves on the diversion conduits and then raising the regulating outlet bulkheads. The transition from flood control to diversion is accomplished lowering the regulating outlet bulkheads.

Also, a residual pool will be maintained that will essentially eliminate sediment transport out of the reservoir, reduce turbidity in the water released from the project, and provide refuge habitat for aquatic species in the reservoir. The residual pool will be about 40 surface acres and about 40 feet deep with about 1,000 acre-feet of volume.

4.5 Hydrology During Construction

4.5.1 Flood Control Evaluation. Flood routings were done with data for seven historic floods in the Willamette basin for both the without-diversion and with-diversion conditions during construction. The routings were done using the reservoir regulation computer program HEC-5. Cougar and Blue River were evaluated separately for flood control, that is, it was assumed that only one of the two projects was under construction at one time. Also see Volume II, Technical Appendices B and C, Engineering Analysis for Blue River and Cougar lakes, respectively.

At Cougar Lake, the minimum outflow is 300 ft^3/s and the maximum outflow is 5,000 ft^3/s (normal maximum release). The minimum flood control pool elevation is 1,532 feet during the winter season (top graph in figure 20). During construction, the lowest pool elevation in winter is 1,350 feet. As a result, there will be an additional 60,000 acre-feet of flood control storage available during construction. The diversion will be controlled to a maximum of 2,000 ft^3/s outflow up to a pool elevation of 1,510 feet. Above this elevation, the diversion will be closed and the regulating outlets used to pass outflow until use of the spillway is required. Flow requirements at control points on the McKenzie and Willamette rivers, and the allowable rates of flow increase remain the same as in the without-diversion condition.

The bottom graph in figure 20 shows an example of how flood routings during construction at Cougar will effect reservoir outflows and pool elevations. The peak inflow for the 1953 flood was 16,400 ft^3/s, about a 15 percent probability event (7 year recurrence interval). A flood of this magnitude is most likely to occur during November through February. Construction would be taking place between elevations 1,480 and 1,540 during this time. As shown on the upper graph, the pool elevation would be above 1,540 for about 6 days and above elevation 1,480 for more than 20 days. If additional rainfall occurs and inflows increase, it will take even longer to lower the pool elevation. Construction site flooding is limiting the construction season from about June through October, depending on rainfall, and is adding to the overall length of the construction period (about 4 years).

At Blue River, the minimum outflow is 50 ft^3/s and the maximum outflow is 3,000 ft^3/s (normal maximum release). The minimum flood control pool elevation is 1,180 feet during the winter season (top graph in figure 21). During construction, the lowest pool elevation during the winter is 1,180 feet (the same as minimum flood control pool).

At elevations equal to or greater than 1,180, the diversion will be closed and the regulating outlets used to pass outflow until use of the spillway is required. As a result, the flood control routings for Blue River during construction will be the same as the without-construction condition. Flow requirements at control points on the McKenzie and Willamette rivers, and the allowable rates of flow increase also remain the same as the without-diversion condition. The bottom graph in figure 21 shows how flood routings during construction will effect reservoir outflows and elevations.

4.5.2 Flow Augmentation. Water is released from Cougar and Blue River lakes to assist in augmenting flow in the Willamette River at Albany (5,000 ft^3/s) and Salem (6,500 ft^3/s). Flow augmentation in the mainstem McKenzie is incidental to this operation, with a goal to provide at least 2,500 ft^3/s near Vida for EWEB needs. Blue River Lake is drawn down first and Cougar Lake is third in the Willamette system to augment flows. During construction, neither project will have sufficient storage available to help meet the minimum flow requirements at Albany and Salem.

A flow routing analysis was performed to evaluate the additional storage needed from other reservoirs, and to evaluate the flow reductions on the South Fork, Blue, and mainstem McKenzie rivers during construction at the Cougar and Blue River projects. Figure 22 shows the typical order of lake drawdown for flow augmentation of the Willamette basin, and the available conservation storage above Albany and Salem.

The focus of the flow routing analysis was the summer regulation of the system (primarily July and August) for flow augmentation. The base condition used represents the Willamette system as it has been operated over the last several years. Flow records used for the analysis represent the low (1977), average (1985) and high (1984) flow years based on the average flow in the Willamette River at Salem and the McKenzie River near Vida. A summary of the results of the flow routing analysis is provided below. Also see exhibit B to the main report.

Figure 19 – *Diversion Plan for Blue River Lake*

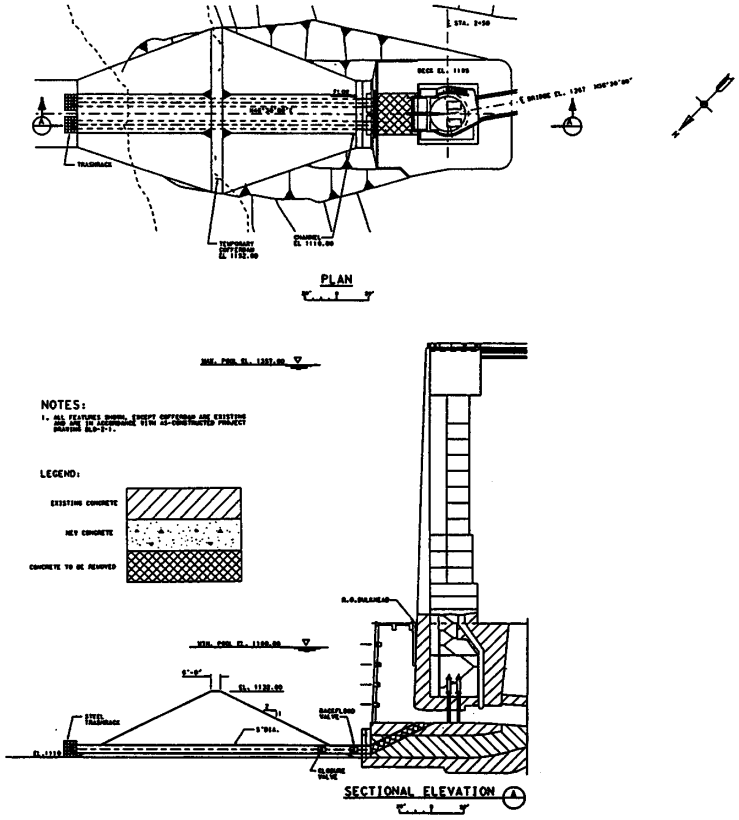
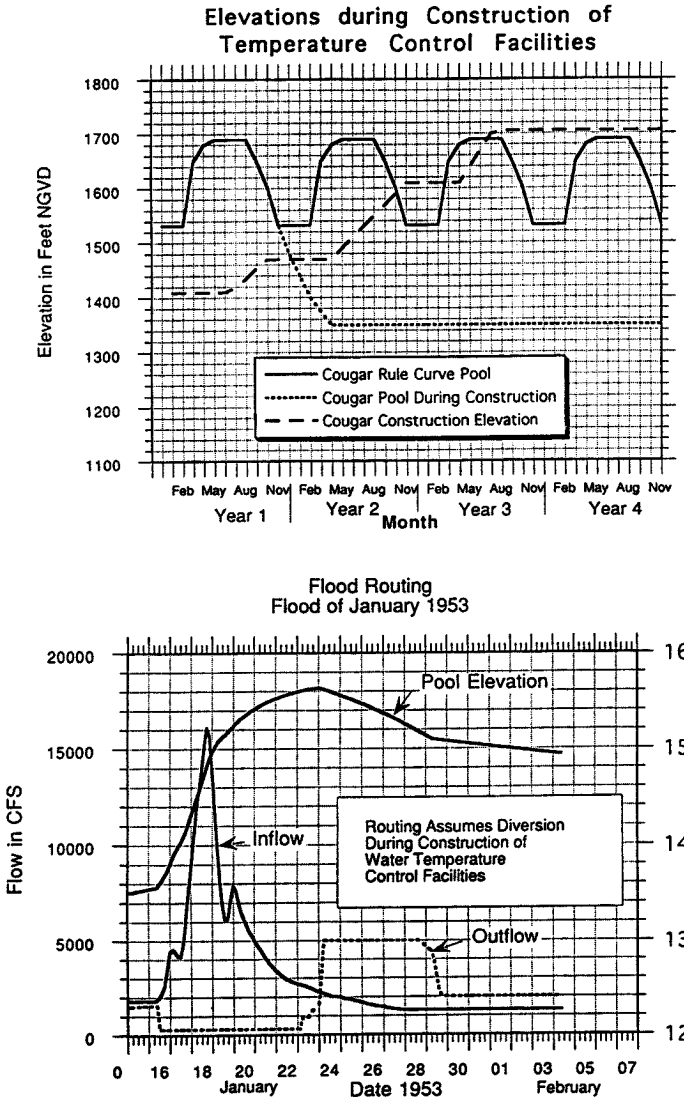


Figure 20 – *Elevations During Construction and Flood Routing, Cougar Lake*



During construction in the summer (conservation season), there will be times in August and September during average to low flow years when outflows fall below minimum levels of 300 ft^3/s for Cougar and 50 ft^3/s for Blue River (tables 12 and 13). Summer flows in the mainstem McKenzie near Vida would be reduced by about 5 to 20 percent during construction (figure 23 and table 15). The Corp's goal to provide at least 2,500 ft^3/s in the McKenzie as measured at the Vida gage. The Corps is not required to meet this goal and flows often fall below this level as the system is operated now. During construction, flows will likely drop below 2,500 ft^3/s more often in average to low flow years.

The summer flow augmentation requirements of 5,000 ft^3/s at Albany and 6,500 ft^3/s at Salem can be met at all times unless the Willamette basin experiences extreme drought conditions with record low flows (table 14). The analysis shows that even in 1977, the lowest flow year in the 77 years of record at Salem, there was enough water in the system to meet these flow requirements.

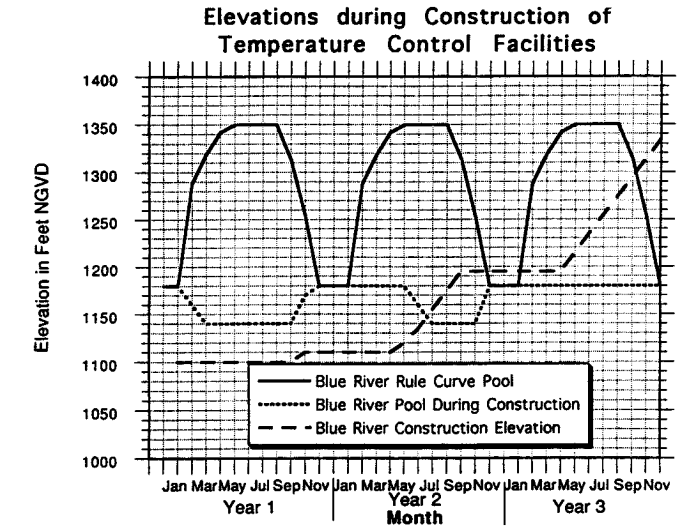
Impacts to the Willamette reservoirs during construction vary, and in any given year depend on flow conditions. During construction, any shortage in augmentation flow will be made up by Hills Creek, Lookout Point, Cougar (during Blue River construction), Blue River (during Cougar construction), and to a lesser extent Fall Creek. Hills Creek and Lookout Point together account for about 50 percent of the conservation storage in the system above Albany. Fall Creek, Cougar and Blue River total over 30 percent of the conservation storage. The other projects, Cottage Grove, Dorena, and Fern Ridge are smaller and do not have sufficient storage to maintain flow augmentation.

Cougar Lake has about twice as much conservation storage as Blue River Lake so higher outflows and earlier evacuation of the pools would be expected at Hills Creek and Lookout Point during construction at Cougar (table 12 and figures 24 and 25).

During construction at Cougar and Blue River, the outflow and pool elevation impacts at Hills Creek under average and high flow years, and at Lookout Point under high, average, and low flow years were found to be minor when compared to the base condition. Currently, the Hills Creek pool is kept above elevation 1,516 as long as possible through Labor Day for recreation purposes. It appears from the routings that there will not be a problem meeting this goal in average to high flow years. In low flow years, the pool may drop below elevation 1,516 by one month earlier (figure 24).

Based on the results of the flow routing analysis, it appears that impacts to the Santiam basin projects (Green Peter, Foster, and Detroit) will be very minor. Some releases in low flow augmentation for Salem may be necessary in lower than average years.

Figure 21 – *Elevations During Construction and Flood Routing, Blue River Lake*



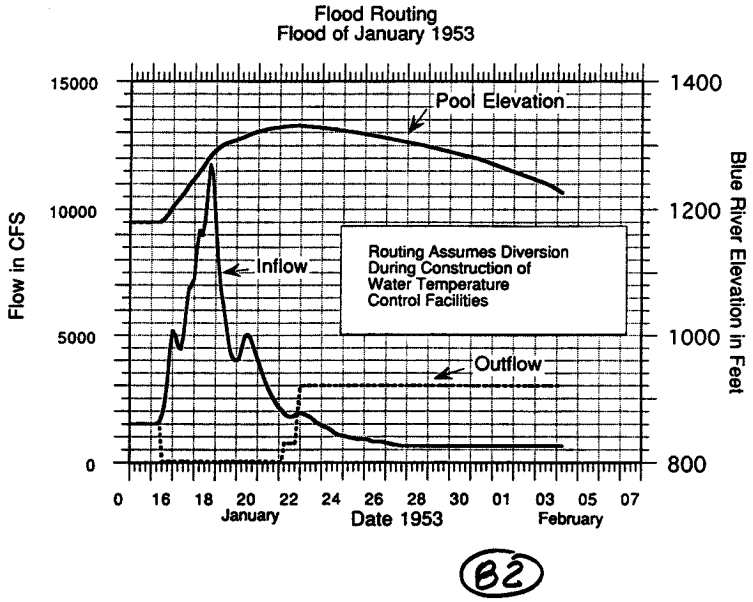


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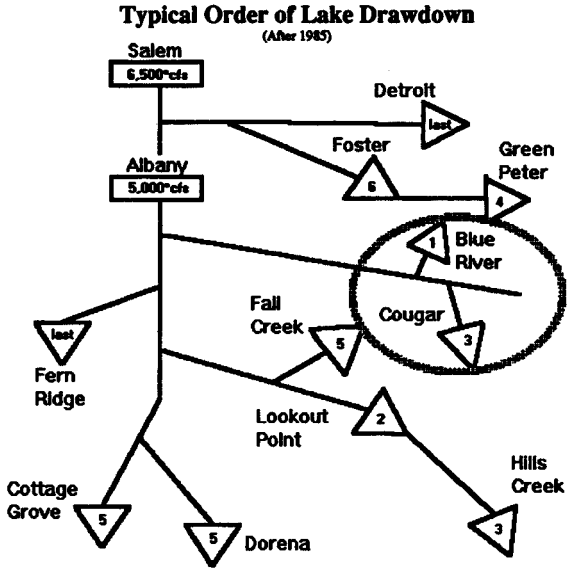
Figure 22 -- *Order of Reservoir Drawdown and Conservation Storage Amounts*



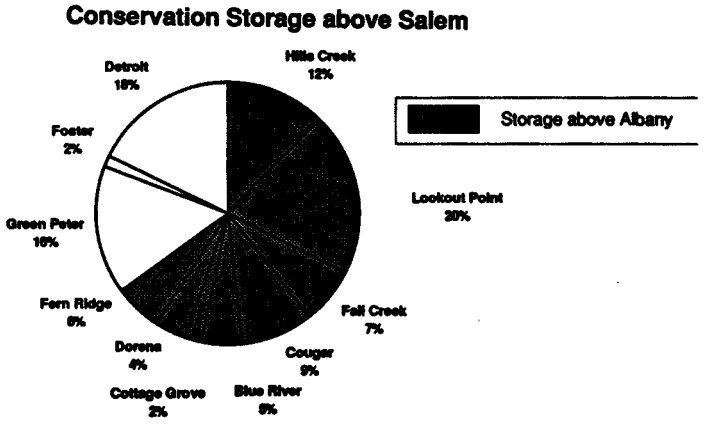


Table 12 -- Estimated Conservation Flows and Elevation Differences During Construction

COUGAR CONSTRUCTION (no storage at Cougar)
Mean monthly flows in the South Fork in ft^3/s for water years 1967-1986

Month	During Construction (inflow=outflow) (ft^3/s)	Without Construction (based on HEC-5) (ft^3/s)	No. of Times 300 ft^3/s Not Met During Construction	Estimated In-Stream Elevation Differences[1] (feet)
July	403	570	3	0.3
August	317	470	8	0.3
September	314	760	8	0.8

BLUE RIVER CONSTRUCTION (no storage at Blue River)
Mean monthly flows in the Blue River in ft^3/s for water years 1967-1986

Month	During Construction (inflow=outflow) (ft^3/s)	Without Construction (based on HEC-5) (ft^3/s)	No. of Times 50 ft^3/s Not Met During Construction	Estimated In-Stream Elevation Differences[2] (feet)
July	84	240	2	0.8
August	47	170	11	0.9
September	63	360	10	1.4

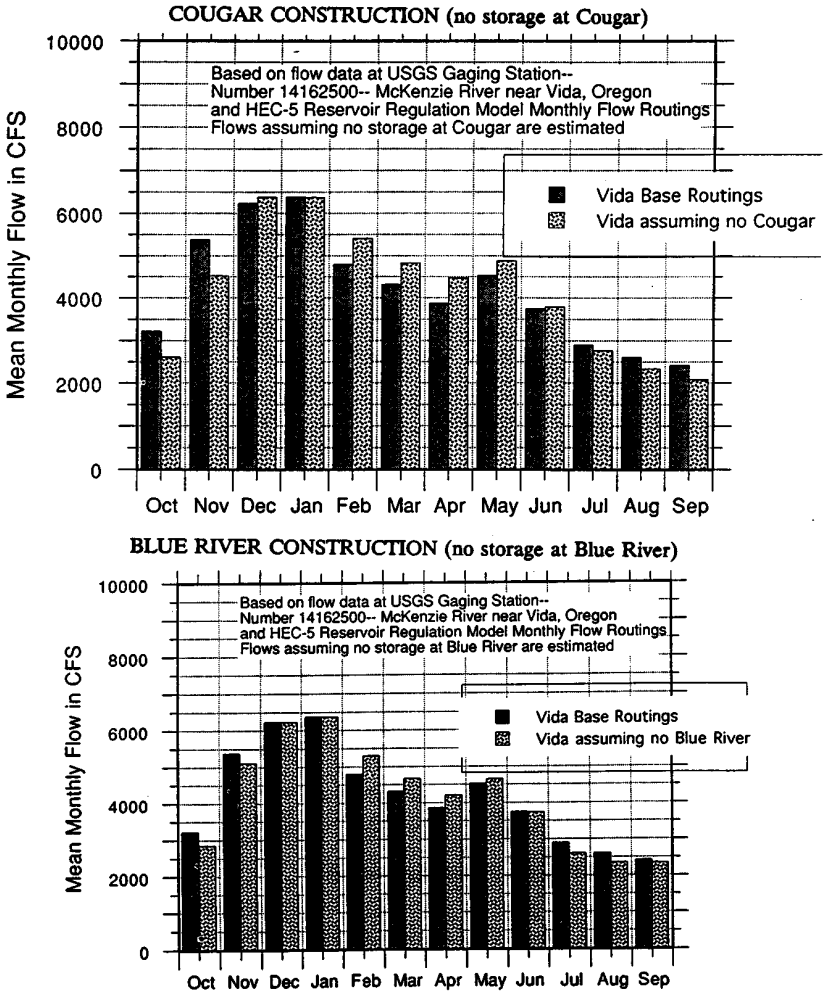
[1] Based on stage-discharge relationship at USGS gaging station 14159500, South Fork McKenzie River near Rainbow, OR, and applies only to this location.
[2] Based on stage-discharge relationship at USGS gaging station 14162200, Blue River at Blue River, OR and applies only to this location.

Table 13 -- *Average Monthly Outlflows During Construction* (in cfs)

Location	Month	Base Condition	Cougar Construction	Blue River Construction
Average Flow Year 1985				
Hills Creek	Jul-85	500	700	600
	Aug-85	400	500	400
	Sep-85	1350	1350	1350
Lookout Point	Jul-85	2100	2500	2300
	Aug-85	2500	2500	2500
	Sep-85	2000	2000	2000
Cougar	Jul-85	600	349*	800
	Aug-85	300	300*	500
	Sep-85	808	331*	396
Blue River	Jul-85	300	500	54*
	Aug-85	300	500	35*
	Sep-85	300	300	57*
Low Flow Year 1977				
Hills Creek	Jul-77	300	600	500
	Aug-77	900	1000	1000
	Sep-77	1000	1000	1000
Lookout Point	Jul-77	2000	2500	2300
	Aug-77	2400	2500	2500
	Sep-77	2000	2000	2000
Cougar	Jul-77	800	288*	800
	Aug-77	700	263*	900
	Sep-77	700	271*	894
Blue River	Jul-77	400	500	57*
	Aug-77	400	500	39*
	Sep-77	250	250	74*

* Outflow is equal to inflow during construction

Figure 23 -- *McKenzie River Flows Near Vida During Construction* (mean monthly flows in cfs, water years 1967-1986)

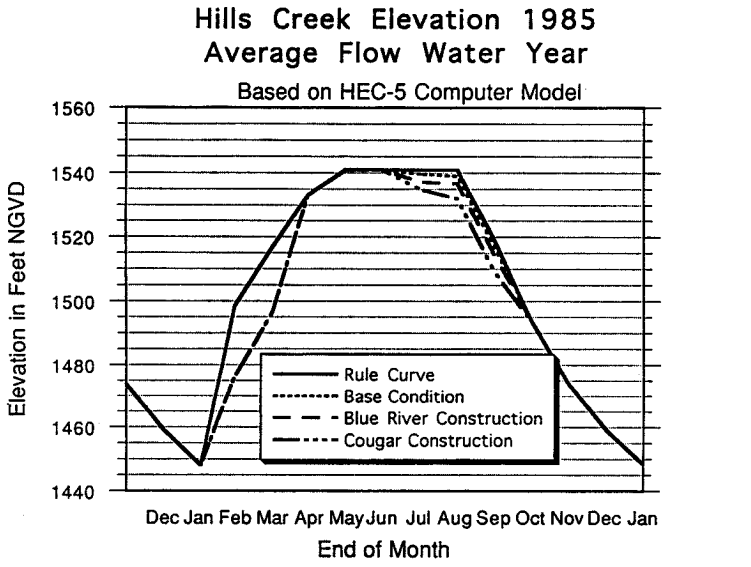


Note: Assumes no flow augmentation during construction.

Table 14 -- *Monthly Average Flows at Control Points During Construction* (in cfs)

Control Points	Month	Base Condition	Cougar Construction	Blue River Construction
Average Flow Year 1985				
Vida	Jul-85	2780	2730	2740
	Aug-85	2220	2420	2160
	Sep-85	2830	2150	1970
Albany	Jul-85	5270	5670	5430
	Aug-85	5300	5550	5310
	Sep-85	6320	5740	5580
Salem	Jul-85	7740	8140	7890
	Aug-85	7150	7400	7160
	Sep-85	9470	8880	8730
Low Flow Year 1977				
Vida	Jul-77	2670	2260	2330
	Aug-77	2450	2110	2290
	Sep-77	2310	1880	2330
Albany	Jul-77	5180	5270	5140
	Aug-77	5310	5070	5250
	Sep-77	6420	6060	6480
Salem	Jul-77	6980	7060	6930
	Aug-77	6740	6630	6680
	Sep-77	8330	7940	8390

Figure 24 – *Hills Creek Elevations During Construction*



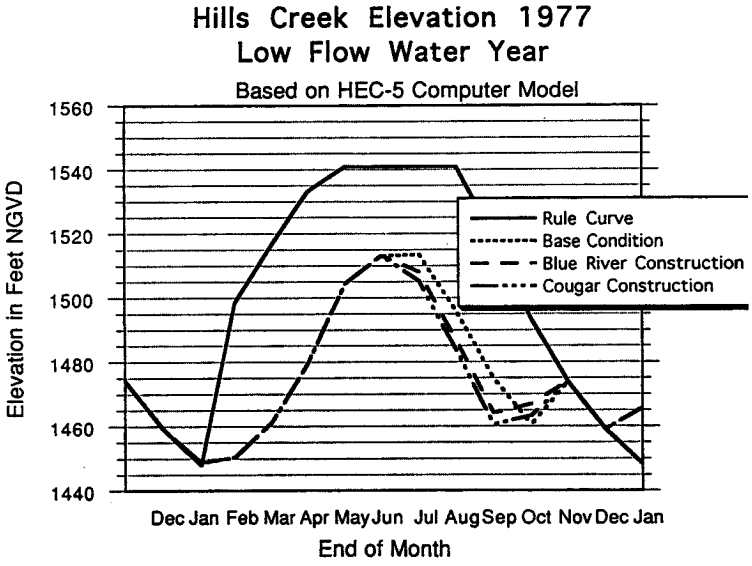
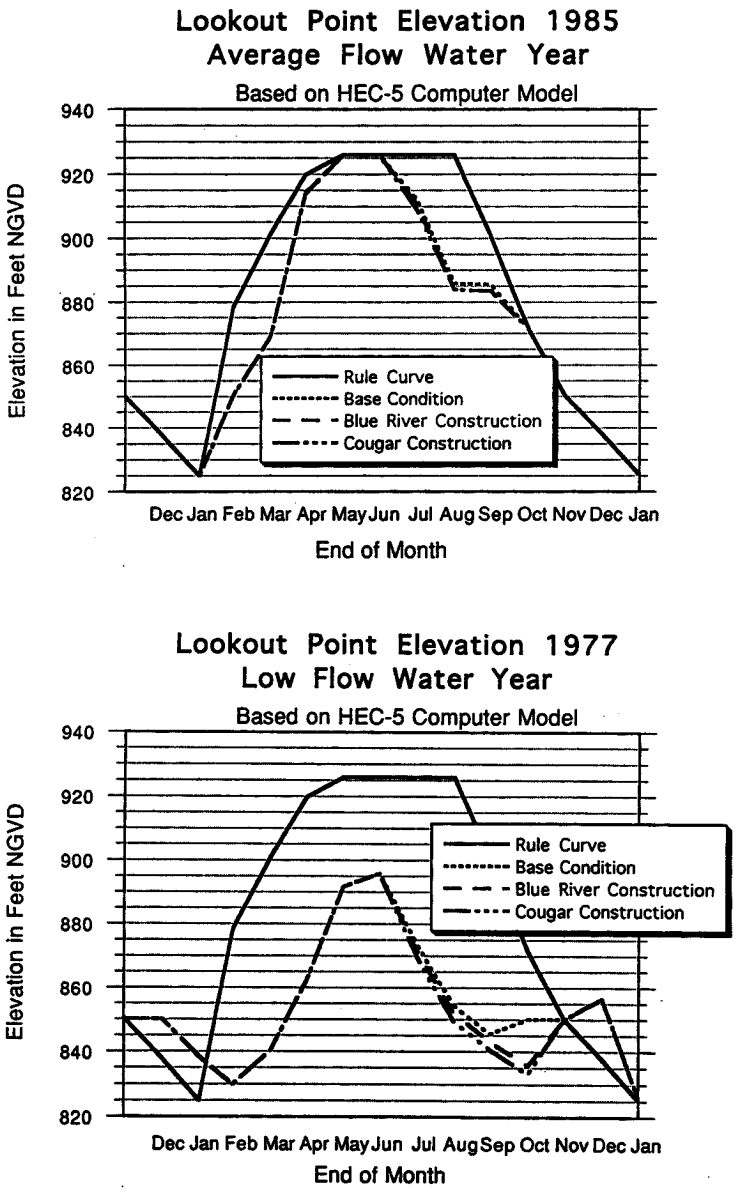


Figure 25 – *Lookout Point Elevations During Construction*



4.6 Operation and Maintenance Considerations

Reservoir temperatures at Cougar and Blue River vary the most for about six months, (May through October). The frequency of operation of the sluice gates for the ports and trash handling during this period will be higher as compared to the rest of the year. It is estimated that an operator working 2 hours per day will be needed for gate operation during this six month period. Cleaning and trash handling is estimated to take one day per week.

At Cougar, about 300 to 400 hours are spent each year for maintenance of the existing intake tower. The modified intake tower is estimated to take about 1,200 additional hours annually for maintenance. At Blue River, about 250 to 300 hours are spent each year for maintenance of the existing intake tower. The modified intake tower is estimated to take about 900 additional hours annually for maintenance.

It is estimated that 20 percent of the operating equipment will need replacement once every 10 years after the original installation at each project.

4.7 Hazardous, Toxic, and Radiological Waste (HTRW) Investigation

An investigation covering the proposed contractor staging areas and the area immediately around the intake structures was undertaken to determine the potential for encountering HTRW during construction at Cougar and Blue River. Ground and aerial photographs of dam construction at both projects were examined and show that there does not appear to have been any large-scale or long-term storage or use of hazardous materials near the intake structures.

At the proposed contractor staging area for Cougar (Strube Flats), four test pits were excavated in its northern portion. A thin asphalt pavement layer was found a few inches below ground in test pit 1. Soil samples were taken and analyzed for hydrocarbons, volatile organic compounds, semivolatile organics, organochlorine pesticides, polychlorinated biphenyls (PCBs), 23 target analyte list (TAL) metals, and toxicity characteristic leaching procedure (TCLP) metals for barium and chromium.

Diesel fuel and oil were detected in test pit 1 at concentrations of 229 and 92 parts per million (ppm), respectively which are below the Oregon cleanup standard of 500 ppm. No volatiles, semivolatiles, pesticides, or PCBs were detected in any samples. Aluminum, barium, calcium, iron, magnesium, manganese, potassium, and sodium were detected in most samples at concentrations greater than 100 ppm. Arsenic, chromium, cobalt, copper, lead, nickel, vanadium, and zinc were detected in all samples at concentrations lower than 100 ppm. Oregon does not have maximum allowable soil concentration standards for aluminum, calcium, cobalt, iron, magnesium, potassium, sodium, vanadium, and zinc. Detected concentrations of barium, chromium, copper, lead, manganese, and nickel are several orders of magnitude below Oregon maximum allowable soil concentration standards for industrial or residential sites. Arsenic was detected at a concentration above Oregon maximum allowable standard (0.4 ppm residential, 3 ppm industrial) in test pits 1 (5 ppm) and 2 (4 ppm).

At the proposed staging area at Blue River, Stone and Webster, an EWEB contractor, drilled boreholes and excavated test pits during the summer of 1993. No contamination was detected.

There are no sites in Blue River, Rainbow, or McKenzie Bridge, Oregon (towns closest to the dams), on EPA's Comprehensive Environmental Response, Compensation and Liability Act Information System site list. The Oregon State DEQ Operations office indicated that they are not aware of any potential HTRW sites near the dams. There are also no sites in Blue River, Rainbow, or McKenzie Bridge on the Oregon DEQ's Underground Storage Tank facilities list, Confirmed Release and Inventory of Hazardous Substance Sites list, or the Environmental Cleanup Site Information System list. DEQ indicates that the only HTRW site near Cougar dam not on their site listings is the South Fork McKenzie River oil spill site, immediately across from the proposed contractor staging area. The Portland District has excavated petroleum-contaminated soil (believed related to dam construction) and is studying potential treatment and disposal options for the soil. Oregon DEQ indicated that they are not aware of any potential HTRW sites near Blue River dam.

The possibility of encountering HTRW during construction at Cougar and Blue River is low. The intake structures are founded on bedrock, staging areas immediately beside them were small, and only materials and equipment used for the structure itself were placed there. At Cougar, the proposed contractor staging area is free of contaminants at concentrations above Oregon standards except for arsenic, but detected levels are slightly (1 ppm and 2 ppm) above the standard for industrial sites. Petroleum contamination from the South Fork McKenzie oil spill site would not migrate to the proposed staging area; it would enter the river and be taken downstream. At Blue River, borings and test pits excavated in the proposed contractor staging area during 1993 showed no contamination.

Construction specifications for the temperature control projects will include provisions for pollution prevention and cleanup, the removal of all equipment and supplies from the sites upon completion, and the restoration of the staging areas. In addition, specifications will prohibit the contractor from performing any excavation in the staging areas. Additional study is planned during the next design phase for both pool areas to identify any problem areas which could be exposed during reservoir drawdown. Due to their isolated locations, contamination of accumulated sediments within the reservoirs is unlikely. However, it is recommended sediment samples be taken near the intake structures and near any potential problem areas identified during further design studies.

4.8 Cost Estimate

According to Corps of Engineers Engineering Circular 1110-2-538, a baseline cost estimate to implement the projects, if authorized for construction, was developed. Tables 15 and 16 are a from the Executive Cost Summary, baseline cost estimate. The current fully-funded costs includes an estimate of inflation based on Office of Management and Budget guidelines and the tentative construction schedule. For the selected plan, the fully-funded cost estimated at $45 million. Also see Volume II, Technical Appendix D, Cost Estimates.

Table 15 -- *Total Cost Summary for Blue River and Cougar*

TOTAL - ALL CONTRACTS ****** TOTAL PROJECT COST SUMMARY ****** PAGE 1 OF 5

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE FEASIBILITY REPORT AS OF 1 AUG 94

PROJECT: WILLAMETTE RIVER TEMPERATURE CONTROL — DISTRICT: PORTLAND

LOCATION: COUGAR AND BLUE RIVER DAMS, OREGON — P.O.C.: PATRICK T. JONES P.E., CHIEF, COST ENGINEERING BRANCH

CURRENT MCACES ESTIMATE PREPARED: 22 SEPT 94 — AUTHORIZ./BUDGET YEAR: 1996

EFFECTIVE PRICING LEVEL: 1 JUN 94 — EFFECT. PRICING LEVEL: 1 OCT 94 — *** FULLY FUNDED ESTIMATE ***

ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	COST ($K)	CNTG ($K)	TOTAL ($K)	COST ($K)	CNTG ($K)	FULL ($K)
04 - - -	DAMS										
0403- -	OUTLET WORKS	20,995	4,842	23%	25,838	21,178	4,884	26,062	26,312	6,087	32,399
	TOTAL CONSTRUCTION COSTS ===>	20,995	4,842	23%	25,838	21,178	4,884	26,062	26,312	6,087	32,399
01 - - -	LANDS AND DAMAGES	74	10	14%	84	74	10	84	85	11	96
30 - - -	PLANNING, ENGINEERING & DESIGN	6,263	679	11%	6,942	6,332	686	7,018	7,287	791	8,078
31 - - -	CONSTRUCTION MANAGEMENT	3,174	389	12%	3,563	3,209	394	3,603	4,088	496	4,584
	TOTAL PROJECT COSTS ========>	30,506	5,920	19%	36,427	30,793	5,974	36,767	37,772	7,385	45,157
									TOTAL FEDERAL COSTS ==========>		45,157
									TOTAL NON-FEDERAL COSTS =====>		0
									THE MAXIMUM PROJECT COST IS ==>		$45,157

DISTRICT APPROVED:

PROJECT MANAGER

CHIEF, COST ENGINEERING

for CHIEF, OPERATIONS

CHIEF, PLANNING & ENGINEERING

CHIEF, CONSTRUCTION

ADDE (PM)

CHIEF, REAL ESTATE

CHIEF, RESOURCE MANAGEMENT

DISTRICT COUNSEL

DIVISION APPROVED:

4/12/95 CHIEF, COST ENGINEERING

DIRECTOR, REAL ESTATE

Acting DIRECTOR, PPMD

APPROVED DATE: 12 Apr 95

Table 16 -- Contract Cost Summary by Project

CONTRACT A - Cougar Dam — ****** TOTAL CONTRACT COST SUMMARY ******

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE FEASIBILITY REPORT AS OF 1 AUG 94

PROJECT: Willamette Temperature Control Project — DISTRICT: PORTLAND

LOCATION: Cougar Dam, Oregon — P.O.C.: PATRICK T. JONES P.E., CHIEF, COST ENGINEERING BRANCH

		CURRENT MCACES ESTIMATE PREPARED: 22 SEPT 94 EFFECTIVE PRICING LEVEL: 1 JUN 94				AUTHORIZ./BUDGET YEAR: 1996 EFFECT. PRICING LEVEL: 1 OCT 94				*** FULLY FUNDED ESTIMATE ***				
CCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
04 - - -	DAMS													
0403- -	OUTLET WORKS, COUGAR DAM	12,932	2,885	22%	15,817	0.9%	13,045	2,910	15,955	Jan-2000	17.1%	15,276	3,408	18,684
	TOTAL CONSTRUCTION COSTS ===>	12,932	2,885	22%	15,817	0.9%	13,045	2,910	15,955	Jan-2000	17.1%	15,276	3,408	18,684
01 - - -	LANDS AND DAMAGES	40	6	15%	46	1.1%	40	6	46	Jan-1997	8.1%	43	6	49
30 - - -	PLANNING, ENGINEERING & DESIGN	3385	362	11%	3,747	1.1%	3,422	366	3,788	Jan-1997	8.1%	3,699	396	4,095
31 - - -	CONSTRUCTION MANAGEMENT	1704	247	14%	1,951	1.1%	1,723	250	1,973	Jan-2000	20.2%	2,071	301	2,372
	TOTAL PROJECT COSTS ========>	18,061	3,500	19%	21,561		18,230	3,532	21,762			21,089	4,111	25,200

CONTRACT B - Blue River Dam — ****** TOTAL CONTRACT COST SUMMARY ******

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE FEASIBILITY REPORT AS OF 1 AUG 94

PROJECT: Willamette Temperature Control Project — DISTRICT: PORTLAND

LOCATION: Blue River Dam, Oregon — P.O.C.: PATRICK T. JONES P.E., CHIEF, COST ENGINEERING BRANCH

		CURRENT MCACES ESTIMATE PREPARED: 22 SEPT 94 EFFECTIVE PRICING LEVEL: 1 JUN 94				AUTHORIZ./BUDGET YEAR: 1996 EFFECT. PRICING LEVEL: 1 Oct 94				*** FULLY FUNDED ESTIMATE ***				
CCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
04 - - -	DAMS													
0403- -	OUTLET WORKS, BLUE RIVER DAM	8,063	1,957	24%	10,021	0.9%	8,133	1,974	10,107	Nov-2004	35.7%	11,036	2,679	13,715
	TOTAL CONSTRUCTION COSTS ===>	8,063	1,957	24%	10,021	0.9%	8,133	1,974	10,107	Nov-2004	35.7%	11,036	2,679	13,715
01 - - -	LANDS AND DAMAGES	34	4	12%	38	1.1%	34	4	38	Jan-2001	23.3%	42	5	47
30 - - -	PLANNING, ENGINEERING & DESIGN	2878	317	11%	3,195	1.1%	2,910	320	3,230	Jan-2001	23.3%	3,588	395	3,983
31 - - -	CONSTRUCTION MANAGEMENT	1470	142	10%	1,612	1.1%	1,486	144	1,630	Nov-2004	35.7%	2,017	195	2,212
	TOTAL PROJECT COSTS ========>	12,445	2,420	19%	14,866		12,563	2,442	15,005			16,683	3,274	19,957

4.9 Construction Impacts of the Selected Plan

This section summarizes the major, short-term impacts anticipated to occur during construction of the selected plan. Also see the EIS and referenced exhibits for more information.

4.9.1 Overview. Construction impacts will last for about 4 years at Cougar and about 3.5 years at Blue River. Construction of the SWS for each project will be phased to reduce flow and other impacts on the downstream watershed and Willamette system. During construction in the summer months (conservation season), each reservoir will be operated as run-of-river, with inflow equal to outflow, a condition similar to what existed before flow augmentation from reservoir storage. Construction will then stop in the fall and flood control operations begin. Flood control operations involve storing water to meet downstream flood control obligations, and will likely flood the construction site. Maintaining flood control operations during construction at the projects is adding to the overall length of the construction period.

The initial drawdown for construction will expose the original streambed for most of the length of each reservoir, except near the dams where a residual pool will be maintained to eliminate sediment transport out of the reservoirs, reduce turbidity in the water released from the projects during construction, and provide refuge habitat for resident fish and aquatic organisms. More detailed information on the residual pools can be found in exhibit A. The residual pool at Cougar will be about 80 surface acres and about 76 feet deep with about 3,000 acre-feet of volume. It will have a turn-over time of about 4 to 6 days during summer, which should preclude depletion of dissolved oxygen. The residual pool at Blue River will be about 40 surface acres and about 40 feet deep with about 1,000 acre-feet of volume. It will have a turn-over time of about 8 to 10 days during the summer months, which should preclude depletion of dissolved oxygen.

During review of the draft report, a concern was expressed that the water temperature of the residual pool during Cougar construction may become too warm during the summer to support bull trout. A modelling analysis was performed to consider the effects of warming in the unwatered channel from the upstream USGS gage to the residual pool. The maximum daily temperatures in the South Fork during original construction in the early 1960s were used for the evaluation (USGS gage sites above and below Cougar, 6.5 miles apart). Any temperature increase would be at a maximum when the reservoir had been cleared of vegetation, removing any shading which might moderate any heat gain just prior to completion of construction. The results of this analysis are discussed below, and more detailed information can be found in section 1.6.1 of Exhibit A.

During construction of the temperature control modification, there will be a return to a unwatered and unshaded river leading to the head of the residual pool. This leaves about 4.7 miles, or 72 percent of the distance between the gages that would return to a condition similar to just prior to completion of the original construction. As a result of less exposure, however, there should be a smaller heat gain than that observed during original construction.

Inflow temperatures to the residual pool were increased to account for the entire originally unshaded and unwatered river. Daily mean stream temperatures entering the residual pool may rise to a little more than 60° F on the hottest days, which occur in August. The warmest daily maximum temperatures flowing into the residual pool could reach 65° F. The model was rerun using these revised inflow temperatures. Results show that the warmest daily mean outflow temperature from the residual pool in early August would about 63° F. This amounts to an increase in the river's daily mean temperature of about 3° F as it passes through the residual pool. There likely would be little diurnal variation in the temperature of the outflow since the release occurs from the bottom of the residual pool where the coolest water is found. Although surface temperatures could reach as high as 70° F in early August, the residual pool would be thermally stratified and would provide much cooler temperatures lower in the pool (about 59° to 62° F).

Timing of the initial drawdown would be similar for both Blue River and Cougar lakes. Starting on February 1, there would be a goal to lower the lake gradually to the elevation of the residual pool by May 1 (earliest date). This is because natural flows have generally fallen to manageable flow rates in the spring and for which diversion capacities were selected. This gives the maximum length construction season, until the flood control season in November makes continued construction too risky.

4.9.2 Water Quality Impacts. Based on previous analyses, the accumulation of sediment in Blue River Lake may be as low as 363 acre-feet or as high as 726 acre-feet. At Cougar, sediment accumulation may be as low as 926 acre-feet or as high as 1,872 acre-feet. Turbidity is problematic because it is associated with water movement over bare earth and is a byproduct of erosion. The soil type undergoing erosion has everything to do with the color and persistence of the turbidity. Biologic activity, such as algae formation, also causes coloration and turbidity. Given enough time, this same biologic activity also helps reduce turbidity. Particles making up turbidity are usually colloidal (clay-sized) and by definition are difficult to settle out of the water column. Prevention and control of turbidity during construction at the projects are necessary.

Turbidity profiles measured at Cougar Lake in the summer 1971 showed increased turbidity below the level of the outlet. The bottom turbidity was 20 JTUs. This turbid water will be released as the lake is drawn down for construction. Other parameters such as ph, total solids, and conductance were all consistent with turbid water below the level of the outlet. Dissolved oxygen measured during subsequent studies showed no decrease in the lower turbid waters. Release of water from the lower levels should pose no water quality threat downstream. Drawdown for construction will occur much earlier in the year during a period of higher flows when there is a higher likelihood of turbid inflow. Re-erosion of sediment deposits in the lake will likely increase turbidity 10 fold.

Another finding in 1971 was that a reservoir with a bottom outlet cleared more quickly following an storm and did not retain turbid water in the deeper portion of the reservoir.

During construction, the diversion tunnel will be the outlet at the bottom of the reservoir so the residual minimum pool should readily clear following a storm event.

When Fall Creek Lake was completely drawn down during in 1989, the turbidity levels in the release flows were recorded. As the lake neared its bottom, the turbidity was about 100 NTUs. As the last of the pool disappeared and Fall Creek reclaimed its original channel, the turbidity suddenly rose to over 600 NTUs. For construction at Blue River and Cougar, by retaining residual pools and controlling the rate of lake drawdown, the silty and coarser fractions eroded from sediment deposits in the lakes would settle out in the residual pool. Clay-sized particles will stay suspended in the water column and will pass downstream through the system.

Turbidity levels of release flows could reach as high as 100 NTUs as the lake level approaches the residual pool. However, because of the large residual pools, turbidity could be half this amount. Also, erosion control measures such as seeding flood tolerant plants, silt fences, hay bales, or soil cement will be used on exposed sediment deposits considered to be at most risk of erosion to reduce turbidity created by storms during construction.

Subsequent high water events exceeding the capacity of the diversion will cause the flood control pool to rise. These high water events may cause further re-erosion and re-suspension of sediment and associated increases in turbidity levels. The return of the flood control pool to the residual pool level and use of erosion control measures will keep turbidity levels as low as possible.

Turbidity levels may, at times, exceed the state standard (no more than a 10 percent cumulative increase in natural stream turbidity as measured relative to a control point immediately upstream of the turbidity-causing activity) during the initial drawdown and during succeeding storm events during the construction period. Pre-construction monitoring for turbidity is necessary and will be done to establish background levels against which turbidity during construction can be monitored. Further adjustments or erosion control measures would be taken, as necessary, to keep turbidity levels low throughout the construction process. Also, sediment sampling is scheduled to be performed during the next phase of design. This information could be used to estimate the water clarity during reservoir drawdown and the sediment transport/water clarity of the reservoir releases. In addition, hydrographic surveys are scheduled for checking conditions at the diversion tunnel portal, and could be extended to cover the reservoirs to provide additional data.

4.9.3 Biological Impacts. At Cougar, a fish barrier screen, or some other method, will be used to keep bull trout from being transported through the diversion tunnel where mortality is expected to be high.

Some fish and other aquatic organisms may be carried downstream during the initial drawdown of Blue River reservoir. Mortality of fish passing through the diversion tunnel is

expected to be high with survivors likely occupying available habitat downstream. If habitat is not available, these organisms may displace other aquatic organisms already established.

In early August, the warmest daily mean outflow temperature from the residual pool at Cougar would be about 63° F; at Blue River, it would be nearly 70° F. Fall and winter outflow temperatures will be nearly equal for inflow and outflow at both projects. During construction at Cougar, water temperatures at Vida are expected to be reduced from current conditions by 3° F in the fall. During construction at Blue River, water temperatures at Vida, show a 3° to 5° F reduction in the fall. These water temperatures during construction will more closely mimic natural conditions. Warmer temperatures in the spring and early summer will likely encourage spring chinook migration and invertebrate and algae production and generally raise the level of productivity of the streams. Cooler temperatures in the fall will likely decrease early emergence of spring chinook fry.

Riparian and wetland vegetation along the rivers below the projects will be exposed to more natural run-of-river flows during the construction period. Currently, mean flows in August are about 300 ft^3/s in Blue River and about 600 ft^3/s in the South Fork (minimum outflow is 50 ft^3/s at Blue River and 300 ft^3/s at Cougar). During construction, August flows in the Blue River would be about 47 ft^3/s and water levels lowered about 1 foot. In the South Fork, August flows would be about 317 ft^3/s and water levels about 0.3 feet lower. These lower flows would mimic natural conditions and are not expected to significantly impact riparian vegetation. Grasses and forbs would be expected to pioneer into the exposed portions of the riverbed over the course of the summer which is a natural event for non-regulated streams.

Impacts to wildlife from construction of the projects and changes in operation are considered minimal. Neither Blue River or Cougar have established riparian communities along their periphery. The annual drawdown for flood control and operation at full pool during the summer have precluded riparian development along the periphery of these lakes. This lack of riparian habitat limits the presence of aquatic furbearers, amphibians and birds normally associated with riparian habitat fringing a body of water. Lower stream flows downstream of the projects during summer will essentially mimic natural stream flow conditions prior to regulation by the dams. Wildlife species should benefit from a return to natural streamflow conditions during the construction period.

Average monthly flows from Cougar during the first construction year (initial drawdown period) will be about 300 ft^3/s higher than average inflow during December to February, and about 60 ft^3/s higher than inflow during March and April (the allowable rates of flow increase will not be changed). Amphibians which use bodies of water in the floodplain for egg-laying and larval rearing may be adversely impacted by these higher flows. Higher water levels also may result in the formation of ponds elsewhere in the floodplain. The net impact is unknown. The increase in flows (about 30 ft^3/s during February and March) associated with the initial drawdown at Blue River is considered negligible. Flows during the other construction years should be comparable to inflow and impacts should be negligible. Turbidity impacts would be most noticeable in the stream reaches below the projects during the initial drawdown period.

Net impacts on wildlife associated with the streams and ponds downstream of the projects is unknown but would probably be most prevalent during the initial drawdown period.

Staging areas for construction will be temporarily impacted by material storage and heavy equipment usage. These areas will be restored following construction, so consequently, this impact is not expected to be significant. Following construction and refilling of each reservoir, any affected habitats will begin to reestablish and fish and other aquatic organisms will recolonize. The reservoir areas are expected to fully recover from construction impacts within a few years after refilling.

4.9.4 Threatened and Endangered Species. A biological assessment was prepared to determine whether federally listed may be adversely affected by the selected plan (exhibit C). These species include the peregrine falcon, bald eagle, northern spotted owl, Oregon chub, and bull trout. The biological assessment was forwarded to the FWS in September 1994 and concludes that the selected plan is not likely to adversely affect any of these species.

By letter dated November 14, 1994 (exhibit C), the FWS concurred that the proposed action is not likely to adversely affect the peregrine falcon, bald eagle, northern spotted owl, and Oregon chub. Although the FWS concurred that ultimately, the proposed project is likely to benefit bull trout, individual mortality may occur during construction. If bull trout is listed prior to project completion, the Corps must formally consult on the expected impacts to bull trout.

4.9.5 Cultural Resources. In 1993, a preliminary survey revisited previously recorded sites and noted new archaeological sites on the two reservoirs. In 1994, Heritage Research Associates tested and recorded the cultural material located within the sites. Six sites were determined to be in the impact area for Blue River and six sites for Cougar. Three sites for Blue River and 3 sites for Cougar may meet criteria for eligibility on the National Register. For these sites, further testing and evaluation for nomination features, monitoring, and protection/stabilization procedures, if needed, are recommended to ensure compliance with federal historic preservation laws. Monitoring during the drawdown period is recommended for the remaining sites.

4.9.6 Socio-Economic Impacts. There will be no water-related recreational use of Cougar or Blue River Lakes when they are under construction. Forest Service recreational areas will remain open for public use, and some recreationists are likely to continue using the area around the impacted lake for non-water-related recreational activities, even though their recreational experience may be diminished. Any areas determined to be unsafe because of construction or reservoir drawdown will be closed, signed, and/or fenced to preclude access. During drawdown, most recreationists are expected to use an alternative site located in the area, or at another lake. Downstream recreational activities will continue and no safety problems are anticipated because outflows during construction will conform to existing outflow rates for the projects. After construction is completed, recreational use and value will return to pre-construction levels.

Transfer of recreators to alternative sites may result in less recreator demand for goods and services from local businesses in Leaburg, Vida, Blue River, and other communities in the study area. However, construction would contribute to the local economy via direct and indirect increased demands for labor, goods, and services. The employment and business income generated by construction activities in the local area will help offset some of the losses from reduced recreation.

4.9.7 Hydropower Losses. The Cougar powerhouse is expected to be inoperable during construction at Cougar. The annual energy loss is estimated at 148,400 megawatt hours at an annual value of about $3 million. For the entire construction period, energy generation losses are valued at about $11.5 million. The dependable capacity at Cougar (20 megawatts annually) also would be lost during construction. This loss is valued at about $1.5 million annually or about $5.4 million for the entire construction period.

There may be impacts to energy production at EWEB's Leaburg and Walterville facilities during construction. Impacts are expected to occur only in July to October. The average loss in energy production during Cougar construction is about 9,500 megawatt hours annually, valued about $204,000, and during Blue River construction is about 6,400 megawatt hours annually, valued at about $137,800.

4.10 Operational Impacts of the Selected Plan

4.10.1 Biological Impacts. The long-term impacts resulting from modifying release temperatures at Cougar and Blue River were previously discussed in section 3.6 (Environmental Outputs of the Alternative Scenarios) of the main report.

4.10.2 Water Quality Impacts. A concern has been expressed about modifying Blue River and Cougar for temperature control and the subsequent release of surface waters (see EWEB letter September 1994, Exhibit C). EWEB believes that downstream drinking water taste and odor complaints may be correlated with algae blooms in the reservoirs. Complaints are of a "fishy" and "musty" taste or odor (river water) in the finished drinking water. Activated carbon added to the treatment process has been reported to not completely eliminate the problem.

In 1991, water was released from the surface layers at Cougar and an increase in the taste and odor problems at the Hayden Bridge Filtration Plant was reported. Because algae require light for photosynthesis, they are found in the surface layers. As the algae bloom depletes nutrients needed for growth, they die off and their cellular products are released into the water column. These cell products are thought to cause the "fishy" taste and odor. Subsequent succession of other algae species clarifies the water as the summer progresses. There seems to be no other significant blooms and no other periods of time when there are taste and odor problems.

The concern is that using releases from the surface layers of the reservoirs for temperature control will cause intense algae blooms increasing the taste and odor problems at the Hayden Bridge Filtration Plant. Also, additional organic loading may increase water quality treatment costs and reduce compliance with water quality regulations. There are other potential sources which may contribute significantly to the problem such as soil fungi. These may be activated in the soils on the sides of the reservoir by the emptying and filling of the reservoir during normal operations. Correlation between taste and odor problems and the presence of algae may only be coincidental. The literature has not made a clear case for associating algae with taste and odor problems. Additional investigation is needed and will be done to determine whether the current sources of the problem are Blue River and Cougar reservoirs, which furnish only a fraction of the McKenzie River flow, or if there might be other sources of the problem in the McKenzie subbasin. Pre- and post-construction monitoring will be performed from the McKenzie River above the confluence with the South Fork and at intermediate locations below the confluence with Blue River. EWEB will be involved in the monitoring program. If monitoring results indicate an impact will occur, then the associated NED costs will be estimated during the PED phase.

4.10.3 Hydropower Losses. Installation of the SWS at Cougar will increase the headloss at the project and subsequently decrease power production at the Cougar powerhouse. The annual energy generation loss is estimated to be 2,300 megawatt hours valued at $48,000. The annual dependable capacity is estimated to be reduced from 20 megawatts to 19.34 megawatts, valued at about $49,800.

4.11 Coordination and Monitoring

4.11.1 Interagency Committee. An interagency committee will be established for coordination and response to unforeseen problems that may arise during construction. Representatives from ODFW, FWS, NMFS, Forest Service, Oregon DEQ, EWEB, USEPA, and McKenzie Watershed Council have asked to participate.

4.11.2 Temperature and Fishery Monitoring. After construction, a monitoring and evaluation program is necessary to assess the success of modifying temperatures and more importantly, to develop an operational strategy that maximizes fisheries production in the system. Experience in the Rogue River basin indicates that the best operating strategy could not be developed until the temperature control structures were operational and the actual effects on fish populations determined. Once a similar data base is developed for the McKenzie, minor adjustments to operation can be made to compensate for natural factors, such as low water years, that affect fish populations to maximize benefits to fish.

The monitoring and evaluation plan will be developed cooperatively by the Portland District and resource agencies during the next phase of design. It is suggested that temperatures be monitored hourly for 3 years after construction at the face of both dams and at Vida. Existing USGS gage stations would be used to collect this data. Reservoir temperature data also will be gathered to determine the changing temperature profile with the temperature control system in operation. Normal project operations will be maintained during this period. After this monitoring, sufficient data should be available to determine the effectiveness of the system.

Fishery resources should be monitored for a period of 7 years after construction to encompass the full range of life cycle stages. Adult returns to Leaburg are currently being monitored by EWEB and this data would be compared with post-construction data to determine the increase in returns and age composition of the population. Spawning ground surveys conducted by ODFW will be expanded, if necessary, to include upriver areas to determine the change in spawning distribution. ODFW fry counts at Leaburg dam will be used to determine changes in upriver fry emergence timing. If this data is inconclusive, a fry trap would be used in the South Fork to determine emergence timing. As the data is collected, minor operational changes may be made in order to maximize conditions. At the end of monitoring, the best operational strategy that maximizes fisheries production will have been developed.

In addition, this information on the effectiveness of temperature control at the McKenzie projects would be valuable in determining usefulness at other projects.

5. PLAN IMPLEMENTATION

5.1 Design and Construction

A schedule for implementation of the selected temperature control plan for Cougar and Blue River is shown on figure 26. During the next phase of design or preconstruction engineering and design (PED) phase, further detailed site investigation studies and the preparation of a Feature Design Memorandum (FDM) will serve as the basis for preparing plans and specifications PED is scheduled to begin in May 1995 for Cougar Lake and in April 1999 for Blue River Lake. A Value Engineering (VE) study, or cost effectiveness review, will be performed at the beginning of the PED phase. The VE study will be accomplished using technical experts from the Chief of Engineer's Value Engineering study team, Waterways Experiment Station, and the Portland District. Focus items for the VE study include investigating project features to identify potential cost savings and to reduce the overall construction schedule.

During the PED phase, the District will continue to coordinate with the resource agencies and local groups. It is anticipated that many of these agency and group representatives also will be involved with the interagency committee during construction. Examples of items to be coordinated and/or developed include, but are not limited to, any changes to the selected plan that results from the VE study and development of plans for drawdown, disposal of sediment, erosion control, and post-construction monitoring and evaluation.

The Corps would be responsible for preparing detailed plans and specifications necessary to award a contract for construction of the selected plan. Congress would authorize the project and appropriate the funding required for construction of the projects. Construction is estimated to require 47 months at Cougar and is scheduled to begin in April 1998. For Blue River, construction is estimated to require 43 months and is scheduled to begin in April 2002. Construction may take as long as 4 years at Cougar and 3.5 years at Blue River, because of maintaining flood control and utilizing a construction season from about May through October, depending upon rainfall.

5.2 Real Estate Requirements

All the construction right-of-way requirements for the selected plan at the Cougar and Blue River projects are located on federally managed lands within the existing Corps project boundaries. All of the lands within the two project boundaries fall either under the administrative jurisdiction of the Forest Service or the Corps and the construction right-of-way requirements at both project locations include lands under the jurisdiction of both agencies. That portion of the construction right-of-way required as actual sites for both modified intake structures, as well as the exit channel of the diversion tunnel at Cougar and the cofferdam at Blue River, are located on lands which fall under the administrative jurisdiction of the Corps.

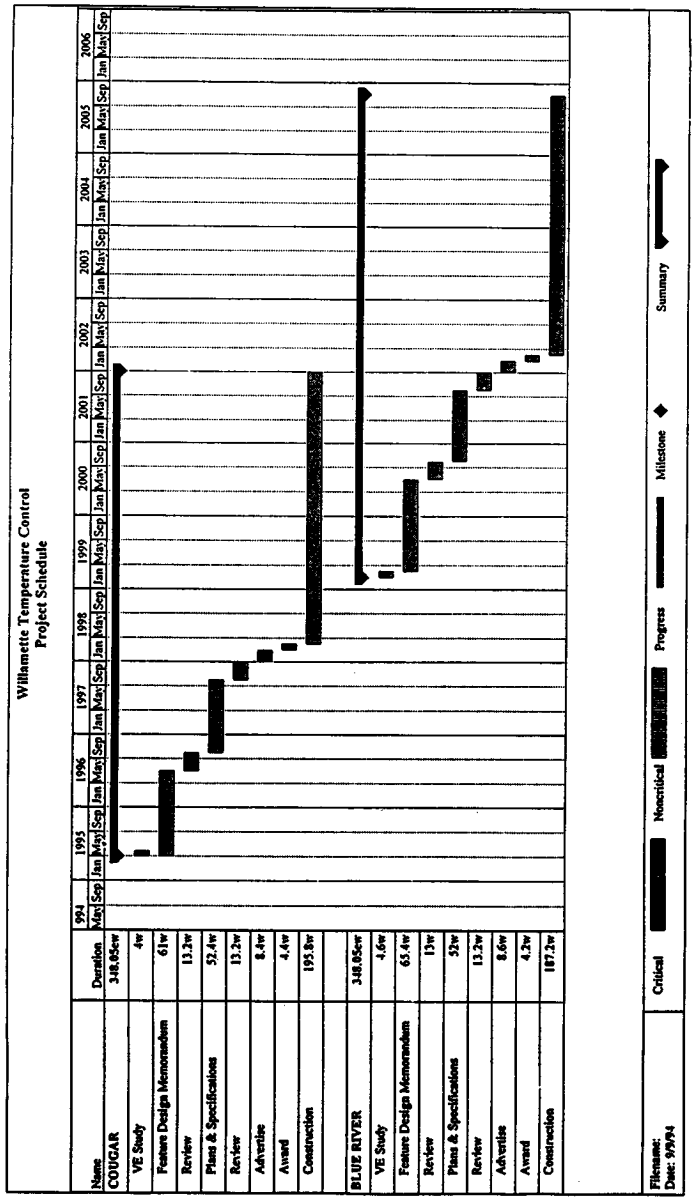


Figure 26 -- *Implementation Schedule for the Selected Plan*

Discussions initiated with Forest Service during the feasibility phase will continue during FDM preparation. A real estate section will be included in each FDM to outline all construction right-of-way requirements involved at the specific project locations. A Memorandum of Understanding (MOU) between the two federal agencies will be developed for each project location (Cougar and Blue River) during the plans and specifications stages to outline specific responsibilities of each agency during construction. These MOU's will grant the Corps and its contractors permission to enter upon, occupy, and use Forest Service lands within the project right-of-way requirement for the purpose of constructing the selected plan. Construction activities will be monitored with relationship to the negotiated MOU's and amendments will be developed, if required.

The construction right-of-way requirements at Cougar Lake include the following areas:

- Land within 300-foot radius of both the existing intake structure and the existing diversion tunnel intake portal (at 6.5 acres each) to be used as active construction areas.

- An approximately 1.6 acre "L" shaped parcel immediately below the diversion tunnel exit portal (located beside the powerhouse) to be used as an active construction area to construct the exit channel.

- A 5.75 acre parcel adjacent to Box Canyon Road about two miles downstream of Cougar Dam (at 3.25 miles by road) is identified as a contractor staging area and disposal area.

- The 1,280 acres within the Cougar Lake maximum conservation pool are also considered part of the total construction right-of-way requirement as the yearly construction season drawdown of the reservoir pool will require use of the exposed lake bed for various construction related activities (i.e. archaeological sites, safety concerns, debris and sediment removal). Access from the contractor's staging area to the various active construction sites is by use of Box Canyon Road and West Side Road. These two roads are Forest Service roads and the particular road segments which are required for the selected plan extend through lands which fall under the administered jurisdiction of either the Corps or the Forest Service.

The construction right-of-way requirements at Blue River Lake include the following areas:

- Land within 400-foot radius of the existing intake structure (at 11.5 acres) to be used as an active construction area.

- A 50 by 150 foot contractor staging area near the existing intake structure access bridge.

- A 1.4 acre parcel of land located approximately 1,000 feet downstream of Blue River Dam to be used as both a contractor staging area and disposal area.

• The 975 acres within the Blue River Lake maximum conservation pool are also considered part of the construction right-of-way requirement as the yearly construction season drawdown of the reservoir pool will require use of the exposed lake bed for various construction related activities similar to those cited for the Cougar Lake location. Access from the contractor's staging areas to the active construction sites is by use of Corps project roads, Forest Service access roads and paved Lane County Road 591.

5.3 Non-Federal Cost Sharing

Non-federal cost sharing is usually required for federal participation for implementation of water resources projects. For a number of years, the issue of project cost sharing has been a concern to various resource agencies and regional interests. For a variety of reasons, many of which are discussed here, these entities believe that the Corps has a residual responsibility at the Blue River and Cougar projects, and that construction of temperature control facilities should be 100 percent federally financed.

By a letter dated March 15, 1994, the Northwest Power Planning Council (NWPPC) formally requested that the Corps reconsider the cost sharing policy for the Cougar and Blue River projects (Exhibit C, Correspondence). Congressional representatives, the State of Oregon, and the McKenzie Watershed Council also recently expressed similar views opposing cost sharing (Exhibit C).

The Corps reconsidered the specific issues relating to cost sharing for the proposed temperature control projects, and as a result, construction costs will be repaid according to the allocations to the original project purposes. This was based on guidance set forth in the Conference Report accompanying the Energy and Water Development Act of 1995. This guidance supports installation of temperature control facilities as project modifications which mitigate for the fish and wildlife impacts on the Cougar and Blue River projects. This decision was made specifically for these two projects and does not represent a change in policy or the establishment of a precedent for other work.

For Blue River, the allocations to the original project purposes include flood control (69 percent), irrigation (29.5 percent), and low flow regulation (1.5 percent). For Cougar Lake, the allocations to the original project purposes include flood control (70 percent), power (23 percent), irrigation (6 percent), and navigation (1 percent).

Costs allocated to power are reimbursable pursuant to Section 10(f) of the Federal Power Act. Energy generated by the Cougar project is marketed by the Bonneville Power Administration to help meet local and regional energy demand within the federal Columbia Power system. Costs allocated to irrigation also are reimbursable, pursuant to Reclamation Law. The Bureau of Reclamation has responsibility for marketing water held in Blue River to individual irrigators or irrigation districts.

6. COORDINATION, PUBLIC VIEWS AND COMMENTS

Coordination with federal and state agencies, local groups, and the public has been ongoing for the Willamette temperature control study since the 1980's. Coordination activities were held in the early 1980's as part of the initial investigations of temperature control in the McKenzie (WSTCS), and as part of the public involvement program for the Willamette River Basin Review reconnaissance study. A series of public meetings were held in March/April 1990 in Eugene, Sweet Home, and Stayton. Comments recorded from these meetings for the McKenzie subbasin were supportive of implementing temperature control at the Cougar and Blue River projects.

Coordination with the fishery agencies (ODFW, NMFS, FWS) and other interested agencies and local groups was maintained throughout the current feasibility study. Letters expressing their views on the proposed projects are found in exhibit C, Correspondence, Volume I. The purpose of these meetings with key agencies and groups are summarized below.

- August 3, 1994: Concerns raised by the Forest Service in their letter dated July 11, 1994.

- April 28, 1994: Plans for diversion during construction at both Cougar and Blue River. The fishery agencies and the Forest Service attended, were discussed.

- January 25, 1994: The purpose of the meeting was to update the resource agencies, the NWPPC and EWEB on the study and to discuss potential project cost sharing.

- December 1, 1992: The purpose of the meeting was to discuss the proposed salmon analysis requirements with NMFS and FWS.

- April 26, 1991: The purpose of the meeting was to initiate early coordination on the feasibility study with ODFW, NMFS, FWS, OWRD, and EWEB.

At an In-Progress Review meeting on July 22, 1993, held with Corps Division and Washington staff, strong support for modification of both projects for temperature control was expressed by representatives of ODFW, NWPPC, FWS, NMFS, and the Columbia Basin Fish and Wildlife Authority. The ODFW, NWPPC, and FWS reiterated their support during a Feasibility Review Conference held with Corps Division and Washington staff on November 1, 1994.

A notice of initiation of the scoping process for the EIS appeared in the Federal Register on February 25, 1993. On February 22, 1993, a news release was widely distributed also requesting scoping comments on the proposed plan. Three letters were received in response to the scoping notice, and all favorably supported the need for temperature control facilities (exhibit C).

The draft feasibility report with draft EIS was distributed for review on January 3, 1995. The notice of availability of the draft EIS appeared in the Federal Register on January 13, 1995, which initiated the 45-day review period. A news release announcing the availability of the draft report and announcing public meetings was released on January 17, 1995.

Public meetings were held on February 7 and 8, 1995, in Springfield and Blue River, Oregon, respectively. Transcripts of the meetings are on file at the Portland District, and a summary of comments is provided in section 5 of the final EIS.

During review of the proposed project by the Forest Service for compliance with the Wild and Scenic Rivers Act, concerns were expressed that conditions in the residual pool at Cougar would not be suitable to maintain the bull trout population found in Cougar reservoir, and that access to upstream spawning areas in South Fork may be blocked by sediment accumulation and/or adverse water quality conditions.

Meetings were held in March 1995 to discuss these concerns with the bull trout working group, a federal/state interagency group formed to recommend ways to protect and enhance bull trout populations in Oregon. Additional investigation of these concerns has been undertaken and a variety of measures are being proposed to minimize impacts to bull trout during construction at Cougar. This information has been added to the final EIS. The final FWS Coordination Act Report is attached to the final EIS and contains the following recommendations:

Recommendation 1: *Complete the McKenzie River Temperature Control feasibility study and seek Congressional authorization and appropriation to implement the project.*

District Response: The feasibility study will be completed in Fiscal Year (FY) 1995. Preconstruction Engineering and Design (PED) is scheduled for initiation in May 1995 for Cougar Lake and detailed design initiated in April 1999 for Blue River Lake. Documentation is being submitted to Congress for authorization and appropriation in the Water Resource Development Act of 1996 to implement the projects (see Section 5.1 of the main report).

Recommendation 2: *Construct temperature control measures at both Blue River and Cougar dams to achieve full potential benefits and reduce the affect all existing project-caused adverse temperature conditions for aquatic resources.*

District Response: Installing a selective withdrawal system at both the Cougar and Blue River projects has been selected as the final plan (see Section 3.6 of the main report).

Recommendation 3: *Develop and implement a monitoring and evaluation plan, in cooperation with the resource agencies, that would be implemented with project operation, to document project accomplishments, identify any shortcomings, and make corrections as needed to achieve the full range of resource benefits.*

District Response: A monitoring and evaluation plan has been incorporated into the proposed projects (see Section 4.11 of the main report). This plan will be developed in cooperation with the resource agencies. An interagency committee will be established for coordination and response to unforeseen problems that may arise during construction.

Recommendation 4: *Fully fund these items as non-reimbursable project costs to the Federal Government consistent with the significant benefits to natural resources of national importance and to support other ongoing basin-wide restoration efforts in the McKenzie River basin.*

District Response: The cost of the temperature control modifications at the Cougar and Blue River projects will be repaid according to the allocations to the original project purposes (see Section 5.3 of the main report). Non-federal cost sharing is not required.

7. CONCLUSIONS

• The study is in partial response to two Congressional resolutions, the Senate Committee on Public Works resolution adopted November 15, 1961, for the Willamette River Basin Comprehensive study, and the House Committee on Public Works and Transportation resolution adopted September 8, 1988, for the Willamette River Basin Review study.

• The objective of the study is to replicate documented pre-project water temperatures downstream from the Corps of Engineers Cougar and Blue River projects.

• These projects have altered downstream water temperatures in the South Fork, Blue, and mainstem McKenzie rivers. Existing temperatures are cooler in the late spring/summer and warmer in the fall/winter than pre-project conditions, which has impacted the ecosystem below these projects. Temperature impacts were not anticipated when the projects were constructed in the 1960s.

• Replicating pre-project temperatures throughout the year requires access to and withdrawal of the warmest water available in the pools. Tributary inflows to Blue River are warmer than at Cougar, and it warms more quickly in the spring. About 43 percent of the warm surface water available in both projects is in the Blue River pool.

• Indicator species selected to characterize the outputs of temperature modifications include Willamette spring chinook salmon, a species being reviewed for listing under the Endangered Species Act; bull trout, a candidate for listing under the Endangered Species Act; and native rainbow trout, an important sport fish. They have a high degree of public interest and represent good ecological indicators for temperature changes because one or more key life stage is strongly temperature dependant.

• Cooler late spring/summer water temperatures impede upstream migration of spring chinook and the growth of native trout, including bull trout.

• Warmer fall/winter temperatures accelerate egg incubation and fry emergence of spring chinook, and subjects the salmon fry to unfavorable conditions such as high flows and scarce food, which leads to their poor survival.

• Alternatives for modifying temperatures include operational changes, a curtain barrier, mixing devices, and a selective withdrawal system. Selective withdrawal is preferred because of its proven reliability, durability, operational flexibility for both cooling and warming release temperatures, and ability to provide target temperatures.

• Alternative scenarios for installing selective withdrawal at Cougar only, at Blue River only, or at both projects were evaluated with respect to their performance in replicating pre-project water temperatures and their environmental outputs for the three indicator species.

• Installing selective withdrawal at both projects was found to significantly improve water temperatures in the South Fork and Blue rivers, and provides the best conformance to meeting pre-project temperatures on the mainstem McKenzie.

• In order to evaluate the benefits to spring chinook salmon production from each of the scenarios, an analysis was performed using life cycle data and estimates of temperature/survival relationships.

• Results show that the Cougar plus Blue River scenario provides the best improvement for salmon fry survival by reducing early emergence and providing better rearing conditions.

• The Cougar plus Blue River scenario was found to maximize the number of annual adult spring chinook returns a relatively low marginal cost per adult return.

• By restoring water temperatures, improved food supplies and growth conditions for resident trout, including bull trout, are expected. As measured by increases in trout growth units, the best improvement is seen in the South Fork, Blue, and mainstem McKenzie rivers when temperature control is installed at both projects.

• For bull trout, water temperatures particularly for adult migration, spawning, and early egg incubation periods in the fall will be substantially improved.

• Based on the results of all analyses, the installation of selective withdrawal at both projects was selected as the final plan.

• Selective withdrawal will be added directly to the existing intake towers and positioned upstream over the regulating outlet works (and power penstock for Cougar). The system operates for flows up to 2,000 ft^3/s at Cougar and 1,000 ft^3/s at Blue River. Beyond these flows, the largest ports will be opened to pass flood flows because the reservoirs will be well mixed and temperature control not required.

• Construction impacts, although major, will last for about 4 years at Cougar and about 3.5 years at Blue River. Construction of each project will be phased to reduce flow and other impacts on downstream watersheds and Willamette system. Maintaining flood control is adding to the overall length of the construction period.

• Summer flows in the mainstem McKenzie may be reduced by about 5 to 20 percent during construction at Cougar or Blue River. There will be times in August and September during average to low flow years when outflow from the projects may fall below minimum levels.

• The summer flow augmentation requirements at Albany and Salem can be met during construction at Cougar or Blue River. Impacts from reregulating other Willamette reservoirs to meet these flow requirements are expected to be minor.

• The initial construction drawdown will expose the original streambed for most of the length of each reservoir, except near the dams where a residual pool will be maintained to essentially eliminate sediment transport out of the reservoirs, reduce turbidity in the water released from the projects during construction, and provide refuge habitat for resident fish and aquatic organisms.

• At Cougar, a fish barrier screen, or some other method, will be used to keep bull trout from being transported through the diversion tunnel, where mortality is expected to be high. A variety of measures are being proposed to minimize impacts to bull trout during construction at Cougar. Some fish and other aquatic organisms may be carried downstream during the initial drawdown at Blue River. Survivors of passage will likely occupy available downstream habitats. Fish mortality is expected to be high.

• The selected plan is not expected to adversely affect federally listed species.

• Recreational areas will remain open for public use, although areas determined to be unsafe because of construction or reservoir drawdown will be closed, signed, and/or fenced to preclude access. Some recreationists and anglers are expected to use an alternative recreational site located in the area, or at another Corps lake.

• The Cougar powerhouse will be inoperable during construction at Cougar, resulting in major losses in electrical energy production.

• During the next phase of design, a value engineering study will be performed to ensure the project is constructed in the most cost effective manner and will focus on ways to reduce the overall construction period. Project coordination will continue with the resource agencies, local groups, and the public.

• An interagency committee will be established for coordination and response to unforseen problems that may arise during construction.

• After construction, a monitoring and evaluation program will be undertaken to assess the success of modifying temperatures and to develop an operational strategy to maximize fisheries production in the McKenzie system.

8. RECOMMENDATIONS

I have given careful consideration to all significant aspects of this study in the overall public interest, including engineering and economic feasibility, as well as social and environmental effects. The selected plan described in this report provides the optimum solution for installing temperature control facilities at the Cougar and Blue River projects in the McKenzie subbasin of Oregon.

I recommend that the existing Cougar and Blue River projects be modified with multilevel, ported intake structures in order to replicate pre-project downstream water temperatures to benefit anadromous and native fish species, especially the Willamette spring chinook salmon and bull trout. Returning to a more natural cycle of water temperatures recreates an important component of the ecosystem required by the aquatic community. The fully-funded cost estimate for installing multilevel intake towers at both projects is estimated at $45 million. The cost of the modifications will be repaid according to the allocations to the original project purposes.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of national Civil Works Construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and/or implementation of funding.

Date: 21 Sept 95

TIMOTHY L. WOOD
Colonel, EN
Commanding

[First Endorsement]

CENPD-ET-PP (CENPP-PR-P/Apr 95) (1105)
Mr. Weaver/kb/(503)323-3826
SUBJECT: Willamette River Temperature Control, McKenzie Subbasin, Oregon, Final Feasibility Report and Environmental Impact Statement

CDR, North Pacific Division, Corps of Engineers, P.O. Box 2870, Portland, OR 97208-2870 24 APR 1995

FOR CDR, USACE (CECW-PW), 20 MASS AVE NW, WASH DC 20314-1000

I concur in the conclusions and recommendations of the District Commander.

ERNEST J. HARRELL
Major General, USA
Commanding

Willamette River Temperature Control McKenzie River Subbasin, Oregon
Final Environmental Impact Statement
Feasibility Report

LEAD AGENCY: U.S. Army Corps of Engineers, Portland District

TYPE OF ACTION: Legislative

ABSTRACT: This Environmental Impact Statement (EIS) for the Willamette Temperature Control, McKenzie Subbasin, Oregon, Feasibility Report, evaluates the impacts of three construction alternatives to replicate the temperatures of the McKenzie River at Vida, Oregon, existing prior to construction of Blue River and Cougar Reservoirs. These alternatives are: to construct a selective withdrawal system (SWS) at Blue River Dam; to construct an SWS at Cougar Dam; and, the preferred alternative, to construct SWS at both Blue River and Cougar Dams on a staggered schedule. The No Action alternative is also evaluated.

Blue River and Cougar Reservoirs were constructed in the 1960's with single re-regulating outlets located at or near the bottom of the dams. The magnitude of impacts to fisheries from a change in temperature regimes of the rivers below the dams were not expected at the time of design and construction. Since construction, cold-water fish habitat above Leaburg Dam has been underutilized, while habitat below Leaburg is over-crowded. Populations of Willamette spring chinook from the McKenzie River Subbasin have declined since the mid-1960's and have remained low since the construction of Blue River and Cougar Reservoirs. In the fall, warmer water remains near the surface until the pools are drawn down for flood control, which depletes the cool water layer and allows the warm surface water to reach the regulating outlets located deep in the reservoirs. Installation of SWS consisting of multilevel intake towers at one or both reservoirs is expected to improve river temperatures for fish.

In order to install SWS, the reservoir(s) would be drawn down, essentially to riverbed with a small residual pool for trapping sediment, from May to October for 4 years. Short-term, adverse impacts would occur during the construction period. These include loss of hydropower and recreation, increases in turbidity, and reduced river flows. After construction, operation of the SWS is expected to closely replicate pre-project temperature regimes of the McKenzie, resulting in greatly increased populations of spring chinook salmon and native trout. Mitigation during and after construction includes monitoring of temperature, flow, and turbidity. A variety of mitigation measures have been proposed to respond to concerns for bull trout during construction at Cougar Lake.

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SUMMARY

Major Conclusions

The preferred alternative for the Willamette Temperature Control Study, McKenzie Subbasin, Oregon, is to install a multi-level, ported selective withdrawal structure (SWS) at the existing intake structure to control release temperatures at both the Cougar and Blue River projects. Construction would occur on a staggered schedule, while maintaining flood control during the construction period. This alternative most closely fits the study objective of replicating target temperatures in Blue River, South Fork McKenzie River, and mainstem McKenzie river at Vida. Once temperatures approximate the pre-reservoir regime, numbers of Willamette spring chinook salmon and native trout are expected to increase significantly in the McKenzie Subbasin.

During construction of a SWS at the Cougar and Blue River projects, river sediments would be removed and placed elsewhere within waters of the United States. A Section 404(b)(1) Evaluation concludes that the preferred alternative would comply with Section 404(b)(1) guidelines. Since the feasibility report/Final EIS will be submitted to Congress for authorization prior to construction, an exemption to obtaining state water quality certification, as provided by Section 404(r) of the Clean Water Act, is being requested.

Areas of Controversy

No areas of controversy were identified during scoping. As the study progressed, the Forest Service expressed concern about construction impacts on the South Fork McKenzie, a potential addition to the National Wild and Scenic Rivers System, as well as concerns regarding recreation impacts during the construction. These issues are addressed in the final EIS.

Issues to be Resolved

The primary issue to be resolved is coordination with the Forest Service regarding consultation on the South Fork McKenzie, a Section 7(b) study river. The Forest Service will issue a determination on diminishment of Segments 2 and 3 of the South Fork McKenzie after the final EIS is filed with the EPA. Additional consultation with the U.S. Fish and Wildlife Service may be necessary if the bull trout, a candidate one species, is listed under the Endangered Species Act prior to construction.

Willamette River Temperature Control
Final Environmental Impact Statement

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Willamette River Temperature Control
Final Environmental Impact Statement

Chapter 1
PURPOSE AND NEED

1.1 Purpose

The purpose of the proposed Willamette temperature control project is to modify temperatures for the Cougar and Blue River projects with the objective of replicating pre-reservoir water temperatures on the South Fork of the McKenzie River and on Blue River, below the reservoirs, and on the mainstem McKenzie River, all in Oregon. The present feasibility report is in partial response to two Congressional resolutions that provide authority for the Corps of Engineers to conduct temperature control studies at the Blue River and Cougar lakes projects, located in the McKenzie Subbasin of the Willamette River basin. These are the Senate Committee on Public Works resolution adopted November 15, 1961, for the Willamette River Basin Comprehensive study, and the House Committee on Public Works and Transportation resolution adopted September 8, 1988, for the Willamette River Basin Review study.

1.2 Need

Construction of Cougar and Blue River reservoirs in the 1960's and subsequent operation altered the temperature regime of the South Fork McKenzie, Blue, and the McKenzie rivers below the projects. Because of reservoir operation for flood control, river temperatures are now warmer in fall and early winter and cooler in spring and summer than they were prior to reservoir construction. These effects are primarily above Leaburg Diversion Dam near Vida. Populations of salmon and resident trout are less than optimal due to the fishes failure to migrate to available habitat on the mainstem McKenzie River above Leaburg. Habitats below Leaburg are overcrowded. Fishery resource agencies' studies indicate that the reason for the underutilization of habitat above Leaburg is due to the change in temperature regime (see FWS 1994, Coordination Act Report).

Construction of the reservoirs reduced existing habitat for anadromous fish. Mitigation was required, taking the form of fish hatcheries further downstream. The McKenzie salmon hatchery was built as mitigation for the loss of salmon spawning habitat resulting from inundation by the Blue River and Cougar dams. The run eliminated by Cougar Dam was estimated at 3,860 adult chinook, and at Blue River Dam, 200 adults. The Corps mitigation was for 4,060 adult chinook salmon. This fulfilled the Corps obligation for mitigation at that time. However, because of unforeseen impacts of operation, available stream habitat is not fully utilized due to temperature changes. Therefore, restoring stream temperatures in South Fork McKenzie, Blue, and the mainstem McKenzie rivers is needed.

Chapter 2
ALTERNATIVES

2.1 Introduction

The Willamette System Temperature Control Study (WSTCS), McKenzie River Subbasin, was initiated by the Portland District, Corps of Engineers (Corps) in August 1982 to address the concerns of federal and state resource agencies about project effects on water temperatures downstream of dams. The study was to be conducted in phases. Phase I was a baseline technical description and analysis of temperature effects of current operations and the potential of meeting temperatures recommended by resource agencies using selective water withdrawal facilities. The Phase I study report (Corps, 1987), found it possible, using multilevel water withdrawal towers, to discharge water for the Blue River and Cougar projects at or near recommended temperatures without modifying the release schedule of either project.

Phase II (Corps, 1988, unpublished letter report) evaluated the technical and economic viability of different alternatives. These included dual and single wetwell structures, towers with six and nine ports, streambed modification and other methods. Various structural designs were assessed. These included dual wetwell tower (ported), single wetwell tower (ported), single wetwell tower with weir, fabric weir, telescoping tower, leaning tower, sloping tower and down draft mixer. These were evaluated by a team of experts; the last four designs were determined to be inappropriate at Blue River and Cougar projects. Dual wetwell towers were also rejected because they were more expensive to build and maintain, while offering only a little more effectiveness than a single wetwell. Streambed modification was determined to be inappropriate because temperature gains obtained from widening the streambed would not be commensurate with environmental effects. The three remaining structural designs (single wetwell ported tower, single wetwell tower with weir, and fabric weir) were recommended for further evaluation.

2.2 Alternative Measures Considered

Proceeding from the alternatives recommended for further study in the interim studies, the main report evaluates nonstructural and structural alternatives to achieve the pre-project temperature modifications.

Two types of mixing devices were considered to modify the water temperature of releases from the Blue River and Cougar projects: localized mixers and deep tube mixers. Using mixing devices to modify release water temperatures may be less expensive and cause fewer construction impacts than other structural methods. Localized mixers are most appropriate for low head projects with small discharges and would not be effective at Cougar and Blue River projects because of their depth. Deep tube mixers are similar to localized mixers, but water is delivered to the level of the intake through a vertical series of telescoping pipes. Deep tube

mixers would allow for access to warm surface water at the projects throughout the year. However, the mixer's discharge end is not physically connected to the regulating outlet, and warm surface water delivered by the deep tube mixer and cold hypolimnetic water would be withdrawn through the intakes. This may induce substantial mixing of surface and hypolimnetic water. This internal mixing of in-lake thermal resources is likely to reduce the effectiveness in warming water temperatures during the spring and cooling water temperatures in the fall. Control over the quantity and thermal characteristics of releases must be maintained, and a deep tube mixer would not provide a high level of control or operational flexibility. This alternative is still in the conceptual stage and has not been tested in the laboratory or applied in the field. Because of the lack of experience with deep tube mixers' structural feasibility and design, they were not considered further in this study.

In addition to alternative designs, consideration has been given to implementation alternatives. These are to construct a selective withdrawal structure at one project only; construct both projects simultaneously; construct both projects on a staggered schedule (i.e., construct Cougar, and when complete, construct Blue). Consideration has also been given to construction with or without maintaining a summer conservation pool.

The No Action alternative is a continuation of the existing situation, with no construction of temperature control towers at either project. This is described in the main report as the "without-project condition" and in Chapter 3 of this Final EIS.

2.3 Plans Eliminated from further Consideration

Construction of both projects simultaneously has been eliminated from further consideration in order to maintain options of utilizing one reservoir to provide low flow augmentation while the other project is under construction. Construction without operation for the projects' authorized purpose, flood control, has also been eliminated from further consideration. Although this may allow for a shorter construction period, flood impacts on the McKenzie River and the Willamette, especially in the Eugene/Springfield area, would be too severe. Construction while maintaining a summer conservation pool has also been eliminated because water temperatures in the pool would get too warm due to solar heating, adversely affecting downstream fisheries, and because of the risk of flooding the construction work area.

Also eliminated from further consideration is an operational change of keeping the pools at or near minimum flood control pool, except during floods, with reservoir releases during non-flood periods held at inflow levels. This was eliminated because operational changes would not meet the study objective of modifying water temperatures to replicate pre-project conditions. Some partial improvement in release temperatures may be possible using operational changes. However, changing the operation of the reservoirs does nothing to alter the location of the warm water layer or the regulating outlets located deep in the reservoirs. Non-flood control authorized purposes (power, navigation, irrigation) also would be foregone.

2.4 Preferred Alternative

The preferred alternative is to install a multilevel, ported intake structure (also referred to as a selected withdrawal system, or SWS) to the existing structure for temperature control at both the Blue River and Cougar projects, on a staggered schedule, while maintaining flood control during the construction period. A staggered schedule reduces downstream flow impacts, which would be severe if both projects were constructed simultaneously, and helps with low flow augmentation for the McKenzie River. A summary of the design elements and construction activities follows with more detail in the Feasibility Report, Volume I, and Volume II, Technical Appendices B and C. Proposed construction schedules are dependent on actual weather conditions during construction. During dry years construction could occur over more months; for wet years, the construction period would be shortened.

2.4.1 Blue River Lake.

a. Project Features and Operation. Under the proposed action, a multilevel intake structure would be attached to the existing intake tower and positioned over the existing regulating outlet works. The intake structure would be a rectangular tower, constructed of reinforced concrete, with seven ports designed to withdraw water to control reservoir discharge water temperatures. Two bypass ports would provide both temperature control and flood discharge capacity. All nine ports would discharge into a single wet well in the new intake structure, thence to regulating outlet. All of these ports would be used to selectively withdraw and mix water from different temperature strata in the reservoir. The existing concrete trashrack would be replaced with a similar one with the same level of protection.

This system would be operated to modify project outflow temperatures to approximate the temperature conditions before the dam was constructed. The new structure would allow outflow temperature control for discharges up to 1,000 cubic feet per second (cfs). Above 1,000 cfs the two bypass ports would fully open to pass flood flows to the existing regulating outlet. This would allow the existing regulating outlets to bypass the multilevel intake structure and operate to the full capacity of the structure. For flows this large the pool is well mixed and operation for temperature control is not required.

b. Construction. In order to construct the intake tower, lake levels at Blue River reservoir would be reduced initially from elevation 1,180 (flood control pool) to elevation 1,132, with no storage capacity. A portion of the new tower structure would be founded on the floor of the intake channel just upstream of the outlet. A rockfill cofferdam (60 feet long by 130 feet wide at the base) would be placed upstream of the dam. The cofferdam would have a top elevation of 1,152. Water would be diverted through two 72-inch conduits from the upstream face of the cofferdam to one or both of the regulating outlets. The diversion would pass inflow to 800 cfs at 16 feet of head. The channel floor would then be dewatered (via pumps) and prepared for foundation placement. It is estimated that about 500 cy of

sediment will need to be removed from the channel floor during foundation preparation. When the diversion cannot safely maintain the pool below the construction, the contractor must evacuate the construction site and the project will begin flood control operations. Construction will resume when the diversion is able to safely maintain the pool below the level of construction. A residual pool about 40 feet deep with 40 surface acres and nearly 1,000 acre-feet of volume would be maintained behind the cofferdam to trap sediment. The project would be run-of-river (inflow equals outflow) during construction and essentially at streambed above the residual pool.

Initial pool drawdown would occur in the spring of the first year of construction (2002). Construction would begin in May. By December, the tower would reach elevation 1,110; normal flood control function of the reservoir would resume at this time and construction would cease. Run-of-river operation would begin again in about April. The tower would top out in May of the fourth construction year. During the last construction year (2005), the reservoir would again be drawn down to run-of-river to install gate hoists and operating equipment. The cofferdam and conduit pipe would be removed. The reservoir would return to normal (flood control) operation by about November 2005.

Three construction laydown areas are anticipated: a 60,000 square foot (1.4 acre) site immediately downstream of the dam, a 500,000 square foot (11.5 acres) site within 400 feet of the existing intake structure, and a 7,500 square foot (0.2 acre) site near the intake structure access bridge.

c. Operation During Construction. During construction of intake towers at Blue River Lake, the project would be operated for flood control if necessary, though due to the low rainfall it is not probable that flood control will be required. During the winter flood control season a minimum flood control pool (elevation 1,180) would be maintained, with flood flows released through the regulating outlet at the normal maximum rate of 3,000 cfs per day. At elevations above 1,180, the diversion would be closed and the regulating outlet used to pass outflow until use of the spillway is required. Instead of beginning to refill the conservation pool in February, as is the normal practice, the reservoir would be drawn down at this rate to run-of-river by May, with the cofferdam and conduits handling any expected summer storm flows.

During the construction of intake towers at Cougar Reservoir, the Blue River project would be operated within its rule curve, but may be drawn down earlier in the summer to augment flows in the Willamette River. Operation of Blue River and other Willamette River projects to avoid less than minimum flows at Salem has been analyzed by the Corps' reservoir Regulation staff. During average and low flow years, Hills Creek, Lookout Point and Cougar reservoirs would release water earlier than usual to augment flows in the Willamette River while Blue River Lake is drawn down for construction.

2.4.2 Cougar Lake.

a. Project Features and Operation. Under the proposed action, a multilevel intake structure would be attached to the existing intake tower and positioned over the existing regulating outlet works and power penstock. The intake structure would be a rectangular tower, constructed of reinforced concrete, with eight ports designed to withdraw water to control reservoir discharge water temperatures. Two larger ports, located at elevation 1,475 feet and opposite the existing regulating outlets, would provide both temperature control and flood discharge capacity. All 10 ports would discharge into a single wet well in the new intake structure, then to the power penstock. The ports would be controlled by slide gates to allow selective withdrawal of water from the different temperature zones in the reservoir. Three types of trashracks (coarse fixed, fine and floating) would be provided. The multilevel intake structure would not preclude the installation of a second penstock, although it is not required to supply water to the second penstock at this time.

This system would be operated to modify project outflow temperatures to resemble the conditions before the dam was constructed. The new structure would allow outflow temperature control for discharges up to 2,000 cfs. Above 2,000 cfs the two bypass ports would fully open to pass flood flows to the existing regulating outlet. This would allow the existing regulating outlets to bypass the multilevel intake structure and operate to the full capacity of the structure. For flows this large the pool is well mixed and operation for temperature control is not required.

b. Construction. In order to construct the intake tower, lake levels at Cougar Reservoir would be reduced initially from elevation 1,532 (minimum flood control pool) to elevation 1,350. It is proposed to reopen the diversion tunnel used to divert the South Fork McKenzie when the reservoir was constructed in 1962. Sediments and debris in the pool blocking the tunnel would be removed and deposited within the upstream pool area. The amount of sediments to be removed or their composition is not known, but they are expected to be uncontaminated, fine sediments approvable for instream deposition. Cougar Lake would be drawn down via regulating outlet at normal flood control season rates of 5,000 cfs. Once the diversion tunnel has been cleared and opened, the remainder of the pool would be drawn down to elevation 1,350 at a rate of 2,000 cfs. Drawdown would occur in the spring of the first year of construction (1998). Flows during construction would be regulated by control structures in the diversion tunnel.

A residual pool would be maintained at elevation 1,350 to trap sediments and provide habitat for bull trout. This pool would be about 80 surface acres and about 76 feet deep with nearly 3,000 acre-feet of volume. The diversion tunnel intake would be screened to prevent bull trout from exiting the residual pool. The project would be run-of-river (inflow equals outflow) during construction and essentially at streambed above the residual pool.

Mean monthly river flow is 1,400 cfs in May and 900 cfs in June and less than 400 cfs from July through September; however, most of the flow is concentrated in a few storm events. The design of this diversion scheme would operate for flows to 2,000 cfs. A flow of 2,000 cfs provides sufficient capacity to operate the project with the diversion tunnel. During diversion the pool would be regulated between the entrance of the Rush Creek diversion tunnel at elevation 1,450 feet and the upstream portal to the main diversion tunnel at elevation 1,290 feet. The storage between these elevations should provide some protection for the construction. Large events exceeding the capacity and storage during diversion would be controlled with the regulating outlet.

Flood control function would be maintained. During summer floods, construction would cease any time reservoir levels above 1,450 were predicted. Flood waters would be released via the diversion tunnel at the 2,000 cfs rate, and the lake would be drawn down so that construction could resume. Construction would not occur during the normal flood control season (October-March); however the pool would be kept as low as feasible without increasing downstream flooding so that drawdown for the next construction year would be timely. It is expected that for the first year, the tower would be constructed to elevation 1,470; by the third year, the tower would be "topped out" to elevation 1,705. During these construction years, the reservoir pool would be kept at elevation 1,450 except when flooding was expected. The fourth year of construction, the reservoir would be drawn down to elevation 1,350 in order to install control gates, weirs, and operating equipment. The reservoir would be returned to normal operation (i.e., flood control) by about September of the fourth year (2001).

The exit channel of the diversion tunnel, beside the powerhouse, would require excavation and installation of slope protection (riprap) in order to accommodate flows up to 2,000 cfs.

Three construction laydown areas are anticipated: a 250,000 square foot (5.7 acres) site at rivermile 2.5 of the South Fork McKenzie at the construction site used when Cougar Dam was constructed (Strube Flat), and two 280,000-square-foot (6.4 acres each) sites near the intake structure and the intake portal.

c. Operation. During construction of intake towers at Cougar Lake, the project would be operated for flood control when necessary. During the winter flood control season a minimum flood control pool, with usual fluctuating levels, would be maintained. Flood flows would be released at the normal maximum rate of 5,000 cfs. Above pool elevation 1,510, the diversion would be closed and outflows passed through the regulating outlet until use of the spillway is required. Instead of beginning to fill for conservation pool in February, the reservoir would be drawn down to 1,350 by May, with the diversion tunnel handling any expected summer storm flows.

During the construction of intake towers at Blue River Reservoir, Cougar project would be operated within its rule curve, but may be drawn down earlier in the summer. Operation of

Cougar and other Willamette River projects to avoid less than minimum flows at Salem has been further analyzed by the Corps' Reservoir Regulation staff. During average and low flow years, Hills Creek, Lookout Point and Blue River reservoirs would release water earlier than usual to augment flows in the Willamette River while Cougar Lake is drawn down for construction.

2.5 Monitoring & Evaluation

Two phases of monitoring would be implemented. Preconstruction monitoring is planned to measure conditions such as turbidity and algae. Turbidity, erosion rates, construction traffic and safety issues would be monitored during construction. Other monitoring may be included in the Memorandum of Understanding with the Forest Service.

A monitoring and evaluation plan would be developed cooperatively by Portland District and resource agencies during the next phase of design (Preconstruction Engineering and Design) and implemented after construction. Reservoir temperatures and river temperatures at the dams and downstream would be monitored. Fishery resources would also be monitored. Results of this monitoring could lead to minor operational adjustments to maximize desirable conditions for fish. See Section 4.11 of the main report for more details.

2.6 Coordinating Committee

The construction scenarios are based on available information average seasonal conditions. A coordinating committee consisting of representatives of the U.S. Fish and Wildlife Service, EPA, National Marine Fisheries Service, the Corps, the McKenzie Watershed Council, Oregon Department of Fish and Wildlife, Oregon Water Resources Department, Oregon Department of Environmental Quality, and other relevant agencies, will be established prior to construction. During construction, if unanticipated events occur, this committee would evaluate the situation and make recommendations.

2.7 Alternatives Comparison

Table 2-1 summarizes and compares the impacts of the alternatives (construct at Blue River Dam, construct at Cougar Dam, the preferred alternative of constructing at both projects on a staggered schedule, and No Action). These impacts are described in Chapter 4 of the EIS.

2.8 Mitigation

Mitigation measures are those measures not already incorporated into the alternatives that could mitigate otherwise unavoidable adverse impacts. During the feasibility study, various proposals, such as monitoring plans, residual pools to trap sediments, and the coordinating committee have been incorporated into the alternative scenarios.

Concerns have been expressed that conditions in the residual 80-surface acre pool that would remain in the summer during construction at Cougar would not be suitable for bull trout survival. Even if they can survive, they would be trapped in the reservoir and unable to migrate to upstream spawning areas. These concerns have been evaluated, and a variety of measures are being proposed to respond to these concerns. Resolutions to these and other unforeseen problems would be handled during construction by an interagency coordinating committee so that problems can be coordinated with all involved agencies and handled quickly. The proposed construction scenario was discussed with the bull trout working group, an interagency group formed to recommend ways to enhance bull trout populations. Several possible mitigation measures were discussed and proposed. A variety of sediment control methods would be used to stabilize the drawdown zone and reduce turbidity levels in the residual pool. Supplemental food for the bull trout could be provided in the residual pool. ODFW has suggested that adult spring chinook could be transported upstream of Cougar to spawn. It is anticipated that fry and juveniles would provide a food supply in the residual pool as they move downstream. Hatchery rainbow trout could also be directly stocked in the residual pool. Either of these methods would assist in providing the food supply necessary for bull trout survival. Supplemental feeding is expected to reduce predation by adult bull trout on younger bull trout to some extent. In addition, it is proposed to place structures for cover for subadults and juveniles in the residual pool to further prevent predation. Possible stranding of bull trout in the upstream passage from the pool could be remedied by dredging out a single channel, placing structures to reduce velocity barriers, and creating pool areas for resting. Velocity barriers may also form in the channel area downstream of the sediment wedge and structures would also need to be placed to make these passable. Temperature refuges could also be provided by artificially shading some of the pools created for passage. Based on incorporating the above measures recommended by the bull trout working group and the agencies, it is likely that only minimal impacts would occur to the bull trout population upstream and that they should survive the construction phase of the project.

Prior to construction, a Memorandum of Understanding would be prepared with the Forest Service addressing land management and safety issues. No additional mitigation measures have been identified.

Table 2-1 -- Summary Comparison of Impacts by Alternative

RESOURCES AND ISSUES	ALTERNATIVES			
		SELECTIVE WITHDRAWAL SYSTEM AT		
	NO ACTION	BLUE RIVER ONLY	COUGAR ONLY	COUGAR & BLUE RIVER
WATER QUALITY				
Turbidity during construction (spring drawdown and 4 major storm events)	No change	Blue River may temporarily exceed state stds 5 times/yr. No change for McKenzie	South Fork may temporarily exceed state stds 5 times/yr. No change for McKenzie.	Same situation as for South Fork & Blue rivers. No change for McKenzie.
HYDROLOGY				
Number of times do not meet minimum flows in Jul/Aug during const	No change	23 times /year	19 times/year	23 times/yr Blue River 19 times/yr Cougar
TARGET WATER TEMPERATURES FOR MAINSTEM (VIDA)				
Percent achievement of targets for spring/summer warming	No change (0%)	31%	53%	56%
Percent achievement of targets for fall/winter cooling	No change (0%)	39%	67%	95%
TARGET WATER TEMPERATURES FOR BLUE RIVER				
Percent achievement of targets for spring/summer warming	No change (0%)	90%	N/A	90%
Percent achievement of targets for fall/winter cooling	No change (0%)	88%	N/A	88%
TARGET WATER TEMPERATURES FOR SOUTH FORK				
Percent achievement of targets for spring/summer warming	No change (0%)	N/A	83%	83%
Percent achievement of targets for fall/winter cooling	No change (0%)	N/A	71%	71%
SPRING CHINOOK SALMON OUTPUTS				
Fry emergence timing in Blue River (number days improvement)	None	26 to 47	N/A	26 to 47
Fry emergence timing in South Fork (number days improvement)	None	N/A	44 to 48	44 to 48
Fry emergence timing at Vida (number days improvement)	None	1 to 5	9 to 12	13 to 17
Avg. annual adult returns to McKenzie (number additional fish)	0	4,400	8,100	16,700
Thermal potential for fish movement (hours > 52°F)	35	48	66	89
NATIVE RAINBOW TROUT OUTPUTS				
Trout growth units at Vida and percent improvement	1460 (0%)	1492 (+2%)	1572 (+8%)	1604 (+10%)
Trout growth units in Blue River and percent improvement	1383 (0%)	2229 (+61%)	N/A	2229 (+61%)
Trout growth units in South Fork and percent improvement	1095 (0%)	N/A	1758 (+60%)	1758 (+60%)
BULL TROUT OUTPUTS (South Fork and Mainstem only)	12 to 20°F	N/A	5 to 12°F	5 to 12°F
Improvement in life stage temperatures	Higher than optimum		reduction	reduction
RECREATION				
Total days lost during project construction	None	11,840	25,368	37,208
Total days devalued during project construction	None	36,016	118,004	154,020
Total days transferred during project construction	None	178,568	374,680	553,248
WILD AND SCENIC RIVER VALUES (South Fork Only)	No change	No change	S. Fork temporarily degraded by turbidity. Bull trout concerns. Long-term fishery improvement.	Same as Cougar only
ECONOMICS				
Value of total recreation losses	No change	$95,200	$153,528	$248,728
Concessionaire/Forest Service losses during construction	No change	Up to 80% loss total revenue	Up to 70% loss of total revenue	Up to 80% at Blue & 70% at Cougar
Employment during construction	No change	+35 jobs/4 years	+35 jobs/4 years	+35 jobs/8 years
Cougar powerplant losses	No change	No change	148,400 Mwh lost/yr of const or avg. annual loss of $3.19 million. Loss for life of project at $97,800/year.	Same as Cougar only Same as Cougar only
EWEB powerplant losses (sum of avg. monthly losses Jul-Oct)	No change	6,405 Mwh per const year	9,497 Mwh per const year	Same as Blue only & Cougar only
Annual value foregone	None	$137,720	$204,180	Same as Blue only & Cougar only

Chapter 3
AFFECTED ENVIRONMENT

3.1 Willamette Basin Overview

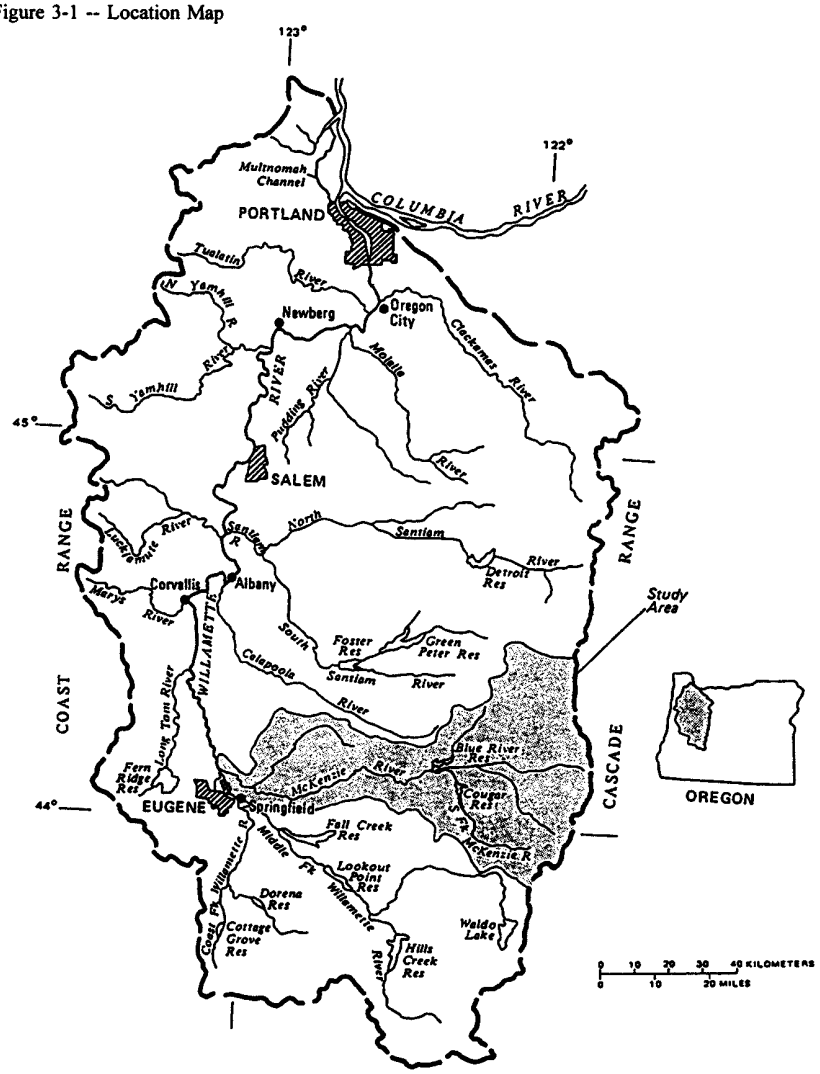
The Willamette River Basin, containing an area of approximately 12,000 square miles, is located in northwestern Oregon (figure 3-1). The basin is bounded on the east by the Cascade Range, on the west by the Coast Range, and on the south by the Calapooya Mountains. The Willamette River is formed by the joining of the Middle and Coast Forks in the southern end of the valley near Eugene. From there, it flows northward for 187 miles to join the Columbia River. The major tributaries rise in the Cascade Range and enter the river from the east. These include the Middle Fork Willamette, McKenzie, Santiam, Molalla, and Clackamas rivers. West-side tributaries heading in the lower-elevation Coast Range include the Long Tom, Marys, Luckiamute, Yamhill, and Tualatin rivers.

There are 13 Corps reservoir projects within the Willamette River Basin. Operation of the Willamette Basin projects is based on the Flood Control Act of 1938 and subsequent authorizations. The general objective for reservoir regulation of these 13 Corps dams is to provide a maximum degree of flood protection by operating the reservoirs to control runoff caused by concentrated storm events and/or rapid snowmelt conditions. A significant level of flood protection has been achieved by virtue of these storage projects at strategic locations on major tributaries. The reservoirs also provide water for irrigation, municipal and industrial water supply, low flow augmentation for water quality and fish, and recreation.

Eight Corps' multiple-purpose projects in the Willamette Basin contain power generating facilities, three of which are re-regulation dams. Releases made from the power projects are utilized to generate electrical energy for local and regional consumption. Energy generated by the Corps' Willamette projects is marketed by Bonneville Power Administration to help meet local and regional energy demand within the Federal Columbia River Power System.

Minimum reservoir releases have been established at each of the Corps' Willamette projects to help maintain in-stream flows. These releases were established in the interest of protecting fish habitat and also to accommodate existing rights of access to natural streamflows. Storage releases from the Corps' reservoirs also augment channel depths for navigation and have helped to reduce levels of pollution that formerly prevailed in the basin streams. Over time, water quality has become an important state and federal objective. Flows of 5,000 cfs and 6,500 cfs are maintained at Albany and Salem, respectively, to help ensure water quality in the river. Flow augmentation also benefits wildlife and the resident and anadromous fish which inhabit the system. The general increase in water quality resulting from streamflow augmentation has improved fishery habitat and helps to facilitate the migration of anadromous species. Spring chinook salmon provide a significant recreational fishery in the Willamette and lower Columbia River, as do winter and summer runs of steelhead.

Figure 3-1 -- Location Map



In summary, the authorized storage projects within the Willamette Basin serve a variety of beneficial purposes. The coordinated operation of individual units to serve system needs is a critical factor in the management of the water resources in the basin. (The preceding and following information is taken from a variety of existing Corps documents, both published and non-published. These include interim reports in 1987 and the 1991 Willamette River Basin Review Reconnaissance Study.)

3.2 McKenzie River Subbasin Including Blue River and Cougar Reservoirs

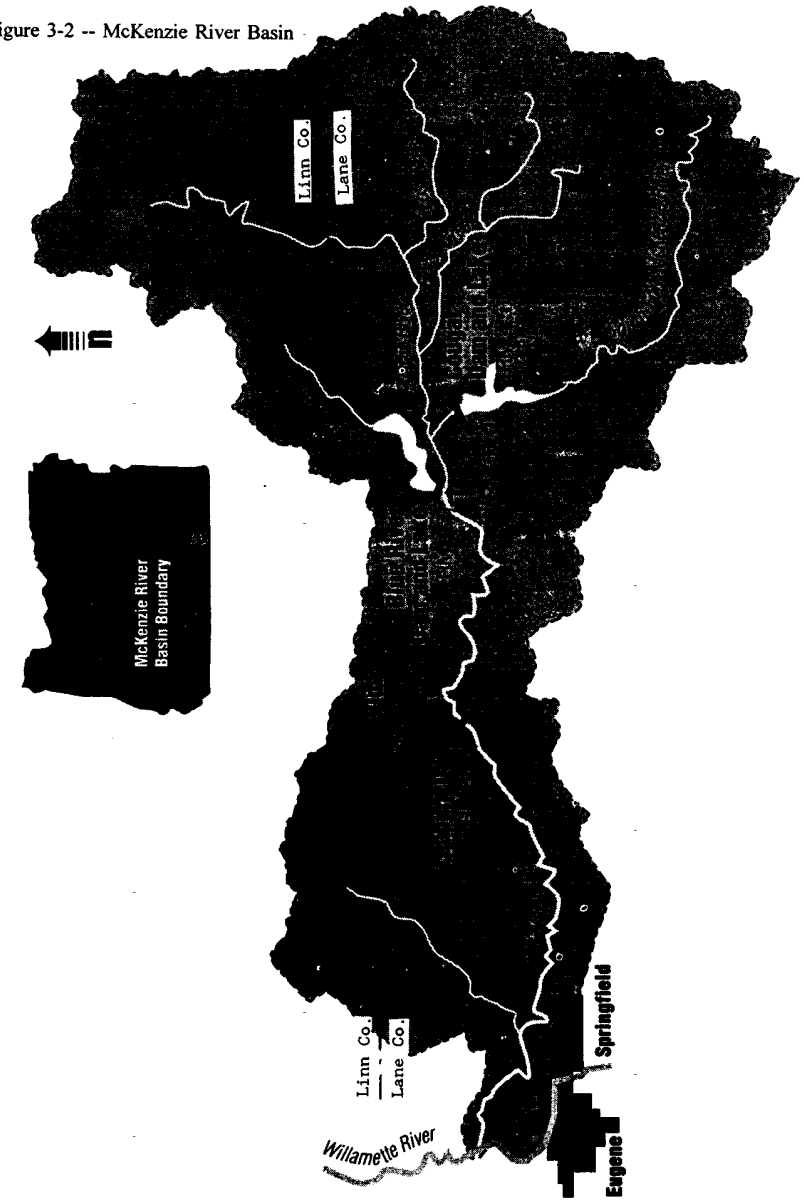
The McKenzie River system is a subbasin of the Willamette River Basin. The drainage area of the subbasin is 1,342 square miles, most of which is mountainous with elevations above 2,000 feet, and comprises 12 percent of the Willamette Basin. It is bounded on the east by the Cascade Range, on the north and south by foothills of the Cascade Range, and on the west by the Willamette River. Approximately 90 percent of the basin is above 1,000 feet NGVD (National Geodetic Vertical Datum) and 70 percent is above 2,000 feet. Extremes within the basin range from 350 feet near the mouth of the McKenzie to 10,354 feet at the summit of North Sister (Oregon State Water Resources Board, 1961, cited in Corps, 1987). The length, elevation drop, and average gradient of the major tributaries of the McKenzie are shown in table 3, in section 2.3 of the main report.

The McKenzie River Subbasin has a temperate marine climate, characterized by relatively wet winters and dry summers. About 80 percent of the normal precipitation falls between October and May. Mean annual rainfall ranges from about 39 to 51 inches near Eugene to about 110 inches at the headwaters of Blue River. The normal annual air temperature at Mahlon-Sweet Airport in Eugene (the nearest first-order weather station) is 53.5° F. Normal monthly temperatures range from 40° F in January to 61° F in July. Extremes range from -12° F to 108° F. The normal annual windspeed is 11 feet per second (f/s). Normal monthly windspeed ranges from 9.8 f/s in October to 12.5 f/s in March. The maximum windspeed of at least 1-minute duration was 92 f/s (USGS, 1988).

The McKenzie River originates in the Cascades and flows west for 90 miles before joining the Willamette at RM 175 near Eugene. Gradients are moderate to steep with abundant sources of spawning gravel. Summer flows are high, partially due to the extensive lava beds in the headwaters acting as subsurface reservoirs. Average discharge is 6,000 cfs. Most streams are cold with temperatures rarely exceeding 65° F except in the lower watershed.

The majority of the subbasin is located in Lane County, Oregon, with a small portion in Linn County (figure 3-2). The largest city in the subbasin is Springfield with a population of 44,680 (1990). Immediately to the west is Eugene, with a 1990 population of 112,670 (Oregon Employment Division, 1992). The primary economic base is the lumber industry. The extensive fish and wildlife resources and natural areas contribute to a significant recreational economic base.

Figure 3-2 -- McKenzie River Basin



3.2.1 Major Tributaries. The McKenzie River originates at Clear Lake (at RM 89.6 in the northeast corner of the basin). It flows southward for approximately 15 miles and then turns westward for 75 miles to its confluence with the Willamette River. Approximately 8 miles south of Clear Lake (at RM 81.9), the McKenzie River is joined from the north by the Smith River. Seventeen miles south of Clear Lake, the McKenzie River is joined from the south by Lost Creek. Six miles farther downstream, just past McKenzie Bridge, the river is joined from the south by Horse Creek, which is fed by Separation Creek. Six miles downstream from the confluence of Horse Creek, the South Fork McKenzie joins the McKenzie, again from the south. Two and a half miles farther downstream, the McKenzie is joined from the north by Blue River. The next major junction is with Gate Creek, from the north, at Vida, 14.2 miles downstream from Blue River. The final tributary of the McKenzie River at RM 13.7 is the Mohawk River.

3.2.2 Hydropower. The steep gradients and the large volume of runoff (more than 3.9 million acre-feet, or 16 percent of the Willamette River flow) contribute to the value of the system as a hydroelectric resource. There are eight water development projects in the system. Two are multi-purpose projects administered and operated by the Corps of Engineers. The remainder are owned and operated by Eugene Water and Electric Board (EWEB).

The hydropower project farthest upstream is EWEB's Carmen-Smith project, near Clear Lake. Water is withdrawn from the McKenzie below Koosah Falls (RM 87.6) and diverted to Smith Lake on the Smith River. EWEB uses the water as it passes from Smith Lake to the Trail Bridge project to produce power. Trail Bridge is a reregulating project used to dampen the daily fluctuation in stream flow caused by cyclic releases from Smith Lake. Carmen and Smith projects are small; usable storage capacity is 300 and 9,900 acre-feet, respectively.

The next EWEB project is Leaburg Dam at RM 38.8, which diverts water into the Leaburg Power Canal for hydro-power generation. Water from the Leaburg Canal is returned to the McKenzie at RM 33.2. EWEB again diverts water from the McKenzie into the Walterville Power Canal at RM 28.5. Water from this canal is returned to the McKenzie at RM 20.9.

Two additional hydropower projects for the McKenzie River system have been authorized by Congress. Both are modifications to the existing multi-purpose projects. The addition of a third generating unit at Cougar and the construction of Strube Dam and Lake as a reregulating facility to even out the flows from peaking operations at Cougar has been proposed (Corps, 1979). Strube Dam is in inactive status.

The construction of two Francis turbine generator units with an installed capacity of 29-Megawatts, a sloping gate structure, a 10-foot-diameter penstock tunnel, powerhouse, and a tailrace channel have been proposed for Blue River Lake. EWEB has received a license from the Federal Energy Regulating Commission to construct this project. However, the project is currently on hold.

3.2.3. Existing Corps Projects. Cougar and Blue River are the two multi-purpose Corps projects in the McKenzie subbasin. Cougar Dam was completed on the South Fork McKenzie in 1963 and on Blue River in 1968. The Blue River project does not have fish passage facilities. Cougar has an adult collection facility and a juvenile downstream migrant collector. Neither facility was very effective and are currently not used. Mitigation for lost upstream production is provided by hatchery releases.

3.2.4 Blue River Dam and Reservoir. Blue River Dam is on Blue River at RM 1.8, about 42 miles east of Eugene and about 1.5 mile north of the town of Blue River on U.S. Highway 126. Blue River Dam consists of a 270-foot-high (above streambed), rock-filled embankment, a gate-chute spillway, a concrete intake structure, a regulating outlet tunnel, and a stilling basin. A 70-foot-high embankment, about 4 miles east of the main dam, closes a small saddle along the left shore of the lake. The main dam is 1,250 feet long, and the saddle dam is 1,535 feet long.

At full pool, Blue River Lake is 6.4 miles long and 0.7 miles wide, with a surface area of 1,280 acres. It is about 200 feet deep near the regulating outlet when the pool is at 1,357 foot elevation (maximum conservation pool). There is about 4,000 acre-feet of dead storage in the lake. The lake provides 89,520 acre-feet of storage at full, of which 85,000 acre-feet is usable flood storage. This includes 6,300 acre-feet storage for summer flood control. The lake is normally maintained at an elevation of 1,350 feet for conservation purposes.

The rule curve (seasonal regulation schedule) for Blue River Lake is illustrated in figure 11 in the main report. Filling begins February 1 at a rate not to exceed 1,183 acre-feet per day. Between March 1 and May 10 the lake is filled at a rate of 643 acre-feet per day. Between May 10 and September 1, the lake is held at an elevation of 1,350 feet and inflow matches outflow with the provision that a low water release of 50 cfs is maintained. Between September 1 and November 15 the lake is drawn down at a rate not to exceed 1,037 acre-feet per day. During the major flood season (November 15 to February 1), the lake is periodically drafted to minimum flood control pool (El. 1,180) to provide sufficient storage capacity to control floods.

3.2.5 Cougar Dam and Reservoir. Cougar is on the South Fork McKenzie River at RM 4.5, about 42 miles east of Eugene. Cougar Lake Dam is a rock-filled dam with an earth core. It is 519 feet high (435 feet above streambed) and 1,600 feet long. It has a gated spillway at the right abutment, power and outlet tunnels through the left abutment and a powerhouse with an installed generating capacity of 25,000 kw. There are two Francis turbines of 12,500 kw capacity each and provisions for installing a third unit of 35,000 kw for future peaking capacity. The authorized reregulating dam (Strube) would be necessary for peaking at Cougar. Cougar Lake is 6.5 miles long at full pool and about 330 feet deep near the face of the dam. The lake has 54,170 acre-feet of dead storage and 207,970 acre-feet of storage at elevation

1,690 feet (Maximum Conservation Pool). Full pool is at 1,699 feet elevation and will store 219,270 acre-feet with a usable storage capacity of 165,100 acre-feet. This includes 11,300 acre-feet of storage that is reserved for summer flood control.

The rule curve (seasonal regulation schedule) for Cougar Lake is illustrated in figure 11 in the main report. Filling begins on February 1 with a filling rate of 2,213 acre-feet per day. Between March 1 and May 10 the rate of filling is 1,155 acre-feet per day. Between May 10 and September 1 the pool is held at maximum conservation pool. During this period inflow equals outflow with the provision that a minimum outflow of 250 cfs is maintained. Between September 1 and December 1, water is withdrawn from the lake at a rate not to exceed 1,500 acre-feet per day. Unless there is a need for secondary flood control storage, the lake is periodically drafted to minimum flood control pool (El. 1,532) from December 1 through February 1 to control winter floods.

3.3 Physical Environment

3.3.1 Airshed. The McKenzie River subbasin airshed is generally under the influence of maritime westerly airflow. Historically, the airshed has been affected by smoke from fires (forest fires, slash burning) and by dust from roads and unvegetated fields and disturbed areas. The need to improve air quality in the Willamette Valley led to state laws and smoke management practices. The Oregon Smoke Management Plan was adopted by the Oregon Department of Forestry, federal land managing agencies and the Oregon Department of Environmental Quality in January 1972. The Clean Air Act designated all National Wildernesses established before August 7, 1977, as Class I (allowing the least increases in air quality deterioration). Other lands in the state, including Wilderness additions made after August 7, 1977, are assigned Class II status, with the state having authority to upgrade status. Wilderness additions adjacent to Cougar Reservoir are eligible for reassignment to Class I status. As amended, the Clean Air Act directs federal agencies to comply with state and local regulations directed at preventing and controlling air pollution.

Within the McKenzie subbasin above Leaburg, air quality is generally good, being primarily influenced by smoke from managed slash burns within the Willamette National Forest or from private forest lands. Burning is conducted in accordance with the State Smoke Management Plan. Visibility is monitored on the Wilderness Areas to ensure particulates are not exceeded. Trends point to an improvement in overall air quality due to stricter standards resulting in less slash burning (Forest Service, 1990).

3.3.2 Hydrology.

Flows. Mean annual flows (table 4 in the main report) and extremes for the periods of record of gaging stations at selected locations of the McKenzie River, beginning at the headwaters, illustrate the system's dynamics (Friday and Miller, 1984, cited in Corps, 1987). Mean annual

discharge from Clear Lake is 469 cfs. Maximum discharge was 3,360 cfs on December 23, 1964. Minimum discharge was 137 cfs on September 23, 1977, and November 4, 1980. A brief description of the flows for sections of the McKenzie and its tributaries, beginning at its headwaters, is given below.

Eight miles downstream, below Trail Bridge reregulating dam, the average annual flow increases to about 1,000 cfs. Maximum discharge here was estimated at 11,200 cfs on December 22, 1964. Minimum discharge was 185 cfs on February 3, 1983.

Average annual discharge from Lost Creek is estimated at 713 cfs. There is no permanent gaging station at Lost Creek; thus, extremes cannot be estimated. The average annual flow of the McKenzie increases approximately 70 percent at this junction. A significant portion of the flow in Lost Creek comes from springs draining porous lavas. Water temperatures of Lost Creek and the McKenzie are very similar.

Flows at McKenzie Bridge are reported for the period before and after completion of Smith River and Trail Bridge dams. Mean annual flows before and after completion of these dams were 1,662 and 1,739 cfs, respectively. Maximum discharge was 19,100 cfs on December 22, 1964. Minimum discharge was 805 cfs on October 20, 1931 (Ibid.).

Average annual flow of Horse Creek is approximately 500 cfs. Since the period of record is so short, no extremes are estimated. Horse Creek drains glaciers on South Sister and is similar to Lost Creek in its subbasin hydrology. The average annual flow of the McKenzie increases by approximately 22 percent at this confluence.

Flows from the South Fork McKenzie River are also reported for the period before and after construction of Cougar Lake project. Mean annual flows of the South Fork McKenzie before (1948-1962) and after (1964-1982) the completion of Cougar Dam were 927 and 818 cfs, respectively. Maximum discharge before construction of Cougar Lake was 17,600 cfs on December 11, 1956. Minimum discharge was 17 cfs on November 18, 1965. Extremes since completion were presented only for months of year (Friday and Miller, 1984). These varied from a high of 3,246 cfs during one January to a low of 90 cfs during an April of water years 1964-1982. The average annual flow of the main stem McKenzie is increased by approximately 24 percent at this confluence. The South Fork McKenzie originates in the Cascades and is fed by snowmelt in the spring. Much of the snowmelt reaches the river by way of porous lava beds. Flows are thus sustained throughout the summer months.

Before the completion of Blue River Dam (1936-1964), the average annual flow from Blue River was 393 cfs. Since completion (1969-1982), average annual flow has been 481 cfs. Maximum discharge before completion was 13,300 cfs on December 28, 1945, and the minimum discharge was 11 cfs, August 21, 22, 1961. Extremes after completion of the dam were 7,270 cfs on February 23, 1968, and 0.80 cfs on October 8, 10, 11, 1968 (Ibid.). The

average annual flow of the McKenzie is increased approximately 12 percent by the flow from Blue River. A relatively large portion of the annual yield of Blue River occurs in April and May due to snowmelt. A lack of ground water releases is evident in the low base flow in late summer.

Average annual discharge of the McKenzie near Vida was 4,001 cfs for the period of record before the completion of Blue River, Cougar, and Smith projects (1925-1962), and 4,115 cfs after completion (1964-1982). Maximum discharge was estimated at 64,400 cfs on December 28, 1945. A minimum discharge of 1,260 cfs was observed in 1931 and 1933 (Ibid.).

Gate Creek contributes a mean annual flow of about 200 cfs to the McKenzie. This increases the McKenzie's flow by about 5 percent. Maximum discharge from Gate Creek was 7,140 cfs on December 22, 1964, and the minimum was 12 cfs on November 26, 27, 1952 (Ibid.).

The Leaburg Canal withdraws water from the McKenzie at Leaburg Dam and returns it approximately 6 miles downstream near Cogswell Creek. Water is also withdrawn from the McKenzie via the Walterville Canal at RM 28.5 and returns it at RM 20.9. The average annual withdrawal and return at both these canals is estimated at 2,000 cfs (Dale Hagey, EWEB, pers. comm., August 19, 1985). These withdrawals and returns decrease and increase the flow in the McKenzie by about 50 percent. (Withdrawals may change with relicensing.)

The Mohawk River contributes a mean annual flow of 535 cfs to the McKenzie. This contribution increases the McKenzie River flow by about 10 percent. Recorded extremes for the Mohawk were 13,000 cfs on December 22, 1964, and 8.2 cfs on September 9, 1967 (Friday and Miller 1984, cited in Corps, 1987). The Mohawk rises from a lower elevation than the other tributaries and does not significantly contribute to snowmelt. It also has a low baseflow during the summer.

Mean annual discharge from the McKenzie River into the Willamette River was 6,018 cfs for the period 1945-1963. Mean annual discharge since the completion of Blue River, Cougar, and Smith River projects (1964-1982) is estimated at 4,864 cfs. Extremes for the period of record were 88,200 cfs on December 29, 1945, and 1,080 cfs August 19, 1966 (Ibid.).

Water Quality. The water quality of the mainstem McKenzie, South Fork McKenzie, and Blue rivers in the study area is of high quality (table 3-1). This high quality water is essential for maintaining the anadromous fish habitat in the study area. There are few pollution discharges into these streams above Vida. The major pollution impact on the mainstem McKenzie comes from industrial waste discharges in the lower subbasin.

Dissolved oxygen levels are consistently high and there do not appear to be any dissolved oxygen limitations (levels below 8.0 mg/l) to fish resources in the study area. The pH levels also are consistently within desirable limits of pH 7.0 to 8.0.

Turbidity levels in the study area streams are generally low, and these streams are known for their esthetically pleasing water clarity. However, increases in turbidity levels in study area streams have been noted with the passage of sediment-enriched water from Cougar and Blue River lakes during flood conditions.

Temperatures are cold, rarely above 65°F, reflecting the snowfall/snowmelt that filters through the porous lavas in the headwaters. Below the confluence with the South Fork McKenzie, however, historic temperatures have been altered due to Cougar and Blue River projects. The well-documented change in temperature regimes extends to the EWEB reservoir at Leaburg. Temperatures at Vida, collected in a study by USGS (1990), are reflected for the year 1984 in figure 3-3 and further discussed in Exhibit A, Temperature Data and Modeling Analysis.

Water Quality at Blue River and Cougar Reservoirs. The time period that water is impounded is one of the most important factors that affects the water quality of each lake. Most of the water entering from November through March is released quickly, but the water entering from April through October has a longer retention time allowing solar radiation to heat the surface waters, causing thermal stratification. For example, water temperature data for Blue River reservoir from August 1980 show water temperatures ranging from 51.8° F near the bottom (180-foot depth) to about 73.4° F at the surface. Thermal characteristics play an important role in the physical, chemical, and biological interactions occurring in the lakes. A full discussion of existing temperature conditions in Blue River and Cougar reservoirs and the resulting effect downstream is presented in section 2.4 of the main report. Emptying the lakes in the fall has provided opportunities to reduce nutrient enrichment. Blue River and Cougar lakes are similar in their water quality characteristics (table 3-1) and are typical of surface waters in western Oregon. Mineral content is low as indicated by relatively low concentrations of total dissolved solids. The water is soft and poorly buffered, with total alkalinity and hardness each ranging from 10 to 30 milligrams per liter (mg/l). Dissolved oxygen levels are consistently high, ranging from 8.4 to 11.3 mg/l. Because the reservoirs are situated in remote, forested areas, urban contributions to nutrient loading are minimal.

Algae studies show that the phytoplankton composition of the Willamette reservoirs resemble that of many oligotrophic lakes (those poor in nutrients) in the Oregon Cascade Range. Diatoms such as *Asterionella formosa, Fragilaria crotonensis, Synedra ulna, Stephanodiscus astraea*, and *Melosira granulata* are present. Predominant green algae include *Eudorina elegans, Straurastrum longiradiatum*, and *Sphaerocystis sp.* Concentrations of nitrate-nitrogen, orthophosphate, and other algal nutrients are not excessively large (seldom greater than 0.1 mg/l) and are derived primarily from rainfall, watershed soils, and other natural sources. (See Exhibit C, Correspondence, EWEB, 1994)

Because Cougar and Blue River lakes are nitrogen limited, they support a healthy population of *Anabaena circinalis* (a common filamentous algae) from late March to July. Every year is different depending on varying factors that are not well understood. Algal blooms have been

Figure 3-3 -- Relationship Between Number of Spring Chinook Passing Leaburg Dam, and Mean Hourly Water Temperatures, 1986-1989

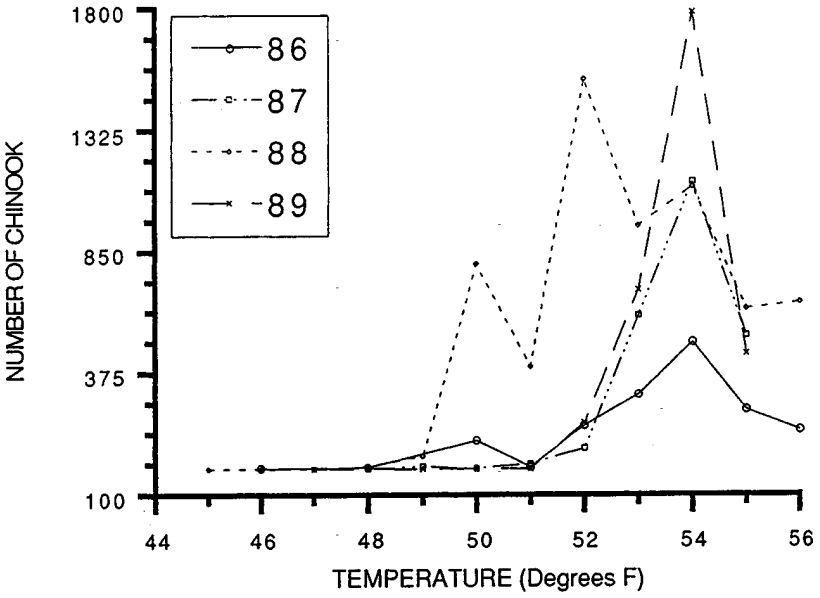


Table 3-1 -- Water Quality Data

BLUE RIVER AND COUGAR RESERVOIRS (@ 1 meter near outlet)
(Collected by Eugene Water and Electric Board)

Date	Dis. Oxygen (mg/l)		pH		Turbidity (NTU)		Total Kjeldahl Nitrogen (mg/l)		Total Phosphorus (mg/l)	
	Blue	Cougar	Blue	Cougar	Blue	Cougar	Blue	Cougar	Blue	Cougar
5/15/92	9.8	9.5	8.8	8.2	2.9	0.7	0.066	0.058	ND	ND
6/23/92	8.5	8.6	7.9	7.9	1.3	0.8	ND	ND	0.012	0.012
8/12/92	NS	8.4	NS	7.9	NS	1.1	NS	ND	NS	0.044
4/6/94	11.1	11.3	6.8	7.5	2.9	0.8	ND	ND	0.025	0.010
5/5/94	10.8	10.9	8.1	7.6	1.6	1.2	–	–	–	–
5/18/94	11.0	11.1	8.7	9.0	0.6	2.7	–	–	–	–

ND = Not detectable at 0.01
NS = Not sampled

MCKENZIE RIVER AT GOODPASTURE BRIDGE (RM 47.7)
(Collected by Eugene Water and Electric Board)

Date	pH	Conductivity	Dis. Oxygen (mg/l)	Alkalinity	Turbidity (NTU)
12/31/89	7.6	32.0	12.8	23.0	0.6
1/10/90	7.1	23.2	11.8	17.0	13.4
2/21/90	7.2	34.0	12.4	21.0	1.4
3/21/90	7.2	32.0	11.6	21.0	1.0
4/18/90	7.4	33.0	11.2	22.0	0.7
5/30/90	7.5	36.0	8.6	21.0	1.2
6/20/90	7.3	36.0	9.6	22.0	1.0
7/26/90	7.5	36.0	10.4	22.0	0.5
8/29/90	7.5	42.0	9.6	25.0	1.3
9/90	7.3	44.0	9.8	26.0	0.8
10/25/90	7.3	40.0	10.4	25.0	1.1
11/14/90	7.4	37.0	10.2	24.0	1.8
12/18/90	7.5	33.0	11.4	23.0	3.0
Average	7.4	35.2	10.8	22.5	2.1

MCKENZIE RIVER NEAR VIDA (RM 47.7)
(Summary of Data from STORET, Aug 1977 to Apr 1985)

Parameter	Maximum	Minimum	Mean
Turbidity (NTU)	10.000	0.600	1.800
Diss. Oxygen (mg/l)	12.400	10.400	11.500
pH	7.800	6.500	7.200
Alkalinity (mg/l as CACO3)	23.000	14.000	19.900
Total Nirtogen (mg/l as N)	0.900	0.040	0.350
Ammonia Nitrogen (mg/l as N)	0.140	–	0.044
Total Phosphorus (mg/l as P)	0.060	0.010	0.030

known to occur when conditions are right (water temperature, day length, seasonal weather patterns, and proportion of nutrients). These algal blooms appear to occur at the surface, and density drops proportionately with depth. They are characterized by blue-green water color with rows of concentrated filaments appearing pale green in color. The population density takes a sharp drop within a few days of the bloom as the species dies off. (Exhibit C, EWEB)

Winter storm events produce the highest turbidities in watershed streams that enter the reservoir pools. Generally, turbid inflows reaching the reservoirs tend to sink into deep waters and move toward the dam, and are then passed downstream through low elevation outlets. Turbidity levels sampled in 1992 and 1994 show a range of 0.6 to 2.9 NTUs for both lakes.

In 1983 the Portland District investigated the potential for the existence of contaminants in the Willamette Basin reservoirs. A water quality constituent was considered a contaminant if it resulted in impaired project purposes, violated federal or state water quality standards, or threatened humans, fish or wildlife. Cougar and Blue River reservoirs were not identified as having potential contaminants in this investigation.

Temperatures of tributary streams to the reservoirs differ from the water temperatures measured immediately below the dams. The patterns of temperature differ also, being colder in summer and warmer in winter. Section 2.4, Existing Thermal Conditions of the main report, and Exhibit A provide detailed discussion of existing temperatures at the projects.

3.3.3 Geology, Seismology, Soils. The basin is made up primarily of sedimentary, volcanic, and alluvial rock units. The oldest rocks consist of sandstone and siltstone and are exposed along the base of the Coburg Hills. Volcanic rocks form the Cascade Range and are divided into basalts, andesites and rhyolites. Alluvial deposits made up principally of coarse volcanic sand and gravel extend far up the McKenzie River Valley. Porous lavas of the High Cascades store large quantities of precipitation and release the water gradually, sustaining relatively high streamflows during the summer months.

Although soils in the project area are derived from a variety of parent rocks, they have some general features in common. Soil profiles are moderately acid with well aggregated and porous surface horizons. Soils developed on pyroclastic rock material tend to be deep and fine-textured, frequently poorly drained, and the site of mass movement. These parent materials form clay loam A horizons or silty clay loam B horizons that are gravelly on steep slopes. Soils derived from basalt and andesite are generally well-drained, stonier and coarser textured than pyroclastic soils. They are more stable but poorly developed with gravelly loam or sandy loam surface texture. Alluvial soils have also developed in the river bottoms and flood plains (Corps, 1974).

Geological Conditions at Blue River Reservoir.

Geologic Setting. Blue River Dam and Reservoir is located in the Western Cascade Range, which is composed primarily of Tertiary igneous rocks. During the last glacial age, Blue River was diverted to its present course by glacial blockage at its confluence with the McKenzie River, which was then located near the present day Saddle Dam area. Subsequent stream erosion produced a narrow canyon with steep side slopes in the main dam area and a somewhat wider canyon with steep side slopes in the middle and upper reservoir area. Fluvioglacial gravel deposits with depths ranging up to more than 100 feet are common in the reservoir area. A mixture of gravel, talus, and slide debris is common along the valley floor and abutments downstream of the dam. The project area is underlain with an uncorrelatable array of rock units, including basaltic and andesitic intrusives, contact breccias, fragmental pyroclastics, volcanic sandstones, and welded tuffs. These rock units have been subjected to regional tectonism; consequently, much of the rock has been hydrothermally altered and offset by closely-spaced, high-angle faults which predominantly strike northwest with lateral continuity parallel to the alignment of the local ridges. Rapid river erosion during valley development has resulted in open relief planes that dip both out of and parallel to the valley slopes. During excavation for the main dam, separations were noted along the faults and relief joints to depths of 50 feet below the surface. The separation created loose blocks which had a tendency to creep out of the hillside and appear as outcrops.

Blue River Reservoir Landslides. Several landslides and potential landslide zones exist within the Blue River reservoir area. None of the landslide zones listed in the *Reservoir Slide Potential Report*, 1968, are considered potentially dangerous. None of the slides identified are within the normal minimum pool and, therefore, are not further described.

Geological Conditions at Cougar Reservoir.

Geologic Setting.

a. Bedrock. Cougar Dam is in the Western Cascade Range which is comprised primarily of early to middle Tertiary pyroclastics, basalt flows, and basalt intrusives. The oldest rock in the area is a water-lain pyroclastic series which was later faulted, intruded by basalt dikes, and covered with basalt flows which are interbedded with some pyroclastics. Hydrothermal processes have slightly altered the rock along basalt/tuff contacts and major fault planes. At the dam the river has cut a precipitous canyon and a narrow channel to elevation 1,190 through this rock sequence. The abutments are basalt rock which rise above the valley floor some 400 feet. The river valley trends north-south and averages 350 feet wide at river grade. The river flows in a bouldery channel with an average gradient of 64.5 feet per mile.

b. Overburden. The valley slopes are mantled with residual soils, slope wash, talus, glacial till, and thick glacial silts. The overburden depth ranges from a few inches to 100 feet. The

overburden on the left abutment upstream of the axis in the vicinity of the intake structure consists of basalt talus with a brown silt binder and is 4 feet or less in depth.

Cougar Reservoir Area Landslides. The combination of weathered pyroclastic bedrock, steep slopes, and areas of deep overburden have produced conditions which have lead to landslide activity. Much of the reservoir area has the potential for becoming unstable when disturbed by toe erosion, periods of high precipitation, drawdown of the reservoir, roadway excavation, or seismic activity. Areas of instability which have significant portions of their toe area within the drawdown zone are currently being impacted by drawdown under present conditions (normal low pool). Only slides which are within the lower 2.5 miles of the reservoir would be impacted by construction drawdown below normal low pool level.

3.4 Biological Environment

3.4.1 Vegetation. The study area (McKenzie River Subbasin from Vida upstream and including the forested watersheds of Blue River and Cougar reservoirs) is within the Western Cascade Province, western hemlock zone (Franklin and Dyrness, 1973). The dominant tree species in this area is the Douglas-fir, although western hemlock is the climax species. Predominant coniferous tree species include western red cedar, incense-cedar, noble fir, Pacific silver fir, and grand fir. Associated woody plants include red whortleberry, Cascades mahonia, salal, Pacific rhododendron, and American devil's club. Much of the watershed has been managed for timber, thus clear cut areas in various stages of regeneration are obvious. Douglas-fir is the predominant species for replanting after harvest. No threatened or endangered plants are known to occur in the study area (Forest Service, 1990). Several species on the Regional Forester's Sensitive Species List occur in the general area of the project.

The McKenzie mainstem has a fringe of vegetation, including old-growth trees and various riparian species, on the north side. Pasture and vegetation associated with rural residential area are more prominent on the northern shore. The south side is less developed and is more heavily vegetated than the northern shore. Large western red cedar, Douglas-fir, shrubs and herbaceous plants grow along the river (Corps, 1973). Vegetation associated with the Douglas-fir forests is typical of the low-elevation Western Oregon Cascade Range, with salal, Oregon grape, bracken and sword ferns, vine maple, and hazel. Flood plain and high water table areas adjacent to the McKenzie and tributaries include alder, cottonwood, big leaf maple, and devil's club (BLM, 1993). Rooted aquatic macrophytes are also present in the ecosystem. These groups provide the nutrients and cover for the higher organisms and are important to the well-being of the ecosystem.

The South Fork McKenzie Basin below Cougar Dam supports a variety of plant life in various stages of succession. Portions of this area have been logged in the past. Gravel extraction and other construction activities altered portions of the river area during construction of Cougar Dam. The area from the dam to the confluence with the McKenzie is

fairly flat, with potholes, constructed ponds, and side channels twisting through the flood plain. Riparian and wetland vegetation, typical of western Oregon, includes cottonwood, willow, alder, cattail, bulrush, horsetail, water milfoil, water buttercup, and pondweeds. Numerous species of forbs, grasses, shrubs, and ferns form understory or ground cover. Coniferous forest, including old growth, is a component of the flood plain, with Douglas-fir, western hemlock and western red cedar most abundant. Pacific yew and incense-cedar also occur. Oregon oak has been found on drier benches (FWS, 1979).

Blue River below the dam has a fringe of shrubby vegetation with some Douglas-fir and western hemlock trees. The upper portion, which was scraped clear during dam construction, has recovered but is at a different stage of succession than locations downstream, where portions are more heavily forested. Near the dam, vegetation is still sparse, with shrubs and grasses predominating. The community of Blue River is located at the confluence of Blue River with the McKenzie. Except for the community park, which is partially forested, vegetation along the river is a riparian fringe, with some trees and a shrubby bank.

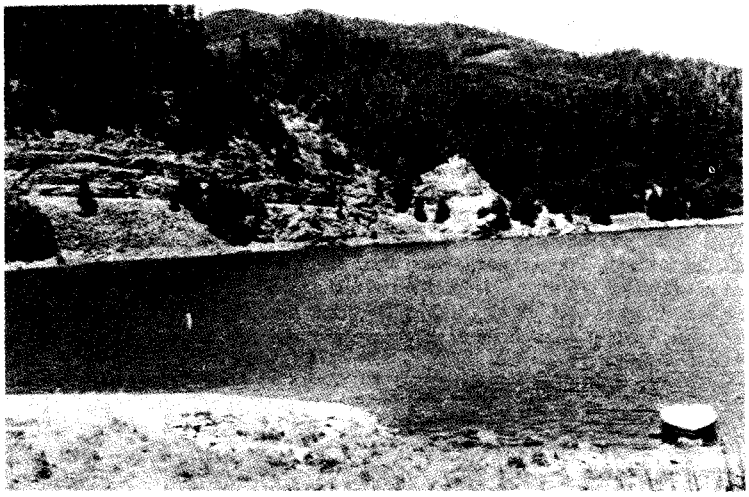
Lands adjacent to Cougar Reservoir are heavily forested with Douglas-fir, western hemlock, and cedars predominant (figure 3-4). During construction, vegetation was removed below full pool and has not re-established except at tributaries and the upper reach of South Fork McKenzie. Some riparian vegetation has returned along the tributaries, forming shoreline vegetation along conservation pool level. Small trees, shrubs, grasses, and sedges are dominant. Some emergent vegetation occurs in the shallow areas, along with various forms of algae.

Vegetation associated with Blue River Reservoir is similar to Cougar Reservoir. The Forest Service has attempted some revegetation below full pool, consisting of plants tolerant of submerged/dry conditions, such as bald cypress and sedges. Revegetation efforts have been only partially successful (Rick Ley, Forest Service, pers. comm., 1994) (figure 3-4).

3.4.2 Wildlife. Wildlife species in the study area are typical of those commonly found on the west slope of the Cascades. Both game and nongame species are present. Big-game animals include Roosevelt elk, black-tailed deer, and black bear. Upland game birds include blue and ruffed grouse, mountain quail, and band-tailed pigeon. Fur bearers include beaver, raccoon, and less commonly river otter, bobcat, and mink. A variety of small mammals occur in various project area habitats, including several species of squirrels, chipmunks, mice, and rabbits. Small populations of waterfowl inhabit the river, reservoir, and riparian areas, including mallards, common mergansers, wood ducks, and harlequin ducks, a "sensitive" species within the Willamette National Forest and a candidate for listing under the Endangered Species Act (ESA). (In compliance with the National Forest Management Act, the Willamette National Forest has a forest management plan that includes consideration of sensitive species and biological diversity). A total of 11 sensitive wildlife species are known to occur in the Willamette National Forest. Five of these species, red-legged frog, bald eagle,

Figure 3-4 -- Photos of Blue and Cougar Lakes

Blue River Lake



Cougar Lake at Slide Creek Campground

American peregrine falcon, northern spotted owl, and harlequin duck can reasonably be expected to occur in the vicinity of the project or immediate downstream locations. Many species of non-game birds inhabit the area. A 1973 survey found over 70 species within 1/2 mile of Cougar Reservoir (Corps, 1973). Various salamanders and frogs, including the red-legged frog (also a candidate species under ESA), inhabit the South Fork McKenzie (Forest Service, 1992).

Wildlife species in the basin listed under ESA include the bald eagle, northern spotted owl, peregrine falcon, and Oregon chub. Table 3-2 shows the listed species and candidate species as provided by FWS. Bald eagles, listed as threatened under ESA, occasionally occur at the project reservoirs where they feed on fish. Peregrine falcon, listed as endangered, have been sighted in the Willamette National Forest, although no nesting pairs have been identified in the study area. Potential nesting sites have been identified in the McKenzie River drainage.

Northern spotted owls, federally endangered, utilize mature and old-growth forests for nesting, roosting, and foraging. Several activity centers have been identified in the study area, and the Forest Service is managing some of the area around Cougar Reservoir as northern spotted owl habitat (Forest Service, 1990; Ruby Seitz, Forest Service, pers. comm., 1994)

Oregon chub, a federally endangered fish species, is known to occur in the upper McKenzie River, but has not been reported within the study area.

3.4.3 Fish and Aquatic Species. The McKenzie River supports diverse populations of anadromous and resident fish and aquatic organisms. Anadromous fish species include spring chinook salmon, winter run steelhead trout, and Pacific lamprey. Resident native cold water species include rainbow, cutthroat, and bull trout. Brook trout have been introduced into the subbasin and are also widely distributed.

Warm water resident species include a variety of native and non-native species. Native species include northern squawfish, largescale sucker, chieselmouth, redside shinner, brook lamprey, and a variety of sculpins and daces. Dominant non-native species include white and black crappie, largemouth bass, and brown bullhead.

The bull trout is a sensitive fish species in the McKenzie Subbasin. The U.S. Fish and Wildlife Service recently (June 7, 1994) decided that though the bull trout is warranted for listing under ESA, it is precluded from listing by higher priority species in its range. Consequently, the bull trout will not be listed but has been elevated to Category 1 candidate species status.

Cougar and Blue River reservoirs both provide habitat that supports a variety of aquatic species typical of a lake environment. Both reservoirs contain resident trout populations and Cougar has a small resident bull trout population. Cougar is stocked annually with rainbow

Table 3-2 -- FWS Federally Listed Species That may Occur in the Project Area

LISTED SPECIES[LY]		
Birds		
Peregrine falcon	*Falco peregrinus*	LT
Bald eagle	*Haliaeetus leucocephalus*	LT
Northern spotted owl	*Strix occidentalis caurina*	CH LT
Documented		
Fish		
Oregon chub	*Oregonichthys crameri*	LE
PROPOSED SPECIES		
None		
CANDIDATE SPECIES		
Mammals		
White-footed vole	*Arborimus albipes*	C2
California wolverine	*Gulo gulo luteus*	C2
Pacific fisher	*Martes pennanti pacifica*	C2
Pacific western big-eared bat	*Plecotus townsendii townsendii*	C2
Documented		
Birds		
Northern goshawk	*Accipiter gentilis*	C2
Harlequin duck	*Histrionicus histrionicus*	C2
Documented		
Amphibians and Reptiles		
Northwestern pond turtle	*Clemmys marmorata marmorata*	C2
Northern red-legged frog	*Rana aurora aurora*	C2
Foothill yellow-legged frog	*Rana boylii*	C2
Cascades frog	*Rana cascadae*	C2
Spotted frog (western OR)	*Rana pretiosa*	C1
Fish		
Bull trout	*Salvelinus confluentus*	C1
Documented from the McKenzie River		
Plants		
Tall bugbane	*Cimicifuga elata*	C2
Howell's montia	*Montia howellii*	C2

(LE) - Listed Endangered (LT) - Listed Threatened (CH) - Critical Habitat has been designated for this species
(PE) - Proposed Endangered (PT) - Proposed Threatened (PCH) - Critical Habitat has been proposed for this species

trout (100,000 fingerlings) and Blue River with catchable rainbow trout (10,000 in April, 8,000 in May). Blue River also serves as an experimental reservoir rearing program being conducted by ODFW. Approximately 200,000 hatchery spring chinook fry were planted in Blue River reservoir in the spring of 1994. Due to high mortality in the regulating outlet at the dam, and because these are hatchery stock that may compete with native fish, ODFW may discontinue the program. (Jeff Ziller, ODFW, pers. comm., 1994)

Although no studies of aquatic communities in the McKenzie River have been done, the McKenzie River likely contains an abundance of invertebrate species including crayfish, snails, stoneflies, mayflies and caddisflies as well as a variety of micro and macro algae species. Eight species of macro-invertebrates, Category 2 candidates under ESA and considered by the Forest Service as sensitive (Forest Service, 1990), are likely to occur in the Willamette National Forest. Three species of caddisfly may occur in the South Fork McKenzie below Cougar Dam (Jim Capurso, Forest Service, pers. comm., 1994).

Three McKenzie River fish species were chosen as indicator species: Willamette spring chinook salmon, resident rainbow trout, and bull trout. These three species were chosen for evaluation because they are all important economic species with a high degree of public interest; they are all good ecological indicators for temperature changes because one or more key life stage is strongly temperature dependent; there is a fair to good quantity of existing information describing the species use of the study area (as well as their basic life history requirements); and all three species occur in the study area of influence.

Willamette Spring Chinook Salmon

The Willamette River stock of spring chinook is one of six stocks of spring chinook in the lower Columbia River below Bonneville Dam. These fish use the major tributaries of the Columbia River including the Cowlitz, Kalama, Lewis, Sandy, and Washougal rivers, and the Willamette River System. The Willamette River spring chinook stock is native to the McKenzie River.

Adult spring chinook begin entering the Columbia River in late winter, reaching the Willamette River as early as February. The run generally peaks in April with the migration complete in late May (ODFW, 1990). They enter the McKenzie River in early spring as the water begins to reach 52-54°F. They migrate upstream until the water temperature becomes too warm and then they hold in deep pools in the mainstem and tributaries before making a final migration to spawning areas in the fall. Most of the fish in the McKenzie River hold between Hayden Bridge and Leaburg Dam.

Spawning occurs throughout the basin and normally begins in early September, peaks in mid- to late September and ends by mid-October. Eggs incubate for 65 to 80 days with most fry emerging in February to March under normal conditions. In the South Fork McKenzie,

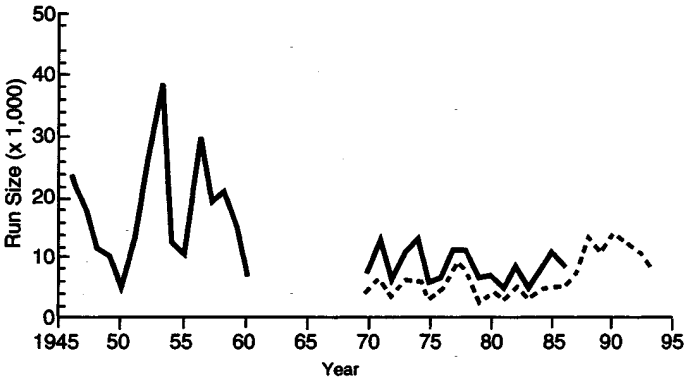
emergence occurs as early as December because warm water releases from Cougar reservoir in the fall accelerate development. Wild juvenile spring chinook reside in freshwater from 3 to 18 months with 3 distinct periods of migration. A movement can occur in late winter to spring, soon after emergence, in late fall and early winter , and in the following spring. Fry in the McKenzie migrate soon after emergence based on collections at Leaburg Dam by ODFW.

Spring chinook stocks in the McKenzie River have been managed primarily as hatchery stocks with natural production now comprising only 5 to 15 percent of total population (NPPC, 1990). Hatchery reared spring chinook have been stocked in the McKenzie since 1902 when the river was racked at Hendricks Bridge to collect adults as an egg source for the hatcheries. Between 1902 and 1947 as many eggs as possible were collected with the peak egg take in 1928 of 27.7 million eggs (ODFW, 1988). Other high years of egg take (in excess of 20 million eggs) were 1926, 1927, 1930, 1935, and 1936.

Past egg collection has been viewed as a minimum index of run size but not an accurate predictor because racks were not always installed in time to intercept the entire run, or were removed when hatchery capacity was reached, or natural spawning occurred downstream of the racks and in intervening tributaries. The early releases from egg takes were fry and fingerlings in poor condition, and it is believed very little hatchery contribution to the returning adults was realized until the 1950's (Wallis, 1961). Adults were last collected at the rack in the Walterville Canal in 1960, and because of declining runs, adult collections were reduced to less than 7 percent of the runs from 1954 through 1960 to allow escapement of spawners upstream (ODFW, 1988).

The estimated average run size in the McKenzie during the period 1945-1960 was about 18,000 spring chinook, with a high of 38,000 in 1953 and a low of 6,000 fish in 1950 (ODFW, 1988). An analysis by the Oregon Fish Commission in the late 1940's estimated that the largest run into the McKenzie was about 46,000 fish in 1941 based on Willamette Falls counts and a 39 percent distribution to the McKenzie River (FWS, 1948). Figure 3-5 shows the estimated spring chinook run size during the pre-project years (1946-1960) when count information was available. This is the total estimated return to the McKenzie River and includes hatchery fish, escapement, and catch. Since completion of Cougar Dam in 1964 and Blue River Dam in 1970 the average run size has been only about 6,700 fish, with only about 2,900 passing upstream of Leaburg Dam (table 3-3). Temperature changes in the river from releases out of Cougar and Blue River reservoirs were suspected early as a possible cause of reduced returns because of the adverse impacts of temperature to the early trap and haul effort at Cougar Dam (Korn and Ingram, 1969). Spring chinook were delayed at the mouth of the South Fork apparently because of cold water temperatures. When warmer waters were experimentally released from the surface of Cougar reservoir, fish migrated into the South Fork and entered the trap.

Figure 3-5 -- Estimated Run Size of Spring Chinook in the McKenzie River, 1946-1993 (ODFW, 1988-1993)



Note: Difference in run size since 1970, indicated by the dashed line, is the result of a change in the way ODFW makes estimates.

Analysis of temperature changes in the McKenzie as a result of the operation of the projects (Corps, 1990, 1993) showed that temperatures downstream of the dams, and in particular in the South Fork McKenzie were colder in the spring and warmer in the fall than pre-project temperatures due to water being released from the bottom of the reservoir (figure 3, section 1.4, main report). In the spring and summer the water on the bottom is colder than the surface water; releasing this water prevents the river temperatures from warming as they would naturally. In the fall, after all the bottom water has been released, the warmer surface water is released preventing the river from cooling down as it would naturally during this time.

Delay and/or blockage at Leaburg Dam of migrating spring chinook adults was suspected to be the result of the cold water released during the early portion of the run (May and early June). Delaying migration upstream of Leaburg Dam resulted in shifting the distribution of spawning from above to below Leaburg Dam, which significantly underseeded habitat upstream of Leaburg Dam.

A survey of available spawning habitat upstream of Leaburg Dam (Sedell et al., 1992) indicates that both the quantity and quality of spawning habitat is good and has not changed substantially from what was there historically. A comparison of available spawning habitat to

Table 3-3 -- Estimated Return of Spring Chinook to the McKenzie River

Run Year	Leaburg Dam count	Hatchery Return	Catch	Below Leaburg Dam Redds	Below Leaburg Dam Escapement	Total Return	Return as % of Will. Falls	WF count (X1000)	Percent caught
1970	2991	20	525	278	1251	4787	14.0	34.2	11.0
1971	3602	232	621	415	1868	6323	14.2	44.6	9.8
1972	1547	301	1125	177	797	3770	14.4	26.2	29.8
1973	3870	56	1510	556	2502	7938	18.9	42.0	19.0
1974	3717	0	1022	689	3101	7840	17.6	44.5	13.0
1975	1374	0	461	346	1557	3392	17.8	19.1	13.6
1976	1899	396	139	409	1841	4275	19.3	22.2	3.3
1977	2714	1517	1071	850	3825	9127	22.8	40.0	11.7
1978	3058	1464	924	599	2696	8142	17.1	47.5	11.3
1979	1219	798	303	155	698	3018	11.3	26.6	10.0
1980	1980	807	381	219	986	4154	15.4	27.0	9.2
1981	1078	784	493	282	1269	3624	12.0	30.1	13.6
1982	2241	1460	627	241	1085	5413	11.7	46.2	11.6
1983	1561	821	221	172	774	3377	11.0	30.6	6.5
1984	1000	1901	618	271	1220	4739	10.9	43.5	13.0
1985	825	1923	467	381	1715	4930	14.3	34.5	9.5
1986	2061	1705	383	315	1418	5567	14.2	39.1	6.9
1987	3455	1593	1368	212	954	7370	13.4	54.8	18.6
1988	6753	2487	1215	484	2178	12633	17.9	70.5	9.6
1989	3976	3154	1864	228	1026	10020	14.5	69.2	18.6
1990	7115	3206	1704	160	720	12745	17.9	71.3	13.4
1991	4359	4483	1986	161	725	11553	22.0	52.5	17.2
1992	3816	3407	1200	106	477	8900	21.2	42.0	13.5
1993	3617	2051	1200	142	639	7507	23.5	32.0	16.0
Ave.	2910	1440	893	327	1472	6714	16.1	41.3	12.9

Catch in 1993 is an educated guess.

Escapement below Leaburg Dam = No. of Redds below Leaburg X 4.5 Fish/Redd.

1] From ODFW, 1993

actual use, based on redd surveys (table 3-4), indicated that less than 1 percent of the available gravels would be needed for the maximum number of redds observed during the period 1965 to 1991 (335 redds). This assumed only 50 percent of the total gravels (1,026,250 square yards) are available for spawning (adequate depths, velocities, cover, etc.) and that 12.2 square yards are needed for each spawning pair (Armour, 1991). In fact, the mean number of redds for this period (156) would require only 0.3 percent of the potential area available.

Redd counts have also shifted from primarily above to primarily below Leaburg dam (ODFW, 1993). The number of adults returning to the Carman-Smith spawning channel below Trail Bridge reservoir have also decreased from about 170 fish in the early 1960's to about 15 fish since 1979 (ODFW, 1993). It appears then that spawning habitat upstream of Leaburg Dam is significantly underseeded at existing levels of escapement and that adults are not migrating into the area. ODFW has noted strong correlations between increased numbers of fry migrating from the system with increased adult returns indicating that the increased number of fish are able to effectively use the habitat (ODFW, 1993).

Spawning above Leaburg occurred primarily during September, with about 95 percent being completed by September 30, and only 5 percent occurring within the first week of October (figure 3-6). Distribution of spawning is 30 percent in the mainstem downstream of the South Fork to Leaburg, 60 percent above the South Fork, and 10 percent in the South Fork. Prespawning mortalities are 5 percent above South Fork, 23 percent in the South Fork, and 18 percent downstream of the South Fork.

Warm water releases from Cougar and Blue River dams in the late summer and fall accelerate development of the eggs and results in earlier than normal emergence of fry. Early emergence can reduce the survival of the fry since they emerge at a time when conditions are unsuitable and food is not available.

Fry were sampled above and below the South Fork and in the South Fork to determine emergence timing. Fry emerged as early as the first week in December in the South Fork, with substantial numbers observed through December and January for both the South Fork and mainstem downstream of the South Fork. In comparison, fry did not emerge upstream of the South Fork in Horse Creek and Lost Creek until the middle of February and not until the middle of March in the Carmen-Smith spawning channel.

Using 1,800 temperature units (the cumulative number of degrees above 32°F each day) as the total number of units needed before spring chinook fry emerge from the gravel, emergent dates can be determined using temperature data from 1992. (table 3-5). Using the South Fork as the standard (0 point), areas upstream of the South Fork (natural conditions) with spawning on or before September 15 (60 percent has occurred by this date) had an average date of fry emergence 85 days later than South Fork. Even locations downstream of the South Fork were

Table 3-4 -- Comparison of Actual Spawning use (# of redds) with Spawning Habitat Availability for the Mainstem McKenzie River above Leaburg Dam

	Total Redd Count	**Habitat Availability 1)**	
Year	W/O Tribs (Helicopter Survey)	Reach #	Spawning Gravels (yd^2)
1965	270	1	994,594
1966	123		
1967	---	2	292,404
1968	232		
1969	105	3	533,132
1970	119		
1971	129	4	51,319
1972	46		
1973	236	5	89,375
1974	88		
1975	85	6	60,020
1976	129		
1977	335	Total	2,020,844
1978	283		
1979	40		
1980	88		
1981	84		
1982	109		
1983	76		
1984	90		
1985	52		
1986	131		
1987	150		
1988	324		
1989	233		
1990	235		
1991	255		
Mean	156		

1) From Sedell, et al. 1992. Spawning gravels were substrate classes small rubble (SR) and medium rubble (MR) ranging from .25" to 5.9" in size. The reaches 2-6, representing a total of 1,026,250 yd^2 of spawning gravels, occur upstream of Leaburg Dam.

Figure 3-6 -- Spring Chinook Spawning Time Periods in the McKenzie River for 1992 (ODFW 1993).

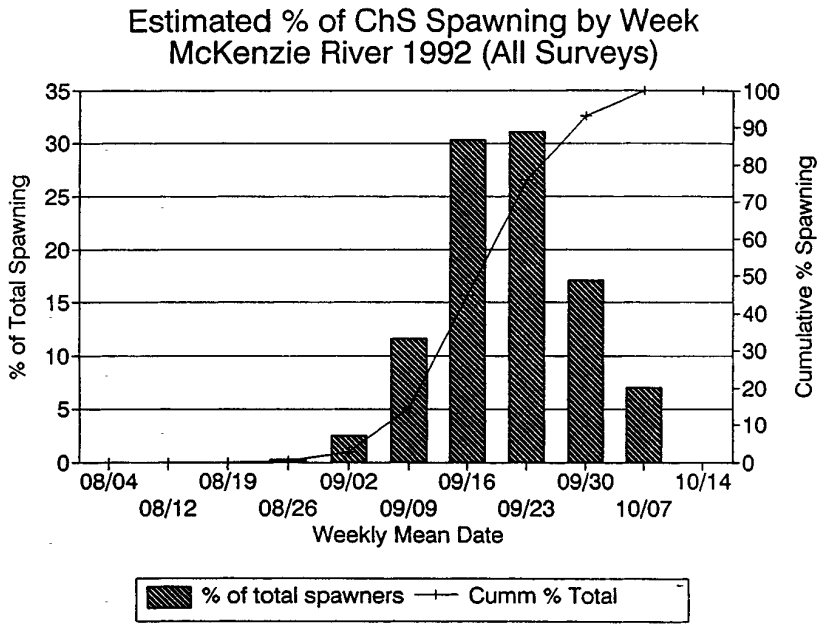


Table 3-5 -- Time to Reach 1800 Temperature Units Based on Time of Spawning

WEEK OF REACHING 1800 TEMPERATURE UNITS - FOR SWIM UP STAGE

		Spawning Date									
	Area	09/01/92	Diff in Mean Day	09/15/92	Diff in Mean Day	09/28/92	Diff in Mean Day	10/15/92	Diff in Mean Day
Below SF	Main @Leaburg	11/29-12/5/92	21	12/27/92-1/2/93	30	2/7-2/13/93	28	3/14-3/20/93	7
	Main @Finn Rock	12/6-12/12/92	28	1/3-1/9/93	36	2/7-2/13/93	28	3/21-3/27/93	14
	SOUTH FORK	11/8-11/14/92	0	11/29-12/5/92	0	1/10-1/16/93	0	3/7-3/13/93	0
Above SF	Main @Bruckhart	1/31-2/6/93	84	2/21-2/27/93	85	3/21-3/27/93	70	4/11-4/17/93	35
	HORSE CR	2/7-2/13/93	91	3/7-3/13/93	99	4/4-4/10/93	84	?	
	LOST CR	1/10-1/16/93	63	1/24-1/30/93	57	2/14-2/20/93	35	2/28-3/6/93	+8
	CARMEN-SMITH	2/14-2/20/93	98	3/14-3/20/93	106	4/4-4/10/93	84	?	

1] From ODFW, 1993

21-28 days later than the South Fork. Spawning in the South Fork is not successful because of early emergence (Dave Anderson, ODFW, pers. comm., 1995).

The combination of underseeded habitat upstream of Leaburg Dam and early emergence reducing fry survival has decreased natural production of spring chinook in the McKenzie River (ODFW, 1988; FWS, 1990; NMFS, 1990).

Native Rainbow Trout

The native rainbow trout (McKenzie redsides) was chosen as an indicator species because of its widespread distribution throughout the area, popularity with anglers, and importance as a sport fish. Populations of native and hatchery rainbow trout are found in the mainstem McKenzie up to Tamolitch Falls and in the lower portions of the larger tributaries above Leaburg Dam, including the South Fork and Blue River.

Substantial numbers of wild rainbow trout occur in conjunction with an intensively managed hatchery program. Fingerling hatchery rainbow were stocked initially in the mainstem (as early as the 1920's) but this was discontinued in the 1950's because of poor survival (ODFW, 1988). Subsequent stocking of legal-sized rainbow peaked in 1967 with a high of 149,000 fish, and continues today with lesser numbers released to the mainstem and in Cougar reservoir. About 18,000 legal size rainbow are stocked in Cougar in April and May, with expectations that most will be caught within a month of release.

The McKenzie River system has long been one of Oregon's most popular rivers for native trout fishing, and both native and hatchery fish contribute to angler catch (ODFW, 1990a). Since the 1950's, the mainstem and tributaries have been closed to harvest of rainbow 14 inches and longer; rainbow longer than 20 inches are considered steelhead.

Cougar and Blue River reservoirs have impacted rainbow trout in the McKenzie River system by inundating productive stream habitats, blocking migratory routes, and changing water quality conditions downstream. At the same time, the reservoirs have provided habitat for trout and are managed accordingly. They receive moderate-to-heavy angling pressure.

Very little information exists on the distribution and abundance of native rainbow trout in the McKenzie Subbasin, but catch and other data indicate substantial numbers are still present (ODFW, 1988). The percentage of native to hatchery fish caught in creel surveys in the 1950's compared to the 1970's showed a decline, but this does not necessarily reflect a decline in the abundance of native trout. It may be the result of hatchery fish being easier to catch, and more available to anglers, as well as anglers targeting on hatchery fish. In both 1974 and 1983 native fish represented about 10 percent of the catch (ODFW, 1988). The catch per angler and catch rate of trout less than 14 inches for both native and hatchery trout have remained fairly constant since 1948, but the catch and release of native rainbow trout

greater than 14 inches per guided angler has increased since about 1960. About three-fourths of the native rainbow trout caught by electro-fishing in the lower McKenzie River were 4 to 8 inches in length, while legal-sized rainbow (6 to 14 inches) represented about 60 percent. Less than 4 percent of the rainbow were 14 inches or longer, and most native rainbow trout kept by anglers in the 1983 creel survey were 7 to 11 inches.

It is likely that native trout populations in the mainstem below South Fork to Leaburg Dam and in the tributaries downstream of the two dams are at depressed levels, compared to other McKenzie River sections, because of the stocking of legal-sized hatchery fish and the emphasis on a put-and-take fishery (ODFW, 1988). The section of the river from Blue River downstream to Leaburg Dam has been the heaviest stocked in the past. Stocking also occurs in the tributaries, but streamflow and temperatures are not suitable until April through July for the Blue River, and until June in the South Fork (ODFW, 1988). Native trout have been protected from harvest in the South Fork since 1992 to protect their populations.

Empirical data do not exist for the McKenzie River to demonstrate any relationships between temperature changes downstream of the projects and changes to the wild or hatchery rainbow trout in the system. However, these relationships have been developed for other river systems using trout growth units, as an index of water temperatures favorable for trout growth. This same methodology has been applied to the McKenzie River for this study. Trout growth units are determined by the number of temperature-degree-days between 42 and 63°F, the range at which trout growth can occur in the wild (Fraley and Graham, 1982). One day at 43° equals one trout growth unit. These data are available from the temperature modeling (Exhibit A) and compare differences for the South Fork, Blue River, and mainstem McKenzie down to Leaburg Dam. Table 3-6 shows the differences in trout growth units for those stream reaches under three different water years for existing conditions. These units are calculated during the period March through October and as such represent a time period of heavily regulated flow, or releases from storage. In general, both tributaries show relatively cooler water (lower numbers) than the mainstem, with the South Fork being the coolest. Interestingly, during a low flow year, this is time of warmest water in the mainstem (highest number) because of the increased effect of solar heating on relatively low flows; but it is the period of coolest water (lowest numbers) in the tributaries because of the amount of flow released from storage during those periods.

Table 3-6 -- Trout Growth Units for Three Water Years by Stream Reach

Stream Reach	Water Year		
	Normal	High Flow	Low Flow
Blue River	1383	1485	1081
S.F. McKenzie	1095	1016	999
Mainstem @ Vida	1460	1464	1876

Trout growth units for resident trout are temperature degree-days between 42-63°F for the period March 1 through October 31. Because trout growth is a function of both water temperature and food availability, many authors have also looked at aquatic insect production in dam tailwaters, in comparison to unregulated segments (Stanford and Ward, 1983; Perry et al., 1987; Ward and Stanford, 1979; and Ward and Stanford, 1982). These studies include reservoirs with hypolimnial releases similar to Cougar and Blue River reservoirs.

Generally where conditions have been altered such that temperatures are uniformly colder and lack daily and/or seasonal fluctuations, and waters are enriched with nutrients from the reservoir, aquatic insect populations are much less diverse and have larger numbers of individuals. These highly restricted insect fauna strongly influence trout populations and their ability to assimilate food organisms (Ward and Stanford, 1982).

These conditions likely exist in both the South Fork and Blue River downstream of the projects, and to a lesser extent in the mainstem below the South Fork. Wild rainbow trout are most affected by reservoir releases since they are present for their complete life cycle while hatchery fish are in the system for a short time (75 percent of catchable trout are caught within 2 weeks of stocking).

Bull Trout

Bull trout distribution in the McKenzie System is primarily upstream of Leaburg Dam in the mainstem to Tamolitch Falls, and in the South Fork (including Cougar Reservoir). Main population areas include the South Fork, mainstem McKenzie, Trail Bridge, and Carmen-Smith. Occasionally, bull trout are counted in the ladder at Leaburg Dam moving upstream, and significant migrations have been noted for the species (Pratt, 1992). A 1983 creel survey conducted from Armitage Park to just above Blue River (mainstem only) showed that bull trout represent less than 5 percent of the native trout caught by anglers (ODFW, 1990a).

Bull trout were selected for evaluation because they are a State species of concern, a candidate for listing under ESA, and they occur in the mainstem and South Fork McKenzie River. Based on their status, any additional impacts should be avoided and restoration opportunities identified.

Over two-thirds of bull trout populations statewide are considered to have at least moderate risk of extinction, including the South Fork McKenzie River population (Howell and Buchanan, 1992; Ratliff and Howell, 1992). Populations in the McKenzie River Subbasin were assumed to be at risk because of overharvest, passage barriers, habitat degradation, and hybridization with brook trout.

Life history information for bull trout shows very narrow temperature ranges (figure 3-7). Table 3-7 shows a comparison of these temperature ranges with existing conditions in the South Fork and downstream in the mainstem McKenzie River. In general, the spawning and egg incubation periods are the most temperature impacted under existing conditions because they occur at a period when ambient air and water temperatures are declining naturally, but increasing under existing release conditions. The existing water temperatures are substantially greater than optimum conditions (by 12 to 20°F).

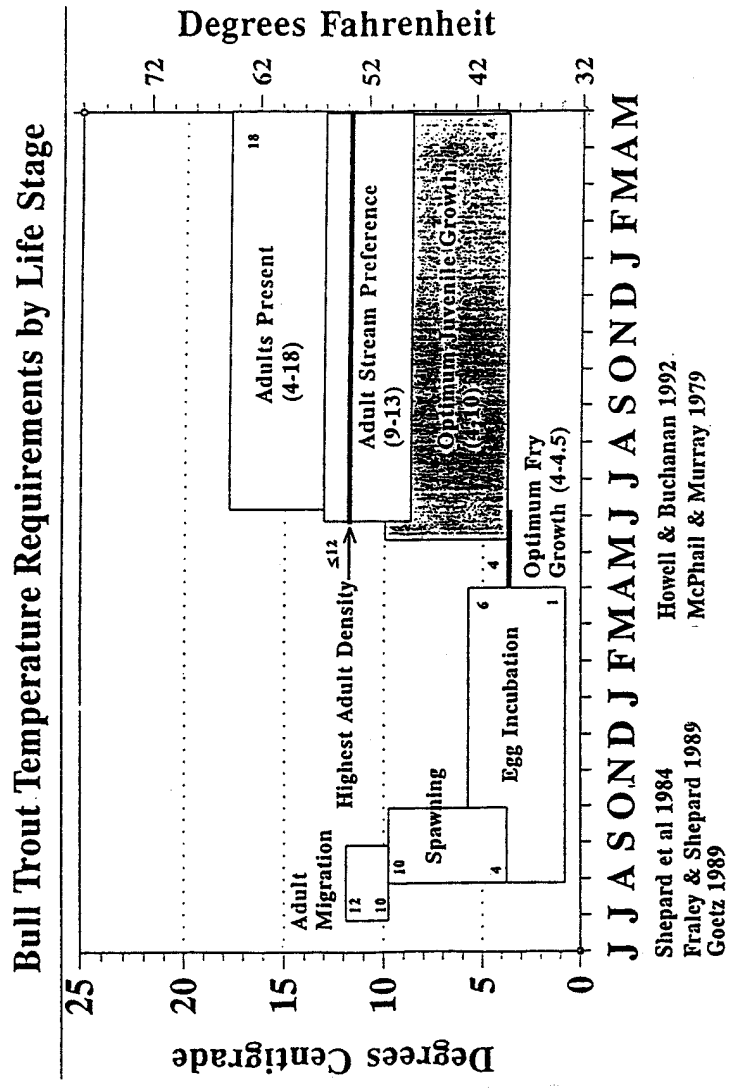
Table 3-7 -- Comparison of bull trout life history temperature requirements by life stage with existing temperature conditions in the South Fork and mainstem McKenzie rivers. [1]

Life Stage & Time Period	Required Temp. Range (°F)	Existing Temp. Range (°F)	
		S. Fork	Mainstem (below S. Fork)
Adult Migration (July-Sept)	50 - 54	52 - 58	46 - 52
Spawning (Sept-Oct)	38 - 50	54 - 62	50 - 56
Egg Incubation (Sept-April)	38 - 42	62 - 40	50 - 38
Optimum Fry Growth (April-June)	38 - 40	42 - 46	44 - 48
Optimum Juvenile Growth (Year round)	38 - 48	40 - 62	40 - 56

[1] Required temperatures from figure 3-7 (references there) and existing temperatures from Corps modeling (Corps, 1993).

Bull trout also have specific habitat needs for many of their life stages. For example, they spawn in areas with groundwater influence; additionally, juveniles and adults are associated with complex cover of in-channel woody debris, undercut banks, and pools, while young-of-the-year are associated with side channels, stream margins, or other low velocity areas. These habitat features influence bull trout use of an area.

Figure 3-7 -- Bull Trout Temperature Requirements



Food items for bull trout include terrestrial and aquatic insects, macro-zooplankton, mysids, and fish. Fish are the common food for bull trout larger than 8 inches, and large bull trout may feed exclusively on fish. For reasons discussed with resident rainbow trout, food items for bull trout are probably limited in the South Fork because of existing temperature conditions. Under existing conditions, bull trout distribution and use of habitat in the area of influence is not expected to change.

Bull trout are known to occur in Cougar Reservoir, though the population level is unknown. An angler who targets on bull trout in Cougar reservoir has caught 26 fish since 1989 (FWS, 1994, CAR). An ODFW biologist estimates between 100 and 500 bull trout inhabit the reservoir (Jeff Ziller, ODFW, pers. comm., 1994).

3.5 Cultural Environment

3.5.1 Land Use Statewide Planning Goals. A review of the Oregon Statewide Planning Goals indicates that Goals 5, 6 and 8 could be relevant to the proposed project. Goal 5 is to conserve open space and protect natural scenic resources, including potential state and federal Wild and Scenic Rivers. Goal 6 is to maintain and improve air, water, and land resources, and Goal 8 is to satisfy recreational needs of citizens and visitors. Study areas of the McKenzie River Subbasin are within Lane County Rural Comprehensive Plan. Designation of lands in this area is forest land, mostly zoned as Non-Impacted Forest Lands. The purpose of this zone is to implement forest land policies of the plan and to conserve forest land for uses consistent with statewide planning Goal 4. Water intake facilities, reservoirs, solid waste disposal sites, conservation of water quality, provision for fisheries resources, and road work are included as permitted uses or allowed uses subject to director approval.

Land surrounding the two reservoirs is administered by the Forest Service. The Willamette National Forest Land and Resource Management Plan (1990) establishes the general direction for use and management of the forest lands. Elements of the plan that could relate to the Corps action involve management prescriptions, standards and guidelines (including developed recreation, scenic retention, special wildlife habitat, special interest areas, wilderness) for Forest Service-administered lands at Cougar and Blue River reservoirs and management of wild and scenic study rivers (Blue River and South Fork McKenzie).

3.5.2 Transportation. The main highway serving the McKenzie Subbasin is SR 126 (formerly U.S. 126) which traverses Lane County from Florence through Eugene/Springfield to north of McKenzie Bridge, connecting with U.S. 20. Traffic counts for the McKenzie Highway (SR 126) near the town of Blue River were 650 vehicles (average daily count) in 1992 (ODOT, pers. comm., 1994). Forest roads link SR 126 to Blue River and Cougar Lakes. Aufderheide Drive, a National Scenic Byway, parallels the South and North Forks of McKenzie River, forming a loop drive to Oak Ridge where it connects with SR 58. This drive

is heavily used by recreators accessing Cougar Lake and South Fork McKenzie above the reservoir, and by sightseers. Use on July and August weekends, 1993, exceeded 850 vehicles daily (Forest Service, 1994 letter, Exhibit C).

3.5.3 Recreation/Esthetics. There are a number of factors that contribute to the value of the waters of the McKenzie River Subbasin as an economic, recreational, and esthetic base. A large percentage of the subbasin is mountainous and undeveloped. Seventy percent is forested and is administered by the federal government as multiple-use forest lands, water projects, and as wilderness areas (Willamette Basin Task Force, 1969). As a result, the waters of the McKenzie River system are cool, clean, clear, and located in attractive settings. These attributes contribute to the high value of the McKenzie as a recreational base; as a prime spring chinook, steelhead and trout stream; and as a source of domestic and municipal water supply.

The entire length of the McKenzie River is classified by ODFW as valuable for fish rearing and recreation. The lower river (RM 0-11) and the river above the confluence of Blue River is managed mainly for wild salmonids (members of the salmon family that spawn and rear naturally as opposed to being hatchery spawned and reared). These two reaches of the river have access and terrain limitations, and are less frequently used by anglers. The primary salmon and trout production areas are located below the confluence of the South Fork in the McKenzie River and in unobstructed tributaries. The reach between the South Fork McKenzie River and Leaburg Dam is also the area of highest recreational use.

In terms of the intensity of sports fishing pressure it supports, the McKenzie River Subbasin may be the most valuable of the Willamette River tributaries. For example, more than 50,000 anglers were estimated to have used the reach from Armitage Park to the Blue River confluence during the period April 23 through October 31, 1983 (ODFW, 1985, in Corps, 1987). Blue River Lake and Cougar Lake are also good fishing areas. For example, the average number of fish caught per hour at Blue River and Cougar lakes during the seasons of 1971 through 1975 was estimated at 0.77 and 1.11, respectively. This compares favorably with a 5-year average (1969-1973) of 0.67 fish per hour for lakes and reservoirs within areas administered by the Northwest Region of ODFW (Ibid.).

There has been an observed recent increase of raft and river boat use on the Blue, South Fork McKenzie, and McKenzie rivers. Fluctuations in stream flow resulting from operation of Cougar and Blue River projects can cause boating safety concerns and affect fishing and other recreational use. There are several parks or waysides/boat launches downstream from RM 60, where the South Fork enters the McKenzie. At the confluence is Delta Campground, operated by the Forest Service (concessionaire), and Hamlin Boat Launch. There is a city park at Blue River. On the main stem McKenzie from South Fork to Leaburg Dam are Forest Glen Boat Launch, Finn Rock Rest Area, Howard J. Morton State Park, McMullins Landing, Silver Creek Landing, Rennie's Landing, Martin Rapids, Ben and Kay Dorris State Park, Whitewater

Park, Sheppard Landing, Clover Point County Park, GoodPasture Bridge, and Water Board Park (EWEB). Several of the boat landings are administered by BLM.

Recreational activities in the portion of the lower McKenzie administered by the BLM include angling, boating, picnicking, and nature study. Boating includes drift boats, rafts, canoes, and kayaks by both anglers and nonanglers. Recreational visitor use from May to August 1991 totaled 171,000 visits. The highest use occurred in June, the lowest in August (BLM, 1993).

There is no commercial permit requirement on the lower McKenzie. According to the McKenzie River Guides Association, the lower McKenzie River below the confluence of the McKenzie and Blue rivers is heavily used by both commercial guides and recreational boaters. The commercial guides in these reaches are primarily guiding fishing tours targeting on trout, steelhead, and some spring chinook.

The lower McKenzie River receives a great deal of nonangler recreational boating use because of its proximity to the populous Eugene/Springfield area. There are some commercial guided tours for sightseeing. Over the last 20 years, the Eugene Parks and Recreation Department Outdoor Program has annually sponsored rafting trips in the lower reaches of the McKenzie River. Numerous nonangler recreational boaters float the lower McKenzie River during the summer months. Approximately 36,200 users floated the river from Armitage Park to Blue River, Oregon, according to the 1983 McKenzie River Creel Survey. The heaviest nonangler boating was generally in the lower McKenzie River above Leaburg Dam. Highest nonangler recreational boating is associated with sunny days, weekends, and holidays.

The McKenzie River, above the South Fork of the McKenzie River, is managed by the Forest Service. The majority of this area has been designated a National Wild and Scenic River. This area is used by both recreational and commercial boaters. Users in this area are typically very experienced boaters who can handle the difficult and challenging waters of the upper reaches of the McKenzie. Most of these users put into the water in the upper reaches and end their boating prior to the South Fork McKenzie.

Recreational use of Blue River below the dam is limited. There is virtually no boating that occurs on Blue River. ODFW does not stock hatchery fish within Blue River, and there are no boat ramps on Blue River. There is some bank fishing and tubing that occurs in conjunction with the community park.

Very few boaters use the South Fork McKenzie. This is due to several factors. There is a relative lack of accessibility to the South Fork. One boat ramp on the South Fork McKenzie near the South Fork Bridge receives limited use by kayakers and some drift boaters. The South Fork is not stocked with hatchery fish, and the angling in other nearby, easily accessible, frequently stocked rivers is better. There are some strong rapids in the upper part of the South Fork below the dam. The lower part of the South Fork, near its confluence with

the mainstem, is marshy and difficult to navigate. Operators at Cougar Reservoir estimate there may be no more than 10 users on the South Fork on a summer weekend day. The South Fork offers limited opportunities for commercial boaters since the waters are typically low. Permits for commercial use on the South Fork McKenzie average only two to three per year.

Wild and Scenic Rivers. Three free-flowing segments of the upper McKenzie River were designated National Wild and Scenic River (Recreational) in 1988. The designated sections are several miles upstream of the confluence with South Fork. An 11-mile segment of the lower McKenzie, from Goodpasture Bridge east to the Forest Service administrative boundary, has been found by the BLM (Eugene District) to be suitable for federal designation under the National Wild and Scenic River System, with a recommended potential classification of recreational. The BLM would continue to manage the segment to protect its outstandingly remarkable qualities, regardless of Congressional designation (USDI, BLM, 1994).

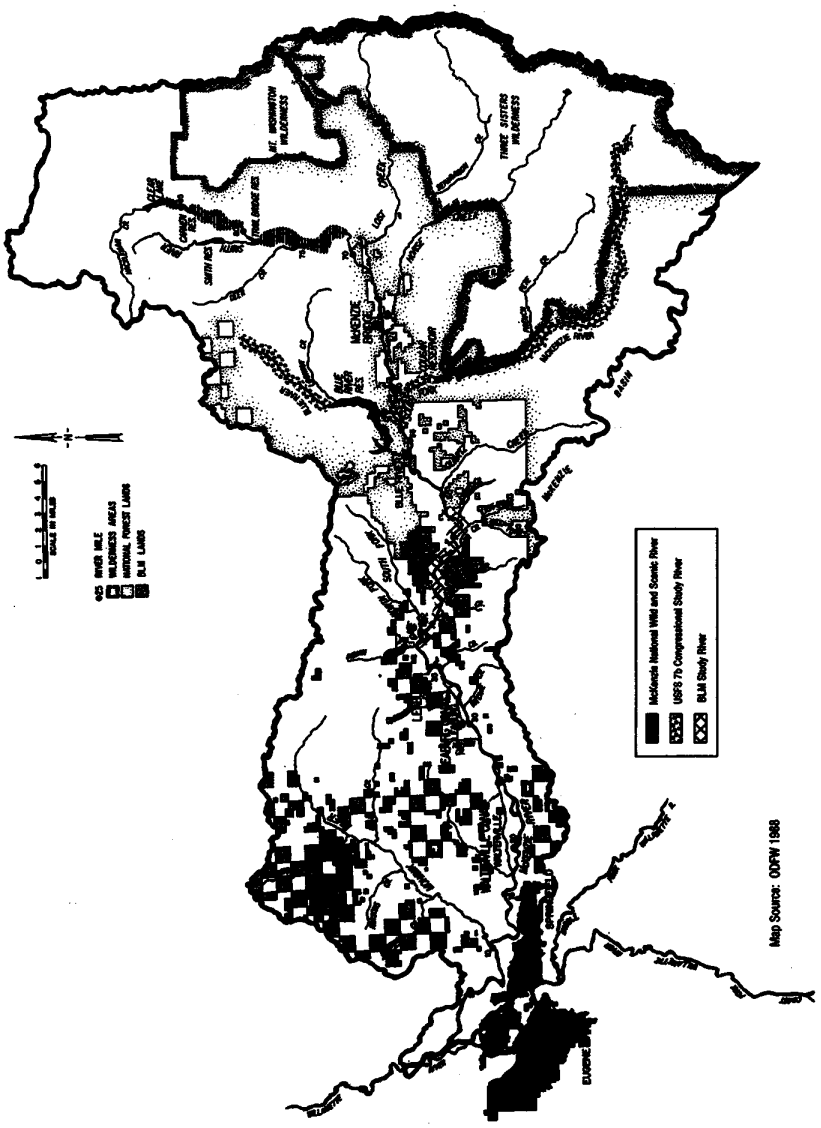
Blue River, from its headwaters to Blue River Lake, was designated a National Wild and Scenic study river in 1988. The Forest Service conducted the study to determine if Blue River qualifies for National status and determined it was ineligible (Forest Service, Mar 15, 1995, letter, Exhibit C). The Willamette National Forest Land and Resource Management Plan (Forest Service, 1990) does not recommend eligibility; however, the recommendation has not been forwarded to Congress (Jackie Deitrich, Forest Service, pers. comm., 1994).

The South Fork McKenzie (exclusive of Cougar Lake) was added to the State Scenic Waterway program in 1988. The river is being studied for inclusion under the National Wild and Scenic Rivers Act and is managed by the Forest Service to maintain the qualities for which the river is being studied. Segment 3, from Cougar Dam to the confluence with McKenzie River, is managed for "National recreation river" status during the study (Forest Service 1990). Figure 3-8 shows the river segments and their status.

Recreation at Blue River Lake. Blue River Lake has several small day use and camping facilities operated by the Corps and by Willamette National Forest. Corps facilities include a visitor viewpoint at the main dam (Lucky Boy) and a boat ramp at the auxiliary dam. The Forest Service administers Mona Creek Campground and Lookout Boat Ramp. The Forest Service is planning to upgrade and expand Lookout Campground in the near future. Use trends are similar to those at nearby Cougar Lake; visitors are attracted primarily for fishing, and they desire more and/or larger fish. From 1985 to 1989 the lake received an average of 66,500 visitor days of use, ranking it 11th overall among the 13 Willamette Basin lakes.

In order to meet downstream flow requirements, Blue River Lake is currently drafted first among all 13 Willamette Valley lakes. Consequently it experiences severe drawdown during mid-summer that affects recreation facilities. Users complain of early water releases; many desire the water remain through Labor Day. Under current operations, boaters are unable to launch by mid-July via the Lookout Boat Ramp. However, the trout fishery is not dependent

Figure 3-8 -- McKenzie Subbasin, National Wild and Scenic Rivers



on high lake levels. The Forest Service has undertaken a long-term effort to revegetate drawdown zones in the lake; early drawdown exposes more and larger areas of the lake for off-road vehicle use and impact. There are also concerns regarding the impact of water release on cultural resources below full pool and on unstable soils at dispersed camp sites exposed by drawdown during normal operation of the project.

The Forest Service also administers the H.J. Andrews Experimental Forest (HJA), located adjacent to and northeast of the reservoir. Although there are no recreation facilities within the HJA, dispersed recreation is allowed except where otherwise posted (Forest Service, 1990).

Esthetics. Blue River Lake controls runoff from a watershed of 88 square miles. The area is characterized by steep forested slopes, narrow small creeks, and diverse forest types. Creeks form larger streams with broad flood plains. Rough rock pinnacles and outcrops are common. The lake itself is narrow and winding and cannot be seen in its entirety from any one point. Reservoir slopes are steep, with relatively little flat land adjacent to the water. Lowering of the pool, which begins in mid-July, exposes denuded rock areas and mud banks that are visually degrading and make access difficult. Construction activities left many disturbed areas which have not revegetated, although the Forest Service has attempted revegetation in some slope locations (Corps, 1974a). Revegetation has been partly successful. Exposed rock walls remain unvegetated.

The Willamette National Forest manages the lands surrounding Blue River Lake with visual quality objectives of "retention" (in general, human activities not evident to the casual Forest visitor) and "partial retention" (in general, human activities may be evident but subordinate to the characteristic landscape) (Forest Service, 1990).

Recreation at Cougar Lake. Cougar Lake is a relatively large lake on the South Fork of the McKenzie. It has several day use and camping facilities operated by the Corps and by Willamette National Forest. Corps facilities are limited to view points at the dam. The Forest Service administers the Echo day use area (picnic grounds and boat launch) and Slide Creek Campground. Use trends are similar to those at nearby Blue River Lake; visitors are attracted primarily for fishing, and they desire more and/or larger fish. Reservoir operations, limited facilities and other constraints limit recreational use; between 1985 and 1989 Cougar Lake received an annual average of around 60,000 visitors, ranking it 12th in popularity among the 13 Willamette lakes. However, the lake is receiving increasing use, enhanced in part by National Scenic Byway status of nearby Aufderheide Drive. There is an observed increase of older persons with motor homes needing easier access, use of sail boards and jet skis on the lake, and user conflict between speedboats and fishing boats. There is also dispersed recreation, including camping, along the reservoir and the South Fork, especially during the summer. The reservoir's south end attracts considerable use as a day use and parking area for persons going to Terwilliger Hot Springs (Forest Service, Blue River Ranger District, 1994).

The drawdown priority for Cougar Lake is currently third for meeting downstream flow requirements, reflecting its relatively low priority as a recreation lake. The trout fishery in the lake is not dependent on high lake levels; however, users desire that boat ramps stay usable through Labor Day. The Forest Service has undertaken a long-term effort to revegetate drawdown zones in the lake; early drawdown exposes more and larger areas of the lake for off-road vehicle use and impact.

Esthetics. Cougar Lake controls runoff from a watershed of 210 square miles. The area is characterized by steep forested slopes, narrow small creeks, and diverse forest types. Creeks form larger streams with broad flood plains. Rough rock pinnacles and outcrops are common. The lake itself is approximately 6 miles long, narrow, and deep. Many small drainages in well-defined ravines enter the lake on either side. Reservoir slopes are steep, with relatively little flat land adjacent to the water. Lowering of the pool, which begins in mid-August, exposes denuded rock areas and mud banks which are visually degrading and make access difficult. Construction activities have left many disturbed areas which have not revegetated, making a sharp contrast to the surrounding forest (Corps, 1974b). The Forest Service has attempted revegetation in some slope locations, and has been partly successful. Massive rock walls from construction blasting remain unvegetated.

The Willamette National Forest manages the lands surrounding Cougar Lake with visual quality objectives of "preservation" (wilderness area: ecological change only), "retention" (in general, human activities not evident to the casual Forest visitor) and "partial retention" (in general, human activities may be evident but subordinate to the characteristic landscape). Lands along the South Fork McKenzie below Cougar Dam are managed for "partial retention." (Forest Service, 1990)

Cougar Lake is accessed from SR 126, which parallels the McKenzie River from the Eugene-Springfield area to east of McKenzie Bridge, just past Delta Campground to Forest Service Road 19, recently designated the Robert Aufderheide Memorial Drive National Scenic Byway. The Byway parallels the South Fork McKenzie, provides access to the Corps overlook at Cougar Dam, parallels the south reservoir's entire length, and continues along the South Fork McKenzie State Scenic Waterway (and national study river). In total, the Aufderheide Scenic Byway parallels the McKenzie South and North forks for 70 miles on Forest Road 19 (Forest Service, 1990). Average daily traffic counts for 1993 indicate use by about 500 vehicles in June and over 600 in July and August (Forest Service letter in Exhibit C, 1994).

3.5.4 Archeology and History. The Blue River and Cougar reservoirs are located in the region previously inhabited by Kalapuyan speakers. Archeological evidence indicates that these people occupied the foothill and valley areas of the McKenzie River drainage, and their eastern settlements extended to the eastern slopes of the Cascades around 1750 A.D. The Kalapuyans practiced a seasonal subsistence pattern of hunting, fishing, and gathering. Winter

villages were established, and several seasonal camps in the vicinity of specific resources areas were used throughout the year.

The various pressures on populations from the Euro-American migrations westward probably caused the abandonment of the villages in the foothills of the western Cascades during the early historic times.

There have been few concentrated archeological efforts to define the prehistory of this region. Further, the population was greatly affected in the late 1700's and early 1800's by contagious diseases introduced by the Euro-Americans. Probably less than one-tenth of the Kalapuyan people survived.

The few survivors relinquished their claims to the McKenzie drainage area under the Dayton Treaty of 1855, and were removed to the Grande Ronde Reservation. It is thought that they are now extinct as a separate entity.

Most of the historical events in the upper McKenzie region were associated with mining. The gold fields in Idaho were linked to the Eugene area when Felix Scott, Jr., planned and initiated the construction of the McKenzie Fork Wagon Road. Begun in the 1860's, the toll road was finally opened in the fall of 1872.

The town of Blue River is closely associated with mining. The post office at this town was established in 1866. Several other settlements became the focus for development within the region. These include McKenzie Bridge, an important crossing originally spelled "McKinzie" and changed in 1918; Rainbow, named after rainbow trout found in the river; Foley Springs, a hot springs commercial venture; and Belknap Springs, also a resort.

In 1993, a preliminary survey revisited previously recorded sites and noted new archeological sites on the two reservoirs. In 1994, the cultural material located within the reservoirs was tested and recorded. This included six sites at Cougar Reservoir and seven sites at Blue River Reservoir.

3.5.5 Socio-Economics. The McKenzie River Subbasin is within Linn and Lane counties. The Eugene/Springfield Metropolitan Statistical Area is Lane County's population center; Eugene is the second most populous city in Oregon. Lane County has exhibited a capacity for strong, nearly uninterrupted population growth. From 1910 to 1990, population in Lane County grew at an average rate of over 30 percent each decade. According to the Bureau of Census, the population of Lane County was about 275,200 in 1980, and 293,700 in 1992. The population of Linn County was 89,750 in 1980, and 95,000 in 1992.

Although lumber and wood products is the dominant manufacturing industry in the area, its role has been steadily diminishing. Non-timber manufacturing has steadily gained in

importance over the last 12 years. Manufacturing industries, such as electrical equipment and transportation equipment, have grown to play a large role in the local economy. Expansion also has occurred in industries such as printing and publishing, non-electrical machinery, and food processing.

Employment in Lane and Linn counties is greatly affected by the timber industry. In 1978, the unemployment rate in the Eugene/Springfield area was at 6.8 percent, and in Linn County at 7.4 percent. At the height of the recession in the early 1980's, the unemployment rate in the Eugene area rose to a high of 12.5 percent. Employment levels fluctuated and, with diversification, gradually improved over the next few years. The Eugene area rebounded and grew dramatically. In 1990, the unemployment rate dropped to 5.8 percent. Linn County, however, retains a higher unemployment rate (10.3 percent in 1992) reflecting its continued dependence on the timber industry.

The very rural, mountainous McKenzie River area provides mostly year-round homes for local residents and summer homes for a large population of vacationers and retired citizens who winter in the southern or southwestern United States. There are very few multi-unit, rental type dwellings. There were as many as 330 vacant housing units in the study area in 1990. A significant proportion, about 223 units, were intended for seasonal, recreational, and occasional use. Most of these units are owned by retired citizens who return to the study area for the summer. A proportion of the remaining vacant units are homes on the market for sale. (U.S. Dept. of Commerce, Bureau of Census, 1990).

Although the rental vacancy rate is typically low in the Eugene/Springfield area, there will likely be rental housing available. The relatively low rental vacancy rate in this area is partially due to the high proportion of college and university students in these areas.

Some residents of the study area currently commute to the Eugene/Springfield area every day to work. The commute is along the two-lane McKenzie Highway 126 for the most part, and takes about 1 to 1.5 hours one way. The Lane Transit District currently runs four round-trip buses per weekday from Eugene, up Highway 126, to the community of Blue River. The entire route one-way takes approximately 1.25 hours. Additional socioeconomic information may be found in Technical Appendix A, Economic Analysis, of Volume II of the Feasibility Report.

Chapter 4
ENVIRONMENTAL EFFECTS OF ALTERNATIVES

The potential adverse and beneficial consequences of installation and operation of temperature control facilities at Blue River and Cougar reservoirs are described in this section, along with possible mitigation measures. Study of this proposed action has been supported and encouraged by Congress and federal and state fishery agencies because of the expected long-term benefits to fish. The construction of the project, however, is expected to have numerous short-term, adverse impacts. Thus the discussion of each action alternative on the various resources is divided into an analysis of construction impacts and subsequent operation impacts. Absence of definitive data for some resource impacts, such as reservoir sediment amounts and composition, and uncontrollable events, such as a series of dry years, results in estimates of impacts based on the best available data and the assumption of normal water-years.

The alternatives analyzed are: Alternative 1, installation of multi-level ported system at Blue River Lake; Alternative 2, installation of multi-level ported system at Cougar Lake; Alternative 3, installation of multi-level ported system at Cougar and Blue River lakes on a phased, staggered schedule (the preferred alternative); and Alternative 4, No Action (continuation of the present situation).

4.1 Physical Environment

4.1.1 Airshed. Construction of multi-level ported intake towers at both Blue River and Cougar reservoirs would expose most of the reservoir floor, resulting in fugitive dust from drying sediments (if disturbed), odor from decaying vegetation, and some additional smoke from burning debris removed from the reservoir floor. None of these expected impacts can be measured, nor are they expected to be significant to the extent of violating Oregon air quality standards. Although fine, clay particles may be exposed, a crust would probably form due to drying. Winds are usually light except during winter storms, when the flood pool would cover the sediments. Burning of logs removed from the reservoirs is regulated by the state, and there may be a demand for log utilization by the wood products industry. Dust and odors may cause temporary discomfort to recreationists at the reservoirs.

Noise from rock blasting at Cougar reservoir may cause temporary discomfort to recreationists and travellers on Aufderheide Drive. This activity would occur during the first year of construction and would be coordinated with the FWS and Forest Service to avoid disturbance to northern spotted owls, and with the U.S. Navy to avoid accidental detonation from training flights.

These minor airshed impacts would be localized at the reservoir undergoing construction, thus there would be more cumulative impact under Alternative 3 then Alternatives 1 and 2. There would be no additional air quality impacts during operation for temperature control. No changes to existing air quality would occur under the No Action alternative.

4.1.2. Geology, Soils, Seismicity. The study area is located in Zone 3, moderate probability for earthquakes. Neither construction nor operation would affect this probability, nor would drawdown for construction result in additional impacts should an earthquake occur. Should a structurally damaging earthquake occur during construction, there would be less likelihood of flood damage downstream, since the reservoirs would already be drawn down.

Landslide Areas Potentially Impacted by Construction Drawdown at Cougar Reservoir. Known landslide areas identified in the Cougar Reservoir area are summarized below.

- An active landslide exists for a 0.5-mile-long reach on the right bank between the embankment and the mouth of the East Fork McKenzie River. This area is designated as Area 1 in the *Reservoir Slide Potential Report* 1968. It is considered a potentially dangerous slide only during a major earthquake event.

- A small active landslide zone, 200 feet wide by 300 feet long, exists on the left bank of the East Fork McKenzie River.

- An active landslide zone, 200 feet wide, exists on the right bank of the reservoir about 2,400 feet upstream from the confluence of the East Fork McKenzie. This zone extends up-slope about 1,200 feet.

- An active landslide zone exists starting about 800 feet upstream from Walker Creek and extending about 5,000 feet upstream along the shoreline. This zone extends up-slope about 1,000 feet. This area is designated as Area 2 in the 1968 Report. It is considered a potentially dangerous slide only during a major earthquake event. Slow, progressive failures of this area currently occur during winter months and during drawdown to normal low pool.

- An active landslide zone, about 200 feet wide by 200 feet long, exists on the right bank of the reservoir, about 2,700 feet downstream from the mouth of Slide Creek.

- An active landslide zone, about 500 feet long, is located just downstream from the mouth of Smith Creek. The uphill extent of this zone was not determined.

The slide areas which have the potential for causing damage due to drawdown are areas of deep soil or decomposed rock with the toe of the slide extending below the pool area. Those slides which have their toe located above minimum pool would not be impacted by the additional drawdown. The slide areas located on the west bank all fall into this category. Slides on the east bank from East Fork upstream to Rider Creek appear to extend to below minimum pool and have the potential for causing movements which extend to above the East Bank Road, and therefore can cause damage to the existing roadways. Damage would probably be limited to horizontal and vertical movements of a few inches to several feet. It is anticipated that damage to the road would be easily repaired due to the nature of the road, which is a little-used, gravel 4-wheel-drive road.

Landslides within the reservoir area are normally the type which move in a relatively slow progressive manner with the initial movement occurring near the toe and progressing upslope over a period of time. Due to the distance from the toe area to the East Bank Road and the slow rate of progression of these slides, the period of time required for movement to occur in the roadways may be a year or more after the initial movement occurs, and may continue for a few years after construction is completed.

Blue River Reservoir Landslides. Several landslides and potential landslide zones exist within the Blue River Reservoir area. None of the landslide zones listed in the *Reservoir Slide Potential Report*, 1968, is considered potentially dangerous. None of the slides identified is within the normal minimum pool, and therefore, no adverse impact is anticipated by the drawdown of Blue River reservoir during construction.

No construction would occur under the No Action alternative, so no impacts to soils or geologic conditions would occur.

4.1.3 Hydrology

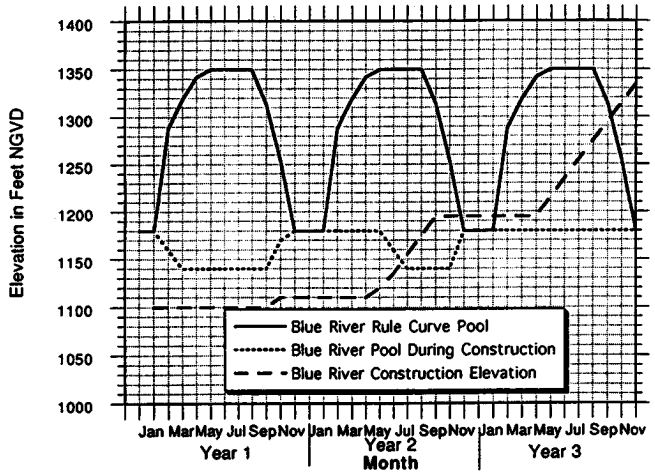
Hydrology at Blue River. Blue River Lake is currently operated to maintain the flow of the McKenzie River near Vida and the Willamette River at Harrisburg at or below flood regulation goals of 14,500 cfs and 42,500 cfs, respectively. The minimum outflow is 50 cfs and the maximum outflow is 3,000 cfs (normal maximum release). This situation would continue with the No Action alternative.

During construction at Blue River, as shown on the top graph in figure 4-1, the lowest pool elevation during the winter season is 1,180 feet (the same as minimum flood control pool). At elevations equal to or greater than 1,180 feet, the diversion would be closed and the regulating outlets used to pass outflow until use of the spillway is required. As a result, the flood control routings for Blue River during construction would be the same as the without construction condition. Flow requirements at control points on the McKenzie and Willamette rivers, and the allowable rates of flow increase also remain the same as the without construction condition. The bottom graph of figure 4-1 shows an example of how flood routings during construction would affect reservoir outflows and pool elevations.

During construction in the summer months (conservation season), there would be times in August and September when the flows in Blue River would fall below 50 cfs (table 4-1). For the mainstem McKenzie near Vida, summer flows at Vida would be reduced by about 5 to 20 percent out of the 2,500 to 3,000 cfs currently available in the summer months (figure 4-2).

Average monthly flows in Blue River have met the 50 cfs minimum since construction of the reservoir. This condition would continue under the No Action alternative.

Figure 4-1 -- Elevations During Construction and Flood Routing, Blue River Lake



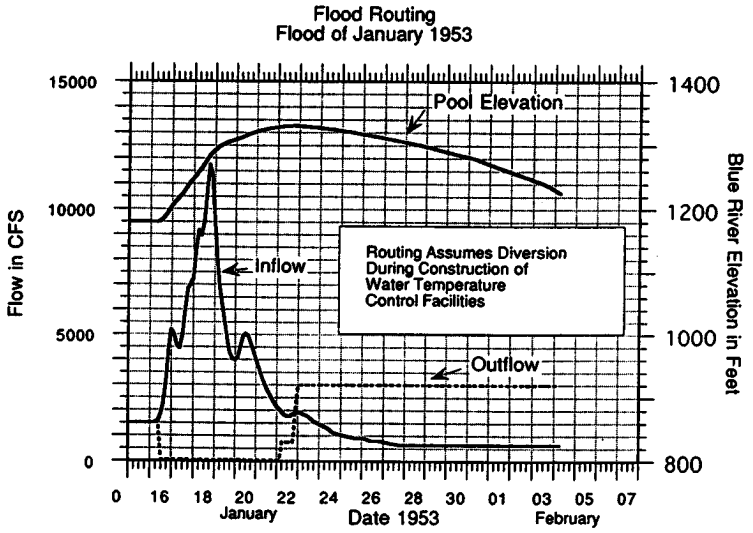


Table 4-1 -- Estimated Conservation Flows and Elevation Differences in Blue River During Construction at Blue River Lake

(Mean monthly flows in cfs for water years 1967-1986; no storage at Blue River)

Month	During Construction (inflow = outflow)	Without Construction (No Action)	No. of Times 50 cfs Not Met during construction	Estimated Elevation Differences
July	84 cfs	240 cfs	2	0.8 feet
August	47 cfs	170 cfs	11	0.9 feet
September	63 cfs	360 cfs	10	1.4 feet

Minimum flow requirements in the Willamette River at Albany (5,000 cfs) and Salem (6,500 cfs) are met by the Willamette system of reservoirs. Blue River Lake is drawn down first. During construction, Blue River would not have storage available to help meet the minimum flow requirements at Albany and Salem. An estimate of the difference in flow that would be made up from other reservoirs in the Willamette system is shown on table 4-2.

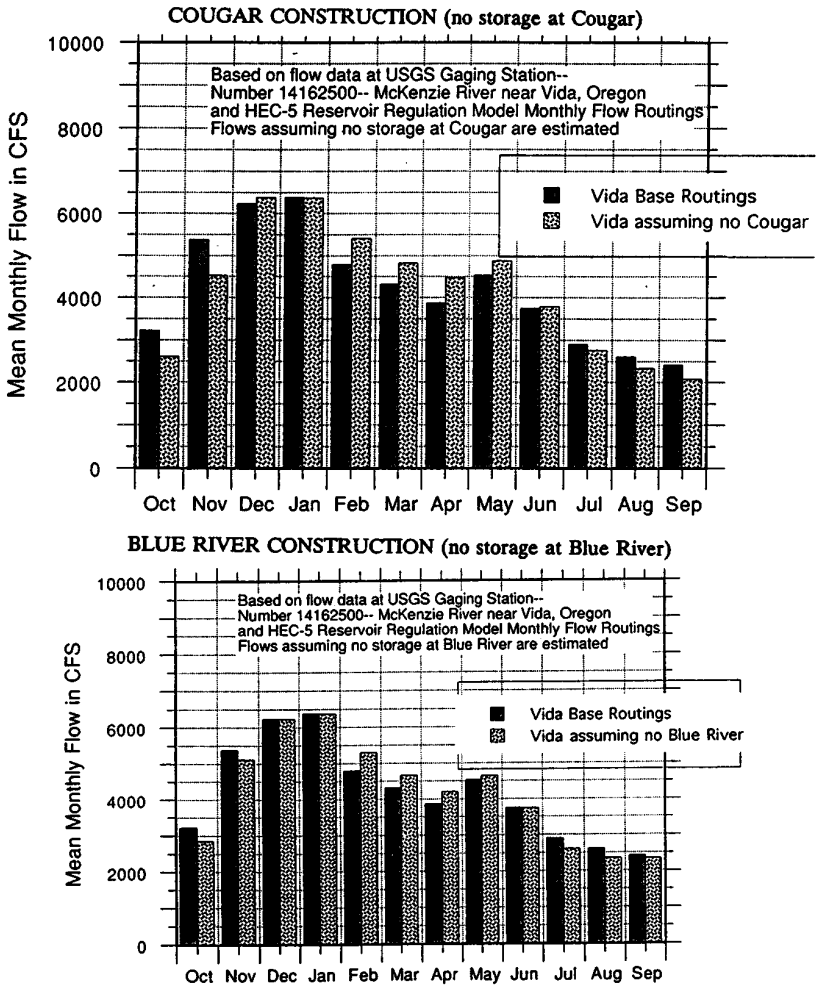
Table 4-2 -- Estimated Monthly Flow Required to Offset Loss of Storage for Blue River

Willamette River at Albany
Estimated Monthly Flow in CFS
Required to make up for the loss of Blue River Lake Storage
and achieve the minimum required flow of 5000 cfs**
Water Years 1967-1986
Drainage Area-- 6840 square miles
Based on HEC-5 Reservoir Regulation Model Monthly Flow Routings

Water Year \ Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1967	0	0	0	0	0	0	0	0	0	0	270	20
1968	0	0	0	0	0	0	0	0	0	330	150	280
1969	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	230	280
1971	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	70	240	180	70
1974	240	0	0	0	0	0	0	0	0	0	380	0
1975	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	240	260	0
1977	0	0	0	0	0	0	0	0	0	470	210	140
1978	210	0	0	0	0	0	0	0	0	240	250	0
1979	0	0	0	0	0	0	0	0	0	250	0	270
1980	0	0	0	0	0	0	0	0	0	250	0	270
1981	0	0	0	0	0	0	0	0	0	250	0	260
1982	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	510	0
1984	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	240	270	0
1986	0	0	0	0	0	0	0	0	0	230	0	0

** These flow values were estimated by taking the Albany flows from a base condition routing, subtracting the Blue River Lake contribution, then subtracting that result from 5000 cfs
The numbers roughly estimate the flow needed to achieve the minimum flow at Albany if the Blue River Lake contribution is taken away as would be the case during Temperature Control Facilities construction

Figure 4-2 -- McKenzie River Flows Near Vida During Construction



Note: Assumes no flow augmentation during construction.

Hydrology at Cougar Lake. Cougar Lake is currently operated to maintain the flow of the McKenzie River near Vida and the Willamette River at Harrisburg at or below flood regulation goals of 14,500 cfs and 42,500 cfs, respectively. The minimum outflow is 300 cfs, and the maximum outflow is 5,000 cfs (normal maximum release). Minimum flood control pool elevation is 1,532 feet. This would remain the situation under the No Action alternative.

During construction at Cougar, the lowest pool elevation during the winter season would be 1,350 feet (top graph, figure 4-3). As a result, there would be an additional 60,000 acre-feet of flood control storage available during this time. The diversion would be controlled to a maximum of 2,000 cfs outflow up to a pool elevation of 1,510 feet. Above this elevation, the diversion would be closed and the regulating outlets used to pass outflow until use of the spillway is required. Flow requirements at control points on the McKenzie and Willamette rivers, and the allowable rates of flow increase remain the same as in the existing condition.

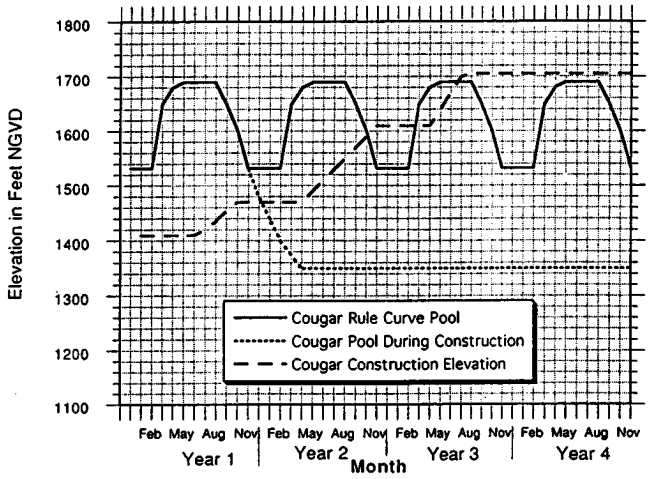
The bottom graph in figure 4-3 shows an example of how flood routings during construction will affect reservoir outflows and pool elevations. The peak inflow for the 1953 flood was 16,400 cfs, about a 15 percent probability event (7-year recurrence interval). A flood of this magnitude is likely to occur during November through February. Construction would be taking place between elevations 1,480 and 1,540 during this time. As shown on the upper graph, the pool elevation would be above 1,540 for about 6 days and above elevation 1,480 for more than 20 days. If additional rainfall occurs and inflow increases, it would take even longer to lower the pool elevation. Construction site flooding limits the construction season from about June through October, depending on rainfall, which extends the construction period to 4 years. The actual construction period may be shorter or longer depending on weather conditions.

During construction in the summer months (conservation season), there are several times in August and September when the flows in the South Fork would fall below 300 cfs for extended periods of time (table 4-3). For the mainstem McKenzie River near Vida, summer flows at Vida would be reduced by about 10 to 20 percent out of the 2,500 to 3,000 cfs currently available in the summer months (figure 4-2).

Average monthly flows in the South Fork McKenzie have met the 300 cfs minimum with one exception since construction of Cougar Reservoir. This condition would continue under the No Action alternative.

Minimum flow requirements in the Willamette River at Albany (5,000 cfs) and Salem (6,500 cfs) are met by the Willamette system of reservoirs. Cougar Lake is third in the system of reservoirs to be drawn down to augment flows. During construction of the temperature control facilities, Cougar would not have any storage available to help meet the minimum flow requirements at Albany and Salem. An estimate of the difference in flow that would be made up from other reservoirs in the Willamette system is shown on table 4-4.

Figure 4-3 -- Elevations During Construction and Flood Routing, Cougar Lake



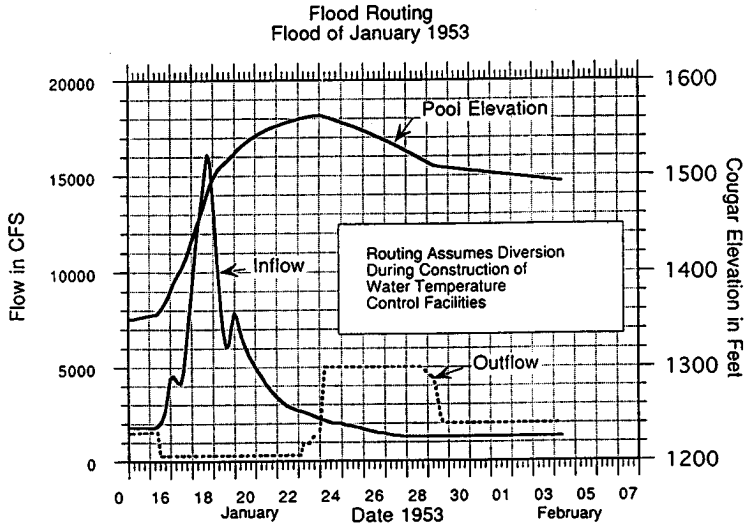


Table 4-3 -- Estimated Conservation Flows and Elevation Differences in the South Fork During Construction at Cougar Lake

(Mean monthly flows in cfs for water years 1967-1986; no storage at Cougar)

Month	During Construction (inflow= outflow)	Without Construction (No Action)	No. of Times 300 cfs Not Met during Construction	Estimated In-Stream Elevation Differences
July	403 cfs	570 cfs	3	0.3 feet
August	317 cfs	470 cfs	8	0.3 feet
September	314 cfs	760 cfs	8	0.8 feet

Table 4-4 Estimated Monthly Flow Required to Offset Loss of Cougar Storage

COUGAR CONSTRUCTION Willamette River at Albany

Estimated Monthly Flow in CFS
Required to make up for the loss of Cougar Lake Storage
and achieve the minimum required flow of 5000 cfs**
Water Years 1967-1986
Drainage Area-- 4840 square miles
Based on HEC-5 Reservoir Regulation Model Monthly Flow Routings

Water Year	Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1967	.....	0	0	0	0	0	0	0	0	0	0	470	0
1968	.....	0	0	0	0	0	0	0	0	0	310	300	170
1969	.....	0	0	0	0	0	0	0	0	0	0	0	0
1970	.....	0	0	0	0	0	0	0	0	0	0	440	0
1971	.....	0	0	0	0	0	0	0	0	0	0	0	0
1972	.....	0	0	0	0	0	0	0	0	0	0	0	0
1973	.....	0	0	0	0	0	0	0	0	0	280	330	140
1974	.....	0	0	0	0	0	0	0	0	0	0	0	0
1975	.....	0	0	0	0	0	0	0	0	0	0	0	0
1976	.....	0	0	0	0	0	0	0	0	0	0	0	0
1977	.....	0	0	10	0	200	0	0	0	0	0	370	260
1978	.....	30	0	0	0	0	0	0	0	0	20	460	0
1979	.....	0	0	0	0	0	0	0	0	0	450	0	70
1980	.....	0	0	0	0	0	0	0	0	0	280	0	110
1981	.....	0	0	0	0	0	0	0	0	0	0	930	0
1982	.....	0	0	0	0	0	0	0	0	0	0	0	0
1983	.....	0	0	0	0	0	0	0	0	0	0	0	0
1984	.....	0	0	0	0	0	0	0	0	0	0	0	0
1985	.....	0	0	0	0	0	0	0	0	0	290	830	0
1986	.....	0	0	0	0	0	0	0	0	0	270	630	0

** These flow values were estimated by taking the Albany flows from a base condition routing, subtracting the Cougar Lake contribution, then subtracting that result from 5000 cfs

Hydrology for Willamette River. Water is released from Cougar and Blue River lakes to augment flow in the Willamette River at Albany and Salem. At Cougar, the minimum outflow is 300 cfs, and the maximum outflow is 5,000 cfs (normal maximum release). Minimum flood control pool elevation is 1,532 feet. At Blue River, the minimum outflow is 50 cfs and the maximum outflow is 3,000 cfs. Minimum flood control pool elevation is 1,180 feet. Flow augmentation in the mainstem McKenzie is incidental to this operation. There is a goal to provide a minimum of 2,500 cfs in the mainstem near Vida for EWEB needs. However, the Corps is not required to meet this goal.

Minimum flow requirements in the Willamette River at Albany (5,000 cfs) and Salem (6,500 cfs) are met by the Willamette system of reservoirs. Blue River Lake is first and Cougar Lake is third in the system of reservoirs to be drawn down to augment flows. During construction of the temperature control facilities, neither project would have storage available to help meet the minimum flow requirements at Albany and Salem. A flow routing analysis was performed to evaluate the additional storage needed from other reservoirs, and to evaluate the flow reductions on the South Fork, Blue, and mainstem McKenzie Rivers during construction at the Cougar and Blue River projects.

The focus of the analysis was the summer regulation of the system (primarily July and August) for low flow augmentation. The base condition used represents the Willamette system as it has been operated over the last several years. Flow records used for the analysis represent the low (1977), average (1985) and high (1984) flow years based on the average flow in the Willamette River at Salem and the McKenzie River near Vida. More information on the results of the flow routing analysis is provided in Section 4.5.2 of the main report and in Exhibit B.

The summer flow augmentation requirements of 5,000 cfs at Albany and 6,500 cfs at Salem can be met at all times unless the Willamette Basin experiences extreme drought conditions with record low flows (see table 14 in the main report). The analysis shows that even in 1977, the lowest flow year in the 77 years of record at Salem, there would be enough water in the system to meet these flow requirements.

Impacts to the Willamette reservoirs during construction vary, and in any given year depend on flow conditions. During construction, any shortage in augmentation flow will be made up by Hills Creek, Lookout Point, Cougar (during Blue River construction), Blue River (during Cougar construction), and to a lesser extent Fall Creek. Hills Creek and Lookout Point together account for about 50 percent of the conservation storage in the system above Albany. Fall Creek, Cougar and Blue River total over 30 percent of the conservation storage. The other projects, Cottage Grove, Dorena, and Fern Ridge are smaller and do not have sufficient storage to maintain flow augmentation. An estimate of the difference in flow that would be made up from other reservoirs in the Willamette system is shown on tables 4-2 and 4-4.

Cougar Lake has about twice as much conservation storage as Blue River Lake, so higher outflows and earlier evacuation of the pools would be expected at Hills Creek and Lookout Point during construction at Cougar (see table 13 and figures 24 and 25 of the main report). During construction at Cougar and Blue River, the outflow and pool elevation impacts at Hills Creek under average and high flow years, and at Lookout Point under high, average, and low flow years were found to be minor when compared to the base condition. Currently, the pool at Hills Creek is kept above elevation 1,516 as long as possible through Labor Day for recreation purposes. It appears from the routings that there would not be a problem meeting this goal in average to high flow years. In lower flow years, however, the pool may drop below elevation 1,516 by as much as 1 month earlier (figure 24 of the main report).

Indirect impacts of augmentation during construction are discussed in Section 4.4.3 of this EIS. Impacts are related to elevation changes. No impacts related to earlier flow, flow durations, or water temperature are expected.

Based on the results of the flow routing analysis, it appears that impacts to the Santiam Basin projects (Green Peter, Foster, and Detroit) would be insignificant. Some releases in low flow augmentation for Salem may be necessary in lower than average years.

Flow augmentation necessary under the Blue River Only and Cougar Only alternatives could change operation at Hills Creek and Lookout Point reservoirs (on the Middle Fork of the Willamette) as well as at Blue River and Cougar reservoirs for up to 4 years. Under the Preferred Alternative, changes in operation would extend up to 8 years. There would be no change for flow augmentation under the No Action alternative.

4.1.4 Water Quality

Water Quality During Construction. This section summarizes the potential water quality changes anticipated to occur downstream of the Blue River and Cougar projects during the construction of water temperature control facilities. Of primary concern are the magnitude and temporal changes in water temperature, suspended sediments, turbidity and dissolved oxygen. Because suspended sediments would settle out in the residual pools, there are no anticipated impacts from suspended sediments.

Temperature Impacts-Construction. Hydrometeorological data for the years 1982-1984 were available for use in this analysis. These years were a little wetter and cooler than average. A reservoir operation model, HEC-5Q, processed the hydrometeorological data and routed flow and temperature through Cougar and Blue River reservoirs and downstream to Vida on the mainstem McKenzie River. The basic assumptions for evaluation of the construction plan are:

- Flood control operation remains unchanged.
- Installation of temperature control facilities first occurs at Cougar.

The adopted minimum fishery flows are:

Blue River:	50 cfs year-round
Cougar:	300 cfs (February-June)
	200 cfs (July-November)

Diversion capacities were set considering the seasonal flows during construction which would occur during the low flow season. Diversion capacities are:

• Blue River diversion is 800 cfs until the cofferdam is overtopped at elevation 1,152 feet (NGVD) then the capacity of the regulating outlet with the gates fully open.

• Cougar's existing diversion tunnel plug would be tapped and operating gates installed. The capacity to dissipate energy in the powerhouse tailrace would limit the flow through the diversion tunnel to 2,000 cfs. If a flood flow should cause the pool to rise to elevation 1,510 feet (NGVD) the flow would then be through the regulating outlet at capacity with the gates fully open.

• Flow downstream past Vida was limited to 14,000 cfs.

The rate of construction was estimated from the volume and rate of placement of the concrete for the WTC system, assuming a May 1 start of construction. For Cougar, the schedule considered the needs of construction, minimum flows for fish without refilling the pool until completion of construction (Exhibit A, Figure A-9). For Blue River, the plan is to keep the pool elevation below 1,140 feet (NGVD) as much as possible for 2 years (see Figure A-10).

Results from the initial model runs show the following:

• At Blue River, summer time peak daily mean outflow temperature reaches nearly 70°F, which is 5 to 6° warmer than the inflow temperature. In the late fall and winter, the outflow and inflow temperatures are nearly the same (figure 4-4).

• At Cougar, the residual pool during the summer yields a peak daily mean outflow temperature of nearly 58°F, which is 3 to 6° warmer than inflow temperatures. Fall and winter release temperatures are nearly equal for both the inflow and outflow (figure 4-5).

At Vida on the mainstem McKenzie River, the following temperature changes were estimated by use of the model:

• Effects at Vida during construction at Cougar show about a 3°F reduction in river temperature in the fall (Exhibit A, figure A-13). This is due to a smaller pool, which has a high turn-over rate and passes the cooler inflows through the project. The flow rate is reduced as well because there is no need to evacuate the pool for flood control (it has been held at a low level for construction). The river temperature reduction is limited by dilution from cooler mainstem McKenzie River flow.

Figure 4-4 -- Flow and Temperature Results for Blue River

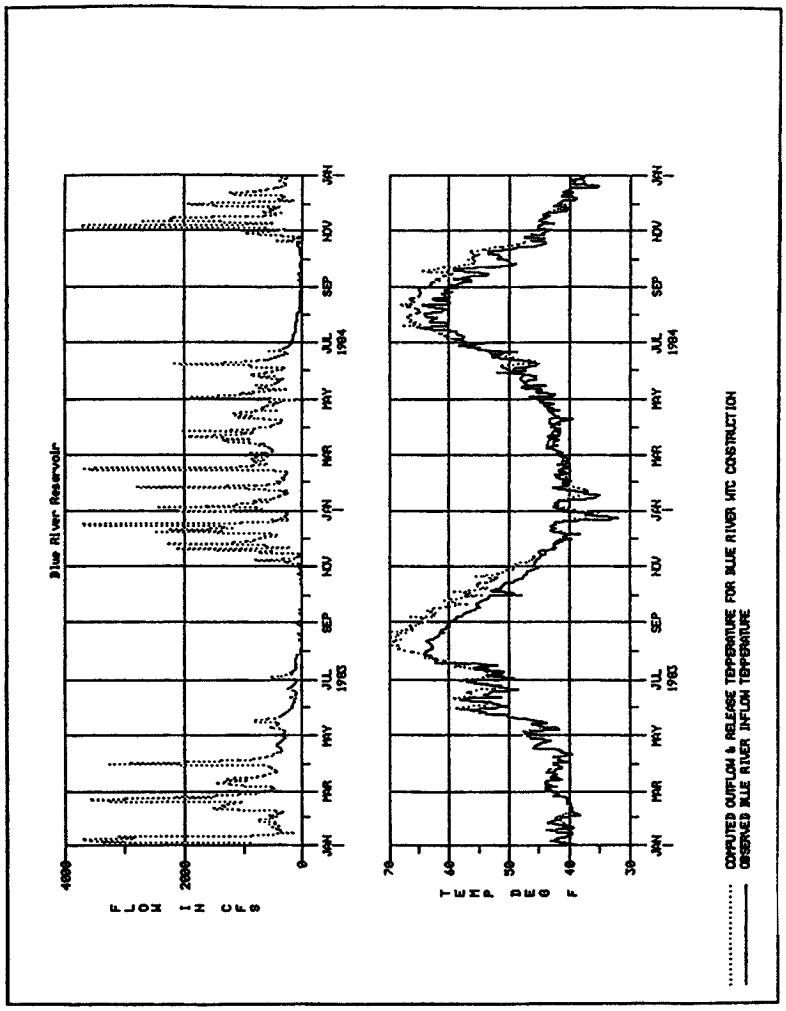
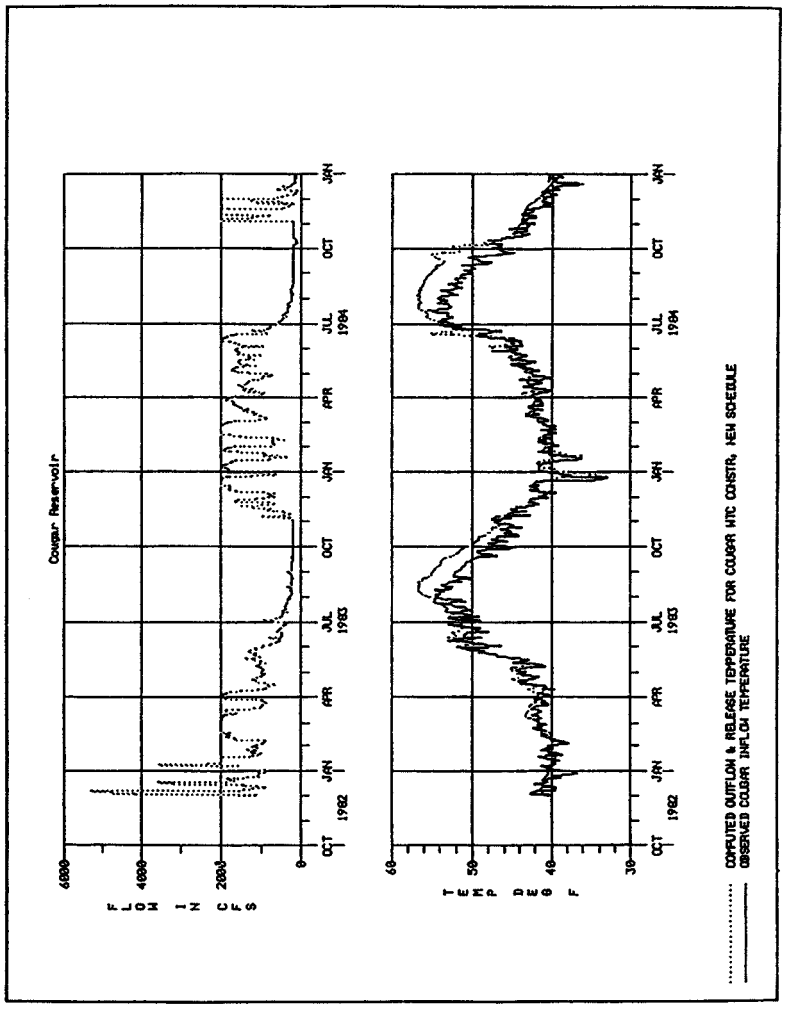


Figure 4-5 -- Flow and Temperature Results for Cougar



• With the temperature control system at Cougar in place, construction at Blue River would cause a 3 to 5° reduction in river temperature at Vida in the fall for reasons similar to the effects of construction at Cougar (Exhibit A, figure A-14).

During review of the draft report, a concern was expressed that the water temperature of the residual pool during Cougar construction may become too warm during the summer to support bull trout. A modeling analysis was performed to consider the effects of warming in the unwatered channel from the upstream USGS gage to the residual pool. The maximum daily temperatures in the South Fork during original construction in the early 1960's were used for the evaluation (USGS gage sites above and below Cougar, 6.5 miles apart). Any temperature increase would be at a maximum when the reservoir had been cleared of vegetation, removing any shading which might moderate any heat gain just prior to completion of construction. The results of this analysis are discussed below, and more detailed information can be found in section 1.6.1 of Exhibit A.

During construction of the temperature control modification, there will be a return to an unwatered and unshaded river leading to the head of the residual pool. This leaves about 4.7 miles, or 72 percent of the distance, between the gages that would return to a condition similar to just prior to completion of the original construction. As a result of less exposure, however, there should be a smaller heat gain than that observed during original construction.

Inflow temperatures to the residual pool were increased to account for the entire originally unshaded and unwatered river. Daily mean stream temperatures entering the residual pool may rise to a little more than 60°F on the hottest days, which occur in August. The warmest daily maximum temperatures flowing into the residual pool could reach 65°F. The model was rerun using these revised inflow temperatures. Results show that the warmest daily mean outflow temperature from the residual pool in early August would be about 63°F. This amounts to an increase in the river's daily mean temperature of about 3°F as it passes through the residual pool. There likely would be little diurnal variation in the temperature of the outflow since the release occurs from the bottom of the residual pool where the coolest water is found. Although surface temperatures could reach as high as 70°F in early August, the residual pool would be thermally stratified and would provide much cooler temperatures lower in the pool (about 59 to 62°F).

Turbidity. Turbidity (opaqueness or cloudiness caused by suspended particles) is expected to increase over the short term under all construction alternatives and may exceed state water quality standards for brief, intermittent periods. High levels of turbidity typically occur in both regulated and non-regulated streams during spring flood conditions. Turbid water may be aesthetically displeasing and causes decreased light penetration. These secondary impacts are discussed in the EIS sections 4.3.1, 4.3.2 and 4.4.4. Maintaining a residual pool would essentially eliminate sediment transport out of the reservoirs and reduce turbidity in the water released from the projects during construction.

Particles making up turbidity are usually colloidal and by definition are difficult to settle out of the water column. Prevention and control of turbidity during construction are necessary. Turbidity profiles were measured at Cougar Reservoir in summer 1971 (*Hills Creek Reservoir Turbidity Study*, Water Resources Research Institute, Oregon State University, Corvallis, Oregon, December 1971). This showed increased turbidity below the level of the reservoir outlets. The bottom turbidity was 20 JTUs (approximately equivalent to 20 NTUs). This turbid water would be released as the reservoir is drawn down for construction. Other parameters such as pH, total solids, and conductance were all consistent with turbid water below the level of the outlet. Dissolved oxygen measured during subsequent studies showed no decrease in the lower turbid waters. Release of water from the lower levels should pose no water quality threat downstream. Drawdown during construction would occur much earlier in the year during a period of higher flows when there is a higher likelihood of turbid inflow. Re-erosion of sediment deposits in the reservoir will likely increase turbidity 10-fold.

Another finding of the study was that a reservoir with a bottom outlet cleared more quickly following a storm and did not retain turbid water in the deeper portion of the reservoir. This is the existing situation at Blue River, thus significant increases in turbidity are not expected at this project. At Cougar, however, the existing regulating outlet is not at the lowest level. During construction, the diversion tunnel would be the outlet at the bottom of the reservoir, and turbid water is more likely to occur. The residual pool, however, should readily clear following a storm event as suspended particles settle out. For additional discussion of the turbidity study, see Section 1.6.2 in the main report.

For construction at Blue River and Cougar, by retaining residual pools and controlling the rate of reservoir drawdown, the silty and coarser fractions re-eroded from sediment deposits in the reservoirs should settle out in the residual pool. Turbidity levels could reach as high as 100 NTUs as the reservoir approaches the residual pool condition. However, with a residual pool this large, turbidity could be half of this amount. Succeeding high water events should produce less turbidity, but this would depend on the magnitude of each event (large events generate more turbidity).

Subsequent high water events exceeding the capacity of the diversion would cause the pool to rise. These high water events may cause further re-erosion and re-suspension of sediment with associated increases in turbidity. The gradual return to the residual pool would maximize the recession of turbidity levels.

Timing of the drawdown would be similar for both Blue River and Cougar reservoirs. Starting on February 1, there would be a goal to lower the reservoir gradually to the elevation of the residual pool by May 1 (earliest date). This is because natural flows have generally fallen to manageable flow rates in the spring and for which diversion capacities were selected. This gives the maximum length construction season, until the flood control season in November makes continued construction in the flood control pool too risky.

Erosion control measures such as seeding flood tolerant plants and placing silt fences, hay bales, or soil cement on the exposed sediment deposits will be necessary to reduce turbidity created by rain storms during the construction season.

Turbidity levels may, at times, exceed the state standard (no more than a 10 percent cumulative increase in natural stream turbidity as measured relative to a control point immediately upstream of the turbidity-causing activity) during the initial drawdown and succeeding storm events during the construction period. For impact estimation purposes, four storm events per construction season were estimated. For the Blue River only alternative, turbidity standards for Blue River may be exceeded five times each construction year. For the Cougar only alternative, these standards for the South Fork McKenzie River may be exceeded five times per construction year. These impacts would be cumulative under the preferred alternative. Pre-construction monitoring for turbidity is necessary to establish background levels against which turbidity during construction can be monitored with further adjustments or erosion control measures taken as necessary.

Turbidity related to removal of sediments from the reservoir floors, and placement of this material upstream, to prepare for construction would be short-term. Disturbed sediments would settle out in the residual pools. A detailed evaluation is presented in the Section 404(b)(1) Evaluation following the EIS.

Flows in the mainstem McKenzie River would dilute the turbidity from the Cougar and Blue River Lake projects. Turbidity is not expected to cause water quality impacts further downstream in the river. Turbidity levels under the No Action alternative would remain as they are described in the affected environment.

Dissolved Oxygen. The potential exists for reduction in dissolved oxygen levels below the dams from the lowering of the reservoirs for construction of the temperature control facilities. Lowering the reservoirs below the minimum flood control pool may cause some erosion of sediments deposited in the reservoir, and the project outflow to be more turbid. Because the organic content of the sediments deposited in the reservoir are thought to be quite low, the oxygen demand also should be low. However, the planned testing of the reservoir sediments for their organic and chemical composition during the PED phase would aid in fully estimating any reduction in dissolved oxygen levels.

Turbulent mixing in the South Fork would reoxygenate the water, aiding in recovery of the dissolved oxygen levels. Dilution (1:3 <=> 1:4) of the South Fork discharge in the mainstem McKenzie also would speed the recovery and likely limit any decreases in oxygen levels.

Water Quality After Construction

Temperature Impacts-Operation With multi-level ported SWS at Blue River Lake, temperatures in Blue River would approximate the target temperatures for that river, and to a lesser extent the temperatures on the mainstem McKenzie River at Vida. With multi-level ported SWS in operation at Cougar Lake, temperatures in the South Fork McKenzie below the dam would approximate the target temperatures set by the fisheries agencies for that stretch of river and, to a lesser extent, the mainstem McKenzie at Vida. With temperature control at

both projects, temperatures at Vida are more closely replicated than with Cougar only. The achievement of target temperatures for the spring/summer warming and fall/winter cooling periods for each construction alternative is summarized in table 8 in the main report.

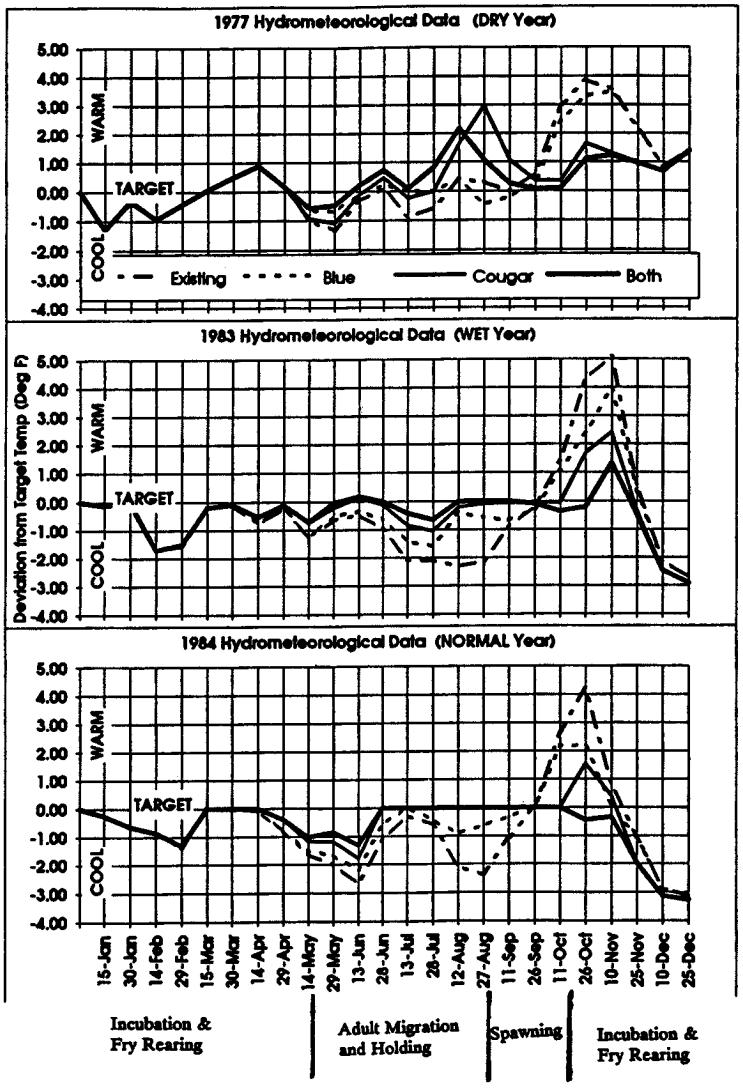
Results show a significant improvement in water temperatures in the South Fork and Blue rivers under the full range of hydrometeorological conditions. The percentage of time target temperatures that are met range from 84 to 91 percent for spring warming and 83 to 95 percent for fall cooling for the Blue River, and from 71 to 85 percent for spring warming and 63 to 88 percent for fall cooling for the South Fork McKenzie River. See figure 4-6 and section 4.3.2.

The No Action alternative would continue the existing situation, with target temperatures rarely being met in the spring or fall.

Water Quality Impacts. A concern has been expressed about modifying Blue River and Cougar for temperature control and the subsequent release of surface waters (see EWEB letter, September 1994, Exhibit C).

The concern is that using releases from the surface layers of the reservoirs for temperature control will cause intense algae blooms, increasing the taste and odor problems at the Hayden Bridge Filtration Plant. Also, additional organic loading may increase water quality treatment costs and reduce compliance with water quality regulations. There are other potential sources which may contribute significantly to the problem, such as soil fungi. These may be activated in the soils on the sides of the reservoir by the emptying and filling of the reservoir during normal operations. Correlation between taste and odor problems and the presence of algae may only be coincidental. The literature has not made a clear case for associating algae with taste and odor problems. Additional investigation is needed and will be done to determine whether the current sources of the problem are Blue River and Cougar reservoirs, which furnish only a fraction of the McKenzie River flow, or if there might be other sources of the problem in the McKenzie Subbasin. Pre- and post-construction monitoring would be performed from the McKenzie River above the confluence with the South Fork and at intermediate locations below the confluence with Blue River. EWEB would be involved in the monitoring program. If monitoring results indicate an impact would occur, then the associated NED costs will be estimated during the PED phase.

Figure 4-6 -- Temperature Control Effects on the mainstem McKenzie from SWS



4.2 Biological Environment

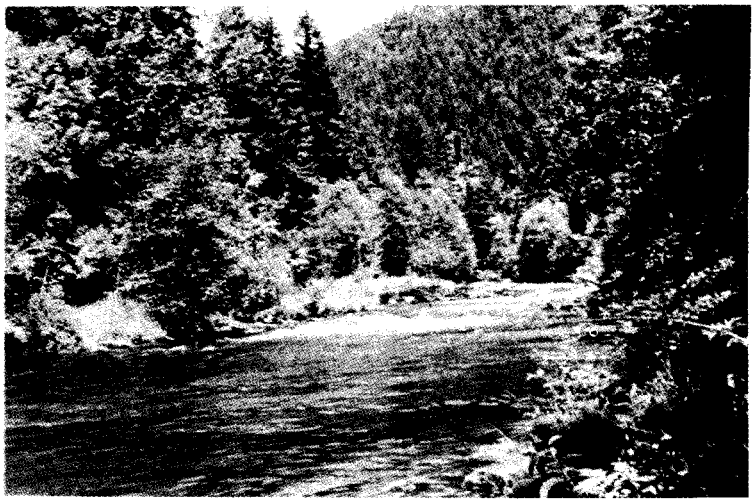
4.2.1 Vegetation. During construction, vegetation along the conservation pool elevation at each reservoir and reservoir tributaries would be without pool-related ground water. The pool shoreline at both reservoirs is mostly rocky, and exposed from July to April when normal pool operation results in less than conservation-full pool. Thus, construction-related drawdown is not expected to significantly affect existing shoreline vegetation, although some desiccation of forbs could occur. Riparian vegetation along tributaries could be desiccated depending on weather conditions since pool levels would be drawn down in April-May and remain low until December. The Forest Service has planted some areas of Blue River Reservoir below conservation pool with species tolerant of periods of inundation/exposure; some plantings have survived. These include bald cypress and sedge. These areas would receive less inundation and more exposure under Alternatives 1 and 3, resulting in some expected loss of plants. Vegetation would be unaffected by the No Action alternative.

Riparian and wetland vegetation along the rivers below the projects could suffer desiccation during construction. Flow in Blue River during August would be about 47 cfs (or less) instead of the present 170 cfs, dropping Blue River about 0.9 feet. While trees and deeply-rooted shrubs would probably tolerate some desiccation, shallow-rooted plants may not survive the de-watered flood plain condition. Low flows during summer mimic natural stream conditions; annual plants would occur in the exposed areas where soil is present. This type of vegetation would be expected to re-colonize by natural succession after construction (figure 4-7). Shrubs, grasses, ferns, and small trees (maple, alder, conifers) would be cleared at the diversion tunnel portal, near the powerhouse at Cougar Dam. This is a filled, disturbed area which requires excavation for diversion of reservoir waters during construction to flow into the South Fork McKenzie River. As this area would be rip rapped, this vegetation would not re-establish.

Vegetation at the construction lay down/material storage site at Strube Flat, near RM 2 of South Fork McKenzie, would be trampled or cleared. This includes grasses, shrubs and possibly some trees. About 8 acres would be affected. Similar impacts would be expected at the construction lay down site below Blue River Dam. About 1.4 acres of grass and shrubs would be cleared (figure 4-7). Sensitive plant species are not expected to occur in these laydown areas as they were used for laydown/materials storage purposes during initial construction of the dams. Thus, they were highly disturbed sites. Successional development of vegetation at these former construction areas has been slow, and indication of the poorly developed soils at these locations.

The Forest Service has identified two sensitive plant species, *Poa laxiflora* and tall bugbane (*Cimicifuga elata*), as occurring in the general project area. *P. laxiflora* is found in riparian zones, hardwood/conifer forests, and alder flats. Tall bugbane is found in moist hardwood/conifer habitats, which are not expected to be impacted by any of the alternatives.

Figure 4-7 -- Photos of Blue River and Cougar Dam



Blue River, below the dam, at the Community Park (July 1994)

Strube Flats, west of Cougar Dam

The lay down, or staging areas, in the project vicinity would also be impacted by material storage and heavy equipment use during construction. These areas would be restored following project construction; thus, the expected impact is minor and temporary.

Summer flow in the South Fork McKenzie below Cougar Dam would be reduced from present operations to occasionally less than minimum flows (300 cfs), dropping the river level about 0.3 feet. Some desiccation of riparian and wetland vegetation may occur. As low flows would occur in summer and fall, mimicking natural stream conditions, impacts to riparian and wetland vegetation are expected to be negligible as these plants would be adapted to this regime.

The No Action Alternative would have no effect on vegetation.

4.2.2 Wildlife. Possible impacts to wildlife are generally secondary to vegetation and other habitat conditions. Riparian and wetland vegetation along the rivers below the projects would be exposed to natural run-of-river flows during the construction period. Presently, flows of 350 cfs occur in Blue River during August; August flows during construction would be about 47 cfs and 0.9 feet lower. These lower flows would mimic natural conditions and are not expected to significantly impact riparian vegetation. Grasses and forbs would be expected to pioneer into the exposed portions of the riverbed over the course of the summer, which is a natural event for non-regulated streams.

Impacts to wildlife from construction and changes in project operation are considered minimal. Neither project has established riparian communities along their periphery. The annual drawdown for flood control and operation at full pool during summer have precluded riparian development along the periphery of these lakes. This lack of riparian habitat limits the presence of aquatic furbearers, amphibians, and birds normally associated with riparian habitat fringing a body of water.

Construction related impacts to bald eagles, northern spotted owls, and American peregrine falcons, which are federal ESA species and also on the Regional Forester's Sensitive Species List, have been addressed in the biological assessment forwarded to and concurred with by the FWS (Exhibit C). Harlequin ducks are known to occur on the South Fork of the McKenzie below Cougar Dam. Sediment entrapment in the residual pool and erosion control measures, such as seeding the drawdown area, are expected to minimize sedimentation problems in the river downstream of the project. Thus, no negative impact to harlequin ducks would be expected. Further, the project would mimic natural stream hydrographs which should be more conducive to harlequin duck habitat. A substantial length of river would be reexposed with drawdown, which may also be used again by harlequin ducks. Other sensitive species are not expected to occur in the project area, for example, California wolverine, northwestern pond turtle, greater sandhill crane, and white-footed vole. Some sensitive species that have been recorded in the general region of the project represent unusual occurrences of individuals outside their normal range (e.g., furruginous hawk, great gray owl). These individuals would not be affected by any of the alternatives.

Lower stream flows below the projects during summer would essentially mimic natural stream flow conditions for these streams prior to regulation. Wildlife species would benefit from a return to natural streamflow conditions during the construction period. Natural streamflow conditions result in exposed gravel bars and banklines. These exposed areas provide nesting habitat for spotted sandpipers. They also provide suitable conditions for herbaceous plant growth and seedling emergence/establishment of riparian shrubs and trees. These plant species provide forage and seeds for a number of wildlife species. Lower stream levels also result in entrapment of invertebrates and vertebrates in pools, thus making them available for wildlife foraging in these pools.

Releases between the end of flood control season and start of the construction period in year one would result in higher turbidity levels downstream of the projects than existing releases. Average monthly flows during December-February (first construction year only) would be about 336 cfs higher than average inflow from Cougar Reservoir. About 63 cfs increase above inflows would also occur for March and April in the first construction year. Amphibians which utilize bodies of water in the flood plain for egg-laying and larval rearing may be adversely impacted by these higher flows during the first construction year if flows enter these ponds. Higher water levels may also result in the formation of ponds elsewhere in the flood plain. The net impact varies with the extent of the floodplain that is inundated. The increase in outflows (about 27 cfs during February and March) associated with Blue River construction is considered negligible. Flows during the other construction years should be comparable to inflow, and impacts should be negligible. Turbidity would be most noticeable in the stream reaches below the project during the first construction year drawdown. Turbidity reduces the available light, thus could reduce photosynthesis and other processes that are light-dependent. Net impacts on wildlife associated with the streams and ponds downstream of the projects are unknown but would probably be most prevalent during the first construction year drawdown.

Operation of the completed projects would return the downstream rivers to more natural temperature conditions, which should benefit amphibians, including red-legged frogs.

4.2.3 Fisheries and Aquatic Species

Construction Impacts - Construction of the temperature control towers at both Cougar and Blue River reservoirs will require having the reservoirs drawn down for up to 4 years each. Drawdown at both projects would begin in the late winter or early spring in order that mobilization can start in early April and construction by May or June. The reservoirs would be operated as run-of-river projects from April until October or November (depending on rainfall) when construction would stop and flood control operations begin. Flood control operations would involve storing water to meet downstream flood control obligations, which may result in flooding of the construction site. Drawdown and run-of-river operations would be started again in April and construction would begin in May. Drawing the reservoir down to streambed, above the residual pools, would result in the loss of most of the reservoir habitat during the years of construction. The provision of a residual pool about 40 surface acres, 40 feet deep with a volume of about 1,000-acre feet at Blue River and about 80 surface acres

about 76 feet deep with a volume of about 3,000 acre-feet at Cougar would maintain some refuge habitat. Diversion conduits would be screened at Cougar; fish would be retained behind the dam.

Operation of the reservoir area as run-of-river with minimal flood control would prevent any reservoir or stream habitat from establishing during the construction period. Water quality should be sufficient to maintain fish in the residual pools. Since the pool would turn over every few days, an adequate food supply should be available.

Following construction and refilling of the reservoir, the habitat would begin to reestablish; fish and other aquatic organisms would recolonize the reservoir. Plant species would reestablish in the shoreline areas if previously occurring there. The reservoir area is expected to fully recover from construction impacts within a few years of refilling.

Downstream areas would also be impacted by changed water quality and flow conditions. Changes in downstream conditions during construction was modeled using the reservoir operation model. A complete discussion is provided in the Technical Appendices B and C.

The warmest daily mean outflow temperature from the residual pool at Cougar in early August is expected to increase to about 63°F; at Blue River it may increase to about 70°. 0These increases are less than those occurring under existing reservoir operation. Fall and winter temperatures would be nearly equal for inflow and outflow for Cougar and Blue River.

Downstream river temperatures at Vida, below the confluences of the South Fork and Blue rivers, showed a 3° reduction in the fall from current conditions during the construction of SWS at Cougar. This is due to the lack of a full reservoir pool and the colder inflow waters being passed directly through the project. River temperature at Vida during the construction of Blue River tower, assuming that the Cougar tower would be operational, showed at 3 to 5° reduction in the fall from existing conditions. This is probably also due to the lack of a reservoir and that colder inflows are passed directly through the project. (figures 4-4 and 4-5.)

Turbidity levels would also increase downstream during reservoir drawdown as the sediment that has been deposited on the bottom of the reservoir is re-eroded. While re-eroded sediment would be trapped by the residual pools, the amount of turbidity produced would depend on the type of sediment present and how much erosion occurs during drawdown. No information is available on this; however, an estimate can be made based on some research done at Fall Creek Reservoir, also in the Willamette basin. Fall Creek is drawn down annually to release spring chinook that are reared in the reservoir. In 1989 turbidity measurements were taken at the outflow during drawdown (Figure A-15, Exhibit A). Turbidity was generally slightly less than 100 NTUs until the water level dropped into the old river channel. Turbidity then peaked at levels slightly less than 600 NTUs until the water level was higher than the river channel, at which time it dropped back to low levels. It appears that the high turbidity levels are due to the water scouring out the old channel and that once it rises above this level, erosional forces are not as great.

If this is similar to what would occur at Cougar and Blue River, the peak of the turbidity would occur in August during the first construction season with subsequent construction seasons producing less turbidity. Maintenance of a residual pool behind the dams would also reduce turbidity levels downstream since it would allow the heavier material to settle out. Fine, colloidal material would pass on down stream. Sediment stabilization methods would be used in the drawdown zone to reduce turbidity. It is expected that turbidity would be more likely to occur downstream from Cougar, because the regulating outlet is not at the deepest portion of the reservoir. Drawdown from the diversion tunnel could encounter more turbidity. Initial drawdown from Blue River is not expected to have significant increases in turbidity.

Some reduction in dissolved oxygen may occur as a result of re-suspending sediments back into the water. The actual level is expected to be minimal since the material is believed to be low in organic material. Also, turbulent mixing downstream would likely re-oxygenate the water and further reduce the impact.

Changes in temperature, turbidity, and dissolved oxygen levels would impact aquatic organisms downstream of the projects. The level of the impact would depend on the extent and duration of the change. Temperature changes during construction are considered to be somewhat beneficial since they would more closely mimic natural conditions. Warmer temperatures in the spring and summer would likely encourage spring chinook migration and invertebrate and algae production and generally raise the level of productivity of the stream. Cooler temperatures in the fall would decrease early emergence of spring chinook fry and improve their survival.

Increased turbidity levels in the spring and summer may delay migration of spring chinook and trout and reduce productivity in the river by reducing light penetration. Since the material carried downstream would be primarily fine sediment (colloids), it is not anticipated that it will settle out until it reaches the lower McKenzie or Willamette rivers.

Changes in dissolved oxygen levels are not expected to be significant based on the type of sediment that is believed to be present and the amount of re-oxygenation that would occur downstream.

Having the reservoirs drawn down would also affect the flow rates downstream. Flows would generally be greater in the early spring since the water would be released downstream, and lower in the summer since there would be no stored water available for release. In the late summer it may not be possible to meet minimum flows during some years. This change in flow would impact aquatic habitat, streamside vegetation, and associated wetland areas. In early spring, when flows would be higher than normal, and more area would be flooded, more aquatic habitat available; there also would be more natural stream conditions for riparian vegetation and wetland areas. In the South Fork, higher water levels may cause spring chinook to spawn in areas that may be dewatered later in the year, which could reduce the survival of some of the eggs and fry. However, there is little success under existing conditions due to poor fry survival rates. Lower water levels in the summer, particularly in Blue River,

though more closely mimicking natural conditions, would also reduce aquatic and riparian habitat and water for wetland areas. This would happen primarily in the late summer to early fall when vegetation is beginning to die out.

Bull Trout

Drawing down Cougar reservoir for construction of the temperature control tower may affect the existing population of bull trout upstream of Cougar reservoir. This population is estimated to consist of from 50 to 100 mature adults as well as an unknown number of subadults and juveniles. It is believed that these fish are part of the original fluvial (rears in rivers) McKenzie River population that was cut off when Cougar dam was constructed and have subsequently adapted into an adfluvial (rears in lakes) type that spawns upstream in tributaries of the South Fork and then migrates downstream as subadults to rear in Cougar reservoir. Consequently, Cougar Reservoir now plays a role in the life cycle of these fish.

During construction, Cougar Reservoir would be drawn down to an 80-acre residual pool. In order to assess the impacts of the drawdown on the bull trout population upstream of Cougar and to develop methods to minimize these impacts, the proposed construction scenario was discussed with the bull trout working group, an interagency group formed to recommend ways to enhance bull trout populations. The bull trout working group felt that it would be better to keep the bull trout in the reservoir rather than pass them downstream though the diversion tunnel, where conditions are not as suitable for survival. It was also decided that blocking them upstream of the reservoir during construction would not be suitable for maintenance of the population since the reservoir has become an integral part of their life history. Consequently, it was decided to allow the bull trout to remain in the residual pool during construction and to screen the outlet into the diversion tunnel to block adults, subadults and juveniles from going through the diversion. The bull trout working group as well as the agencies (ODFW, FWS, Corps) agreed with this approach.

Concerns have been expressed that conditions in the residual 80-surface acre pool that would remain in the summer during construction would not be suitable for bull trout survival and that even if they can survive they would be trapped in the reservoir and not be able to migrate to upstream spawning areas.

Specific concerns with the residual pool include: unsuitable temperatures, high turbidity levels that would prevent effective feeding, lack of food source due to the disruption of the existing reservoir habitat, and increased predation by adult bull trout on subadults and juveniles due to confining the fish in a smaller area. These concerns have been evaluated, and a variety of measures are being proposed to respond to these concerns. Resolutions to these and other unforeseen problems would be handled during construction by an interagency coordinating committee so that problems can be coordinated with all involved agencies and handled quickly. A discussion of currently proposed solutions to the above concerns follows.

Modeling of projected temperatures in the residual pool has indicated that on the average temperatures would not exceed the upper limit of what bull trout can accommodate. Daily

maximum temperatures may exceed these limits, depending on weather conditions; however, there should be enough stratification in the reservoir for a thermocline to form with the colder water below the thermocline providing a refuge for the bull trout (see Exhibit A for more information). Recent information has also indicated that bull trout populations can occur in areas with temperatures greater than the 58°F that was originally thought to be the upper limit. Populations in southern Oregon occur in areas with temperatures up to 65-70° (Bob Hooton, ODFW, pers. comm., March 1995).

It has also been suggested that the original modeling of temperatures in the reservoir did not adequately deal with the heating that would occur as the South Fork flowed through the drawdown zone. A recent re-evaluation of this heating was done using temperature data from 1963. This is considered representative of the drawdown condition, since this was a period when the reservoir area had been cleared of vegetation but had not been filled. The results of this re-evaluation confirmed the original predictions of a 3 to 6° warming in this reach. Though these temperature levels may reduce growth, it is unlikely that they would make the residual pool unsuitable for bull trout.

Turbidity levels in the residual pool are expected to be highest during the initial drawdown but would disperse rapidly once the stream establishes a channel. A variety of sediment control methods also would be used to stabilize the drawdown zone and reduce turbidity levels in the residual pool. Consequently, it is expected that turbidity, though initially high during drawdown, would not affect feeding behavior of fish once the reservoir is stabilized and turbidity levels are reduced.

Food supply in the reservoir is expected to be lower than what is available now since much of the productive area of the reservoir would be out of water during the spring and summer when productivity is highest. Loss of this productivity would directly affect the small fish and invertebrates that adult and subadult bull trout use as a food supply. It is proposed to provide supplemental food for the bull trout in the residual pool. ODFW has suggested that adult spring chinook could be transported upstream of Cougar to spawn. It is anticipated that fry and juveniles would provide a food supply in the residual pool as they move downstream. Hatchery rainbow trout could also be directly stocked in the residual pool. Either of these methods would assist in providing the food supply necessary for bull trout survival.

Predation of subadult and juvenile bull trout by adult bull trout may be increased by concentrating the fish in a smaller area. Supplemental feeding is expected to reduce this to some extent. In addition, it is proposed to place structures for cover for subadults and juveniles in the residual pool to further prevent predation. Both of these methods are expected to reduce predation.

Blocking the passage of adult bull trout from the residual pool to upstream spawning areas may impact the long-term survival of the population. It is therefore important that passage be maintained during the reservoir drawdown. Possible passage problems include both physical barriers as well as water quality conditions. A braided channel could occur as the South Fork

flows across the sediment wedge that could occur at the head of the reservoir. Braided channels generally do not have sufficient water depth to allow fish to pass or may erode differentially, creating water falls or velocity barrier areas. Possible solutions include dredging out a single channel, placing structure to reduce velocity barriers and creating pool areas for resting. Velocity barriers may also form in the channel area downstream of the sediment wedge, and structure would also need to be placed to make these passable.

Water temperature or turbidity could also block passage for short periods of time. It is possible that during warm weather daily maximum temperatures could exceed the limit for bull trout migration. This, however, would only occur for a short period of time during the day and it is assumed fish would pass when temperatures return to an acceptable level. Temperature refuges could also be provided by artificially shading some of the pools created for passage. High turbidity levels could also block migration. This, however, likely would occur only during a storm event, as it does now; when turbidity levels return to normal, passage would be restored.

Based on incorporating the above measures recommended by the bull trout working group and the agencies, it is likely that only minimal impacts would occur to the bull trout population upstream and that they should survive the construction phase of the project.

Operational Impacts

The impacts of operating the projects with the selective withdrawal systems in place would depend upon how the system is operated. For this analysis it is assumed that the system would be operated to meet the target temperatures developed by the resource agencies (see Exhibit A) using existing operational constraints. The target temperatures were based on pre-project conditions and are averages over the period of record for given periods of time during the year that are important in the life cycle of the fish species present. Table 4-5 presents the recommended temperature ranges used to develop the target temperatures. Figure 4-6 shows these temperatures compared to existing conditions (no action) and construction alternatives on the mainstem McKenzie River. Pre-project temperatures were chosen since it was believed that returning the mainstem McKenzie, South Fork, and Blue rivers to what was there naturally before Cougar and Blue River dams were built would be most beneficial for the ecosystem.

The success of meeting these target temperatures with temperature control at Cougar alone, at Blue River alone, and with both projects is shown in figure 4-6. The center line is the median of the target temperatures, and the graphs are the deviation from this under natural conditions with the various projects operating. As is shown, both projects with temperature control facilities (preferred alternative 3) most closely approximates the target temperatures.
Table 4-6 shows the results of SWS performance, as measured by average temperature differences, between the without-project condition (no action) and each construction

Table 4-5 -- *Recommended Water Temperature Ranges (in degrees Fahrenheit)*

Location	Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SFMR	Max	41	41	41	43	48	55	63	64	58	51	45	41
	Min	39	40	40	41	44	51	57	59	54	49	44	40
BR	Max	41	41	41	43	48	55	63	64	58	51	45	41
	Min	39	40	40	41	44	51	57	59	54	49	44	40
MR	Max	40	43	43	45	48	52	56	56	53	47	45	43
	Min	40	43	42	44	47	49	52	53	51	47	45	43

SFMR - South Fork McKenzie River, RM 3.9 (Rainbow gage), Oct 1955 - Sep 1963
BR - Blue River, RM 8.5, temperature data Oct 1963 - Sep 1967.
MR - McKenzie River, RM 47.7 (near Vida), temperature data Oct 1961 - Sep 1963.
Source: FWS, ODFW, and NMFS joint letters dated 14 Sep 1984 and 13 Mar 1985.

alternative. Model results were compared to the target temperatures by computing the difference between the temperature resulting from the without-project condition (or alternative scenario) and the target temperature. Minimizing the average annual difference from the target temperatures was the goal for each construction alternative (this value would be ± 0 for perfect conformance). The measure of improvement results from the change in the average temperature difference between the without-project condition and the alternative scenario evaluated.

For example, the average temperature difference in the South Fork between the without-project condition and the target temperatures was found to be ± 5.2°F (1984 data). Installing a selective withdrawal system at Cougar beneficially reduces the average temperature difference to ± 1.6°, for a 3.6° reduction from the without-project condition.

Spring Chinook

In order to evaluate the effects on the spring chinook population from temperature control, an analysis was performed that used information on fry emergence timing, spawning distribution, and spawning success (Appendix B of the FWS Coordination Act Report). Using 1,800 temperature units (a temperature unit is each degree above 32°F) for emergence timing of fry, differences in emergence were predicted for three stream reaches (above the South Fork, in the South Fork, and below the South Fork) with various temperature control alternatives for different water years.

Varying survival rates were established for fry, assuming early emergence is detrimental to survival. Survival of egg to fry was estimated to be 25 percent for fish emerging in mid-March (the best condition), and zero at date of spawning (mid-September, the worst condition). A straight line relationship was assumed between these two dates to give a

survival per day based on number of days to emergence. Emergence date (time to reach 1,800 tu's) was then calculated using the temperature modeling data for any given alternative and flow year, and a survival was associated with that date.

Spawning and emergence dates were estimated using September 15 to represent early spawning fish and September 30 for late spawning fish. The portion of fish spawning prior to and after September 15 was estimated using redd counts and carcass surveys (ODFW, 1992). Fish spawning prior to September 15 was estimated to be 35 percent.

Table 4-6 -- SWS Performance as Measured by Average Temperature Differences

Location	Alternative	Without-Project vs Target Temperatures[1]	With-Project vs Target Temperatures[2]	Reduction (Improvement)[3]
South Fork	Cougar Only - 1984	± 5.2°F	± 1.6°F	3.6°F
	5-year Average	± 5.6°F	± 1.4°F	4.2°F
Blue River	Blue R. Only - 1984	± 4.8°F	± 1.0°F	3.8°F
	5-year Average	± 5.3°F	± 1.2°F	4.1°F
Vida	Cougar Only - 1984	± 1.5°F	± 0.9°F	0.6°F
	5-year Average	± 1.4°F	± 1.0°F	0.4°F
Vida	Blue R. Only - 1984	± 1.5°F	± 1.1°F	0.4°F
	5-year Average	± 1.4°F	± 1.2°F	0.2°F
Vida	Cougar & Blue R - 1984	± 1.5°F	± 0.8°F	0.7°F
	5-year Average	± 1.4°F	± 0.8°F	0.6°F

[1] The average temperature difference between without-project condition and the target temperatures.
[2] The average temperature difference between with-project condition and target temperatures.
[3] The reduction in average temperature difference between the with- and without-project conditions.

Table 4-7 summarizes the analysis results for the estimated days to emergence for existing conditions for three different water years by stream reach for two different dates of spawning (September 15 and September 30). Earlier spawning is especially subject to early emergence when it occurs below the projects and is influenced by the relative warm waters being released at that time, as indicated by the days to emergence in the South Fork vs. above South Fork for September 15 spawning.

Fish agencies estimate that, prior to the construction of the Cougar and Blue River projects, about 65 percent of the spring chinook production occurred above Leaburg Dam. Under existing conditions, this distribution appears reversed with about 35 percent of spring chinook

Table 4-7 -- Estimated days to emergence[1/] for three different water years, by stream reach, for without project (existing) temperature conditions.

Spawning on September 15

Water Year	Below S. Fork[2/]	South Fork[3/]	Above S. Fork[4/]
Average Year	131	86	180
Low Flow Year	131	118	180
High Flow Year	141	127	180

Spawning on September 30

Water Year	Below S. Fork[2/]	South Fork[3/]	Above S. Fork[4/]
Average Year	150	115	180
Low Flow Year	134	110	180
High Flow Year	156	124	180

[1/] Assumes 1800 TU's for emergence
[2/] Based on WES Temperature modeling at Vida
[3/] Based on Inflow Temperature to Cougar Reservoir
[4/] Based on estimated emergence on March 15

production occurring above Leaburg Dam. Modifying release temperatures at both projects is expected to restore the production distribution back to pre-project conditions (Interagency meeting, November 17, 1994).

ODFW has identified an average annual run of 10,000 adult spring chinook salmon as a management goal upstream of Leaburg Dam. It is recognized that this goal is not representative of the full potential of the McKenzie Subbasin, which has been estimated as supporting about 38,000 adult spring chinook salmon. Consequently, it was decided by the fishery agencies that 65 percent of this estimate, or 24,700 fish, is a reasonable assumption for the maximum number of fish that could be supported above Leaburg Dam. This assumption also is supported by the 1992 survey of available spawning habitat upstream of Leaburg Dam.

The distribution of the benefits to adult spring chinook between the alternatives was evaluated using the heat budgets of the two reservoirs. Meeting the target temperatures requires access to and withdrawal of the warmest water available in the pools. There is little cold water carryover in Blue River Lake, so it warms more quickly in the spring. About 43 percent of warm surface water available in both projects is associated with Blue River Lake. Applying the percentages of available warm water between the two pools gives a more reasonable

assumption of the potential of each project to warm water temperatures in late spring and summer to promote migration into the study area.

With all construction alternatives, the modified water temperatures would approximate conditions that occurred naturally before the projects were built and would improve spring chinook production. For the Cougar only alternative, a significant improvement in fry emergence timing (later emergence by 44 to 48 days) occurs in the South Fork McKenzie. Improvement would also occur under the Blue River only alternative, with later emergence occurring by 26 to 47 days in the Blue River. Under the No Action alternative, fry emergence would continue with emergence around 114 days instead of the desired 180 days, with no days of improvement.

Under each construction alternative, fry emergence timing is somewhat improved for mainstem McKenzie River. The Blue River only alternative shows a 1- to 5-day difference (improvement) in fry emergence timing at Vida. For Cougar only, a 9- to 12-day improvement is shown. By adding temperature control to both projects, a 13- to 17-day improvement is shown. By reducing early emergence and providing better rearing conditions, the ecosystem would be returned to a more natural condition, thus improving fry survival. These improvements in fry emergence timing were used to predict adult returns under each alternative.

Numerous authors have identified the importance of temperature to spring chinook migration (Armour 1991, Bell 1986, and Reiser and Bjornn 1989). It has been identified that a water temperature of 52°F was needed for spring chinook to begin passing Willamette Falls and Leaburg Dam, and that migration timing has been shifted later by several weeks at Leaburg Dam, compared to pre-project conditions (FWS, 1994). The NMFS also reported that passage at Leaburg Dam occurred at the time of day when peak temperatures were reached (late afternoon and early evening); and that modified operations to increase temperatures during the early spring chinook migration period in 1990 and 1991 produced increased passage at Leaburg Dam during those operations (NMFS, 1991). In the Rogue River Basin, ODFW (1986) has documented the importance of the early portion of the spring chinook run because these are larger, older fish, generally destined to the upper portion of the basin. Similar fish in the McKenzie River would be destined to the upper mainstem (Carmen-Smith Spawning Channel) and tributaries (Horse and Lost creeks), all significantly underseeded.

In order to evaluate the effects of Blue River on migration timing, an evaluation was done using hourly temperature data to determine when the temperature reached 52°F and the amount of time each day the temperature exceeded 52°. The main report section 3.7.4, figure 15, shows that Blue River alone moves the time earlier in June when water temperature reaches 52° than under existing conditions. It also increases the number of hours in a day that the water temperature is above 52°.

Construction of temperature control facilities at both projects would result in an increase in the production of wild spring chinook in the basin by providing conditions that would enable

them to utilize the large amounts of unused habitat in the upper watershed. It would also change the ecosystem back to more natural conditions, which would likely improve fry survival by reducing early emergence and providing better rearing conditions.

Based on the discussed assumptions (timing of fry emergence, spawning dates, percent of production above Leaburg Dam), estimates of additional spring chinook adult returns (output) for hydrometerological conditions representing a normal (1984), wet (1983), and dry (1977) year were derived for average annual (over a project life of 50 years) condition.

Table 4-8 -- Average Annual Adult Chinook Salmon Returns at Leaburg (additional # of fish)

Alternative	1977 (dry)	1983 (wet) & 1984 (normal)
Blue River Only	4,400	4,400
Cougar Only	9,900	8,100
Cougar & Blue River	18,500	16,700
No Action	0	0

Under the No Action alternative, hatchery production will likely sustain the majority of spring chinook, with some wild reproduction. Present numbers of adult chinook above Leaburg (about 3,000) are expected to continue. Numbers of fish may increase slightly from the effects of normal to wet years, and decrease slightly after dry years. Spawning success in the South Fork McKenzie below Cougar Dam would remain very low due to early emergence.

Resident Trout

Improved temperature conditions would primarily benefit wild trout since they are in river during all stages of their life cycle. Hatchery fish are managed by ODFW primarily as a put and take fishery and are present for only a short period of time.

Restoring stream temperatures to near normal (pre-project) conditions in other rivers has returned the natural timing of insect life cycle events and insect community structure to normal conditions (Ward and Stanford, 1979). This has increased diversity of insect species and provided greater availability of food supply to all life stages of trout (fry, juvenile and adults). Additionally, increased food supplies in warmer waters increases the ability of fish to assimilate food and increase their biomass (size) which can increase survival (Fry, 1971; Lagler et al., 1962).

Wild trout populations in the tributaries affected by temperature control would respond to the significantly improved growth conditions, and population levels would increase toward their full potential within the limits of habitat or other factors. Quantifying this change in numbers of fish is difficult because no baseline population information exists for these stream reaches.

Changes would be more subtle in the mainstem McKenzie downstream of the South Fork. While there may not be changes in the overall numbers of resident trout, existing wild trout would also respond to increased temperatures and food availability and probably increase in size, resulting in increased angler effort and harvest of trout in all of the project area.

Changes in trout growth units by alternative for different water years are shown in table 4-9. The Blue River alternative shows improvements of 34 to 53 percent increases in Blue River, compared to existing conditions, and a small increment of improvement in the mainstem at Vida (2 to 3 percent). However, this increment is measurable in addition to changes that would occur with Cougar modifications, which show improvements of 38 to 46 percent in the South Fork, and 5 to 8 percent at Vida. There would be no improvement (no change) for the No Action alternative. Hatchery production would likely continue to sustain the majority of rainbow trout runs.

Bull Trout

Bull Trout populations in the South Fork and mainstem McKenzie River would respond to temperature changes similar to the resident trout. Improved food supplies and growth conditions for resident trout, and improved fry survival for chinook, would mean improved food sources for adult bull trout, which are known to prey on these fish. There may also be more exchange of adult bull trout between the South Fork and mainstem populations as habitat conditions (temperature ranges) become more favorable in the South Fork downstream of Cougar Dam. Also, recruitment to the South Fork (tailwaters) and mainstem populations from bull trout production in the South Fork upstream of Cougar would make temperature conditions more suitable for bull trout in these areas.

It is unknown if the specialized habitat conditions for spawning or fry and juvenile rearing for bull trout exist in the South Fork. If they do, the temperature changes with the project would favor their use, compared to existing conditions. For the period of September through November, which includes adult migration, spawning, and early egg incubation, temperatures are reduced by 5 to 12°F with the project, which would put them within the range of suitable temperatures for those life stages (table 3-7).

A habitat improvement project by the Forest Service for fisheries restoration in the South Fork may provide some of the specialized habitat areas used by bull trout. This project involves re-connection of some off-stream, side channels with the South Fork that are presently dewatered so they would become wetted, permanent aquatic habitats. In-stream habitat work to create large woody debris, and additional structures are being provided as well. Improved temperature conditions in the South Fork would also improve habitat utilization for resident trout and bull trout in this new habitat.

Under the No Action alternative, water temperatures would remain 12 to 20° higher than optimum. Bull trout populations would continue to decline and remain at risk of extinction.

Table 4-9 -- Change in Trout Growth Units (TGUs) and Precent Increases With and Without Temperature Control

	Trout Growth Units on Tributaries		
Alternative Scenario	Normal Year (1984)	High Flow 1983	Low Flow 1977
Blue River			
W/O Temp Control	1383	1485	1081
W/ Temp Control	2229	2265	2303
Percent Increase	61%	52%	113%
Cougar			
W/O Temp Control	1095	1016	999
W/ Temp Control	1758	1803	1853
Percent Increase	60%	77%	85%

	Trout Growth Units on Mainstem (Vida)		
Alternative Scenario	Normal Year (1984)	High Flow 1983	Low Flow 1977
Blue River Only			
W/O Temp Control	1460	1464	1876
W/ Temp Control	1492	1506	1919
Percent Increase	2%	3%	2%
Cougar Only			
W/O Temp Control	1460	1464	1876
W/ Temp Control	1572	1592	1979
Percent Increase	8%	9%	5%
Cougar & Blue River			
W/O Temp Control	1460	1464	1876
W/ Temp Control	1604	1634	2023
Percent Increase	10%	12%	8%

4.2.4 Threatened and Endangered Species. Three bird species known to occur in the Cougar-Blue River area are listed under the ESA. Bald eagle and peregrine falcon are not expected to be affected by any alternative. The northern spotted owl has several activity centers in the forest above the intake tower at Cougar Reservoir. Under Alternatives 2 and 3, blasting to remove rock during the first construction year potentially could disturb the owls. Alternative 1 and the No Action alternative would not disturb the northern spotted owl. A biological assessment was prepared and forwarded to FWS regarding listed species (Exhibit C). FWS has concurred with the Corps' assessment that the proposed action is not likely to adversely affect listed species, i.e., bald eagle, peregrine falcon, northern spotted owl, and Oregon chub (Oregon chub do not occur in the McKenzie Subbasin).

FWS further concurred with the Corps' determination of benefit, over the long term, to bull trout, a candidate one species which is warranted but precluded for listing. However, individual mortality could occur during project construction (Exhibit C).

Several candidate species occur or may occur in the study area. These include the bull trout (known to occur) and eight macro-invertebrates which may occur. During construction at Cougar, a trash rack with fish barrier screen will be installed over the diversion tunnel portal prior to the initial reservoir drawdown. The fish screen is necessary to keep bull trout, a candidate species for listing under the ESA, from being transported through the diversion tunnel. The fish screen also will preclude passage of other adult and juvenile fish through the diversion tunnel.

The clear, cold water from the reservoirs has created a preferred habitat for the caddisfly, and thus there is potential for three species of caddisfly listed as sensitive to occur in South Fork McKenzie below the dam (Jim Capurso, Forest Service, pers. comm., 1994). The turbidity expected during drawdown could adversely affect caddisfly by reducing water clarity and light penetration for short time periods. The dilution effect of the mainstem McKenzie River is expected to eliminate impacts from turbidity in the McKenzie River. Operation with temperature control should again provide suitable habitat. Alternative 1 would temporarily disturb habitat for 1.7 miles of Blue River; Alternative 2 would disturb habitat for 4.5 miles of South Fork McKenzie; and Alternative 3 would temporarily reduce habitat for a combined 6.2 miles of river. The No Action alternative would continue the existing situation with no effect on caddisflies, should they occur.

4.3 Cultural Environment

4.3.1 Land Use. Impacts to land use are not expected. Land use planning regulations/zoning for Lane County would be unaffected by any alternative. For the long term, Corps actions are expected to comply with the Willamette National Forest Land and Resource Management Plan (1990). Short-term impacts regarding recreation and the South Fork McKenzie, a National Wild and Scenic study river, may require specific coordination between the Corps and the Forest Service to be in compliance with the forest plan.

4.3.2 Transportation. During construction at Cougar, about 3 miles of Aufderheide National Scenic Byway (Forest Service 19) would be used by construction equipment, some of which would haul materials from the construction lay down area at Strube Flats to the construction site. Use of heavy equipment may cause minor damage to the pavement. Increased traffic due to construction would probably cause some delay for other traffic, which is primarily recreation-oriented, although some logging trucks also use the road. Traffic safety issues will be dealt with in the MOU with the Forest Service.

Potential landslides on the east side of Cougar Reservoir could damage a gravel road. This is a little-used, non-maintained, 4-wheel drive road already partially blocked by landslides. Access from construction lay down site to Blue River Dam is on a gated Corps gravel road and county road 591, a paved road with low recreation use (the main road for recreation sites is further east). Heavy construction equipment may cause minor damage to the pavement.

4.3.3 Recreation. The recreational qualities of the South Fork McKenzie, Segment 3 (below Cougar Dam), a National Wild and Scenic study river, could be temporarily degraded by the construction element of the proposed project at Cougar Reservoir, due to higher turbidity and change in water flow. Operation, however, would enhance recreation qualities as numbers of fish increase in response to temperature normalization, providing more fish for anglers and sightseers. Segment 2 could be subjected to some loss of bull trout, resulting in concerns by the Forest Service that the fishery value of the South Fork could be diminished. Mitigation measures to avoid diminishment have been proposed (See sections 2.6 and 4.2.3, Bull Trout).

No adverse effects on the segment of mainstem McKenzie River recommended by the BLM for national status are expected. During construction of the proposed projects the flows in the lower McKenzie could differ from those experienced under without-project conditions (no action). The extent of the change would depend on weather conditions. Stocking of hatchery fish in the mainstem McKenzie River during the construction period would be the same under any alternative as under without-projects conditions, and angling is not anticipated to be different. Although flows may change, the water elevation is not expected to be significantly affected under any alternative, thus impacts to recreational boating or other river-oriented recreation are not expected. Existing recreation use of Blue River and South Fork McKenzie River is so limited that impacts, other than easily accommodated displacement, are not expected.

Under the No Action alternative, fishing on the mainstem McKenzie River may decline if numbers of chinook salmon decline. Estimates of possible decline are not available. Other forms of recreation are not expected to be affected.

The following analysis of impacts to recreation and fishing due to proposed construction of multi-level towers at Cougar and Blue River dams used Unit Day Value (UDV) method of evaluation. The UDV method is based on expert opinion to approximate the amount an average recreational user would be willing to pay for the recreational resources provided

under the without (No Action alternative) and with-project (construction alternatives) conditions. The annual value of users willing to pay can be determined by multiplying the UDV by the level of use in a recreation category.

The information regarding the level of use for recreation and fishing for this analysis was obtained from Corps and Forest Service records. However, Corps information was limited to 1989 through 1993 and Forest Service data were limited to 1993. Drawing statistical inferences from such limited data is impractical. It is assumed that the 5-year average is the best estimate of future use of Corps facilities and that the information provided by the Forest Service is the average use of its facilities. Table 4-10 outlines the data provided by the Corps and the Forest Service. This level of recreation would continue under the No Action alternative.

Table 4-10 -- Average Annual Recreation Use Days at Cougar and Blue River Lakes (1989-1993)

	Blue River Lake		**Cougar Lake**	
	Fishing	Recreation	Fishing	Recreation
Corps Average	4,760	37,920	6,836	55,460
Forest Service Avg.	6,825	7,100	8,400	34,175
Combined Average	11,585	45,020	15,236	89,635
TOTALS	56,605		104,871	

Several assumptions were made to estimate the recreation impacts during construction; they are described in detail in the Technical Appendix A. Two cases were analyzed to give a range of possible recreation impacts: case 1 assumes only the reservoir under construction has recreation impacts; case 2 assumes management of the Willamette Basin system to meet minimum flows at Albany during construction, resulting in additional recreation impacts at Blue River during a normal precipitation year, and at both Blue River and Hills Creek projects if construction occurs during dry years. Case 2 is the most probable condition, thus impacts described below reflect that situation.

There are no assumed impacts for operation differing from existing situation, since basic operation would not change under any alternative. The No Action alternative would continue the existing situation.

Willamette Valley Flow Augmentation. Flow augmentation needed from Willamette Valley projects during construction could result in recreation impacts at Hills Creek, Blue River, and

Cougar reservoirs during average and low flow years. These reservoirs would be drawn down earlier than usual to provide flow augmentation. Recreation during July is most likely to be affected due to water levels being drafted below boat ramp elevations earlier in the season.

Under high flow conditions when a SWS is constructed at Cougar or Blue River, little to no change is expected from the existing conditions for use of boat ramps at Hills Creek, Lookout Point, at Cougar during Blue River construction, or at Blue River during Cougar construction. During average flow conditions, no additional impacts are expected, except at Blue River when Cougar is under construction. A decrease in water surface elevation at Blue River is expected to occur about 1 month earlier (near the end of July through August) because of its usage for flow augmentation. Water related recreation use would be reduced as the Saddle Dam, Lookout Creek, and Mona boat ramps become unusable. Recreationists are likely to continue their use of Blue River Lake for activities not water related.

For construction during low flow conditions, no change is expected from the existing conditions for use of boat ramps at Lookout Point, Cougar during Blue River construction, or at Blue River Lake during Cougar construction. Ramps at these projects would be unusable under all alternatives, including No Action. For Hills Creek, a decrease in water surface elevation is expected to occur near the end of July, and the C.T. Beach Park boat ramp may not be available for use. This change is not expected to significantly affect recreation usage at Hills Creek beyond what presently occurs during typical low flow conditions.

Blue River Lake. The total recreational use at this lake was estimated in the without-project analysis at 56,605 user days, with 45,020 user days for general recreation and 11,585 user days for general fishing. It is assumed for this analysis that 20 percent, or 9,004 user days, of activities like hiking that are independent of the lake's water level would continue during construction but their unit day values (UDVs) would be lower because of drawdown. Of the remaining user days, 5 percent, or 1,801 user days, are lost because facilities at nearby lakes are full when these recreationists choose them for their activities. The remaining 34,215 user days are assumed to transfer to other nearby lakes without a loss in value.

Ninety percent of the user days for general fishing would transfer to other nearby lakes, but the remaining 10 percent, or 1,159 user days, are lost. Those unit days that do not transfer represent a deduction from the project's recreation output.

During construction at Blue River Lake, these are the expected total impacts that would occur to recreation under the Blue River only alternative 1, each year for the 4 years of construction. Additional impacts would occur at Blue River Lake during the 4 years of construction at Cougar Lake. Construction activities at Cougar Lake are expected to lead to losses in additional general recreation at Blue River Lake in July and August. Blue River visitation for the months of July and August averages approximately 29 percent of total annual visitation. This is based on Corps visitation records for 1985 through 1989, as developed in the Willamette River Basin Review Reconnaissance Study, June 1991. Applying this percent to the combined average Blue River general recreation visitation yields an average

of 13,056 visitor days for the months of July and August. It is anticipated that 80 percent, or 10,445, of the general recreators using Blue River Lake in July and August would transfer to other recreation areas if construction activities at Cougar Lake lead to early drawdowns of Blue River Lake. Of the recreators who attempt to transfer approximately 5 percent, or 522, would not find suitable recreation substitutes. The recreators who stay account for 2,611 recreation days. Additionally, 10 percent, or 1,159 user days of general fishing, are assumed lost.

Cougar Lake. Total annual recreational use at this lake is estimated to be 104,871 user days, with 89,635 user days for general recreation and 15,236 for general fishing. For this analysis, it is assumed that 30 percent of the general recreation user days, or 26,890 user days, would continue to occur at Cougar Lake while it is drawn down, but their value would be lower because of the lower unit day value from drawdown. Of the remaining 70 percent of user days, 5 percent, or 3,137 user days, are lost as recreational facilities at the other nearby lakes are at capacity when these recreationists wish to use them for their recreational activities. The balance of recreation user days, or 59,608 user days, are transferred to other nearby lakes.

Ninety percent of the user days for general fishing would transfer to other nearby lakes but the remaining 10 percent, or 1,524 user days, would not transfer. Those unit days that do not transfer represent a reduction of the project's recreation output.

Hills Creek Lake. During extremely dry years, construction activities at Cougar may necessitate lowering Hills Creek Lake in July and August. Based on Corps visitation records for 1985 through 1989 (Willamette River Basin Review Reconnaissance Study, June 1991), approximately 16 percent, or 11,296, of the general recreation use on Hills Creek Lake occurs during July and August. It is expected that approximately 70 percent, or 7,907, of these users would transfer to another body of water. Possibly 10 percent of these transferring users, or 791 users, would not find a substitute body of water and would be considered losses.

Given lower lake levels in July and August due to augmentation during construction at Cougar Lake, it is anticipated that approximately 5 percent, or 507 fishing use days would be lost at Hills Creek Lake. This number is relatively low since most fishing on the lake occurs in the spring months.

Blue Lake and Cougar Combined (preferred alternative). The impact in terms of annual lost, devalued, and transferred recreation days (with fishing and general recreation days combined) is summed from the individual projects and shown in table 4-11. Impacts at Cougar Lake would occur over 4 years, while impacts at Blue River Lake would occur over 8 years, more severely during the 4 years of construction at Blue River Lake. Additional impacts would occur at Hills Creek Lake during Cougar construction during very low flow years (similar to 1977). This condition is unlikely, occurring on a probability of about 2 percent, but is provided as a "worst case" analysis. Excluding Hills Creek, recreation impacts (total general recreation and fishing) over the 8 years of construction would total 37,208 days lost, 154,020 days devalued, and 553,248 days transferred.

Table 4-11 -- Recreation Impacts for Preferred Alternative

Project	Const. yrs 1-4 (Cougar) Annual recreation days lost/devalued/transfer			Const. yrs 5-8 (Blue) Annual recreation days lost/devalued/transfer		
Blue River	1,681	2,611	20,350	2,960	9,004	44,642
Cougar	4,661	26,890	73,320			
Hills Creek*	(1,298)	(3,388)	(7,116)			
Total Annual	6,342	29,501	93,670	2,960	9,004	44,642
TOTAL (x4)	25,368	118,004	374,680	11,840	36,016	178,568

* Impacts at Hills Creek Lake would occur only if construction years were unusually dry, and are not included in the total figures, since greater flows would be expected to occur 98 percent of the time, based on flow records from 1925-1992.

4.3.4. Esthetics. Construction at either reservoir requires drawdown from May to October that would expose most of the reservoir floor. Much of the shoreline at both reservoirs is steep and unvegetated, presenting a discordant view during late summer/fall seasons during normal operations. Construction drawdown which leaves most of the reservoir in a "streambed" condition would expose large, unvegetated mudflats containing rotted stumps, submerged logging debris, and any items which may have been left on the reservoir floor or have fallen into the reservoir during the past 20-some years. From designated viewpoints or roads, these vistas would not be scenic until construction is complete and the reservoirs re-filled. Possible odors from drying sediments/rotting logs would add to the general lack of esthetics. However, the sight of the reservoir floor could be interesting, if not attractive, to some viewers. Increased turbidity in the South Fork McKenzie and Blue rivers during drawdown and after summer storms may temporarily detract from esthetics. The No Action Alternative would have no effect on existing aesthetic conditions.

4.3.5 History and Archeology. The analysis of adverse effects to archeological and historic properties (sites) at either reservoir is predicated on three assumptions. First, all sites are undergoing a natural process of deterioration in their natural setting; there is no static continuum. The actual mechanisms include soil breakdown, natural erosions, and organic disintegrations.

Second, the construction of the dam and reservoirs increased the rate of site deterioration; this is an adverse effect as defined by the National Historic Preservation Act. Mechanisms of

deterioration here include wind and wave erosion, inundation, rapid fluctuations, freezing, heaving, slumping, siltation, and other geomorphic processes, as well as human-induced effects such as vandalism and vehicle activities.

After a period of time, the intensity of these effects stabilizes, and the severity of the deterioration is decreased. However, if any of the operation factors changes (pool level, season, rate of flow, accessibility, etc.), the intensity of the deterioration is further increased, and the adverse effect is renewed.

A monitoring program and mitigation plan, coordinated with the State Historic Preservation Office and affected Native American governments, would be in place prior to construction. This would reduce potential adverse impacts. Potential vandalism of sites might be prevented by the use of additional enforcement. Potential for adverse impacts to cultural sites is greatest for the preferred alternative since both reservoirs would be drawn down. No additional impacts are expected from the No Action Alternative.

4.3.6 Socio-Economic Conditions.

Labor and Service Impacts. The demand for goods and services for the proposed temperature control alternatives would be in the form of labor and materials, and may have some direct and/or indirect impact on local businesses. Direct impacts result when labor or materials needed for the proposed project are hired directly from local suppliers. Studies have shown that for construction of large water resource projects the local areas are typically not able to provide many of the required goods and services (Haveman and Krutilla, 1968). For this reason, it is anticipated that the direct impacts to the local area would be limited.

Indirect impacts occur as economic activity is generated as a result of the direct impacts. For example, local service industries such as hotels and restaurants may experience increased business from laborers brought into the region for construction. About one-third of the total project costs for all of the proposed alternatives are attributable to direct labor costs. These costs would induce various indirect socioeconomic impacts. A discussion of these impacts follows (see Technical Appendix A in Volume II of the report for more information).

Direct Labor. For each of the proposed projects, it is estimated that total direct labor requirements would consist of a permanent staff of about 35 persons, employed full time by the construction company. Personnel would include a project superintendent, foremen, engineers, payroll and clerical personnel, and on-site personnel.

It is estimated that approximately 50 percent of the work force would be from outside the area. The other 50 percent could be drawn from the local area, Eugene/Springfield, and surrounding areas. There is not sufficient information to determine whether or not the local area could provide the labor resources needed without drawing from other sectors with similar labor resource needs. Any payments to direct labor hired from the local area would benefit the local economy.

Indirect Labor. Indirect employment may be generated and/or maintained in various other industries due to construction-induced requirements for material and supplies. This would include the manufacture of materials used at the project and employment in related service industries and trade sectors which would produce goods or services to be used in project construction. Estimates of the numbers of persons associated with this type of labor are unavailable for this level of study; however, Haveman and Krutilla (1968) note that indirect production and off-site labor demands may be as large as the demands for direct labor. These indirect demands would be of a different nature than the direct labor demands. Typically, indirect demands are made primarily on the service sectors of the economy, such as eating and hotel type establishments, in meeting the needs of the construction crew. Any payments to indirect labor hired from the local area would benefit the regional economy.

Construction of SWS at Blue River and Cougar projects could contribute to the local economy via direct and indirect labor, as described above. There would be a greater contribution under the preferred alternative since twice as much material and labor would be required to construct both projects than would occur under either Blue River Only or Cougar Only alternatives. No impacts would occur under the No Action alternative. Any employment and business income generated by construction activities could help offset some of the expected losses due to reduction in recreation.

Economic Impact on Recreational Use. The economic impact on recreation at Blue River and Cougar lakes from constructing multi-level towers is measured as the difference in recreational value between without- and with-project conditions. (see Appendix A, Economics)

Blue River Lake (Alternative 1). The proposed construction would result in an average annual loss of $23,800 for each of the 4 years of construction, for a total loss of $95,200 (Not adjusted for changes in dollar value). This represents the combined average annual values for general recreation and general fishing.

Cougar Lake (Alternative 2). The proposed construction would result in an average annual loss of $38,382 for each of the 4 years of construction, for a total loss of $153,528. This represents the combined average annual values for recreation and fishing, and includes losses at Blue River and Hills Creek.

Cougar Plus Blue River (Preferred Alternative). The combined loss for general recreation and general fishing from construction at Cougar and Blue River lakes is an average annual loss of $23,800 for 4 years at Blue River plus $38,382 for 4 years at Cougar, Blue River, and Hills Creek for a total of $248,728.

No Action Alternative. The existing situation would continue, with no economic losses due to construction.

These losses in recreation may result in less recreator demand for goods and services from local businesses in Leaburg, Vida, Blue River, and other communities in the study area. These losses would be greatest over the 8-year period estimated for construction of the preferred alternative. Recreation transferred to other lakes would result in contributions to those local economies.

Over the long term, some increase in recreation value for fishing on the mainstem McKenzie, South Fork McKenzie, and Blue rivers would be expected for the construction alternatives as fish numbers increase; however, there are no data on which to base estimates. Some decrease in value would be expected under the No Action Alternative, as fish numbers remain stable or decline, depending on weather conditions.

Economic Impact to Campground Concessionaires/Forest Service. It is likely that Slide Creek campground (on Cougar Lake) and/or Mona campground (Blue River Lake) would be impacted by the construction alternatives. Decreases in the level of recreational use at campgrounds on Cougar and Blue River lakes would decrease the total camping fees collected, or total revenue, at the fee campgrounds, which are operated by concessionaires. For the concessionaire, both transferred and lost visitor use days represent a loss, assuming that the transfers do not go to other concessionaire operated sites. Since 15 percent of receipts are provided to the Forest Service, any loss to the concessionaire represents a loss to the Forest Service.

The decrease in fees collected would be in direct proportion to the sum of the number of user days transferred and lost, holding all other things constant. The impact at Cougar Lake would result in a maximum 70 percent reduction in total revenue collected. At Blue River Lake the impact would result in an approximately 80 percent reduction in total revenue, all other variables held constant. Under the preferred alternative, these reductions would occur over an 8-year period, as opposed to a 4-year period for the Blue River or Cougar only alternatives. There would be no impacts to concessionaires under the No Action Alternative.

The direct impacts of a reduction in total revenue may lead to secondary adjustments. For example, the concessionaires may attempt to reduce their operating costs at the impacted fee campgrounds. To do this they may shorten the operating season to just the peak use period between Memorial Day and Labor Day. They may choose to close Slide Creek or Mona campgrounds while Cougar Lake or Blue River Lake is drawn down. Reducing the length of the camping season would reduce the amount of maintenance required to keep the grounds in shape and cut the cost of having a camp host. Closing two campgrounds during drawdown would reduce the number of campground hosts from four to two.

The 70 to 80 percent impact is the maximum impact projected. The likely impact would be less, depending on to where displaced campers transfer. Some of the campgrounds that the displaced Cougar and Blue River campers could go to would be other Forest Service campgrounds managed by the concessionaire. It is likely that the issue of the impacts of construction alternatives on fee campgrounds would be coordinated during preparation of the

Memorandum of Understanding between the Forest Service and the Corps. Additional discussion is presented in Technical Appendix A.

Hydropower Impacts. During construction, there would be no pool for power production, and downstream flows would be reduced during summer months. Since only Cougar presently produces hydropower, impacts on federal power production are for Cougar alone. It is assumed hydropower facilities at Blue River Lake would not be constructed prior to drawdown at that project.

Federal (BPA) Hydropower. Cougar energy loss with having the powerhouse inoperable would be 148,400 megawatt-hours (MWh) annually, valued at $3,190,000 annually. If the construction period is 3.6 years, this is a loss of 534,240 megawatt-hours valued at $11,484,000.

All of the dependable capacity attributable to the existing Cougar project (20.0 MW) would be lost during the 3.6-year construction period for the proposed Cougar temperature control tower. The annual value of this foregone capacity is $1,509,400. Over the estimated 3.6-year construction period, this would amount to $5,433,840 in dependable capacity losses.

Cougar dependable capacity is estimated to be reduced to 19.34 MW with temperature control in place. With the proposed tower installed about 0.66 MW's, or 660 kilowatts (kw), of dependable capacity are lost at Cougar annually. This represents an annual loss of $49,810. Also, due to head losses with new structure, Cougar energy losses would be 2,240 MWh's annually. This is an additional annual loss of $48,000 averaged over the 50-year life of the project.

EWEB Hydropower. The impacts to average annual hydropower energy production at the Leaburg and Walterville powerhouses is the difference in average annual energy production between the without-project conditions and during construction of Cougar or Blue River. The hydraulic capacity of both the Leaburg and the Walterville projects is exceeded, under all conditions, during all the months of the year except July, August, September, and October. Impacts to hydropower energy production are expected to occur only in those months. Tables 4-12 and 4-13 display the average monthly energy production for the Leaburg and Walterville projects for the relevant months under no action, during Cougar construction, and during Blue River construction conditions. The last column in each table shows the estimated loss of kilowatts during construction. This loss would extend for up to 4 years during the Blue River Only or Cougar Only alternatives; and 8 years for the preferred alternative. There would be no losses for the No Action Alternative. Additional discussion may be found in Technical Appendix A.

Table 4-12 -- Average Monthly Energy Production (MW) At EWEB Facilities, Cougar Construction (Amounts have been rounded. See App. A)

Month	No Action Leaburg/Walter.	Cougar Only Leaburg/Walter.	MW Loss MW	MWh	Value Foregone ($)
July	10.3/8.0	9.5/7.4	1.5	1,116.0	23,994
Aug.	7.8/6.1	7.1/5.6	1.2	892.8	19,195
Sept	10.0/7.8	7.6/6.0	4.2	3,024.0	65,016
Oct.	13.5/9.4	9.5/7.4	6.0	4,464.0	95,976
	Total annual loss:			9,496.8	$204,181

Table 4-13 -- Average Monthly Energy Production (MW) At EWEB Facilities, Blue River Construction (Amounts have been rounded. See App. A)

Month	No Action Leaburg/Walter.	Blue River Only Leaburg/Walter.	MW Loss MW	MWh	Value Foregone ($)
July	10.3/8.0	9.5/7.4	1.5	1,116.0	23,994
Aug.	7.8/6.1	7.3/5.7	.9	669.6	14,396
Sept	10.0/7.8	8.4/6.6	2.8	2,016.0	43,344
Oct.	13.5/9.4	10.9/8.5	3.5	2,604.0	55,986
	Total annual loss:			6,405.6	$137,720

Under the Blue River Only Alternative, the annual value of the foregone energy at the EWEB projects is $137,720 during construction at Blue River. It is estimated that losses would occur over a 3.4-year period and total $468,248 in energy generation losses.

Under the Cougar Only Alternative, the annual value of the foregone energy at the EWEB projects is $204,181 during construction at Cougar. It is estimated that losses would occur over a 3.6-year period and total $735,052 in energy generation losses.

Impacts are additive for the preferred alternative: the value of the foregone energy at the EWEB projects would be $468,248 during construction at Cougar, and $735,052 during construction at Blue River, with a total of $1,203,300 in energy generation losses. (Note that costs are not adjusted to the beginning of the analysis period and do not match figures in Appendix A-A3.)

Social Impacts. Social effects of the construction would impact the communities of Blue River, Leaburg, Walterville, Rainbow, and the other small communities dispersed within the study area, most likely as a result of the increased demand for housing and public services by construction workers. There would be no impacts under the No Action Alternative.

The most immediate effect in the local areas would be on the rental housing market. There are very few multi-unit, rental dwellings. There were as many as 330 vacant housing units in the study area in 1990 with an average of 10 percent vacancy rate (U.S. Dept of Commerce 1990). It is likely that most of the 330 units are not available for rent during the construction season (summer).

The maximum number of construction workers that may be brought into the area for the proposed projects would be about 35. To accommodate 35 construction workers, given the estimate of 2.6 persons per renter-occupied unit, at least 14 of the vacant units would have to be available for rent.

Discussions with the Lane Council of Governments (November 1994) indicate that the availability of suitable rentals in the local area is limited. The Forest Service provides housing in the study area for the crews hired during the summer months. It is unlikely that arrangements for use of this housing could be made since its peak use is during the summer. However, it is likely that a proportion of these workers may have to, or prefer to, live in the Eugene/Springfield area and commute to the construction site. Although the rental vacancy rate is typically low in this university area, there would likely be rental housing available during the summer, when the demand for rental housing by students is lower.

Experience with construction of other major water resource projects has shown that many construction workers prefer to commute to their homes on weekends. This would lessen the impacts on public services in the local areas. Given this, and the fact that the construction seasons would be limited to the summer months, it is not anticipated that there would be significant construction-related impacts on the local school districts or other public services.

4.4 Unavoidable Adverse Impacts

Unavoidable adverse impacts are related to construction activities. Operation of the projects after multi-port intake towers are in place has no known adverse impacts other than a slight decline in hydropower production at Cougar Dam. Unavoidable adverse impacts of construction include turbidity during drawdown, reduced flow during summer months, reduced fish habitat and spawning success, traffic delays on Aufderheide National Scenic Byway, loss of recreation, loss of revenue to campground concessionaires and the Forest Service, loss of hydropower production at Cougar Reservoir, reduction in hydropower production at Leaburg and Walterville, and possible reduced drinking water quality.

4.5 Cumulative Impacts

Cumulative impacts are defined by CEQ Regulations as "... the impact on the environment which results from the incremental impact of the proposed action when added to other past, present and reasonably foreseeable future actions regardless of what agency or person undertakes such actions." Actions which could have cumulative impacts include additional low flow augmentation from the Willamette Basin projects, re-licensing EWEB's hydropower

projects at Leaburg/Walterville (presently before FERC), and watershed improvements undertaken by the Forest Service. Construction of Strube Regulating Reservoir and additional generating unit at Cougar Dam, an authorized Corps project, although not being actively pursued at this time, would also have incremental impacts.

4.6 Relationship Between Local Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity.

Activities during construction at either/both reservoir(s) are considered to be short-term uses of the environment. Adverse impacts identified above are all associated with construction and are local, short-term impacts. The purpose of the action, however, is maintenance of long-term productivity: the long-term productivity of the Willamette River spring chinook, native rainbow trout (redsides), and bull trout, which is expected to result from returning water temperatures to pre-project regimes. The McKenzie River ecosystem above Vida would be expected to increase productivity over the long term once replication of the natural temperature regime occurs.

4.7 Irreversible and Irretrievable Commitments of Resources.

The capital, energy, and labor necessary to construct the intake towers at each project would be irreversibly and irretrievably committed. Organisms not surviving construction drawdown impacts (fish eggs, caddisflies, etc.) would be irreversibly committed, though this should not be an irreversible commitment of species' production, since greater production would be expected after construction is completed.

Chapter 5
REVIEW AND CONSULTATION REQUIREMENTS

5.1 Public Involvement

A Notice of Intent to prepare a draft environmental impact statement on the Willamette River Temperature Control feasibility study was published in the Federal Register on February 25, 1993. A scoping letter, describing the proposed project and requesting comments, was issued on February 22, 1993, and a news release was issued. Three letters, from members of the public and EWEB, were received in response to the scoping letter. Numerous meetings have been held on the study, at which representatives of ODFW and FWS were in attendance. Following release of the draft EIS, a 45-day public comment period took place during which written and verbal comments on alternatives were sought from government agencies and the general public. Two public meetings were held, one in Eugene/Springfield and one in Blue River.

The public participation required in the NEPA process also satisfies the requirements of Section 310(b) of the Water Resources Development Act of 1990, which requires public participation in changes to reservoir operation criteria.

The following is a generalized list of federal, state and local agencies and interested publics to whom copies of the draft EIS were sent:

(1) Federal

Members of Congress
Department of Agriculture
    Forest Service
Department of Energy
    Bonneville Power Administration
Department of Interior
    Bureau of Indian Affairs
    Bureau of Land Management
    Fish and Wildlife Service
    National Park Service
Environmental Protection Agency
Federal Energy Regulatory Commission
National Marine Fisheries Service
Northwest Power Planning Council

(2) State

Oregon Department of Environmental Quality
Oregon Department of Fish and Wildlife
Oregon Department of Parks and Recreation
Oregon Division of State Lands
Oregon Marine Board
Oregon Water Resources Commission
Office of the Governor
Members of State Legislature

(3) Local

Eugene Water and Electric Board
Lane Council of Governments
City of Eugene
City of Springfield
McKenzie Watershed Council
Local libraries

(4) Interested Publics

Businesses and Industries
Commercial and Recreational Fisheries Groups
Commercial and Recreational River Guides
Environmental Groups
News Media
Recreational Groups
Interested Individuals

5.1.1 Final EIS Comments

The Corps distributed over 150 copies of the draft report/EIS, and subsequently received written or verbal input from a total of 24 commentors during the review process. This included 12 speakers at the two public meetings and 19 letters. Corps staff reviewed all written comments and identified substantive comments for response. Letters were assigned an alphabetical letter and each comment a number. In all, 92 written comments were identified. A complete list of commentors and letters and responses is provided in section 5.1.2. Testimony from the public meetings is summarized and responded to. Transcripts from the public meetings are available for review at the Portland District Office.

5.1.2. Response to Comments Generally, commentors support the proposed action while expressing concern over the time estimated for construction. Commentors also felt that short-term impacts during construction are recognized as necessary; however, such impacts would be less severe and of shorter duration if the construction period could be reduced. Specific comments and responses are provided below.

Public Meetings

Two public meetings were held. Six persons spoke at the meeting held in Springfield, Oregon, on February 7, 1995. These included representatives of ODFW, EWEB, and McKenzie Flyfishers. The following is a summary of the comments with Corps responses in parentheses. In addition to general support for the project, comments raised issues regarding the Corps' ability to include some means of downstream passage for migrants at the dams at the same time as temperature control construction (the Corps is not authorized to do this at the present time); who would perform the value engineering review (Corps staff from WES, OVEST, Operations and Construction Divisions); can people outside the Corps participate (the Portland District would be open to considering that, especially the fishery agencies); would resource agencies and the public have a chance to review refined plans and designs (after value engineering study, a feature design memorandum would be prepared. This study may be reviewed by resource agencies when 60 percent and 90 percent complete. The Corps realizes keeping the public informed is important and will look into ways of doing that); can the present design be changed? Can the Corps do something less expensive so funds are available for projects on other rivers? (resource agency requests have been for the kind of design that would replicate pre-project temperatures. This is the objective of the study. Less expensive concepts have been evaluated, but don't fulfill the agencies' requirements); EWEB has concerns about algae growth in warmer water (a Corps hydrologist is in contact with EWEB and will study this issue prior to construction); concern about turbidity during initial construction drawdown (the Corps will address this through the interagency committee).

Another six persons spoke at the meeting in Blue River, Oregon, on February 8, 1995. Comments dealt primarily with construction at Blue River Lake and the economic impacts of the project on the community of Blue River. Concerns were expressed about the length of time required for the project and construction techniques (value engineering study will address this); loss of recreation (the Corps will work with the Forest Service to maintain as much recreation as possible, and to avoid safety hazards to recreationists during construction); cumulative recreation losses from construction at Cougar, and returning to early drafting of Blue River Lake after construction (there will be impacts to recreation at Blue River Lake for up to 8 years of construction. Other studies are addressing the issue to reservoir drawdown sequence and amounts. The Corps is aware that this is an ongoing concern among residents in the Willamette Valley); has the Corps analyzed the impact to the local economy of no recreation for 3 or 4 years? (the draft report discussed this [and additional information has been added to the final EIS]); will any compensation be made to local business owners? (no, none is planned); what will happen to the fish in the two lakes? (Cougar's diversion tunnel will be screened to retain the bull trout, fish in Blue River Lake will not be retained); can fish

passage be added while the reservoirs are down? (the Corps has no authority to do that. We will make sure we don't preclude the possibility of adding it later, however. There is an ongoing study in the Santiam River Basin that is looking at fish passage opportunities).

Written Comments

The following agencies, organizations and individuals submitted written comments. The comment letters and Corps response follows.

List of commentors:

Federal:

1. US Environmental Protection Agency
2. US Department of the Interior
3. US Forest Service
4. US National Marine Fisheries Service

State:

5. Oregon Water Resources Department
6. Oregon Department of Fish and Wildlife
7. Oregon Department of Environmental Quality
8. Oregon Water Resources Department
9. Oregon Northwest Electric Power & Conservation Planning Council
10. Oregon State Marine Board

Local/Organizations:

11. Blue River Development Corporation
12. Eugene Water & Electric Board
13. McKenzie Flyfishers
14. McKenzie River Chamber of Commerce
15. McKenzie Watershed Council
16. Oregon Natural Resources Council
17. Weyerhaeuser

Individuals:

18. Thomas Morse
19. Valerie Rapp
20. Unsigned, from Blue River Public Meeting

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

REPLY TO
ATTNOF: WD-126 February 23, 1995

Timothy L. Wood, Colonel
U.S. Army Commanding
Department of the Army, Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208-2946

ATTN: Planning and Engineering Division

Dear Colonel Wood:

EPA has reviewed the Draft Feasibility Report and Draft Environmental Impact Statement (DEIS) for the Willamette River Temperature Control Study, McKenzie Subbasin, Oregon. EPA's review is conducted in accordance with the National Environmental Policy Act and EPA's authority under Section 309 of the Clean Air Act to comment on the impacts of federally authorized actions.

The feasibility study and DEIS examine alternatives for modifying the temperature of downstream releases from the Cougar Lake and Blue River Lake projects to replicate pre-project water temperatures and benefit anadromous and native fish species. The preferred alternative identified in the DEIS is phased construction of multi-level intake structures (i.e. selective withdrawal systems), consecutively at both projects.

Our comments are as follows:

Pages 2-2 (DEIS), and 43 (Draft Feasibility Report): The nonstructural temperature modification alternatives (i.e. operational flow measures) are briefly discussed in the Draft Feasibility Report on page 43, but are not carried forth as alternatives in the DEIS. The reasons provided in the DEIS for eliminating these operational scenarios from further consideration included concerns about the adverse effects on flow augmentation, power production and recreation, and the apparent constraints on the ability to evaluate these alternatives.

I-1.

Given the significant impacts which would occur over a period of several years during construction of the proposed intake structures, further evaluation of the relative benefits and costs of operational scenarios, and their ability to meet stated temperature modification objectives, is needed. A clear comparison of operational vs. structural benefits and costs (environmental, economic, multiple uses) should be presented for all alternatives which may be considered reasonable.

1-1. We have expanded the discussion in section 2.3 of the EIS for the nonstructural (operational) alternatives. The operational changes would not meet the study objective of modifying water temperatures to replicate pre-project conditions in the study area. Some partial improvement in release temperatures may be possible using operational changes. However, changing the operation of the reservoirs does nothing to alter the location of the warm water layer or the regulating outlets located deep in the reservoirs.

1-2. Pages 2-6, and 5-5: EPA should be included as a participant on the coordinating committee (described on page 2-6 of the DEIS) which would be responsible for making recommendations on corrective measures during the construction phase. Coordination with EPA would also be necessary in the event hazardous materials are encountered at the sites during construction (see page 5-5).

1-3. Page 4 of Section 404 (b)(1) Evaluation, and page 5-4 (DEIS): EPA concurs with the statement that sediments must be analyzed prior to relocation, as indicated on page 4 of the Section 404 (b)(1) Evaluation. That data needs to be provided to EPA Region 10. As such the evaluation does not constitute full compliance with the 404 (b)(1) Guidelines pursuant to Section 404 (r). Further information about the applicability of EPA's review of the subject actions under the 404 (b)(1) Guidelines can be obtained by contacting John Malek, EPA Region 10, (206) 553-1286.

Also, on page 4 of the Section 404(b)(1) Evaluation (last paragraph) insert "water quality criteria" after "Environmental Protection Agency", and (last sentence) change "...sediments would not...", to "...sediments are not expected to..." Then add the following sentence: "The sediments will be analyzed and the data provided to EPA and the state prior to dredging activities."

1-4. Page 5-8: Additional information on the extent of wetland impacts resulting from the dewatering of the reservoirs, the wetland values, and possible long-term effects should be provided in the Final EIS.

1-5. We have rated the DEIS EC-2 (Environmental Concerns-Insufficient Information). A summary of EPA's rating system for DEISs is enclosed for your reference. EPA supports the stated objectives of the DEIS to modify and rectify seasonal downstream temperatures to benefit anadromous and native fish species. We have concerns relating to the adversity of impacts during the protracted interim construction phases. More details regarding the comparative costs and benefits of alternative operational flow measures which meet the objectives, vs. structural measures, should be presented in the FEIS.

We appreciated the opportunity to review the DEIS. Rick Seaborne in the Environmental Review Section is the lead person for this review and may be contacted if further clarifications regarding the above comments are needed at (206) 553-8510.

Sincerely,

for Joan Cabreza, Chief
Environmental Review Section

Enclosure

1-2. We have revised the EIS and main report to include EPA as a member on the interagency coordinating committee. We also added to section 5.2 of the EIS, in the paragraph discussing compliance with the Comprehensive Environmental Response, Comprehensive Compensation and Liability Act, that coordination with EPA is necessary in the event that hazardous materials are found.

1-3. The Section 404(b)(1) Evaluation has been prepared based on existing levels of information for a feasibility study. The quantity and composition of sediment is not precisely known at this time. Further evaluation of the diversion plan for each projects will occur during Preconstruction Engineering and Design. EPA will be kept informed as to the results of the sediment analysis. An additional Section 404(b)(1) Evaluation may be required prior to construction. Also, the Section 404(b)(1) Evaluation has been revised as suggested.

1-4. Information on the extent of wetland impacts was provided in section 4.2.1, Vegetation, section 4.4.2, Wildlife, and section 4.2.3, Fisheries and Aquatic Species of the EIS. The paragraph on page 5-8 of the DEIS discussing compliance with EO 11990 summarized this information.

1-5. During the next phase of design, a Value Engineering (VE) study will be performed to ensure the project is constructed in the most cost effective manner. The VE study also will explore ways to shorten the construction schedule. As stated above, operational alternatives will not meet study objectives of replicating pre-project water temperatures downstream from Cougar and Blue River reservoirs.

SUMMARY OF THE EPA RATING SYSTEM FOR DRAFT ENVIRONMENTAL IMPACT STATEMENTS: DEFINITIONS AND FOLLOW-UP ACTION *

Environmental Impact of the Action

LO–Lack of Objections

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplish with no more than minor changes to the proposal.

EC–Environmental Concerns

The EPA review has identified environmental impacts that should be avoid in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

EO–Environmental Objections

The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU–Environmentally Unsatisfactory

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

Adequacy of the Impact Statement

Category 1–Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2–Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoid in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

Category 3–Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussion are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From EPA Manual 1640 policy and Procedures for the Review of Federal Actions Impacting the Environment.

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
500 NE Multnomah Street, Suite 600
Portland, Oregon 97232-2036

MAR 13 1995
REG & ENV RES

IN REPLY REFER TO:

March 8, 1995

ER 95/52

Colonel Timothy L. Wood, Commanding Officer
U.S. Army Corps of Engineers
Portland District, CENPP-PE-RP
P.O. Box 2946
Portland, Oregon 97208-2946

Dear Colonel Wood:

The Department of the Interior (Department) has reviewed the Draft Feasibility Report and Draft Environmental Impact Statement (DEIS) for the Willamette River Temperature Control Study (Study), McKenzie Subbasin, Oregon. The following comments are provided for your use and information when preparing the Final Environmental Impact Statement (FEIS).

GENERAL COMMENTS

2-1. Modifying the existing intake towers at the Cougar and Blue River projects would provide a selective water withdrawal system whose downstream water temperatures mimic pre-project conditions. These pre-project conditions would eliminate the existing temperature conditions which are adverse to fishery resources in the South Fork McKenzie River, Blue River, and mainstem McKenzie River downstream to Leaburg Dam. The Fish and Wildlife Service (Service) provided the Army Corps of Engineers (Corps) with a Fish and Wildlife Coordination Act (FWCA) report. This FWCA report, which forms the biological basis of the DEIS, identifies substantial benefits to spring chinook salmon, bull trout, and resident rainbow trout with implementation of the Plan. In addition, the Plan would contribute to the overall watershed health and restoration of ecological values in the McKenzie River Basin, and, as such, adds to similar ongoing restoration efforts by Federal, State and local governments implementing the President's Forest Plan. A final FWCA report will be provided for inclusion in the Corps' FEIS.

SPECIFIC COMMENTS

2-2. Page 93, 4.11.2 Temperature and Fishery Monitoring A detailed monitoring and evaluation plan should be developed cooperatively by the Corps, Service, Oregon Department of Fish and Wildlife, National Marine Fisheries Service, and U.S. Forest Service during advanced planning and design. This plan should provide greater detail on time frames, costs, responsibilities, and items to be evaluated for the monitoring plan. It should include similar

Corps of Engineers Responses

2-1. Noted

2-2. We have revised the main report (section 4.11.2) and EIS (section 2.5) to add that the monitoring and evaluation plan will be developed cooperatively by the District and resource agencies during the next phase of design (Preconstruction Engineering and Design).

time frames for both temperatures and fish data, and provide an agreement on how existing data can and should be used and at least a two-life-cycle time period for anadromous fish.

2-3. Pages 1-2. Section 404(b)(1) Evaluation This section identifies that about 500 cubic yards of lake sediment would be removed at each project site during construction and be disposed upstream in the pool area below ordinary high water presumably during the drawdown period. The Department is concerned that this sediment material would likely be resuspended during lake refilling and the resulting increased turbidity would adversely affect fish and wildlife resources. We recommend the FEIS considered making this material available for appropriate commercial or other beneficial uses or disposing it in an upland location that would avoid contact with any watercourses, wetlands, or riparian habitats.

Thank you for the opportunity to comment.

Sincerely,

For Charles S. Polityka
Regional Environmental Officer

2-3. The quantity and composition of sediment is not precisely known at this time. Further evaluation of the diversion plan for each project will occur during Preconstruction Engineering and Design. We will consider, and coordinate with the appropriate agencies, other options for disposal of sediment during this more detailed investigation.

United States Department of Agriculture
Willamette National Forest
Blue River Ranger District
Cascade Center for Ecosystem Management
Blue River OR 97413 (503) 822-3317

Colonel Timothy L. Wood
U.S. Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, Or. 97208-2946

MAR 17 1995

Dear Colonel Wood:

This letter is written in response to the Willamette River Temperature Control Draft Feasibility Report Environmental Impact Statement for the McKenzie Subbasin.

During the development of our Section 7 Wild and Scenic River report we had the opportunity to review this document. This letter identifies issuesthat need to be clarified in the Final EIS, which are not related to the Section 7(b) Wild and Scenic River preliminary determination.

Some of these concerns were mentioned in our previous letters dated July 11, and September 23, 1994. If we were not able to locate a response to our previous letter in the DEIS, have included the comment again in this letter.

1. Memorandom of Understanding (MOU)

Coordinating an MOU was mentioned in our letter of July 11, 1994. We feel this is a valuable step to resolve so any project for Cougar and Blue River Dams can run smoothly for both agencies. On page 2-7 of the DEIS the COE suggests an MOU with the Forest Service. Here is a list of some of the specific items we would encourage for us to address in the MOU.

a. Wood, logs and stumps in the reservoir. The MOU need to address how the woody debris in the reservoir will be removed.

1. b. Public notification. At times there will be an increase in truck traffic along Aufderheide Scenic Byway. Blasting will be occurring prior to construction at Cougar dam. Forest visitors will need to be warned in advance, and the appropriate signing and advanced warnings will need to be posted.

With warmer water temperatures there may be an increase in algae blooms. Public notification of changes in sight and smell will be important. Public notification around drawdown dates will need to be published.

When the reservoir is drawn down in the summer there could be an increase in off road vehicle use in the reservoir. The MOU needs to address how off road vehicles will be managed and who will administer enforcement.

Corps of Engineers Responses

3-1. Section 5.2 of the main report discusses more specifically the MOU's required between the Corps and the Forest Service. A timeline for MOU discussions and development has been added to this section. All of the specific items listed in your letter can be addressed in the MOU's, along with any other issues of concern to either agency.

c. Research. There may be an opportunity to do research within the reservoir while it is drawn down. The MOU should address the parameters of access to the site.

3-1.

d. Administration. Who administers the area around Cougar reservoir when drawdown is complete? The COE and Forest Service should set a timeline for MOU development which fits both agencies program planning.

2. Heritage Resources

3-2. There is a need to understand responsibilities around heritage resources, and ensure that the intent of the Natural Historic Preservation Act is met. Has the COE been working with the State Historic Preservation Office concerning the location and preservation of existing sites? Who will be responsible for monitoring exposed sites?

3. Fish and water quality

3-3. a. The initial flushing caused by draw down may have drastic effects on fish. Once drawdown has occurred, fish may be trapped in isolated pools, making them vulnerable to anglers, predators and high temperatures. Mortality from these factors should be considered in project planning, and methods to alleviate mortality should be designed into the project.

3-4. b. If Cougar reservoir is drawn down for 3-4 years during construction, consider the establishment of juvenile fish passage. This is an opportunity to meet Northwest Power Planning and State of Oregon objectives to provide fish passage at this site. The type of passage structure in place at Green Peter dam should be considered at Cougar Dam. It does not seem reasonable to undertake this construction project and then duplicate the effort in the near future.

3-5. c. Jim Capurso is misquoted on macroinvertebrates pg 4-32. What he said is "There are 8 macroinvertebrates that are likely to occur on Willamette National Forest and are on the Regional Foresters sensitive species list. The effects of the project upon these species should be discussed. We have limited info on these species, but based on what we know, there's a potential for Limnephilus atercus, Rhycophila unipunctata, and Oligophlebodes mostbento to occur in the South Fork McKenzie below the dam."

3-6. d. On page 70 of the DEIS it states that 80 acre pool will eliminate sediment transport out of the reservoir. We would suggest you consider using the word minimize or reduce rather than eliminate. Some sediment would eventually pass out of the pool downstream.

4. Threatened and Endangered.

3-7. Because this project is on National Forest land, the COE must discuss the effects of the project upon species included on the Regional Foresters sensitive species list. This is in addition to the threatened and endangered species in

3-2. Plans for the protection and preservation of cultural, or heritage resources, has commenced as per the requirements of the National Historic Preservation Act (NHPA) of 1966, as amended in 1993, and the implementing regulations. The section 106 process of NHPA has been initiated (inventories of the drawdown area and areas of direct and indirect impact), potential impacts addressed, and a draft protection preservation in preparation. This will be presented to the SHPO as well as affected Native American governments. The approach for the consideration of, and protection of, cultural properties has been discussed with the Preservation Archeologist from the SHPO, and representatives from the cultural programs from Native American governments. An agreement document detailing the protective measures will be prepared with the cooperation of the tribal cultural programs and submitted to the SHPO for review and signatures. This document will contain a monitoring and protection/preservation plan for all future actions. The initial field report and recommendations were not included in the public review document due to the sensitive nature of cultural resources.

3-3. A drawdown plan will be developed in cooperation with the resource agencies during the Preconstruction Engineering and Design phase of project development.

3-4. The 1991 Energy and Water Development Appropriations Act (PL 101-514) added funding and directed the Corps to analyze the feasibility of installing temperature control facilities at the Cougar and Blue River projects. We have no authorization or funding to initiate studies of fish passage in the McKenzie subbasin. The ODFW and FWS have agreed to be involved in further design work so the selective withdrawal structures are designed in a way that would not preclude future methods for other fish management opportunities in the McKenzie subbasin, such as fish passage. We do have an on-going reconnaissance study for the South Santiam subbasin which is investigating methods of providing fish passage. Being considered are collection facilities upstream of the reservoir and at the dam. If any of these methods prove feasible, application to other reservoirs in the Willamette may be possible.

3-5. We have revised the EIS as suggested.

3-6. See Exhibit A to the main report, section 1.6, for the detailed discussion concerning sedimentation, the purpose of the residual pools, and turbidity of releases. This information was summarized in the main report and EIS. Maintaining a residual pool will essentially eliminate sediment transport out of the reservoirs and reduce turbidity in the water released from the projects during construction. By having the residual pools and controlling the rate of reservoir drawdown, any silty and coarse fractions re-eroded from sediment deposits in the reservoirs would settle out in the residual pool. Also, erosion control methods will be applied during drawdown to minimize transfer of sediments into the residual pool. Any fine sediments (colloidals) retained in suspension are expected to pass through the system.

3-7. We have added additional information in the final EIS concerning the expected effects of the project on the species included in the Regional Forester's sensitive species list.

their project biological assessment. We would be happy to supply you with a copy of the Regional Foresters list.

5. Wildlife

3-8. a. Big game habitat could be improved if grass vegetates the slide slopes. There is an opportunity for big game forage enhancement combined with sediment stabilization by grass seeding. If this activity occurs, efforts should be made to use native grass seed or annuals only. Native grass seed propagation could happen in cooperation with the Forest Service. Seeding should be scheduled 1-2 years in advance. After completion of the project the materials staging area below the Cougar dam should be restored and revegetated to prevent encroachment by noxious weeds. Native grass seed is recommended.

3-8. All practicable erosion control techniques will be used during construction. An erosion control plan, including plant species to be used, will be developed cooperatively with the appropriate state and federal agencies during PED when more detailed information is available on the type and amount of material, as well as the slope of the drawdown zone. Section 4.2.1 of the EIS indicated that staging areas would be restored after construction. Specifics of the restoration plan including plant species to be used could be developed between our agencies during the MOU coordination.

3-9. b. To help reduce the spread of noxious weeds, its recommended to wash earth moving equipment before the project begins.

3-9. We can specify in the construction contract that all earth moving equipment be washed before entering the construction sites.

6. Monitoring

3-10. On page 93 of the DEIS it discusses a monitoring program to assess the success of the project on water temperatures and fishery production in the system. We would like to see the Final EIS address who will be responsible for the monitoring program.

3-10. We have added additional information to the EIS (section 2.5) concerning the monitoring program as described in section 4.11 of the main report.

7. Coordination Committee

3-11. On page 92 of the DEIS it mentions establishing an interagency committee to work to fine tune any operational problems during construction. We would like to encourage you to assemble this team well in advance of construction, and not wait until the construction phase begins.

3-11. We will continue our coordination with the resource agencies and other groups during the preconstruction engineering and design phase. We anticipate many of these agency and group representatives also will be involved with the coordinating committee during construction.

8. Drawdown of Hills Creek Reservoir

3-12. On page A2-24 of the technical appendices it describes the low flow scenario and how it effects other reservoirs. Our concern is the possibility of having Hills Creek reservoir boat ramps unavailable for use at the same time construction is occurring at Cougar reservoir. We would like to be kept informed and participate in any changes or effects to Hills Creek reservoir.

3-12. We will keep your agency and others involved concerning flow augmentation plans during construction via the coordinating committee. Augmentation plans will be based on the type of water year predicted during any particular construction season.

9. Length of Drawdown

3-13. The length of drawdown appears to have wide spread effects to many issues such as recreation and fish. Have you considered any alternatives that would reduce the length of the drawdown? Specifically, have you pursued the feasibility of underwater construction?

3-13. We have developed an appropriate construction schedule for the feasibility level of design. A value engineering (VE) study is the first activity scheduled during the preconstruction engineering and design phase. The VE is being done to ensure the project is constructed in the most cost effective manner and also will focus on ways to shorten the overall construction period.

10. Local Economy

3-14. In the technical appendices it describes that 50% of the work force needed for the project may be hired locally. We would encourage you to pursue and support hiring local people. Hiring local people in the Blue River and McKenzie Bridge area is one way to help off set the impacts of fewer forest visitors using the reservoirs during construction.

Your primary contact for issues or comments is Lynn Burditt, District Ranger at the Blue River Ranger District. I look forward to our continued cooperation as you develop the Final EIS for this project.

Sincerely,

for Darrel L. Kenops
Forest Supervisor
Willamette National Forest

3-14. We will advertise a contract for actual construction work. The number of employees and equipment used will be a decision made by the contractor. Local residents can request a list of plan holders at the time the contract is advertised. Interested residents could then contact these contractors to make proposals for employment or equipment usage. In addition, we can inform residents of the contractor who is awarded the contract prior to initiation of the work.

UNITED STATES DEPARTMENT OF COMMERCE
Office of the Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

March 28, 1995

RECEIVED
APR 1 8 1995
ENVIRONMENTAL RESOURCES
BRANCH

Colonel Timothy L. Wood
Corps of Engineers, Portland District
ATTN: CENPP-PE-E
P.O. Box 2946
Portland, OR 97208-2946

Dear Colonel Wood:

Enclosed are comments on the Draft Environmental Impact Statement for Willamette River Temperature Control Study, Mckenzie Subbasin, Oregon. We hope our comments can assist you. Thank you for giving us an opportunity to review the document.

Sincerely,

Donna S. Wieting
Acting Director
Ecology and Conservation Office

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
ENVIRONMENTAL & TECHNICAL SERVICES DIVISION
525 NE Oregon Street
PORTLAND, OREGON 97232-2737
503/230-5400 FAX 503/230-5435

MAR 1 5 1995

F/NW03

Colonel Timothy L. Wood
Corps of Engineers, Portland District
ATTN: CENPP-PE-E
P.O. Box 2946
Portland, Oregon 97208-2946

RE: Draft Feasibility Report and Draft Environmental Impact Statement, Willamette River Temperature Control Study, McKenzie Subbasin, Oregon

Dear Colonel Wood:

The National Marine Fisheries Service (NMFS) has completed its review of Volume I and II of the Draft Feasibility Report (DFR) and Draft Environmental Impact Statement (DEIS) for the Willamette River Temperature Control Study, McKenzie Subbasin, Oregon. Our comments are based on NMFS' responsibility for the protection and enhancement of marine, estuarine, and anadromous fishery resources, and their supporting habitats.

4-1. During construction of the selective withdrawal system at Cougar Lake, construction of the exit channel of the diversion tunnel beside the powerhouse will require an estimated 1,300 cubic yards of sediment to be removed. It is estimated that about 500 cubic yards of sediment will need to be removed from the channel floor at Blue River Lake during foundation preparation. It has been proposed that the excavated sediment would be placed at some undetermined location upstream of the respective dam site, within the confines of the reservoir, but below ordinary high water. We recommend that the sediment not be disposed of within the reservoir, but at an acceptable upland site.

4-2. Erosion control measures such as seeding flood tolerant plants, silt fences, hay bales, placing soil cement on the exposed sediment deposits, or construction of a temporary containment dike will be necessary to reduce turbidity created by sediment being washed into the stream by rain storms during the construction season. The DFR states that further adjustments or erosion control measures would be taken, as necessary, to keep turbidity levels low throughout the construction process. Please define these erosion control measures.

Corps of Engineers Responses

4-1. The quantity and composition of sediment is not precisely known at this time. Further evaluation of the diversion plan for each project will occur during the Preconstruction Engineering and Design phase (PED). We will consider and coordinate with the appropriate state and federal agencies on other options for disposal of sediment during this more detailed investigation.

4-2. All practicable erosion control techniques will be used during construction. An erosion control plan will be developed cooperatively with the appropriate state and federal agencies during PED when more detailed information is available on the type and amount of material, as well as the slope of the drawdown zone.

The DFR states that temperatures will be monitored hourly for three years after construction at the face of both dams and at the U.S. Geological Survey station at Vida. Fishery resources will be monitored for a period of seven years after construction to encompass the full range of life cycle stages. The average generation time for one life cycle of Willamette River spring chinook salmon is four years (Ron Garst, U.S. Fish and Wildlife Service, February 21, 1995). Therefore, we recommend that fishery resources be monitored for a period of eight years after construction to encompass two generations of life cycle stages. In addition, we recommend that temperatures be monitored hourly for eight years in conjunction with the fishery resource monitoring. Finally, we recommend the Corps of Engineers develop and implement a monitoring evaluation plan, in cooperation with the resource agencies, that would be implemented with project operation, to document accomplishments, shortcomings, and make corrections as needed to fully achieve resource benefits. In addition to monitoring changes in fry emergence timing and spawning distribution, the evaluation plan should include analyses of post-project effects on adult migration past Leaburg Dam, including the number of adults passing the dam, and any delay they experience.

4-3.

Thank you for the opportunity to comment on this DFR and DEIS. Questions regarding this letter should be directed to Garwin Yip of my staff at (503) 230-5419.

Sincerely,

Jacqueline Wyland
Division Chief

cc: ODFW, Corvallis - N. MacHugh
USFWS, Portland - R. Garst
CBFWA - C. Hawkes
NPPC - A. Duncan
House Committee on Natural Resources
OWRD - M. Pagel
USDOI, Solicitor's Office - B. Scott-Brier

4-3. Your recommendations are noted. As discussed in the feasibility report, a temperature and fishery monitoring program is planned by the Corps after construction. While the report describes the general characteristics of this program, a detailed post-construction monitoring plan will be developed during PED in cooperation with the appropriate state and federal agencies and other interested groups. We hope your agency will participate in further design coordination.

The 7-year period is based on extensively monitoring one full life cycle (spawning ground surveys and fry emergence sampling). This would allow for 2 years after construction for the operational aspects to adjusted before the monitoring program begins, and then 5 years of monitoring to include the 5-year-old returning fish. To monitor two life cycles would require 10 to 12 years and is unlikely to provide a great deal of additional information. Most likely after the detailed monitoring program, adult returns and fry emergence timing will continue to be monitored at Leaburg dam by EWEB and ODFW. This information can then be used to adjust the temperature regulation system to maximize adult returns and fry survival.

March 14, 1995

Oregon

WATER
RESOURCES
DEPARTMENT

Attn: CENPP-PE-E
Timothy L. Wood
Colonel, U.S. Army
Army Corps of Engineers
P.O. Box 2946
Portland, OR 97208-2946

MAR 21 1995

Dear Colonel Wood:

The State of Oregon has completed its review of the Draft Feasibility Report and Draft Environmental Impact Statement for the Willamette River Temperature Control Study, McKenzie Subbasin. The five agencies which have commented on the project are the Departments of Environmental Quality, Fish and Wildlife, Marine Board, and Water Resources and the Oregon delegation to the Northwest Power Planning Council.

The state is very supportive of Corps of Engineers efforts to replicate the pre-reservoir temperature regimes in the McKenzie Subbasin. Furthermore, the state strongly supports that the costs will be fully paid by federal funds without local cost sharing.

5-1. We have reviewed the comments from the different agencies and found that there are no conflicting issues raised. The two major issues to draw to your attention are 1) concern over the turbidity which the projects may generate during the construction phase and 2) the need to work closely with the state to respond to any unforeseen problems. To assist in this coordination, the Water Resources Department should be added to the Interagency Commitee. Please refer to the specific agency comments, which are attached to this letter, for additional details.

Thank you for the opportunity to comment on the U.S. Army Corps of Engineers Draft EIS. We look forward to working with the Corps on this project. If you or your staff have any agency specific questions about the state's coordinated response, they may be directed to the agency which raised the concerns. Issues of broader scope should be directed to the Water Resources Department which is acting as the state coordinating agency.

Sincerely,

Martha O. Pagel
Director

cc: Paula Burgess, Governor's Natural Resource Policy Advisor
Rudolph A. Rosen, Department of Fish and Wildlife
Bob Rice, Water Resources Department
Gregory McMurray, Department of Environmental Quality
Angus Duncan and Joyce Cohen, Northwest Power Planning Council

Commerce Building
158 12th Street NE
Salem, OR 97310-0210
(503) 378-3739
FAX (503) 378-8130

5-1. Exhibit A to the main report provides a detailed discussion of the turbidity levels expected to be generated during construction at Cougar and Blue River. All practicable turbidity control techniques will be used during construction. We have revised the final report and EIS to indicate the participation of three state agencies (ODFW, ODEQ, and OWRD) on the interagency coordinating committee which will assist us in responding to unforeseen problems during construction. We also will continue our coordination with these state agencies during additional design work.

Oregon

DEPARTMENT OF
FISH AND
WILDLIFE

OFFICE OF THE
DIRECTOR

December 29, 1994

Colonel Tim Wood
District Engineer, Portland District
Army Corps of Engineers
P. O. Box 2946
Portland, OR 97208 2946

Dear Colonel Wood:

I support the conclusions of your Portland District staff listed in the December 1994 Draft Feasibility Report and EIS for Willamette Temperature Control in the McKenzie subbasin. This document describes the maximum production potential of a naturally producing stock of Willamette spring chinook in the McKenzie River watershed.

The data provided to your modeler for analysis in the Feasibility Report came from ODFW and FWS, working in close cooperation with the Portland District COE. We appreciate this cooperative approach to resource management.

Willamette Basin management goals for spring chinook include sustaining a wild population for the future. Such natural production is generally accepted as the key to salmon restoration and recovery of the declines that are leading to more and more listings of salmon species under the Endangered Species Act (ESA). The McKenzie watershed is the most significant Willamette sub-basin habitat with potential for restoration. Control of reservoir discharge temperatures to mimic pre-project temperatures and timing has the potential to return some thirty thousand adult spring chinook and also increase production of bull trout, which is a candidate for listing under ESA. Willamette temperature control facilities will produce fishery benefits, however the risks of construction of these facilities may have environmental impacts to bull trout. We are aware of such potential short-term impacts and will work with your staff and other resource agencies to examine impacts relative to benefits.

6-1.

I thank you and your staff for your time and cooperation on this important study which we hope will result in authorization of the needed temperature control structure.

Sincerely ,

RUDOLPH A. ROSEN
Director

6-1. Noted. We will continue to work with the resource agencies on ways in which to minimize short-term impacts to bull trout during construction at Cougar.

Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

RECEIVED
FEB 14 1995
WATER RESOURCES DEPT.
SALEM, OREGON

February 10, 1995

Mr. Bob Rice
Water Resources Department
158 12th Street NE
Salem, OR 97310-0210

SUBJECT: Cougar and Blue River Water Temperature Control Project

REFERENCE: Draft Feasibility Report and Environmental Impact Statement

Dear Mr. Rice:

I have reviewed the referenced documents on behalf of the Department of Environmental Quality. The Department supports the Corps of Engineers' efforts to achieve pre-reservoir temperature regimes in the McKenzie subbasin. The Department believes that natural, historical temperature regimes will best support those beneficial uses related to biological integrity.

The Department's major area of concern with the project is the control of turbidity during the construction phase. As described in Section 4.9.2 of the Feasibility Study, the reservoir drawdown will expose sediments deposited since the reservoirs were filled. Release flows with turbidities as high as 100 Nephelometric Turbidity Units (NTUs) are predicted, but the study states that "adjustments or erosion control measures would be taken, as necessary, to keep turbidity levels low throughout the construction process."

7-1. The Section 404(b)(1) Evaluation for the project includes the following finding:

> VI. c. The proposed action is expected to be in compliance with applicable State water quality standards, with the exception of possible temporary exceedance of turbidity standards during construction, for which a variance will be sought

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Portland, OR 97204-1390
(503) 229-5696
TDD (503) 229-6993
DEQ-1

Corps of Engineers Responses

7-1. See Exhibit A to the main report, section 1.6, for a detailed discussion concerning the purpose of the residual pools and turbidity of releases. Maintaining a residual pool will essentially eliminate sediment transport out of the reservoirs and reduce turbidity in the water released from the projects during construction. By having the residual pools and controlling the rate of reservoir drawdown, any silty and coarse fractions re-eroded from sediment deposits in the reservoirs would settle out in the residual pool. Also, erosion control methods will be applied during drawdown to minimize transfer of sediments into the residual pool.

We have removed the discussion of obtaining a variance in section VI.c. of the Section 404(b) Evaluation. All practicable turbidity control techniques will be used during construction.

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WATER RESOURCES DEPT.
SALEM, OREGON

Oregon's water quality standards do not provide for variances. However, the standard for turbidity, cited below, includes the conditions of such an exception.

OAR 340-41-445(2) No wastes shall be discharged and no activities shall be conducted which either alone or in combination with other wastes or activities will cause violation of the following standards in the waters of the Willamette Basin:

(c) Turbidity (Nephelometric Turbidity Units, NTU): No more than a 10 percent cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity. However, limited duration activities necessary to address an emergency or to accommodate essential dredging, construction or other legitimate activities and which cause the standard to be exceeded may be authorized provided all practicable turbidity control techniques have been applied and one of the following has been granted:

7-I.

(A) Emergency Activities: Approval coordinated by DEQ with the Department of Fish and Wildlife under conditions they may prescribe to accommodate response to emergencies or to protect public health and welfare.

(B) Dredging, Construction or other Legitimate Activities: Permit or certification authorized under terms of Section 401 or 404 (Permits and Licenses, Federal Water Pollution Control Act) or OAR 141-85-100 et. seq. (Removal and Fill Permits, Division of State Lands), with limitations and conditions governing the activity set forth in the permit or certificate.

The Department expects that all practicable turbidity control techniques will be utilized during project construction.

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SALEM, OREGON

The Department welcomes the opportunity to participate on the Interagency Committee described in Section 4.11.1 of the Feasibility Study. This will allow active participation and coordination of responses to any unforeseen environmental problems. Thank you for the opportunity to comment.

Sincerely,

Gregory McMurray, Ph.D.
Standards & Assessments Section
Water Quality Division

GM:crw
SA\WC13\WC13227.5

March 13, 1995

Oregon

WATER
RESOURCES
DEPARTMENT

Attn: CENPP-PE-E
Timothy L. Wood
Colonel, U.S. Army
Army Corps of Engineers
P.O. Box 2946
Portland, OR 97208-2946

Dear Colonel Wood:

Thank you for the opportunity to comment on the Draft Feasibility Report and Draft Environmental Impact Statement for the Willamette River Temperature Control Study, McKenzie Subbasin. The Department supports the Corps efforts to achieve pre-reservoir temperature regimes in the McKenzie Subbasin through the use of multilevel ported intake structures as described in the Draft EIS.

The need for moderating the temperature of water coming from Cougar and Blue River Reservoirs is indicated in the Department's 1992 Willamette Basin Report. Presently, the water released from the reservoirs has a measurable effect on water temperature from June to November, which is detrimental to fish growth.

8-1. The Department's major concern with the project is that good communication needs to occur between the Corps and the state so that fluctuations in streamflow during the construction period have a minimal impact on the multiple benefits that the projects provide. The Water Resources Department has the lead role in coordinating state responses on reservoir operations. Consequently, we believe that the proposed Interagency Committee should include a representative from our Department. This Committee, which is designed to respond to unforeseen problems that may result due to the construction, is one avenue available to maintain open communication. We believe that maintaining operational flexibility during construction is vital.

Thank you for the opportunity to comment on the proposal. The Department looks forward to working with you on this project. If you have further questions, please contact Watermaster Gene McGinnis (687-3620) or Regional Manager Tom Paul (378-8455, ext. 281).

Sincerely,

Bob Rice

Bob Rice
Resource Management Division

Commerce Building
158 12th Street NE
Salem, OR 97310-0210
(503) 378-3739
FAX (503) 378-8130

8-1. We have revised the final report and EIS to indicate your participation on the interagency coordinating committee. We will work closely with the OWRD concerning flow augmentation plans during construction at each project, and will keep all the agencies involved via the interagency committee.

RECEIVED
MAR - 9 1995
WATER
SALEM OREGON

March 3, 1995

Colonel Timothy L. Wood
District Engineer, Portland District
Army Corps of Engineers
P.O. Box 2946
Portland, OR 97208-2946

Dear Colonel Wood,

As Oregon Council members to the Northwest Power Planning Council, we support the conclusions of the Portland District staff as identified in the Corps' December 1994 Draft Feasibility Report and Environmental Impact Statement for Willamette River Temperature Control in the McKenzie River Subbasin, Oregon. The feasibility study recommends modifying both the Corps' Cougar and Blue River projects in the McKenzie River Basin with selective withdrawal facilities for water temperature control, with the costs to be repaid according to the allocations of the original project purposes.

Since 1982, the Council's Columbia River Basin Fish and Wildlife Program has called on the Corps to evaluate alternatives to mitigate for the temperature effects of Cougar and Blue River dams on naturally spawning McKenzie River chinook salmon and resident fish. These evaluations were delayed for a number of years by the Corps' insistence on local cost sharing for the studies, an issue which has since been clarified by Congress. 9-1.

The feasibility study investigated various alternatives to modify the temperatures of both projects' releases to try to replicate pre-project water temperatures downstream to benefit both anadromous and native resident fish species. Returning the river to a more natural annual water temperature cycle will recreate an important component of the McKenzie River ecosystem required by the aquatic community. The draft feasibility report recommends that selective withdrawal devices be installed at both projects to provide access to, and withdrawal of, the warmest water available from both reservoirs in order to replicate pre-project temperatures throughout the year. We concur with the report's recommendation.

We recognize that major impacts of constructing temperature control facilities at these projects will last up to 4 years. Construction at each project should be phased to reduce impacts on fish and aquatic life in the vicinity of each project, as well as to reduce flow and other impacts on downstream watersheds and the Willamette River system. We urge the Corps to coordinate closely with other resource agencies to minimize construction-related impacts. 9-2.

Thank you for the opportunity to review the December 1994 Draft Feasibility Report and Environmental Impact Statement for Willamette River Temperature Control in the McKenzie River Subbasin, Oregon. We urge the Corps to install these facilities at the earliest possible date. We will work with the Corps to ensure authorization, if required, and funding of these needed temperature control facilities.

Sincerely,

Angus Duncan
Oregon Council Members, Northwest Power Planning Council

Joyce Cohen

Oregon

NORTHWEST ELECTRIC POWER & CONSERVATION PLANNING COUNCIL

Joyce Cohen
Angus Duncan
Council Members

John A. Kitzhaber
Governor

620 SW 5th Avenue
Suite 1025
Portland, OR 97204
(503) 229-5171
FAX (503) 229-5173

Corps of Engineers Responses

9-1. Noted

9-2. We will continue our coordination with the resource agencies and other interested groups during the additional design work and during construction via the interagency coordinating committee.

RECEIVED Oregon
MAR - 8 1995
WATER RESOURCES DEPT
SALEM, OREGON

MEMORANDUM

STATE MARINE BOARD

DATE: March 3, 1995

TO: Bob Rice, Resource Management Division
Department of Water Resources

FROM: Wayne Shuyler, Assistant Director

SUBJECT: Cougar and Blue River Temperature Control Project

Sorry to have taken so long to review the Draft Feasibility Report and EIS for the above mentioned project. As you can imagine, large technical documents are not my preferred reading material. However, I will try to contribute some feedback generally characterizing our agency's concerns for this project.

10-1. First, many of our customers utilize Cougar and Blue River Reservoirs for boating activities. While they are not the most heavily used lakes in the upper Willamette Basin, they may be favorite lakes for those who use them. The extended construction draw-down will mean the temporary loss of these lakes for flat-water boating resulting in the displacement of these users. These boaters will be forced to use other reservoirs in the area creating even more congested conditions on the water and more crowding of available facilities on the shore of these other reservoirs. Conditions will only worsen if drought, run-off shortfalls, or required releases from dams shrink the available surface water for boating during the Summer months.

10-2. As you may be aware, low water conditions have been a perennial condition for many of the Corps projects in the upper Willamette. The Marine Board has encouraged and offered financial assistance towards the development of low-water access sites on several reservoirs. One of these identified sites is Lookout Campground located on Blue River. This project is identified in our Six-Year Plan (copy enclosed), the designs have been completed, but the Willamette National Forest has had difficulty obtaining the necessary matching funds to contribute to this project.

10-3. Our plan calls for the extension of the ramp to below normal low water levels, a new road, floats, restroom, and fish-cleaning station (estimated cost: $161,946.) We would encourage that funds to complete this project be appropriated as a part of the Temperature Control project and that construction take place during the draw down or sooner.

10-4. At Cougar Reservoir we have identified needed boating enhancements at Echo, Slide Creek and Sunnyside. Improvements at these sites would include restrooms, ramp repairs or new construction, fish cleaning stations, as well as parking. Funds to complete these projects should also be made available in conjunction with the temperature control project so that the improvements could be made during drawdown.

435 Commercial St. NE
Salem, OR 97310-0650
(503) 378-8587
FAX (503) 378-4597

10-1. A detailed assessment of recreation impacts during construction of the temperature control modifications can be found in attachment A-2 of Technical Appendix A, Economics. This information has been summarized in the main report and EIS. There will be a temporary loss of reservoir recreation while Cougar and Blue River are under construction, and these users will be displaced. Although we have developed an appropriate construction schedule for the feasibility level of design, a value engineering (VE) study will be done to focus on ways to shorten the overall construction period, and subsequently reduce recreational and economic impacts to the local area.

10-2. Noted. The Forest Service has jurisdiction of the recreational activities on Cougar and Blue River lakes. There are issues of wetlands and cultural resources at the Lookout site, in addition to funding.

10-3. The 1991 Energy and Water Development Appropriations Act (PL 101-514) added funding and directed the Corps to analyze the feasibility of installing temperature control facilities at the Cougar and Blue River projects. During construction of the temperature control modifications, the residual pool being maintained at each project will not be able to support water-based recreational use.

10-4. See response No. 10-3.

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10-5. Another critical low-water project is Signal Point located on Lookout Point Reservoir. This lake is under utilized because all of its access sites are usable only at full or near-full pool elevations. A site for a low water ramp has been identified but has not been built. Construction of this site should be completed before the emptying of Cougar begins. This would help mitigate for the loss of Cougar and Blue River during their relative construction periods. Again, funds for this project should be appropriated as a part of the temperature control authorization.

10-6. Finally, the Marine Board, County Sheriffs, and Oregon State Police provide the resources necessary for marine patrols, boating law enforcement, and search and rescue services on all reservoirs and river reaches in the upper Willamette basin. The Corps of Engineers and Forest Service have not contributed financially to these efforts even though they manage the water in the lakes and rivers, the land surrounding these lakes and rivers, and many of the facilities used by visitors to these lakes and rivers.

10-7. It has been our hope that the federal government would help to augment state and local agencies law enforcement programs by contributing funding, equipment, or manpower. The temperature control project may not be the appropriate vehicle for this kind of partnership to be consummated, but we would encourage WRD to at least mention the costs to local law enforcement agencies from the closure of each lake and the corresponding increases in use of other lakes in the basin.

10-5. A low water boat ramp is proposed at Lookout Point Lake as a joint project between the Corps, Lane County, and the Oregon Marine Board. The Corps prepared an Environmental Assessment and Section 404 Evaluation and the FONSI was signed on March 29, 1995. A parking lot, floating dock and vault toilet also will be provided. Lane County expects to obtain funds from your agency. Once funds are obtained, construction is expected within 2 years.

10-6. The District recently met with you concerning this issue. We have no funds in our operation and maintenance budget for law enforcement or search and rescue programs. Law enforcement during construction of temperature control facilities may be an item for discussion between the Corps and the Forest Service.

10-7. See response No. 10-6. We concur that the temperature control project is not the appropriate vehicle to pursue a partnership of this nature.

BOATING FACILITY NEEDS
Requested for 1993-1999 Funding

County: Lane

SITE, LOCATION, AND SPONSER	1993-1995	1995-1997	1997-1999
Big Lake U.S. Forest Service Detroit Ranger Station		Rep. Ramp, Floats $85,750	
Blue River Reservoir Lookout Boat Launch Site U.S. Forest Service - Willamette National Forest	Rep. Ramp, Parking, Road, Float, New Vault Toilet, Fish Cleaning Station, Signs $161,946		
Saddle Dam U.S. Forest Service - Willamette National Forest		New Ramp, Parking, Road, Float, Vault Toilet, Fish Cleaning Station, Signs $204,598	
Carter Lake Carter Lake Boat Ramp U.S. Forest Service - Siuslaw National Forest	Rep. Road, Float, Piling, Vault Toilet $97,802		
Cougar Reservoir Echo Boat Launch U.S. Forest Service - Willamette National Forest	New Flush Toilet, Fish Cleaning Station, Signs $86,943		

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WATER RESOURCES DEPT.
SALEM, OREGON

BOATING FACILITY NEEDS
Requested for 1993-1999 Funding

County: Lane

SITE, LOCATION, AND SPONSER	1993-1995	1995-1997	1997-1999
Cougar Reservoir Slide Creek Campground U.S. National Forest Willamette National Forest		Rep. Ramp, Parking, Road, Fish Cleaning Station, Signs $136,302	
Sunnyside Recreational Area U.S. Forest Service - Willamette National Forest			New Ramp, Parking, Road, Float, Vault Toilet, Fish Cleaning Station $245,516
Dexter Reservoir Dexter Park Lane County Parks Division		Rep. Parking, Float $90,463	
Lowell Park Lane County Parks Division	New Boom, Breakwater $112,775		
Dorena Reservoir Baker Bay Park Lane County Parks Division		Rep. Parking $86,084	

Senator Mark Hatfield
711 Hart
Senate Office Building
Washington, D.C. 20510

February 16, 1995

Senator,

The Blue River Development Corporation is a local grass roots organization that is interested in economic development in the Upper McKenzie River Valley. Our community has been, during the previous 20 years, severely impacted by the declining forest industries. We have just started the economic recovery process and are interested in any and all activities that effect our livelihood.

The Temperature Control Project for Cougar and Blue River Reservoirs has the potential, in the short term, to have severe economic effects on local businesses. For the longer term, the project is a plus and it has our support if done properly. We have two comments about this project:

11-1. Our first point is that the Corp of Engineers has been authorized to study the feasibility of retro fitting the Cougar and Blue River Dams with temperature control devices. They haven't been authorized to study fish passage. Returning temperatures to natural conditions will benefit fish and in turn benefit the local communities. However, fish hatcheries have not mitigated fish passage, as originally intended. Fish biologists indicate that hatchery raised fish are genetically inferior to indigenous fish. Fish passage is needed! Construction impacts, environmentally and economically, may be minimized if both temperature control and fish passage are implemented simultaneously. To do otherwise would be irresponsible.

11-2. Our second concern is the loss of business from recreation users during the temperature control construction phase, and if the fish passage is done separately then the local communities would be subjected to two rounds of construction. The economic losses would be compounded. The Draft Feasibility Report and Environmental Impact Statement For The Willamette River Temperature Control Project was silent about economic impacts to businesses in the Upper McKenzie River Valley.

11-3. Total construction time, per reservoir, is four years for a total of eight years. What may be done to shorten the construction phase? While construction is occurring on one reservoir, would it be possible to hold the water in the other reservoir for an extended period?

Your attention on this very important matter would be appreciated.

Monty D Wilson
Blue River Development Corporation

cc: Congressman Defazio
McKenzie River Reflections
U.S. Army Corps of Engineers

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Corps of Engineers Responses

11-1. The 1991 Energy and Water Development Appropriations Act (PL 101-514) added funding and directed us to analyze the feasibility of installing temperature control facilities at the Cougar and Blue River projects. We have no authorization to initiate a study of fish passage in the McKenzie subbasin. The resource agencies have agreed to be involved in further design work so the selective withdrawal structures are designed in a way that would not preclude future methods for other fish management opportunities in the McKenzie subbasin, such as fish passage. We do have an on-going reconnaissance study for the South Santiam subbasin which is investigating methods of providing fish passage. Being considered are collection facilities upstream of the reservoir and at the dam. If any of these methods prove feasible, application to other reservoirs in the Willamette basin may be possible.

11-2. Section 4.3.3 of the EIS discusses impacts to recreation and Section 4.3.6 describes regional and local economics during construction. Technical Appendix A, Economics, provided additional information on expected impacts to the local communities. We have revised the final report and EIS to reflect more of the information contained in Technical Appendix A.

11-3. We have developed an appropriate construction schedule for the feasibility level of design. A Value Engineering (VE) study is the first activity scheduled during Preconstruction Engineering and Design. The VE study will focus on ways to shorten the overall construction period.

During construction, the Corps must maintain specific summer flow augmentation requirements for the Willamette basin and the flood control capability of the reservoirs. We cannot hold the water in the reservoir not under construction for an extended period because of the need to draw down the reservoir for flood control.

EWEB
Eugene Water & Electric Board
500 East 4th Avenue
Post Office Box 10148
Eugene, Oregon 97440-2148 503•484•2411
Fax 503•484•3762

March 13, 1995

Colonel Timothy L. Wood
Portland District, Army Corps of Engineers
P.O. Box 2946
Portland, OR. 97208-2946

ATTN: CENPP-PE-E

Dear Colonel Wood,

Commissioners
Dorothy Anderson
Mike Dyer
Sarah Hendrickson
Jeff Osanka
Susan Smith
General Manager
Randy L. Berggren

The Eugene Water & Electric Board (EWEB) has reviewed the Draft Feasibility Report and Environmental Impact Statement (DFR & EIS) for Willamette River Temperature Control, McKenzie River Subbasin. EWEB continues to be fully supportive of the preferred alternative for the project, and commends your staff for the quality of work displayed in the draft document.

12-1. We appreciate the efforts by your staff to address our concerns on the potential negative effects on drinking water quality at our Hayden Bridge Filtration Plant. As detailed by Mr. Doug Wise, EWEB's Water Supply & Treatment Supervisor at the Hayden Bridge Filtration Plant in a letter to Mr. Russell Davidson of your staff, dated September 2, 1994, there are several water quality issues related to the construction and operation of the temperature control projects at Cougar and Blue River reservoirs that have real product quality, regulatory compliance, and financial implications to EWEB.

12-2. Increased turbidity caused by erosion and down-cutting of sediment deposits during construction draw-downs, and taste, odor and increased organic loading problems associated with the release of algae-rich surface water from the reservoirs during the late spring and summer continue to be our primary concerns. We estimate that the increased use of activated charcoal to treat higher algae concentrations or increased turbidity would cost EWEB about $500 per day of treatment. Although highly effective, our experience is that the treatment will not remove all taste and odor from the water, leading to an increase in customer complaints and the potential for reduced public confidence in our service. In addition, as outlined in Mr. Wise's letter referenced above, a significant increase in the concentrations of disinfection by-products regulated by the Safe Drinking Act, could lead to major expenses for additional treatment capabilities.

Corps of Engineers Responses

12-1. Noted

12-2. Noted. We appreciate the additional information on your concerns.

12-3. We are encouraged by the information in the DFR & EIS pertaining to these issues and look forward to participating with your staff and representatives of other agencies in the planning, coordination and monitoring efforts as discussed in the document. We are particularly anxious to continue discussions on pre- and post-construction water quality monitoring. EWEB is under the impression that the initial pre-project monitoring is to begin in 1995.

12-3. Initial pre-project monitoring will be initiated during Preconstruction Engineering and Design, which is scheduled to begin in May 1995 for Cougar.

12-4. The DFR & EIS identifies adverse effects during construction on EWEB's power generation at our Leaburg and Walterville projects resulting from reduced flow augmentation during the summer and fall, but does not estimate cost impacts on EWEB. EWEB roughly estimates our costs due to lost generation will be about $260,000 per year during the Cougar construction period, and about $180,000 per year during the Blue River construction. These costs are based on an estimated market value of 25 mills. While the costs are significant to us, EWEB views these costs as justified by the probable long term benefits of the project to the aquatic productivity of the McKenzie subbasin. However, we strongly advocate efficiency review to determine potential for reducing the time that will be required to complete project construction.

12-4. Estimated costs for lost generation have been added to the final report. A detailed discussion of the calculations used can be found in Technical Appendix A, Attachment A-3, Hydropower Analysis. A value engineering (VE) study is the first activity scheduled during Preconstruction Engineering and Design and will focus on ways to shorten the overall construction period.

12-5. As a fellow steward of the water resources of the McKenzie River, EWEB believes it is in everyone's interest to maintain healthy populations of wild spring chinook salmon and bull trout in the subbasin. Including effective fish passage into the design at Cougar Reservoir would take an additional step toward assuring this goal by allowing chinook salmon access to historic spawning and rearing areas in the South Fork and its tributaries above Cougar Dam. EWEB encourages the Corps of Engineer to thoroughly investigate the potential economic, environmental and logistic advantages and disadvantages of including downstream fish passage into design and construction phases of the temperature control project. EWEB is willing to work on behalf of the Portland District for a change in project authorization and funding to include the evaluation, design and construction of effective downstream migrant passage concurrent with the temperature control structures. Achieving both temperature control and downstream fish passage (at Cougar) in the most cost effective manner and within the established project schedule should be pursued.

12-5. The 1991 Energy and Water Development Appropriations Act (PL 101-514) added funding and directed the Corps to analyze the feasibility of installing temperature control facilities at the Cougar and Blue River projects. We have no authorization to initiate a study of fish passage in the McKenzie subbasin. The resource agencies have agreed to be involved in further design work so the selective withdrawal structures are designed in a way that would not preclude future methods for other fish management opportunities in the McKenzie subbasin, such as fish passage. We do have an on-going reconnaissance study for the South Santiam subbasin which is investigating methods of providing fish passage. Being considered are collection facilities upstream of the reservoir and at the dam. If any of these methods prove feasible, application to other reservoirs in the Willamette basin may be possible.

12-6. EWEB is concerned about the potential biological impacts during construction related to turbidity, dissolved oxygen and fish mortality. The small population of bull trout in the South Fork appears to be potentially at risk. EWEB agrees that the outlet at Cougar should be screened. This appears to be a major engineering and operational task. We look forward to reviewing the design. We concur with the formation of an interagency committee to coordinate and respond to unforeseen problems during construction. EWEB will gladly serve on the committee.

12-6. Noted. We will continue our coordination with you, the resource agencies, and other interested groups during the additional design work, and during construction via the interagency coordinating committee.

Thank you for the opportunity to review and comment on this important project. EWEB staff anticipates working closely with your staff through all phases of project development.

Sincerely,

Laurie Power
Environmental Manager

cc: D. Anderson, EWEB Commissioner
J. Osanka, EWEB Commissioner
D. Wise, EWEB
E. Jordan, EWEB
J. Allen, USFS, McK. Br. R.D.
L. Burditt, USFS, Blue R. R.D.
L. Bilheimer, Pac. R. Council
B. Bumstead, MFRP
N. MacHugh, ODFW, Corvallis
J. Ziller, ODFW, Springfield
W. Stampe, USCOE, Lowell

McKENZIE FLYFISHERS

P.O. BOX 10665 • EUGENE, OREGON 97440-2665

3570 Glen Oak Dr.
Eugene, Oregon 97405

TO ENCOURAGE FLYFISHING AS A METHOD OF ANGLING

Corps of Engineers
Portland District
P. O. 2946
Portland, Oregon 97208-2946

MAR 15 1995

To Whom It May Concern:

I am writing to comment on your draft EIS for the installation of temperature control devices on Cougar and Blue River dams. As Conservation Co-chairman of the McKenzie Flyfishers, I represent 120 anglers from the Eugene-Springfield area. We strongly support your project but we do have some areas of concern.

13-1. We are concerned about the four years of summer low-pool time that the Draft EIS calls for. This will not only have substantial impact on the recreationists who use the lakes, but in the case of Cougar will impose serious hardships on the resident bull trout population. We urge you during the value engineering phase of the project to make every effort to shorten the construction period.

13-2. Our most serious concern deals with the limited scope of the projects. Because of the current plight of the salmon and the bull trout, we know that every effort will soon be made to enhance their chances of survivability. It is, then, inevitable that sooner or later Cougar Dams' inoperable downstream migrant passage system will be renovated. We firmly believe that since the temperature control project will require the reservoir to be drawn down, we should be using that window of opportunity to install workable downstream migrant passage.

13-3. Certainly such passage would prove to be cost effective as it would open up many miles of excellent spawning habitat for chinook and for mainstream bull trout. We also believe that no additional authorization will be needed for the project as fish passage was authorized for the dam during its initial construction phase. We urge you to seek funds for the design and installation of such a system. We assume that such a design effort would not extend the construction time or delay the start of the project.

Thank you very much for your consideration of our comments.

Sincerely

Robert G. Bumstead
Co-chair, Conservation Committee

Corps of Engineers Responses

13-1. Noted. The VE study will focus on ways to shorten the overall construction period.

13-2. We have no authorization to initiate a study of fish passage in the McKenzie subbasin. The resource agencies have agreed to be involved in further design work so the selective withdrawal structures are designed in a way that would not preclude future methods for other fish management opportunities in the McKenzie subbasin, such as fish passage. We do have an on-going reconnaissance study for the South Santiam subbasin which is investigating methods of providing fish passage. Being considered are collection facilities upstream of the reservoir and at the dam. If any of these methods prove feasible, application to other reservoirs in the Willamette basin may be possible.

13-3. We would need authorization and appropriation of funds to specifically investigate fish passage at Cougar Lake. The study and design efforts required by Corp regulations to investigate fish passage, if done in conjunction with and at the level of this feasibility study, would significantly delay the start of construction for the temperature control modifications.

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McKENZIE RIVER CHAMBER of COMMERCE

P.O. Box 1117
Leaburg, Or 97489
(503) 896-3330

February 22, 1995

Karen Bahus, Study Manager
Planning and Engineering Division
Department of the Army
Portland District, Corps of Engineers
P.O. Box 2946
Portland, OR 97208-2946

Dear Ms. Bahus,

The McKenzie River Chamber of Commerce represents about 165 businesses and residents interested in the economic and social welfare of our area. Board members of the Chamber recently reviewed the "Draft Feasibility Report and Environmental Impact Statement - Willamette River Temperature Control, McKenzie Subbasin, Oregon."

14-1. We would like to commend the Corps on its thorough study. The McKenzie Chamber certainly favors efforts to preserve and enhance the quality of life in the rural areas of Oregon. We support the Temperature Control Study's proposal to mitigate the effects of temperature impacts to benefit anadromous and native fish species and understand those impacts were not anticipated when the projects were constructed in the 1960's. We value the importance of the McKenzie as a key watershed in Oregon and realize that a reinvestment into the ecosystem can benefit local citizens and families as well as visitors who are drawn to this unique natural environment.

14-2. During the approximately 10 year span that the Cougar and Blue River Reservoirs will be drawn down, impacts to the local tourism economy could reach more than $1 million. This will affect the nine timber impacted communities throughout the sixty mile stretch of the McKenzie River Valley. In the past, the McKenzie Chamber has been designated as the umbrella organization to represent the entire Valley and receive federal funding for strategic planning and facilities construction. We would like to work with the Corps to develop and implement plans to mitigate the economic impacts from Temperature Control activities as well.

14-1. Noted

14-2. During the next phase of project design, we will focus our efforts on ways to shorten the overall time required to construct the project to reduce the construction costs and the environmental, recreational, and economic impacts to the local area. The final report discusses in detail the anticipated impacts to recreation during construction of the temperature control modifications. Also as a result of construction, however, there will be increased employment and business income in the local area that will help offset some of the losses to the local tourism economy. Other than reducing the construction time involved, the Corps has no authority to develop and implement plans to mitigate economic impacts for this project.

14-3. The McKenzie River Chamber of Commerce encourages efforts to continue and strengthen our work with the Corps to develop a strong visitor information center at the Old McKenzie Hatchery at Leaburg Lake. We appreciate the support given to this project thus far by the Corps, acting as a member of the Lane County McKenzie Hatchery Task Force. The Corps has served along with representatives from the Willamette National Forest, ODFW, BLM, EWEB, US Soil Conservation Service and local citizens, to make the Hatchery Tourist Information Center a reality.

14-4. We would like to discuss a proposal to help offset losses to our local economy and tourism industry by providing funds for full time staffing at the Hatchery site. We would encourage the Corps' participation in a partnership to provide funds for construction of the proposed new interpretive Center at the Hatchery as well.

14-5. Other methods of mitigating economic impacts are needed. The Chamber has taken the lead role in shaping Marketing Plans for the McKenzie River Valley. Corps participation in and financial support for these Marketing Plans will help ensure people throughout the Northwest continue to view the McKenzie Valley as a desirable vacation destination point during Temperature Control construction.

Working together with the Corps, the McKenzie Chamber believes we can help our rural area balance economic and development efforts in a way that will complement stewardship of our valuable natural resources.

Sincerely,

Louise Engelman

Louise Engelman
President

14-3. We will continue our involvement with the Lane County McKenzie Hatchery Task Force under our project operations responsibility and in cooperation with the other agencies.

14-4. The Corps has no appropriations to fund project operations to provide full time staffing or a new interpretive center at the McKenzie Hatchery.

14-5. The Corps has no jurisdictional authority to participate in or financially support Marketing Plans for the McKenzie Valley.

The McKenzie Watershed

Partner Organizations

- Agripac Cooperative
- City of Eugene
- City of Springfield
- East Lane Soil & Water Conservation District
- Eugene Water & Electric Board
- Lane County
- McKenzie Fisheries Restoration Project
- McKenzie Residents Association
- Mohawk Community Council
- Oregon Division of State Lands
- Oregon Water Resources Department
- Pacific Rivers Council
- Rural Resources Development Committee
- Springfield Utility Board
- U.S. Army Corps of Engineers
- U.S. Bureau of Land Management
- U.S. Forest Service
- Weyerhaeuser Company
- Willamalane Park and Recreation District

Lane Council of Governments

125 East Eighth Avenue
Eugene, Oregon 97401

(503) 687- 4283

Fax (503) 687- 4099

March 15, 1995

MAR 17 1995

FAX'd 3/14/95 @ 4:34P

Attn: CENPP-PE-E
Colonel Timothy L. Wood
U.S. Army Corps of Engineers
PO Box 2946
Portland OR 97208-2946

Dear Colonel Wood:

At its March 9, 1995 meeting the McKenzie Watershed Council agreed by consensus to support the Corps' efforts to achieve pre-reservoir temperature regimes in the McKenzie Subbasin through the use of multilevel ported intake structures as described in the Draft Feasibility Report and Draft Environmental Impact Statement for the Willamette River Temperature Control Study, McKenzie Subbasin.

The McKenzie Watershed Council is an advisory body established in 1993 with the purpose of helping to address management issues in the McKenzie River watershed and to provide a framework for coordination and cooperation among key interests. The mission of the 20 member council (which includes the Corps) is to foster stewardship of the McKenzie River watershed resources, deal with issues in advance of resource degradation, and ensure sustainable watershed health, function and uses.

The Council has the following specific comments on the Draft EIS:

15-1. • Funding: In May 1994, the McKenzie Watershed Council agreed by consensus to seek a 100 percent federally funded temperature control project. The Council strongly supports the Corps decision to fully fund this project without requiring local cost-share.

15-2. • Fish Passage and Project Timeliness: Cougar Reservoir was originally built with fish passage which has proven to be ineffective. The Council supports fish passage at Cougar Reservoir to open up the South Fork and its tributaries to effective Chinook spawning. Merging fish passage and temperature control construction would be economically and environmentally desirable. The Council requests that funds be allocated for the design and engineering of effective downstream migrant passage in timely conjunction with the design and engineering of the temperature control structures.

Corps of Engineers Responses

15-1. Noted

15-2. The 1991 Energy and Water Development Appropriations Act (PL 101-514) added funding and directed the Corps to analyze the feasibility of installing temperature control facilities at the Cougar and Blue River projects. We have no authorization or funding to initiate a studies of fish passage in the McKenzie subbasin. The resource agencies have agreed to be involved in further design work so the selective withdrawal structures are designed in a way that would not preclude future methods for other fish management opportunities in the McKenzie subbasin, such as fish passage. We do have an on-going reconnaissance study for the South Santiam subbasin which is investigating methods of providing fish passage. Being considered are collection facilities upstream of the reservoir and at the dam. If any of these methods prove feasible, application to other reservoirs in the Willamette basin may be possible.

15-2. The Council is concerned about the overall length of time to complete the projects: four years at Cougar and another four years at Blue River. The Council would not want to see fish passage at Cougar delay the temperature control project.

15-3. • Interagency Team: Good communication needs to occur between the Corps and all interested parties. The proposed Interagency Committee which is designed to respond to unforeseen problems that may result due to the construction, is one avenue available to maintain open communication. Since the McKenzie Watershed Council was created to provide a framework for coordination and cooperation among key interests, we believe the Council should be added to the Interagency Team.

15-4. • Bull Trout Mitigation: In the long run the project is expected to improve bull trout habitat. However, in the short-term bull trout may suffer from reduced habitat during construction. Due to these short-term consequences, the Council advocates for additional mitigation for bull trout at Cougar Reservoir.

15-5. • Recreational Impacts: Additional information is needed to assess the recreational impacts of the project. For example, would impacts to certain recreational user groups be severe, which could seriously harm individual businesses?

15-6. • Non-structural Solutions: The Draft EIS only briefly mentions non-structural options to resolving the temperature control problem. A more in-depth review of these possibilities is needed before dismissing the idea.

Thank you for the opportunity to comment on the proposal. The McKenzie Watershed Council looks forward to working with you on this project. If you have further questions, please contact project manager Kathi Wiederhold at (503) 687-4430 or Bob Rice of the McKenzie Coordination Team (503) 378-8455, x238.

Sincerely,

Bob Bumstead
Council Co-Chair

Pat Thompson
Council Co-Chair

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Last Saved: March 14, 1995

We have developed an appropriate construction schedule for the feasibility level of design. A value engineering (VE) study is the first activity scheduled during Preconstruction Engineering and Design, and is being done to ensure the project is constructed in the most cost effective manner. The VE study also will focus on ways to shorten the overall construction period.

15-3. Noted. We have revised the final report and EIS to indicate your participation on the coordinating committee.

15-4. The Corps, Oregon Department of Fish and Wildlife, the US Fish and Wildlife Service, and the Forest Service held further discussions in March 1995 on minimizing impacts to bull trout during construction at Cougar Lake. The final report and EIS have been updated to include a plan of response to bull trout concerns during construction at the Cougar project.

15-5. Sections 4.3.3 and 4.3.6 of the EIS discuss impacts to recreation and regional economics during construction. Technical Appendix A, Economics, provides more information on expected impacts to the local communities. We have revised the EIS to reflect additional information found in Technical Appendix A.

15-6. Nonstructural alternatives are discussed in section 3.4.2 of the main report. We have expanded the discussion in section 2.3 of the EIS for the nonstructural (operational) alternatives. The operational changes would not meet the study objective of modifying water temperatures to replicate pre-project conditions in the study area. Some partial improvement in release temperatures may be possible using operational changes. However, changing the operation of the reservoirs does nothing to alter the location of the warm water layer or the regulating outlets located deep in the reservoirs.

OREGON
NATURAL
RESOURCES
COUNCIL

MAIN OFFICE

VISION BUILDING, SUITE 1050
522 SOUTHWEST FIFTH AVENUE
PORTLAND, OREGON 97204
503-223-9001

Protecting Oregon's lands, waters and natural resources

MAR 15 1995

13 March 1995

Department of the Army
Portland, District, Corps of Engineers
PO Box 2946
Portland, OR 97208-2946

Fax: 503-326-6401

ATTN: CENPP-PE-E

RE: Willamette River Temperature Control: McKenzie Subbasin, Oregon
Comments on the Draft Feasibility Report/DEIS

I am writing on behalf of Oregon Natural Resources Council to comment on the Willamette River Temperature Control Study. ONRC certainly supports modifications to improve water temperature for fish downstream of the Cougar and Blue River dams, but does have some concerns about the project as now proposed.

16-1. ONRC's biggest concern is that the scope of the project may be inappropriately narrow. It is our understanding that there is currently no real fish passage beyond either dam. This being the case, it would make sense to install or remodel fish passage facilities at the same time. Economic and ecological costs would be minimized and ecological benefits maximized by combining modifications for downstream temperature improvements with modifications for upstream passage improvements. While the Corps apparently does not currently have the authorization to look beyond temperature improvements, it has been suggested that the installation of effective fish passage (at Cougar at least) was authorized when the dam was first constructed. As worthwhile as the temperature improvements are, it seems unwise to undertake such an expensive and lengthy construction project to do these alone.

16-2. In addition, ONRC believes that dam removal should always be considered as a possible alternative, and the costs and benefits of such evaluated in addition to lesser measures such as temperature and fish passage improvements.

Sincerely,

Diane Valantine

Diane Valantine
Salmon and Rivers Program Leader

Corps of Engineers Responses

16-1. The 1991 Energy and Water Development Appropriations Act (PL 101-514) added funding and directed the Corps to analyze the feasibility of installing temperature control facilities at the Cougar and Blue River projects. We have no authorization to initiate a study of fish passage in the McKenzie subbasin. The resource agencies have agreed to be involved in further design work so the selective withdrawal structures are designed in a way that would not preclude future methods for other fish management opportunities in the McKenzie subbasin, such as fish passage. We do have an on-going reconnaissance study for the South Santiam subbasin which is investigating methods of providing fish passage. Being considered are collection facilities upstream of the reservoir and at the dam. If any of these methods prove feasible, application to other reservoirs in the Willamette basin may be possible.

16-2. Section 3.3 of the main report discussed the planning constraints of this study. The Blue River and Cougar projects are operated as part of a system of reservoirs for many purposes in the Willamette basin. A planning constraint established for this study is that alternatives developed for modifying release temperatures do not significantly affect the authorized purposes of the reservoirs. The primary purpose of the reservoirs is to provide flood damage reduction, and the average annual damages prevented are estimated at $10 million for Blue River and $13 million for Cougar (October 1993 price level). The stored water in the reservoirs also provide other regional benefits such as power generation, recreation, irrigation, and municipal water supply. In this context, removal of the Cougar and/or Blue River dams is not considered a reasonable alternative.

Containerboard Packaging

Weyerhaeuser

P.O. Box 275
Springfield, Oregon 97477
Tel (503) 746 2511
Fax (503) 741 5670

February 22, 1995

U.S. Army Corps of Engineers
Portland District, CENPP-PE-E
PO Box 2946
Portland, OR 97208-2946

Attention: Ms. Lynne Hamilton

Subject: Comments Regarding Volume 1 of the Draft Feasibility Report and Draft Environmental Impact Statement for the Willamette River Temperature Control Study, McKenzie Subbasin, Oregon

Weyerhaeuser would like to thank the United States Army Corps of Engineers (Corps) for the opportunity to comment on the Selective Withdrawal System (SWS) projects proposed for the Blue River and Cougar dams on the upper McKenzie. Weyerhaeuser fully supports the goal of improving fish habitat to increase fish survival and growth. Healthy populations of fish and other aquatic life are valuable resources that merit reasonable and cost effective investments of resources.

17-1. Weyerhaeuser, however, is concerned that potential impacts during construction of these projects were not fully understood or anticipated by the Corps in preparing its draft feasibility report. Our primary concern is that construction activities during the dry summer months could lower river levels to the point of restricting water from reaching Weyerhaeuser's manufacturing facilities in Springfield, Oregon. The mill's intake is located on a side channel on the south side of the river at river mile 16. This channel already requires periodic hydraulic dredging to ensure adequate flows reach the mill's intake pumps during normal low flow conditions. With flows projected to decrease up to 20%, the river level may drop to the point that insufficient water would be available to sustain mill operations. Dredging the channel deep enough to insure an adequate supply of water may not be feasible where it passes under the I-105/126 Highway.

17-2. Weyerhaeuser employs over 900 people on the plant site and supports many other businesses in the Eugene/Springfield community. The containerboard mill produces 1800+ tons per day of unbleached kraft linerboard which is shipped up and down the West Coast and throughout the Pacific Rim. Our particleboard mill is a major producer as well. Adversely impacting operations of our facilities would have a significant impact on Weyerhaeuser's businesses and employees, and the general community.

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Corps of Engineers Responses

17-1. We have had further discussions with your senior process engineer, Mr. Loren Leighton, about your concerns. He provided the following information so we could investigate your concerns further:

-- river elevation needed to provide adequate flows is estimated at 466.5
-- the side channel to the intake is typically dredged every summer
-- low flows during Sep/Oct 1992 caused problems at the intake

We have reviewed flow data from 1992, which was an extreme low flow year and the lowest since 1930. In October 1992, the lowest observed flow at Vida was 1,330 cfs. Mr. Leighton reported to us that this extreme low flow did not impact the mill's operation.

In the feasibility report, we used 1973 as a low flow year for our modelling work and about 1,890 cfs is the lowest flow estimated at Vida during construction at Cougar (no pool at Cougar). In addition, the Corps currently releases a minimum flow of 300 cfs from Cougar during the summer months. During construction at Cougar during a low flow year (1973), as based on our modelling analysis, the lowest expected release from Cougar is about 260 cfs.

17-2. There is no way to predict whether another extreme low flow condition will occur while we are constructing the temperature control modifications. However, we do not expect to cause adverse impacts to your mill operations under the low, average, and high flow conditions as modelled in the feasibility report and as long as you continue to annually dredge the side channel to the intake.

17-3. In order to resolve this issue to the satisfaction of Weyerhaeuser and the Corps, we request a meeting with Colonel Wood and the Corps' project manager to discuss the potential impacts of the SWS projects on Weyerhaeuser's water supply. An uninterrupted supply of water is critical to Weyerhaeuser's operations. Therefore, it is essential to resolve any potential dispute between Weyerhaeuser and the Corps. Weyerhaeuser recommends hosting this meeting at its Springfield mill site so that the Corps personnel can observe the area of potential impact. Please contact Loren Leighton, senior process engineer, at 741-5702 to set up the meeting to discuss Weyerhaeuser's concerns.

17-4. In order to minimize the potential impacts of the SWS projects, Weyerhaeuser suggests that the Blue River project be constructed first because the impact on McKenzie River flows will be smaller. The experience the Corps gains from the Blue River project could be utilized to minimize construction time at the larger Cougar project, thereby reducing the down river impacts.

We appreciate your consideration of Weyerhaeuser's comments and look forward to meeting with the Corps regarding this matter in the near future.

Richard E. Hanson

Richard E. Hanson
Vice President & Mill Manger

ns

cc: Colonel Timothy L. Wood - U.S. Army, Corps of Engineers, Portland District
Keith Eubus
Loren Leighton
Sue Zeni
Mark Rauch

17-3. We have been coordinating with Mr. Leighton by phone. He agrees that at this time, there seems to be no need for a meeting at the Springfield mill site.

17-4. The temperature control modification is planned at Cougar first because modifying water temperatures in the South Fork McKenzie River would restore more fish habitat than available in the Blue River, and would take advantage of these benefits in the South Fork as early as possible. Also, the fishery agencies prefer that release temperatures be modified at Cougar first. We have developed an appropriate construction schedule for the feasibility level of design. A value engineering (VE) study is the first activity scheduled during Preconstruction Engineering and Design, and is being done to ensure the project is constructed in the most cost effective manner and also will focus on ways to shorten the construction periods at the projects.

February 20, 1995

Col. Timothy L. Wood
District Engineer
Portland District
US Army Corps of Engineers
PO Box 2946

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Dear Sir:

This letter comments on the Draft Feasibility Report and Environmental Impact Statement addressing Willamette River Temperature Control; McKenzie Subbasin, Oregon prepared December 1994. While I am pleased with the conclusion (e.g. Selective Withdrawal Structures at Blue River and Cougar) I am concerned with the accuracy and validity of some of the methods, inferences, and data presentations of the document.

1. Justification of action.

Portland District decision makers need to make a significant management adjustments regarding temperature control in the Willamette. This adjustment is to get out of denial about when the temperature effects of these projects was realized and become far more efficient planners and engineers.

In each section of the document prepared by Portland District, a statement is made alluding that temperature effects were not realized at the time of construction. If this were true then the technical staff of Portland District at the time of construction were truly incompetent, failing any exam addressing the annual heat budgets of large water bodies. Since most hydrologist and engineers can solve heat budget equations, it would be more correct to say that resource agencies did not voice concerns about potential thermal effects at the time of construction. Since water pollution effects in the mainstem Willamette were a major environmental concern that would be mitigated by the additional summer flows to be provided by Blue River and Cougar, it is likely that temperature effects were not at the top of the list of concerns for resource agencies at that time .

18-1.

However, the absence of a voiced concern is not a justification to ignore temperature effects. The Corps of Engineers is the action agency for the Willamette

Corps of Engineers Responses

18-1. Noted. Taken in context with the entire paragraph, the statement implies that the magnitude of impact to fish resources from changing release temperatures was not anticipated during original project construction.

projects and are responsible for the effects of the operation of these facilities. This is particularly significant since improving conditions for fish life in the Willamette is an consistent theme of House Document 81-531, Vol. V, March 20, 1950 (see pages 1731-1734, 1739, 1817,1831, 1850, 1852, 1863, 1866, 1867, 2034, 2035, 2237, 2239, & 2284) and one of the stated purposes of these projects. Furthermore, temperature effects were specifically recognized in House Document 81-531. The last sentence at the bottom of Page 1732 of this document reads "Reservoir operations also would affect the quantity, quality, and temperature of the water in the streams below the dams.".

18-1.

2. Document formatting.

I would like to suggest the District re-evaluate the apparent need for redundancy by developing four or more separate stand-alone documents (e.g. a feasibility report, an EIS, an economic analysis, and Engineering Analysis). Each of these documents repeats enough of the same information to frustrate the most tolerant of customers. Please write a final document that reduces redundancy by incorporation by reference. One description of the existing environment, one description of economic analysis, and one description of the proposed operation and its effects is enough.

18-2.

It would also be useful for the District to select and use a standard set of tables or graphics for illustrating temperature effects. The number different ways your staff and others has presented the effects data reported in the 1987 WSTCS Phase I report is remarkable. There is a need to delegate, to one person, the authority and responsibility of integrating and standardizing the data and information in this document. Please make this thing user friendly or we will think you trying to snow us.

3. Headwater storage benefits/Federal responsibility for conditions below Leaburg.

The construction and operation of Blue River and Cougar projects has resulted in a change in the annual flow patterns of the McKenzie below the confluence of Blue River. The principal changes has been a decrease in mean daily flows in winter (meets flood control objectives) and an increase in mean daily flows in summer and early fall (flow augmentation) [see Figure V.2.5. of the 1987 WSTCS report]. Summer flow near Vita, Oregon now averages about 2500 cfs. The lowest mean daily flow (10 day intervals) for a the pre-project period (1925 - 1962) was about

18-3.

18-2. The District follows a document format prescribed by our regulations for feasibility reports. However, some information in the report is repeated intentionally because of the need to understand the performance of selective withdrawal in achieving pre-project water temperatures for all data years, by stream location, and for each scenario. The Hydrologic Engineering Center performed additional temperature modelling work to evaluate this performance.

18-3. See section 3.2.1, Study Objectives, of the main report. As agreed between the District and the resource agencies, flows are based on existing regulation schedules for the Cougar and Blue River projects. No change in existing regulation schedules are proposed for operating the selective withdrawal structures.

1700 cfs. I believe the Leaburg and Walterville canals have the capacity to withdrawal about 2000 cfs from the McKenzie River on a routine basis. Thus, the net effect of Blue River and Cougar projects has be to enable Eugene Water and Electric Board (EWEB) to maximize hydropower production from their two facilities throughout the year (winter flows are well above 2500 cfs).

Headwater storage benefits in the McKenzie are those added flow benefits associated with the operation of Blue River and Cougar that EWEB is required to compensate the Federal Treasury (similar to the compensation the US government makes to Canada for the storage effects of its projects on the Columbia). The feasibility study and EIS both point out the flows of 2500 cfs at Leaburg Dam are a goal of the operation of Blue River and Cougar projects. Because these operations enable EWEB to withdraw, more water in summer and fall than would be available without Blue River and Cougar projects, it is unwise to preclude the McKenzie River below Leaburg from the project study area.

18-3.

If it were determined that these additional summer flows were to remain in the McKenzie River between the withdrawal and return points, McKenzie River flows could be increased by as much as a third. Since Federal actions are enabling EWEB of operate at maximum capacity, it would be prudent to examine the non-structural benefits of additional water in the Mainstem McKenzie below Leaburg Dam.

4. Documentation of spawning conditions.

Because of the importance of the Sedell et. al. 1992 study it would be helpful to include some of the tabular or graphical results of his study in this report.

18-4.

5. Size and number of selective withdrawal ports.

It is difficult to understand why the selective withdrawal ports at Blue River and Cougar are to be sized to pass 1000 and 2000 cfs respectively. Selective withdrawal is needed for only a portion of the year. That portion is June through mid October. This is the period the lakes are sufficiently thermally stratified to permit meaningful temperature modification in project discharges. Maximum discharge for Blue River in summer averages less than 600 cfs (Figure V.2.3. in 1987 WSTCS report). Maximum discharge for Cougar in October averages less that 1,200 cfs (Figure V.2.1. in 1987 WSTCS report). Since more than one port can be opened at one time, the volume of water passing is determined by the size of the

18-5.

18-4. The results of the Sedell study are incorporated by reference in the main report and EIS. This report is available at the Portland District.

18-5. Section 1.4 in Exhibit A, which follows the EIS, provides more detailed information concerning the sizing of the ports and the number of ports for the selective withdrawal systems at Blue River and Cougar. During the next phase of design, a Value Engineering (VE) study will be performed to ensure the project is constructed in the most cost effective manner. The VE study also will explore ways to shorten the construction schedule.

Reference was made to telescoping towers used in Japan to selectively withdraw water from high projects. Mitsubishi Heavy Industries, LTD. has designed and constructed many different types of selective withdrawal systems. Telescoping float and mechanical type cylinder and semi-cylinder gates and flat multiple gate systems have been used on or inside freestanding towers or attached to upstream faces of concrete gravity dams. Freestanding steel tower systems with cylinder gates with capacities up to 20 cms (700 cfs, Shirakawa Dam) and semi-cylinder gates (Omachi Dam, attached to concrete dam) were built with a capacity of 25 cms (875 cfs). Others such as a low head selective withdrawal telescopic cylinder gate was installed to the existing dam at Matsubara Dam with a capacity of 85 cms (2,975 cfs) and the referenced 65 cms (2,321 cfs) is a surface withdrawal semi-circular multiple gate system installed on the upstream face of Kusaki Dam. Conceptually, this system has many similarities with that of the intake designed for Elk Creek Dam. The key point to recognize is that for the larger capacity withdrawal systems, either a concrete dam is required for support or a significant freestanding tower structure, as is the case presented in the feasibility report. The appropriate structure and type of gating will be further studied in the next phase, but one can see that whatever mechanized system is employed it becomes of secondary importance relative to the magnitude of the structure required to support the system for seismic and normal loading criteria.

wetwell not the port. Thus, the size of the port can be smaller but the project still pass the flood events occurring between June and Mid-October. Figures V.2.2. and V.2.4. of the 1987 WSTCS report show that period of significant flow variation occur before and after June through Mid-October.

Since the period of temperature effects is relatively short and since the ports can be "throttled" to select and mix water from different strata, the necessity of having more that 6 ports (the regulating outlet and 5 ports) at each tower needs to be questioned. The incremental benefits (added number of days of meeting target temperatures) of having more than 5 selective withdrawal ports may not be justified. This is important since the resource agencies have yet to define the performance standards of the project. Maximum flexibility is a justifiable objective
18-5. only as long as there is no meaningful differential costs associated with what you do.

If the District is insistent on meeting target temperatures each day of the thermal effects season it should have examined the telescoping towers used in Japan to selectively withdraw water from high head projects (see Memorandum, CENPP-PL, Jan 89, subject: Letter Report on Results of Phase II Work, Willamette System Temperature Control Study (WSTCS) McKenzie River Subbasin). Mitsubishi Corporation has constructed towers capable of withdrawing 65 cms (2,321 cfs) of water over a range of 50 meters. This is comparable to the design proposed for Cougar.

6. Thermal units for resident fish.

The method used to estimate the benefits of temperature control to rainbow trout is mis-leading. One can only compare trout growth units, as determined by the number of days water temperature is in a given range, between reaches or streams if the other habitat conditions are similar. The habitat conditions of the South Fork McKenzie, McKenzie and Blue River are very different. I suggest one could improve the thermal conditions in Blue River below the dam to the point that the optimal
18-6. thermal conditions for rainbow trout were met every day of the year and you would still not significantly increase the number of rainbow trout living in the Blue River below Blue River Dam.

The benefits to salmonids of temperature control at Blue River and Cougar will be in the mainstem McKenzie, and in the South Fork McKenzie. Furthermore, it will be different in each stream as determined by other habitat factors (e.g. configuration of the streambed, distribution and abundance of gravel of different sizes,

18-6. The US Fish and Wildlife Service is one of the key agencies involved in partnership with the District on the feasibility study. The Coordination Act Report discusses why the concept of trout growth units is a valid methodology for this study, and this information was used in the EIS. Also, restoring temperatures in the mainstem McKenzie will improve habitat conditions below Leaburg by reducing overcrowding.

availability of woody debris, etc.).

The use of trout growth units to assess effects was developed by the Fish and Wildlife Service in the Fish and Wildlife Coordination Act Report for Temperature Control at Blue River and Cougar. Accepting this analysis at face value does not absolve the District of the responsibility of accurate evaluations. Should the District continue to use trout growth units, it needs to make sure the reader understands that an improvement in thermal conditions do not equate to an one to one improvement in the number of rainbow trout a stream will produce or can it be used to rank improvements between streams unless the other conditions are very similar.

18-6.

If the district is interested in maximizing fish improvement benefits it should look at the potential for habitat improvement of the Mckenzie below Leaburg. The simple action of increasing flows in the McKenzie River between the withdrawal and return points of the Leaburg and Walterville canals would represent a significantly greater habitat improvement in the McKenzie River Basin than will temperature improvements in the Blue River. This is because McKenzie River streambed conditions below Leaburg are of higher quality than the streambed conditions between Blue River Dam and the confluence of Blue River.

7. Ecological Indicators.

I have no idea, nor does anyone else, what an ecological indicator is. This is political correctness at its worst. You have chosen three fish of social and economic importance to index the effects of temperature during different life cycle phases. If the District wanted to illustrate the effects of temperature on an ecosystem it should have chosen species of plants and animals from all trophic levels (e.g. two or three aquatic plant species, two or three insect species, one or two amphibians, two or three non-salmonid resident fish and the salmonids). Instead it chose species from only the top trophic level. Study of an array of species representing all trophic levels would have allowed the District to make some inferences about the effect of temperature on the biotic components of the McKenzie River ecosystem. Please expunge this phrase from your document. I gives Portland District a bad name.

18-7.

8. Minor Problems :

Figure 3 of Feasibility Report needs to indicate data years. I suggest that you

18-8.

18-7. As discussed in the main report and EIS, three fish species were chosen for evaluation by the resource agencies as key indicators to represent study objectives and help characterize the outputs of the temperature modifications. The Coordination Act Report (pages 6-7) provides further information on why these species were selected.

18-8. Figure 3 is based on pre- and post-project USGS data and is meant to be a general graph. Text on page 5 of the main report has been revised to reflect this.

18-8. generate a general temperature effects graph to represent the conditions below Blue River and Cougar. This would eliminate the need for a data reference.

18-9. The District needs to include Letter report of 1989 in section 1.5 of Feasibility Report so that the section on alternatives considered has a information base.

18-10. Figure 6 of Feasibility report is mis-labeled These figures represent the percentage contribution of Blue River and South Fork McKenzie River to the flow of the mainstem McKenzie River near Vida **NOT** pre and post project flows (see Figure V.2.7. of 1987 WSTCS Report).

18-11. Figure 11 of the Feasibility report shows the drawdown of Blue River and Cougar beginning at the same time. This was not the case at the time the 1987 WSTCS and the 1989 Letter Report on the McKenzie River Basin was developed. If the information in Figure 11 is correct then appropriate caveats need to be developed to insure the accuracy of the data presented and their interpretations.

18-12. The statement regarding relative coldness of Blue River and Cougar relative to other Willamette Reservoirs can only be true if data were collected at all lakes in at similar times of the same year. To my knowledge that has not happened.

18-13. Second paragraph of Section 3.4.2 needs to be re-thought. As it now stands it is an excuse not to do look at non-structural alternatives. Non-structural alternatives are a viable part of any analysis and should not be dismissed simply because it does not have the same effect on temperatures as does a tower. The District needs to look at some combination of non-structural and structural to gain the most improvements in the McKenzie system (see notes on effects of improving flows below Leaburg Dam).

18-14. Section 3.6 of the Feasibility study is the first discussion of weirs. Since there are a number of different weir configurations it would be informative that we get more information on what types were considered and why they were rejected. This section dispenses with them very quickly. Besides I can't find Exhibit A.

18-15. Table 11 of Feasibility Report does not define the units. Without this I can't judge the value of the information in this table. I shall assume that the units for trout are trout growth units. I have already voice my concern for the use of this index of effects/benefits.

18-16. Section 4.11 of Feasibility Report: Any monitoring and evaluation program needs

18-9. See subsection 1.5.4 for a general discussion of the early temperature control investigations on the McKenzie subbasin. The 1989 letter report was never finalized and is considered a working document. It is available at the Portland District.

18-10. We have revised the label on figure 6 to match the 1987 WSTCS report.

18-11. We have removed the statement "seasonal regulation schedule" from both graphs since the graphs are a representation of the schedule diagrams from the Reservoir Regulation Manual for each project. These graphs only relate to carrying out the flood control purposes of the reservoirs. However, the reservoirs on the Willamette basin are managed on a priority basis for flow augmentation, and Blue River is used first.

18-12. The statement on the relative coldness of Blue River and Cougar Lakes has been deleted.

18-13. See the response to comment 18-3. As discussed in Section 3.4.2, the nonstructural alternatives (operational changes) do not meet the study objective of modifying water temperatures to replicate pre-project conditions in the study area.

18-14. Exhibit A follows the EIS and contains more information on weirs.

18-15. The first column of table 11 indicates that trout growth units and percent improvement are shown for the scenarios.

18-16. We concur that adequate gaging is needed for the monitoring and evaluation program. Monitoring is being recommended for those species where data are available for comparison.

to ensure that there are enough temperature and flow gages in the system to adequately monitor the effects and to establish performance objectives. Figure VI.3.1. illustrates a system of temperature and flow gages that would provide adequate descriptions of the thermal budget of McKenzie River System as effected by the Federal action.

18-16.

The District also needs to adopt an ecosystem approach to any monitoring and evaluation program it funds. Without it you will be less able to develop reasonable descriptions of the cause and effect relationships that you need to judge results.

18-17. Second paragraph of EIS abstract needs to be rewritten to reflect comments on when effects were observed and to change the sentence developing a relationship between temperature effects and flood control. Temperature effects occurs during the conservation season not during the flood control season.

18-18. Figure 4-2 of EIS needs to have both figures the same size so that data can be easily compared. Two tables would give better comparison.

18-19. Table 4-10 of EIS: Please change the word average in the categories Corps Average and USFS Average to Facilities and eliminate it from the category Combined Average.

Section 4.3.6 of the EIS needs to be expanded to address headwater storage benefits.

18-20.

The cumulative impacts section of the EIS needs to be expanded to address the effects of the Federal action below Leaburg Dam. As outlined above there is an effect and an opportunity for additional improvement of McKenzie River system by improving mainstem flow below Leaburg Dam.

Section 7 of Economics Report is redundant.

18-21.

Section 8 of Economics Report needs to have the word Ecosystem taken out. We are not nearly at a level of ecosystem analysis and benefits assessments.

Thomas E. Morse
8848 NE. Hancock
Portland, Oregon 97220

Thomas E. Morse

18-17. We have clarified the second paragraph in the EIS abstract. In the fall, warmer water remains near the surface until the pools are drawn down for flood control, which depletes the cool water layer and allows the warm surface water to reach the regulating outlets located deep in the reservoirs.

18-18. The graphs in figure 4-2 are meant to show the modelled changes in flows on the mainstem McKenzie near Vida for the existing condition and during construction at each project. The intent is not a comparison of the two graphs.

18-19. Table 4-10 has been revised as suggested.

18-20. As discussed previously, no change in existing regulation schedules are proposed for operating the selective withdrawal structures.

18-21. See response to comment 18-2. Section 7 of Technical Appendix A, Economics, presents the same temperature data found in Exhibit A but in a more visual form. We have removed the word "ecosystem" from the title of Section 8 because this section solely discusses benefits in relation to the key indicator fish species.

Val Rapp
56815 North Bank Road
McKenzie Bridge, Oregon 97413
Phone: (503) 822-3348

ATTN: CENPP-PE-E
Willamette River Temperature Control — McKenzie Subbasin
Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, OR 97208-2946

February 16, 1995

Dear Corps of Engineers,

I have reviewed the Draft Environmental Impact Statement (DEIS) for the Willamette River Temperature Control Project (McKenzie Subbasin). The project's preferred alternative is to build temperature control facilities at both Blue River and Cougar Reservoirs in the McKenzie Subbasin.

I strongly support the preferred alternative. The DEIS does an excellent job of explaining the need for this project: to mitigate unforeseen adverse effects on wild fish that resulted from the construction of Blue River and Cougar Dams. The document also does a good job of identifying and clearly displaying the short-term, adverse impacts of constructing the temperature control facilities, and the expected long-term benefits to fish.

19-1. I believe the project is justified as mitigation for adverse effects from the reservoirs, and for its benefits to wild fish. However, many people will want to see economic justification for the project. There is also likely to be considerable public concern about the cost of the project and the short-term adverse effects of construction. Therefore, it is crucial to state the case for the long-term benefits, including economic benefits, as strongly as possible.

19-2. I believe the DEIS's discussion of long-term economic benefits from the project could be strengthened. For instance, in a recent study, the Oregon Department of Forestry found that each wild coho salmon produced on the Elliott State Forest (coast range) contributed from $56-211 to personal income in local fishing and recreational industries. (Lettman, G.J., et al., November 1993. Elliott State Forest Plan Alternatives: An Economic Overview. Oregon Department of Forestry, Salem, OR.)

19-3. A similar analysis could be done on the McKenzie spring chinook. If each chinook salmon was worth $50 to the local economy (a conservative estimate), then the anticipated output of 16,700 additional chinook to the river would be worth $835,000 each year to local economies. Improving the production of wild salmon is not only the right thing to do, but also has important economic benefits. Del Skeesick (fish biologist on the Willamette National Forest) has done some work with analyzing the economic benefits of

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19-1. Noted. Analysis of economic efficiency by comparing the costs and benefits is fundamental to formulation and evaluation of any potential water resource development project. However, in the case of activities relating to environmental resources, particularly threatened or endangered species, monetizing benefits is not routinely achievable and may not be appropriate. A great deal of research has been directed toward improving methods for determining monetary values, but none of the methods are widely supported. Given these shortcomings in a traditional benefit-to-cost analysis, a cost-effectiveness approach (or incremental analysis) was done for the temperature control project to ensure that the highest level of biological improvement is achieved for each dollar spent.

19-2. See above response. In the feasibility study, the main report is the vehicle that provides a detailed explanation of the plan formulation and plan selection processes that lead to justification of the selected plan.

19-3. Even though the Willamette spring chinook salmon has recreational and commercial values, the focus of the Corps' analysis is not on the monetary aspects of the indicator species. Improvements in these types of values are not necessarily the best indicators of improvements to the overall ecosystem. Indirect benefits of biological improvements such as increased recreational and commercial values within a region may be considered as supporting information.

the Willamette spring chinook, and may be able to contribute to this analysis. This type of analysis strengthens the Corps's arguments in favor of the preferred alternative.

19-4. In addition to the good reasons already pointed out in the DEIS for building the temperature control facilities, there are other reasons for going ahead with the project. We are beginning to see, on other rivers, that if a salmon stock declines to the point that it is listed as threatened or endangered, there are considerable economic costs involved with attempts to recover the stock. It is not yet certain that any of these recovery attempts will be successful, despite their considerable cost. It is vastly preferable, then, to improve the production of a salmon stock before it declines to the point of being listed. A number of reputable biologists and ecologists, such as Chris Frissell (OSU), have pointed out that the "best buy" for our conservation dollars is to conserve and strengthen the salmon stocks still in relatively good condition, where quality habitat is available. This is the case, of course, for the McKenzie component of the Willamette spring chinook run. It may be appropriate to discuss this regional context for the McKenzie chinook in the Final EIS.

Again, I strongly support the preferred alternative. I believe the temperature control facilities can make an important contribution to improving production of spring chinook in the upper McKenzie River. This benefit is important to the local community and economy. In a regional context, the project will also help to maintain the Willamette spring chinook run and prevent this stock from ever being listed as threatened or endangered.

Sincerely,

Valerie a. Rapp

Val Rapp

19-4. The Corps is placing increased emphasis on addressing the need to preserve and protect environmental values, especially in relation to fish and wildlife species of national or regional significance, such as the Willamette spring chinook salmon and bull trout. We believe that restoring the water temperatures below the Cougar and Blue River projects will significantly improve the aquatic habitat for spring chinook, bull trout, and other fish and aquatic species. The regional context of the Willamette spring chinook salmon is discussed in sections 3.4.3 and 4.2.3 of the EIS and in the main report.

We Would Appreciate Your Comments!

Cougar/Blue River Temperature Control Facilities
Comment Sheet

Blue River Meeting
8 Feb 1995

Corps of Engineers Response

Comments

In recent studies hydrothermal geologic, cultural history. Much of the recent evidence validates the early concerns and case that the Cow Sility and Cayuse tribes voiced at the building of these dams. Their placement has affected fish in quantity size and variety due to an ancient volcanic and cultural tradition including fetish and effigies positioned throughout these mountains.

In the last 30 years there has been such an exchange of information and expanded of cultural horizons that a dialogue is now imminently possible.

All the ground + water temp in this valley is still glacial and volcanic.

Please drop in comment box, or, if mailing from home, please fold this sheet and tape or staple at the edge so that our address shows. Please add postage.

We appreciate your comments on the relationship between the hydrothermal, geologic, and cultural facets of the McKenzie valley.

there is also quite a bit of seismic evidence that our temp. and water control are inter-continental. The nuclear installations and water control in Europe + Russia affect us as we affect them. In fact now is a very good time to measure effects and results of decommissioning Trojan.

5.2 Compliance with Applicable Federal Environmental Statutes and Regulations

This section presents and analyzes the federal statutes, implementing regulations, and orders that are potentially applicable to the proposed action.

Archaeological Resources Protection Act
The Archaeological Resources Protection Act provides for the protection of cultural properties located on public and Native American lands; establishes permit requirements for the excavation or removal of cultural properties from public or Native American lands; and establishes civil and criminal penalties for the unauthorized appropriation, alteration, exchange, or other handling of cultural properties.

Reservoir drawdown to streambed could result in new or increased exposure of cultural sites, and potentially lead to vandalism. Appropriate monitoring methods will be developed to prevent or minimize vandalism.

National Historic Preservation Act
The National Historic Preservation Act requires that federal agencies evaluate the effects of federal undertakings on historical, archeological, and cultural resources, and afford the Advisory Council on Historic Preservation the opportunities to comment on the proposed undertaking.

The first step in the process is to identify cultural resources included on (or eligible for inclusion on) the National Register that are located in or near the project area. The Section 106 process has been initiated. The second step is to identify the possible effects of proposed actions. The lead agency must examine whether feasible alternatives exist that would avoid such effects. If an effect cannot reasonably be avoided, measures must be taken to minimize or mitigate potential adverse effects.

The Corps, in coordination with the State Historic Preservation Office and Native American tribes, is identifying cultural resources and sites in the project areas for inclusion on the National Register. In addition, the Corps is evaluating the effects of the proposed alternatives on these sites and measures that might be implemented to mitigate the potential effects. Implementation of any of the alternatives would affect cultural sites to varying degrees. Larger areas of the cultural sites would be exposed at lower pool levels. Sites normally inundated might be exposed during drawdown and subject to impacts from vehicular traffic, vandalism, and erosion from wind and waves. Repeated cycles of exposure and inundation might accelerate decomposition of organic materials contained within the sites.

Native American Graves Protection and Repatriation Act
The Native American Graves Protection and Repatriation Act addresses the recovery, treatment, and repatriation of Native American and Native Hawaiian human remains and cultural items (associated funerary objects, unassociated funerary objects, sacred objects, and objects of cultural patrimony).

The implementation of any drawdown measure could result in the exposure of Native American human remains and cultural items. In the event this should happen, the appropriate tribe(s) and lineal descendants will be notified and the necessary actions taken to protect the burials as prescribed by law.

Reservoir Salvage Act
The Reservoir Salvage Act (Public Law 86-582), as amended in 1974 by the Archaeological and Historic Preservation Act, provides for preservation of historical and archeological data that might otherwise be irreparably lost or destroyed by flooding as a result of construction of a dam or alterations of terrain caused as a result of any federal project. This act limits the expenditures to carry out the purposes of the act. The Corps will notify the Secretary of Interior and assist with funding as required under this act.

Clean Air Act of 1970, as Amended
This Act establishes a comprehensive program for improving and maintaining air quality throughout the United States. The goals of the CAA are achieved through permitting of stationary sources, restricting the emission of toxic and other pollutants from stationary and mobile sources, and establishing National Ambient Air Quality Standards (NAAQS). The CAA programs are implemented through combined federal, state, and local efforts. Title IV of the Act includes provisions for complying with noise pollution standards.

The proposed alternatives presented in the EIS would likely increase fugitive dust emissions from the exposed reservoir shorelines and bottom areas. This increased particulate matter is not expected to affect the status of attainment areas (places where the status of attainment areas are met) and nonattainment areas.

In addition, reduced generation of hydroelectric power as a result of drawdown of Cougar Reservoir and reduction in river flow might indirectly cause additional air emissions from thermal power plants. These facilities, however, will not impair the air quality in the region because they are subject to New Source Performance Standards and permitting requirements that restrict the air emissions from such facilities to ensure that air quality is not degraded.

Clean Water Act
The Clean Water Act (CWA) of 1977, as amended, sets national goals and policies to eliminate discharge of water pollutants into navigable waters, to regulate discharge of toxic pollutants, and to prohibit discharge of pollutants from point sources without permits. The CWA also authorizes EPA to establish water quality criteria that are used by states to establish specific water quality standards.

The water quality issues pertaining to the alternatives are increased turbidity, dissolved oxygen, and change in water temperatures. The alternatives could cause further departure from required water quality levels for turbidity over the short term.

Section 402 of the CWA addresses the National Pollution Discharge Elimination System (NPDES), wherein a stormwater discharge permit is required if construction activities would disturb a total of 5 acres or more. The State of Oregon Department of Environmental Quality administers the NPDES program applicable to federal activities in Oregon. The Corps will obtain any necessary NPDES permits and develop required monitoring plans to reduce construction-related erosion and run off prior to construction.

Section 404 of CWA requires state water quality certification be obtained prior to placement of fill within waters of the United States, including wetlands. Several fills, mostly within the reservoirs, are expected to occur due to the proposed project. A Section 404 Evaluation has been prepared based on existing levels of information. Additional evaluations may be required prior to construction. An exemption of state water quality certification under 404(r) is requested as the Corps action meets the qualifications.

A previous Oregon administrative rule [OAR 340-41-470(1)] had a policy of prohibiting any further waste discharges in the McKenzie Subbasin above Hayden bridge. An interim rule, allowing some discharges, expired January 31, 1995. A revised rule, adopted in February, allows discharges, subject to standard conditions. State water quality certification may be requested at a later date.

Comprehensive Environmental Response, Comprehensive Compensation and Liability Act

Provisions for evaluation and cleanup of hazardous, toxic, and radioactive wastes (HTRW) are included in this Act. Pre-construction site investigation indicates HTRW is not expected to be a problem. Should this situation change during construction, the presence of HTRW will be responded to within the requirements of the law (including notifying the EPA) and Corps regulations and guidance.

Endangered Species Act of 1973 as Amended

Coordination with FWS has been completed. A biological assessment was prepared and forwarded to FWS regarding listed species. FWS has concurred with the Corps' assessment that the proposed action is not likely to adversely affect listed species, i.e., bald eagle, peregrine falcon, northern spotted owl, and Oregon chub. (There would be no effect on Oregon chub as they do not occur in the McKenzie River Basin.) The FWS further concurred with the Corps' determination of benefit, over the long term, to bull trout, a candidate one species which is warranted but precluded for listing. However, individual mortality could occur during project construction. Should the bull trout be listed prior to project completion, further conference/consultation would be expected. The biological assessment and concurrence letter are in Exhibit C.

Fish and Wildlife Coordination Act
A draft Fish and Wildlife Service Coordination Act report was prepared for the proposed action and was included in the EIS following the Section 404(1)(b) Evaluation. The final report together with a Portland District response letter is included in the final EIS.

Migratory Bird Treaty Act (1918)
The Migratory Bird Treaty Act represents congressional ratification of the 1916 Migratory Bird Treaty with Canada. Similar treaties were later established with Mexico, Japan, and the (former) U.S.S.R. These treaties provide, in part, protection of songbirds, prohibits trafficking (buying or selling) in all wild migratory birds and establishes management of migratory game birds. The Willamette River Temperature Control Project should not result in the take or loss of migratory birds, although some migratory birds (northern spotted owl, harlequin duck, osprey) may be temporarily disturbed. Thus, the project would not violate the provisions of the Migratory Bird Treaty Act.

Safe Drinking Water Act, as Amended
The Safe Drinking Water Act pertains to the safety of public water systems, and sets national primary drinking water regulations and maximum containment level goals. Specific contaminants (over 80 in 1986) are identified for EPA to regulate. States generally have primacy for enforcement of the regulations, and may adopt more stringent rules.

During construction, increased turbidity from drawdown (initial and annual) and possible increases in algae could occur. Increases in algae may result in additional treatment of drinking water. EWEB withdraws raw water from the McKenzie River at Hayden Bridge, near Springfield, for public drinking water supplies. Further investigation would be necessary to determine if algae increases resulting in problems with drinking water would be caused by the proposed project. A monitoring program is included in PED.

Federal Water Project Recreation Act
In planning any federal navigation, flood control, reclamation, or water resource project, the Federal Water Project Recreation Act requires that full consideration be given to the opportunities that the project affords for outdoor recreation and fish and wildlife enhancement. The Act requires planning with respect to the development of recreation potential. Projects must be constructed, maintained, and operated in such a manner if recreational opportunities are consistent with the purpose of the project.

Recreation sites have been developed at federal projects involved in the proposed action and are operated by a variety of entities. Specific types of short-term impacts include dewatering boat ramps, docks, and swimming beaches. Water-oriented campgrounds and day-use areas could become less desirable because of exposed shoreline and increased distance to water.

Pacific Northwest Electric Power Planning and Conservation Act
The Northwest Power Act was passed by Congress on December 5, 1980. This law created the nine-member NPPC (an interstate agency whose members are appointed by Idaho,

Montana, Oregon, and Washington governors). NPPC was entrusted with adopting a Fish and Wildlife Program for the Columbia River Basin by November 1982 and preparing a 20-year Regional Electric Power and Conservation Plan by April 1983. Thesé plans are periodically updated.

NPPC's Fish and Wildlife Program established a number of goals for restoring and protecting fish populations in the basin. In 1990, under contract to NPPC, the Oregon Department of Fish and Wildlife developed goals and objectives to restore and protect fish in the McKenzie River Subbasin.

Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act designates qualifying free-flowing river segments as wild, scenic, or recreational. The Act establishes requirements applicable to water resource projects affecting wild, scenic, or recreational rivers within the National Wild and Scenic Rivers System, as well as rivers designated on the National Rivers Inventory. Under the Act, a federal agency may not assist the construction of a water resources project that would have a direct and adverse effect on the free-flowing, scenic, and natural values of a wild or scenic river. If the project would affect the free-flowing characteristics of a designated river or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the area, such activities should be undertaken in a manner that would minimize adverse impacts and should be developed in consultation with the National Park Service. Similar requirements apply to study rivers; however, the criterion is "no diminishment" for a Section 7 (b) study river.

The South Fork McKenzie River, a State Scenic Waterway, is under study by the Forest Service for inclusion in the National Wild and Scenic Rivers System. The river is managed by the Forest Service to maintain the qualities for which the river is being studied. Segment 3, from Cougar Dam to the confluence with McKenzie River, is managed for "National recreation river" status during the study. The recreational qualities could be temporarily degraded by the construction element of the proposed project, due to higher turbidity and change in water flow. Operation, however, would enhance recreation qualities as numbers of fish increase in response to temperature normalization. Segment 2 is above the reservoir. The Forest Service is concerned that construction drawdown could affect bull trout populations in this segment. Concerns on segment 3, below the dam, were also raised. Blue River, above the reservoir, was also under study by Forest Service for inclusion into the National System and determined to be ineligible. Impacts to Blue River are not expected. Notification of the Forest Service, under Section 7 (b), applicable to study rivers, has been initiated. The Regional Forester's determination will be issued after their review of the Final EIS after it is filed with the EPA (Exhibit C).

Water Resources Development Act of 1990

Congress generally authorizes water resources projects through biennial legislation, such as the Water Resources Development Act (WRDA) of 1990. Section 310(b) of WRDA 1990 requires public participation in changes to reservoir operation criteria.

Flood Control Act of 1962
This act provided general authority for development of Strube (Re-Regulating) Lake and additional generating capacity at Cougar Reservoir. A General Design Memorandum and Environmental Impact Statement for Strube Lake and Cougar Additional Unit, Oregon, was prepared by the Corps in 1979. Funds to construct this project have not been appropriated. No funds have been expended on Strube for several years. Strube was not included in the FY 1995 budget submission to Congress, and it does not appear that funds will be provided in the near future.

Since Strube Lake, to be located at RM 2.6 of the South Fork McKenzie River, is an authorized project (inactive status), construction of the multi-port intake tower at Cougar Reservoir technically would not preclude construction of the Strube Re-Regulating project. Design of the multi-port intake tower has specifically included direction that it cannot interfere with placement of the additional power generating unit at Cougar. Construction of Strube Lake as provided by the Flood Control Act of 1962 would negate most of the South Fork McKenzie benefits of the multi-port intake tower at Cougar Dam, since it would flood an additional two miles of river, but would have no effect on construction or operation of a multi-ported intake tower at Blue River Dam. Operation of Strube Re-regulating reservoir would mix the waters released from Cougar. Waters released from Strube would not have the temperature extremes of the water released from present-day Cougar project.

Designation of South Fork McKenzie as a National Wild and Scenic River would reduce, if not remove, the probability of Strube Lake being constructed.

Analysis of Impacts on Prime and Unique Farmlands, CEQ Memorandum 1976
No prime or unique farmlands would be affected by the proposed action.

Executive Order 11990, Protection of Wetlands, 24 May 1977
Executive Order 11990 authorizes federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking federal activities and programs. Any agency considering a proposal that might affect wetlands must evaluate factors affecting wetland quality and survival. These factors should include the proposal's effects on the public health, safety, and welfare due to modifications in water supply and water quality; maintenance of natural ecosystems and conservation of flora and fauna; and other recreational, scientific, and cultural uses.

No filling would occur in wetland areas. Wetlands along the South Fork McKenzie may be temporarily de-watered during construction. Wetlands in tributaries to the reservoirs, if dependent on conservation pool for water supply, could be desiccated or degraded. Once pool levels returned to normal operations, the wetlands would recover.

Executive Order 11988, Floodplain Management, 24 May 1977
If a federal agency program will affect a flood plain, the agency must consider alternatives to avoid adverse effects in the flood plain or to minimize potential harm. It is not expected that the proposed project would adversely affect the flood plain. Flood control would continue at each reservoir. Although waters could be higher than present during early spring drawdown, water released from the reservoirs would not exceed rule curve levels.

State and Local Plans and Laws
The CEQ regulations (40 CFR § 1506.2) require consideration of the consistency of a proposed action with approved state and local plans and laws.

Oregon Water Management Plan for the Willamette Basin. This plan was approved by the Oregon Water Resources Commission in January 1992. The purpose of the plan is to guide the Commission and the Water Resources Department in setting priorities for developing programs and conducting activities in the Willamette basin. The plan established recommended actions for other agencies, as well as priorities for coordination with other agencies, organizations, and individuals to address water resource issues and problems in the basin. One of the six major water resource issues identified in the plan deals with reservoir operations and the management of stored water. Two implementing actions identified under this issue deal with the state promoting the Corps " ... to make the structural modifications to the reservoirs necessary to mitigate project impacts on water temperature and fish passage," and for the Corps to "... control the temperature of released water as part of its responsibility to mitigate the impacts of dam construction."

Oregon Scenic Waterway Program. The South Fork McKenzie is a designated river in the Oregon Scenic Waterway program. This program is administered by the Oregon State Parks and Recreation Department. Its goals are to protect the free-flowing character of designated rivers for fish, wildlife, and recreation; protect and enhance scenic, aesthetic, natural recreation, scientific, and fish and wildlife values along scenic waterways; and encourage other local, state, and federal agencies to act consistently with the goals of the program.

Oregon Statewide Comprehensive Outdoor Recreation Plan (SCORP). The SCORP is in the process of revision. The draft 1994-1999 SCORP has recently been circulated for public review. Relevant to the Corps proposed action is Issue VIII-Protecting the Resource- Goal: Maintain viable natural ecosystems, including cultural and aesthetic value, while providing compatible recreation. Replicating pre-dam river temperatures would maintain and/or restore the McKenzie River ecosystem for chinook salmon, rainbow trout, and bull trout.

McKenzie River: Willamette River Subbasin, Salmon and Steelhead Production Plan. This 1990 plan was prepared by the Oregon Department of Fish and Wildlife (ODFW) with funds from the NPPC and the Columbia Basin Fish and Wildlife Authority. It is a part of NPPC's long-term planning program as directed by the NWPA 1980. The 1990 plan is taken largely from the 1988 McKenzie Subbasin Fish Management Plan, with revised and updated recommended strategies derived from that plan.

The plan has general habitat protection objectives and strategies. Policies relevant to the proposed action are to prevent or reduce potential losses of fish production from habitat degradation and to review proposed habitat improvement projects. Strategies include reducing delayed migration of spring chinook and trout above Leaburg Dam resulting from releases of cold water from Cougar and Blue River dams; obtaining mitigation and compensation for reduced production of spring chinook and trout due to changes in water temperature, flow, and turbidity from releases at Blue River and Cougar dams (includes encouraging Corps to determine costs of retrofitting these dams to regulate temperature); and maintaining necessary flows and water quality for fish production.

Anadromous Fish Production plan objectives include a policy of managing the McKenzie Subbasin for production and harvest of naturally produced and hatchery spring chinook salmon. The biological objective is to increase the average annual run to 18,000 adults. This would include the 4,060 adults returning to the McKenzie that are produced annually from hatchery release (Corps mitigation). Achievement of this objective should not reduce wild trout production. Opportunity to harvest 2,000 spring chinook is another objective. Strategies to achieve these objectives relative to the Corps proposed action include encouragement of the Corps to complete the temperature control study.

Summer steelhead plan objectives are to maintain a return of 2,400 adult summer steelhead to the McKenzie Subbasin (with a sport catch of 1,200) and reduce the potential impact of summer steelhead on the production of native trout and spring chinook. Strategies to achieve this do not include actions by the Corps.

The Corps is in compliance with this plan in that it responds to the strategy to complete the temperature control study.

ODFW McKenzie Subbasin Fish Management Plan. This plan was released in April 1988. It formed the basis of the 1990 NPPC McKenzie Plan, discussed above.

Other Agency Plans

Blue River Hydropower. Initial temperature control consideration in the McKenzie Subbasin began in the late 1970's during a Corps study for providing hydropower at Blue River Lake. The Corps feasibility report (June 1982) recommended that temperature control be evaluated during subsequent post-authorization studies. The hydropower project was authorized in the 1986 Water Resources Development Act (P.L. 99-662), and included a provision that non-federal agencies could develop the hydropower project if licensed by the Federal Energy Regulatory Commission (FERC) within 3 years of authorization. The Eugene Water and Electric Board (EWEB) received a FERC license in November 1989 for hydropower development. Action was taken by the resource agencies to commit EWEB to providing temperature control, but EWEB countered that if temperature control were mandated, the cost of power would preclude development, and that temperature control should be a federal responsibility. In June 1992, the Corps was advised by EWEB that an agreement had been signed that does not obligate EWEB to construct temperature control facilities, but relies on

the Corps to study and develop temperature control facilities, if warranted. EWEB has indicated that this hydropower project is on indefinite hold.

Relicensing of EWEB Projects at Leaburg and Walterville. In 1991 Eugene Water and Electric Board (EWEB) applied to the Federal Energy Regulatory Commission (FERC) for relicensing projects at Leaburg and Walterville. A draft EIS is under preparation for an April 1995 distribution. The issue of concern relative to the Corps action is the amount of minimum streamflows EWEB would be required to bypass.

Willamette National Forest Land and Resource Management Plan 1990. The Land and Resource Management Plan guides all natural resource management activities and establishes management standards and guidelines for the Willamette National Forest. The plan is revised at least every 15 years or when the Forest Supervisor determines a revision is necessary. Elements of the plan that could relate to the Corps action involve management prescriptions, standards and guidelines (including developed recreation, scenic retention, special wildlife habitat, special interest areas, wilderness) for Forest Service-administered lands at Cougar and Blue River reservoirs and management of wild and scenic study rivers (Blue River and South Fork McKenzie). For the long term, Corps actions are expected to comply with the forest plan. Short-term impacts may require specific coordination between the Corps and the Forest Service to be in compliance with the forest plan.

Forest Service and BLM Activities for the Northern Spotted Owl. The plan for forest lands within the range of the northern spotted owl identifies restoration plans for key watersheds, emphasizing ecosystem management for all forest species, and especially opportunities to deal with the decline of many stocks of anadromous fish, including bull trout and Willamette spring chinook salmon. The upper mainstem McKenzie, its upstream tributaries of Horse and Lost creeks, and the South Fork McKenzie have been identified as key watersheds in the plan. Significant levels of restoration are expected for at least the next 5 years under the plan. Action by the Corps would be in compliance with this plan.

BLM Recreation Management Plan for the McKenzie River Recreation Management Areas, Oregon (draft 1993) and Eugene District BLM Proposed Resource Management Plan 1994. These plans include recommendations for managing and acquiring/exchanging lands along the mainstem McKenzie River between Goodpasture Bridge to the Willamette National Forest administrative boundary. This segment of the river is recommended by BLM for inclusion in the National Wild and Scenic River System, status recreational. Action by the Corps would be in compliance with these plans.

Chapter 6
LIST OF PRINCIPAL PREPARERS

While individuals have responsibilities for preparing sections of an EIS, it is an interdisciplinary team effort. Additionally, Corps Portland District and North Pacific Division specialists and contractors review the analysis and supply information. Contributions by individual preparers are subject to revision by other specialists and by management during the internal review process.

Name	Discipline/Expertise	Experience	Primary Responsibility
Karen Bahus	BA Biology/Chemistry MA Regional Studies 15 years	Biologist, Planner	Study manager
Doug Clarke	BS Civil Engineering 7 years	Civil engineer, Management	Project manager reviewer
Russell L. Davidson	MSCE Water Res Plng and mgt 23 years	Environmental engineer Hydraulic & Civil engineer	Water quality
Alan Donner	BS Civil Engineering 15 years	Hydraulic engineer	Hydrology
Geoff Dorsey	BS, MS Wildlife Science 13 years	Wildlife biologist Wildlife resources	
Maria Gregory	BS Education, graduate studies in env. planning 14 years	Environmental planning, Public Affairs, Recreation planning, Writer-editor	Editing, document production
L.D. Hamilton	BA Geography, MA Geography/biology 20 years	Env. spec., community planner, Env. protect. spec., writer-editor, outdoor rec. planner	EIS coord. and prep. rec., vegetation, land use; Sec. 404 Eval.

Name	Discipline/Expertise	Experience	Primary Responsibility
Rich Hannan	BS Civil Engineering BS Geology 22 years	Geotechnical engineer landslides	Geotechnical design,
Brenda Kerr	BS Economics 5 years	Economist	Regional economics, recreation analysis
Kim W. Larson	BS Zoology MS Fisheries biology 20 years	Environmental specialist Fishery Biologist	Anadromous fish, resi- dent fish
Ronald Larson	BS Geology 37 years	Geology, Engineering	Geology, groundwater
Ron Musser	BS Forestry MS Forestry 20 years	Real estate appraiser	Real estate issues, construction laydown & disposal site coord.
R. Anthony Norris	BS Civil Engineering 2 years	Hydraulic engineer	Hydraulic design
Brian Pilette	BS Economics 3 years	Economist	Regional economics
Karl Swanson	BS Civil Engineering 10 years	Civil engineer	Engineering analysis
Lynda Walker	BS, MA Anthropology 19 years	Archeologist Outdoor recreation plng	Archeology, history

Contractors: Heritage Research Associates, Eugene, Oregon.

Chapter 7
GLOSSARY

Acre-foot - The volume of water that will cover 1 acre to a depth of 1 foot.

Anadromous fish - Fish, such as salmon or steelhead trout, that are born in freshwater, migrate to and mature in the ocean, and return to fresh water as adults to spawn.

Annual operating plan - A yearly plan for operating storage reservoirs in the Willamette River basin.

Assured refill curve - A curve showing minimum elevations which must be maintained at each project to ensure refill, even if the third lowest historical water year occurred; it sets limits on the production of energy.

Augmenting - Increasing; in this application, increasing river flows above levels that would occur under normal operations by releasing water from storage reservoirs.

Bypass system - Structure at a dam that provides a route for fish to move through or around the dam without passing through the turbines.

Capacity - The maximum sustainable amount of power that can be produced by a generator or carried by a transmission facility at any instant.

Cofferdam - A watertight enclosure from which water is pumped to expose the bottom of a body of water and permit construction.

Cubic feet per second (cfs) - A unit of measurement pertaining to flow of water. One cfs is equal to 449 gallons per minute.

Demand - The rate at which electric energy is used, whether at a given instant or averaged over any designated period.

Desiccate - To dry up, cause to dry up, or deprive of moisture.

Discharge - Volume of water flowing in a given stream at a given time, usually expressed in cubic feet per second.

Draft - Release of water from a storage reservoir.

Drawdown - The distance that the water surface of a reservoir is lowered from a given elevation as water is released from the reservoir.

Edaphic - Of or relating to soil, especially as it affects living organisms.

Endemism - Native or limited to a certain region (endemic).

Epilimnion - A fresh water zone of relatively warm water in top layer of reservoir in which mixing occurs as a result of wind action and convection currents.

Escapement - Number of salmon that actually return to a stream to spawn.

Firm energy - Guaranteed or assured energy.

Fish hatchery - A facility in which fish eggs are incubated and hatched and juvenile fish are reared for release to lakes or rivers.

Fish ladders - A series of ascending pools constructed to enable salmon or other fish to swim upstream around or over a dam.

Fish passage facilities - Features of a dam that enable fish to move around, through, or over without harm. Generally an upstream fish ladder or a downstream bypass channel.

Flood control rule curve - A curve, or family of curves, indicating reservoir drawdown required to control flood flows. (also called Mandatory Rule Curve or Upper Rule Curve).

Flow - The volume of water passing a given point per unit of time.

Fluvial - Of, pertaining to, or inhabiting a river or stream.

Forebay - The portion of a reservoir at a hydroelectric project that is immediately upstream of the dam.

Freshet - A rapid temporary rise in streamflow caused by heavy rains or rapid snowmelt.

Fry - Recently hatched fishes.

Full pool - The maximum level of a reservoir under its established normal operating range.

Fiscal year - the annual period used for budgeting purposes; the federal fiscal year begins October 1 and ends on September 30.

Generation - Act or process of producing electric energy from other forms of energy; also the amount of electric energy so produced.

Hydraulic head - The vertical distance between the surface of the reservoir and the surface of the river immediately downstream from the turbine and dam.

Hydraulic jump - A transition in water flow when water accelerates over a local steep gradient and enters a lower gradient immediately downstream. The water accelerates, its surface lowers, and accumulates energy. At the lower gradient, the flow decelerates, the water surface rises, and the accumulated energy is dissipated in a region of extremely turbulent flow.

Hydroelectric - The production of electric power through use of the gravitational force of falling water.

Hydrology - The science dealing with the continuous cycle of evapotranspiration, precipitation, and runoff.

Hydrometeorological observations - Rainfall, snowpack, and other climatic measurements used to predict runoff.

Hypolimnion - A lower level of water in a stratified lake, characterized by a uniform temperature that is generally cooler than that of other strata in the lake.

Intake - The entrance to a turbine at a dam, a diversion works, or a pumping station.

Interchange energy - Electric energy received by one utility system usually in exchange for energy to be delivered to another system at another time or place. Interchange energy is to be distinguished from a direct purchase or sale, although accumulated energy balances are sometimes settled in cash.

Invert elevation - The lowest entrance elevation that can carry water within the system, e.g., the bottom of the inside of a pipe or tunnel. If the water is above the invert elevation of the pipe entrance, the pipe can be used to move water.

Jack - An early maturing male salmonid fish.

Jackson Turbidity Units (JTU) - A measure of the cloudiness of the water.

Littoral - On or along the shoreline.

Load - The amount of electric power or energy delivered or required at any specified point or points on a system. Load originates primarily at the energy-consuming equipment of the customers.

Low pool - At or near the minimum level of a reservoir under its established normal operating range.

Mainstem - The principal portion of a river in a river basin, as opposed to the tributary streams and smaller rivers that feed into it.

Megawatts - A megawatt is 1 million watts, a measure of electrical power.

Mills/kwh - one tenth of one cent per kilowatt hour; for example, 35 mills/kwh equals 3.5 per kwh.

National Geodetic Vertical Datum (NGVD) of 1929 - A fixed reference adopted as a standard geodetic datum for elevations determined by leveling. Geodetic datum is fixed and does not take into account the changing stands of sea level. Because there are many variables affecting sea level, and because the geodetic datum represents a best fit over a broad area, the relationship between the geodetic datum and local mean sea level is not consistent from one location to another in either time or space. NGVD should not be confused with mean sea level (MSL), which is a changing tidal datum.

Nephelometric Turbidity Unit (NTU) - A measure of turbidity based on scattered light at a 90° angle.

Nonpower operating requirements - Operating requirements at hydroelectric projects that pertain to navigation, flood control, recreation, irrigation, and other non-power uses of the river.

Oligotrophic - Deficient in plant nutrients, and usually having abundant dissolved oxygen and no marked stratification.

Operating limits - Limits or requirements that must be factored into the planning process for operating reservoirs and generating projects. (Also see operating requirements, below.)

Operating requirements - Guidelines and limits that must be followed in the operation of a reservoir or generating project. These requirements may originate in authorizing legislation, physical plant limitations or other sources.

Operating rule curve - A curve, or family of curves, indicating how a reservoir is to be operated under specific conditions and for specific purposes.

Operating year - The 12-month period, from August 1 through July 31, that is used for power system planning purposes.

Outages - Periods, both planned and unexpected, during which the transmission of power stops or a particular power-producing facility ceases to function.

Peak loads - The maximum electrical demand in a stated period of time. It may be the maximum instantaneous load or the maximum average load within a designated period of time.

Project outflow - The volume of water per unit of time discharged from a project.

Redds - Salmon spawning nests in gravel.

Refill - The point at which the storage reservoirs of the hydro system are considered "full"

from the seasonal snowmelt runoff.

Reservoir draft rate - The rate at which water, released from storage behind a dam, reduces the elevation of the reservoir.

Reservoir elevations - The levels of the water stored behind dams, stated in reference to mean sea level or NGVD.

Reservoir storage - The volume of water in a reservoir at a given time.

Resident fish - Fish species that reside in fresh water throughout their lives.

Riparian - Relating to, living on, or located on the bank of a watercourse, lake or tidewater.

Rule curves - Water levels, represented graphically as curves, that guide reservoir operations.

Run-of-river - The condition of inflow equaling outflow after water has pooled behind a dam.

Salmonids - Of or pertaining to fish of the family Salmonidae, including salmon, trout, and steelhead.

Sensitivity - The degree to which a given outcome is subject to change based on changes in assumptions or input parameters. A sensitivity test is intended to compare the consequences of the same action under differing sets of assumptions.

Smolt - A juvenile salmon or steelhead migrating to the ocean and undergoing physiological changes to adapt its body from a freshwater to a saltwater environment.

Spawning - The releasing and fertilizing of eggs by fish.

Spill - Water passed over or through a spillway or through regulating outlets without going through turbines to produce electricity. Spill can be forced, when there is no storage capability and flows exceed turbine capacity, or planned, for example, when water is spilled to enhance juvenile fish survival.

Spillway - Overflow structure of a dam.

Storage reservoirs - Reservoirs that provide space for retaining water from springtime snowmelts. Retained water is released as necessary for multiple uses-power production, fish passage, irrigation, and navigation.

Streamflow - The rate at which water passes a given point in a stream, usually expressed in cubic feet per second (cfs).

Subyearlings - Juvenile fish less than 1 year old.

Tailrace - The canal or channel that carries water away from a dam.

Target temperatures - Pre-project water temperatures.

Trout Growth Units (TGU) - The number of temperature degree-days between 42 and 63°F at which trout growth can occur.

Turbidity - Cloudiness caused by light-scattering colloidal particles suspended in water.

Turbine - Machinery that converts kinetic energy of a moving fluid, such as falling water, to mechanical or electrical power.

Velocity - Speed; the time rate of linear motion in a given direction.

Chapter 8
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Chapter 9
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SECTION 404(b)(1) EVALUATION
WILLAMETTE RIVER TEMPERATURE CONTROL
COUGAR AND BLUE RIVER RESERVOIRS
LANE COUNTY, OREGON

I. Introduction

Section 404 of the Clean Water Act of 1977 requires that all civil works projects involving the discharge of dredged or fill material into waters of the United States be evaluated for water quality effects prior to making the discharge. This evaluation assesses the effects of fill, consisting of concrete temperature control intake structures, to be constructed at Blue River Dam on the Blue River, and Cougar Dam, on South Fork of the McKenzie River. A temporary cofferdam at the Blue River project site is also evaluated as fill, as is the placement of 2,600 cubic yards of rip rap in the excavated diversion tunnel outfall at Cougar Dam. Also evaluated are the effects of the discharge of material removed during construction of temperature control intake towers at Cougar Reservoir and Blue River Reservoir and deposited upstream below ordinary high water level. Both Blue River and South Fork McKenzie are tributaries to the McKenzie River in Lane County, Oregon.

Since the feasibility report/EIS will be submitted to Congress for authorization prior to construction, an exemption to obtaining state water quality certification, as provided by Section 404(r) of the Clean Water Act, will be requested.

II. Description of the Proposed Activity

The preferred alternative is to provide temperature control at both Blue River and Cougar Dam projects, on a staggered schedule, and while maintaining flood control during the construction period. A staggered schedule reduces downstream flow impacts for the McKenzie River. The design elements and construction activities are summarized below. For more detail, refer to the Feasibility Report and the Environmental Impact Statement.

Blue River Project. Under the proposed action, a multi-level intake structure would be attached to the existing intake tower and positioned over the existing regulating outlet works. The intake structure would be a rectangular tower, constructed of reinforced concrete, with seven ports designed to withdraw water to control reservoir discharge water temperatures. This structure would be 257 feet tall, and about 24 feet by 30 feet at the base, with tapered walls 2 feet thick at the top. In order to construct the intake tower, lake levels at Blue River Reservoir would be reduced initially from elevation 1,180 (flood control pool) to elevation 1,132, which is essentially run-of-river, with no storage capacity. A portion of the new tower structure would be founded on the floor of the intake channel just upstream of the outlet. A rockfill cofferdam (60 feet long by 130 feet wide at the base) would be placed upstream of the dam, with two 72-foot diameter conduits to divert the river flow to the regulating outlet. The cofferdam and conduits would remain in place for the duration of construction (2002-2005). It is estimated that about 500 cy of sediment will need to be removed from the channel

floor during foundation preparation. Although their composition is not known, the sediments are expected to be uncontaminated, fine sediments approvable for instream deposition.

A residual pool about 40 feet deep with 40 surface acres and nearly 1,000 acre-feet of volume would be maintained behind the cofferdam to trap sediment. The project would be run-of-river (inflow equals outflow) during construction and essentially at streambed above the residual pool.

Cougar Project. Under the proposed action, a multi-level intake structure would be attached to the existing intake tower and positioned over the existing regulating outlet works and power penstock. The intake structure would be a rectangular tower, constructed of reinforced concrete, with eight ports designed to withdraw water to control reservoir discharge water temperatures. This structure would be 302 feet tall and approximately 45 feet by 54 feet at the base, with tapered walls 2 feet thick at the top. In order to construct the intake tower, lake levels at Cougar Reservoir would be reduced initially from elevation 1,532 (flood control pool) to elevation 1,350, with no storage capacity. It is proposed to reopen the diversion tunnel used to divert the South Fork McKenzie when the reservoir was constructed in 1962. If sediments and debris in the pool are blocking the tunnel, they would be removed and deposited within the upstream pool area. At the upstream portal of the diversion tunnel, it is estimated that 500 cy of lake sediment and debris will require removal. Although the exact amount of sediments to be removed or their composition is not known, they are expected to be uncontaminated, fine sediments approvable for instream deposition. (An additional 404 evaluation will be prepared, if necessary, once this situation is known.) Rock excavation of about 4,750 cy is required around the base of the intake structure. In addition, the diversion tunnel portal, located by the powerhouse, must be enlarged and rip rapped to withstand the diverted waters as the reservoir is lowered. Approximately 1,300 cubic yards of fill material would be removed from an old roadway blocking the portal and 2,600 cubic yards of rip rap placed in the re-opened channel.

A residual pool would be maintained at elevation 1,350 to trap sediments and provide habitat for bull trout. This pool would be about 80 surface acres and about 76 feet deep with nearly 3,000 acre-feet of volume. The diversion tunnel intake would be screened to prevent bull trout from exiting the residual pool. The project would be run-of-river (inflow equals outflow) during construction and essentially at streambed above the residual pool.

III. Description of the Fill and Discharge Sites

Blue River Project

1) Intake Structure. The fill site is behind the dam and attached to and positioned over the existing regulating outlet, located at the left abutment of the dam, at river mile 1.8 of the Blue River. Existing sediments would be removed in order to construct the foundation.

2) Cofferdam. This site is located upstream of the proposed intake structure.

3) Discharge Site for Removed Sediments. Sediments would be placed at some undetermined location upstream of the dam site and below ordinary high water, if upland placement cannot be accomplished.

Cougar Project

1) Intake Structure. The fill site is behind the dam and attached to and positioned over the existing regulating outlet located at the left abutment of the dam at river mile 4.4 of the South Fork of the McKenzie River.

2) Discharge Site for Removed Sediments. Sediments would be placed at some undetermined location upstream of the dam sites and below ordinary high water, if upland placement cannot be accomplished.

3) Fill Site for Diversion Tunnel Portal. Approximately 2,600 cy of rock rip rap would be placed in the excavated diversion tunnel portal, located on the downstream side of the dam adjacent to the powerhouse.

IV. Factual Determinations

a. Physical Substrate Determinations

Blue River Project

1) Intake Structure. The substrate is primarily andesite, with basalt and/or pyroclastic rocks, covered with an estimated 6 feet of sediments accumulated over the 25 years since the dam was constructed.

2) Cofferdam. The substrate is andesite covered with sediments.

3) Disposal Site. The substrate of the disposal site is primarily bedrock or erosional material originating in the watershed. The disposal of material would slightly alter the gradient and physical composition of the sites. Velocities within the reservoir during operation would disperse and relocate the material. Heavier material would eventually accumulate on reservoir slopes or behind the dam. Suspended material would be discharged through the regulating outlet and spillway during reservoir operation.

Cougar Project

1) Intake Structure. The substrate is primarily basalt, with andesite and/or tuff, covered with an estimated 6 feet of sediments accumulated over the 30 years since the dam was constructed.

2) Disposal Site. The substrate of the disposal site is primarily bedrock covered by erosional material originating in the watershed. The disposal of material would slightly alter the gradient and physical composition of the sites. Velocities within the reservoir during operation would disperse and relocate the material. Heavier material would eventually accumulate on reservoir slopes or behind the dam. Suspended material would be discharged through the regulating outlet and spillway during reservoir operation.

3) Fill Site. Once material was excavated from the old fill in front of the diversion portal, the re-opened channel would connect with the South Fork McKenzie backwater area behind the powerhouse. This channel would be rip rapped below ordinary high water to protect the sides from eroding due to the force of water exiting the diversion tunnel. This is a disturbed area; however, it is still waters of the United States.

b. Water Circulation, Fluctuation, and Salinity Determinations The fill and disposal action would have little or no effect on water circulation, fluctuation, or salinity.

c. Suspended Particulate/Turbidity Determination Short-term turbidity is expected to occur wherever sediments have been disturbed and relocated, during reservoir refill and subsequent operation of the reservoir for flood control. Turbidity from sediment relocation would be indistinguishable from turbidity related to reservoir operation.

d. Contaminant Determinations Fill consisting of intake towers would be composed of concrete. As the site would be dry during construction and the concrete would be cured prior to refill, there would be no contamination of river water from the concrete. Sediments at the construction sites will be analyzed prior to relocation; however, no unacceptable quantities, concentrations, or forms of contaminants critical to the proposed disposal site are expected. Rip rap material would be clean, excavated rock from an upland source.

e. Aquatic Ecosystem and Organism Determinations Impacts of fill and discharge to the structure and function of the aquatic ecosystem and organisms would be minor, in that the reservoirs would be drawn down to run-of-river and any existing aquatic ecosystem in the reservoirs would be destroyed. Some emergent vegetation would be destroyed during excavation of the diversion tunnel portal at Cougar.

f. Proposed Disposal Site Determinations The fill and discharge of material would not violate Environmental Protection Agency water quality criteria or state water quality standards. Relocation of sediments is not expected to introduce substances into surrounding waters or violate the primary drinking water standards of the Safe Drinking Water Act (42 USC 300 et seq.). The sediments will be analyzed and the data provided to EPA and the state prior to removal and fill activities.

g. Determination of Cumulative effects on the Aquatic Ecosystem The fill and disposal action is not expected to have significant adverse cumulative effects on the aquatic ecosystem.

h. Determination of Secondary Effects on the Aquatic Ecosystem The proposed work would not cause any secondary effects on the aquatic ecosystem that could be isolated from the overall proposed action.

V. Coordination A draft environmental impact statement, describing the proposed action, was prepared and circulated for review. The proposed action was coordinated with appropriate federal, state, and local resource agencies, organizations, and interested members of the public through a Notice of Intent to prepare the EIS (February 22, 1993). Comments were received from 24 commentors including:

U.S. Environmental Protection Agency
U.S. Department of the Interior
U.S. Forest Service
Oregon Department of Environmental Quality
Oregon Department of Water Resources
Oregon Department of Fish and Wildlife
various interest groups and other publics

VI. Findings of Compliance or Non-Compliance with the Restrictions on Discharge

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. The "no action" alternative was considered and rejected because it would not be responsive to fish needs in the area.

c. The proposed action is expected to be in compliance with applicable state water quality standards, with the exception of possible temporary exceedance of turbidity standards during construction, for which a variance will be sought.

d. The proposed action would not violate the toxic effluent standards of Section 307 of the Clean Water Act.

e. The proposed action is not likely to adversely affect listed threatened or endangered species or their critical habitat. Biological assessments documenting this conclusion have been prepared and concurred with by the US Fish and Wildlife Service.

f. The proposed fill and disposal of material would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, and wildlife. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability, and recreational, esthetic, and economic values would not occur.

g. Appropriate steps to minimize potential adverse impacts would be specified in the construction contracts.

With the inclusion of appropriate and practical conditions to minimize pollution and adverse effects to the aquatic ecosystem, the proposed action is specified as complying with the requirements of the Section 404(b)(1) guidelines.

Date: 21 Apr 95

TIMOTHY L. WOOD
Colonel, EN
Commanding

US FISH AND WILDLIFE SERVICE
COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oregon State Office
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266
(503) 231-6179 FAX: (503) 231-6195

April 12, 1995

Colonel Timothy L. Wood
District Engineer, Portland District
U.S. Army Corps of Engineers
Portland, OR

Dear Colonel Wood:

This letter, and the previously provided detailed report of June 3, 1994, constitute the Fish and Wildlife Service's (Service) final Fish and Wildlife Coordination Act Report for the Willamette River Temperature Control Study, McKenzie Subbasin, Lane County, Oregon. These documents constitute the Section 2b report within the meaning of the Act (48 stat. 401, as amended, 16 U.S.C. 661-662, et. seq.) to address potential fish and wildlife benefits and impacts with structural modifications at Cougar and Blue River Dams in the Mckenzie River Basin. The modifications would restore temperature regimes downstream by use of selective withdrawal systems added to existing intake towers, substantially improving aquatic life in specific stream reaches. The letter and report are intended to be part of the Army Corps of Engineers' (Corps) Final Feasibility Report/Final Environmental Impact Statement for the study.

We have coordinated the report with the Oregon Department of Fish and Wildlife (ODFW) and the National Marine Fisheries Service (NMFS), and their letters of concurrence are attached. The Columbia Basin Fish and Wildlife Authority also concurred in the report's findings, and their letter of support is also attached. We also coordinated our findings with the Eugene Water and Electric Board and U.S. Forest Service, Willamette National Forest, because of their strong interest in and possible involvement with implementation of the project, although they did not provide written comments on the report.

We have agreed with the Corps to not reprint or rewrite the earlier draft report (June 1, 1994) because the findings remain basically unchanged, and the Corps did not provide detailed, written comments on the draft. We have continued to work closely with the Corps in development of fish and wildlife information for both the draft and final Feasibility Reports and EIS, and the

projects overall, long term benefits to fish and wildlife continue to be significant as reported in the earlier draft report. Further, the report's recommendations are still appropriate.

In summary, restoring water temperatures downstream of these projects to general pre-project conditions would benefit native Willamette spring chinook salmon, bull trout, and native rainbow trout. These three fish species were selected as important ecological and economic indicators with a high degree of public interest and key life history stages that are strongly temperature dependent. While project accomplishments are reported specifically in outputs for these three species, it is recognized that they are also excellent indicators of the overall health of the aquatic system. Accordingly, benefits would occur to the entire stream community in affected stream reaches. These benefits are consistent with and supportive of other, ongoing efforts to restore watershed and basin-wide health to natural resources, as being implemented by the President's Forest Plan.

Installation of selective withdrawal at both projects would significantly improve water temperatures in the South Fork and Blue Rivers and provide the best conformance to pre-project water temperatures on the mainstem McKenzie downstream to Leaburg Dam. Results of an analysis using life cycle data for spring chinook show that this scenario provides the best improvement for salmon production by reducing fry early emergence and prespawning mortality of adults. It would maximize the number of annual adult spring chinook returns at the lowest overall marginal cost per return and substantially increase wild spring chinook distribution upstream of Leaburg Dam.

Restoring water temperatures would also improve food supplies and growth conditions for both resident rainbow trout and bull trout. As measured by increases in trout growth units, the best improvement is seen in the South Fork, Blue, and mainstem McKenzie Rivers when temperature control is installed at both projects. For bull trout, water temperatures particularly for adult migration, spawning, and early egg incubation periods in the fall will be substantially improved in the South Fork McKenzie River.

Construction impacts would occur for about 4 years at Cougar and about 3.5 years at Blue River and be phased to reduce flow and other impacts on the downstream watershed and Willamette system. An 80-acre residual pool would be maintained at Cougar Reservoir during the non-flood control season (construction period) to protect the existing population of bull trout in the South Fork watershed. Concern has been raised that conditions in this residual pool may not support bull trout and/or they may become isolated from the upstream portions of the watershed. The Corps has met with the McKenzie River bull trout working group, fishery agencies and the Forest Service to identify specific measures that would be implemented during construction to protect bull trout. These measures will be spelled out in the final EIS and the issue will be monitored by the Corps and the interagency committee that will be formed to deal with construction-related concerns.

Following construction, a monitoring and evaluation program would be implemented to capture project-specific details on fishery accomplishments, water conditions, and operational conditions consistent with the natural variability that occurs in these events. This would allow for the necessary fine tuning and adjustments in operations to insure project benefits are maximized over time. It would also allow development of a data base to evaluate both temperature control and fish passage opportunities in the McKenzie River Basin and at other Willamette River Basin Projects, as they relate to long term plans for basin-wide restoration.

In light of this information and the specific findings in the detailed report, it is the recommendation of the Service that the Corps:

1.) complete the McKenzie River Temperature Control Feasibility Study and seek Congressional authorization and appropriation to implement the project;

2.) construct temperature control measures at both Blue River and Cougar Dams to achieve full potential benefits and reduce the existing project-caused adverse temperature conditions for aquatic resources;

3.) develop and implement a monitoring and evaluation plan, in cooperation with the resource agencies, that would be implemented with project operation to document project accomplishments, identify any shortcomings, and make corrections as needed to achieve the full range of resource benefits; and

4.) fully fund these items as non-reimbursable project costs to the Federal Government, consistent with the significant benefits to natural resources of national importance and to support other ongoing basin-wide restoration efforts in the McKenzie River Basin.

Sincerely,

for Russell D. Peterson
State Supervisor

RLG/ae

Attachments

Oregon

DEPARTMENT OF
FISH AND
WILDLIFE

NORTHWEST
REGIONAL OFFICE

November 21, 1994

Colonel Tim Wood
District Engineer, Portland District
Army Corps of Engineers
P.O. Box 2946
Portland OR 97208 2946

Dear Colonel Wood:

Appropriate staff of the Oregon Department of Fish and Wildlife have extensively reviewed the U.S. Fish & Wildlife service's June 14, 1994, draft Fish and Wildlife Coordination Act Report for the McKenzie River Temperature Control Project and wholeheartedly concur with its analysis and conclusions regarding the effects of the Blue River and Cougar projects on temperatures in the McKenzie River Basin, Oregon.

The McKenzie River provides exceptional resident trout fisheries and is the remaining major Willamette River tributary producing spring chinook salmon naturally. Hypolimnetic releases from the reservoirs result in unnatural thermal pulsing and a modified temperature regime in the South Fork and mainstem McKenzie Rivers. Mitigation for the mortality, hence reduced production and other negative effects has long beeen sought by ODFW and other fishery agencies.

We fully concur with the USFWS Coordination Act Report.

In harmony with nature,

Nancy M. MacHugh

Nancy M. MacHugh
Interagency Fish & Wildlife Coordinator

NOV 6 1994

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December 9, 1994

Colonel A.W. Hines
District Engineer, Portland District
Army Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208-2946

Dear Colonel Hines:

The Columbia Basin Fish and Wildlife Authority (CBFWA) is a regional association of the Columbia Basin's fish and wildlife managers, comprising two federal and four state agencies and twelve Indian tribes. This organization enables the agencies and tribes to work in concert with the Northwest Power Planning Council (NPPC) to attain restoration of fish and wildlife resources in the Columbia Basin.

The CBFWA Members have reviewed the U.S. Fish and Wildlife Service's June 3, 1994, draft Fish and Wildlife Coordination Act report for the McKenzie River Temperature Control Project and concur with its analysis and conclusions regarding the effects of the Blue and Cougar projects in the McKenzie River Basin, Oregon. The McKenzie River provides exceptional resident trout fisheries and is the remaining major tributary for naturally producing spring chinook salmon in the Willamette River Basin. Hypolimnetic releases from the reservoir result in unnatural thermal pulsing and a modified temperature regime in the South Fork and mainstem McKenzie rivers. Mitigation for the projects' deleterious impacts on McKenzie River fish production has long been sought by the state and federal fishery agencies.

We fully support the Corps moving forward with the multi-level intake temperature control facilities as described in the September 1994 Draft Feasibility Report and Environmental Impact Statement - Willamette River Temperature Control, McKenzie River Subbasin, Oregon.

Sincerely,

John R. Donaldson
Executive Director

cc: CBFWA Members
Angus Duncan, NPPC
Randy Hardy, BPA
House Committee on Natural Resources
Martha Pagel, OWRD
USFWS-Portland Regional Office
Ron Garst, USFWS-Portland Field Station
Barbara Scott-Brier, USDI-Solicitor's Office
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UNITED STATES DEPARTMENT OF COMMERCE
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PORTLAND, OREGON 97232-2737
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FEB 10 1995

F/NW03

Mr. Ronald Garst
U.S. Fish and Wildlife Service
Ecological Services
Oregon State Office
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266

RE: Draft Fish and Wildlife Coordination Act Report for the McKenzie River Temperature Control Project

Dear Mr. Garst:

The National Marine Fisheries Service (NMFS) has completed its review of the U.S. Fish and Wildlife Service's June 3, 1994, draft Fish and Wildlife Coordination Act Report (Report) on the proposed McKenzie River Temperature Control Project. The McKenzie River supports, among other fish, spring and fall chinook salmon and summer steelhead. Although fall chinook salmon and summer steelhead are not native to the McKenzie River, spring chinook salmon are native to the McKenzie Subbasin, which is considered the most important remaining area for potential natural production of spring chinook in the Willamette Basin (Columbia Basin System Planning Production Plan, 1990).

Since the completion of Cougar Dam on the South Fork McKenzie River in 1963 and Blue River Dam on Blue River in 1969, water temperatures in the McKenzie River have been less than optimal for anadromous salmonid survival and reproduction. Hypolimnetic releases from Cougar and Blue River reservoirs have caused a shift in peak temperature from mid-to-late July before the projects were constructed, to late September or early October. This shift has resulted in adverse effects to fishery resources, including delayed and/or blocked migration of adult chinook salmon at Leaburg Dam and subsequent increase in prespawning mortality, accelerated salmon egg incubation, early fry emergence and presumably increased juvenile mortality. Mitigation for the projects' adverse impacts on McKenzie River fish production has long been sought by the state and Federal fishery agencies.

We concur with the Report's analysis and conclusions regarding the effects of the Blue and Cougar projects and fully support the U.S. Army Corps of Engineers moving forward with the multi-level intake temperature control facilities.

Thank you for the opportunity to comment on the Report. Questions regarding this letter should be directed to Garwin Yip of my staff at (503) 230-5419.

Sincerely,

for Jacqueline V. Wyland
Division Chief

cc: ODFW
COE - Portland
CBFWA - Hawkes

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Portland Field Office
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December 13, 1994

Colonel Tim Wood
District Engineer, Portland District
U.S. Army Corps of Engineers
P.O. Box 2946
Portland, OR 97208-2946

Dear Colonel Wood:

The U.S. Fish and Wildlife Service (FWS) is in support of the revised assumptions and benefits analysis being completed by the Corps for the draft feasibility report and EIS for the Willamette Temperature Control Study, Mckenzie River Projects. The revised assumptions were developed cooperatively by the Corps, FWS, and Oregon Department of Fish and Wildlife to address benefits of the projects to spring chinook salmon in the Mckenzie River.

It was clear at the last planning conference that the resource agencies were concerned that the draft Fish and Wildlife Coordination Act report assessment (June, 1994) was not sensitive to potential benefits with Blue River Project modifications, and that it was important to do such an assessment in support of correcting the existing adverse temperature conditions with the Blue River project. The revised assessment attempts to display the incremental changes that would occur with temperature control at the Blue River project and will be incorporated into the Service's final Coordination Act Report.

Thank you and your staff for their cooperation on this important project, and the time and effort devoted to completion of the project reports, which will hopefully soon lead to authorization and funding for construction.

Sincerely,

Russell D. Peterson
State Supervisor

RG/ae

United States Department of the Interior

FISH AND WILDLIFE SERVICE

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June 3, 1994

Colonel A.W. Hines
District Engineer, Portland District
U.S. Army Corps of Engineers
Portland, Oregon 97208-2946

Dear Colonel Hines:

Attached for your review and comment is the Service's draft Fish and Wildlife Coordination Act report for the McKenzie River Temperature Control Project. We are providing two copies of the report and have provided an earlier (March 1994) working copy of this draft. Please provide comments on the draft by July 11, 1994.

Copies are also being provided to the Oregon Department of Fish and Wildlife, National Marine Fisheries Service, US Forest Service, Eugene Water and Electric Board, Columbia Basin Fish and Wildlife Authority, and Power Planning Council. Please feel free to direct questions to Ron Garst at 503-231-6179. We would like to acknowledge biologists Kim Larson and Mark Smith for their assistance in preparing this information.

Sincerely,

for Russell Peterson
Field Office Supervisor

RG/meh/C:ron4/6-2-94

June 1, 1994

Colonel A.W. Hines
District Engineer, Portland District
US Army Corps of Engineers
Portland, Oregon 97208-2946

Dear Colonel Hines:

This letter report is the Fish and Wildlife Coordination Act Report, within the meaning of Section 2b of the Act (48 Stat. 401, as amended, 16 U.S.C. 661-662, et seq.) for the proposed McKenzie River Temperature Control Project. The report addresses potential fish and wildlife benefits and impacts associated with structural modifications at Cougar and Blue River Dams in the McKenzie Basin. The purpose of the modifications is to restore temperature regimes downstream of those projects to pre-project conditions and reduce existing adverse temperature conditions. The report is intended to be part of the Corps' ongoing feasibility level study for the project.

We have coordinated this report with the Oregon Department of Fish and Wildlife (ODFW) and National Marine Fisheries Service (NMFS) which are in agreement with its findings as based on the attached letters of comment and concurrence. We have also coordinated closely with the Eugene Water and Electric Board (EWEB), Willamette National Forest of the US Forest Service, and Northwest Power Planning Council because of their strong interest and/or possible involvement in implementation of the project. Information in the report is based on data provided by the Corps as of March 1994. The Service previously reported on the McKenzie River Temperature Control Study in a Planning Aid Letter (December, 1990) and a draft report (October, 1992) that identified issues and potential methodologies for evaluation. Subsequent to those reports, numerous meetings have been held between the Corps and the resource agencies to refine the methods of analysis for the project and discuss ongoing issues as the study proceeds.

Authority for the Corps' present feasibility study was provided by Congress in the Energy and Water Development Appropriations Bill of 1991 (PL 101-514), which identified additional funds under the Willamette River Basin Review Study. The existing study is an evaluation of installing temperature control structures at Blue River and Cougar Dams and a continuation of efforts looking at temperature control in the McKenzie River under the Willamette River Basin Review Study. The draft reconnaissance report (Corps, 1991) for the Willamette River Basin Review Study (Vol. 1&2) has not been finalized, but it does provide a reconnaissance level evaluation of temperature control at these McKenzie River projects. The present study is an effort to complete the feasibility phase review and evaluation since temperature control in the McKenzie River has been an issue for over a decade. During this period, the Northwest Power Planning Council's fish and wildlife program pursuant to Section 4(h) of the Power Planning and Conservation Act of 1980 has contained measures calling for the construction of multi-level towers at Blue River and Cougar Dams (measures 704(c), 1&2).

PROJECT SETTING

The Willamette River Basin encompasses the major cities of western Oregon (Portland, Salem, Eugene) and the 11,200-square-mile basin supports a high percentage of the state's total population. The population of the nine counties lying wholly or partially within the basin has increased over 2.5 times from 691,000 in 1940 to 1,839,700 in 1987 (Corps, 1989).

Major tributaries in the basin include the Clackamas, Santiam, and McKenzie Rivers and the Coast Fork and Middle Fork Willamette Rivers. Other tributaries include the Tualatin, Yamhill, Luckiamute, Mary's, Long Tom, Calapooia, Pudding, and Molalla Rivers.

The McKenzie River drainage includes about 1,300 square miles (about 12 percent of the Willamette Basin) in Lane and Linn counties. The mainstem of the McKenzie River originates at Clear Lake about 90 river miles (RM) upstream of its confluence with the Willamette River at RM 171.8. There are about 1,040 miles of perennial streams in the McKenzie Basin, including the major tributaries: South Fork McKenzie, Blue, Smith, and Mohawk Rivers; and Lost, Horse, Quartz, Gate and Camp Creeks.

About 20 percent of the McKenzie Basin is in Federal ownership managed by the U.S. Forest Service and Bureau of Land Management for timber production, wilderness areas, and other uses. Most of the basin is mountainous with steep forested ridges. A narrow valley with relatively flat land along the river characterizes the lower McKenzie mainstem and Mohawk River. Elevations range from over 10,000 feet above sea level on the North Sister peak, to 350 feet near the river's mouth. About 90 percent of the drainage is above 1,000 feet in elevation and more than 70 percent is above 2,000 feet in elevation. Most of the basin's streams have steep gradients, especially in their upper reaches.

Average annual precipitation ranges from about 45 inches near Springfield, Oregon to over 100 inches in the headwaters. More than 40 percent occurs during the November through January period, whereas only about 10 percent occurs during June through September. About one-third of the precipitation above 4,000 feet in elevation occurs as snowfall, with accumulations exceeding 90 inches in the central Cascades. Snowmelt percolating through an extensive lava plateau at 5,500 to 6,000 feet in elevation contributes cool waters and sustained flows in the mainstem McKenzie River and upper tributaries during summer.

Average monthly regulated flow (USGS data) measured in the lower mainstem near Armitage Park (RM 3) ranges from a low of about 2,500 cubic feet per second (cfs) in August to a high of 12,300 cfs in January for the period 1964-1972 (ODFW, 1990). Natural flow patterns of the McKenzie River and some of its tributaries have been changed by a number of dams, diversions, and water withdrawals for out-of-stream uses. Figure 1 is a map of the McKenzie River Basin showing land ownerships, major tributaries, and some of the existing projects in the basin.

PROJECT DESCRIPTION

Cougar Reservoir was formed by the completion of Cougar Dam in 1963 at River Mile (RM) 4.5 on the South Fork of the McKenzie River. The dam is a 452-foot-

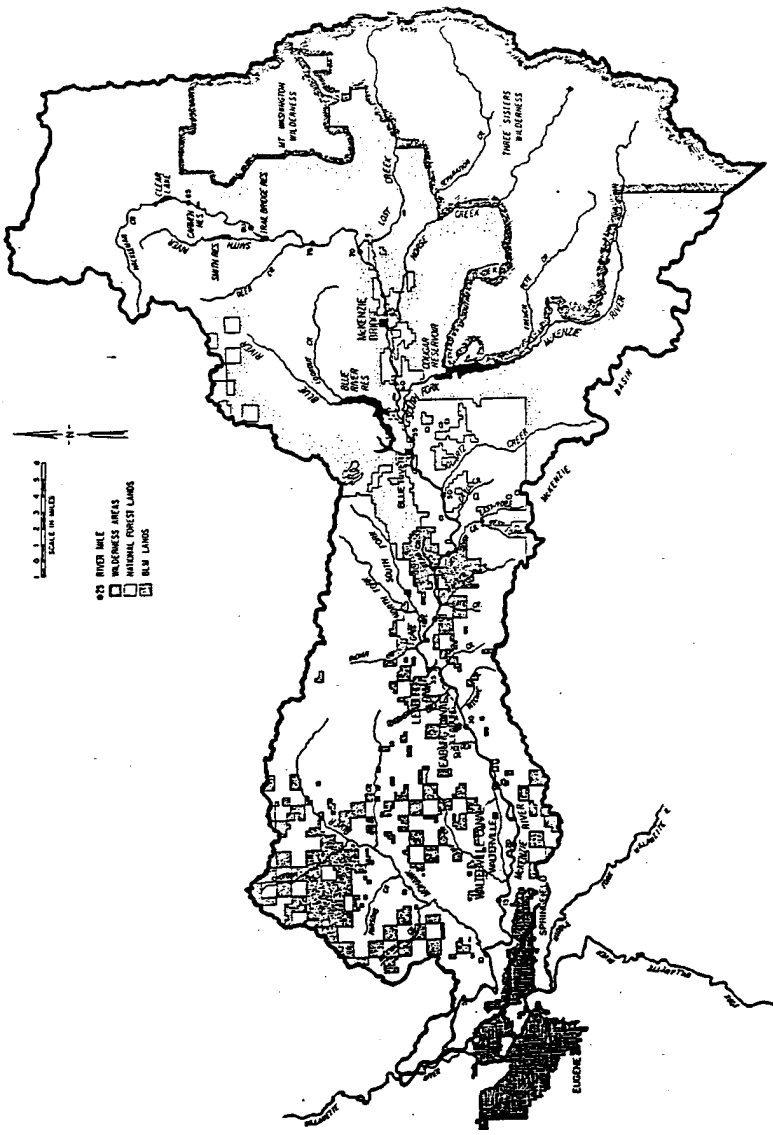

Figure 1. Map of the McKenzie subbasin.

high embankment structure forming a reservoir with a surface area of 1,234 acres at full pool and a 219,080 acre-foot storage capacity. The South Fork is a left-bank tributary to the McKenzie River which enters at RM 59.7. The Blue River is a major right-bank tributary to the McKenzie River at 57.0. Blue River Dam is located at RM 1.7 on the Blue River and was completed in 1969. It is a 321-foot-high embankment dam forming a reservoir with a surface area of 948 acres at full pool, and storage capacity of 89,520 acre-feet. Figure 2 shows the projects' location in the McKenzie River Basin. These two projects are operated as part of 13 Corps projects in the Willamette River Basin for the primary authorized purposes of flood control, irrigation, and downstream navigation improvement (Corps, 1991). Secondary project purposes include power production, recreation and low flow augmentation for pollution abatement and fishery improvement. Cougar Dam has a power plant with a 25,000 kilowatt generating facilities. Blue River does not have power at present but is under FERC license (Project No. 3109-019) to EWEB to add a 15,000 kilowatt capacity plant to the project. Both projects release water for downstream purposes through the reservoir outlets near the bottom of the pool.

Both projects blocked the upstream and downstream passage of salmon, steelhead, and resident trout at the damsites. Fish collection facilities were built at Cougar Dam for spring chinook but these proved unsuccessful and have not been operated as part of the project (Korn and Ingram, 1969). Upstream passage facilities were not provided at either project and mitigation for the losses to both anadromous and resident fish was to be provided by hatcheries. The Leaburg Trout Hatchery was built to mitigate the loss of resident trout spawning and rearing areas due to inundation and/or blockage by the Corps' projects in the Willamette Basin. The entire annual operating budget is funded by the Federal Government (Corps, 1989). The Corps also built the McKenzie Salmon Hatchery as mitigation for the loss of salmon and steelhead spawning habitat that occurred as a result of inundation of habitat with Blue River and Cougar Dams. The Corps of Engineers funds 50 percent of the Annual operating budget (Corps, 1989). The run eliminated by Cougar Dam was estimated to be 3,860 adult chinook salmon (Corps, 1979), with an additional 200 adults spawning above Blue River Dam; thus, the Corps' mitigation provided at Mckenzie Hatchery is for the return to the McKenzie River of 4,060 Adults. The State contributes the balance of the operation and maintenance costs to produce an additional 4,000 fish, thus the total facility goal becomes 8,000 spring chinook returning to the river annually.

A number of alternatives have been evaluated for their ability to provide temperature control at the two projects (Corps, 1991b). These include modifying the existing intake structure or constructing new intake structures, or some combination of modified and new structures operated at one or both of the projects. The feasibility study has focused on a modified outlet structure at each project with an attached singe wet-well, with either throttled ports or adjustable weirs. Preliminary cost analysis showed that throttled ports were less expensive and these have been the focus of detailed analysis. Table 1 presents details on the proposed release facilities at each project that were used in modeling downstream temperature conditions.

Temperature changes to the McKenzie River, including the South Fork downstream of Cougar Dam and Blue River downstream of Blue River Dam, have been well documented. As part of the Willamette River System temperature control study (WSTCS), the Corps (Morse et al., 1987) evaluated the potential of improving McKenzie River temperatures with multi-level towers by comparing without and

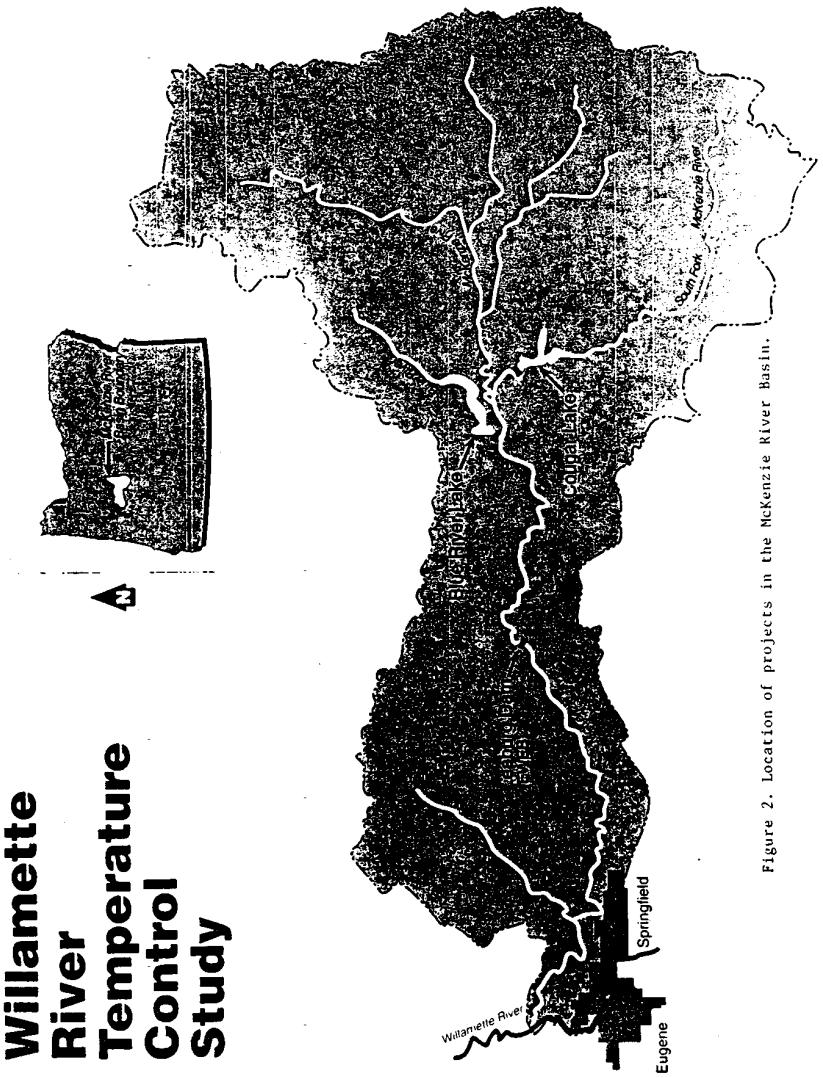

Figure 2. Location of projects in the McKenzie River Basin.

Table 1. Details on proposed and existing release facilities at Cougar and Blue River Dams, McKenzie River temperature Control Project. A]

	Cougar Dam			Blue River Dam		
Intake Type	Size (ft)	Max Flow (cfs)	Elev (ft)	Size (ft)	Max Flow (cfs)	Elev (ft)
Existing Release Facilities						
Primary	10.5' dia.	12,500 cfs	1525.00[1]	4.75'x 8'	8,400 cfs	1132.00
Spillway	80' wide	76,140 cfs	1656.75	70' wide	53,220 cfs	1321.00
Proposed Release Facilities						
Level 1	14.5'hx7'w	1,000 cfs	1525.00	9'hx6'w	500 cfs	1132.00
2	14.5'hx7'w	1,000 cfs	1565.00	9'hx6'w	500 cfs	1132.00
3	14.5'hx7'w	1,000 cfs	1580.00	9'hx6'w	500 cfs	1197.00
4	14.5'hx7'w	1,000 cfs	1595.00	9'hx6'w	500 cfs	1223.00
5	14.5'hx7'w	1,000 cfs	1610.00	9'hx6'w	500 cfs	1255.00
6	14.5'hx7'w	1,000 cfs	1625.00	9'hx6'w	500 cfs	1274.00
7	14.5'hx7'w	1,000 cfs	1640.00	9'hx6'w	500 cfs	1299.00
8	14.5'hx7'w	1,000 cfs	1655.00	9'hx6'w	500 cfs	1318.00
9	14.5'hx7'w	1,000 cfs	1670.00	9'hx6'w	500 cfs	1334.00
Spillway	80'wide	76,140 cfs	1656.75	70'wide	53,220 cfs	1321.00

A] From Corps of Engineers, 1993-"McKenzie River Water Temperature Study" Project Report 93-1

[1]Existing bottom intake elevation has been set at 1,525 feet due to bottom geometry affects on withdrawal water temperature.

with tower operations (existing rule curves) and the ability to meet target temperatures recommended by the resource agencies.

Early in the WSTCS, the Corps asked the resource agencies to establish specific temperatures and flow objectives so that the projects could be evaluated in terms of their ability to meet these objectives. It was assumed the objectives would define the optimum conditions for aquatic resources in the McKenzie River system. Lacking the necessary information to relate flows and temperatures and, equally important, the specific relationships of temperature and flows to habitat use and availability for important life stages for species of interest, the agencies were reluctant to do this. Instead, it was agreed that the temperature objectives should replicate pre-project (without project) water temperatures, and flows would be the existing rule curves for project operations at Cougar and Blue River dams. Table 2 lists the recommended temperatures and flows provided by the resource agencies. The temperatures are a range for each month representing the

Table 2. Recommended temperatures (1) and flows (2) for the McKenzie River temperature control study.

MONTH	COUGAR			BLUE RIVER			MCKENZIE RIVER AT VIDA		
	TEMP(F)	MIN FLOW	MAX FLOW	TEMP (F)	MIN FLOW	MAX FLOW	TEMP (F)	MIN FLOW	MAX FLOW
Jan.	39-41	400		39-41	50		40	2000	
Feb.	40-41	400		40-41	50		43	2000	
Mar. 1-15	40-41	400		40-41	50		42-43	2000	
Mar. 16-31	40-41	250		40-41	50		42-43		
April	41-43	250		41-43	50		44-45		
May	44-48	250		44-48	50		47-48		
June	51-55	250		51-55	50		49-52		
July	57-63	250		57-63	50		52-56		
Aug.	59-64	250		59-64	50		53-56		
Sept. 1-9	54-58	250		59-64	50		51-53		
Sept. 10-30	54-58	400	1100	54-58	50		51-53	2500	3700
Oct. 1-10	49-51	400	1100	49-51	50		47	2500	3700
Oct. 11-31	49-51	400		49-51	50		47	2000	
Nov.	44-45	400		44-45	50		45	2000	
Dec.	40-41	400		40-41	50		43	2000	

(1) Source FWS, ODFW, and NMFS joint letters of 14 Sept., 1984 and 13 March, 1985; temperature ranges are average monthly minimum and maximum temperatures for pre-project conditions.
(2) Flows in cfs are authorized minimum/maximum from Willamette River Basin Project authorizations.

average monthly minimum and maximum temperatures for that period, based on pre-project temperature records. The flows do not represent actual project operations but are the authorized flows (min/max) as documented in project authorizations.

The impacts of existing project operations on water temperatures in the McKenzie River and tributaries are well documented (Morse et al., 1987; and USGS, 1988). More recently, the Corps (1990 & 1993) evaluated operations of the Cougar and Blue River Projects to determine if modified temperature outputs could simulate pre-project temperature conditions. The model results demonstrate that it is possible to meet the resource agencies target temperatures over a range of hydrologic and meteorologic conditions (wet/dry &/or cool/warm years). Some of the basic results of these analyses are presented in the attached Appendix A as a brief summary of the physical accomplishment of temperature control at the two projects. Details are provided in the McKenzie River Water Temperature Study (Corps, 1993 and 1994) and are not repeated here. The focus of the Coordination Act Report is to evaluate how these physical changes would impact target species of interest in the projects' area of influence. The scope of the study has included only structural modification to achieve temperature objectives without analyzing low flow modifications could contribute to those objectives. It was not within the scope of this study to evaluate rule curve modification at Willamette Basin Projects.

BIOLOGICAL EVALUATION

The resource agencies met in April 1990 to discuss potential biological changes associated with temperature control in the McKenzie River. Several decisions and study needs were identified and agreed to at that meeting:

> Three important McKenzie River fish species would be evaluated as indicator species of potential changes associated with temperature control - spring chinook salmon, resident rainbow trout, and bull trout;
>
> Changes would be discussed in terms of the management objectives for these species as identified in plans for the McKenzie River (ODFW, 1988 AND 1990);
>
> Changes would be quantifiable and tied to measurable temperature changes predicted with project modifications, to the extent practicable;
>
> In addition to the above three species, temperature changes would be discussed generally in terms of the overall McKenzie River ecosystem, to the extent such information exists;
>
> Additional information needs included: 1) habitat inventories and spawning ground surveys; 2) smolt survival and emergence timing; 3) a simplified spring chinook production model; and 4) resident fish distribution and abundance.

The three indicator species were chosen for evaluation because they are all important economic species with a high degree of public interest; they are all good ecological indicators for temperature changes because one or more key

life stage is strongly temperature dependant; there is a fair to good quantity of existing information describing the species use of the project area (as well as their basic life history requirements); and all three species occur in the project area of influence.

The project area of influence includes the aquatic habitats of the South Fork (S. Fork) McKenzie River downstream of Cougar Dam, the Blue River downstream of that dam, the mainstem McKenzie downstream of the S. Fork confluence to Leaburg Dam, and Cougar and Blue River Reservoirs. While there would be no quantitative changes in riverine habitats with the project, qualitative changes would be substantial with changing temperature regimes. In contrast, short term quantitive changes would occur in the reservoirs during the construction time period (drawdown), and subtle qualitative changes may occur with project operations and any associated reservoir limnology changes.

Numerous sources of general information exists that describes fish and wildlife resources of the Willamette River Basin (Willamette River Basin Comprehensive Study, Willamette River Basin Task Force Report, Appendix D; Fish and Wildlife of Westside Forests of Washington and Oregon, US Forest Service) or more specific to the McKenzie River Basin and aquatic habitats (ODFW Fish Management Plan (1988) and Northwest Power Planning Council Sub basin Plan, McKenzie River (1990)). Information in the Coordination Act Report is limited to the three indicator species because that is the only information collected specifically for the study, and it is assumed impacts would be limited to the aquatic habitats in the project area of influence. The three indicator species are good representation of how temperature changes should benefit aquatic species. These benefits are also discussed more generally for the aquatic ecosystem and related watershed restoration efforts underway in the McKenzie River Basin.

In terms of the additional study needs, the habitat work was completed in February 1992 by the Pacific Northwest Research Station (Sedell et al., 1992); and the spawning ground surveys and smolt survival and emergence timing work was completed by ODFW in late spring 1993. A simplified spring chinook production model was developed cooperatively by the Corps and the Service that ties two key life stages (spawning success and fry survival) to temperature conditions in the mainstem McKenzie and the two tributaries, then predicts adult returns based on these conditions. A method for relating temperature changes to habitat utilization for resident trout was developed by use of an index (Trout Growth Units) that compares temperatures favorable for trout growth to observed water temperatures with project modifications. Additional studies to document resident trout distribution and abundance were not completed because estimates of costs were beyond the study capabilities. No specific data were collected for bull trout and potential effects are evaluated in terms of general life history needs for this species.

The results of these studies are presented below for each of the indicator species, with results compared between without and with project (modified temperature) conditions. The alternatives included looking at each project separately (Blue River or Cougar only) and both projects together. The period of analysis is 50 years.

Without the Project

Spring Chinook

The Willamette River spring chinook is native to the McKenzie River. Details of its life history in the McKenzie River are discussed elsewhere (ODFW, 1988; USFWS, 1990) and not repeated here, except as it relates to the potential benefits of temperature control. Management plans for spring chinook are detailed in documents for the Columbia River sub-basin planning effort (ODFW, 1990 and NPPC, 1990). The Willamette River stock of spring chinook is one of six stocks of spring chinook in the lower Columbia River below Bonneville Dam. These fish use the major tributaries, including the Cowlitz, Kalama, Lewis, Sandy, and Washougal Rivers, in addition to the rivers in the Willamette River System. Spring chinook stocks have been managed primarily as hatchery stocks with natural production comprising only 5 to 15 percent of total population (NPPC, 1990).

Hatchery reared spring chinook salmon have been stocked in the McKenzie since 1902 when the river was racked at Hendricks Bridge. Between 1902 and 1947 the plan was to take as many eggs as possible, with the peak egg take in 1928 of 27.7 million eggs (ODFW, 1988). Other high years of egg take (in excess of 20 million eggs) were 1926, 1927, 1930, 1935, and 1936. Past egg collection has been viewed as a minimum index of run size but not an accurate predictor because racks were not always installed in time to intercept the entire run, or were removed when hatchery capacity was reached, or natural spawning occurred downstream of the racks and in intervening tributaries. The early releases from egg takes were fry and fingerlings in poor condition and it is believed very little hatchery contribution to the returning adults was realized until the 1950's (Wallis, 1961). Adults were last collected at the rack in the Walterville Canal in 1960 and because of declining runs, adult collections were reduced to less than 7 percent of the runs from 1954 through 1960 to allow escapement of spawners upstream (ODFW, 1988).

The estimated average run size in the McKenzie during the period 1945-1960 was about 18,000 spring chinook (ODFW, 1988). The high year during this same period was 1953 at about 38,000 fish and the low year was 1950 at about 6,000 fish. Pre-project analysis by the Oregon Fish Commission in the late 1940's estimated the largest run in the Willamette up to that time was 1941, with an estimated 120,000 spring chinook above Willamette Falls (FWS, 1948). Using a 39 percent distribution to the McKenzie River based on pre-project evaluation of the Willamette Valley Projects by the Oregon Fish Commission (FWS, 1948), would mean about 46,000 fish for the McKenzie River that year. Figure 3 shows the estimated spring chinook run size during the pre-project years (1946-1960) when count information was available (ODFW, 1988). This is the total estimated return to the McKenzie River and includes hatchery fish, escapement, and catch. It also shows the average run size to the McKenzie River since the projects were completed at the Cougar and Blue River sites. Table 3 updates this information to 1993 and shows other information such as the distribution of fish upstream of Leaburg Dam, catch, return as a percent of Willamette Falls count, redd distribution, and other information.

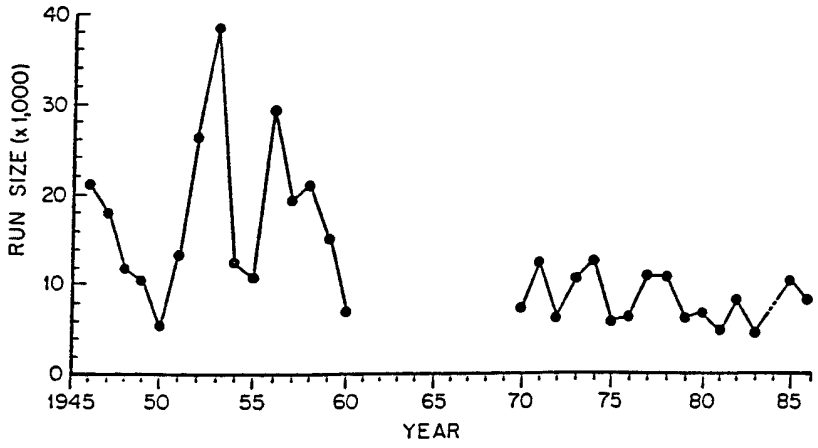

Figure 3. Estimated run size of spring chinook in the McKenzie River, 1946-86, (ODFW, 1988).

Table 3. Estimated return of spring chinook to the McKenzie River[1]

Run Year	Leaburg Dam count	Hatchery Return	Catch	Below Leaburg Dam Redds	Below Leaburg Dam Escapement	Total Return	Return as % of Will. Falls	WF count (X1000)	Percent caught
1970	2991	20	525	278	1251	4787	14.0	34.2	11.0
1971	3602	232	621	415	1868	6323	14.2	44.6	9.8
1972	1547	301	1125	177	797	3770	14.4	26.2	29.8
1973	3870	56	1510	556	2502	7938	18.9	42.0	19.0
1974	3717	0	1022	689	3101	7840	17.6	44.5	13.0
1975	1374	0	461	346	1557	3392	17.8	19.1	13.6
1976	1899	396	139	409	1841	4275	19.3	22.2	3.3
1977	2714	1517	1071	850	3825	9127	22.8	40.0	11.7
1978	3058	1464	924	599	2696	8142	17.1	47.5	11.3
1979	1219	798	303	155	698	3018	11.3	26.6	10.0
1980	1980	807	381	219	986	4154	15.4	27.0	9.2
1981	1078	784	493	282	1269	3624	12.0	30.1	13.6
1982	2241	1460	627	241	1085	5413	11.7	46.2	11.6
1983	1561	821	221	172	774	3377	11.0	30.6	6.5
1984	1000	1901	618	271	1220	4739	10.9	43.5	13.0
1985	825	1923	467	381	1715	4930	14.3	34.5	9.5
1986	2061	1705	383	315	1418	5567	14.2	39.1	6.9
1987	3455	1593	1368	212	954	7370	13.4	54.8	18.6
1988	6753	2487	1215	484	2178	12633	17.9	70.5	9.6
1989	3976	3154	1864	228	1026	10020	14.5	69.2	18.6
1990	7115	3206	1704	160	720	12745	17.9	71.3	13.4
1991	4359	4483	1986	161	725	11553	22.0	52.5	17.2
1992	3816	3407	1200	106	477	8900	21.2	42.0	13.5
1993	3617	2051	1200	142	639	7507	23.5	32.0	16.0
Ave.	2910	1440	893	327	1472	6714	16.1	41.3	12.9

Catch in 1993 is an educated guess.

Escapement below Leaburg Dam = No. of Redds below Leaburg X 4.5 Fish/Redd.

1] From ODFW, 1993

In summary, while the pre-project run size to the McKenzie River averaged about 18,000 spring chinook, since 1970 this average has been only about 6,700 fish, with only about 2,900 passing upstream of Leaburg Dam. Temperature changes were suspected early as a possible cause of reduced returns because of the adverse impacts of temperature to the early trap and haul effort at Cougar Dam (Korn and Ingram, 1969). In that effort, spring chinook delayed entry to the S. Fork because of reduced water temperatures, and then could not enter the trap until warmer waters were released from the surface. Surface waters would entice fish to enter the system but could not be dedicated as part of normal operations because the water did not go through the powerhouse. Accordingly, this practice was not adopted as part of routine project operations and trap and haul was abandoned.

The Service's PAL for WSTCS (USFWS, 1990) discussed several possible means whereby changed temperature conditions have impacted spring chinook salmon. These included delay and/or blockage at Leaburg Dam of migrating spring chinook adults because of cold water temperatures during the early portion of the run (May and early June), a corresponding shift in the distribution of spawning above and below Leaburg Dam, significantly underseeded habitat upstream of Leaburg Dam, and early emergence of fry because of increased water temperatures during egg incubation. The combination of significantly underseeded habitat upstream of Leaburg Dam and the potential for early emergence to reduce fry survival or otherwise affect adult returns (ODFW, 1985) means natural production of spring chinook in the McKenzie River has been impacted by project-caused temperature changes (USFWS, 1990; NMFS, 1990). These impacts were not anticipated or mitigated when the projects were built.

The habitat work conducted for the project (Sedell et.al., 1992) did not suggest any reasons for reduced run size based on habitat availability. Instead, spawning conditions appeared to be good in both the quantity and quality of spawning gravels, and only minor changes were noted in the distribution and frequencies of suitable spawning substrates for five stream reaches examined upstream of Leaburg Dam. In fact, the habitat work also supported the resource agencies contention of underseeding of the habitat, based on the availability of suitable spawning substrate when compared to actual use. **Table 4** compares actual spawning use based on redd surveys with spawning habitat availability. By comparing the areas upstream of Leaburg Dam (reaches 2-6) and assuming only 50 percent of the total gravels (1,026,250 square yards) are available for spawning (adequate depths, velocities, cover, etc.), the maximum number of redds during the period 1965 to 1991 (335 redds) would require less than 1 percent of the spawning gravels, assuming 12.2 square yards/spawning pair (Armour, 1991). The mean number of redds for this period (156) would require only 0.3 percent of the potential area available.

In summary, habitat availability for spawning upstream of Leaburg Dam does not appear to be limiting, but the habitat is significantly underseeded at existing levels of escapement. Additional data that suggests underseeding includes early information on run size (returns) to the McKenzie River, with figures for spring chinook that range between 38,000 and 46,000 fish (USFWS, 1990) and levels of egg take during the 1920's and 1930's (ODFW, 1990). Also, ODFW has noted strong correlations between increased numbers of fry migrating from the system with increased adult returns the previous year, meaning that the increased number of fish are able to effectively use the habitat (ODFW, 1993).

Table 4. Comparison of actual spawning use (# of redds) with spawning habitat availability for mainstem McKenzie River above Leaburg Dam.

	Total Redd Count	**Habitat Availability 1)**	
Year	W/O Tribs (Helicopter Survey)	Reach #	Spawning Gravels (yd^2)
1965	270	1	994,594
1966	123		
1967	---	2	292,404
1968	232		
1969	105	3	533,132
1970	119		
1971	129	4	51,319
1972	46		
1973	236	5	89,375
1974	88		
1975	85	6	60,020
1976	129		
1977	335	Total	2,020,844
1978	283		
1979	40		
1980	88		
1981	84		
1982	109		
1983	76		
1984	90		
1985	52		
1986	131		
1987	150		
1988	324		
1989	233		
1990	235		
1991	255		
Mean	156		

1) From Sedell, et. al. 1992. Spawning gravels were substrate classes small rubble (SR) and medium rubble (MR) ranging from .25" to 5.9" in size. The reaches 2-6, representing a total of 1,026,250 yd^2 of spawning gravels, occur upstream of Leaburg Dam.

The physical analysis of temperature modifications with the projects (Corps 1990, 1993) shows that temperatures downstream of the dams, and in the mainstem below the South Fork to Leaburg Dam, are modified by project operations (hypolimnial releases). Basic findings are summarizes in Appendix A. This is the area of influence of project operations and the area where ODFW concentrated its work on spawning distribution and success, and early emergence of fry. The area upstream of the South Fork, including the tributaries (Horse Creek and Lost Creek) were also sampled as a control area (not affected by project temperature releases).

In summary, key findings from that work included spawning distributions of 60 percent above the South Fork, 10 percent in the South Fork McKenzie River, and 30 percent in the mainstem downstream of the South Fork to the Leaburg Pool. In these areas, there were prespawning mortalities of 5 percent above South Fork, 23 percent in the South Fork, and 18 percent downstream of the South Fork. Spawning occurred primarily during the month of September, with about 95 percent being completed by September 30, and only 5 percent occurring within the first week of october. About 40 percent of spawning occurred prior to September 15, with the remainder occurring the last 2 weeks of September (Figure 4).

Fry seining to determine when button-up fry were observed, showed fish as early as the first week in December in the South Fork, with substantial numbers per catch effort being observed through December and January for both the South Fork and mainstem downstream of the South Fork. This compares to observed dates of first fry swim-ups in Horse Creek and Lost Creek in the middle of February, and not until the middle of March in the Carmen Smith spawning channel. Using 1800 temperature units (the cumulative number of degrees above 32° each day), as the total number of units before spring chinook fry emerge from the gravel, different emergent dates can be predicted for different temperature regimes. Using the 1992 temperature data gathered from their study, ODFW calculated the week of reaching 1800 temperature units for different spawning dates. By using the South Fork data as a standard, the difference in time (days) when 1800 units are realized in other reaches can be compared to the South Fork (Table 5). For all areas sampled, upstream of the S. Fork (natural conditions) with spawning on or before September 15 (60 percent has occurred by this date), the average date of fry emergence is 85 days later than S. Fork emergence dates.

Information on fry emergence timing, spawning distribution, and spawning success was used to develop a life cycle model for spring chinook. Using 1800 temperature units for emergence timing of fry, differences in emergence were predicted for three stream reaches (above the South Fork, in the South Fork, and below the South Fork) with various temperature control alternatives for different water years.

The temperature units were calculated by the Corps hydrologic modeling (Corps 1993). A varying survival rate was established for fry survival assuming early emergence is detrimental to survival. Survival of egg to fry was estimated to be 25 percent for fish emerging in mid-March, and zero at date of spawning (mid-September). A straight line relationship was assumed between these two dates to give a survival per day based on number of days to emergence. Emergence date (time to reach 1800 tu's) was then calculated using the temperature modeling data for any given alternative and flow year and a survival was associated with that date. Spawning and emergence dates were

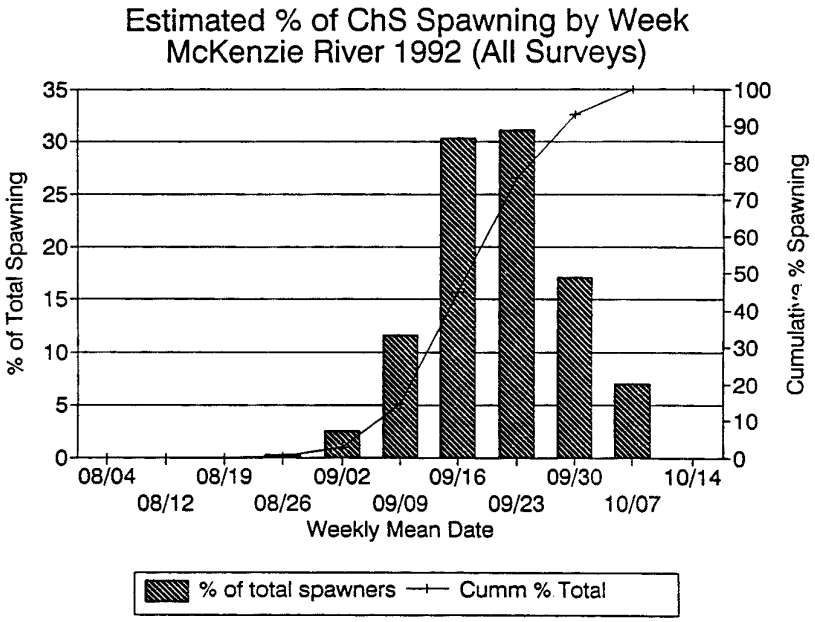

Figure 4. Spring chinook spawning time periods in the McKenzie River for 1992 (ODFW, 1993).

Table 5. Time to reach 1800 Temperature Units based on time of spawning[1]

WEEK OF REACHING 1800 TEMPERATURE UNITS - FOR SWIM UP STAGE

		Spawning Date							
	Area	09/01/92	Diff in Mean Day	09/15/92	Diff in Mean Day	09/28/92	Diff in Mean Day	10/15/92	Diff in Mean Day
Below SF	Main @Leaburg	11/29-12/5/92	21	12/27/92-1/2/93	30	2/7-2/13/93	28	3/14-3/20/93	7
	Main @Finn Rock	12/6-12/12/92	28	1/3-1/9/93	36	2/7-2/13/93	28	3/21-3/27/93	14
	SOUTH FORK	11/8-11/14/92	0	11/29-12/5/92	0	1/10-1/16/93	0	3/7-3/13/93	0
Above SF	Main @Bruckhart	1/31-2/6/93	84	2/21-2/27/93	85	3/21-3/27/93	70	4/11-4/17/93	35
	HORSE CR	2/7-2/13/93	91	3/7-3/13/93	99	4/4-4/10/93	84	?	
	LOST CR	1/10-1/16/93	63	1/24-1/30/93	57	2/14-2/20/93	35	2/28-3/6/93	+8
	CARMEN-SMITH	2/14-2/20/93	98	3/14-3/20/93	106	4/4-4/10/93	84	?	

1] From ODFW, 1993

estimated using September 15 to represent early spawning fish and September 30 for late spawning fish. Proportion of fish spawning prior to and after September 15 was estimated using ODFW 1992 redd counts and carcass surveys. Percent of fish spawning prior to September 15 was estimated to be 35 percent. **Figure 5** shows a schematic of the model and input points used to generate numbers of adults returning upstream of Leaburg Dam. Results are presented in detail in Appendix B, including a list of assumptions for the model.

Table 6 summarizes estimated days to emergence for three different water years by stream reach for two different dates of spawning (September 15 and

Table 6. *Estimated days to emergence[1] for three different water years, by stream reach, for without project (existing) temperature conditions.*

Water Year	SPAWNING ON SEPTEMBER 15		
	Below S. Fork[2]	South Fork[3]	Above S. Fork[4]
Average Year	131	86	180
Low Flow Year	131	118	180
High Flow Year	141	127	180

Water Year	SPAWNING ON SEPTEMBER 30		
	Below S. Fork[2]	South Fork[3]	Above S. Fork[4]
Average Year	150	115	180
Low Flow Year	134	110	180
High Flow Year	156	124	180

[1] Assumes 1800 TU's for emergence
[2] Based on WES Temperature modeling at Vida
[3] Based on Inflow Temperature to Cougar Reservoir
[4] Based on estimated emergence on March 15

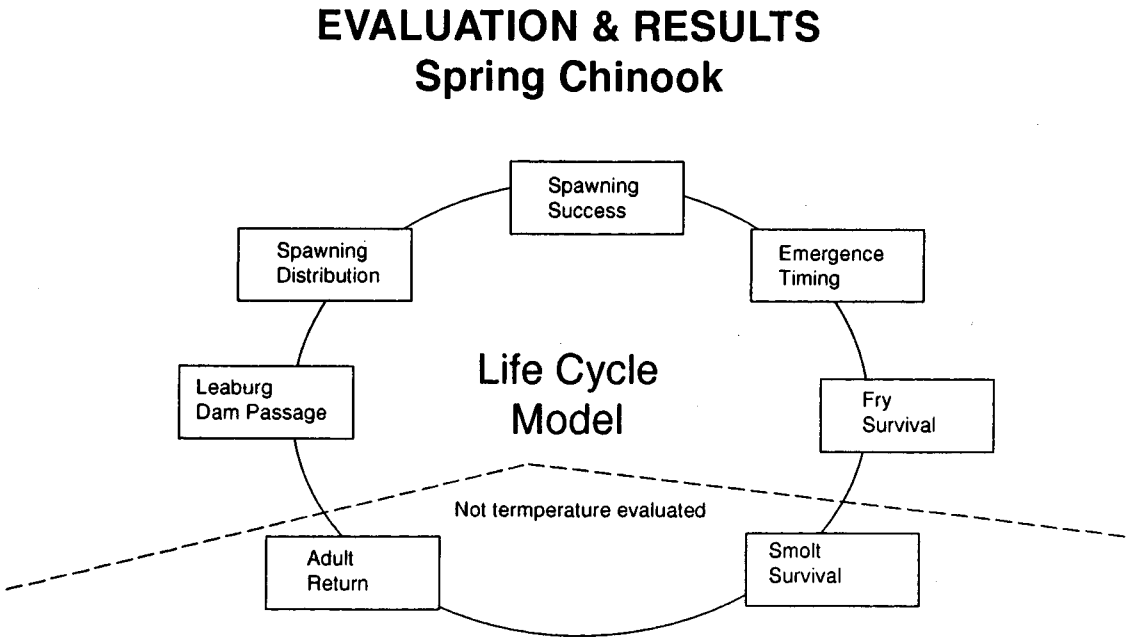

Figure 5. Spring chinook life cycle model for temperature control evaluation.

September 30). Realizing that early emergence is a survival disadvantage, earlier spawning is especially subject to early emergence when it occurs below the projects and is influenced by the relative warm waters being released at that time (note South Fork vs. above South Fork for September 15 spawning).

Running the model over time to predict adult returns for without project conditions shows slightly declining levels in run size for average and low flow years, and a more steady increase in run size with a high flow year. These actual numbers themselves are not meaningful because the model "uses" the same year condition (high, low, etc.) back-to-back for the 50-year period of analysis. The more meaningful numbers from the model are the relative comparisons (a high flow year provides better temperature conditions - later emergence when compared to other years - Table 6), and the comparisons between without and with (modified) temperature conditions (presented later in the report). Appendix B summarizes the without project condition model runs for the various hydrologic conditions analyzed for the project.

Resident Trout

The native rainbow trout (McKenzie resides) was chosen to evaluate for temperature control because of its widespread distribution throughout the area, popularity with anglers, and importance as a sport fish in the McKenzie River. It occurs in the mainstem McKenzie up to Tamolitch Falls and in the lower portions of the larger tributaries above Leaburg Dam, including the South Fork and Blue River. Substantial numbers of wild rainbow trout exist in the McKenzie, in conjunction with an intensively managed hatchery program for rainbow. Fingerling hatchery rainbow were stocked initially in the mainstem (as early as the 1920s) but this discontinued in the 1950s because of poor survival (ODFW 1988). Subsequent stocking of legal-sized rainbow peaked in 1967 with a high of 149,000 fish, and continues today with lesser numbers released to the mainstem and in Cougar and Blue River Reservoirs. Fingerling rainbow are stocked in Cougar Reservoir but not in Blue River Reservoir. About 18,000 legal size rainbow are stocked in Blue River in April and May, with expectations that most are caught within a month of release date. The McKenzie River system has long been one of Oregon's most popular rivers for trout fishing, and both wild and hatchery fish contribute to angler catch (ODFW 1983). Since the 1950s, the mainstem and tributaries have been closed to harvest of rainbow 14 inches and longer and rainbow over 20 inches are considered steelhead.

Cougar and Blue River Reservoirs have impacted rainbow trout in the McKenzie River system by inundating productive stream habitats, blocking migratory routes, and changing water quality conditions downstream. At the same time, the reservoirs have provided habitat for trout and are managed accordingly. They receive moderate-to-heavy angling pressure.

Very little information exists on the detailed distribution and abundance of wild rainbow trout in the McKenzie Basin, but catch and other data indicate substantial numbers are still present (ODFW, 1988). The percentage of wild to hatchery fish caught in creel surveys in the 1950's compared to the 1970's showed a decline, but this does not necessarily reflect a decline in the abundance of wild trout. It may be the result of hatchery fish being easier to catch, more available to anglers, and anglers targeting on hatchery fish. In both 1974 and 1983 wild fish represented about 10 percent of the catch (ODFW, 1988). The catch per angler and catch rate of trout less than 14 inches for both wild and hatchery trout have remained fairly constant since

1948, but the catch and release of wild rainbow greater than 14 inches per guided angler has increased since about 1960. About three fourths of the wild rainbow caught by electrofishing in the lower McKenzie River were between 4 to 8 inches in length, while legal-sized rainbow (6 to 14 inches) represented about 60 percent. Less than 4 percent of the rainbow were 14 inches or larger, and most wild rainbow kept by anglers in the 1983 creel survey were 7 to 11 inches.

Wild rainbow trout will be the true beneficiaries of temperature modifications (compared to hatchery trout) because hatchery fish are in the system so shortly (75 percent of catchable trout are caught within 2 weeks of stocking), while wild trout are present for their complete life cycle. It is likely that wild trout populations in the mainstem below South Fork to Leaburg Dam and in the tributaries downstream of the two dams are at depressed levels, compared to other McKenzie River sections, because of the stocking of legal-sized hatchery fish and the emphasis on a put-and-take fishery (ODFW, 1988). The section of the river from Blue River downstream to Leaburg Dam has been the heaviest stocked in the past. Stocking also occurs in the tributaries, but streamflow and temperatures aren't suitable until April through July for the Blue River, and until June in the South Fork (ODFW, 1988). Wild trout are protected from harvest in the S. Fork since 1992 to protect their populations and target on hatchery fish.

Empirical data do not exist for the McKenzie River that demonstrates any relationships between temperature changes downstream of the projects and changes to the wild or hatchery rainbow trout in the system. However, these relationships have been developed for other river systems using trout growth units, as an index of water temperatures favorable for trout growth. This same methodology has been applied to the McKenzie River for this study. Trout growth units are determined by the number of temperature-degree-days between 42 degrees Fahrenheit and 63 degrees Fahrenheit, the range at which trout growth can occur in the wild (Fraley and Graham, 1982). One day at 42 degrees Fahrenheit equals one trout growth unit. These data are available from the temperature modeling and compare differences for the South Fork, Blue River, and mainstem McKenzie down to Leaburg Dam. **Table 7** shows the differences in trout growth units for those stream reaches under three different water years for existing conditions. These units are calculated during the period March through October and as such represent a time period of heavily regulated flow, or releases from storage. In general, both tributaries show relatively cooler water (lower numbers) than the mainstem, with the South Fork being the coolest. Interestingly, during a low flow year, this is time of warmest water in the mainstem (highest number) because of the increased affect of solar heating on relatively low flows - but the period of coolest water (lowest numbers) in the tributaries because of the amount of flow released from storage during those periods. The more important value of these numbers is the relative comparison of existing conditions against future conditions modified with potential temperature control measures in place. Because trout growth is a function of both water temperature and food availability, many authors have also looked at aquatic insect production in dam tailwaters, in comparison to unregulated segments (Stanford and Ward, 1983; Perry et al., 1987; Ward and Stanford, 1979; and Ward and Stanford, 1982). These works included studies on reservoirs with hypolimnial releases similar to Cougar and Blue River Reservoirs, and presented results in terms of changes in distribution, abundance, and diversity of aquatic insects. In general, where

Table 7. Trout growth units [1] for three water years by stream reach for existing (without project) conditions

Stream Reach	Water Year		
	Normal Year	High Flow	Low Flow
Blue River	1383	1485	1081
S. Fork McKenzie	1095	1016	999
Mainstem @ Vida	1460	1464	1876

[1] Trout growth units for resident trout are temperature degree-days between 42-63°F for the period March 1 through October 31.

conditions have been altered such that temperatures are uniformly colder, lacking daily and/or seasonal fluctuations, and waters are enriched with nutrients from the reservoir, aquatic insect populations are much less diverse (fewer species), with larger numbers of individuals of a few species that are suited for these altered conditions. The highly restricted insect fauna, in combination with other conditions such as cold waters, highly variable flows, etc., strongly influence trout populations and their ability to assimilate food organisms, (Ward & Stanford, 1982). These conditions likely exist in both the South Fork and Blue River downstream of the projects, and to a lesser extent in the mainstem below the South Fork. They would continue to exist in the future unless the temperature regimes are modified to a more nature (pre-project) condition.

Bull Trout

Bull trout distribution in the McKenzie System is primarily upstream of Leaburg Dam in the mainstem to Tamolitch Falls, and in the South Fork, (including Cougar Reservoir). There are 3 or 4 main population areas, including the S. Fork, Mainstem McKenzie, Trail Bridge, and Carmen-Smith. Occasionally, bull trout are counted in the ladder at Leaburg Dam moving upstream, and significant migrations have been noted for the species in general (Pratt, 1992). A 1983 creel survey conducted from Armitage Park to just above Blue River (mainstem only) showed that bull trout represent less than 5 percent of the wild trout caught by anglers (ODFW, 1983).

Bull Trout were selected for evaluation because of the concern for the species' status throughout the state, their known distribution in the mainstem and South Fork McKenzie River, the need to avoid any additional impacts to bull trout from the Corps' projects, and to identify any restoration opportunities. ODFW has listed bull trout as a sensitive/critical species; and it is a Category 2 candidate species under the Endangered Species Act (meaning additional data are needed to determine the appropriateness of listing as threatened or endangered status). The Service has been petitioned to list the bull trout under the Endangered Species Act and a finding on the status of the species is imminent. At such time as a formalized finding is announced, the Corps will be notified promptly.

The Oregon Chapter of the American Fisheries Society (AFS) has special concerns for the status of bull trout and hosted a workshop recently to document information about the species (Howell and Buchanan, 1992). Looking at bull trout distribution statewide, over two-thirds of the populations were considered to have at least moderate risk of extinction, including the South Fork McKenzie River population (Ratliff and Howell, 1992). Populations in the McKenzie river basin were assumed to be at risk because of overharvest, passage barriers, habitat degradation, and hybridization with brook trout. The first three issues are particularly important in the South Fork and the mainstem McKenzie below there.

Specific life history information for bull trout suggests strong temperature associations, in some cases with very narrow ranges. **Figure 6** shows temperature tolerances for different life stages during the time (Calendar period) they occur. **Table 8** shows a comparison of these temperature conditions with existing conditions in the South Fork and downstream in the mainstem McKenzie River. In general, the spawning and egg incubation periods are the most temperature impacted under existing conditions because they occur at a period when ambient air and water temperatures are declining naturally- but increasing under existing release conditions, and the existing water temperatures are substantially greater than optimum conditions (by 12 to 20° F)

Table 8. Comparison of bull trout life history temperature requirements by life stage with existing temperature conditions in the S. Fork and mainstem McKenzie River. 1/

Life Stage & Time Period	Required Temp. Range (°F)	Existing Temp. Range (F)	
		S. Fork	Mainstem (below S. Fork)
Adult Migration (July-Sept.)	50 - 54	52 - 58	46 - 52
Spawning (Sept-Oct)	38 - 50	54 - 62	50 - 56
Egg Incubation (Sept-April)	38 - 42	62 - 40	50 - 38
Optimum Fry Growth (April-June)	38 - 40	42 - 46	44 - 48
Optimum Juvenile Growth (Year round)	38 - 48	40 - 62	40 - 56

1/ Required temperatures from Figure 6 (references there) and existing temperatures from Corps modeling (Corps, 1993).

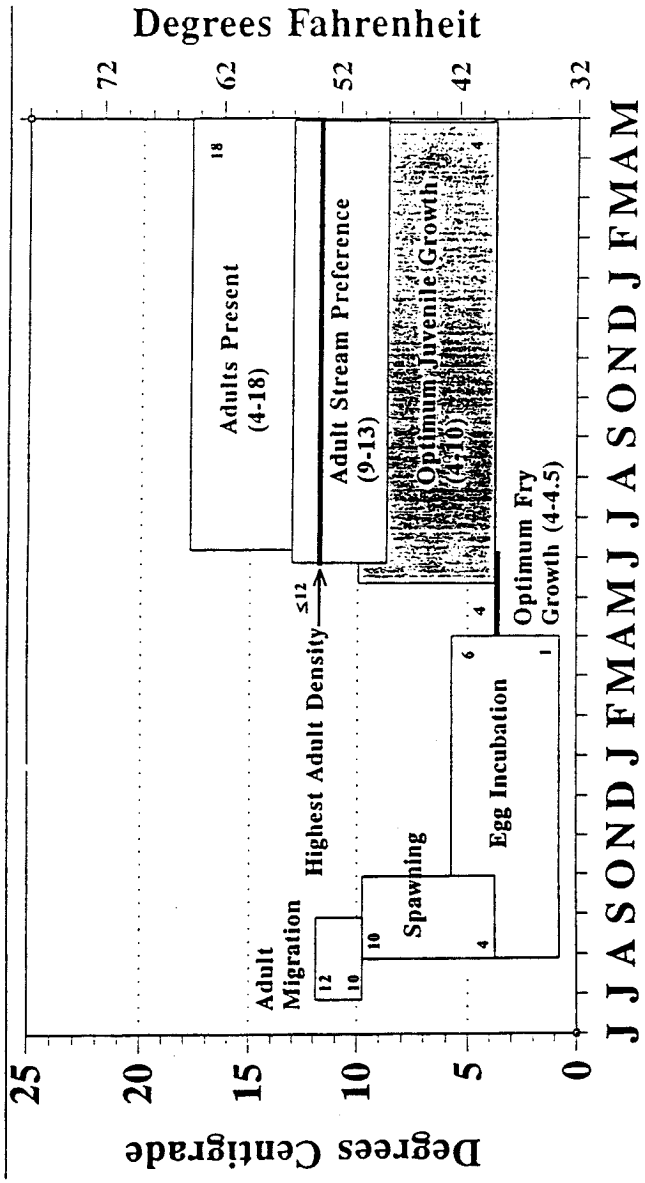

Figure 6. Bull trout temperature requirements.

Beyond just temperature conditions, bull trout have specific habitat needs for many of their life stages. Examples include spawning affinity for areas with groundwater influence; juveniles and adults associated with complex cover of in-channel woody debris, undercut banks, and pools; and young-of-the year associated with side channels, stream margins, or other low velocity areas. These habitat features would also influence bull trout use of the project area. Food items for bull trout include terrestrial and aquatic insects, macro-zooplankton, mysids, and fish. Fish are the common food items in bull trout larger than 8 inches and large bull trout may feed exclusively on fish. For reasons discussed with resident rainbow trout, food items for bull trout are probably limited in the South Fork because of existing temperature conditions. Under existing conditions, bull trout distribution and use of habitats in the area of influence is not expected to change.

With The Project

Spring Chinook

The physical data from the temperature modeling shows that multilevel outlets at Cougar and Blue River Dams are mostly able to meet the target temperatures set by the agencies (Appendix A). More importantly than just meeting the temperature objectives, the modified conditions emulate conditions that occur naturally (without the projects.) They provide similar seasonal ranges that allow biological resources to respond cumulatively (ie. more important than a daily maximum or minimum temperature - the ranges do not approach lethal conditions - egg development and fry emergence timing is a function of the cumulative temperature conditions after spawning has occurred. Accordingly, the temperature changes with modified conditions mean significant improvements in emergence timing for spring chinook fry, and influence the number of adults returning in future years. **Table 9** shows changes in emergence timing for the different alternatives by water year, and **Table 10** shows the estimated return in adults based on the 1st years production, with all alternatives starting with 3,000 adults migrating upstream of Leaburg Dam. Given the first year's returns, **Table 11** shows the time to build run size and reach the ODFW management objectives of 10,000 adults upstream of Leaburg Dam. **Figure 7** shows an example of this run buildup for the alterative of both projects in the average water year (1984).

In summary, compared to the without project conditions, all alternatives show improving trends for spring chinook returns, with some showing rapid buildups to management goal levels (Appendix B). However, the Blue River only alternative shows much longer to reach desired levels, and the both projects alternative shows the same numbers for the Cougar only alternative. Both of these conditions exist because there is no sensitivity built into the production model for Blue River only. The only variable in the model that this alternative influences is fry survival based on emergence timing on the mainstem at Vida. The relatively smaller Blue River project has much less influence than Cougar on the much larger mainstem flows and temperatures. The bottom set of figures in table 9 on dates to emergence timing shows this. With Blue River only, there is only 1 to 5 days difference (improvement) in fry emergence timing at Vida compared to existing conditions.

Table 9. Date of reaching 1800 Temperature Units with project modifications by water year and alternative. 1/

Location	Water Year	Existing Condition	MultiLevel Intake		
South Fork	Low (1977)	18 Jan	8 March		
	High(1983)	14 Jan	7 March		
	Avg.(1984)	1 Feb	15 March		
Blue River	Low flow	3 Feb	1 March		
	High flow	11 Jan	27 Feb		
	Avg. flow	3 Feb	11 March		
Mainstem @ Vida			Blue Only	Cougar Only	Both
	Low flow	11 Feb	12 Feb	22 Feb	24 Feb
	High flow	26 Feb	3 Mar	10 Mar	15 Mar
	Avg. flow	5 Mar	9 Mar	14 Mar	18 Mar

Table 10. Estimated Returns of Adult Spring Chinook Salmon From Year 1 Production Based on Alternative. 1/

Alternative	Average Year	High Flow Year 1983	Low Flow Year 1977
Without Project	2924	3094	2958
Blue River Alone	3094	3232	3146
Cougar Dam Alone	3284	3284	3284
Both Projects	3284	3284	3284

1/ From spring chinook production model (Appendix B).

Table 11. Estimated time to reach 10,000 adult spring chinook returns to Leaburg Dam annually. 1/

Alternative	Average Year	High Flow Year 1983	Low Flow Year 1977
Without Project	declining trend	43	declining trend
Blue River Alone	>50	24	42
Cougar Dam Alone	20	20	20
Both Projects	20	20	20

1/ From Spring chinook production model (Appendix B).

By adding Blue River to the Cougar only alternative, a similar improvement of 2 to 5 days occurs with both projects compared to Cougar only. These small differences would not contribute significantly to fry survival based on how that relationship exists in the model. However, we believe there are important reasons and benefits to be realized from modifying the existing temperature conditions at Blue River. These are mentioned later in the discussion section of the report.

Resident Trout

In contrast with the situation for spring chinook, the benefits analysis for resident trout does show significant improvements with the Blue River only alternative. Table 12 lists the changes in trout growth units by alternative for different water years. The Blue River alternative shows improvements of 34 to 53 percent increases in the Blue River, compared to existing conditions, and a small increment of improvement in the mainstem at Vida (2 to 3 percent). However, this increment is measurable in addition to changes that would occur with Cougar modifications. Cougar modifications show improvements of 38 to 46 percent in the South Fork, and 5 to 8 percent at Vida (Table 12).

Improved temperature conditions for resident rainbow trout would primarily benefit wild trout. As discussed earlier, the area of influence for temperature control is managed by ODFW primarily as a hatchery supported fishery. Wild trout in these stream reaches are most likely at reduced population levels because of harvest and competition with hatchery fish. Restoring stream temperatures to near normal (pre-project) conditions in other rivers has returned the natural timing of insect life cycle events and insect

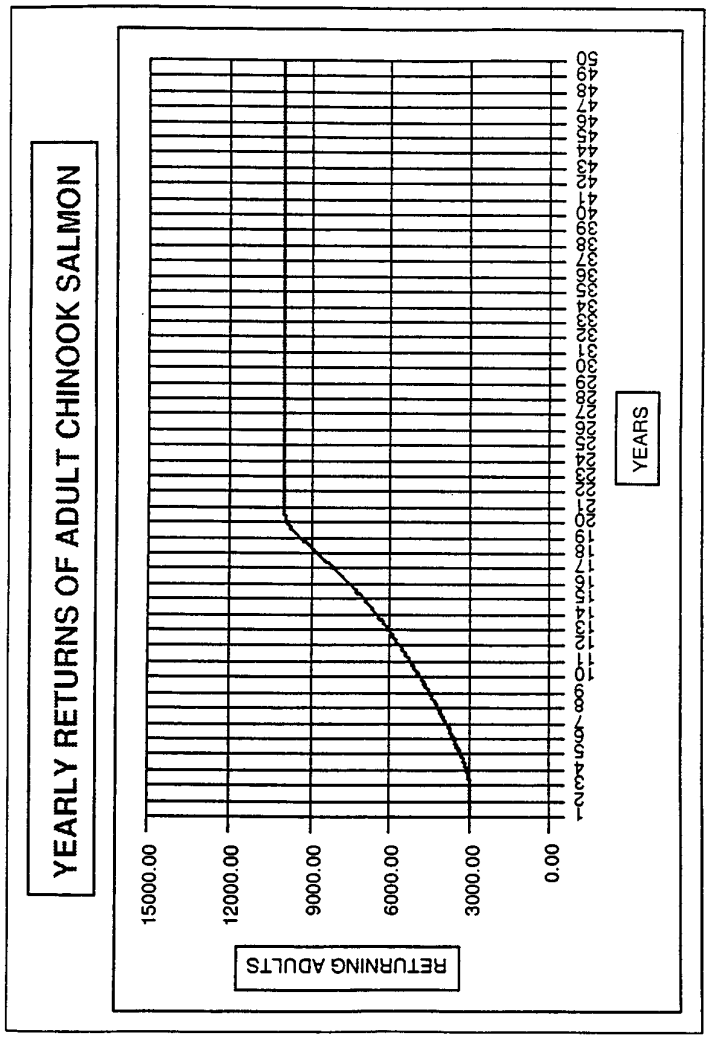

Figure 7. Buildup of spring chinook runs with temperature modification at Blue River and Cougar Projects.

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Table 12. Change in Trout Growth Units (and percent increases) with Mckenzie River Temperature Control Project.

Alternative	Tributary Trout Growth Units		
	Normal Year (84)	High Flow (83)	Low Flow (77)
Blue River			
W/O	1383	1485	1081
	(+38%)	(+34%)	(+53%)
W/Temp.	2229	2265	2303
Cougar			
W/O	1095	1016	999
	(+38%)	(+44%)	(+46%)
W/Temp.	1758	1803	1853

	Mainstream Trout Growth Units (Vida)		
	Normal Year (84)	High Flow (83)	Low Flow (77)
Blue R. Only			
W/O	1460	1464	1876
W/Temp.	1492 (+2%)	1506 (+3%)	1919 (+2%)
Cougar Only			
W/O	1460	1464	1876
W/Temp	1572 (+7%)	1592 (+8%)	1979 (+5%)
Both			
W/O	1460	1464	1876
W/Temp	1604 (+9%)	1634 (+10%)	2023 (+7%)

community structure to normal conditions (Ward and Stanford, 1979). This means increased diversity of insect species and greater availability of food supply to all life stages of trout (fry, juvenile and adults). Additionally, increased food supplies in warmer waters means fish would more readily assimilate this food source into biomass (size) and be relatively larger by age class, compared to existing conditions. In general, larger size can mean increased survival (Fry, 1971; Lagler et.al., 1962). Accordingly, we believe the wild trout population in the tributaries would respond to the significantly improved growth conditions and population levels would increase towards their full potential within the limits of habitat or other factors. It is difficult to quantify this change in numbers of fish because no baseline population information was collected for this study and very little quantifiable information exists for these stream reaches.

Changes would be more subtle in the mainstem McKenzie downstream of the South Fork. While there may not be changes in the overall numbers of resident trout, existing wild trout would also respond to increased temperatures and food availability and probably increase in size. Because the size and numbers of fish also influence angler effort, there would be increased angler effort and harvest of trout in all of the project area. The attached Appendix C presents a methodology for how trout harvest increases can be measured in terms of angler-days. This information is based on the 1983 creel survey conducted by ODFW for the McKenzie River (ODFW, 1990).

Reservoir drawdown for construction would adversely impact resident trout fisheries in the reservoirs. Current estimates are that the pools would be drawn to the level of the existing flood control pools for at least the first two years conservation (summer) season during construction, and then gradually increase as construction proceeds towards completion (no more than four years total). It is likely ODFW would not stock the reservoirs during this construction period (at least the first few years) and the fishery would be foregone for that period. It is estimated that _____ and _____ angler days, annually would be lost at Cougar and Blue River Reservoirs, respectively.

Bull Trout

Bull Trout populations in the South Fork and mainstem Mckenzie River would respond to temperature changes similarly to the resident trout. Improved food supplies and growth conditions for resident trout, and improved fry survival for chinook fry, would mean improved food sources for adult bull trout, which are known to prey on these fish. There may also be more exchange of adult bull trout between the South Fork and mainstem populations as habitat conditions (temperature ranges) become more favorable in the South Fork downstream of Cougar Dam. Also if there is recruitment to the South Fork (tailwaters) and mainstem populations from bull trout production in the South fork upstream of Cougar Reservoir, temperature conditions would be more suitable for bull trout in these areas.

It is unknown if the specialized habitat conditions for spawning or fry and juvenile rearing for bull trout exist in the South Fork. If they do the temperature changes with the project would favor their use, compared to existing conditions. For the period of September through November, which includes adult migration, spawning, and early egg incubation, temperatures are

reduced by 5 to 12°F with the project, which would put them within the range of suitable temperatures for those life stages (Table 8).

A habitat improvement project being completed by the Forest Service for fisheries restoration in the South Fork may provide some of the specialized habitat areas used by bull trout. This project involves reconnection of some off-stream, side channels with the South Fork that are presently dewatered so they will become wetted, permanent aquatic habitats. In stream habitat work to create large woody debris and add other structure to these channels is also being provided. Improved temperature conditions in the South Fork would also improve habitat utilization for resident trout and bull trout in this new habitat.

DISCUSSION

Temperature modifications at Cougar and Blue River projects would restore water temperatures in the tributaries and the mainstem McKenzie River below the South Fork downstream to Leaburg Dam to pre-project conditions. Adult returns of spring chinook upstream of Leaburg Dam would increase to at least desired management levels of the ODFW. A run of 10,000 adults upstream of Leaburg is an increase of 7,000 fish over the average escapement (3,000 fish) above Leaburg since the projects were completed (Table 3). The adverse effects of downstream temperature modifications were not anticipated or evaluated when the projects were originally planned and built, thus these improvements would mitigate some of those impacts. The historic returns to the McKenzie Basin for pre-project years averaged 18,000 fish, compared to the 6,800 spring chinook with the projects - which includes the hatchery production provided to offset losses upstream of the dams.

Doubling the run size of anadromous fish stocks in the Columbia River Basin, as envisioned in the Fish and Wildlife Program of the Northwest Power Planning and Conservation Act, requires improvements in all stocks, including the lower Columbia River Spring Chinook. The McKenzie River is especially important to this stock because of the significant amount of useable habitat still available, and the opportunity to manage and protect wild fish in their native streams. ODFW estimates that escapement of adults upstream of Leaburg dam includes 50 to 80 percent hatchery fish (ODFW, 1993). This is in excess of the state's wild fish policy for areas where hatchery and wild fish are mixed, but of the same stock.

Efforts throughout the Northwest are being taken to reduce the effects of hatchery fish on native stocks where they are mixed, and modify or reduce hatchery programs to emphasize wild fish, including the use of wild fish as broodstock in some areas. Increasing escapement upstream of Leaburg Dam is highly significant for managing wild fish because it increases the numbers of fish into habitat that is greatly underseeded, and it increases the survival of fish presently utilizing that habitat (reduced pre-spawning mortality and increased fry survival - both benefits of temperature modification).

As mentioned earlier, the resource agencies believe it is important to modify temperature conditions at both Blue River and Cougar Projects, although the benefits analysis shows no additional benefits with the increment of Blue River. There are two primary reasons for including Blue River. First, the

production model had only one variable (emergence timing) that would influence results in the mainstem at Vida, while there are likely others that would influence spring chinook returns upstream of Leasing Dam (such as migration timing) that are temperature related. Secondly, the existing evaluation was limited to existing operations, when other operational scenarios may be part of future Willamette Basin operations, and the flexibility of temperature control at both projects is important.

Numerous authors have identified the importance of temperature to spring chinook migration (Armour 1991, Bell 1986, and Reiser and Bjornn 1989). The NMFS identified how temperature affects passage of spring chinook at Willamette Falls and Leaburg Dam, and that migration timing has been shifted later by several weeks at Leaburg Dam, compared to pre-project conditions. NMFS also reported that passage at Leaburg Dam occurred at the time of day when peak temperatures were reached (late afternoon and early evening); and that modified operations to increase temperatures during the early spring chinook migration period in 1990 and 1991 produced increased passage at Leaburg Dam during those operations (NMFS, 1991). In the Rogue River Basin, ODFW (1986) has documented the importance of the early portion of the spring chinook run because these are larger, older fish, generally destined to the upper portion of the basin. Similar fish in the McKenzie River would be destined to the upper mainstem (Carmen Smith Spawning Channel) and tributaries (Horse Creek and Lost Creek), all significantly underseeded. While the resource agencies believed it would be important to include migration timing and passage success at Leaburg Dam, there were no data to develop a specific relationship in the model, and thus, this has not been included in the present evaluation.

Blue River may have a greater impact on early migrations because it is generally the first of the two McKenzie projects drawn down. Releases from that project would have more impact on mainstem temperatures during the spring migration period (April, May, early June) because a similar or larger portion is from Blue River, relative to Cougar releases.

Another major reason to consider modifying Blue River temperature releases is because the existing study only addressed present operations, and the existing modeling only evaluated meeting agency target temperatures, when in fact, both of these may change. In the first situation, we are aware that reauthorization discussions are under way to address how the Willamette Basin Projects might be operated differently for a number of water related issues in the basin (water supply, water quality, instream flow needs, etc.) Such modifications could mean different flow scenarios from the two McKenzie projects. Changes in operations (flows) may further affect how existing temperatures would impact aquatic resources, and thus the need to have a way of dealing with these impacts (modified temperature releases).

On the second point, the Rogue River Basin Projects (Lost Creek and Applegate) have multi-level outlets as part of existing operations and target temperatures are established and met as part of annual operations. These target temperatures have been developed over the period of operation with close monitoring and evaluation by ODFW to establish detailed temperature and flow relationships for the resources of concern at each project. This should be developed for the McKenzie projects with the establishment of a monitoring and evaluation effort as part of project implementation. If modification of temperature conditions at Blue River are not implemented, there will be no opportunity to deal with existing problems in the Blue River, or optimize

conditions in the mainstem below the Blue River - and no flexibility to solve the complete problem and implement the best solution based on the follow-up results. A phased implementation - construction of one project first and then close monitoring of results, would allow details to be developed on specific temperature responses and a complete accounting of project benefits, thus helping to justify completion of the remaining project. Because of the increased benefits with the present analysis it is anticipated that Cougar modifications would be completed first in a phased approach.

In addition to the benefits to spring chinook, there are significant improvements to resident, wild rainbow trout populations in the tributaries and mainstems, and likely improved habitat utilization by adult bull trout in the tailwaters of the South Fork. The response of these indicator species to modified (improved) temperature conditions are examples of benefits that would occur to the aquatic ecosystem in the affected areas. The most obvious change that has been discussed earlier and studied in great detail in other areas is to the aquatic insect community. However, these changes would also directly benefit other species that utilize these resources, such as mountain whitefish, sculpins, and cutthroat trout, and several shore and wading birds, such as dippers and western sandpipers. Indirectly, numerous other species would also respond to the increased numbers of their prey base, such as mink, river otter, great blue heron, common mergansers, and other fish-eating birds and mammals.

The Record of Decision to implement the President's Forest Plan (FEMAT, 1994) for forest lands within the range of the northern spotted owl, includes special attention to key watershed areas for restoration. The plans emphasis is ecosystems management for all forest species, including the concern for aquatic and associated riparian species and habitats - especially opportunities to deal with the decline of many stocks of anadromous fish throughout their range. In the McKenzie Basin the upper mainstem and tributaries, and the S. Fork McKenzie have been identified by the Forest Service as key watershed areas. Initiation of restoration efforts in these areas in 1994 alone will spend about $_____ by the Forest Service, targeted primarily for anadromous fish. Significant levels of restoration are expected for at least the next five years under the plan. Restoring preproject temperature regimes and the resulting increases in anadromous fish is strongly supportive and compatible with watershed restoration. As survival is increased for existing levels of fish returns with the improved temperature conditions, future chinook returns would benefit from additional habitat improvements provided by watershed restoration.

Finally, restoring temperatures to pre-project conditions in streams downstream of high head dams with hypolimnial releases, is not new and well studied and implemented in other basins. Some notable examples in the west include Shasta Dam on the Sacramento River, Flaming Gorge Dam on the Green River, and Hungry Horse Dam on the South Fork Flathead River. In the case of Flaming Gorge Dam, the Bureau of Reclamation (BR) installed selective withdrawl gates in 1979 and dramatically changed the character of the Green River downstream. Uniformly cold waters with poor insect populations and limited trout growth were changed to a nationally recognized premium trout fishery (USFS, 1991). Between 1983 and 1990, recreational use of the river increased by '130 percent, and in 1990, 115,000 users (46 percent nonresident) contributed 54.5 million to the Utah economy. At Hungry Horse Dam on the South Fork Flathead River in Montana, uniformly cold waters (40°F year round) have reduced trout growth from May through October to a fraction of pre-dam

levels, and disrupted life cycles of aquatic insects. Impacts are noted on both the S. Fork and mainstem Flathead Rivers. Analysis of benefits with selective withdrawl (Fraley and Graham, 1982) estimate a potential increase in trout growth in the S. Fork by a factor of ten, and doubling growth in the mainstem. This action is being implemented as part of a fisheries mitigation plan for resident fish under the Northwest Power Act by the Montana Department of Fish, Wildlife and Parks, and local tribes in cooperation with the BPA (Montana DFWP, 1991). At Shasta Dam on the Sacramento River in northern California, stocks of chinook salmon have been adversely impacted by both temperatures and flows downstream, to the point that the winter run chinook has been listed as an endangered species under the Endangered Species Act. Modeling results conducted by the BR demonstrated that temperatures could be improved substantially with selective withdrawl (shutter device) with corresponding significant benefits to winter run and other chinook salmon (USBR, 1991). Looking at all races of chinook over the life of the project, the salmon runs more than doubled for the preferred plan.

RECOMMENDATIONS

In light of the above discussion, it is recommended that the Corps of Engineers:

1). complete the McKenzie River Temperature Control feasibility study and seek Congressional authorization to implement the project;

2). construct temperature control measures at both Blue River and Cougar Dams to achieve full benefits and affect all existing project-caused adverse temperature conditions;

3). develop and implement a monitoring and evaluation plan, in cooperation with the resource agencies, that would be implemented with project operation, to document accomplishments, shortcomings, and make corrections as needed to fully achieve resource benefits; and

4). fully fund these items as non-reimbursable project costs to the Federal Government consistent with the significant benefits to natural resources of national importance, and to mitigate for the impacts to these resources as identified in the Willamette Basin project authorizations

Please let us know of your response to these recommendations. Additionally, if any new project information or issues develop that could require updated or new analyses, we request you contact the Service to seek our input consistent with the Fish and Wildlife Coordination Act.

Attachment

RG/meh/C:RONI/6-1-94

APPENDIXES

A) Results of Corps Temperature Modeling
B) Results of Spring Chinook Production Model
C) Methodology for Economic Analysis of Resident Trout Benefits

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ATTACHMENTS

RESULTS OF CORPS TEMPERATURE MODELING

RESULTS OF SPRING CHINOOK PRODUCTION MODEL

METHODOLOGY FOR ECONOMIC ANALYSIS OF RESIDENT TROUT BENEFITS

CURRENT STUDIES

HEC HEC-5Q

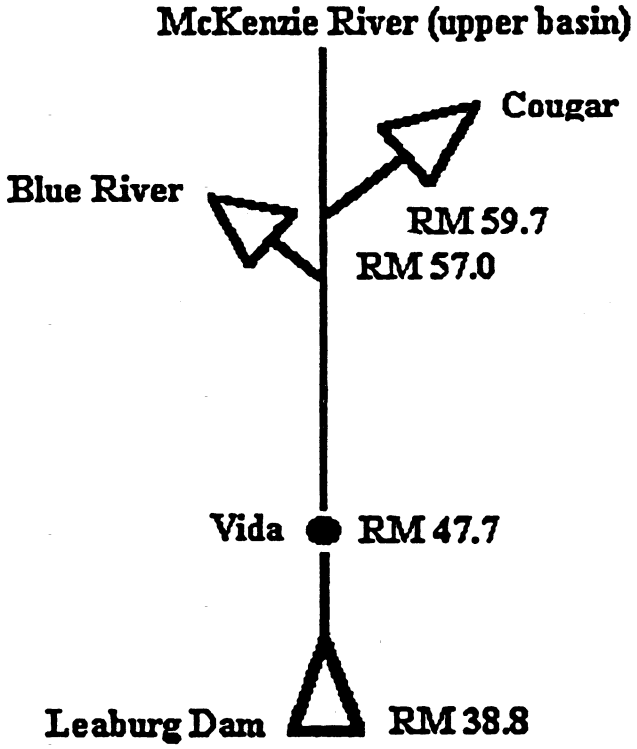
integrated temperature effects

WES WESTEX/WESMIN

design evaluation

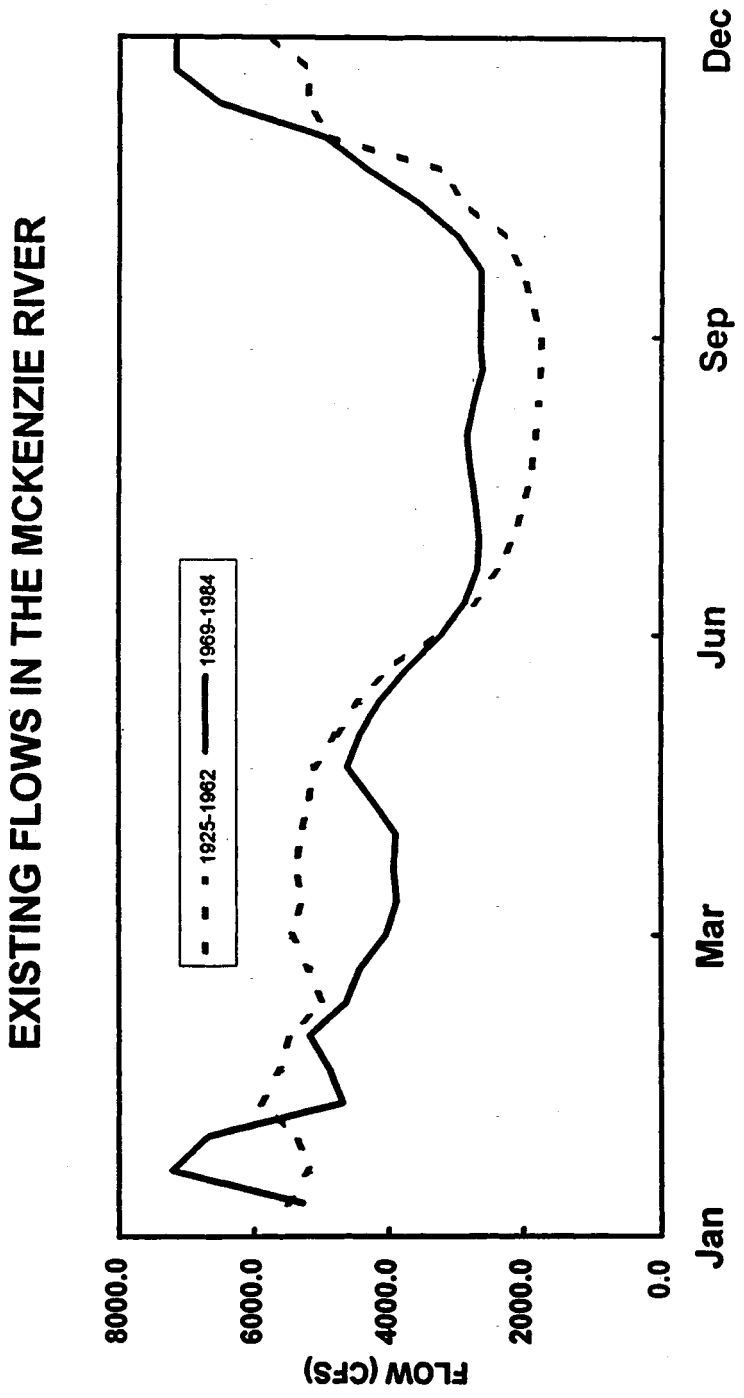
CONCEPTUAL MAP

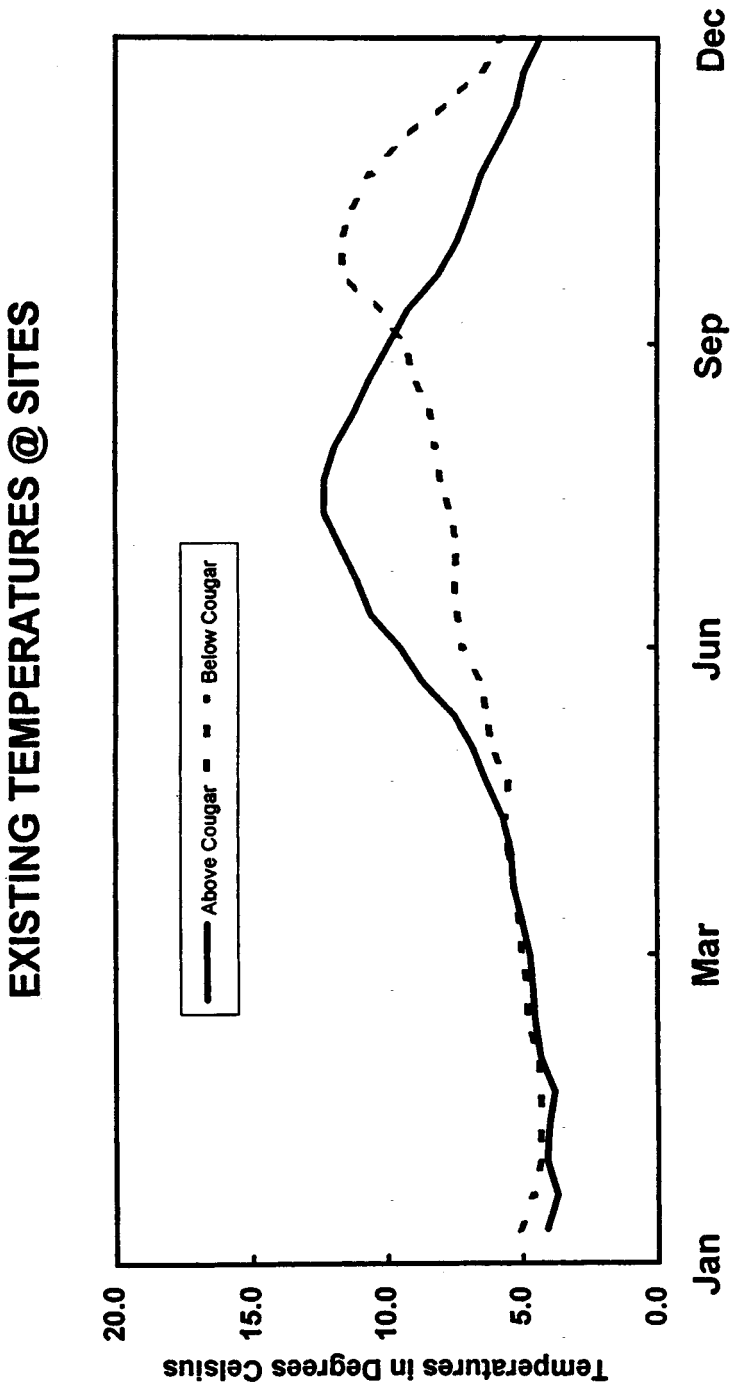
Confluence Location

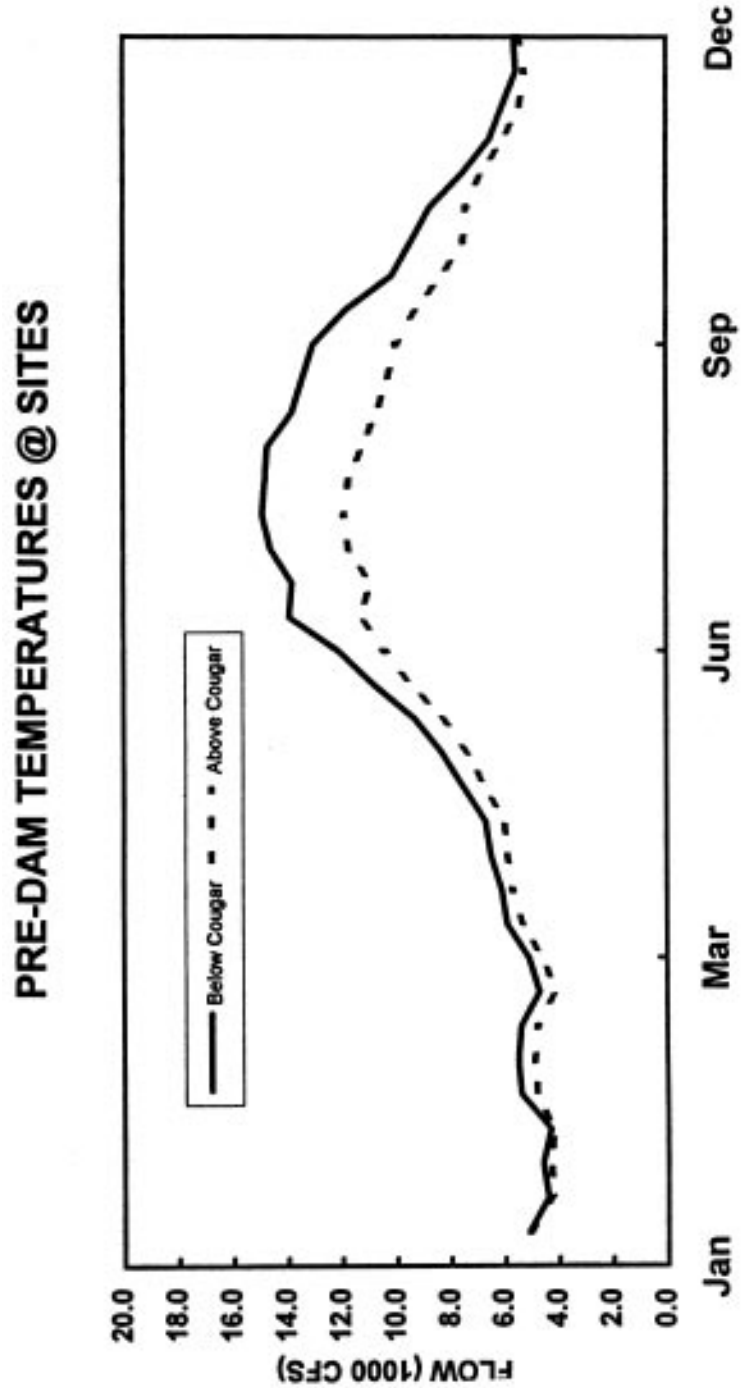


* mean annual discharge

PROJECT EFFECTS


EXISTING FLOWS IN THE MCKENZIE RIVER
1925-1962
1969-1984
8000.0
6000.0
4000.0
2000.0
0.0
FLOW (CFS)
Jan
Mar
Jun
Sep
Dec

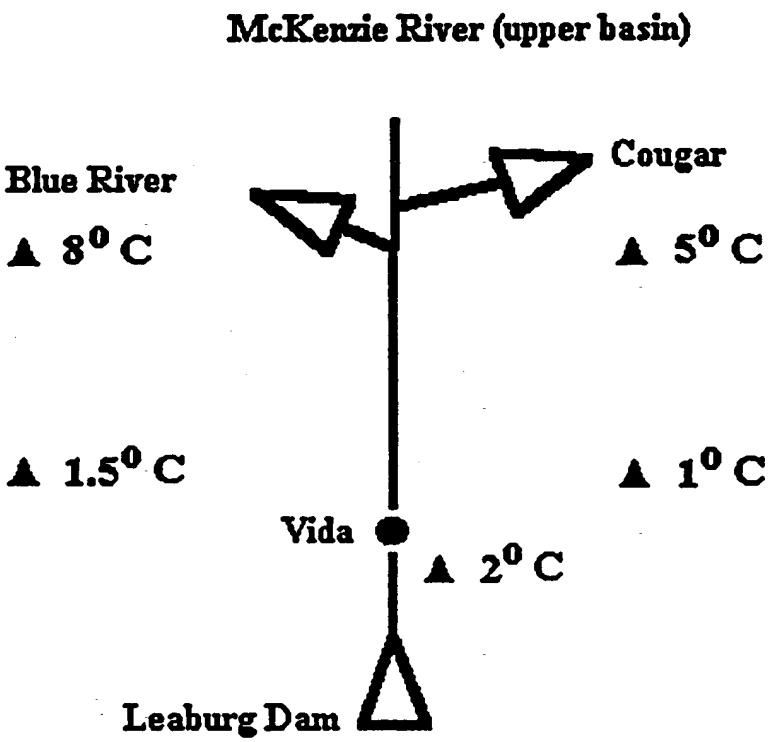

EXISTING TEMPERATURES @ SITES
Above Cougar
Below Cougar
Temperatures in Degrees Celsius
20.0
15.0
10.0
5.0
0.0
Jan
Mar
Jun
Sep
Dec

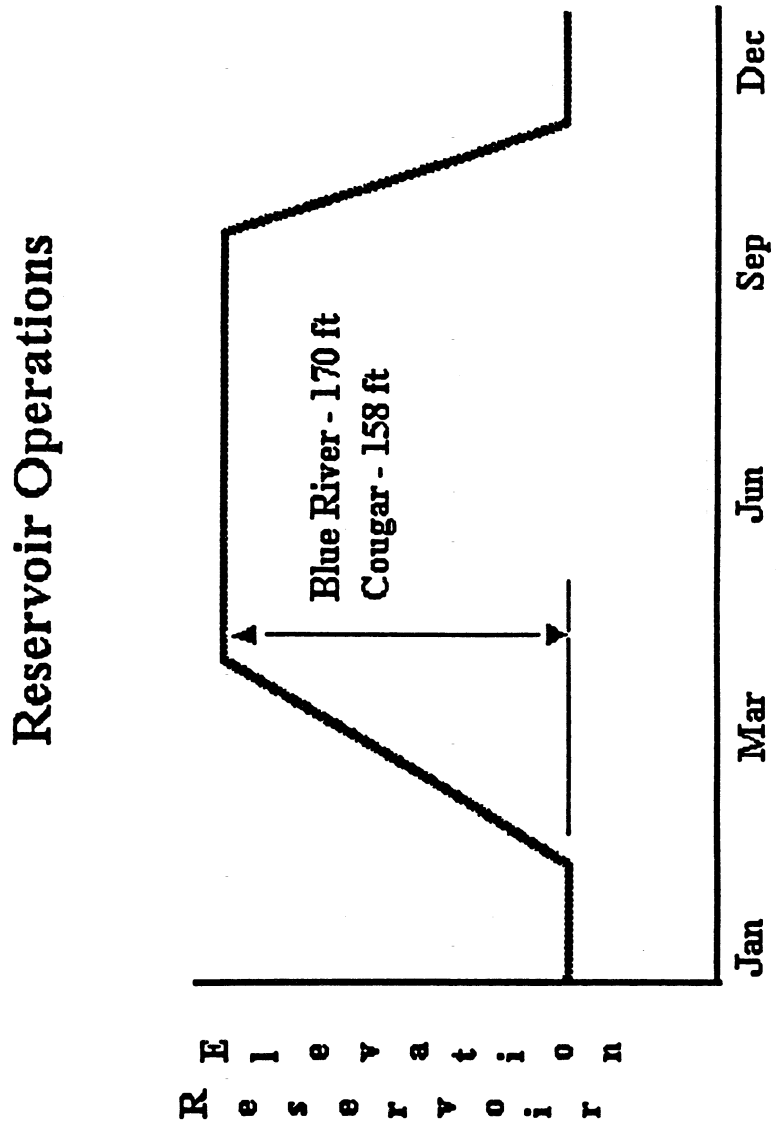

PRE-DAM TEMPERATURES @ SITES
Below Cougar
Above Cougar
FLOW (1000 CFS)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Jan
Mar
Jun
Sep
Dec

PHYSICAL FACTORS

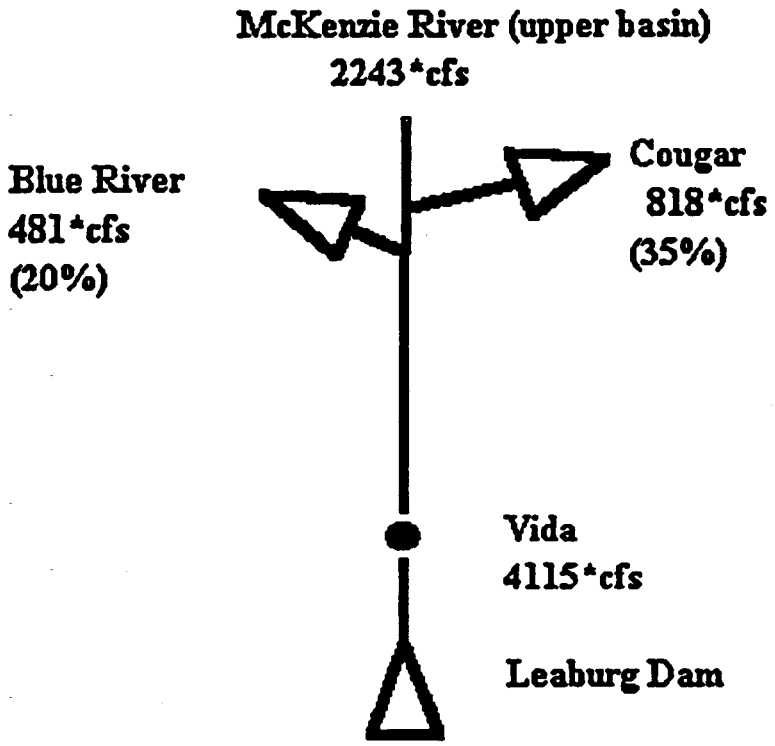
- reservoirs on tributaries
- cool wet winters/
  warm dry summers
- large pool fluctuations
- warm water floats

TEMPERATURE EFFECTS




Reservoir Operations
Blue River - 170 ft
Cougar - 158 ft
Reservoir Elevation
Jan
Mar
Jun
Sep
Dec

FLOW DISTRIBUTION

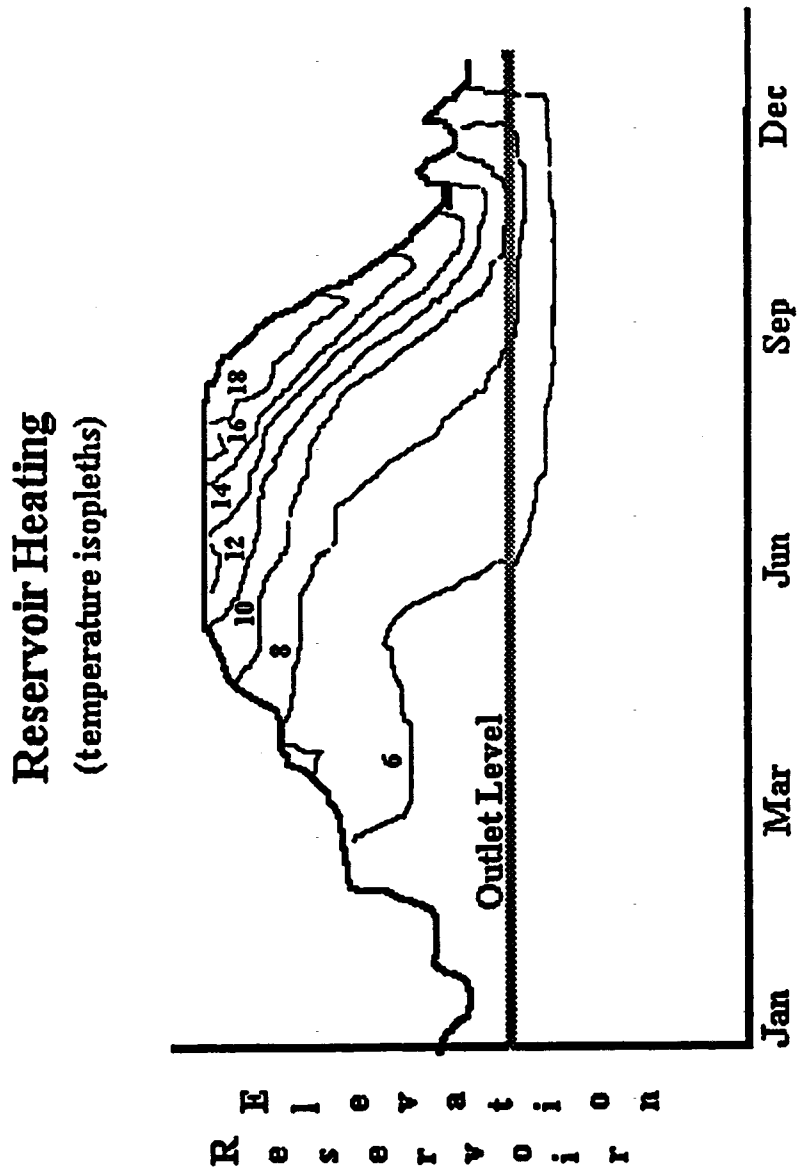


* mean annual discharge

Table 1

Cougar Reservoir Physical Description

Elev. (ft)	Storage (AF)	Max. Flow (cfs)	Surf. Area (acres)	Width (ft)
1274	0	0	0	0
1280	8	0	20	420
1286	41	0	40	444
1292	98	0	60	468
1298	183	0	80	492
1304	303	0	100	510
1322	879	0	120	554
1358	3333	0	140	639
1376	5476	0	155	682
1400	9633	0	170	740
1418	13696	0	180	836
1436	18565	0	280	931
1454	24563	0	320	1027
1472	32140	0	360	1122
1490	40671	0	440	1217
1496	43645	0	480	1249
1502	46682	0	520	1278
1508	49840	0	560	1303
1514	53140	4000	620	1328
1520	56584	5000	690	1353
1526	60171	5600	600	1376
1532	63905	5920	610	1404
1538	67787	5920	620	1429
1544	71809	5920	630	1454
1550	75937	5920	700	1479
1556	80170	5920	720	1504
1562	84509	5920	740	1530
1568	88962	5920	760	1555
1574	93534	5920	777	1580
1580	98225	5920	820	1605
1586	103039	5920	840	1630
1592	107975	5920	850	1656
1598	113036	5920	860	1681
1604	118223	5920	870	1707
1610	123539	5920	880	1733
1616	128983	5920	900	1759
1622	134559	5920	930	1785
1628	140264	5920	970	1811
1634	146098	5920	990	1836
1640	152062	9900	1010	1862
1646	158166	9950	1030	1888
1652	164417	11000	1060	1914
1658	170816	12000	1080	1940
1664	177376	16000	1120	1965
1670	184099	22700	1130	1991
1676	190990	36000	1150	2017
1682	198055	45000	1190	2043
1688	205302	62000	1200	2069
1694	212737	76000	1250	2094
1700	220363	105000	1290	2120


Reservoir Heating
(temperature isopleths)
Reservoir Elevation
Outlet Level
6
8
10
12
14
16
18
Jan
Mar
Jun
Sep
Dec

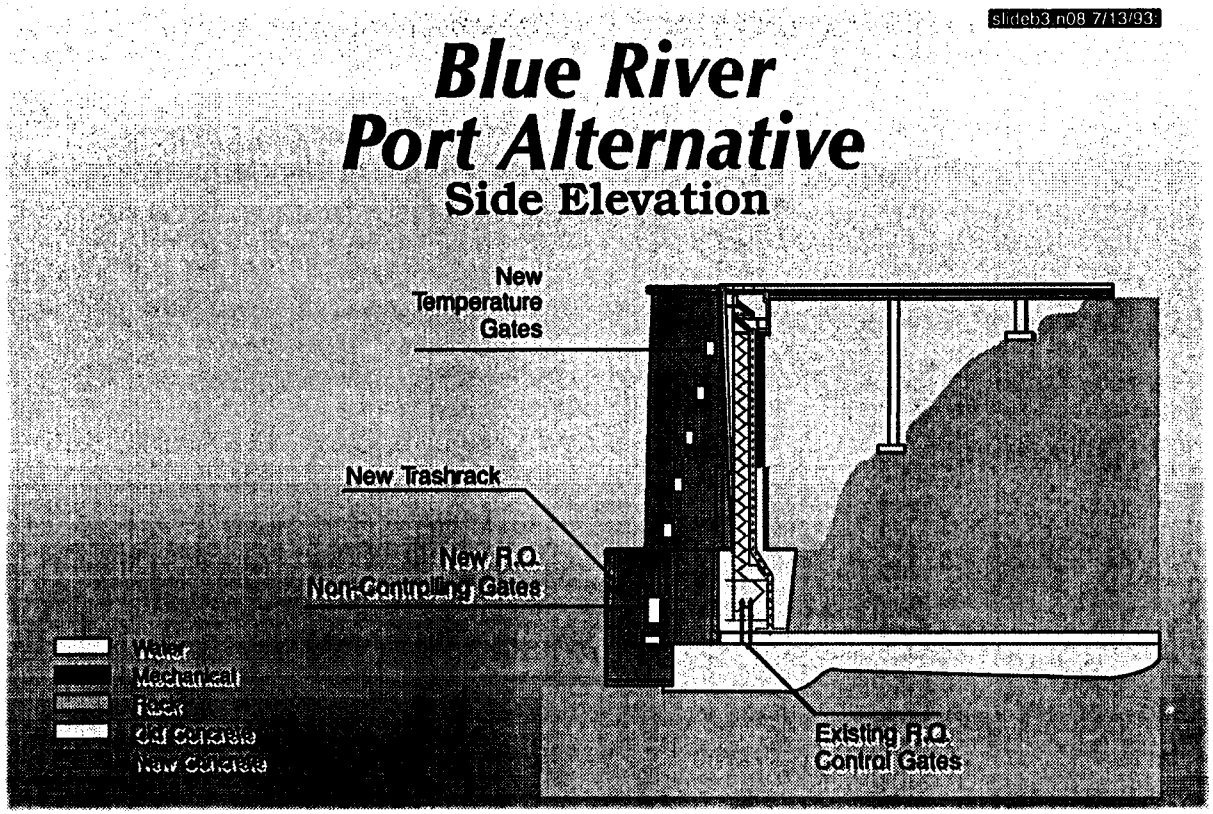
CRITERIA

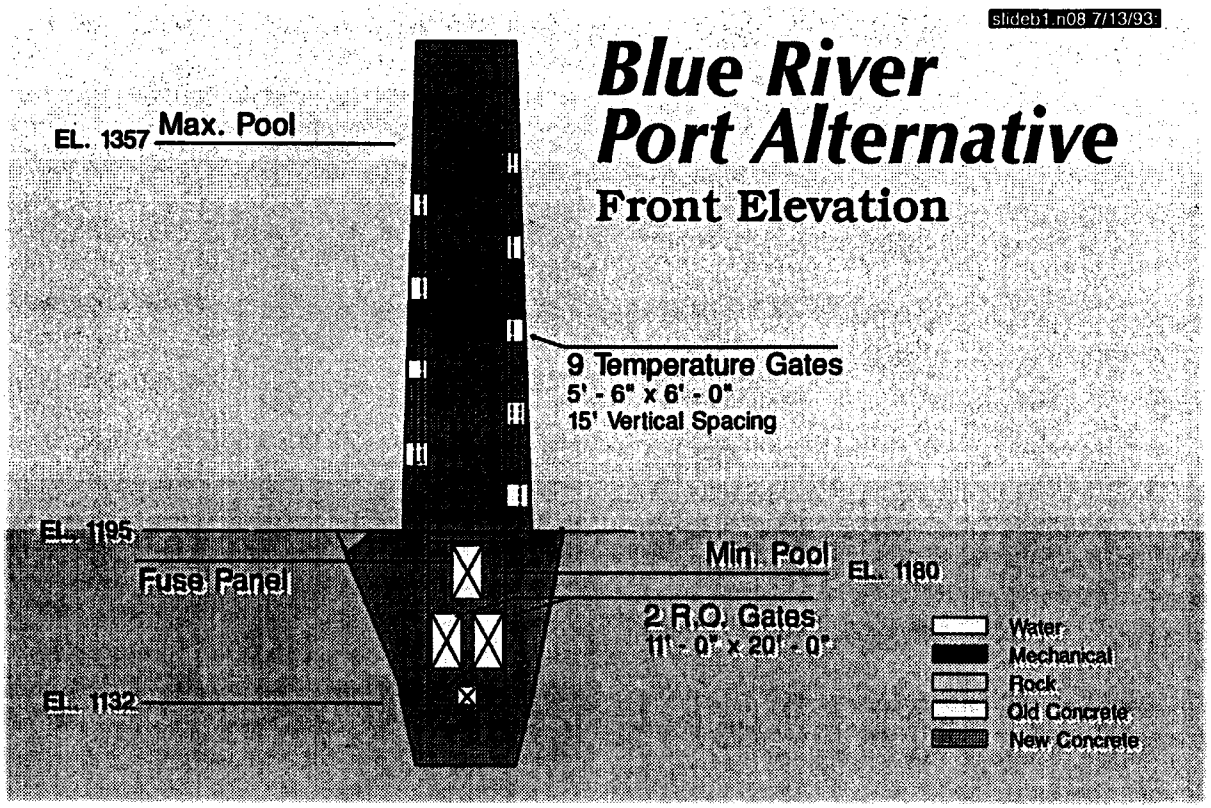
- **Capacity** — **95% Exceed.**
- **Velocity** — **10 fps**
- **Submergence**
  - **15 ft (initially)**
  - **variable**

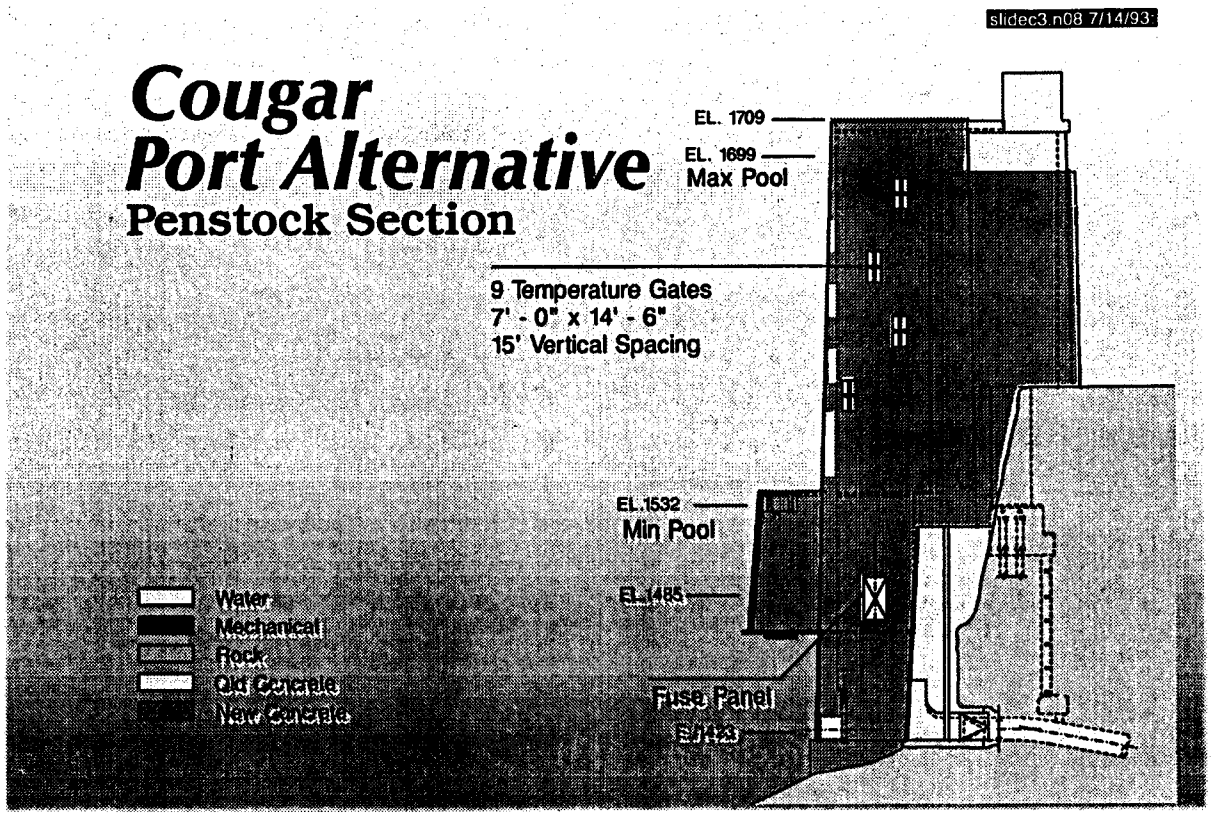
Table 2

Blue River Reservoir Physical Description

Elev (ft)	Storage (AF)	Max. Flow (cfs)	Surf. Area (acres)	Width (ft)
1102	0	0	0	0
1108	6	0	7	147
1114	46	0	11	163
1120	156	0	24	178
1126	320	0	27	191
1132	499	2000	31	205
1138	695	2100	34	220
1144	918	2200	48	238
1150	1209	2500	55	253
1156	1579	2600	65	265
1162	2037	2900	85	280
1168	2585	3100	95	296
1174	3227	3300	120	315
1180	3971	3600	132	329
1186	4804	3800	140	346
1192	5709	4100	155	365
1198	6688	4400	170	380
1204	7748	4500	200	393
1210	8901	4800	220	407
1216	10151	5000	240	423
1222	11501	5200	250	436
1228	12954	5400	260	460
1234	14512	5600	270	462
1240	16178	5800	280	474
1246	17975	5900	320	484
1252	19923	6000	360	490
1258	22030	6100	410	496
1264	24315	6300	450	503
1270	26825	6500	500	511
1276	29574	6700	550	519
1282	32573	6800	600	526
1288	35821	6900	610	540
1294	39326	7100	640	557
1300	43096	7200	650	573
1306	47101	7400	670	590
1312	51308	7600	730	607
1318	55722	7800	750	625
1324	60346	12000	790	643
1330	65178	17900	830	660
1336	70223	25000	850	676
1342	75484	32000	890	691
1348	80951	45000	930	707
1354	86620	55000	950	723
1360	92490	65000	990	738
1366	98490	78000	1020	755


slideb3.n08 7/13/93
Blue River
Port Alternative
Side Elevation
New
Temperature
Gates
New Trashrack
New R.O.
Non-Controlling Gates
Water
Mechanical
Rock
Old Concrete
New Concrete
Existing R.O.
Control Gates


slideb1.n08 7/13/93
Blue River
Port Alternative
Front Elevation
EL. 1357 Max. Pool
9 Temperature Gates
5' - 6" x 6' - 0"
15' Vertical Spacing
EL. 1185
Fuse Panel
Min. Pool
EL. 1180
2 R.O. Gates
11' - 0" x 20' - 0"
EL. 1132
Water
Mechanical
Rock
Old Concrete
New Concrete


slidec3.n08 7/14/93
Cougar
Port Alternative
Penstock Section
EL. 1709
EL. 1699
Max Pool
9 Temperature Gates
7' - 0" x 14' - 6"
15' Vertical Spacing
EL.1532
Min Pool
EL.1485
Water
Mechanical
Rock
Old Concrete
New Concrete
Fuse Panel
EL.1423

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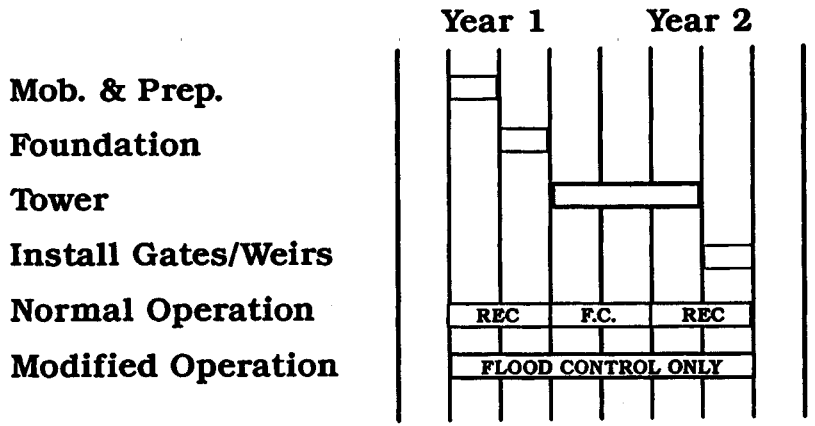
Blue River

Construction Schedule



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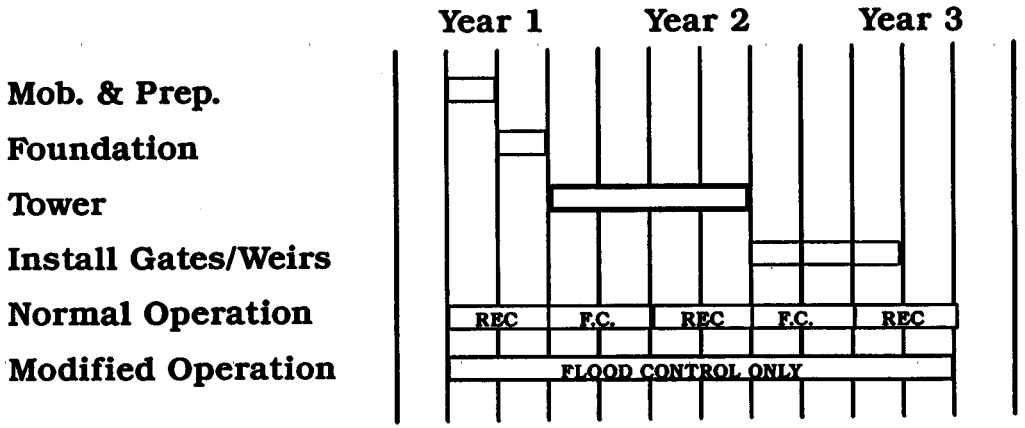
Cougar

Construction Schedule



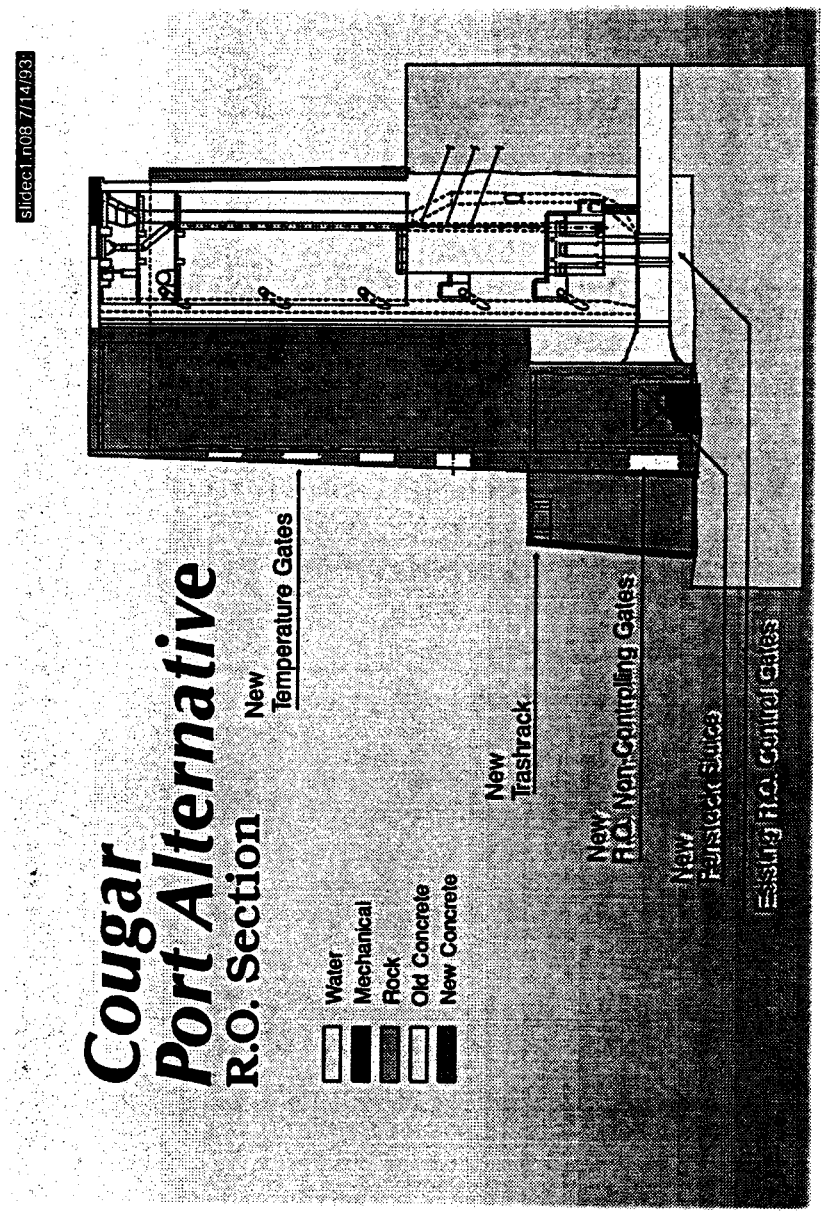

slidec1_rn08 7/14/93
Cougar
Port Alternative
R.O. Section
Water
Mechanical
Rock
Old Concrete
New Concrete
New Temperature Gates
New Trashrack
New R.O. Non-Controlling Gates
New Penstock Slides
Existing R.O. Control Gates

Table 4

Stream Temperature Results above Vida, Oregon

Month	Target Range,°F	Results with Multilevel Intakes		
		At Cougar	At Blue River	At Both
Jan	40.1	good	good	good
Feb	43.2	good	good	good
Mar	43.2-42.1	good	good	good
Apr	45.1-44.1	good	good	good
May	48.2-47.1	good	good	good
Jun	52.2-49.1	good	good	good
Jul	56.1-52.2	fair	fair	good
Aug	56.1-53.2	fair	fair	good
Sep	53.2-51.1	fair	fair	good
Oct	47.1	fair	fair	fair
Nov	45.1	fair	fair	fair
Dec	43.2	fair	fair	fair

good = within ±2°F
fair = within ±4°F

River and at Vida by 1.5°F. (It should be remembered that the reservoirs are not being operated for Vida, but only for the discharge temperature from each dam.)

With the multilevel intakes, the target is missed by 1.5°F on the South Fork, 1.2°F on the Blue River, and at Vida by 1.0°F with Cougar multilevel intake only, 1.2°F with Blue River multilevel intake only, and 0.8°F with both projects' multilevel intakes operating. Therefore, it can be concluded that the Cougar Dam MLI provides an impact of about 4.1°F on the South Fork and Blue River Dam MLI provides a 4.1°F impact on the Blue River. At Vida there is an impact of 0.5°F for Cougar's MLI only, 0.3°F for Blue River's MLI only and 0.7°F from both projects' MLI's operating together.

Based on the simulations for all the scenarios, Tables 6-8 provide estimated dates for salmon fry emergence from the eggs, given fertilization dates of September 1, September 15, and September 30. The assumption is that the fish will emerge after 1800 temperature units (i.e., degree-days) from the fertilization date. This assumption is based on Oregon Fish and Game research. From the average results for the five study years assuming a September 1 fertilization date, Table 6 shows that the Blue River fish emerge 53 days earlier than mainstem fish near Vida for existing conditions. South Fork fish emerge 32 days earlier than mainstem fish near Vida for existing condition.

The desired target temperature regime would delay emergence on the Blue River by 50 days compared to existing conditions, on the South Fork by 47 days, and on the mainstem near Vida by 11 days. The construction of the proposed multilevel intakes would delay emergence on

Table 5

Statistics of Water Temperature Deviations from Target

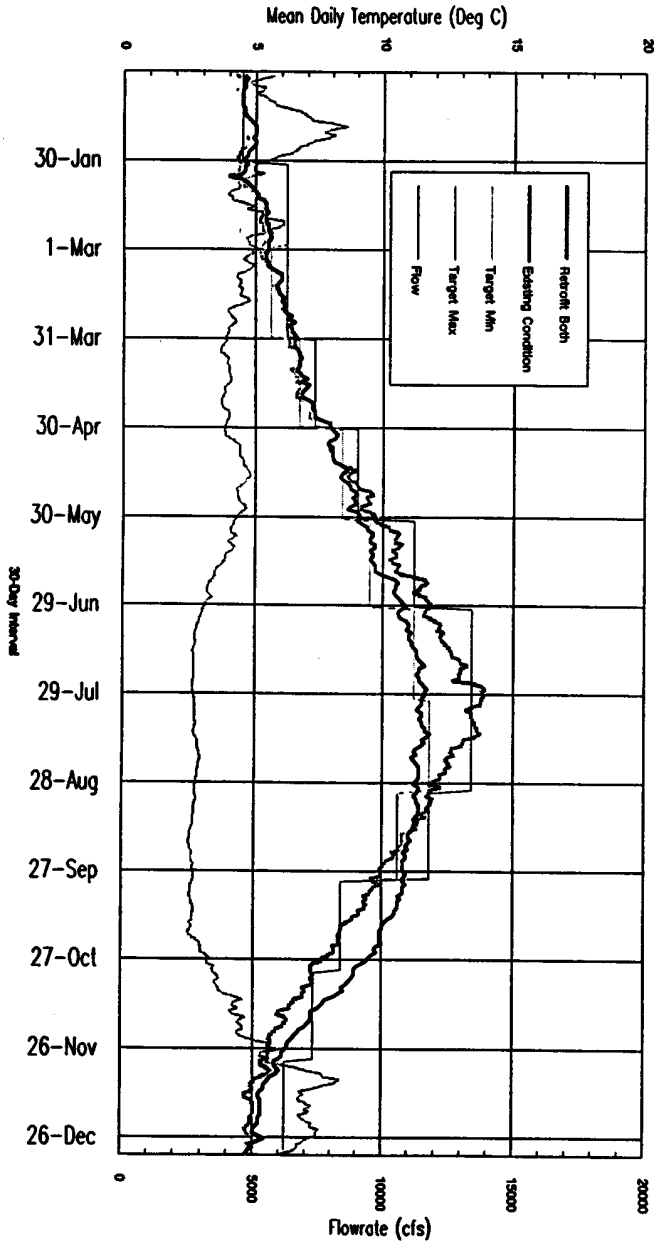
		Present Ability to Meet Target		Proposed Ability to Meet Target	
		Exist-Target (°F)		Multilevel Intake-Target(°F)	
Location	Year	Mean	SD	Mean	SD
Cougar Dam	1977	5.5	4.8	1.3	1.7
	1979	6.1	4.7	1.4	1.5
	1982	5.7	4.5	1.6	1.7
	1983	5.5	4.7	1.4	1.6
	1984	5.2	4.6	1.6	1.8
	Avg	5.6		1.5	
Blue River Dam	1977	5.5	4.2	1.5	2.0
	1979	5.2	4.8	1.3	2.0
	1982	5.4	5.0	1.0	1.5
	1983	5.4	4.7	1.4	1.8
	1984	4.8	4.3	1.0	1.1
	Avg	5.3		1.2	

		Present Ability to Meet Target		Proposed Ability to Meet Target					
		Exist-Target(°F)		MLIC[1]-Target(°F)		MLIB[2]-Target(°F)		MLIBC[3]-Target(°F)	
Location	Year	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Vida	1977	1.1	1.2	0.9	0.9	0.9	1.1	0.7	0.8
	1979	1.4	1.6	1.0	1.1	1.3	1.5	0.9	1.0
	1982	1.8	1.2	1.2	1.0	1.5	0.9	1.0	1.0
	1983	1.5	1.5	0.9	1.2	1.2	1.2	0.7	1.1
	1984	1.5	1.3	0.9	1.1	1.1	1.0	0.8	1.0
	Avg	1.5		1.0		1.2		0.8	

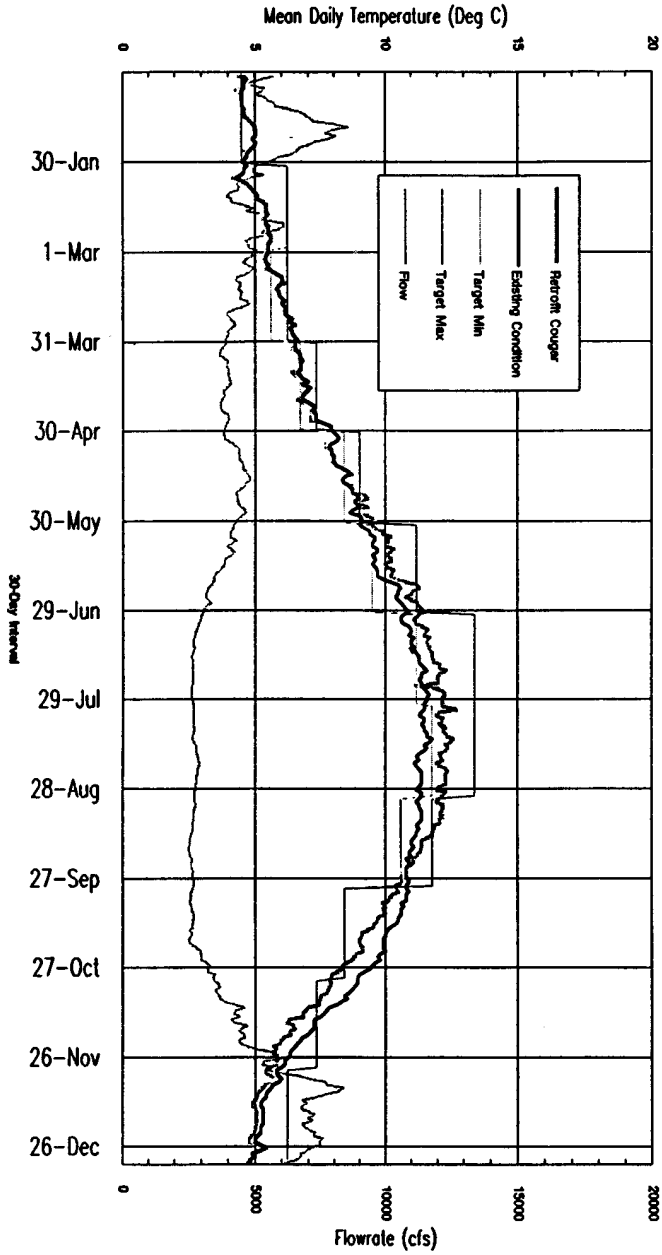
[1]Multilevel intake at Cougar Reservoir only

[2]Multilevel intake at Blue River Reservoir only

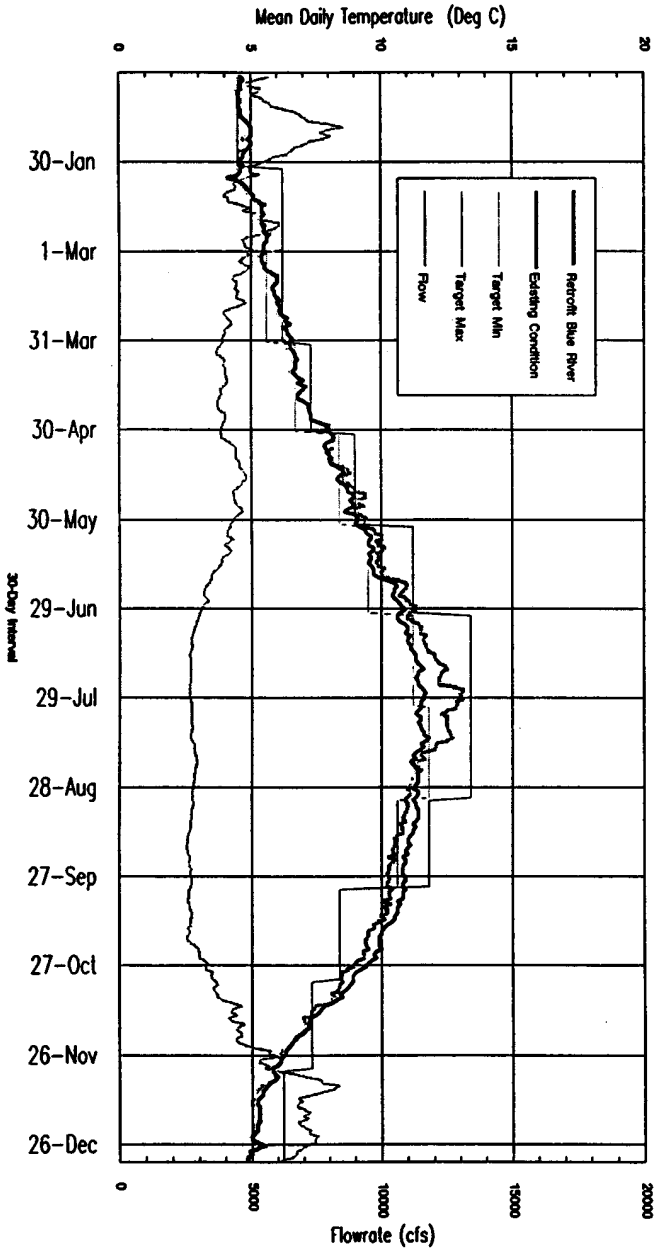
[3]Multilevel intake at both Cougar and Blue River Reservoirs



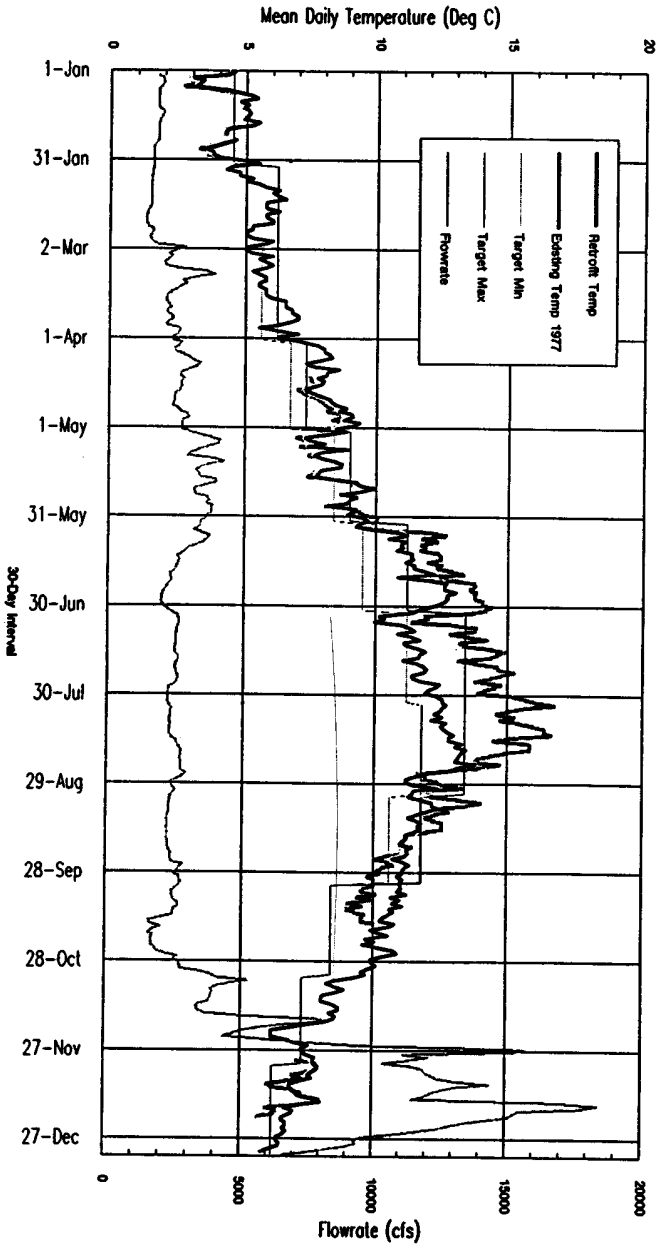
EFFECTS OF RETROFITTING BOTH COUGAR AND BLUE RIVER DAMS FOR TEMPERATURE CONTROL FOR THE AVERAGE YEAR -- TEMPERATURE AND FLOW ON THE MCKENZIE RIVER AT THE USGS GAGE NEAR VIDA, OREGON (RM 49)



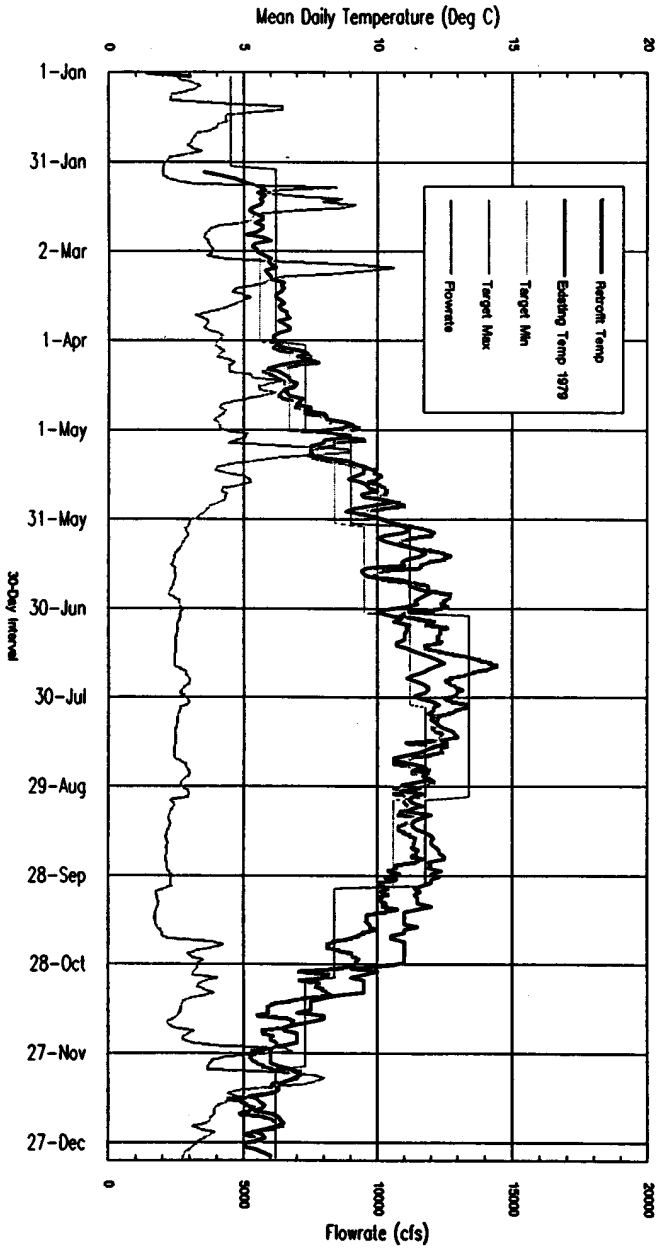
EFFECTS OF RETROFITTING COUGAR DAM FOR TEMPERATURE CONTROL FOR THE AVERAGE YEAR - TEMPERATURE AND FLOW ON THE MCKENZIE RIVER AT THE USGS GAGE NEAR VIDA, OREGON (RM 49)



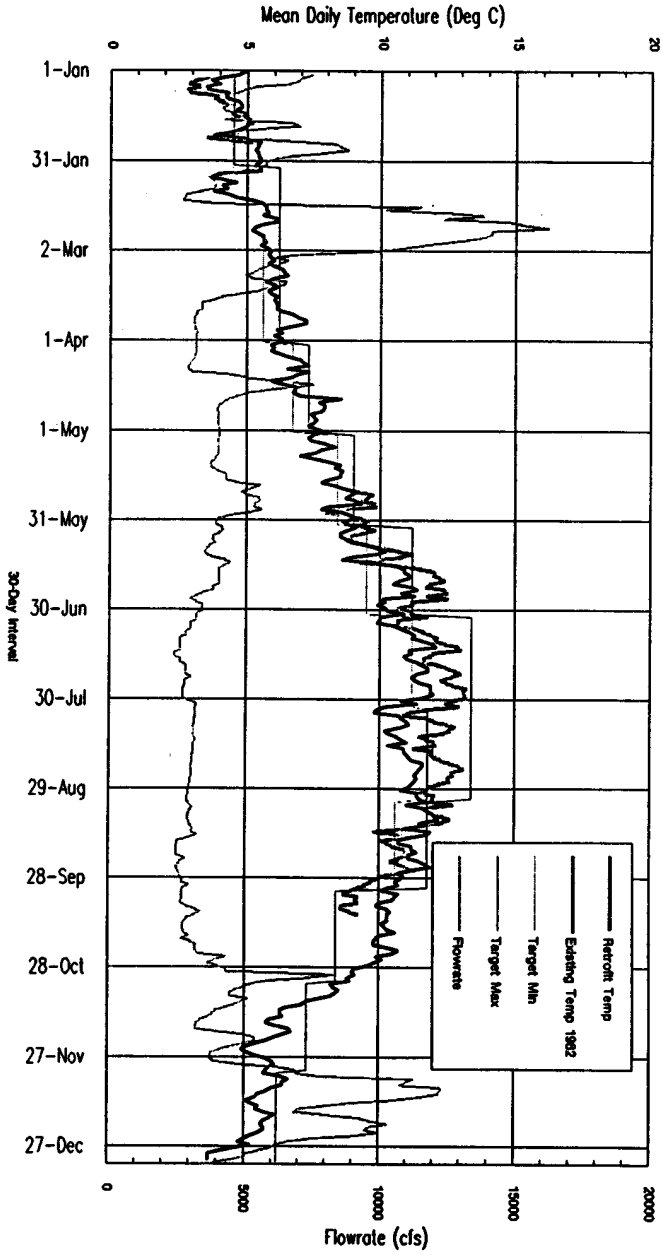
EFFECTS OF RETROFITTING BLUE RIVER DAM FOR TEMPERATURE CONTROL FOR THE AVERAGE YEAR - TEMPERATURE AND FLOW ON THE MCKENZIE RIVER AT THE USGS GAGE NEAR VIDA, OREGON (RM 49)



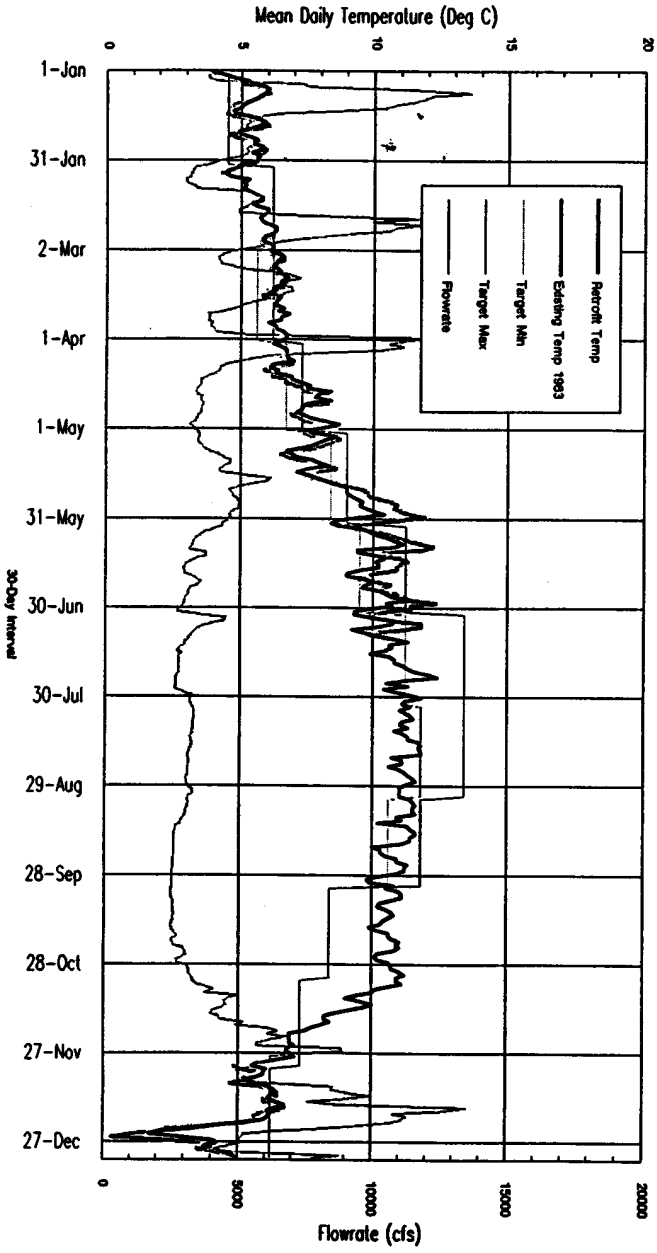
EFFECTS OF RETROFITTING BOTH BLUE RIVER AND COUGAR DAMS FOR TEMPERATURE CONTROL IN A DRY YEAR - TEMPERATURE AND FLOW ON THE MCKENZIE RIVER AT THE USGS GAGE NEAR VIDA, OREGON (RM 48)



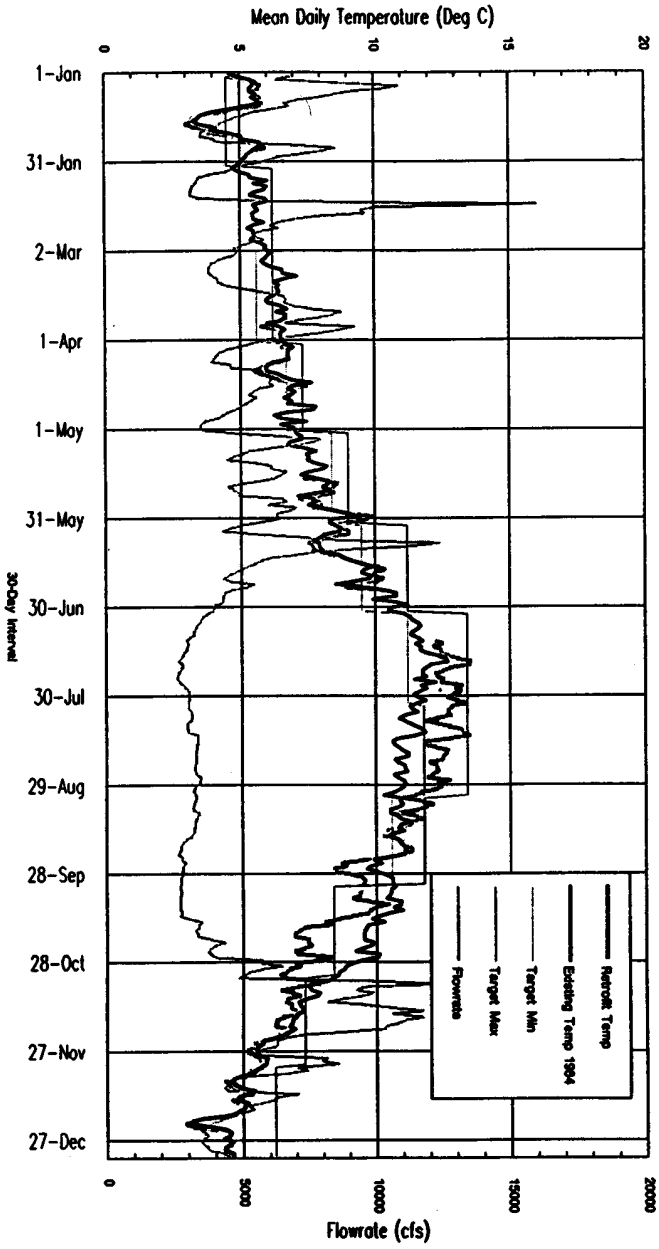
EFFECTS OF RETROFITTING BOTH BLUE RIVER AND COUGAR DAMS FOR TEMPERATURE CONTROL IN A WARM YEAR - TEMPERATURE AND FLOW ON THE MCKENZIE RIVER AT THE USGS GAGE NEAR VIDA, OREGON (RM 48)



EFFECTS OF RETROFITTING BOTH BLUE RIVER AND COUGAR DAMS FOR TEMPERATURE CONTROL IN A COOL YEAR - TEMPERATURE AND FLOW ON THE MCKENZIE RIVER AT THE USGS GAGE NEAR VIDA, OREGON (RM 48)



Effects of Retrofitting both Blue River and Cougar Dams for Temperature Control in a Wet Year - Temperature and Flow on the McKenzie River at the USGS Gage near Vida, Oregon (RM 48)



Effects of Retrofitting both Blue River and Cougar Dams for Temperature Control in a Normal Year - Temperature and Flow on the McKenzie River at the USGS Gage near Vida, Oregon (RM 48)

Table 3

Cougar and Blue River Reservoir's Release Facilities

	Cougar Reservoir			Blue River Reservoir		
Intake Type	Size (ft)	Max Flow (cfs)	Elev (ft)	Size (ft)	Max Flow (cfs)	Elev (ft)
			Existing Release Facilities			
Primary	10.5' dia.	12,500 cfs	1525.00'	4.75' x 8'	8,400 cfs	1132.00
Spillway	80' wide	76,140 cfs	1656.75	70' wide	53,220 cfs	1321.00
			Proposed Release Facilities			
Level 1	14.5'h x 7'w	1,000 cfs	1525.00	9'h x 6'w	500 cfs	1132.00
2	14.5'h x 7'w	1,000 cfs	1565.00	9'h x 6'w	500 cfs	1132.00
3	14.5'h x 7'w	1,000 cfs	1580.00	9'h x 6'w	500 cfs	1197.00
4	14.5'h x 7'w	1,000 cfs	1595.00	9'h x 6'w	500 cfs	1223.00
5	14.5'h x 7'w	1,000 cfs	1610.00	9'h x 6'w	500 cfs	1255.00
6	14.5'h x 7'w	1,000 cfs	1625.00	9'h x 6'w	500 cfs	1274.00
7	14.5'h x 7'w	1,000 cfs	1640.00	9'h x 6'w	500 cfs	1299.00
8	14.5'h x 7'w	1,000 cfs	1655.00	9'h x 6'w	500 cfs	1318.00
9	14.5'h x 7'w	1,000 cfs	1670.00	9'h x 6'w	500 cfs	1334.00
Spillway	80' wide	76,140 cfs	1656.75	70' wide	53,220 cfs	1321.00

[1]Existing bottom intake elevation has been set at 1525' due to bottom geometry affects on the withdrawal water temperature.

In general, the results of the simulations (Figures 22-35) document the impacts of multilevel intakes versus existing intakes and target release temperatures at each dam, below the mainstem confluence with the Blue River and at the gage site above Vida. The legends provide the definition of each curve in the graph. Discussion and interpretation of the graphs are provided in the next section.

6. Results Interpretation

a. Existing Condition, 1984. Examination of Figures 4-16 for calibration of reservoir profiles at both reservoirs confirm that the discharge temperatures from the reservoirs for 1984 conditions are within ±2°F for most of the time and space scales. The months of September and October have slightly higher errors of reproduction, occasionally as large as ±6°F. This error is so significantly diluted by the mainstem McKenzie River temperatures to be literally non-existent downstream of Finn Rock. This dilution can be seen in Figures 19 and 20.

Table 6

Time to 1800 TU's[1]
(1 September Fertilization)

Location	Year	Existing Condition	Target	Multilevel Intakes
Cougar	1977	21 Nov	4 Jan	23 Dec
Dam	1979	6 Nov	4 Jan	17 Dec
	1982	23 Nov	4 Jan	25 Dec
	1983	19 Nov	4 Jan	20 Dec
	1984	25 Nov	6 Jan	28 Dec
	Avg	19 Nov	5 Jan	23 Dec
Blue	1977	28 Oct	17 Dec	6 Dec
River	1979	22 Oct	17 Dec	29 Nov
Dam	1982	25 Oct	17 Dec	19 Dec
	1983	1 Nov	17 Dec	8 Dec
	1984	4 Nov	19 Dec	20 Dec
	Avg	29 Oct	18 Dec	11 Dec

Location	Year	Existing Condition	Target	MLIC[2]	MLIB[3]	MLIBC[4]
Vida	1977	10 Dec	28 Dec - 4 Jan	18 Dec	13 Dec	21 Dec
	1979	10 Dec	28 Dec - 4 Jan	25 Dec	14 Dec	29 Dec
	1982	28 Dec	28 Dec - 4 Jan	12 Jan	6 Jan	20 Jan
	1983	22 Dec	28 Dec - 4 Jan	7 Jan	2 Jan	14 Jan
	1984	3 Jan	28 Dec - 4 Jan	13 Jan	9 Jan	21 Jan
	Avg	20 Dec	1 Jan	3 Jan	28 Dec	9 Jan

[1]The current biological estimate for Spring Chinook eggs from the time of spawning through the incubation period to emergence from the gravel. Temperature Units (TU's) are calculated as follows: TU = mean daily temperature minus 32°F accumulated from assumed spawning date. Dates after 31 December loop on water temperatures from the previous year.

[2]Multilevel intake at Cougar Reservoir only

[3]Multilevel intake at Blue River Reservoir only

[4]Multilevel intakes at both Cougar and Blue River Reservoirs

Table 7

Time to 1800 TU's[1]
(15 September Fertilization)

Location	Year	Existing Condition	Target	Multilevel Intakes
Cougar Dam	1977	11 Dec	12 Feb	1 Feb
	1979	26 Nov	12 Feb	3 Feb
	1982	15 Dec	12 Feb	9 Feb
	1983	8 Dec	12 Feb	31 Jan
	1984	20 Dec	13 Feb	8 Feb
	Avg	10 Dec	12 Feb	4 Feb
Blue River Dam	1977	3 Dec	30 Jan	15 Jan
	1979	16 Nov	30 Jan	5 Jan
	1982	26 Nov	30 Jan	12 Feb
	1983	17 Nov	30 Jan	20 Jan
	1984	2 Dec	1 Feb	4 Feb
	Avg	25 Nov	31 Jan	24 Jan

Location	Year	Existing Condition	Target	MLIC[2]	MLIB[3]	MLIBC[4]
Vida	1977	6 Jan	31 Jan - 3 Feb	22 Jan	10 Jan	25 Jan
	1979	16 Jan	31 Jan - 3 Feb	7 Feb	20 Jan	10 Feb
	1982	5 Feb	31 Jan - 3 Feb	20 Feb	11 Feb	24 Feb
	1983	26 Jan	31 Jan - 3 Feb	9 Feb	1 Feb	15 Feb
	1984	3 Feb	31 Jan - 3 Feb	15 Feb	9 Feb	20 Feb
	Avg	24 Jan	2 Feb	9 Feb	29 Jan	13 Feb

[1]The current biological estimate for Spring Chinook eggs from the time of spawning through the incubation period to emergence from the gravel. Temperature Units (TU's) are calculated as follows: TU = mean daily temperature minus 32°F accumulated from assumed spawning date. Dates after 31 December loop on water temperatures from the previous year.

[2]Multilevel intake at Cougar Reservoir only

[3]Multilevel intake at Blue River Reservoir only

[4]Multilevel intakes at both Cougar and Blue River Reservoirs

Table 8

Time to 1800 TU's[1]
(30 September Fertilization)

Location	Year	Existing Condition	Target	Multilevel Intakes
Cougar Dam	1977	18 Jan	17 Mar	8 Mar
	1979	14 Jan	17 Mar	14 Mar
	1982	30 Jan	17 Mar	17 Mar
	1983	14 Jan	17 Mar	7 Mar
	1984	1 Feb	18 Mar	15 Mar
	Avg	22 Jan	17 Mar	12 Mar
Blue River Dam	1977	3 Feb	12 Mar	1 Mar
	1979	8 Jan	12 Mar	28 Feb
	1982	6 Feb	12 Mar	22 Mar
	1983	11 Jan	12 Mar	27 Feb
	1984	3 Feb	14 Mar	11 Mar
	Avg	25 Jan	13 Mar	7 Mar

Location	Year	Existing Condition	Target	MLIC[2]	MLIB[3]	MLIBC[4]
Vida	1977	11 Feb	28 Feb - 1 Mar	22 Feb	12 Feb	24 Feb
	1979	28 Feb	28 Feb - 1 Mar	12 Mar	3 Mar	14 Mar
	1982	10 Mar	28 Feb - 1 Mar	21 Mar	14 Mar	25 Mar
	1983	26 Feb	28 Feb - 1 Mar	10 Mar	3 Mar	15 Mar
	1984	5 Mar	29 Feb - 1 Mar	14 Mar	9 Mar	18 Mar
	Avg	27 Feb	1 Mar	10 Mar	3 Mar	14 Mar

[1]The current biological estimate for Spring Chinook eggs from the time of spawning through the incubation period to emergence from the gravel. Temperature Units (TU's) are calculated as follows: TU = mean daily temperature minus 32°F accumulated from assumed spawning date. Dates after 31 December loop on water temperatures from the previous year.

[2]Multilevel intake at Cougar Reservoir only

[3]Multilevel intake at Blue River Reservoir only

[4]Multilevel intakes at both Cougar and Blue River Reservoirs

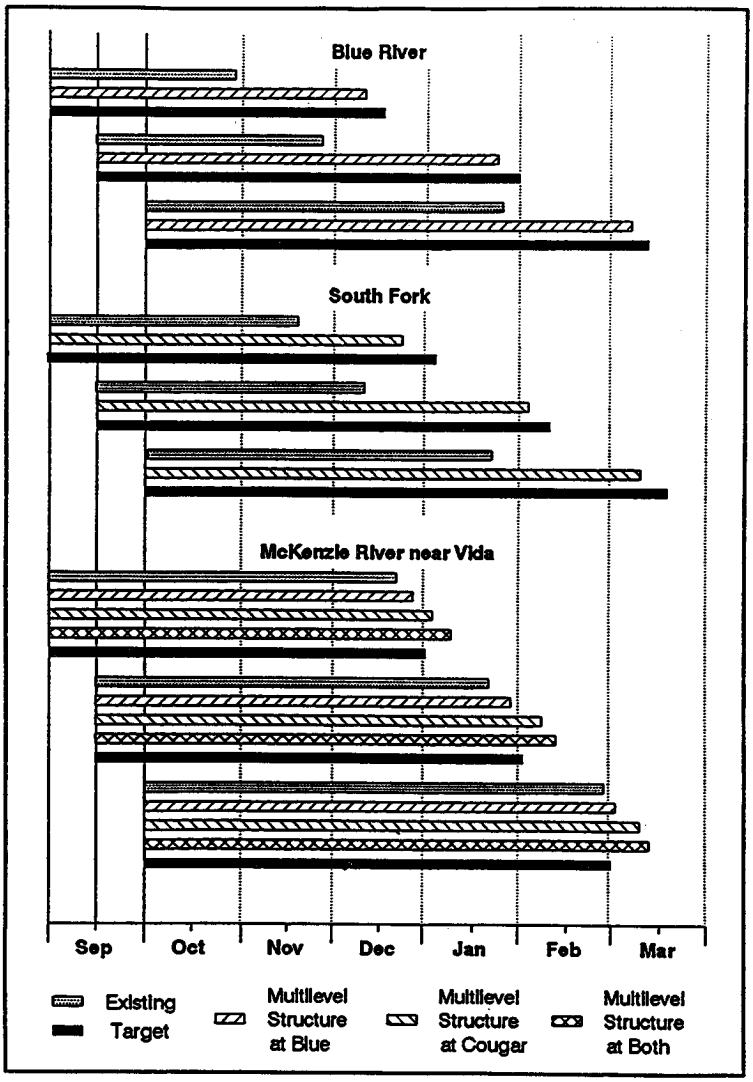


Figure 36. Fish Emergence Analysis for Fertilization Dates of 1, 15, and 30 September (5-year average for 1977, 1979, and 1982-1984)

Table 9

Trout Growth Units[1]

Location	Year	Existing Condition	Target	Multilevel Intakes
Cougar Dam	1977	999	2057	1853
	1979	1059	2057	1990
	1982	1011	2057	1703
	1983	1016	2057	1803
	1984	1095	2060	1758
	Avg	1036	2058	1821
Blue River Dam	1977	1081	2240	2303
	1979	625	2240	2180
	1982	1055	2240	2158
	1983	1485	2240	2265
	1984	1383	2245	2229
	Avg	1126	2241	2227

Location	Year	Existing Condition	Target	MLIC[2]	MLIB[3]	MLIBC[4]
Vida	1977	1876	1530-1993	1979	1919	2023
	1979	1812	1530-1993	1905	1831	1924
	1982	1366	1530-1993	1487	1397	1519
	1983	1464	1530-1993	1592	1506	1634
	1984	1460	1530-1993	1572	1492	1604
	Avg	1596	1762	1707	1629	1741

[1]The Trout Growth Unit (TGU) is an Oregon Fish and Game measure of the growth of resident trout species during the season from March through October when adequate food sources are present. TGU's are calculated as follows: TGU = Mean Daily water Temperature minus 42°F: when 42°F≤MDT≤63°F, otherwise TGU = 0.

[2]Multilevel intake at Cougar Reservoir only

[3]Multilevel intake at Blue River Reservoir only

[4]Multilevel intakes at both Cougar and Blue River Reservoirs

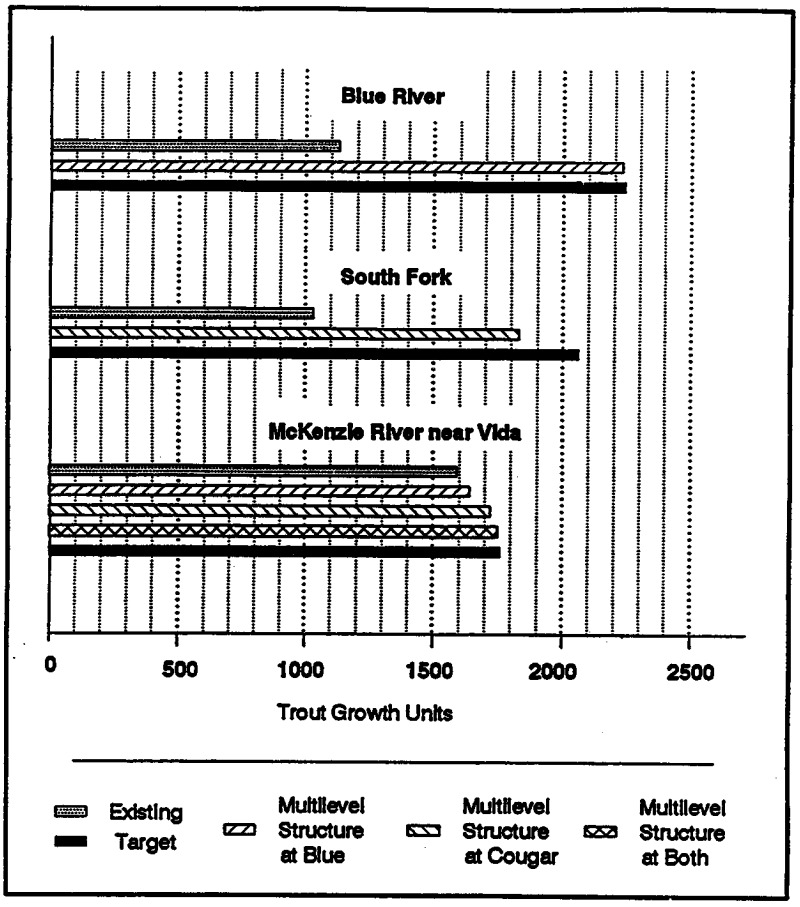


Figure 37. Trout Growth Analysis (5-year average for 1977, 1979, and 1982-1984)

Results of Spring Chinook Production Model

TABLE XXX. Estimated Days To Emergence for an "Average" Year[1] **(Spawning on September 15)**

Alternative	Mainstem below South Fork [2]	South Fork	Above South Fork [5]
Without Project	131 days	~~86~~ days [3]	180 days
Blue River Alone	137 days	86 days [3]	180 days
Cougar Dam Alone	147 days	142 days [4]	180 days
Both Projects	151 days	142 days[4]	180 days

1) Assumes 1800 TU's reguired for emergence and spawning on September 15

TABLE XXX. Estimated Days To Emergence for an "Average" Year[1] **(Spawning on September 30)**

Alternative	Mainstem below South Fork [2]	South Fork	Above South Fork [5]
Without Project	150 days	115 days [3]	180 days
Blue River Alone	155 days	114 days [3]	180 days
Cougar Dam Alone	162 days	173 days [4]	180 days
Both Projects	166 days	173 days[4]	180 days

1) Assumes 1800 TU's reguired for emergence and spawning on September 15

TABLE XXX. Estimated Days To Emergence for a "Low Flow" Year (1977)[1] **(Spawning on September 15)**

Alternative	Mainstem below South Fork [2]	South Fork	Above South Fork [5]
Without Project	131days	118 days[3]	180 days
Blue River Alone	136 days	118 days[3]	180 days
Cougar Dam Alone	147 days	139 days[4]	180 days
Both Projects	151 days	139 days[4]	180 days

1) Assumes 1800 TU's required for emergence and spawning on September 15

TABLE XXX. Estimated Days To Emergence for a "Low Flow" Year (1977)[1] (Spawning on September 30)

Alternative	Mainstem below South Fork [2]	South Fork	Above South Fork [5]
Without Project	134 days	110 days[3]	180 days
Blue River Alone	135 days	110 days[3]	180 days
Cougar Dam Alone	145 days	159 days[4]	180 days
Both Projects	147 days	157 days[4]	180 days

1) Assumes 1800 TU's required for emergence and spawning on September 15

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK

ALTERNATIVE NAME: 11-21-94
Both Projects (1984 flows, normal year)

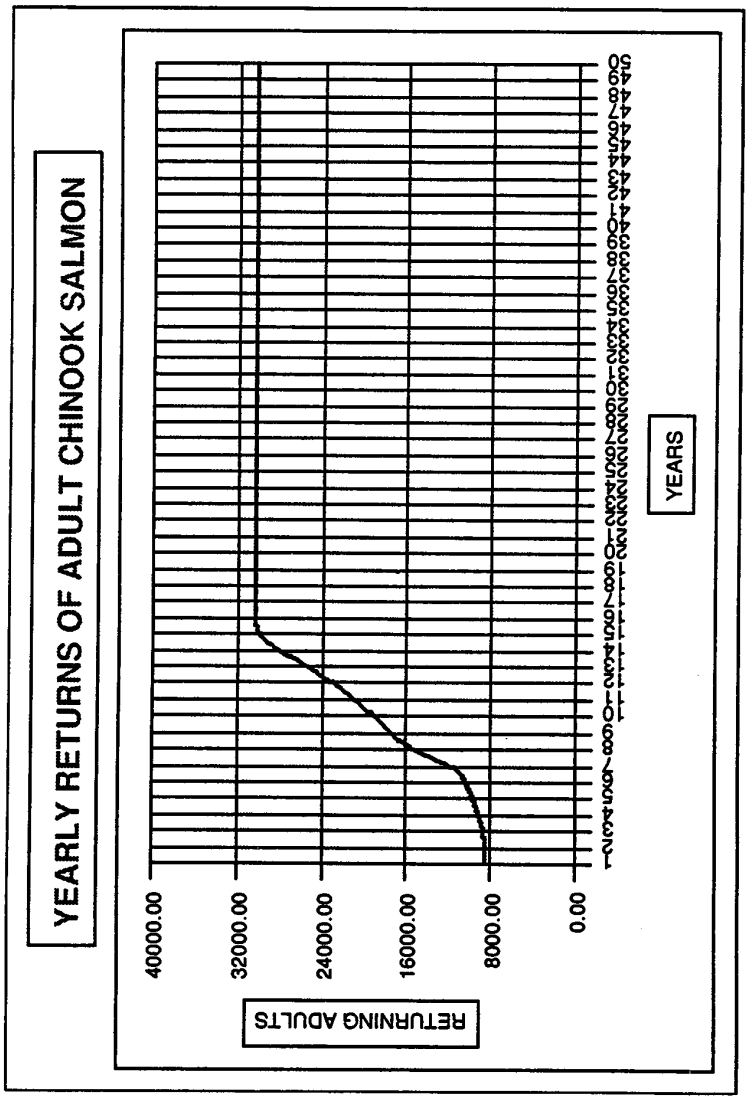
INPUTS			
		Estimated days to emergence (1800 TU's)	
Spawning distribution of fish passing		**SEPT. 15 SPAWNING**	
Leaburg Dam		In South Fork	151
		Below S.F.	158
% above S.F.	0.75	Above S.F.	180
% in S.F.	0.15	**SEPT. 30 SPAWNING**	
% below S.F.	0.10	In South Fork	166
Percentage of fish		Below S.F.	169
spawning prior to Sept. 16	0.35	Above S.F.	180
Average # of Adult Fish	8570	**CONSTANTS**	
Returning to the System		Smolt/adult survival	0.02
		Eggs per female	4000
Average # of Fish Passing	3000		
Leaburg Dam		**pre-spawn mortality**	
		above S.F	0.05
Expected Percentage of Fish		in S.F	0.05
Above Leaburg Dam	0.65	below S.F	0.05
		Fish Passage Goal	24700
Additional Fish Passage		(above Leaburg)	
at Leaburg due			
To Temperature Control	2571		

MAX. TOTAL PRODUCTION = 30270

OUTPUT	ALTERNATIVE NAME: Both Projects (1984 flows, normal year)	
Estimated egg to smolt survival		
In the South Fork	8%	
Below the South Fork	8%	
Above the South Fork	10%	
EXPECTED FISH PASSAGE NUMBERS		
Expected increase in passage at Leaburg due to early passage		2571
Number of fish migrating above S.F.		4178
Number of fish migrating into S.F.		836
Number of fish migrating to below S.F.		557
TOTAL fish passage		5571
ADULTS PRODUCED		
Above the South Fork	15003	
In the South Fork	2400	
Below the South Fork	1600	
TOTAL adults produced	19003	
ESTIMATED RETURN TO LEABURG		6334

Both Projects (1984 flows, normal year)

year	Estimated yearly returns to system	year	estimated yearly returns to system
1	8570	26	30270
2	8570	27	30270
3	8570	28	30270
4	9175	29	30270
5	9609	30	30270
6	10331	31	30270
7	11137	32	30270
8	15705	33	30270
9	17410	34	30270
10	19033	35	30270
11	20878	36	30270
12	22976	37	30270
13	25362	38	30270
14	28074	39	30270
15	30270	40	30270
16	30270	41	30270
17	30270	42	30270
18	30270	43	30270
19	30270	44	30270
20	30270	45	30270
21	30270	46	30270
22	30270	47	30270
23	30270	48	30270
24	30270	49	30270
25	30270	50	30270


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
40000.00
32000.00
24000.00
16000.00
8000.00
0.00
YEARS
ALTERNATIVE NAME:
Both Projects (1984 flows, normal year)

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK

ALTERNATIVE NAME: 11-21-94

Cougar Alone (1984 flows, normal year)

INPUTS

Spawning distribution of fish passing Leaburg Dam	
% above S.F.	0.68
% in S.F.	0.13
% below S.F.	0.18
Percentage of fish spawning prior to Sept. 16	0.35
Average # of Adult Fish Returning to the System	8570
Average # of Fish Passing Leaburg Dam	3000
Expected Percentage of Fish Above Leaburg Dam	0.52
Additional Fish Passage at Leaburg due To Temperature Control	1456

Estimated days to emergence (1800 TU's)

SEPT. 15 SPAWNING	
In South Fork	151
Below S.F.	153
Above S.F.	180
SEPT. 30 SPAWNING	
In South Fork	166
Below S.F.	165
Above S.F.	180

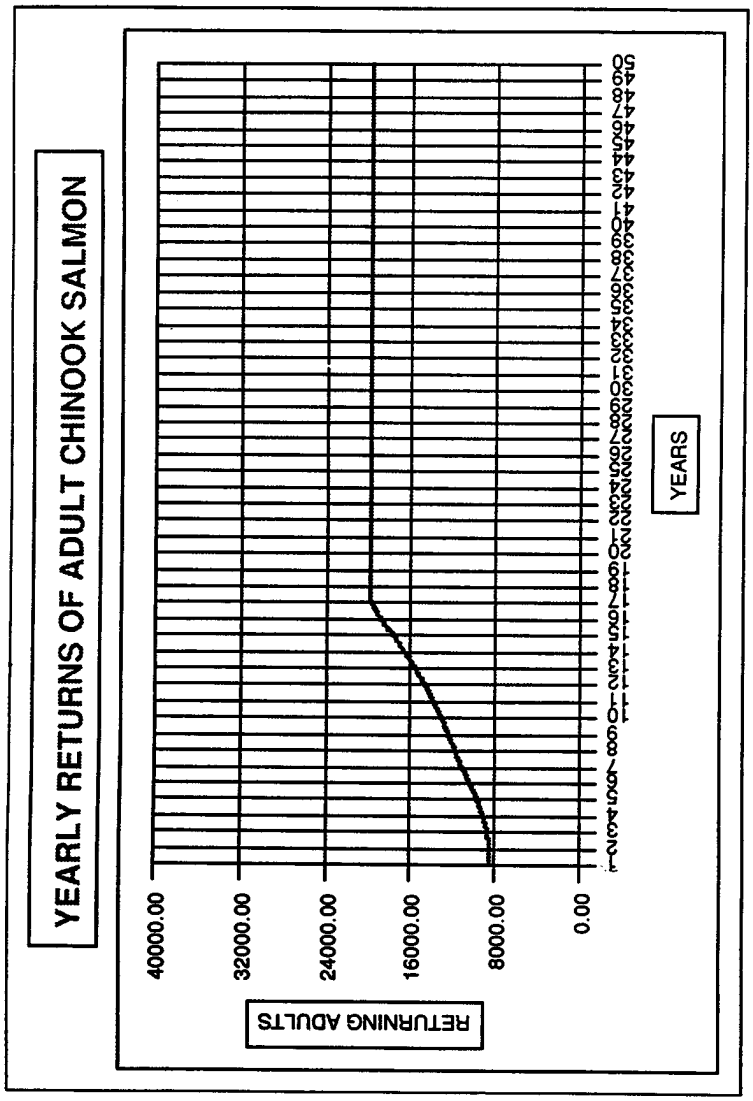
CONSTANTS	
Smolt/adult survival	0.02
Eggs per female	4000
pre-spawn mortality	
above S.F	0.05
in S.F	0.13
below S.F	0.11
Fish Passage Goal (above Leaburg)	14300

MAX. TOTAL PRODUCTION = 19870

OUTPUT	ALTERNATIVE NAME: Cougar Alone (1984 flows, normal year)	
Estimated egg to smolt survival		
In the South Fork	8%	
Below the South Fork	8%	
Above the South Fork	10%	
EXPECTED FISH PASSAGE NUMBERS		
Expected increase in passage at Leaburg due to early passage		1456
Number of fish migrating above S.F.		3030
Number of fish migrating into S.F.		579
Number of fish migrating to below S.F.		802
TOTAL fish passage		**4412**
ADULTS PRODUCED		
Above the South Fork	10882	
In the South Fork	1524	
Below the South Fork	2159	
TOTAL adults produced	**14565**	
ESTIMATED RETURN TO LEABURG		4855

Cougar Alone (1984 flows, normal year)

year	Estimated yearly returns to system	year	estimated yearly returns to system
1	8570	26	19870
2	8570	27	19870
3	8570	28	19870
4	9175	29	19870
5	9609	30	19870
6	10331	31	19870
7	11137	32	19870
8	11745	33	19870
9	12365	34	19870
10	13048	35	19870
11	13799	36	19870
12	14626	37	19870
13	15535	38	19870
14	16536	39	19870
15	17638	40	19870
16	18850	41	19870
17	19870	42	19870
18	19870	43	19870
19	19870	44	19870
20	19870	45	19870
21	19870	46	19870
22	19870	47	19870
23	19870	48	19870
24	19870	49	19870
25	19870	50	19870


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
40000.00
32000.00
24000.00
16000.00
8000.00
0.00
YEARS
ALTERNATIVE NAME:
Cougar Alone (1984 flows, normal year)

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK

ALTERNATIVE NAME: 11-21-94

Blue Alone (1984 flows, normal year)

INPUTS

Spawning distribution of fish passing Leaburg Dam	
% above S.F.	0.67
% in S.F.	0.12
% below S.F.	0.21
Percentage of fish spawning prior to Sept. 16	0.35
Average # of Adult Fish Returning to the System	8570
Average # of Fish Passing Leaburg Dam	3000
Expected Percentage of Fish Above Leaburg Dam	0.48
Additional Fish Passage at Leaburg due To Temperature Control	1114

Estimated days to emergence (1800 TU's)

SEPT. 15 SPAWNING	
In South Fork	96
Below S.F.	147
Above S.F.	180
SEPT. 30 SPAWNING	
In South Fork	124
Below S.F.	160
Above S.F.	180

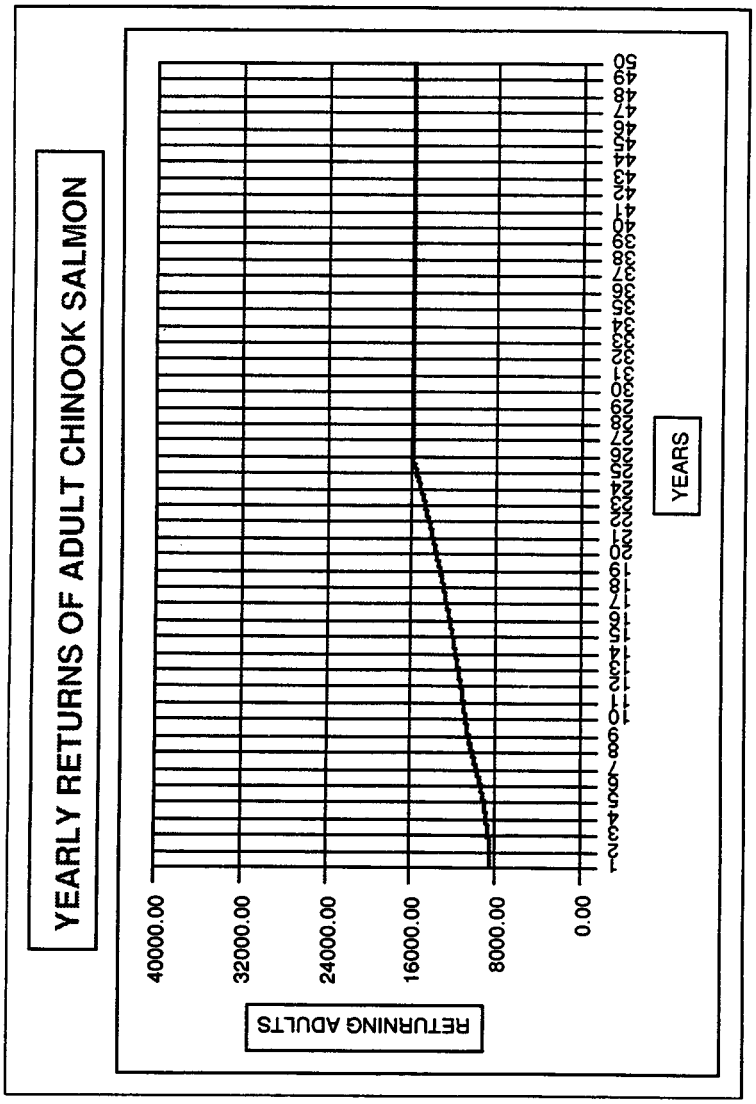
CONSTANTS	
Smolt/adult survival	0.02
Eggs per female	4000
pre-spawn mortality	
above S.F	0.05
in S.F	0.23
below S.F	0.13
Fish Passage Goal (above Leaburg)	10400

MAX. TOTAL PRODUCTION = 15970

OUTPUT	ALTERNATIVE NAME: Blue Alone (1984 flows, normal year)	
Estimated egg to smolt survival		
In the South Fork	5%	
Below the South Fork	8%	
Above the South Fork	10%	
EXPECTED FISH PASSAGE NUMBERS		
Expected increase in passage at Leaburg due to early passage		1114
Number of fish migrating above S.F.		2756
Number of fish migrating into S.F.		494
Number of fish migrating to below S.F.		864
TOTAL fish passage		**4114**
ADULTS PRODUCED		
Above the South Fork	9897	
In the South Fork	718	
Below the South Fork	2273	
TOTAL adults produced	**12888**	
ESTIMATED RETURN TO LEABURG		4296

Blue Alone (1984 flows, normal year)

year	Estimated yearly returns to system	year	estimated yearly returns to system
1	8570	26	15970
2	8570	27	15970
3	8570	28	15970
4	8851	29	15970
5	9053	30	15970
6	9359	31	15970
7	9774	32	15970
8	10208	33	15970
9	10555	34	15970
10	10794	35	15970
11	11026	36	15970
12	11267	37	15970
13	11520	38	15970
14	11784	39	15970
15	12059	40	15970
16	12347	41	15970
17	12648	42	15970
18	12961	43	15970
19	13289	44	15970
20	13631	45	15970
21	13989	46	15970
22	14362	47	15970
23	14752	48	15970
24	15159	49	15970
25	15584	50	15970


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
40000.00
32000.00
24000.00
16000.00
8000.00
0.00
YEARS
ALTERNATIVE NAME:
Blue Alone (1984 flows, normal year)

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK

ALTERNATIVE NAME: 11-18-94
without project (1984 flows, normal year)

INPUTS

Spawning distribution of fish passing Leaburg Dam	
% above S.F.	0.60
% in S.F.	0.10
% below S.F.	0.30
Percentage of fish spawning prior to Sept. 15	0.35
Average # of Adult Fish Returning to the System	8570.00
Average # of Fish Passing Leaburg Dam	3000.00
Expected Percentage of Fish Above Leaburg Dam	0.35
Additional Fish Passage at Leaburg due To Temperature Control	0

Estimated days to emergence (1800 TU's)

SEPT. 15 SPAWNING	
In South Fork	84
Below S.F.	141
Above S.F.	180
SEPT. 30 SPAWNING	
In South Fork	124
Below S.F.	156
Above S.F.	180

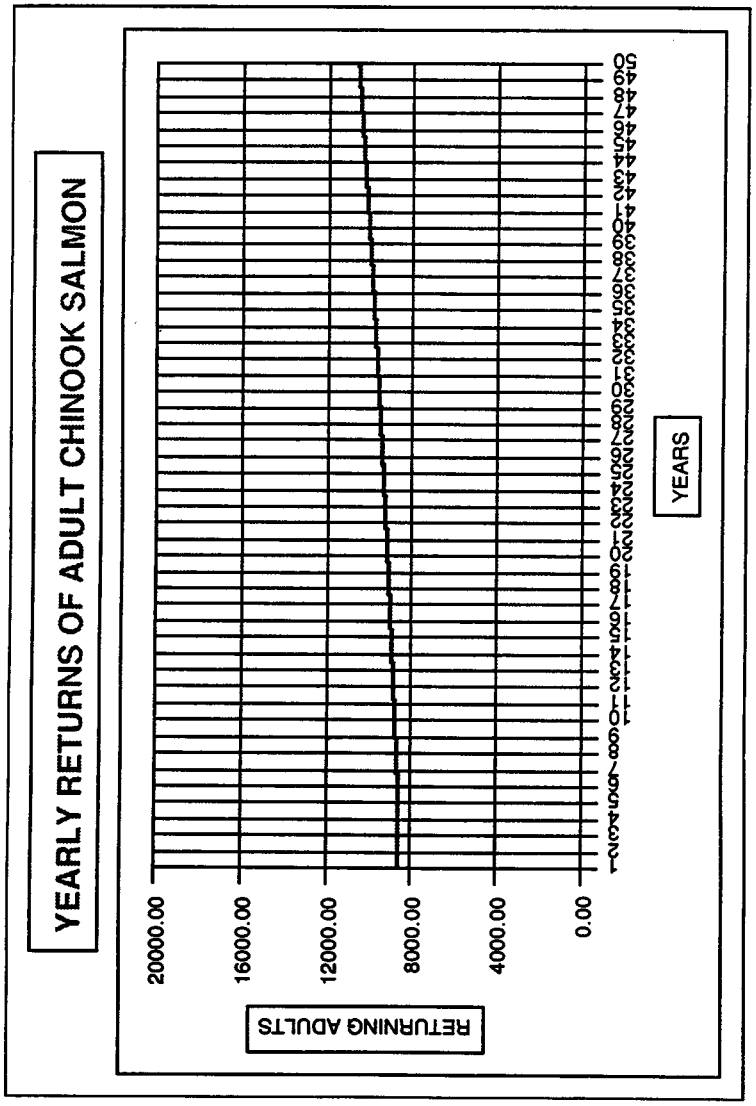
CONSTANTS	
Smolt/adult survival	0.02
Eggs per female	4000
pre-spawn mortality	
above S.F	0.05
in S.F	0.23
below S.F	0.19
Fish Passage Goal (above Leaburg)	10000

TOTAL GOAL FOR BASIN 15571

OUTPUT	ALTERNATIVE NAME: without project (1984 flows, normal year)	
Estimated egg to smolt survival		
In the South Fork	5%	
Below the South Fork	8%	
Above the South Fork	10%	
EXPECTED FISH PASSAGE NUMBERS		
Expected increase in passage at Leaburg due to early passage		0
Number of fish migrating above S.F.		1800
Number of fish migrating into S.F.		300
Number of fish migrating to below S.F.		900
TOTAL fish passage		**3000**
ADULTS PRODUCED		
Above the South Fork	6463	
In the South Fork	437	
Below the South Fork	2204	
TOTAL adults produced	**9103**	
ESTIMATED RETURN TO LEABURG		3034

without project (1984 flows, normal year)

year	eventual adult returns	Estimated yearly returns to system	year	estimated yearly returns to system
1	3034	8570	26	9406
2	3034	8570	27	9450
3	3069	8570	28	9495
4	3104	8588	29	9540
5	3140	8605	30	9586
6	3176	8622	31	9632
7	3213	8657	32	9679
8	3249	8693	33	9726
9	3287	8728	34	9774
10	3325	8765	35	9822
11	3363	8802	36	9871
12	3402	8839	37	9920
13	3441	8876	38	9970
14	3480	8914	39	10021
15	3520	8953	40	10072
16	3561	8992	41	10124
17	3602	9031	42	10176
18	3643	9071	43	10229
19	3685	9111	44	10283
20	3727	9152	45	10337
21	3770	9193	46	10392
22	3814	9235	47	10447
23	3858	9277	48	10503
24	3902	9319	49	10560
25	3947	9363	50	10618


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
20000.00
16000.00
12000.00
8000.00
4000.00
0.00
YEARS
ALTERNATIVE NAME:
without project (1984 flows, normal year)

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK **ALTERNATIVE NAME:** 11-21-94

Both Projects (1983 flows, wet year)

INPUTS

Spawning distribution of fish passing Leaburg Dam	
% above S.F.	0.75
% in S.F.	0.15
% below S.F.	0.10
Percentage of fish spawning prior to Sept. 16	0.35
Average # of Adult Fish Returning to the System	8570
Average # of Fish Passing Leaburg Dam	3000
Expected Percentage of Fish Above Leaburg Dam	0.65
Additional Fish Passage at Leaburg due To Temperature Control	2571

Estimated days to emergence (1800 TU's)

SEPT. 15 SPAWNING	
In South Fork	146
Below S.F.	158
Above S.F.	180
SEPT. 30 SPAWNING	
In South Fork	166
Below S.F.	169
Above S.F.	180

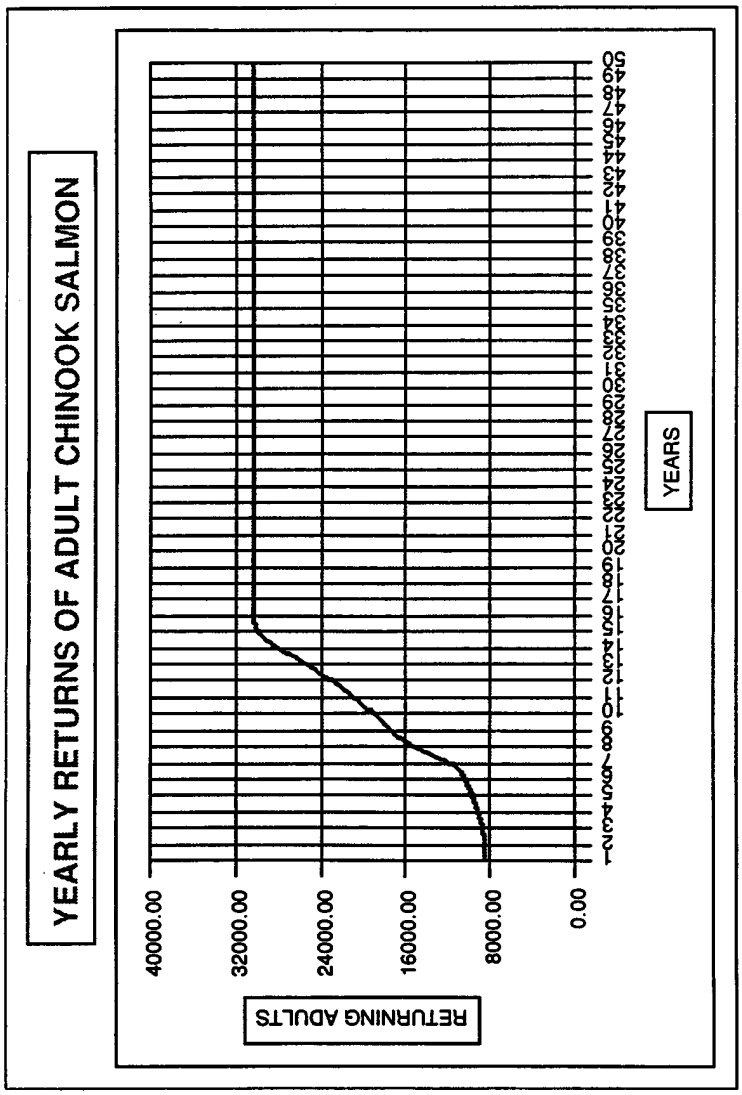
CONSTANTS	
Smolt/adult survival	0.02
Eggs per female	4000
pre-spawn mortality	
above S.F	0.05
in S.F	0.05
below S.F	0.05
Fish Passage Goal (above Leaburg)	24700

MAX. TOTAL PRODUCTION = 30270

OUTPUT	ALTERNATIVE NAME: Both Projects (1983 flows, wet year)	
Estimated egg to smolt survival		
In the South Fork	8%	
Below the South Fork	8%	
Above the South Fork	10%	
EXPECTED FISH PASSAGE NUMBERS		
Expected increase in passage at Leaburg due to early passage		2571
Number of fish migrating above S.F.		4178
Number of fish migrating into S.F.		836
Number of fish migrating to below S.F.		557
TOTAL fish passage		**5571**
ADULTS PRODUCED		
Above the South Fork	15003	
In the South Fork	2400	
Below the South Fork	1600	
TOTAL adults produced	**19003**	
ESTIMATED RETURN TO LEABURG		6334

Both Projects (1983 flows, wet year)

year	Estimated yearly returns to system	year	estimated yearly returns to system
1	8570	26	30270
2	8570	27	30270
3	8570	28	30270
4	9175	29	30270
5	9609	30	30270
6	10331	31	30270
7	11137	32	30270
8	15705	33	30270
9	17410	34	30270
10	19033	35	30270
11	20878	36	30270
12	22976	37	30270
13	25362	38	30270
14	28074	39	30270
15	30270	40	30270
16	30270	41	30270
17	30270	42	30270
18	30270	43	30270
19	30270	44	30270
20	30270	45	30270
21	30270	46	30270
22	30270	47	30270
23	30270	48	30270
24	30270	49	30270
25	30270	50	30270


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
40000.00
32000.00
24000.00
16000.00
8000.00
0.00
YEARS
ALTERNATIVE NAME:
Both Projects (1983 flows, wet year)

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK

ALTERNATIVE NAME: 11-21-94
Cougar Alone (1983 flows, wet year)

INPUTS

Spawning distribution of fish passing Leaburg Dam	
% above S.F.	0.68
% in S.F.	0.13
% below S.F.	0.18
Percentage of fish spawning prior to Sept. 16	0.35
Average # of Adult Fish Returning to the System	8570
Average # of Fish Passing Leaburg Dam	3000
Expected Percentage of Fish Above Leaburg Dam	0.52
Additional Fish Passage at Leaburg due To Temperature Control	1456

Estimated days to emergence (1800 TU's)

SEPT. 15 SPAWNING	
In South Fork	146
Below S.F.	153
Above S.F.	180
SEPT. 30 SPAWNING	
In South Fork	166
Below S.F.	165
Above S.F.	180

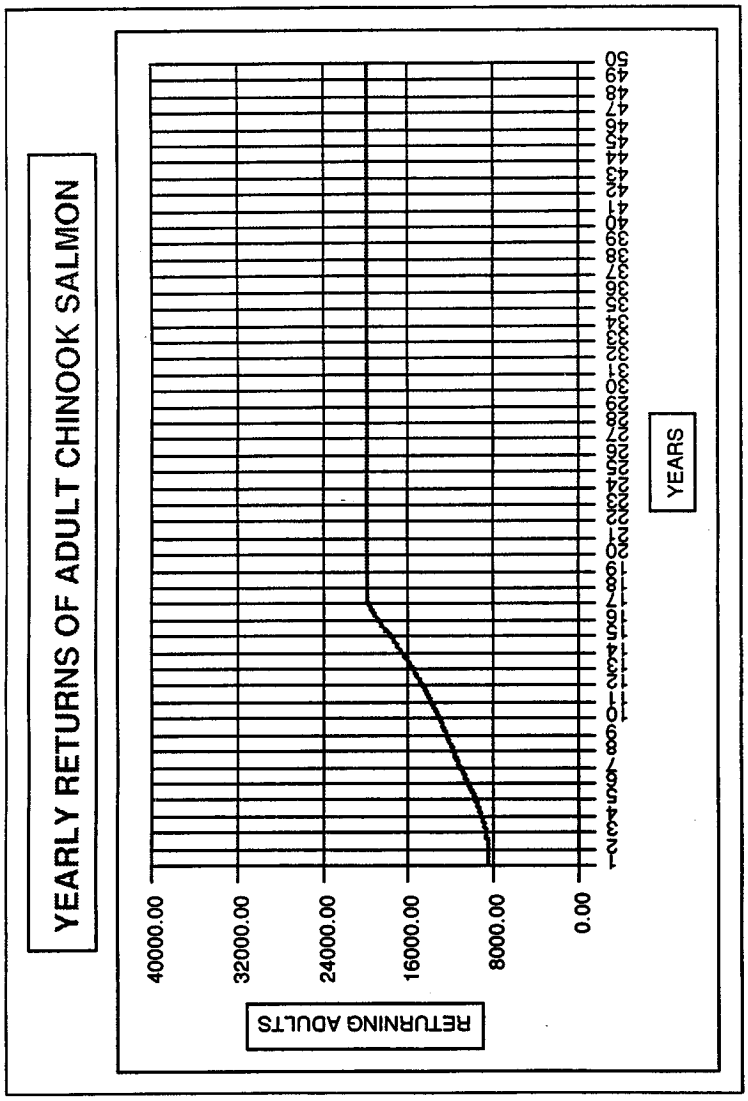
CONSTANTS	
Smolt/adult survival	0.02
Eggs per female	4000
pre-spawn mortality	
above S.F	0.05
in S.F	0.13
below S.F	0.11
Fish Passage Goal (above Leaburg)	14300

MAX. TOTAL PRODUCTION = 19870

OUTPUT	ALTERNATIVE NAME: Cougar Alone (1983 flows, wet year)	
Estimated egg to smolt survival		
In the South Fork	8%	
Below the South Fork	8%	
Above the South Fork	10%	
EXPECTED FISH PASSAGE NUMBERS		
Expected increase in passage at Leaburg due to early passage		1456
Number of fish migrating above S.F.		3030
Number of fish migrating into S.F.		579
Number of fish migrating to below S.F.		802
TOTAL fish passage		**4412**
ADULTS PRODUCED		
Above the South Fork	10882	
In the South Fork	1524	
Below the South Fork	2159	
TOTAL adults produced	**14565**	
ESTIMATED RETURN TO LEABURG		4855

Cougar Alone (1983 flows, wet year)

year	Estimated yearly returns to system	year	estimated yearly returns to system
1	8570	26	19870
2	8570	27	19870
3	8570	28	19870
4	9175	29	19870
5	9609	30	19870
6	10331	31	19870
7	11137	32	19870
8	11745	33	19870
9	12365	34	19870
10	13048	35	19870
11	13799	36	19870
12	14626	37	19870
13	15535	38	19870
14	16536	39	19870
15	17638	40	19870
16	18850	41	19870
17	19870	42	19870
18	19870	43	19870
19	19870	44	19870
20	19870	45	19870
21	19870	46	19870
22	19870	47	19870
23	19870	48	19870
24	19870	49	19870
25	19870	50	19870


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
40000.00
32000.00
24000.00
16000.00
8000.00
0.00
YEARS
ALTERNATIVE NAME:
Cougar Alone (1983 flows, wet year)

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK

ALTERNATIVE NAME: 11-21-94

Blue Alone (1983 flows, wet year)

INPUTS

Spawning distribution of fish passing Leaburg Dam	
% above S.F.	0.67
% in S.F.	0.12
% below S.F.	0.21
Percentage of fish spawning prior to Sept. 16	0.35
Average # of Adult Fish Returning to the System	8570
Average # of Fish Passing Leaburg Dam	3000
Expected Percentage of Fish Above Leaburg Dam	0.48
Additional Fish Passage at Leaburg due To Temperature Control	1114

Estimated days to emergence (1800 TU's)

SEPT. 15 SPAWNING	
In South Fork	84
Below S.F.	147
Above S.F.	180
SEPT. 30 SPAWNING	
In South Fork	124
Below S.F.	160
Above S.F.	180

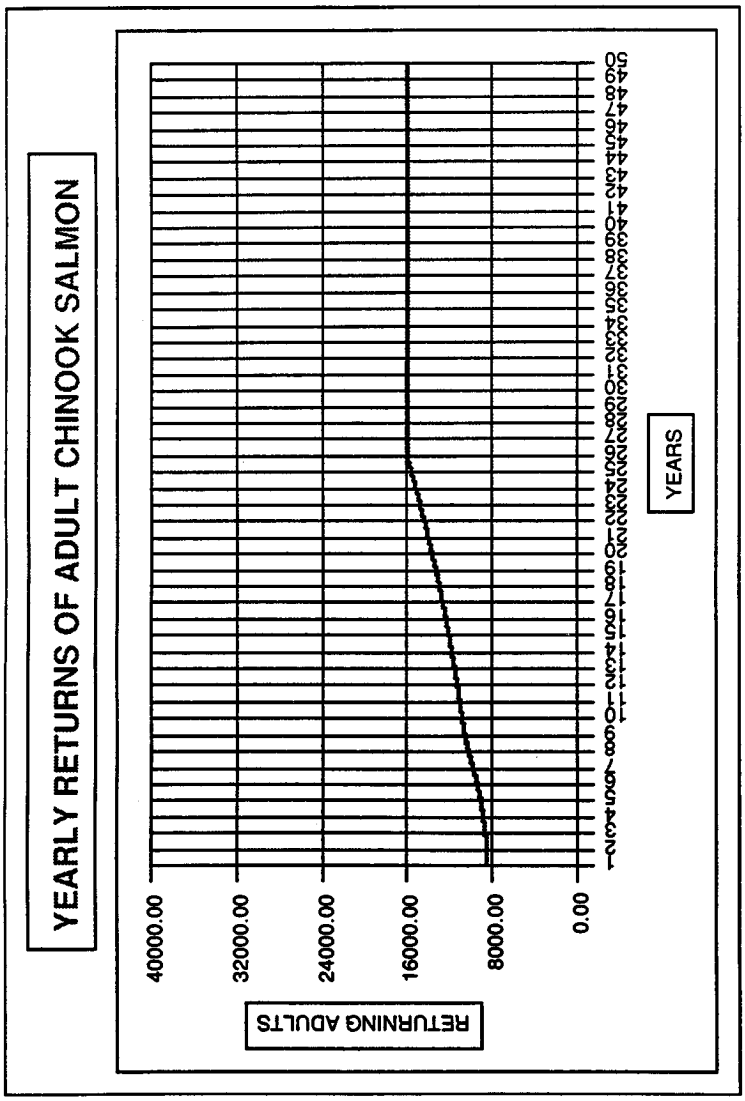
CONSTANTS	
Smolt/adult survival	0.02
Eggs per female	4000
pre-spawn mortality	
above S.F	0.05
in S.F	0.23
below S.F	0.13
Fish Passage Goal (above Leaburg)	10400

MAX. TOTAL PRODUCTION = 15970

OUTPUT	ALTERNATIVE NAME: Blue Alone (1983 flows, wet year)	
Estimated egg to smolt survival		
In the South Fork	5%	
Below the South Fork	8%	
Above the South Fork	10%	
EXPECTED FISH PASSAGE NUMBERS		
Expected increase in passage at Leaburg due to early passage		1114
Number of fish migrating above S.F.		2756
Number of fish migrating into S.F.		494
Number of fish migrating to below S.F.		864
TOTAL fish passage		**4114**
ADULTS PRODUCED		
Above the South Fork	9897	
In the South Fork	718	
Below the South Fork	2273	
TOTAL adults produced	**12888**	
ESTIMATED RETURN TO LEABURG		4296

Blue Alone (1983 flows, wet year)

year	Estimated yearly returns to system	year	estimated yearly returns to system
1	8570	26	15970
2	8570	27	15970
3	8570	28	15970
4	8851	29	15970
5	9053	30	15970
6	9359	31	15970
7	9774	32	15970
8	10208	33	15970
9	10555	34	15970
10	10794	35	15970
11	11026	36	15970
12	11267	37	15970
13	11520	38	15970
14	11784	39	15970
15	12059	40	15970
16	12347	41	15970
17	12648	42	15970
18	12961	43	15970
19	13289	44	15970
20	13631	45	15970
21	13989	46	15970
22	14362	47	15970
23	14752	48	15970
24	15159	49	15970
25	15584	50	15970


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
40000.00
32000.00
24000.00
16000.00
8000.00
0.00
YEARS
ALTERNATIVE NAME:
Blue Alone (1983 flows, wet year)

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK

ALTERNATIVE NAME: 11-18-94
without project (1983 flows, wet year)

INPUTS

Spawning distribution of fish passing Leaburg Dam	
% above S.F.	0.60
% in S.F.	0.10
% below S.F.	0.30
Percentage of fish spawning prior to Sept. 16	0.35
Average # of Adult Fish Returning to the System	8570.00
Average # of Fish Passing Leaburg Dam	3000.00
Expected Percentage of Fish Above Leaburg Dam	0.35
Additional Fish Passage at Leaburg due To Temperature Control	0

Estimated days to emergence (1800 TU's)

SEPT. 15 SPAWNING	
In South Fork	84
Below S.F.	141
Above S.F.	180
SEPT. 30 SPAWNING	
In South Fork	124
Below S.F.	156
Above S.F.	180

CONSTANTS

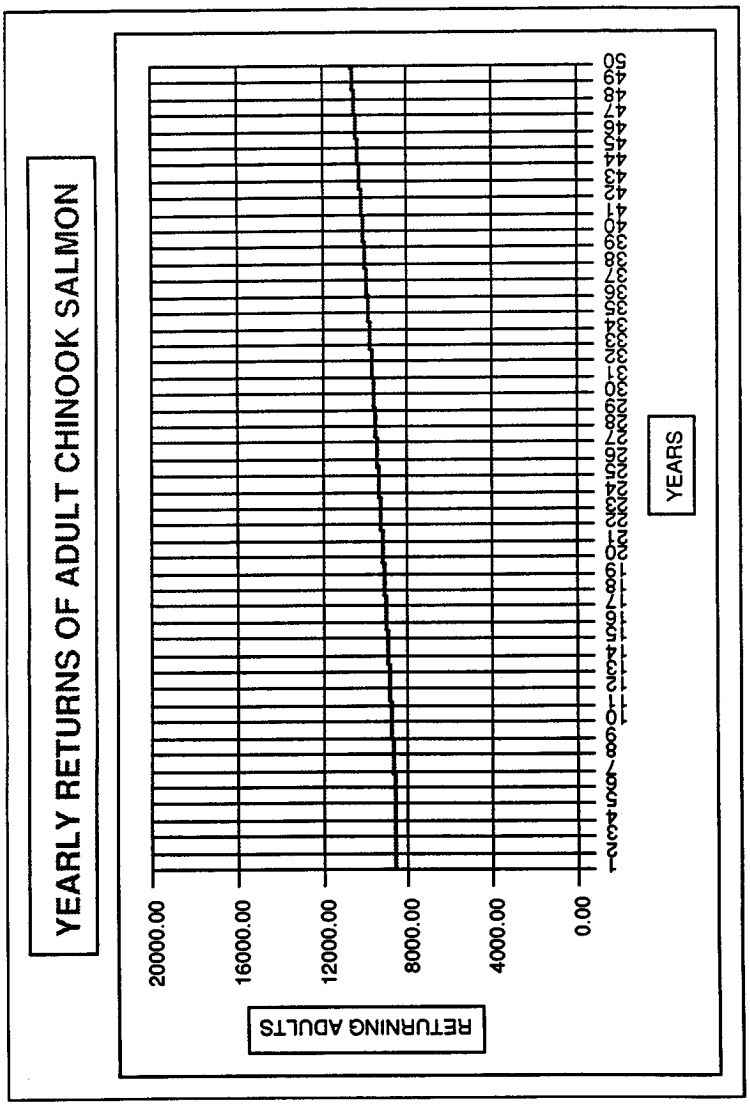
Smolt/adult survival	0.02
Eggs per female	4000
pre-spawn mortality	
above S.F	0.05
in S.F	0.23
below S.F	0.19
Fish Passage Goal (above Leaburg)	10000

TOTAL GOAL FOR BASIN 15571

OUTPUT	ALTERNATIVE NAME: without project (1983 flows, wet year)		
Estimated egg to smolt survival			
In the South Fork	5%		
Below the South Fork	8%		
Above the South Fork	10%		
EXPECTED FISH PASSAGE NUMBERS			
Expected increase in passage at Leaburg due to early passage			0
Number of fish migrating above S.F.			1800
Number of fish migrating into S.F.			300
Number of fish migrating to below S.F.			900
TOTAL fish passage			**3000**
ADULTS PRODUCED			
Above the South Fork		6463	
In the South Fork		437	
Below the South Fork		2204	
TOTAL adults produced		**9103**	
ESTIMATED RETURN TO LEABURG			3034

without project (1983 flows, wet year)

year	eventual adult returns	Estimated yearly returns to system	year	estimated yearly returns to system
1	3034	8570	26	9406
2	3034	8570	27	9450
3	3069	8570	28	9495
4	3104	8588	29	9540
5	3140	8605	30	9586
6	3176	8622	31	9632
7	3213	8657	32	9679
8	3249	8693	33	9726
9	3287	8728	34	9774
10	3325	8765	35	9822
11	3363	8802	36	9871
12	3402	8839	37	9920
13	3441	8876	38	9970
14	3480	8914	39	10021
15	3520	8953	40	10072
16	3561	8992	41	10124
17	3602	9031	42	10176
18	3643	9071	43	10229
19	3685	9111	44	10283
20	3727	9152	45	10337
21	3770	9193	46	10392
22	3814	9235	47	10447
23	3858	9277	48	10503
24	3902	9319	49	10560
25	3947	9363	50	10618


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
20000.00
16000.00
12000.00
8000.00
4000.00
0.00
YEARS
ALTERNATIVE NAME:
without project (1983 flows, wet year)

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK

ALTERNATIVE NAME: 11-21-94

Both Projects (1977 flows, dry year)

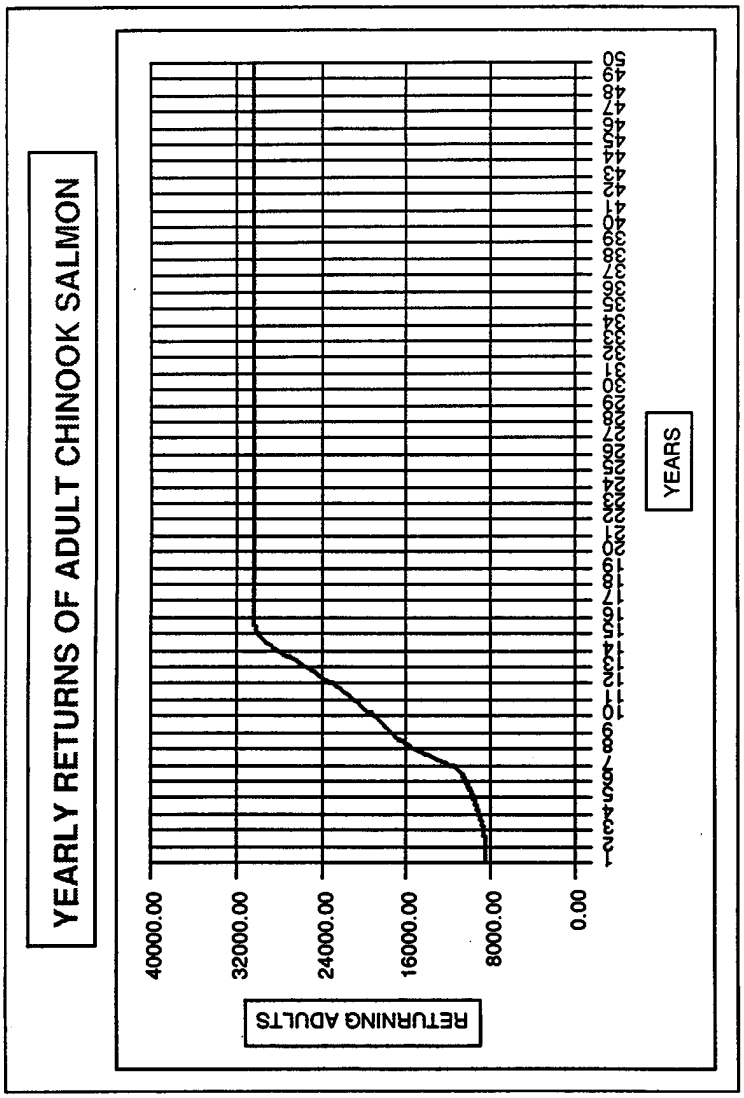
INPUTS			
Spawning distribution of fish passing Leaburg Dam		Estimated days to emergence (1800 TU's)	
		SEPT. 15 SPAWNING	
		In South Fork	139
		Below S.F.	151
% above S.F.	0.75	Above S.F.	180
% in S.F.	0.15	**SEPT. 30 SPAWNING**	
% below S.F.	0.10	In South Fork	157
Percentage of fish spawning prior to Sept. 16	0.35	Below S.F.	147
		Above S.F.	180
Average # of Adult Fish Returning to the System	8570	**CONSTANTS**	
		Smolt/adult survival	0.02
		Eggs per female	4000
Average # of Fish Passing Leaburg Dam	3000	**pre-spawn mortality**	
		above S.F	0.05
Expected Percentage of Fish Above Leaburg Dam	0.65	in S.F	0.05
		below S.F	0.05
		Fish Passage Goal (above Leaburg)	24700
Additional Fish Passage at Leaburg due To Temperature Control	2571		

MAX. TOTAL PRODUCTION = 30270

OUTPUT	ALTERNATIVE NAME: Both Projects (1977 flows, dry year)	
Estimated egg to smolt survival		
In the South Fork	8%	
Below the South Fork	8%	
Above the South Fork	10%	
EXPECTED FISH PASSAGE NUMBERS		
Expected increase in passage at Leaburg due to early passage		2571
Number of fish migrating above S.F.		4178
Number of fish migrating into S.F.		836
Number of fish migrating to below S.F.		557
TOTAL fish passage		5571
ADULTS PRODUCED		
Above the South Fork	15003	
In the South Fork	2400	
Below the South Fork	1600	
TOTAL adults produced	19003	
ESTIMATED RETURN TO LEABURG		6334

Both Projects (1977 flows, dry year)

year	Estimated yearly returns to system	year	estimated yearly returns to system
1	8570	26	30270
2	8570	27	30270
3	8570	28	30270
4	9175	29	30270
5	9609	30	30270
6	10331	31	30270
7	11137	32	30270
8	15705	33	30270
9	17410	34	30270
10	19033	35	30270
11	20878	36	30270
12	22976	37	30270
13	25362	38	30270
14	28074	39	30270
15	30270	40	30270
16	30270	41	30270
17	30270	42	30270
18	30270	43	30270
19	30270	44	30270
20	30270	45	30270
21	30270	46	30270
22	30270	47	30270
23	30270	48	30270
24	30270	49	30270
25	30270	50	30270


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
40000.00
32000.00
24000.00
16000.00
8000.00
0.00
YEARS
ALTERNATIVE NAME:
Both Projects (1977 flows, dry year)

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK

ALTERNATIVE NAME: 11-21-94

Cougar Alone (1977 flows, dry year)

INPUTS

Spawning distribution of fish passing Leaburg Dam	
% above S.F.	0.68
% in S.F.	0.13
% below S.F.	0.18
Percentage of fish spawning prior to Sept. 16	0.35
Average # of Adult Fish Returning to the System	8570
Average # of Fish Passing Leaburg Dam	3000
Expected Percentage of Fish Above Leaburg Dam	0.52
Additional Fish Passage at Leaburg due To Temperature Control	1456

Estimated days to emergence (1800 TU's)

SEPT. 15 SPAWNING	
In South Fork	139
Below S.F.	147
Above S.F.	180
SEPT. 30 SPAWNING	
In South Fork	159
Below S.F.	145
Above S.F.	180

CONSTANTS	
Smolt/adult survival	0.02
Eggs per female	4000
pre-spawn mortality	
above S.F	0.05
in S.F	0.13
below S.F	0.11
Fish Passage Goal (above Leaburg)	14300

MAX. TOTAL PRODUCTION = 19870

OUTPUT	ALTERNATIVE NAME: Cougar Alone (1977 flows, dry year)	
Estimated egg to smolt survival		
In the South Fork	8%	
Below the South Fork	8%	
Above the South Fork	10%	
EXPECTED FISH PASSAGE NUMBERS		
Expected increase in passage at Leaburg due to early passage		1456
Number of fish migrating above S.F.		3030
Number of fish migrating into S.F.		579
Number of fish migrating to below S.F.		802
TOTAL fish passage		**4412**
ADULTS PRODUCED		
Above the South Fork	10882	
In the South Fork	1524	
Below the South Fork	2159	
TOTAL adults produced	**14565**	
ESTIMATED RETURN TO LEABURG		4855

Cougar Alone (1977 flows, dry year)

year	Estimated yearly returns to system	year	estimated yearly returns to system
1	8570	26	19870
2	8570	27	19870
3	8570	28	19870
4	9175	29	19870
5	9609	30	19870
6	10331	31	19870
7	11137	32	19870
8	11745	33	19870
9	12365	34	19870
10	13048	35	19870
11	13799	36	19870
12	14626	37	19870
13	15535	38	19870
14	16536	39	19870
15	17638	40	19870
16	18850	41	19870
17	19870	42	19870
18	19870	43	19870
19	19870	44	19870
20	19870	45	19870
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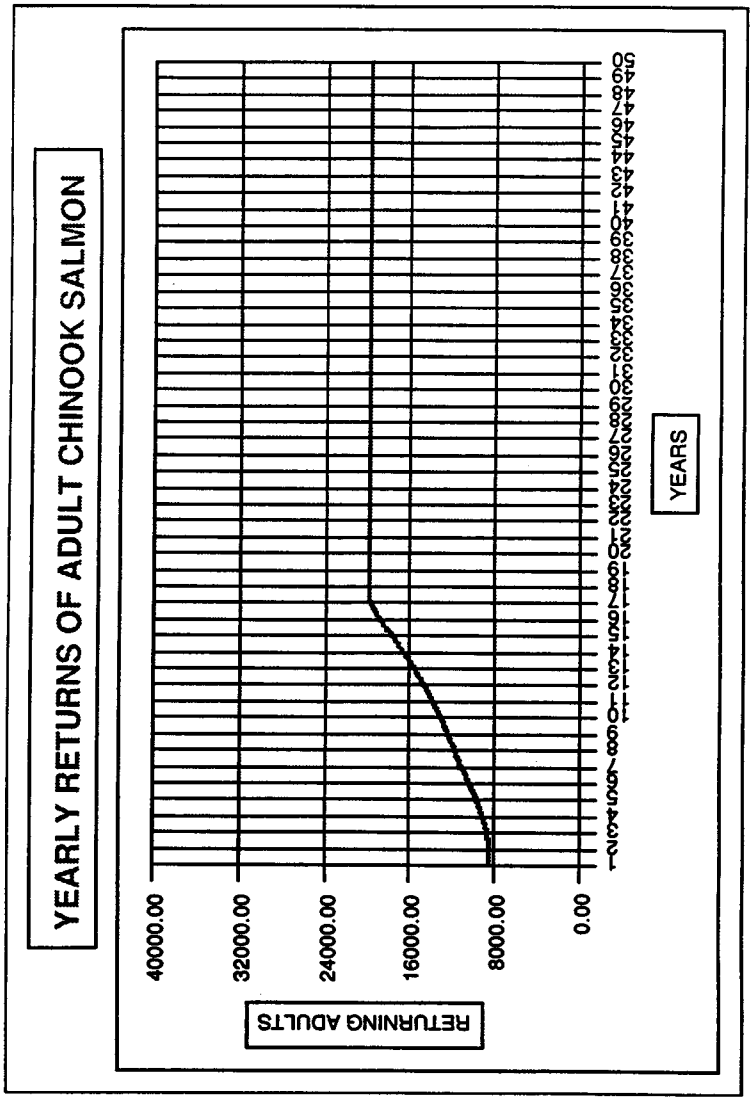
22	19870	47	19870
23	19870	48	19870
24	19870	49	19870
25	19870	50	19870


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
40000.00
32000.00
24000.00
16000.00
8000.00
0.00
YEARS
ALTERNATIVE NAME:
Cougar Alone (1977 flows, dry year)

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK

ALTERNATIVE NAME: 11-21-94
Blue Alone (1977 flows, dry year)

INPUTS

Spawning distribution of fish passing Leaburg Dam	
% above S.F.	0.67
% in S.F.	0.12
% below S.F.	0.21
Percentage of fish spawning prior to Sept. 16	0.35
Average # of Adult Fish Returning to the System	8570
Average # of Fish Passing Leaburg Dam	3000
Expected Percentage of Fish Above Leaburg Dam	0.48
Additional Fish Passage at Leaburg due To Temperature Control	1114

Estimated days to emergence (1800 TU's)

SEPT. 15 SPAWNING	
In South Fork	87
Below S.F.	136
Above S.F.	180
SEPT. 30 SPAWNING	
In South Fork	110
Below S.F.	135
Above S.F.	180

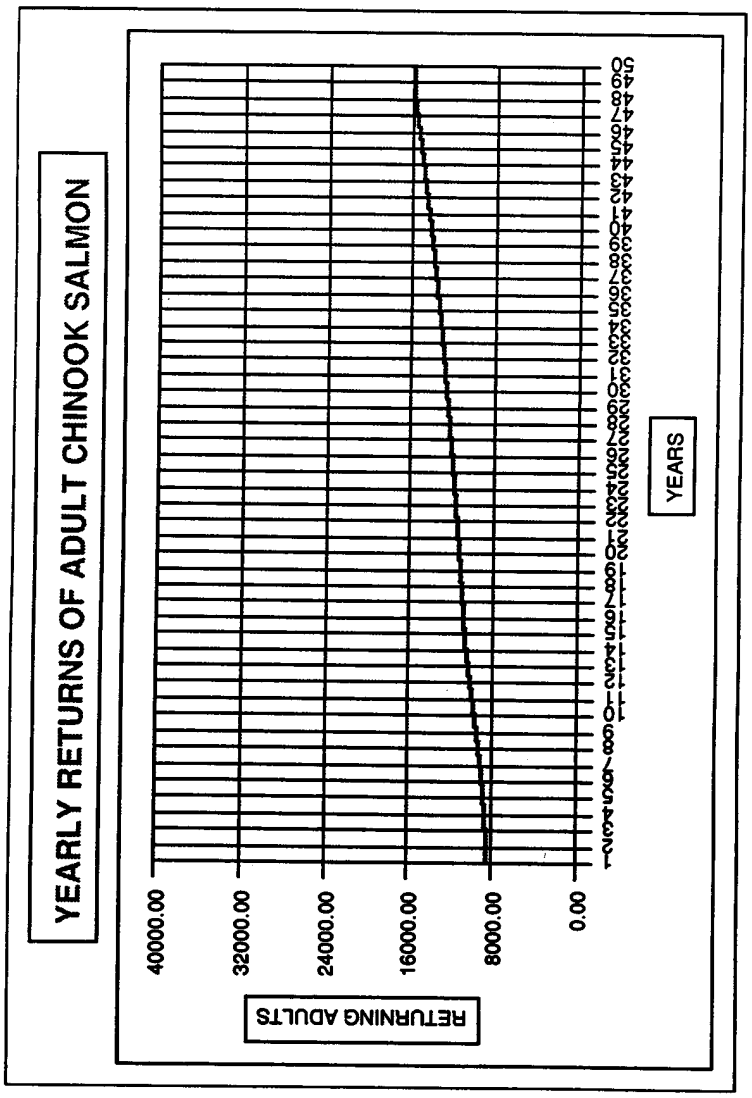
CONSTANTS	
Smolt/adult survival	0.02
Eggs per female	4000
pre-spawn mortality	
above S.F	0.05
in S.F	0.23
below S.F	0.13
Fish Passage Goal (above Leaburg)	10400

MAX. TOTAL PRODUCTION = 15970

OUTPUT	ALTERNATIVE NAME: Blue Alone (1977 flows, dry year)	
Estimated egg to smolt survival		
In the South Fork	5%	
Below the South Fork	7%	
Above the South Fork	10%	
EXPECTED FISH PASSAGE NUMBERS		
Expected increase in passage at Leaburg due to early passage		1114
Number of fish migrating above S.F.		2756
Number of fish migrating into S.F.		494
Number of fish migrating to below S.F.		864
TOTAL fish passage		4114
ADULTS PRODUCED		
Above the South Fork	9897	
In the South Fork	718	
Below the South Fork	1989	
TOTAL adults produced	12604	
ESTIMATED RETURN TO LEABURG		4201

Blue Alone (1977 flows, dry year)

year	Estimated yearly returns to system	year	estimated yearly returns to system
1	8570	26	12035
2	8570	27	12173
3	8570	28	12313
4	8705	29	12456
5	8800	30	12602
6	8943	31	12752
7	9133	32	12904
8	9327	33	13060
9	9525	34	13219
10	9727	35	13382
11	9934	36	13548
12	10145	37	13717
13	10361	38	13890
14	10558	39	14067
15	10701	40	14248
16	10809	41	14432
17	10921	42	14620
18	11034	43	14813
19	11151	44	15009
20	11269	45	15210
21	11390	46	15414
22	11514	47	15624
23	11640	48	15837
24	11769	49	15970
25	11901	50	15970


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
40000.00
32000.00
24000.00
16000.00
8000.00
0.00
YEARS
ALTERNATIVE NAME:
Blue Alone (1977 flows, dry year)

WILLAMETTE TEMPERATURE CONTROL CALCULATIONS

SPRING CHINOOK

ALTERNATIVE NAME: 11-18-94
without project (1977 flows, dry year)

INPUTS

Spawning distribution of fish passing Leaburg Dam	
% above S.F.	0.60
% in S.F.	0.10
% below S.F.	0.30
Percentage of fish spawning prior to Sept. 16	0.35
Average # of Adult Fish Returning to the System	8570.00
Average # of Fish Passing Leaburg Dam	3000.00
Expected Percentage of Fish Above Leaburg Dam	0.35
Additional Fish Passage at Leaburg due To Temperature Control	0

Estimated days to emergence (1800 TU's)

SEPT. 15 SPAWNING	
In South Fork	87
Below S.F.	131
Above S.F.	180
SEPT. 30 SPAWNING	
In South Fork	110
Below S.F.	134
Above S.F.	180

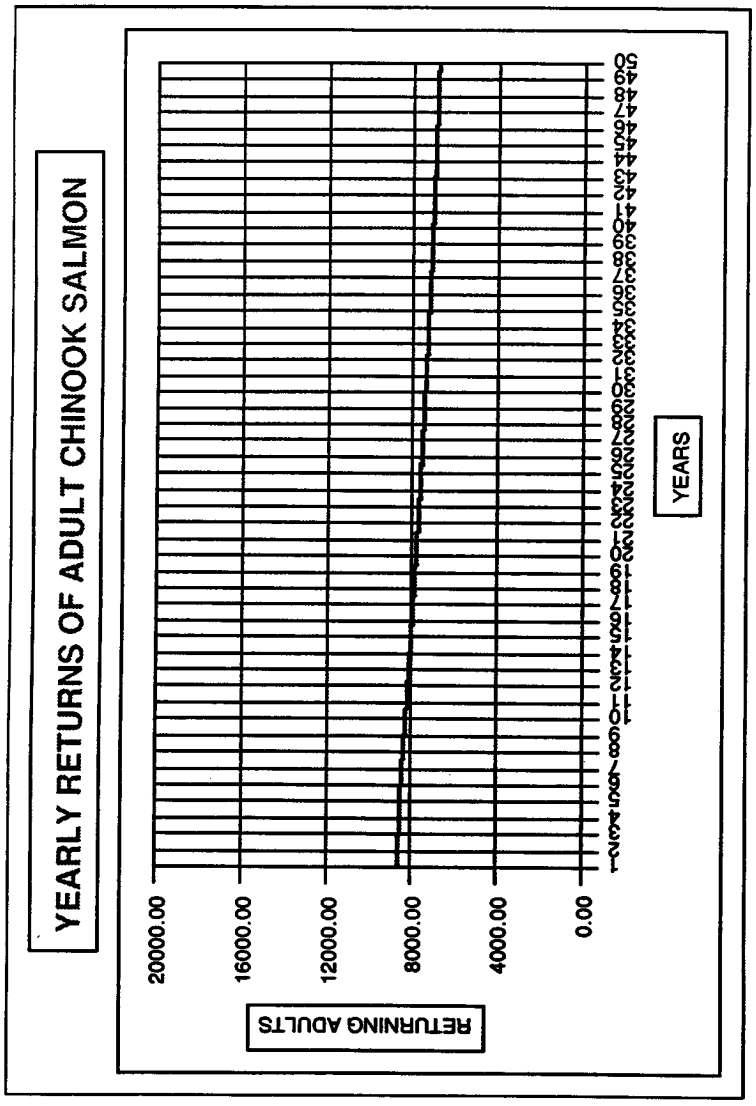
CONSTANTS	
Smolt/adult survival	0.02
Eggs per female	4000
pre-spawn mortality	
above S.F	0.05
in S.F	0.23
below S.F	0.19
Fish Passage Goal (above Leaburg)	10000

TOTAL GOAL FOR BASIN 15571

OUTPUT	ALTERNATIVE NAME: without project (1977 flows, dry year)	
Estimated egg to smolt survival		
In the South Fork	5%	
Below the South Fork	7%	
Above the South Fork	10%	
EXPECTED FISH PASSAGE NUMBERS		
Expected increase in passage at Leaburg due to early passage		0
Number of fish migrating above S.F.		1800
Number of fish migrating into S.F.		300
Number of fish migrating to below S.F.		900
TOTAL fish passage		3000
ADULTS PRODUCED		
Above the South Fork	6463	
In the South Fork	437	
Below the South Fork	1929	
TOTAL adults produced	8828	
ESTIMATED RETURN TO LEABURG		2943

without project (1977 flows, dry year)

year	eventual adult returns	Estimated yearly returns to system	year	estimated yearly returns to system
1	2943	8570	26	7564
2	2943	8570	27	7526
3	2888	8570	28	7489
4	2833	8542	29	7453
5	2780	8514	30	7418
6	2727	8486	31	7383
7	2676	8431	32	7349
8	2626	8377	33	7315
9	2576	8324	34	7282
10	2528	8272	35	7250
11	2480	8221	36	7218
12	2433	8171	37	7187
13	2388	8122	38	7157
14	2343	8074	39	7127
15	2298	8027	40	7098
16	2255	7981	41	7069
17	2213	7936	42	7041
18	2171	7891	43	7013
19	2130	7847	44	6986
20	2090	7804	45	6959
21	2051	7762	46	6933
22	2012	7721	47	6907
23	1974	7681	48	6882
24	1937	7641	49	6857
25	1900	7602	50	6833


YEARLY RETURNS OF ADULT CHINOOK SALMON
RETURNING ADULTS
20000.00
16000.00
12000.00
8000.00
4000.00
0.00
YEARS
ALTERNATIVE NAME:
without project (1977 flows, dry year)

Methodology for Economic Analysis of Resident Trout Benefits

RESIDENT TROUT BENEFIT ANALYSIS

Assumptions:

1.) Trout growth is dependant on water temperature and food availability.

2.) Trout growth units will directly represent the temperature conditions favorable for trout growth (42-63°F).

3.) Returning the tailwaters to near normal (preproject) temperatures would be more conducive to natural timing of insect life cycle events and natural insect community structure.

4.) Improved trout food supplies and warmer water will increase trout feeding behavior and increase the size of the fish, both of which influence angler effort.

5.) Existing angler effort for resident trout in the McKenzie River is still reasonably represented by the 1983 Creel Survey (ODFW, 1990).

6.) Increases in angler effort by stream reach with modified (retro-fit) conditions can be estimated by changes in use (angler days/mi) from either zero or low use at present, to either moderate or high use categories as sampled in the Creel Survey.

7.) Increases in numbers and size of wild trout ≥ 14" length (presently ≈ 10% of the harvest) will improve the quality of the fishery to that comparable to a trophy fishery.

8.) The South Fork of the McKenzie River downstream of Cougar and the mainstream McKenzie River downstream of Blue River will be trophy fisheries.

9.) The dollar value of an angler day for the normal fishery is $18/day and for the trophy fishery is $40/day (1991 Costs).

Mckenzie River 1983 Creel Data[1]

Existing Conditions

Lower Section (34 miles) Armitage to Leaburg

87,688 Total Hrs ÷ 3.1 hrs/trip ÷ 34 miles=

831 Angler Days/mile/yr "Moderate Use"[2]

Middle Section (17 Miles) Leaburg to Blue R. (Excludes Leaburg Pool)

76,590 Total Hrs ÷ 3.1 hrs/trip ÷ 17 miles=

1,453 Angler Days/mile/yr "High Use"[3]

Upper Section (23 Miles) Blue R. to Trail Bridge

415 Angler Days/Mile/Yr "Low Use"[4]

---

[1] ODFW, 1990. Mckenzie River Creel Survey, 1983. Portland, Oregon

[2] Personal Communications. Jeff Ziller. ODFW

[3] See footnote 2

[4] Assumed to be 50% of "Moderate Use" Numbers, No Data Available

Mckenzie River Presumed Changes in Angler Effort with Temperature Control

Alternative:

Blue River Only - Angler Effort in Blue River (1.7 RM) will increase from no use to moderate use (831 Angler Day/Mi); 1.7 x 831= 1,413 Angler Days/Yr Increase, no significant changes are expected elsewhere...

Cougar Only - Angler Effort in South Fork (4.5 RM) will increase from low use to high use; 1,453 Angler Days - 415 Angler Days= +1,038/mi

4.5 x 1,038= 4,671 Angler Days/Yr Increase. Also, because of increase in # fish ≥ 14", this use is considered to be a trophy fishery valued @ 40 $/Angler Day

Angler Effort in mainstream Mckenzie downstream of SF to the Blue River (2.7 RM) will increase from moderate use to high use 1,453 Angler Days - 831 Angler Days= +622/mi

2.7 x 622= 1,679 Angler Days/Yr. Increase, no significant changes are expected elsewhere...

Retrofit @ Both Projects - In addition to the increased angler effort in each of the tributaries and the mainstream down to Blue River (see above). The value of existing effort in the mainstream below Blue River down to Leaburg Pool is expected to increase as a trophy fishery because of the increase in wild trout ≥ 14".

Existing Effort and Value -

24,706 Angler Days/Yr. x $ 18 /Dy

Increased Value

24,706 Angler Days/Yr. x $ 40 /Dy

SUMMARY

Blue River Only: +1,413 Angler Days/Yr

Cougar Only: +6,350 Angler Days/Yr. and increased trophy values $__/Yr

Both Projects: +7,763 Angler Days/Yr. and increased trophy values $__/Yr.

Exhibit A
Temperature Data and Modelling Analysis

WILLAMETTE TEMPERATURE CONTROL FEASIBILITY STUDY
EXHIBIT A
TEMPERATURE DATA AND MODELLING ANALYSES

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WILLAMETTE TEMPERATURE CONTROL FEASIBILITY STUDY
EXHIBIT A
TEMPERATURE DATA AND MODELLING ANALYSES

1.1 Introduction

Existing data from prior studies on the McKenzie subbasin performed by the Portland District was utilized for the current feasibility study. The primary reference for this work is the *Willamette System Temperature Control Study, McKenzie River Subbasin, WSTCS Phase I Study Report*, Volumes I and II, March 1987. The Corps Hydrologic Engineering Center (HEC) in Davis, California, performed additional temperature modelling work to evaluate the installation of selective withdrawal structures (SWS) at the Cougar and Blue River. The following reports were prepared by HEC describing the technical details of the modelling effort and results, which are available at the Portland District office.

- *McKenzie River Water Temperature Study*, Project Report 93-1, September 1993 (updated August 1994).

- *McKenzie River Water Temperature Study*, Addendum A to Project Report 93-1, January 1994 (updated August 1994).

- *McKenzie River Water Temperature Study*, Addendum B to Project Report 93-1, April 1994 (updated August 1994).

Provided below is an abbreviated technical discussion, prepared by the Portland District, of the prior data, modelling efforts, and results used for the current feasibility study. These discussions include the hydrometeorological data used, a description of the HEC modelling effort, an analysis of using ports versus weirs, a sensitivity analysis for selective withdrawal systems, and an analysis of possible water quality changes, including temperatures, during construction.

1.2 Hydrometeorological Data

Much of the existing data from the WSTCS Phase I Study Report (1987) on the McKenzie River was utilized for the current feasibility study. A large amount of meteorological data was preprocessed for input into both the heat budget models both for the design of the selective withdrawal structure and the evaluation of alternatives system configurations. Because of the complex but little known relationships between various meteorological parameters, data sets were chosen from actual annual data sets of years representing a range of conditions.

To provide data sets which were coordinated with the hydrological conditions, including reservoir operations, the data set selection was limited from 1969, the year when Blue River went into service and Cougar was already in service, to 1984 which was used during prior studies. The actual years selected were 1977, 1979, 1982, 1983, and 1984. An examination of

that period of record yielded the following characterization of the hydrometeorological conditions represented by each year.

The years selected for historical reference were 1977, 1979, and 1982. These years are characterized by:

- 1977, a year having the lowest precipitation in the source data period
- 1979, a year having near average precipitation with a warm spring and summer
- 1982, a year of near average precipitation with a cool spring and summer

In addition to the years of historical interest, the years 1983 and 1984 were included since these were the years for which the model (in the prior study) was calibrated and validated and were also years of meteorological interest. The year 1983 was the wettest year in the past 30 years but had the fewest cooling days since 1969. In contrast, 1984 had above average precipitation and had the largest number of cooling days since 1976. Thus, the range of conditions evaluated varied from wet to dry and from warm to cool.

A simplified hydrometeorological label was given to each year for a working definition during the course of this feasibility study as follows:

1977 - DRY Year. This year was the lowest runoff for this period of record.

1979 - WARM Year. This year had a warm spring and summer and near average precipitation.

1982 - COOL Year. This year had a cool spring and summer and near average precipitation.

1983 - WET Year. This year was the wettest year in 30 years prior to 1984.

1984 - NORMAL Year. This year had a wet spring and a dry summer and above average precipitation but more characteristic of a normal weather pattern.

Subsequently, further additional analysis was performed to attempt a statistical characterization for the years selected for evaluation. The probability of exceeding both the annual precipitation and average annual air temperature were evaluated. Average annual air temperature was used to classify years as either warm or cool. The nearest Class A weather station, collecting sufficient meteorological data for use in the computer models simulating the heat budget for the river and reservoirs, was the Mahlon Sweet Airport near Eugene, located 50 to 60 miles west of Blue River and Cougar reservoirs. The weather parameters at this location were used as the source for the heat which warms the reservoirs. Though the reservoirs are located in the foothills of the Cascade Mountains east of Eugene and are a few

hundred feet higher in elevation the models respond to reproduce water temperatures which match actual reservoir and stream temperatures quite closely.

Average annual precipitation was used to classify years as either wet or dry. The computer modeling was based on flows through the reservoirs and in the McKenzie river near the reservoirs. The precipitation station at Leaburg Dam was used for this analysis because it is located at the downstream end of the study area and would reflect stream flow conditions. Analysis was made for three periods of the record.

- The initial selection for the prior study for years to represent hydrometeorological conditions during operation of the reservoirs was the period from 1969 to 1984.

- If selection was made at the beginning of this feasibility study, the period would have been from 1969 to 1991.

- The context of analysis for the period through 1991 is also of interest.

Figure A-1 is a graph displaying the independent probabilities of exceedence of annual mean air temperature at the Mahlon Sweet Airport weather station and the annual mean precipitation at Leaburg Dam for the period of the prior study (1969-1984). The initial selection was made and described for this period. Additional analysis of the other two periods was also performed as well as seasonal analyses based on mean monthly precipitation and air temperature for the same periods.

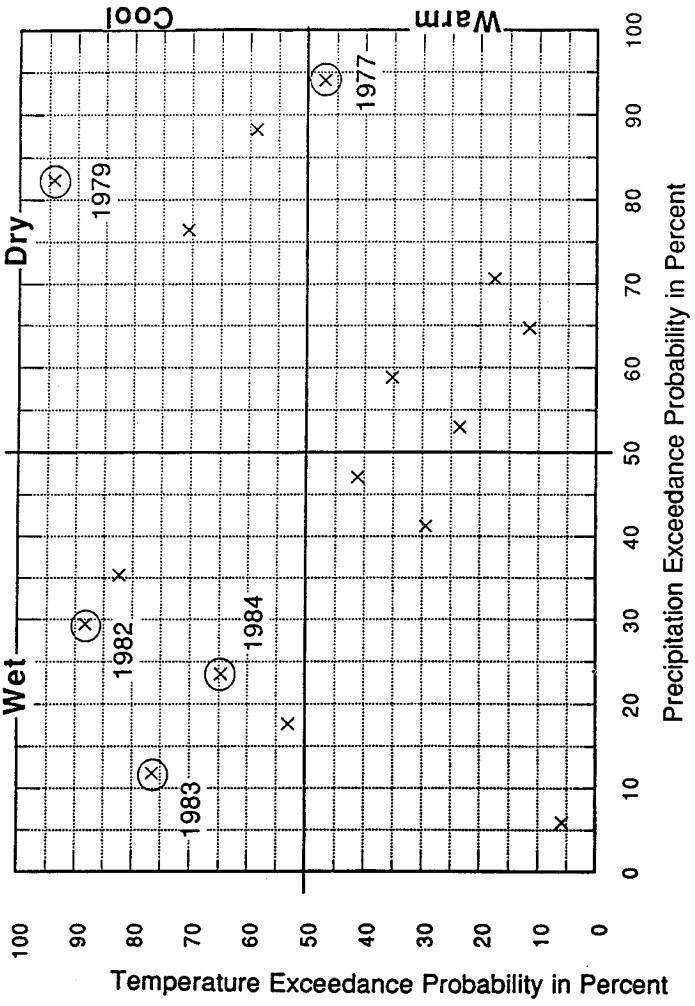
1.3 Performance of the Selective Withdrawal System (SWS)

Evaluating the performance of the SWS was carried out through the use of the reservoir regulation model, HEC-5, in combination with the water quality subroutines which also estimates temperature effects. HEC performed the analysis of temperature effect of selective withdrawal. Their Project Report 93-1 and Addendum A are the basis for the following summary and analysis. Descriptions of the input data requirements and model verification are dealt with in HEC Project Report 93-1.

1.3.1 Alternative Scenarios Evaluated. The following alternative scenarios were evaluated along with the without project conditions:

SWS installed only at Blue River
SWS installed only at Cougar
SWS installed at both Blue River and Cougar

Figure A-1 -- *Precipitation and Temperature Probabilities for Selected Years*



1.3.2 Locations for Water Temperatures. Three locations were chosen to display the water temperature effects:

• The Vida location corresponds to the location of the USGS gaging station on the mainstem McKenzie below the confluence of the South Fork and Blue rivers. It represents the effects of installation and operation of SWS at the dams on the mainstem McKenzie above Leaburg Dam. Water travel time is about a quarter of a day from the dams to Vida.

• The Blue River location corresponds to the location immediately below Blue River dam. It represents the effects of installation and operation of a SWS at Blue River dam located on the Blue River. Water travel time in Blue River is about an hour.

• The South Fork location corresponds to the location immediately below Cougar dam. It represents the effects of installation and operation of a SWS at Cougar dam on the South Fork McKenzie. Water travel time is about 3 hours.

1.3.3 Target Temperatures. Target temperatures were established by consultation with fishery resource agencies and varied monthly (see section 3.2 of the main report). They represent the seasonal temperature conditions that existed prior to the construction of Blue River and Cougar dams. Therefore, the goal of the proposed project is to replicate these seasonally varying pre-project temperature conditions from the releases at Blue River and Cougar dams.

1.3.4 Reservoir Release Schedules. A basic assumption for this feasibility study is that reservoir releases remain unchanged.

1.3.5 Existing Conditions. The computer model was "verified" when it was able to reproduce temperatures measured at the dams in 1984. Simulations for all 5 of the selected years are the existing or base condition against which improvements are measured. The difference between the target and existing condition temperatures illustrates the demand for either cooler or warmer release temperatures.

For explanatory purposes only, the following description of the results is based on 1984 data, which is representative of a normal weather pattern condition. The results for each year are summarized in table A-1. A summary discussion and table showing the achievement of target temperatures (table A-2) also are provided that present the results for the full range of hydrometeorological conditions. Additional information is contained in the HEC reports, which are on file at the Portland District.

Table A-1 -- *SWS Performance Evaluation for All Data Years*

(Temperature in Degrees Fahrenheit / - cool, +warm)

Location	Project Condition	Year	Avg diff	Min diff	Max diff	cool days	warm days	cool Deg-da	warm Deg-da	cool Deg-da Change from Existing	warm Deg-da Change from Existing	cool Change from Existing	warm Change from Existing
Blue River	Existing-Target	1977	5.5	-10.0	9.0	-98	100	-782	877				
		1979	5.2	-9.7	9.3	-93	114	-683	1109				
		1982	5.4	-10.1	2.5	-147	77	-1047	735				
		1983	5.4	-8.1	8.4	-123	75	-1016	693				
		1984	4.8	-8.0	4.3	-131	65	-991	530				
		Avg	5.3	-9.2	6.7	-118	86	-884	789				
Blue River	Multi -Target	1977	1.5	-12.9	13.0	-51	47	-100	117	-682	760	-87%	87%
	Level	1979	1.3	-14.8	11.6	-44	60	-92	186	-491	922	-84%	83%
	Intake	1982	1.0	-14.0	15.0	-51	36	-124	37	-923	698	-88%	95%
		1983	1.4	-14.1	14.7	-47	54	-92	140	-924	552	-91%	80%
		1984	1.0	-12.9	14.4	-104	82	-100	62	-891	468	-90%	88%
		Avg	1.2	-13.7	13.7	-69	66	-102	108	-782	680	-88%	87%
South Fork Mckenzie	Existing-Target	1977	5.5	-6.4	6.5	-179	105	-865	1164				
		1979	6.1	-6.9	7.7	-246	113	-697	1204				
		1982	5.7	-6.1	6.4	-253	96	-1185	802				
		1983	5.5	-5.3	6.4	-188	90	-1094	890				
		1984	5.2	-7.8	5.6	-208	77	-1078	663				
		Avg	5.6	-6.1	5.3	-215	96	-982	943				
South Fork Mckenzie	Multi -Target	1977	1.3	-14.3	11.8	-77	127	-165	392	-690	762	-81%	66%
	Level	1979	1.4	-13.9	14.4	-195	130	-199	267	-698	937	-71%	78%
	Intake	1982	1.6	-13.7	12.3	-186	108	-255	96	-930	705	-78%	88%
		1983	1.4	-13.5	12.3	-122	128	-169	330	-925	560	-85%	63%
		1984	1.6	-13.2	13.5	-146	106	-184	193	-893	471	-83%	71%
		Avg	1.4	-13.7	12.9	-146	129	-196	256	-787	667	-88%	73%
Vida	Existing-Target	1977	1.1	-3.7	5.6	-55	73	-62	206				
		1979	1.4	-4.6	7.3	-67	64	-68	239				
		1982	1.8	-5.2	6.2	-150	49	-298	111				
		1983	1.5	-7.3	7.1	-116	80	-203	175				
		1984	1.5	-4.6	6.2	-139	37	-230	119				
		Avg	1.4	-5.1	6.5	-106	86	-172	170				
Vida	Multi @ Blue -Target	1977	0.9	-3.7	5.3	-42	73	-31	181	-31	25	-50%	12%
	Level River	1979	1.3	-4.6	5.9	-51	67	-48	213	-19	27	-28%	11%
	Intake	1982	1.5	-3.6	4.3	-153	44	-220	75	-78	37	-26%	33%
		1983	1.2	-7.3	5.6	-107	48	-121	122	-82	82	-40%	30%
		1984	1.1	-4.6	4.2	-128	36	-188	73	-73	47	-31%	39%
		Avg	1.2	-4.7	5.0	-96	54	-116	133	-67	37	-38%	28%
Vida	Multi @ Cougar -Target	1977	0.9	-3.7	4.2	-35	111	-38	162	-24	45	-39%	22%
	Level	1979	1.0	-4.6	3.9	-35	91	-34	134	-34	105	-50%	44%
	Intake	1982	1.2	-4.0	3.2	-133	35	-166	42	-132	69	-44%	62%
		1983	0.9	-7.9	5.0	-72	43	-44	73	-139	102	-68%	58%
		1984	0.9	-4.7	3.8	-85	23	-108	39	-122	80	-53%	67%
		Avg	1.0	-5.0	4.0	-72	61	-82	90	-90	80	-51%	51%
Vida	Multi @ BOTH -Target	1977	0.7	-3.7	3.8	-23	108	-17	132	-44	74	-72%	36%
	Level Blue River	1979	0.9	-4.6	3.3	-23	95	-27	104	-41	135	-60%	56%
	Intake & Cougar	1982	1.0	-4.0	1.4	-121	10	-114	5	-184	105	-62%	98%
		1983	0.7	-7.9	3.3	-62	34	-63	32	-150	143	-74%	82%
		1984	0.8	-4.7	1.2	-81	12	-100	7	-130	113	-56%	98%
		Avg	0.8	-5.0	2.6	-62	52	-63	66	-118	114	-68%	79%

Table A-2 -- *SWS Achievement of Target Temperatures* (in percent of the time)

Location	SWS @	1977 (Dry)	1979 (warm, avg precip)	1982 (cool, avg precip)	1983 (Wet)	1984 (normal)	5-Year Average
For Spring/Summer Warming							
Blue River	Blue River	87%	84%	88%	91%	90%	88%
S Fork	Cougar	81%	71%	78%	85%	83%	80%
Vida	Blue River	50%	28%	26%	40%	31%	35%
Vida	Cougar	39%	50%	44%	68%	53%	51%
Vida	Both	72%	60%	62%	74%	56%	65%
For Fall/Winter Cooling							
Blue River	Blue River	87%	83%	95%	80%	88%	87%
S Fork	Cougar	66%	78%	88%	63%	71%	73%
Vida	Blue River	12%	11%	33%	30%	39%	25%
Vida	Cougar	22%	44%	62%	58%	67%	51%
Vida	Both	36%	56%	95%	82%	95%	73%

1.3.6 Effects on the South Fork with SWS.

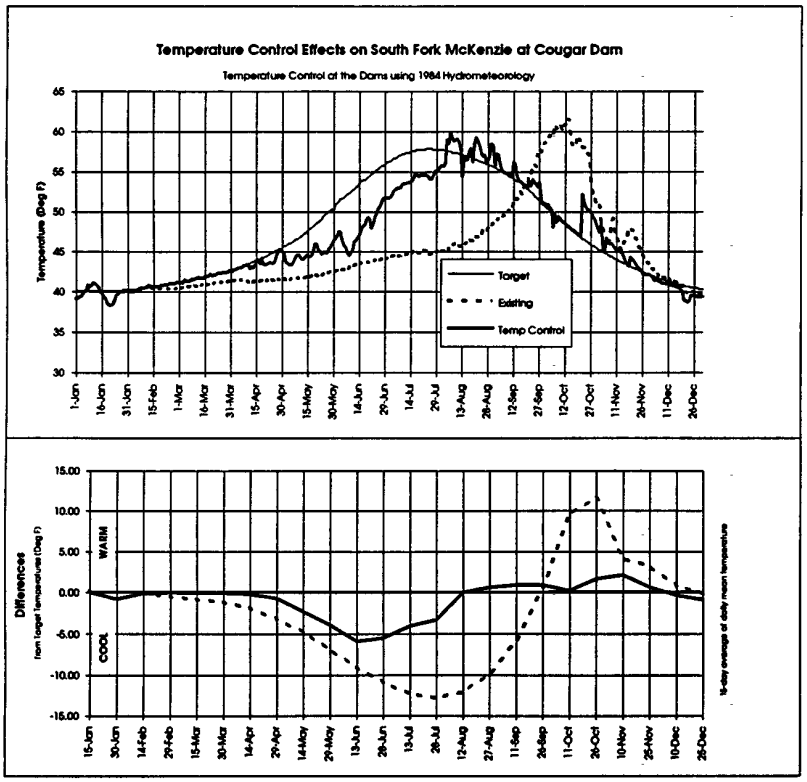
Existing Condition. The simulated water temperature effects of installing a SWS at Cougar Dam are illustrated in figure A-2. The upper graph displays the simulated mean daily temperatures of the release from Cougar Dam for 1984. The dotted line represents the existing release temperature and the heavy black line is the expected release temperature with a SWS installed. The curved black line is the target temperature. The existing condition gives temperatures which are as much as 13.2° F too cool and 13.5° F too warm as compared to the target temperatures.

Statistics on the differences between the existing condition and the target temperature for 1984 are shown at the bottom of figure A-2. The graph in the middle of figure A-2 displays the 15-day mean of the differences between the existing condition and the target temperature by the gray line. The differences between the existing condition and the target temperature on a single day is the degree-day demand. When the release temperature is too cool, there is a demand for warming the difference between the existing condition and the target temperature and the value would be negative. The converse is also true. When the release temperature is to warm, there is a demand for cooling the difference between the existing condition and the target temperature and the value would be positive.

During the season when the lake is filling and when thermal stratification is evident, there are 146 days which are more than a 0.5° F cooler than the target temperature, and 106 days which are more than 0.5° F warmer than the target temperature. For 1984, the temperature was an average of $\pm$5.2° F off the target temperature (average of the absolute value of the deviation from the target temperature). This value represents the "goodness of fit." If the existing condition perfectly conformed to the target temperatures, this value would be $\pm$0.0. There was a demand for 1,078 degree-days of warming in the spring and summer (sum of the negative differences during the stratified period) and 663 degree-days of cooling in the late summer and fall (sum of the positive differences during the stratified period).

Installation of Selective Withdrawal at Cougar. The simulation of Cougar's release temperatures with a SWS was compared to the target temperatures in order to illustrate how well selective withdrawal would function. Statistics on the differences (shown at the bottom of figure A-2) between the simulated release temperature with a SWS installed reveal release temperatures are improved. The variation is within a narrower range than the existing condition. The average temperature deviation has been reduced by the SWS to $\pm$1.6° F, a 4° F reduction from the existing condition, which is a much closer conformance to the target temperatures, or a 71 percent reduction in deviation from the target temperatures. The demand for warming in the spring and summer has been reduced to 184 degree-days (a reduction of 894 degree-days from the existing condition). Selective withdrawal has reduced the warming demand for the spring and summer by 83 percent. The demand for cooling in the late summer and fall was reduced to 193 degree-days (a reduction of 471 degree-days from existing). Selective withdrawal reduced the cooling demand by 71 percent.

Figure A-2 -- *Temperature Control Effects on the South Fork*



Performance Evaluation

Temperature Differences in Degrees Fahrenheit / - cool, +warm

Project Condition	Avg diff	Min diff	Max diff	cool (<-0.5) days	warm (>0. cool Deg-da	warm Deg-da
Existing -Target	5.2	-13.2	13.5	-208	77	-1078	663
Multi Level Intake -Target	1.6	-7.8	5.6	-146	106	-184	193
Change	3.6	-5.5	7.9	-62	-29	-893	471
Change	69%	41%	59%	30%	-38%	83%	71%

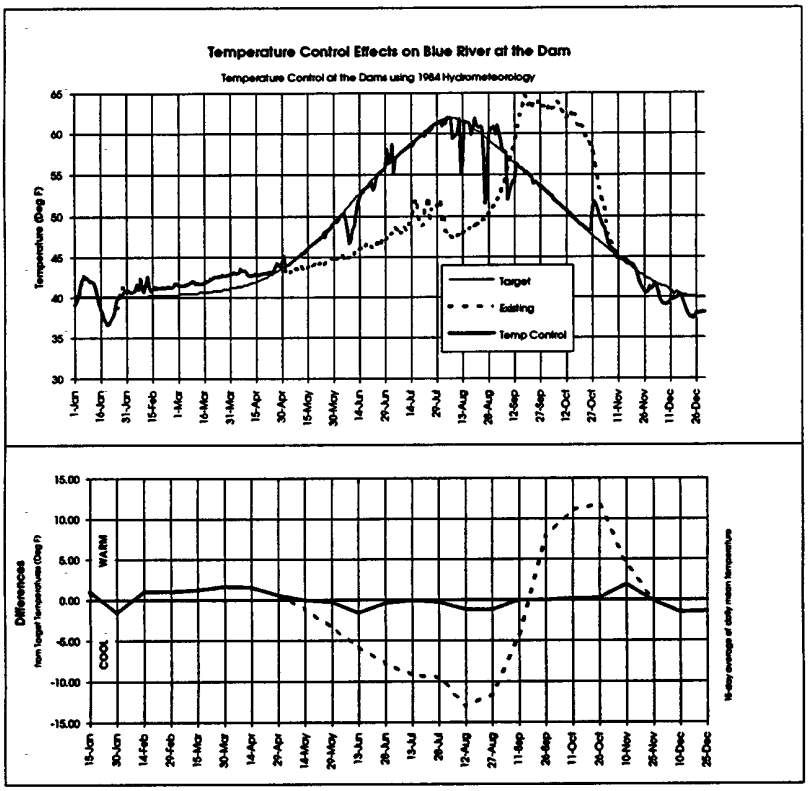
1.3.7 Effects on Blue River with SWS.

Existing Condition. The simulated water temperature effects of installing a SWS at Blue River Dam are illustrated in figure A-3. The upper graph displays the simulated mean daily temperatures of the release from Blue River for 1984. The existing condition gives temperatures which are as much as 14.4° F too cool and 12.9° F too warm as compared to the target temperatures.

Statistics on the differences between the existing condition and the target temperatures are shown at the bottom of figure A-3. The graph in the middle of figure A-3 displays the 15-day mean of the differences between the existing condition and the target temperature. During the season when the lake is filling and when thermal stratification is evident, there are 131 days which are more than a 0.5° F cooler than the target temperature and 65 days which are more than 0.5° F warmer than the target temperature. For 1984, the temperature was an average of ±4.8° F off the target temperature. There was a demand for 991 degree-days of warming in the spring and summer (sum of the negative differences during the stratified period) and 530 degree-days of cooling in the late summer and fall (sum of the positive differences during the stratified period).

Installation of SWS at Blue River. Statistics on the differences (shown at the bottom of figure A-3) between the simulated release temperatures with a SWS installed at Blue River reveal release temperatures are improved. The variation is within a narrower range than the existing condition. The average temperature deviation has been reduced by the SWS to ±1.0° F, a 3.3° F reduction from the existing condition, which is a much closer conformance to the target temperature, or a 77 percent reduction in deviation from the target temperature. The demand for warming in the spring and summer has been reduced to 100 degree-days (a reduction of 891 degree-days from the existing condition). Selective withdrawal has reduced the warming demand for the spring and summer by 90 percent. The demand for cooling in the late summer and fall was reduced to 62 degree-days (a reduction of 468 degree-days from the existing condition). Selective withdrawal reduced the cooling demand by 88 percent.

Figure A-3 -- *Temperature Control Effects on the Blue River*



Performance Evaluation

Temperature Differences in Degrees Fahrenheit / - cool, +warm

Project Condition	Avg diff	Min diff	Max diff	cool (<-0.5) days	warm (>0. days	cool Deg-da	warm Deg-da
Existing-Target	4.8	-14.4	12.9	-131	65	-991	530
Multi Level Intake -Target	1.0	-8.0	4.3	-104	82	-100	62
Change	3.7	-6.5	8.6	-27.0	-17.0	-891	468
Change	78%	45%	67%	21%	-26%	90%	88%

1.3.8 Effects on the Mainstem McKenzie with SWS.

Existing Condition. The simulated water temperature effects on the mainstem McKenzie from installing a SWS at either or both dams are illustrated in figures A-4 and A-5. The existing condition gives temperatures which are as much as 4.6° F too cool and 6.2° F too warm as compared to the target temperatures.

Statistics on the differences between the existing conditions and the target temperatures for 1984 are shown at the bottom of figure A-5. During the season when the lakes are filling and when thermal stratification is evident, there are 139 days which are more than a 0.5° F cooler than the minimum target temperature and 37 days which are more than 0.5° F warmer than the maximum target temperature. For 1984, the temperature was an average of ±1.5° F outside of the target temperature range. If the existing condition perfectly conformed to the target temperature range, this value would be ±0.0. There was a demand for 230 degree-days of warming in the spring and summer (sum of the negative differences during the stratified period) and 120 degree-days of cooling in the late summer and fall (sum of the positive differences during the stratified period).

The simulation of the project release temperatures with a SWS installed at Blue River (MLIB), or installed at Cougar (MLIC), or installed at both Blue River and Cougar (MLIBC) were compared to the target temperatures to illustrate how well each alternative scenario would improve temperatures on the mainstem McKenzie River near Vida.

Installation of SWS at Blue River. For a SWS only at Blue River, the mainstem temperatures at Vida are improved (figure A-5). The variation is within a narrower range than the existing condition. The average temperature deviation has been reduced by the SWS to ±1.1° F, a 0.4° F reduction from the existing condition, which is a closer conformance to the target temperature, or a 27 percent reduction in deviation from the target temperatures. The demand for warming in the spring and summer has been reduced to 158 degree-days (a reduction of 73 degree-days from the existing condition). Selective withdrawal reduces the warming demand for the spring and summer by 31 percent. The demand for cooling in the late summer and fall was reduced to 73 degree-days (a reduction of 47 degree-days from the existing condition), or by 39 percent.

Figure A-4 -- *Temperature Control Effects on the Mainstem McKenzie*

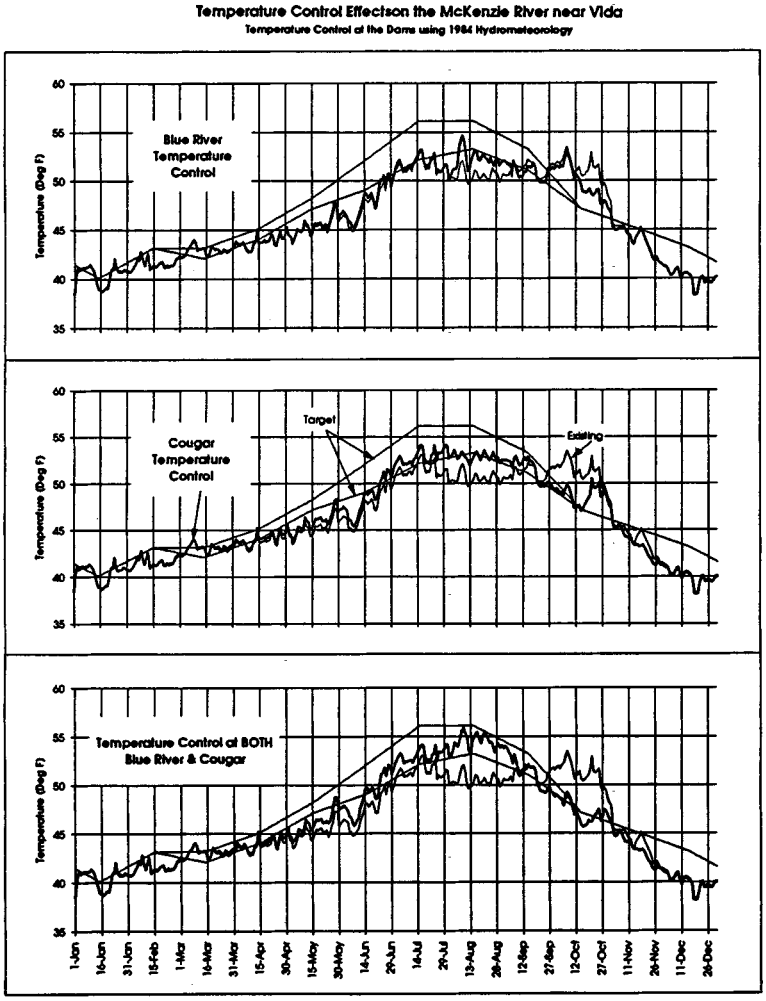
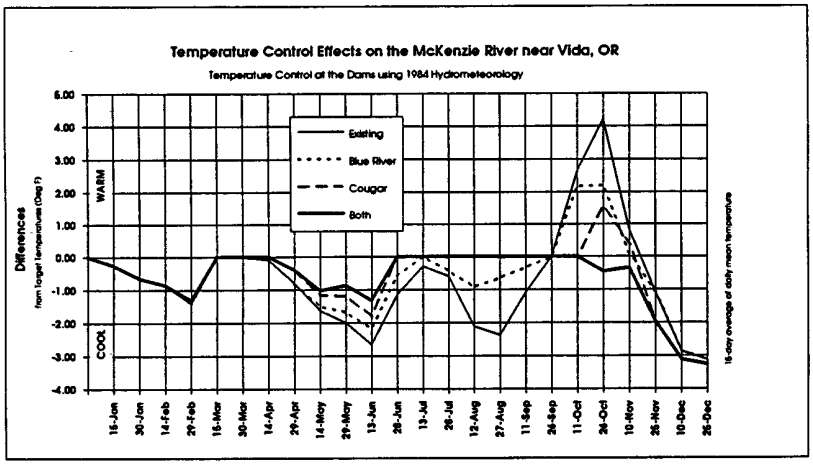


Figure A-5 -- *Summary of Temperature Control Effects on the McKenzie*



Performance Evaluation

Temperature Differences in Degrees Fahrenheit / - cool, +warm

Project Condition	Avg diff	Min diff	Max diff	cool days	warm days	Deg-da	Deg-da
Existing - Target	1.5	-4.6	6.2	-139	37	-230	119
MultiLevel Intake @ Blue River -Target	1.1	-4.6	4.2	-128	36	-158	73
Change from Existing	0.3	0.0	2.0	-11	1	-73	47
Change from Existing	23%	0%	32%	8%	3%	31%	39%
MultiLevel Intake @ Cougar -Target	0.9	-4.7	3.8	-85	23	-108	39
Change from Existing	0.6	0.1	2.4	-54	14	-122	80
Change from Existing	39%	-3%	39%	39%	38%	53%	67%
MultiLevel Intake @ Both BR & C -Target	0.8	-4.7	1.2	-81	12	-100	7
Change from Existing	0.7	0.1	5.0	-58	25	-130	113
Change from Existing	46%	-3%	81%	42%	68%	56%	95%

Installation of SWS at Cougar. For a SWS only at Cougar Dam, the mainstem temperatures at Vida are improved (figure A-5). The variation is within a narrower range than the existing condition. The average temperature deviation has been reduced by the SWS to ±0.9° F, a 0.6° F reduction from the existing condition, which is a closer conformance to the target temperature, or a 40 percent reduction in deviation from the target temperature. The demand for warming in the spring and summer has been reduced to 108 degree-days (a reduction of 122 degree-days from the existing condition) or by 53 percent. The demand for cooling in the late summer and fall was reduced to 39 degree-days (a reduction of 80 degree-days from the existing condition), or by 67 percent.

Installation of SWS at Both Dams. For a SWS at both Blue River an Cougar dams, the mainstem temperatures at Vida are improved (figure A-5). The variation is within a narrower range than the existing condition. The average temperature deviation has been reduced by the SWS to ±0.8° F, a 0.7° F reduction from the existing condition, which provides the closest conformance to target temperatures at Vida (a 53 percent reduction). The demand for warming in the spring and summer has been reduced to 100 degree-days (a reduction of 130 degree-days from the existing condition). Selective withdrawal reduces the warming demand for the spring and summer by 56 percent. The demand for cooling in the late summer and fall was reduced to 7 degree-days (a reduction of 113 degree-days from the existing condition), a reduction of 95 percent.

1.3.9 Summary of Results. An evaluation similar to the one described above for the 1984 condition was performed for each of the 5 years representing the full range of hydrometeorological conditions (table A-1). The achievement of target temperatures for the spring/summer warming and fall/winter cooling periods for each alternative scenario is summarized in table A-2. Results show a significant improvement in water temperatures in the South Fork and Blue rivers under the full range of conditions. The percentage of time target temperatures are met range from 84 to 91 percent for spring warming and 83 to 95 percent for fall cooling for the Blue River, and from 71 to 85 percent for spring warming and 63 to 88 percent for fall cooling for the South Fork McKenzie River.

Performance results for spring/summer warming on the mainstem McKenzie near Vida show that for most data years and the 5 year average, the best conformance to target temperatures occurs when a SWS is installed at both Blue River and Cougar. This is especially significant in average to low flow years (1977, 1979, 1982). Performance results for fall/winter cooling on the mainstem McKenzie near Vida show that for all data years and the 5 year average, the best conformance to target temperatures also occurs when a SWS is installed at both projects. If the Cougar only and both scenarios are compared, significant increases are seen for 1982, 1983, 1984, and the 5 year average between these two scenarios. In summary, meeting the target temperatures under the full range of hydrometeorological conditions requires access to and withdrawal of the warmest water available in both Blue River and Cougar lakes.

The SWSs are described here as achieving less than 100 percent of the warming or cooling demand. Design improvements to the system were under development by the Waterways Experiment Station (WES) at the same time that the system evaluation was being performed by HEC. Consequently, WES's design improvements were not incorporated into the HEC evaluation. HEC's results for the analysis of the performance of the various alternative scenarios gives sufficient information to display the effects and to provide a basis for quantifying the benefits. However, WES design studies do indicate a higher level of performance than is discussed in this section (a higher percentage achievement of the target temperatures).

1.4 Selective Withdrawal Ports versus Weirs

The computer model WESTEX is a one-dimensional model of thermally stratified reservoirs with capability to simulate operation of SWS. A single wetwell system was selected for Cougar Reservoir because of the need to have selective withdrawal capability for both the power penstock and the regulating outlet. When the power generation is shutdown, water is released through the regulation outlet. The algorithm for temperature control using multiple ports in a single wetwell was developed at the Waterways Experiment Station by Howington, et al., and incorporated into WESTEX.

As discussed in section 1.2, hydrometeorological data are required as inputs to the model. Several years of data had been previously preprocessed and these data sets were adopted for this study. As described in section 3.2 of the main report, temperature goals or target temperatures are required to evaluate the effectiveness of various designs.

Design criteria for ports were based on two successful SWS already constructed and in operation. A single wetwell system at Lost Creek Lake and a dual wetwell system at Applegate Lake. In dual wetwell systems, ports are either fully open or fully closed. Flow control is accomplished near the base of the wetwell where the tempered water is released in proportional amounts to meet the target temperature in the outlet tunnel where blending occurs. In the single wetwell system, the ports are throttled to balance the flow through the selected ports to overcome effects of the differing density (temperature) at the port levels, and to blend the port flows within the wetwell to achieve target temperature in the wetwell prior to release into the outlet.

Operating criteria were based on hydraulic model studies for the SWS's at Lost Creek and Applegate Lakes. The limiting velocity through the ports is 10 feet per second, operated at a submergence of 15 feet or greater. These criteria are important factors in controlling turbulence and vortex formation in the wetwell. Turbulence and vortexes in the wetwell could set up damaging vibrations in gates and turbines (downstream appurtenances).

Capacity of the SWS was set at less than the full regulating outlet capacity. However, capacity to pass flood flows remained unimpeded. Flood flows greater than the selective withdrawal capacity would pass through the large lower ports resulting in partial loss of

temperature control during flood releases. Flood flows are usually cooler than normal flows because they occur during cool, cloudy wet weather. The temporary loss of temperature control results in release temperatures which are warmer than the natural flow but cooler than the target temperature, which is desirable. Capacity was initially set for 2,000 cubic feet per second (cfs) for Cougar and 1,000 cfs for Blue River. These capacities are based on an evaluation of three factors:

- Project releases exceeded 5 percent of the time on a daily mean flow for the 5 selected years combined which is 2,000 cfs for Cougar and 1,000 cfs for Blue River (figure A-6).

- Summer augmentation release rate of 500 cfs at Blue River 800 cfs at Cougar.

- Hydropower release is about 800 cfs with hydraulic capacity of 1,350 cfs at Cougar.

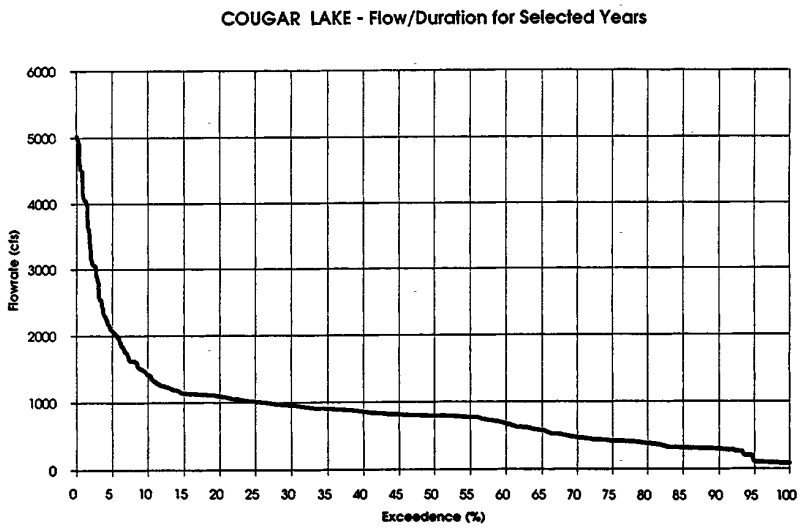
Port size was set at 1,000 square feet for Cougar and 500 square feet for Blue River considering the above factors. Two ports open at capacity. One port during summer augmentation flows with the warmest temperatures which are at the surface (because warmest water has the smallest density and "floats"). A brief study revealed that port size had little effect on capability to control temperature.

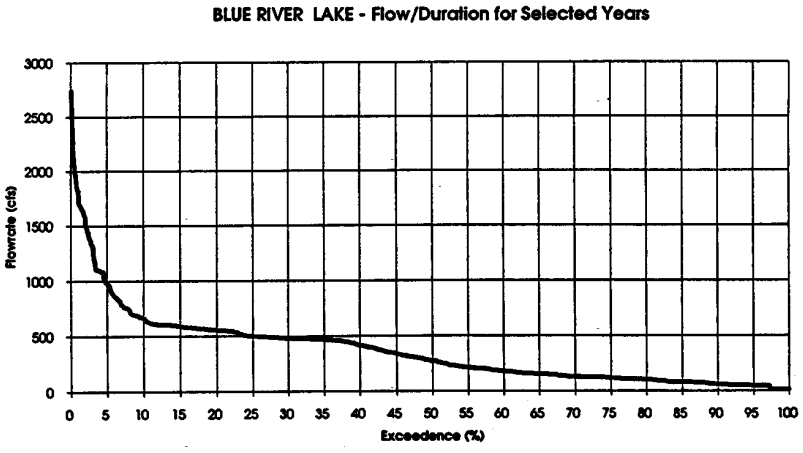
Number and location of ports was studied using a computer model WESMIN which incorporates the thermal budget algorithm of WESTEX. Given the number of ports, WESMIN is used to locate the ports optimally to minimize the deviation from the target temperatures. It was found that 4 or 5 ports yielded the smallest deviation from the target temperatures. Additional ports did not improve performance. Each run for each year yielded a different location for the ports. To optimally meet targets in all selected years, 9 ports are required.

Upon examination of the output, it was clear that reservoir stratification began in April and lasted through October and during that period, the port located highest in the reservoir with adequate submergence was open to meet the target temperatures. This is referred to as the "skimming mode." It became obvious that the need for additional ports was necessary to meet the target temperatures as the reservoir was drawn down in the summer and fall. Any spacing of the 9 ports was a artifact of the 5 selected years. It was decided to evenly space the ports from below minimum flood control pool elevation up to the summer conservation pool elevation (with adequate submergence). Regulating outlets were included.

The drawback of this discrete port design operating in the skimming mode was during reservoir drawdown in late summer when there were occasional abrupt reductions in outflow temperatures. These changes occurred when the dropping reservoir level reduced port submergence, causing the port to close and the next lower port to be opened. The spacing of the ports is greater than the depth of the epilimnion (layer of warm water matching the desired or target temperature). The water temperature at that next lower port is cooler than at the port just closed, resulting in an abrupt lowering of the release temperature.

Figure A-6 -- *Flow/Duration for Selected Years, Cougar and Blue River*





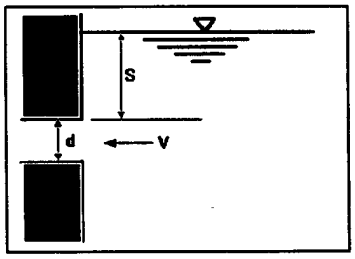
This situation suggested the use of an overflow weir which is continuously lowered as the reservoir level drops. The function of the weir is to merely exclude the cooler water of the lower layers in the reservoir from the intake. A modification to the WESTEX model was made. Results showed a reduction in the abrupt temperature changes as reservoir levels were dropping.

Submergence criterion for the ports was re-examined. Its function was to prevent formation of vortices from forming at the ports operating near the water surface. In the single wetwell system, the gates are required to throttle in order to overcome flow imbalance because of the density (temperature) differences at the selected ports. The port range of operation was set from fully open to 5 percent open to reduce chances for gate vibration and prevent seal damage. In the skimming mode, the port would be fully open when submergence limit was reached. With further reduction in the reservoir level, the port would be closed. This is the source of the abrupt temperature reduction. A gradual closure of the port as the submergence limit was approached while the lower port is gradually opened might alleviate the abrupt temperature change.

A search of the literature on characterization of the submergence limits for vortex formation yielded a simple formulation produced by Gordon which related the limit of vortex formation to submergence, port velocity, and area of port.

$$S \div d = 2.3 \; IF = 2.3 \; (V \div gd) \text{ where, } 1.3.3$$

S = submergence
IF = Froude Number
d = height of port opening
V = velocity = Q/A
Q = Flow rate
A = Area of the gate opening



Incorporating this relationship into the submergence limit and port operating algorithm reduced the abrupt temperature change. The criteria for acceptance of the performance of a temperature control system was set with the advice of the biologists as abrupt temperature changes in the daily mean temperature of no more than 2° C (figure A-7).

The resulting release temperatures from the throttled ports with varying submergence and the weirs were found to be equivalent as shown in figure A-8. The upper graph labeled "WEIRS" depicts their performance. The upper half of the graph shows the elevation of the reservoir water surface for 1984. The bars beneath show the vertical location of the weir. The lower half of the graph depicts the target temperature (the smooth sine curve) and the reservoir release temperature that results from the operation of the weir. The lower graph labeled "PORTS" depicts the performance of the ported single wetwell operating with the varying submergence of the throttled ports.

1.5 Sensitivity Analysis on Selective Withdrawal

Once a SWS is installed at Blue River, or Cougar, or both projects, the potential for restoring pre-project temperatures by operating for target temperatures at Vida or changing reservoir regulation were estimated. Several conclusions can be drawn from results of this analysis as displayed in tables A-3 and A-4. The data in the tables are annual average deviations from the target temperatures. To show the seasonal trends of the deviations, bar graphs of 15-day average deviations were plotted. These graphs are found in HEC's Addendum A to Project Report No. 93-1, as figures A6 through A37 (as referenced in tables A-3 and A-4).

Each annual average deviation represents a bar graph displaying the seasonal variation in the deviations (negative deviation represents release temperatures which are cooler than the target temperatures).

Figure A-7 -- *Cougar Dam, 1984, Daily Temperature Change*

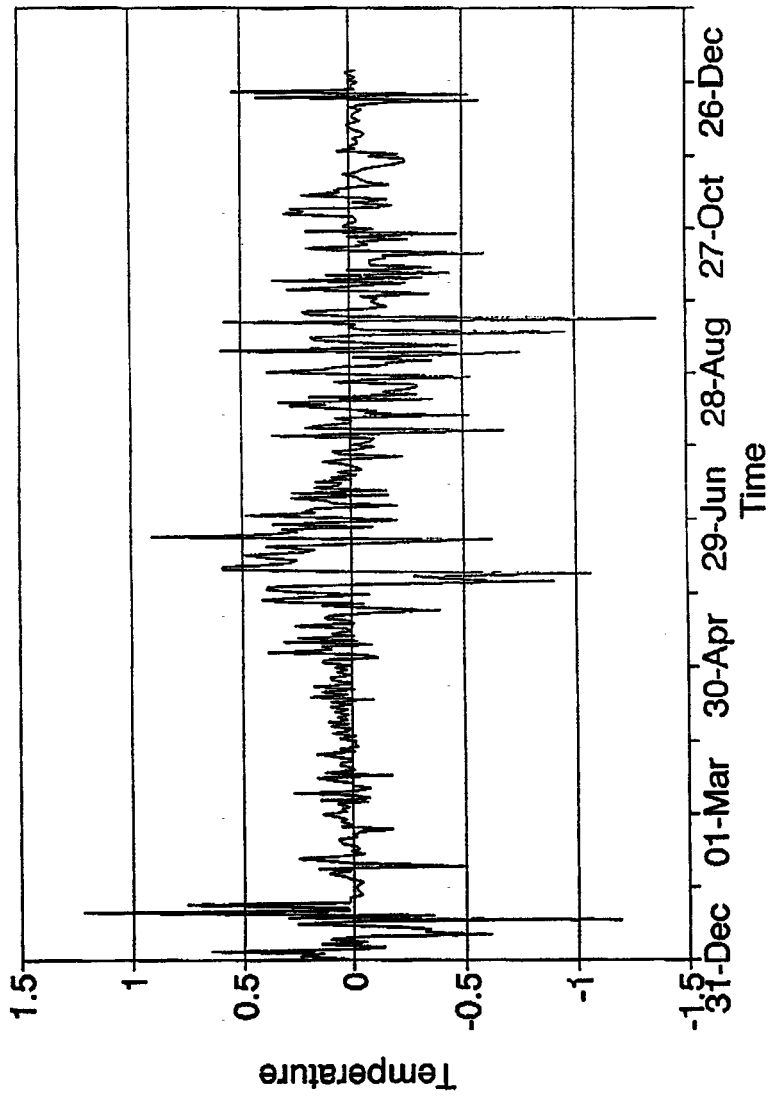
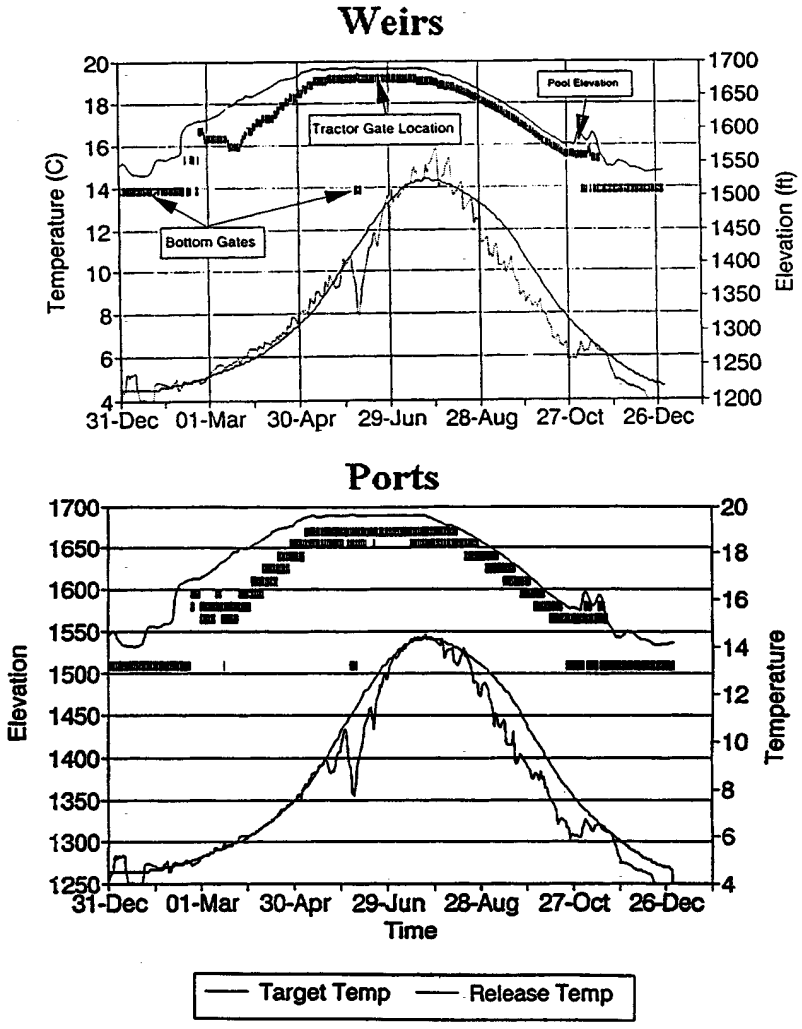


Figure A-8 -- *Performance Graphs, Ports vs Weirs*



In the two scenarios displayed in table A-3, the reservoir release flow rates were specified, as well as the flows at Vida, to be the same as historic flow rates. The only difference is the location of the control point for the target temperatures. The operation for the target temperatures at the dams (At Dam) yields the same results as operating the dams for target temperature at Vida (At Vida). This implies the target temperatures for the dams and Vida are congruent, that is they are well matched or coordinated.

Table A-3
Target Temperature Scenarios
Average Deviation from Target Temperature for 1984
[HEC Figures in ( )]

Location	Temperature Target	Existing Outlet	Selective Withdrawal System installed at Cougar	Blue River	BOTH
S. Fork	At Dam	5.2 (A6)	1.6 (A7)		
	At Vida	5.2 (A14)	2.2 (A15)		
Blue River	At Dam	4.8 (A8)		1.0 (A9)	
	At Vida	4.8 (A16)		2.3 (A17)	
Vida	At Dam	1.5 (A10)	0.9 (A11)	1.1 (A12)	0.8 (A13)
	At Vida	1.5 (A18)	0.9 (A19)	1.1 (A20)	0.8 (A21)

At Dam - Maintain existing release schedule operating selective withdrawal system for the target temperatures at the dams.

At Vida -Maintain existing release schedule operating selective withdrawal system for the target temperatures at Vida.

Although the performance of the SWS was somewhat degraded in the tributaries, no effect was seen at Vida. Therefore, there is no advantage in moving the control point from the dams to Vida.

In table A-4, the control point for temperature was at Vida and the volume balance operation was made allowing the computer program to specify the flow in much the same way as the existing operation and to make selective withdrawal releases to achieve target temperatures at Vida. This operation was run as a base form comparison with the results of the flow augmentation operation. The flow augmentation operates both Blue River and Cougar for both selective withdrawal temperature and release flow rate to achieve the target temperature at Vida.

Table A-4
Reservoir Operation Scenarios
Average Deviation from Target Temperature for 1984
[HEC Figures in ( )]

Location	Operation	Existing Outlet	with SWS installed at Cougar	Blue River	BOTH
S. Fork	Vol Bal	5.0 (A22)	2.4 (A23)		
	Flow Aug	3.1 (A30)	2.1 (A31)		
Blue R.	Vol Bal	4.6 (A24)		2.0 (A25)	
	Flow Aug	2.5 (A32)		2.3 (A33)	
Vida	Vol Bal	1.4 (A26)	0.8 (A27)	1.0 (A28)	0.8 (A29)
	Flow Aug	1.2 (A34)	0.9 (A35)	1.2 (A36)	0.9 (A37)

Vol Bal - Regulates the release flow rate to keep the reservoir volumes balanced between both projects and operates the selective withdrawal systems for target temperatures at Vida to simulate existing flow regulation with temperature control.

Flow Aug - Varies the release flow rate and operate the selective withdrawal systems for target temperatures at Vida.

In summary, neither moving the control point downstream from the dams or augmenting flows by changing the reservoir release schedules improves upon SWS installed at the projects. Some partial improvement in temperature can be made at existing reservoir outlets through flow augmentation, but not at the magnitude necessary to replicate pre-project temperatures to benefit fish and aquatic resources.

1.6 Water Quality Changes During Construction

This section discusses the potential water quality changes anticipated to occur downstream of the Blue River and Cougar projects during the construction of water temperature control facilities. Of primary concern are the magnitude and temporal changes in water temperature, sedimentation/turbidity, and dissolved oxygen.

1.6.1 Water Temperature. Hydrometeorological data for the years 1982-1984 was used in this analysis. These years were a little wetter and cooler than average. A reservoir operation model, HEC-5Q, processed the data and routed flow and temperature through Cougar and Blue River reservoirs and downstream to Vida on the mainstem McKenzie.

The basic assumptions for evaluation of the construction plan are that flood control operation remains unchanged, and that installation of temperature control facilities first occurs at Cougar.

The adopted minimum fishery flows are:

Blue River:	50 cfs year-round
Cougar:	300 cfs (February-June) 200 cfs (July-November)

Diversion capacities were set considering the seasonal flows during construction which will occur during the low flow season. Diversion capacities are:

- Blue River diversion is up to 800 cfs until the cofferdam is overtopped at elevation 1,152 feet (NGVD), and then the capacity of the regulating outlet with the gates fully open.

- Cougar's existing diversion tunnel plug would be tapped and operating gates installed. The capacity to dissipate energy in the powerhouse tailrace would limit the flow through the diversion tunnel to 2,000 cfs. If a flood flow should cause the pool to rise to elevation 1,510 feet, the flow would then be through the regulating outlet at capacity with the gates fully open.

- Flow downstream past Vida was limited to 14,000 cfs.

The rate of construction was estimated from the volume and rate of placement of the concrete for the WTC system assuming a May 1 start of construction. (For Cougar, the desired pool elevation during construction considers the needs of construction, minimum flows for fish without refilling the pool until completion of construction (figure A-9).

For Blue River, the plan during construction is to keep the pool elevation below 1,140 feet as much as possible for 2 years (figure A-10).

Results from the initial modelling for Cougar show that by keeping the residual pool low, peak daily mean outflow temperature reaches nearly 58° F in the summer, which is 3° to 6° F warmer than inflow temperatures. Fall and winter release temperatures are nearly equal for both inflow and outflow (figure A-11). For Blue River, peak daily mean outflow temperature reaches nearly 70° F in the summer, which is 5° to 6° F warmer than the inflow temperature. In the late fall and winter, the outflow and inflow temperatures are nearly the same (figure A-12).

Figure A-9 -- *Cougar Flow and Elevations*

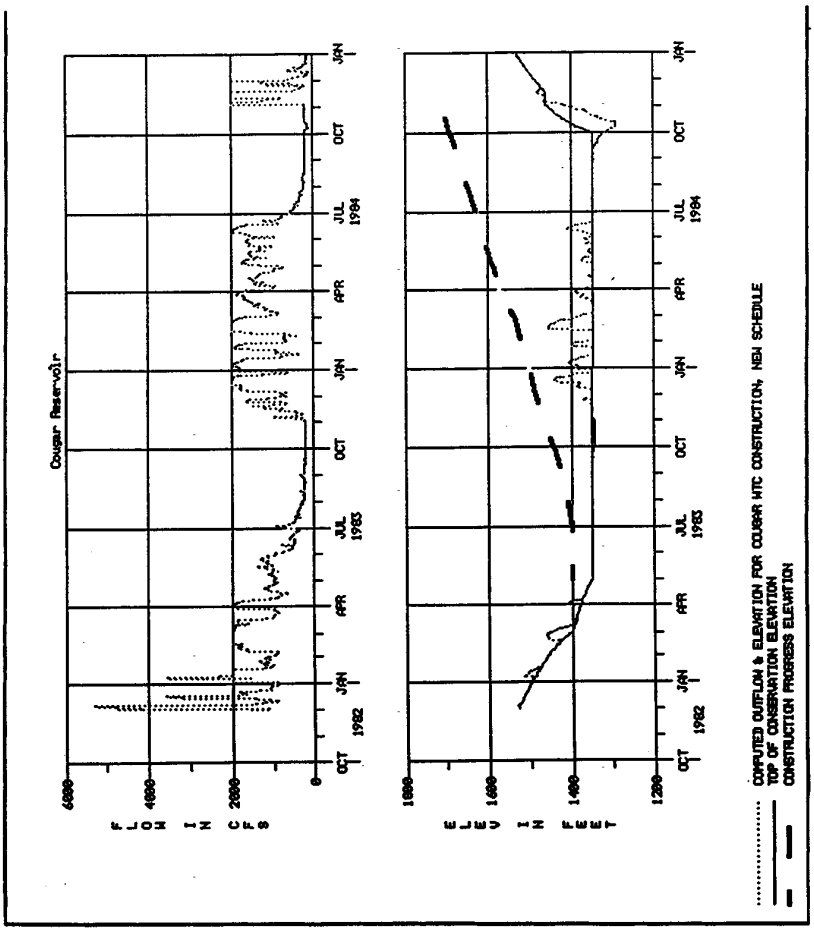


Figure A-10 – *Blue River Flow and Elevations*

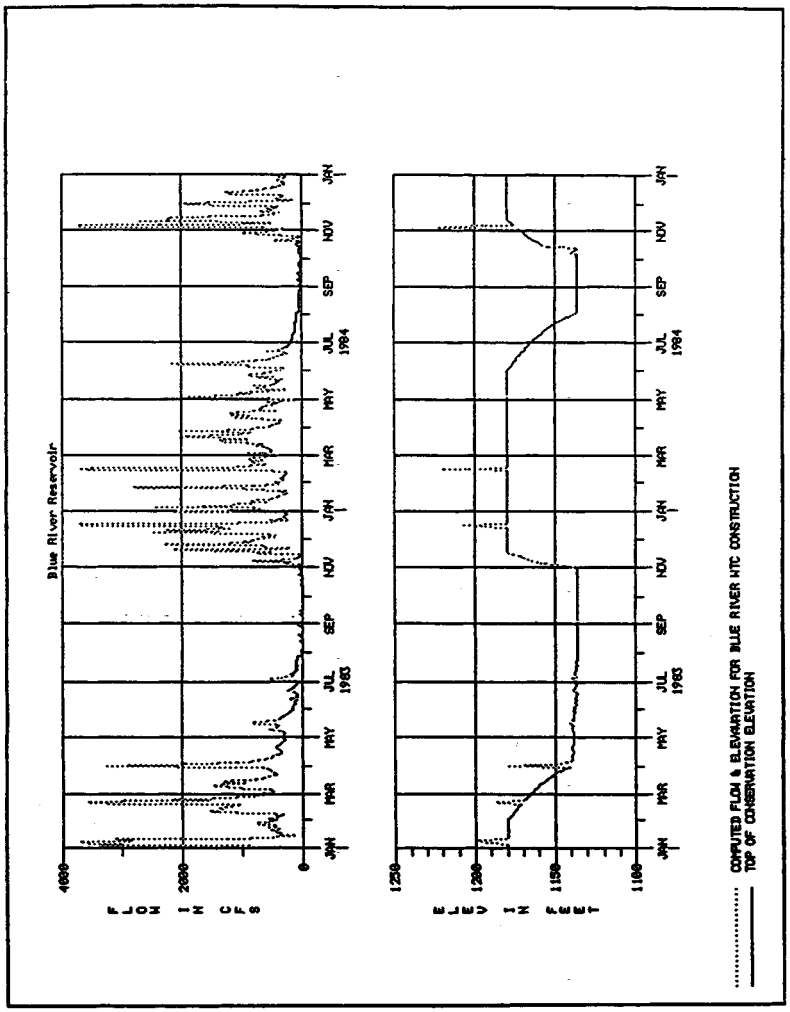


Figure A-11 -- *Flow and Temperature Results for Cougar*

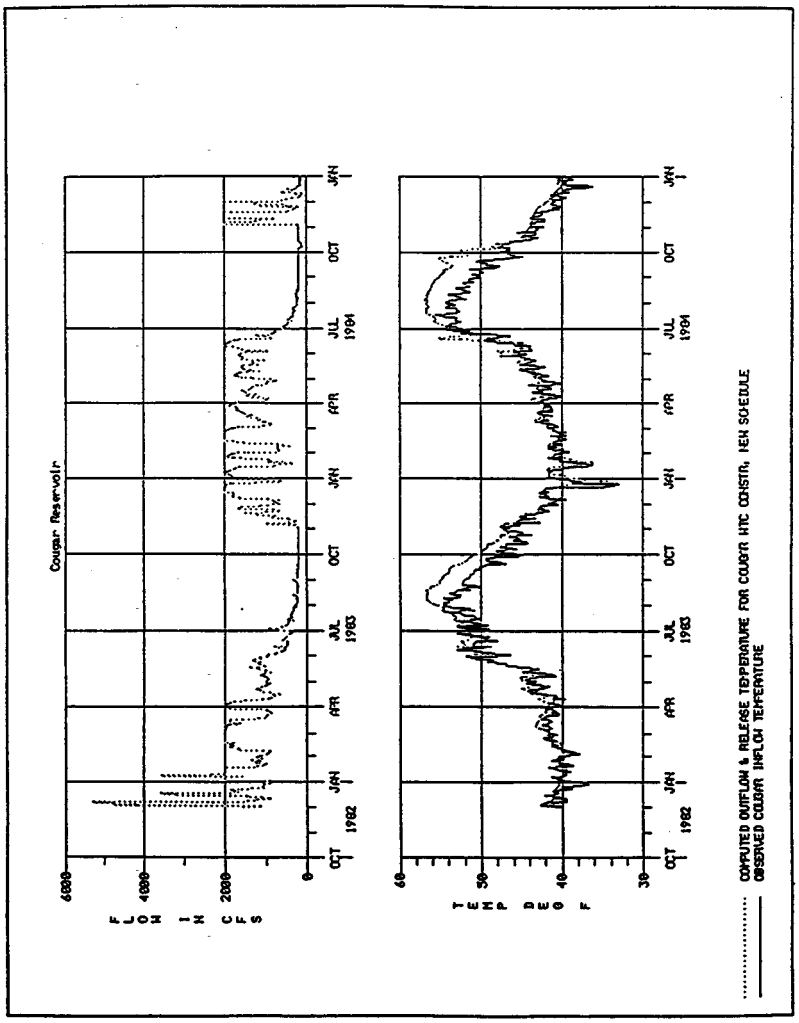
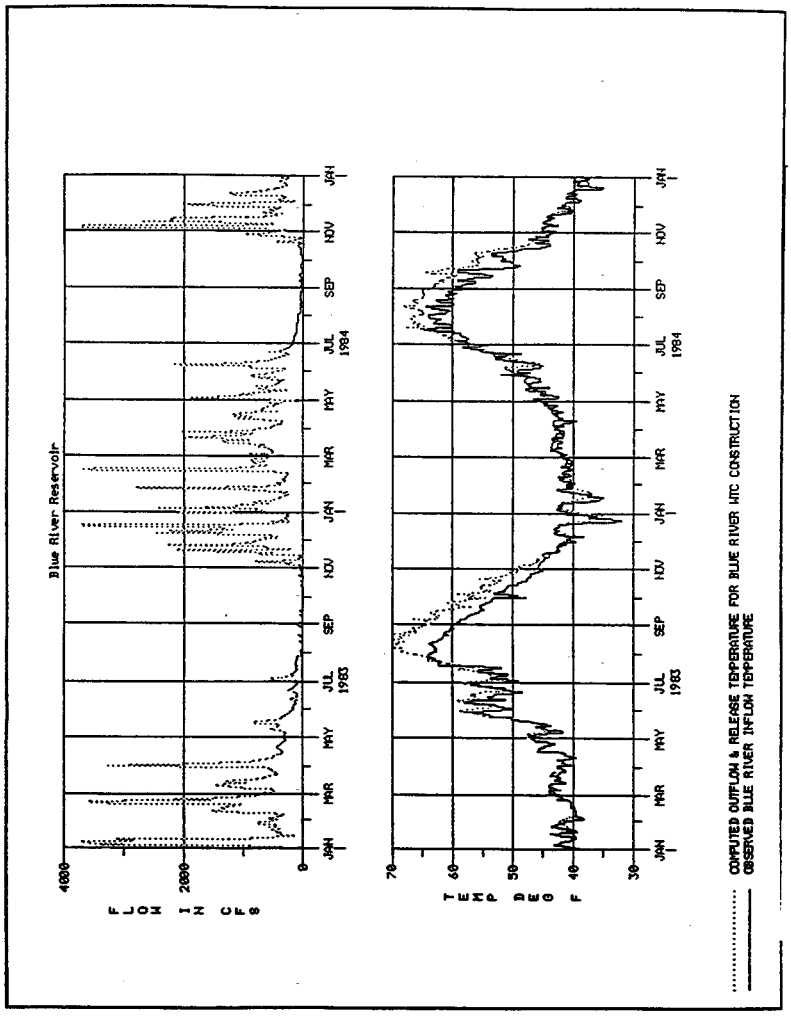


Figure A-12 -- *Flow and Temperature Results for Blue River*



At Vida on the mainstem McKenzie River, the following temperature changes were estimated by use of the model:

• Effects at Vida during construction at Cougar show about a 3° F reduction in river temperature in the fall (figure A-13). This is due to a smaller pool, which has a high turn-over rate and passes the cooler inflows through the project. The flow rate is reduced as well because there is no need to evacuate the pool for flood control (it has been held at a low level for construction). The river temperature reduction is limited by dilution from cooler mainstem McKenzie flow.

• With the temperature control system at Cougar in place, construction at Blue River would cause a 3° to 5° F reduction in river temperature at Vida in the fall for reasons similar to the effects of construction at Cougar (figure A-14).

During review of the draft report, a concern was expressed that the water temperature of the residual pool during Cougar construction may become too warm during the summer to support bull trout. An additional modelling analysis was performed to consider the effects of warming in the unwatered portion in the original channel (from the upstream gage to the residual pool).

Figure A-15 shows the maximum daily temperatures in the South Fork McKenzie at USGS gage sites above and below Cougar (6.5 miles apart) during original construction in the early 1960s. The temperature increase would be at a maximum when the reservoir had been cleared of vegetation, removing any shading which might moderate any heat gain just prior to completion of construction.

During construction of the temperature control modification, there will be a return to a unwatered and unshaded river leading to the head of the residual pool. This leaves about 4.7 miles, or 72 percent of the distance between the gages that would return to a condition similar to just prior to completion of the original construction. As a result of less exposure, however, there should be a smaller heat gain than that observed during original construction.

Inflow temperatures to the residual pool were increased to account for the entire originally unshaded and unwatered river (figure A-16). Daily mean stream temperatures entering the residual pool may rise to a little more than 60° F on the hottest days, which occur in August. The warmest daily maximum temperatures flowing into the residual pool could reach 65° F. The model was rerun using these corrected inflow temperatures. Results show that the warmest daily mean outflow temperature from the residual pool in early August would about 63° F. This amounts to an increase in the river's daily mean temperature of about 3° F as it passes through the residual pool. There likely would be little diurnal variation in the temperature of the outflow since the release occurs from the bottom of the residual pool where the coolest water is found (figure A-17). Although surface temperatures could reach as high as 70° F in early August, the residual pool would be thermally stratified and would provide much cooler temperatures lower in the pool.

Figure A-13 -- *Temperature Effects at Vida During Cougar Construction*

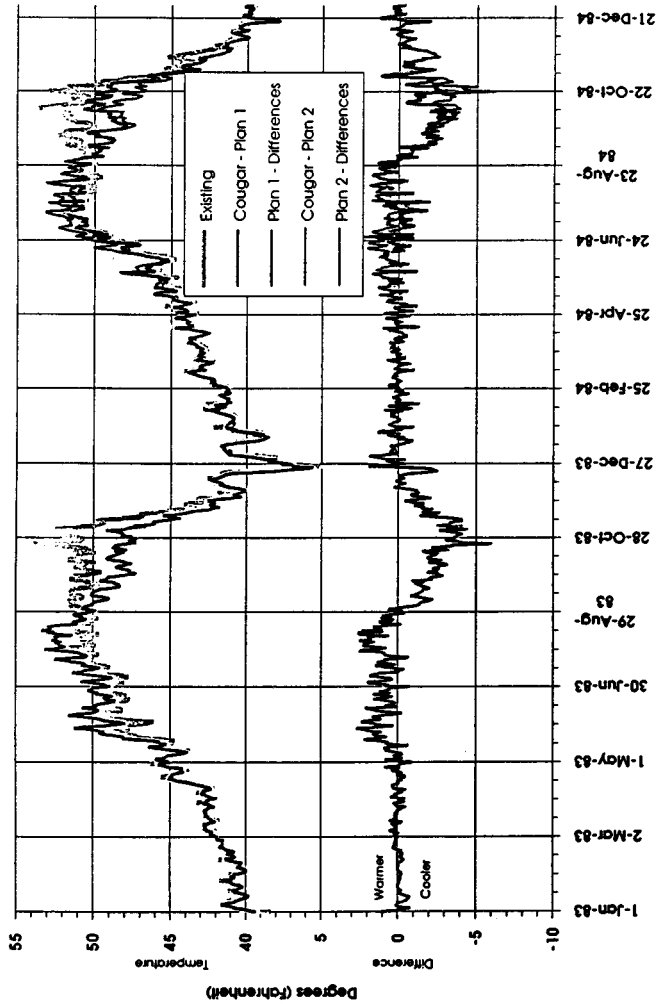


Figure A-14 -- *Temperature Effects at Vida During Blue River Construction*

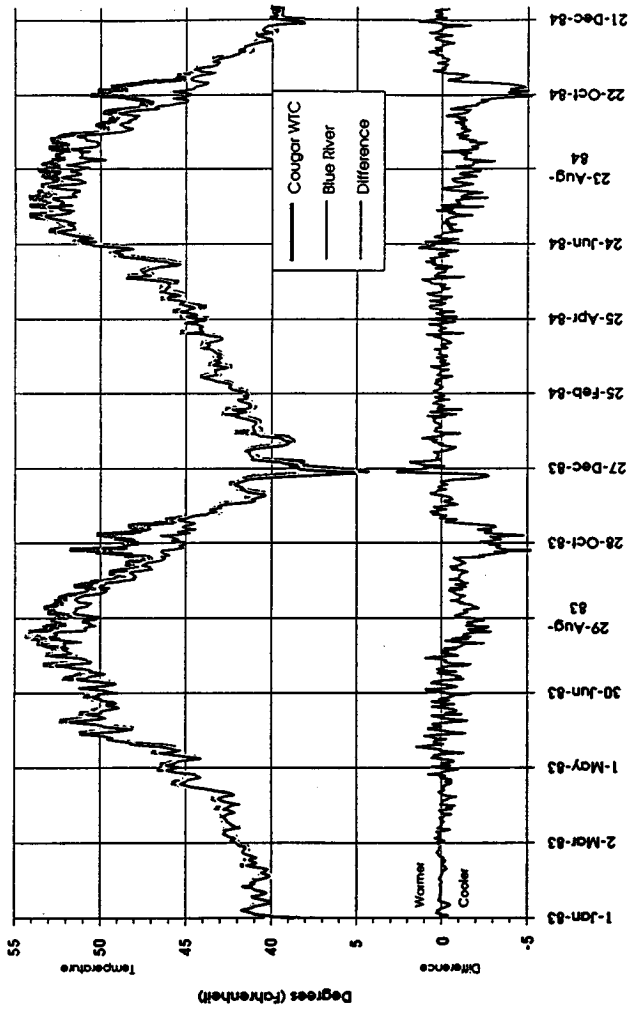


Figure A-15 -- *Maximum Daily Temperatures in the South Fork During Original Construction at Cougar Lake*

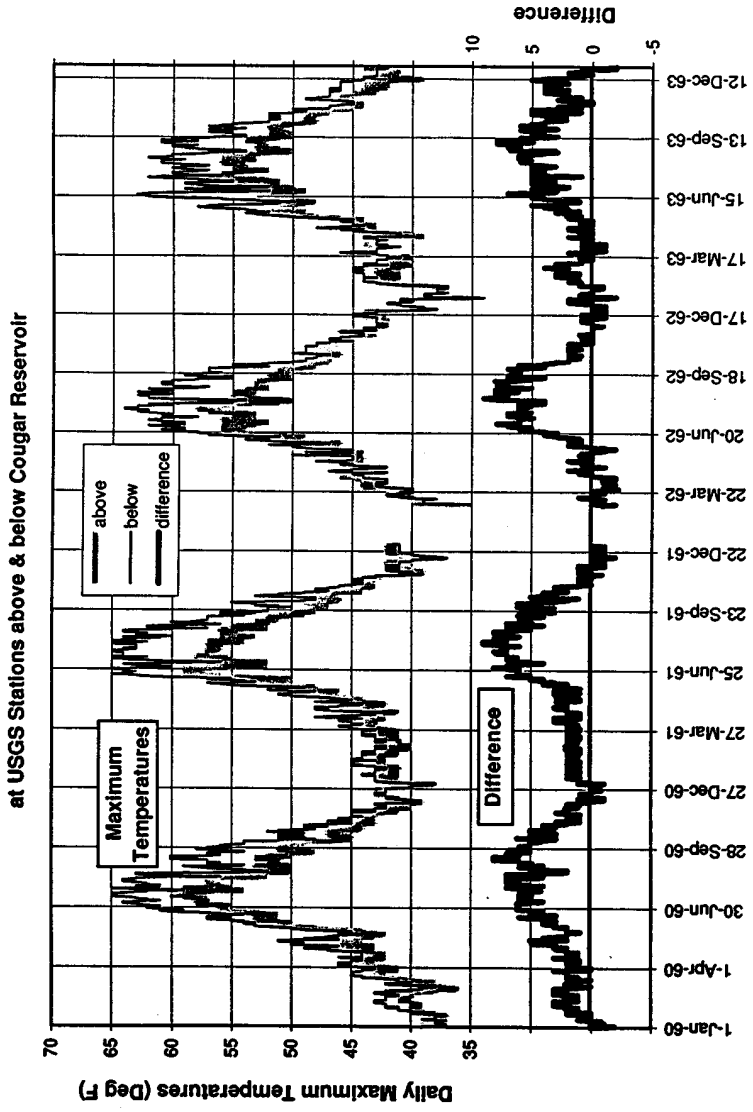


Figure A-16 -- *Inflow and Outflow Temperatures for the Residual Pool at Cougar Lake*

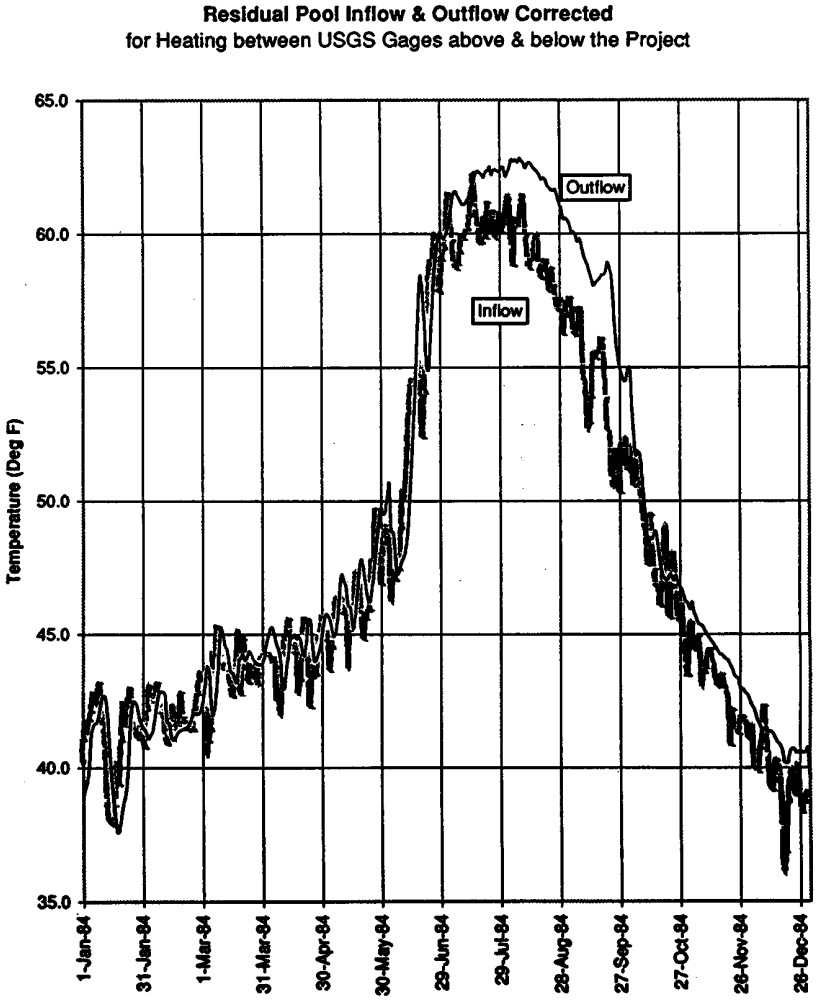
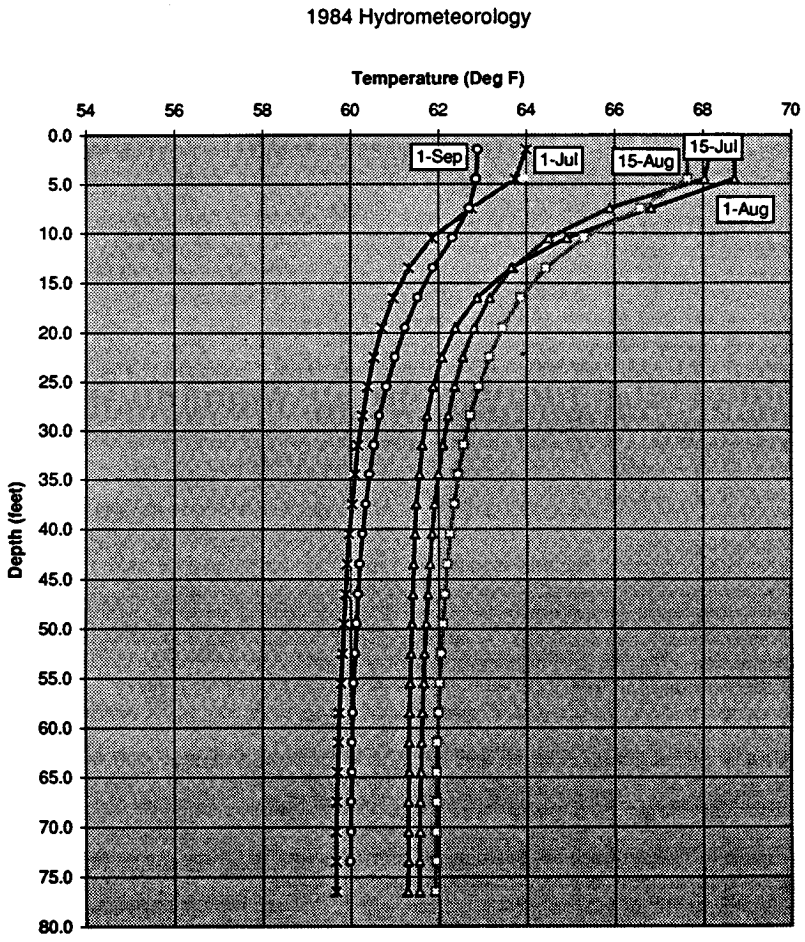


Figure A-17 -- *Temperature Profile of Residual Pool at Cougar Lake*



1.6.2 Sedimentation. The following information was taken from *Sedimentation Ranges Established 1968, Blue River Reservoir, Blue River, Oregon*, October 1969, and *Sedimentation Ranges Established 1963, Cougar Reservoir, South Fork McKenzie River, Oregon*, July 1964. These reports indicate that no suspended sediment observations were made in the vicinity of Blue River and Cougar reservoirs. Between 1949 and 1951, there were 331 samples of suspended sediment taken at the gaging station on the McKenzie near Coburg (53 miles downstream of South Fork confluence). Analyses of those samples showed that during low flows, only a trace of sediment was evident. A maximum concentration of 240 parts per million was observed in a sample taken during a flood. It is estimated that suspended sediment rates at Blue River and Cougar reservoirs will be about the same as those observed on the McKenzie near Coburg.

In addition, an estimate of bedload also was made in the report for Cougar Reservoir. The report states that, "The river bed is composed of gravel and boulders with occasional reefs of solid rock. Where vertical river banks exist, alluvial material composed of topsoil and sand over gravel and boulders is in evidence. During flood periods, the high river velocities cause bank erosion and the movement of bedload material. In the future, some of this bedload material will be deposited at the head of the reservoir. From a reconnaissance of the watershed above Cougar Reservoir, it is estimated that the maximum amount of potential bedload material that could become available in the next 50 years is about 1,000 acre-feet or an average of about 20 acre-feet per year assuming that physical conditions within the area do not materially change." Therefore, using these assumptions, the bedload transport into Cougar Reservoir would be about 720 acre-feet (36 years x 20 acre-feet/year).

The report for Blue River states, "On the basis of these suspended sediment data and prior surveys, it is estimated that the average annual rate of silt and bedload deposition in Blue River Reservoir will be about 0.25 acre-foot per square mile of tributary area." The tributary area of Blue River drainage above the dam is 88 square miles so the yield of suspended sediment would be about 22 acre-feet annually. Since the dam was put in service in 1969 and construction of the selective withdrawal system is scheduled for the year 2002, about 33 years of sedimentation will have occurred in the reservoir. Based on the assumptions in the Blue River report, about 726 acre-feet of sediment may have accumulated in the reservoir.

Based on the same analysis for Cougar, the yield of suspended sediment would be 52 acre-feet annually for the South Fork McKenzie above Cougar with its drainage area of 210 square miles. Since Cougar Dam was put in service in 1963 and construction of the selective withdrawal system is scheduled for the year 1999, about 36 years of sedimentation will have occurred in Cougar Reservoir. Based on the assumptions in the Cougar report, about 1,872 acre-feet of sediment may have accumulated in the reservoir.
A sediment yield of 0.25 acre-feet per square mile of drainage basin is consistent with the findings of 1947 sedimentation survey of Cottage Grove Reservoir performed within 5 years of project operation (*Sedimentation Survey of Cottage Grove Reservoir, Coast Fork Willamette River, Oregon*, July 1949). However, for the underwater portion of the reservoir, the survey was done hydrographically while for the unwatered portion, some of which was inaccessible,

direct measurement was used. This sedimentation rate was associated with an estimated suspended sediment concentration of 154 parts per million flowing into the reservoir.

A subsequent sedimentation survey of Dorena Reservoir in September 1958, after 9 years operation, yielded a sedimentation rate of 0.15 acre-feet per square mile of drainage basin (*Silting in Dorena Reservoir, Row River, Oregon*, October 1958). About 43 percent of the sediment was deposited above the minimum flood control pool and 57 percent below. Most of the sediment was in the middle of the reservoir centered around the original channel at the minimum flood control pool elevation.

A subsequent sedimentation survey of Cottage Grove Reservoir in September 1966, after 24 years operation, yielded a sedimentation rate of 0.13 acre-feet per square mile of drainage basin (*Silting in Cottage Grove Reservoir, Coast Fork Willamette River, Oregon*, February 1967). This survey was performed with the reservoir completely empty. The survey was completed by direct measurements and therefore, is more accurate than the 1947 survey. Most of the material deposited in the reservoir was found to be generally composed of small-sized sediment. About 90 percent of the sediment was deposited below minimum flood control pool. The area of greatest deposit was about the midpoint of the reservoir, and very little silting occurred near the dam and in the upper levels of the pool.

The conclusions of the above reports state that the earlier estimate of sediment yield (0.25 acre-feet per square mile of drainage basin) was too conservative because of the less than ideal condition under which the 1947 Cottage Grove sedimentation survey was made. A more realistic sedimentation rate is probably 0.15 acre-feet per square mile of drainage basin based on the later surveys. This incorporates the actual sediment trapping rates of Dorena and Cottage Grove reservoirs whereas the initial estimates of 0.25 acre-feet per square mile were for the conditions prior to construction of a Corps reservoir and did not include an allowance for sediment trapping efficiency. It can be concluded that a better estimate of sedimentation rates for Blue River and Cougar reservoirs is likely to be closer to 0.15 acre-feet per square mile of drainage basin. Therefore, in Blue River reservoir, the accumulation of sediment might be as low as 363 acre-feet, and as low as 926 acre-feet for Cougar.

Sediment sampling is scheduled to be performed during the next phase of design to determine the gradation and quality of the sediments. In addition, hydrographic surveys are scheduled for checking conditions at the diversion tunnel portal.

1.6.3 Residual Minimum Pools During Construction. Maintaining a residual pool will essentially eliminate sediment transport out of the reservoirs and reduce turbidity in the water released from the projects during construction. These pools also provide refuge habitat for resident fish in the reservoirs during construction.

For Blue River, the invert elevation of the regulating outlet and the diversion tunnel is at elevation 1,132 and the top of the cofferdam is at elevation 1,152. Sixteen feet of head (pool elevation 1,142) is required to pass 800 cfs through the twin 72-inch culverts. Flow through

the culverts can be regulated using the regulating outlet gates. By using the regulating outlet gates, a pool elevation of 1,142 can be maintained by watching the inflow gage and the stage/depth at the cofferdam and adjusting the gates as needed. This will maintain a residual pool about 40 feet deep with 40 surface acres and with nearly 1,000 acre-feet of volume. This residual pool is estimated to have a turn over time of 8 to 10 days during the summer months. There is only another 1,000 acre-feet of storage available to the top of the cofferdam (elevation 1,152) which is needed to provide flood warning time to the contractor for evacuation of the construction site. Reservoir release daily mean temperatures will reach as high as 70° F (5° to 6° F above inflow) in August. Release temperature will remain greater than the inflow temperature through October, at which time these temperatures will become equal to the inflow temperatures.

For Cougar, drawdown requirements were set for 50 feet below the elevation of the excavation for the foundation of the selective withdrawal structure. This was needed to thoroughly drain the rock of the foundation and to provide sufficient storage to provide ample time for contractor evacuation during flooding of the construction site. The connecting Rush Creek tunnel has an upper entrance elevation of 1,452. Reservoir elevation above this level will spill over into the construction site. The bottom of the excavation is elevation 1,407. To minimize seepage problems at the construction site from summer floods, the drawdown would be to elevation 1,350. The entrance to the diversion tunnel is elevation 1,290 although the low point in the reservoir at is elevation 1,274 (which may be silted up to the level of the diversion tunnel portal).

The residual pool maintained at elevation 1,350 will be about 80 surface acres and about 76 feet deep with nearly 3,000 acre-feet of volume. It is estimated to have a turn over rate of 4 to 6 days during the summer months. The warmest daily mean outflow temperature from the residual pool in early August would be about 63° F. This amounts to an increase in the river's daily mean temperature of about 3° F as it passes through the residual pool. Release temperature will remain greater than the inflow temperature through October, at which time temperatures will again become equal to the inflow temperatures.

Preparation of the diversion tunnel portal for draining the reservoir will be accomplished under +200 feet of water. Stoplogs will be removed and the area in front of the portal cleared of debris and silt. The newly installed regulating gates will remain closed until the portal preparation is completed. Following the opening of the tunnel, a trash rack with a fish barrier screen will be installed prior to initiating the reservoir drawdown. The fish screen will be designed to keep adult and juvenile fish, especially bull trout, from being transported through the diversion tunnel.

1.6.4 Turbidity. Turbidity is problematic in that it is associated with water movement over bare earth. It is a byproduct of erosion. The soil type which is undergoing erosion has everything to do with the color and persistence of the turbidity. Biologic activity, such as algae formation, also causes color and turbidity. Given enough time, this same biologic activity also helps reduce turbidity. Particles making up turbidity are usually colloidal and by

there vary definition are difficult to settle out of the water column. Prevention and control of turbidity during construction are necessary.

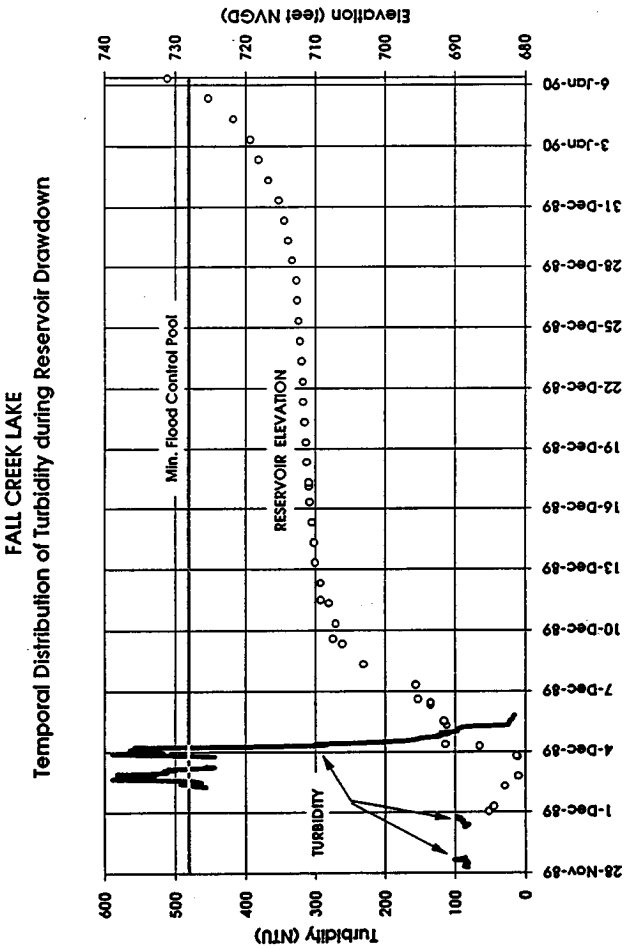
Turbidity profiles were measured at Cougar Reservoir in summer 1971 (*Hills Creek Reservoir Turbidity Study*, Water Resources Research Institute, Oregon State University, Corvallis, Oregon, December 1971). This showed increased turbidity below the level of the reservoir outlets. The bottom turbidity was 20 JTUs. This turbid water will be released as the reservoir is drawn down for construction. Other parameters such as pH, total solids, and conductance were all consistent with turbid water below the level of the outlet. Dissolved oxygen measured during subsequent studies showed no decrease in the lower turbid waters. Release of water from the lower levels should pose no water quality threat downstream. Drawdown during construction will occur much earlier in the year during a period of higher flows when there is a higher likelihood of turbid inflow. Re-erosion of sediment deposits in the reservoir will likely increase turbidity 10 fold.

Another finding of the study was that a reservoir with a bottom outlet cleared more quickly following an storm and did not retain turbid water in the deeper portion of the reservoir. During construction, the diversion tunnel will be the outlet at the bottom of the reservoir thus the residual minimum pool should readily clear following a storm event.

When Fall Creek Reservoir was drawn down and completely emptied during November and December of 1989, the turbidity of the release flow was recorded. Figure A-18 is a graph showing the reservoir elevation and turbidity sequence. It shows that as the reservoir neared the bottom, the turbidity was about 100 NTUs. As the last of the pool disappeared and Fall Creek reclaimed its original channel, the turbidity suddenly rose to over 600 NTUs. This was likely caused by a couple of factors: the sheet flow on the flats nearest the dam suddenly accelerated erosion of the fine-grained sediment deposits; the leading edge of the re-erosion and settling delta moving ahead of the falling reservoir level finally reached the outlet; and the turbulence of Fall Creek reclaiming its channel near the dam entrained the silty fraction of the moving re-erosion/settling delta.

For construction at Blue River and Cougar, by retaining residual pools and controlling the rate of reservoir drawdown, the silty and coarser fractions re-eroded from sediment deposits in the reservoirs should settle out in the residual pool. Turbidity levels could reach as high as 100 NTUs as the reservoir approaches the residual pool. However, with a residual pool this large, turbidity could be half of this amount. Succeeding high water events should produce less turbidity but this would depend on the magnitude of each event (large events generate more turbidity).

Figure A-18 -- *Turbidity During Drawdown at Fall Creek Lake*



Subsequent high water events exceeding the capacity of the diversion will cause the pool to rise. These high water events may cause further re-erosion and re-suspension of sediment with associated increases in turbidity. The gradual return to the residual pool will maximize the recession of turbidity levels.

Timing of the drawdown would be similar for both Blue River and Cougar reservoirs. Starting on February 1, there would be a goal to lower the reservoir gradually to the elevation of the residual pool by May 1 (earliest date). This is because natural flows have generally fallen to manageable flow rates in the spring and for which diversion capacities were selected. This gives the maximum length construction season, until the flood control season in November makes continued construction in the flood control pool too risky.

Erosion control measures such as seeding flood tolerant plants, silt fences, hay bales, or soil cement on the exposed sediment deposits will be necessary to reduce turbidity created by rain storms during the construction season.

Turbidity levels may, at times, exceed the state standard (no more than a 10 percent cumulative increase in natural stream turbidity as measured relative to a control point immediately upstream of the turbidity-causing activity) during the initial drawdown and during succeeding storm events during the construction period. Pre-construction monitoring for turbidity is necessary to establish background levels against which turbidity during construction can be monitored. Further adjustments or erosion control measures would be taken, as necessary, to keep turbidity levels low throughout the construction process.

1.6.5 Dissolved Oxygen. The potential exists for reduction in dissolved oxygen levels below the dams from the lowering of the reservoirs for construction of the temperature control facilities. Lowering the reservoirs below the minimum flood control pool may cause some erosion of sediments deposited in the reservoir, and the project outflow to be more turbid. Because the organic content of the sediments deposited in the reservoir are thought to be quite low, the oxygen demand also should be low. However, the planned testing of the reservoir sediments for their organic and chemical composition during further detailed design (PED) will aid in fully estimating any reduction in dissolved oxygen levels.

Turbulent mixing in the South Fork will reoxygenate the water aiding in recovery of the dissolved oxygen levels. Dilution (1:3 <=> 1:4) of the South Fork discharge in the mainstem McKenzie also will speed the recovery and will likely limit any decreases in oxygen levels in the McKenzie.

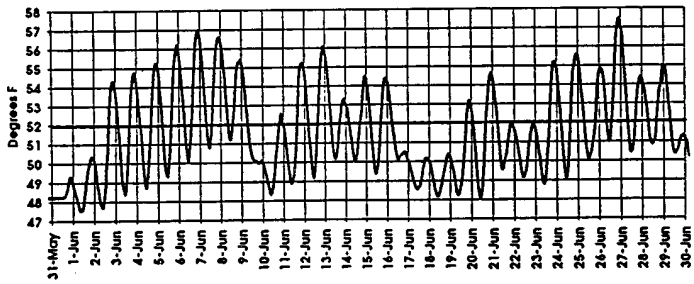
1.7 Thermal Potential for Fish Movement (Diurnal Temperatures near Vida)

It has been identified that a water temperature of 52° F was preferred for spring chinook to begin passing Willamette Falls and Leaburg Dam, and that migration timing has been shifted several weeks later that pre-project conditions at Leaburg Dam because of operation of the Corps lakes. An evaluation was performed to ascertain whether the installation of selective

withdrawal at the Corps projects would affect the thermal potential for fish movement at Leaburg Dam.

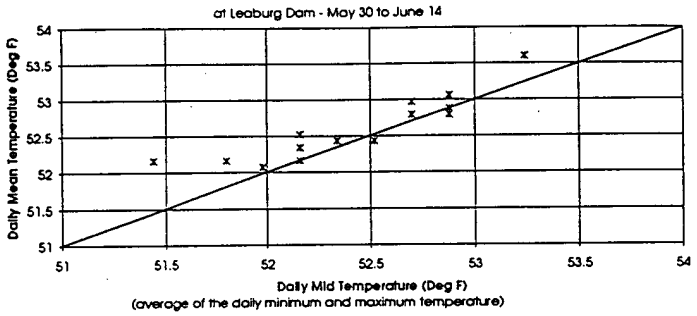
Hourly temperatures were collected at the USGS gaging station at Leaburg Dam (figure A-19). From this record, the daily minimum and maximum temperatures are collected and an integration of the daily record of hourly temperatures is used to determine the daily mean temperature.

Figure A-19 -- *USGS Measured Diurnal Temperature at Leaburg Dam - 1984*



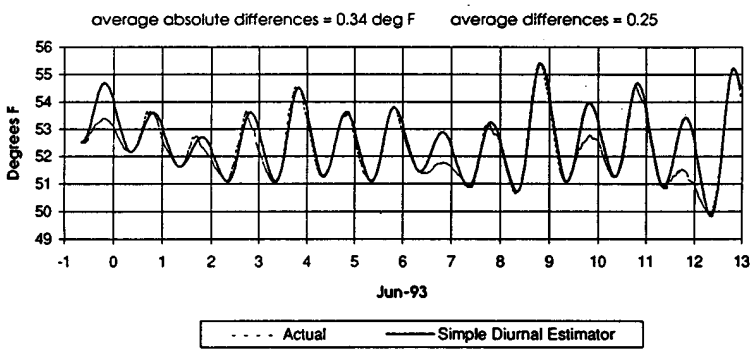
The record of river temperatures for the existing condition for each of the 5 data years consisted of daily maximum and minimum temperatures. The temperature study used daily mean temperatures. The gap needed to be bridged using some simple method. An examination of the diurnal record confirmed a strong correlation between the median temperature (midway between the maximum and the minimum) and the daily mean temperature. Therefore, the median value and the model-estimated daily mean temperature was used to adjust the actual maximum and minimum temperatures (figure A-20).

Figure A-20 -- *Correlation Between Daily Mean and Mid-value Temperature*



The pattern of the daily oscillation between the daily maximum and the daily minimum was derived from existing record over the same 2 week period being investigated. The period of the oscillation changes every day with the length of the day so that short period analysis minimized the error of estimate. The simple diurnal estimating technique was applied using the daily mean, minimum and maximum of the existing hourly temperature data set and compared to the actual hourly data set shown in figure A-21.

Figure A-21 -- *Comparison of Actual Diurnal Temperatures with a Simple Diurnal Estimator*



This diurnal estimating technique was applied to the daily mean temperatures for the month of June. The daily mean temperatures were from the computer model which estimated the temperatures for the alternatives at the USGS Gage near Vida. The results are displayed in figures A-22 and A-23.

Figure A-22 -- *Thermal Potential for Fish Movement in the McKenzie River in 1984*

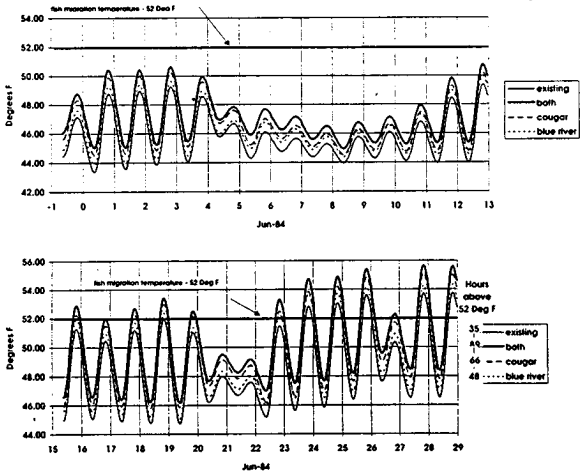
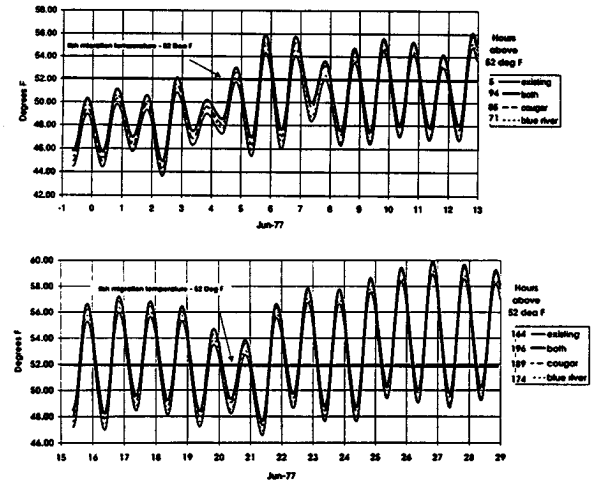


Figure A-23 -- *Thermal Potential for Fish Movement in the McKenzie River in 1977*



The date and number of hours that the river temperature reached 52° F were determined for the existing condition and the alternative scenarios (table A-5). This was done for 1984 and 1977. As seen in the table, the installation of selective withdrawal at both Cougar and Blue River provides the best improvement to the thermal potential for fish movement in the mainstem McKenzie River, near Vida, Oregon.

Table A-5 -- *Thermal Potential for Fish Movement* (in degree-days above 52° F in June)

Year	Existing	With Selective Withdrawal at Blue Rvr	Cougar	Both
1984 - date	June 24	June 19	June 16	June 16
No. of hrs.	35	48	66	89
1977 - date	June 6	June 5	June 5	June 5
No. of hrs.	221	245	274	290

Exhibit B
Analysis for Low Flow Augmentation During Construction

WILLAMETTE TEMPERATURE CONTROL FEASIBILITY STUDY
ANALYSIS FOR LOW FLOW AUGMENTATION DURING CONSTRUCTION

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WILLAMETTE TEMPERATURE CONTROL FEASIBILITY STUDY
EXHIBIT B
ANALYSIS FOR LOW FLOW AUGMENTATION DURING CONSTRUCTION

1.1 Background

Low flow augmentation on the Willamette system during construction of Cougar and Blue River lakes was analyzed using a reservoir system simulation model known as the HEC-5. The HEC-5 model for the Willamette basin was developed in 1991 for the *Willamette River Basin Review Reconnaissance Study* and represents the operation of 13 reservoirs and 11 control points in the basin.

The focus of this analysis for low flow augmentation was the summer regulation of the system (primarily July and August) during construction of temperature control facilities at the Cougar and Blue River projects. Table B-1 provides a summary of the annual mean flows used in the analysis for the Willamette River at Salem and the McKenzie River near Vida. Model results are displayed for flow years representing a low (1977), average (1985) and high (1984) flow condition.

The base condition in the model represents the Willamette system's operation for the past several years. The model routes monthly average flows using the end of month dates. Consequently, the HEC-5 model is an approximation of actual reservoir operations.

Generally, the reservoirs operate in the model as prescribed in the various water control manuals for the Willamette system. Low flow augmentation requirements for the Willamette River are 5,000 cubic feet per second (cfs) at Albany and 6,500 cfs at Salem. This analysis assumes that these flow requirements would always be met in June, July and August.

1.2 Base Condition Criteria

The following base condition (without construction) criteria was developed for the reservoirs in the Willamette basin. This criteria was based on the present operation and discussions with staff at North Pacific Division, Reservoir Control Center.

Cougar Lake -- Minimum release from the project is 300 cfs, up to a maximum release of 900 cfs (full powerhouse capacity) in July and August for low flow augmentation at Albany and Salem.

Blue River Lake -- Minimum release from the project is 50 cfs, up to a maximum release of 500 cfs for low flow augmentation at Albany and Salem in July and August.

Lookout Point Lake -- Minimum release from the project in July is 1,800 cfs (based on the average July release from 1989-1993); minimum release in August is 2,400 cfs (based on the average August release from 1989-1993). In July and August, Lookout Point will release up to 2,500 cfs if necessary for low flow augmentation at Albany and Salem.

Hills Creek Lake -- Minimum release is 300 cfs, but more water is released to maintain Lookout Point above minimum flood control pool. A goal is to maintain the Hills Creek pool elevation above 1,516 feet through Labor Day for recreation purposes.

Dorena Lake -- Minimum release in July and August is 100 cfs; no additional water will be released for low flow augmentation at Albany and Salem.

Cottage Grove Lake -- Minimum release in July and August is 50 cfs; no additional water will be released for low flow augmentation at Albany and Salem.

Fall Creek Lake -- Minimum release in July is 30 cfs, but releases will be up to 200 cfs for low flow augmentation at Albany and Salem. Drafting of Fall Creek will begin after July 31st to reach elevation 815 feet by Labor Day. As a result, releases will be in the range of 200 to 400 cfs in August. The lake will then be drafted to 694 feet by the end of October; held at this level until the end of November, and then filled to minimum flood control level, elevation 728 feet, by the end of December. This simulates the Fall Creek operation to flush fingerling fish from the lake in late fall.

Foster Lake -- The lake will be held near elevation 614 feet until the end of May, and then be filled to elevation 637 feet (maximum conservation pool) until October 15. The minimum release will be 750 cfs in July and 650 cfs in August.

Green Peter Lake -- The lake will be operated to maintain the releases from Foster. Releases will be made for low flow augmentation at Salem, if necessary during record low flows. Green Peter will be kept above elevation 992 feet for as long as possible through Labor Day.

Detroit Lake -- The minimum release from the project in July and August will be 900 cfs. Releases will be made for low flow augmentation at Salem, if necessary during record low flows. The pool will be maintained as high as possible, and above elevation 1,555 feet through Labor Day.

Fern Ridge Lake -- Fern Ridge will be operated to maintain a minimum of 30 cfs in the Long Tom River at Monroe. No additional releases will be made for low flow augmentation at Albany and Salem.

1.3 With-Construction Criteria

During construction at Blue River and Cougar lakes, water will not be stored so no releases for low flow augmentation can be provided in the summer. No hydropower will be generated during construction at Cougar Lake. Model results are generated for the with-construction condition by removing from the model the storage available at the particular reservoir under construction, and using the base condition criteria for the other system reservoirs, including the minimum flow requirements at Albany and Salem.

During construction, the shortage in augmentation flow will be made up by Hills Creek, Lookout Point, Cougar (during Blue River construction), Blue River (during Cougar construction), and to a lesser extent Fall Creek. Hills Creek and Lookout Point together account for about 50 percent of the conservation storage in the system above Albany. Fall Creek, Cougar and Blue River total over 30 percent of the conservation storage. The other projects, Cottage Grove, Dorena, and Fern Ridge are smaller and do not have sufficient storage to maintain flow augmentation. Table B-2 summarizes conservation storage totals in the Willamette system.

1.4 Results and Conclusions

The summer flow requirements of 5,000 cfs at Albany and 6,500 cfs at Salem can be met at all times unless the Willamette basin experiences extreme drought conditions with record low flows. The analysis shows that even in 1977, the lowest flow year in the 77 years of record at Salem, there would be enough water in the system to meet these flow requirements.

Impacts to the Willamette reservoirs during construction vary, and in any given year depend on flow conditions. Cougar Lake has about twice as much conservation storage as Blue River Lake so higher outflows and earlier evacuation of the pools would be expected at Hills Creek and Lookout Point during construction at Cougar. During construction at Cougar and Blue River, the outflow and pool elevation impacts at Hills Creek under average and high flow years, and at Lookout Point under high, average, and low flow years were found to be minor when compared to the base condition. Currently, the Hills Creek pool is kept above elevation 1,516 through Labor Day for recreation purposes. It appears from the routings that there will not be a problem meeting this goal in average to high flow years. In low flow years, however, the pool may drop below elevation 1,516 by about one month earlier.

The results also show an impact at Blue River during Cougar construction, and an impact at Cougar during Blue River construction. The impacts at these projects are faster dropping pool elevations, and higher outflows.

Summer flows in the mainstem McKenzie near Vida would be reduced by about 5 to 20 percent during construction. There is a goal to provide at least 2,500 cfs, as measured at the Vida gage, for EWEB needs. The Corps is not required to meet this goal and flows often fall below this level as the system is operated now. During construction, flows will likely drop below 2,500 cfs more often particularly in average to low flow years.

The monthly routings analysis shows that impacts to the Santiam basin projects (Green Peter, Foster, and Detroit) will be minor. Some releases in low flow augmentation for Salem may be necessary if record low flows were to occur.

There may be opportunities to lower the flow augmentation goals at Albany and Salem during construction at Cougar and Blue River lakes. These goals are coordinated with state and federal agencies each year and are often adjusted in low flow years. For example, 1992 was a lower flow year and the average monthly summer flow at Albany was in the range of 4,200 to 4,900 cfs, and at Salem the average monthly summer flow was about 5,700 cfs.

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Table B-1 -- Summary of Annual Mean Flows

Water Year	Willamette River at Salem (1) CFS	McKenzie River near Vida (2) CFS
1967	20450	3630
1968	18510	3310
1969	28910	4530
1970	23750	3800
1971	30060	5020
1972	34880	5820
1973	15020	3070
1974	37960	5660
1975	24720	4540
1976	27130	4760
1977	9790	2450
1978	24450	4080
1979	19170	3620
1980	19670	3450
1981	19640	3440
1982	30570	4810
1983	29650	4690
1984	28660	4980
1985	21640	3970
1986	22550	4100
1987	18600	3390
1988	18740	3490
1989	21760	4000
1990	18150	3530
1991	20030	3530
1992	15470	3080
1993	24280	4140
Average annual for water years 1967-93	23120	4030

1. Based on records at US Geological Survey Gaging Station Number 14191000
2. Based on records at US Geological Survey Gaging Station Number 14162500

Table B-2 -- Willamette River Basin Projects Conservation Storage

Project	Conservation Storage in Acre-Feet	Percent of total above Albany	Percent of total in System
Hills Creek	194600	18.8	12.2
Lookout Point	324000	31.3	20.4
Fall Creek	107500	10.4	6.8
Cougar	143900	13.9	9.0
Blue River	79000	7.6	5.0
Cottage Grove	28800	2.8	1.8
Dorena	64900	6.3	4.1
Fern Ridge	93900	9.1	5.9
(Total above Albany)	1036600		
Green Peter	250000		15.7
Foster	23900		1.5
Detroit	280900		17.7
(Total above Salem only)	554800		
Total for System	1591400		

Table B-3 -- Willamette River Basin Control Points

Willamette River Basin Control Points

Full Names of Control Points

JASPER	Middle Fork Willamette River at Jasper
GOSHEN	Coast Fork Willamette River near Goshen
SPRINGFIELD	Willamette River at Springfield
VIDA	McKenzie River near Vida
HARRISBURG	Willamette River at Harrisburg
MONROE	Long Tom River at Monroe
ALBANY	Willamette River at Albany
MEHAMA	North Santiam River at Mehama
WATERLOO	South Santiam River at Waterloo
JEFFERSON	Santiam River at Jefferson
SALEM	Willamette River at Salem

Table B-4 -- Monthly Average Flows at Control Points; Base Condition; Low Flow Year (Water Year 1977); Based on HEC5 Computer Model Routings

MONTH	JASPER	GOSHEN	SPRINGFIELD	VIDA	HARRISBURG	MONROE	ALBANY	MEHAMA	WATERLOO	JEFFERSON	SALEM
Oct-76	4530	926	5460	3310	8580	894	9540	2300	1800	3960	13600
Nov-76	3160	249	3410	3280	6770	546	7610	2930	1780	4830	12700
Dec-76	1490	172	1660	1830	3760	65	4070	1250	1230	2590	6880
Jan-77	1920	216	2140	1820	4370	69	4600	1330	950	2540	7440
Feb-77	1430	278	1710	1960	3990	147	4440	1380	1020	2650	7300
Mar-77	1810	912	2720	2650	7100	265	9510	2440	2280	6800	18700
Apr-77	1480	696	2170	2920	5870	101	6720	2200	2090	5190	12500
May-77	2200	1510	3710	3420	8130	90	8900	2440	2470	5990	15500
Jun-77	1610	366	1980	2520	5000	54	5490	1550	877	2800	8840
Jul-77	2370	147	2520	2670	5220	30	5180	1010	1070	1780	6980
Aug-77	2820	146	2970	2450	5330	30	5310	992	843	1500	6740
Sep-77	3360	746	4110	2310	6320	30	6420	1340	549	1820	8330

Table B-5 -- Monthly Average Flows at Control Points; Base Condition; High Flow Year; (Water Year 1984); Based on HEC5 Computer Model Routings

MONTH	JASPER	GOSHEN	SPRINGFIELD	VIDA	HARRISBURG	MONROE	ALBANY	MEHAMA	WATERLOO	JEFFERSON	SALEM
Oct-83	4540	920	5460	3280	8770	919	10200	2540	1710	4120	14300
Nov-83	6760	2880	9640	5810	17800	1630	22300	6720	6450	16100	41900
Dec-83	11000	4290	15300	7150	26500	1840	33600	5330	6940	15500	53400
Jan-84	7260	1760	9030	6370	17400	1020	23300	5600	5030	13200	40600
Feb-84	3940	3670	7620	5780	16400	1830	25600	3030	3400	9470	39100
Mar-84	5300	2590	7890	5950	15500	774	21400	4100	5040	11600	35800
Apr-84	4600	2600	7190	4750	14100	668	18500	2800	2960	7880	28800
May-84	6110	1640	7750	5970	15300	619	17900	5130	4330	11300	30300
Jun-84	6930	1670	8600	5820	16400	259	18600	4750	3440	10000	30000
Jul-84	2170	205	2370	3010	5620	30	6510	1730	1020	2700	9720
Aug-84	2990	161	3150	2440	5480	30	5900	982	700	1270	7230
Sep-84	3540	730	4270	3490	7830	191	8180	2460	493	2680	10400

***(All units in CFS)**

Table B-6 -- Monthly Average Flows at Control Points; Base Condition; Average Flow Year; (Water Year 1985); Based in HEC5 Computer Model Routings

MONTH	JASPER	COSHEN	SPRINGFIELD	VIDA	HARRISBURG	MONROE	ALBANY	MEHAMA	WATERLOO	JEFFERSON	SALEM
Oct-84	5960	1390	7350	4120	12200	979	13000	3460	3190	7210	19600
Nov-84	12400	5620	18100	9280	31700	3160	42000	9040	9380	23600	68900
Dec-84	6690	2880	9570	4600	17300	1490	24300	3410	4520	11400	39500
Jan-85	4340	1150	5490	3430	10300	607	12700	2020	2130	5530	20200
Feb-85	2030	2190	4220	2910	9370	597	12900	2100	2150	6420	21300
Mar-85	1790	1160	2950	2790	7310	323	9520	2030	1950	5620	16700
Apr-85	2210	1390	3600	4790	9790	203	11500	2590	2730	7140	19900
May-85	3100	404	3500	4260	8060	145	8610	3720	1890	6050	15300
Jun-85	3780	723	4500	3950	8780	143	9640	3660	1480	5450	16200
Jul-85	2340	159	2500	2780	5190	30	5270	1300	825	1720	7740
Aug-85	2980	146	3130	2220	5250	30	5300	1020	670	1310	7150
Sep-85	3020	697	3710	2630	6270	121	6320	2520	531	2720	9470

Table B-7 -- Monthly Average Flows at Control Points; Cougar Construction; Low Flow Year (Water Year 1977); Based on HEC5 Computer Model Routings

MONTH	JASPER	COSHEN	SPRINGFIELD	VIDA	HARRISBURG	MONROE	ALBANY	MEHAMA	WATERLOO	JEFFERSON	SALEM
Oct-76	4530	926	5460	2550	7810	894	8780	2300	1800	3960	12900
Nov-76	3160	249	3410	2390	5880	546	6720	2930	1780	4830	11900
Dec-76	1490	172	1660	1820	3750	65	4060	1250	1230	2590	6870
Jan-77	1920	216	2140	1810	4360	69	4600	1330	950	2540	7430
Feb-77	1430	278	1710	1770	3810	147	4260	1380	1020	2650	7120
Mar-77	1810	912	2720	2880	7330	265	9740	2440	2280	6800	18900
Apr-77	1480	696	2170	3440	6390	101	7240	2200	2090	5190	13000
May-77	2200	1510	3710	4200	8910	90	9680	2440	2470	5990	16300
Jun-77	1610	366	1980	2770	5250	54	5740	1550	877	2800	9090
Jul-77	2870	147	3020	2260	5310	30	5270	1010	1070	1780	7060
Aug-77	2920	146	3070	2110	5090	30	5070	1090	868	1630	6630
Sep-77	3420	760	4180	1880	5950	30	6060	1340	524	1790	7940

*(All units in CFS)

Table B-8 -- Monthly Average Flows at Control Points; Cougar Construction; High Flow Year (Water Year 1984); Based on HEC5 Computer Model Routings

MONTH	JASPER	GOSHEN	SPRINGFIELD	VIDA	HARRISBURG	MONROE	ALBANY	MEHAMA	WATERLOO	JEFFERSON	SALEM
Oct-83	4540	920	5460	2520	8010	919	9450	2540	1710	4120	13500
Nov-83	6760	2880	9640	4920	16900	1630	21500	6720	6450	16100	41000
Dec-83	11000	4290	15300	7510	26800	1840	34000	5330	6940	15500	53800
Jan-84	7260	1760	9030	6480	17600	1020	23400	5600	5030	13200	40700
Feb-84	3940	3670	7620	6330	16900	1830	26100	3030	3400	9470	39600
Mar-84	5300	2590	7890	6530	16000	774	22000	4100	5040	11600	36300
Apr-84	4600	2600	7190	5330	14700	668	19000	2800	2950	7880	29300
May-84	6110	1640	7750	6160	15500	619	18100	5130	4330	11300	30500
Jun-84	6930	1670	8600	5820	16400	259	18600	4750	3440	10000	30100
Jul-84	2170	205	2370	3020	5630	30	6520	1730	1020	2700	9730
Aug-84	2990	161	3150	2450	5490	30	5910	982	700	1270	7240
Sep-84	3540	730	4270	2740	7080	191	7430	2460	493	2680	9620

Table B-9 -- Monthly Average Flows at Control Points; Cougar Construction; Average Flow Year (Water Year 1985); Based on HEC5 Computer Model Routings

MONTH	JASPER	GOSHEN	SPRINGFIELD	VIDA	HARRISBURG	MONROE	ALBANY	MEHAMA	WATERLOO	JEFFERSON	SALEM
Oct-84	5960	1390	7350	3360	11400	979	12200	3460	3190	7210	18800
Nov-84	12400	5620	18100	8390	30800	3160	41100	9040	9380	23600	68000
Dec-84	6690	2880	9570	4590	17300	1490	24300	3410	4520	11400	39500
Jan-85	4340	1150	5490	3420	10300	607	12700	2020	2130	5530	20200
Feb-85	2030	2190	4220	3340	9600	597	13400	2100	2150	6420	21800
Mar-85	1790	1160	2950	3190	7710	323	9920	2030	1950	5620	17100
Apr-85	2210	1390	3600	5940	10900	203	12700	2590	2730	7140	21000
May-85	3100	404	3500	4680	8480	145	9030	3720	1890	6050	15700
Jun-85	3780	723	4500	3950	8790	143	9640	3660	1480	5450	16200
Jul-85	2790	159	2950	2730	5590	30	5670	1300	825	1720	8140
Aug-85	3040	146	3180	2420	5510	30	5550	1020	670	1310	7400
Sep-85	2910	697	3600	2150	5690	121	5740	2520	531	2720	8880

*(All units in CFS)

Table B-10 -- Monthly Average Flows at Control Points; Blue River Construction; Low Flow Year (Water Year 1977); Based on HEC5 Computer Model Routings

MONTH	JASPER	GOSHEN	SPRINGFIELD	VIDA	HARRISBURG	MONROE	ALBANY	MEHAMA	WATERLOO	JEFFERSON	SALEM
Oct-76	4530	926	5460	2780	8050	894	9020	2300	1800	3960	13100
Nov-76	3160	249	3410	3010	6500	546	7350	2930	1780	4830	12500
Dec-76	1490	172	1660	1820	3760	65	4070	1250	1230	2590	6870
Jan-77	1920	216	2140	1820	4370	69	4600	1330	950	2540	7440
Feb-77	1430	278	1710	1950	3990	147	4440	1380	1020	2650	7300
Mar-77	1810	912	2720	3070	7530	265	9930	2440	2280	6800	19100
Apr-77	1480	696	2170	3440	6380	101	7240	2200	2090	5190	13000
May-77	2200	510	3710	3780	8480	90	9250	2440	2470	5990	15900
Jun-77	1610	366	1980	2520	5000	54	5490	1550	877	2800	8840
Jul-77	2670	147	2820	2330	5180	30	5140	1010	1070	1780	6930
Aug-77	2920	146	3070	2290	5270	30	5250	992	843	1500	6680
Sep-77	3400	746	4150	2330	6370	30	6480	1340	549	1820	8390

Table B-11 -- Monthly Average Flows at Control Points; Blue River Construction; High Flow Year (Water Year 1984); Based on HEC5 Computer Model Routings

MONTH	JASPER	GOSHEN	SPRINGFIELD	VIDA	HARRISBURG	MONROE	ALBANY	MEHAMA	WATERLOO	JEFFERSON	SALEM
Oct-83	4540	920	5460	2760	8250	919	9680	2540	1710	4120	13800
Nov-83	6760	2880	9640	5540	17600	1630	22100	6720	6450	16100	41600
Dec-83	11000	4290	15300	7150	26500	1840	33600	5330	6940	15500	53400
Jan-84	7260	1760	9030	6370	17400	1020	23300	5600	5030	13200	40600
Feb-84	3940	3670	7620	6350	17000	1830	26300	3030	3400	9470	39600
Mar-84	5300	2590	7890	6280	15800	774	21700	4100	5040	11600	36100
Apr-84	4600	2600	7190	5070	14400	668	18800	2800	2950	7880	29100
May-84	6110	1640	7750	6070	15400	619	18000	5130	4330	11300	30400
Jun-84	6930	1670	8600	5820	16400	259	18600	4750	3440	10000	30000
Jul-84	2170	205	2370	3020	5630	30	6520	1730	1020	2700	9730
Aug-84	2990	161	3150	2440	5480	30	5900	962	700	1270	7230
Sep-84	3540	730	4270	2980	7310	191	7670	2460	493	2680	9660

*(All units in CFS)

Table B-12 -- Monthly Average Flows at Control Points; Blue River Construction; Average Flow Year (Water Year 1985); Based on HEC5 Computer Model Routings

MONTH	JASPER	GOSHEN	SPRINGFIELD	VIDA	HARRISBURG	MONROE	ALBANY	MEHAMA	WATERLOO	JEFFERSON	SALEM
Oct-84	5960	1390	7350	3590	11700	979	12500	3460	3190	7210	19000
Nov-84	12400	5620	18100	9010	31500	3160	41700	9040	9380	23600	68600
Dec-84	6690	2880	9570	4600	17300	1490	24300	3410	4520	11400	39500
Jan-85	4340	1150	5490	3420	10300	607	12700	2020	2130	5530	20200
Feb-85	2030	2190	4220	3300	9760	597	13300	2100	2150	6420	21700
Mar-85	1790	1160	2950	3230	7750	323	9950	2030	1950	5620	17200
Apr-85	2210	1390	3600	5190	10200	203	11900	2590	2730	7140	20300
May-85	3100	404	3500	4360	8150	145	8700	3720	1890	6050	15400
Jun-85	3780	723	4500	3950	8780	143	9640	3660	1480	5450	16200
Jul-85	2540	159	2700	2740	5340	30	5430	1300	825	1720	7890
Aug-85	3060	146	3210	2160	5270	30	5310	1020	670	1310	7160
Sep-85	2930	697	3630	1970	5530	121	5580	2520	531	2720	8730

*(All units in CFS)

Table B-13 -- Monthly Energy Generated; Base Condition; Low Flow Year (Water Year 1977); Based on HEC5 Computer Model Routings

MONTH	HILLS CREEK	LOOKOUT POINT	DEXTER	COUGAR	GREEN PETER	FOSTER	DETROIT	BIG CLIFF
Oct-76	20500	37300	10100	21500	20700	9670	40600	11000
Nov-76	14400	24700	7670	17600	19400	8230	40200	12500
Dec-76	10200	11700	3910	4720	14100	5840	13800	4860
Jan-77	8200	14200	4920	4760	9260	4420	13500	4860
Feb-77	3350	8420	3140	6530	8010	4090	11800	4390
Mar-77	3820	9380	3470	4530	9510	6100	13400	4860
Apr-77	3930	10200	3350	4920	10500	8320	14600	4710
May-77	4430	12200	3460	5900	11200	9630	16900	4860
Jun-77	4560	12900	3340	6230	11300	3920	17500	4710
Jul-77	4780	21200	5740	16700	15400	6440	16500	4380
Aug-77	13900	22700	6900	13400	11600	5190	16300	4380
Sep-77	13900	16700	5570	11800	6300	3130	17300	4710
Project Total for 1977 Water Year Oct 76- Sep 77	106,000	201,600	61,600	118,600	146,300	76,900	232,400	70,200
System Total for 1977 Water Year		1,013,600 MWH						

*(All units in MWH)

Table B-14 -- Monthly Energy Generated; Base Condition; High Flow Year (Water Year 1984); Based on HEC5 Computer Model Routings

MONTH	HILLS CREEK	LOOKOUT POINT	DEXTER	COUGAR	GREEN PETER	FOSTER	DETROIT	BIG CLIFF
Oct-83	20200	37900	10200	21500	20900	9750	41100	11100
Nov-83	24800	45900	11700	17500	61200	15500	68500	14900
Dec-83	24000	68600	12100	16900	56000	15400	44700	15400
Jan-84	22700	43600	12100	18100	36400	15400	50000	15400
Feb-84	5950	17200	5590	15600	11000	11400	14700	4850
Mar-84	18400	38800	10300	16000	40000	15400	34400	9240
Apr-84	18200	35200	8450	12800	17900	10700	23500	5820
May-84	25700	61100	12100	24600	39900	15400	60300	14500
Jun-84	24800	65500	11700	23800	34600	15200	55300	13200
Jul-84	13400	23900	5330	11300	12300	5790	27900	6660
Aug-84	8450	29600	6900	8550	10300	4430	18300	4380
Sep-84	22800	27100	6710	23300	5910	2850	43900	10800
Project Total for 1984 Water Year Oct 83- Sep 84	229,400	494,400	113,200	210,000	346,400	137,200	482,600	126,300
System Total for 1984 Water Year		2,139,500 MWH						

Table B-15 -- Monthly Energy Generated; Base Condition; Average Flow Year (Water Year 1985); Based on HEC5 Computer Model Routings

MONTH	HILLS CREEK	LOOKOUT POINT	DEXTER	COUGAR	GREEN PETER	FOSTER	DETROIT	BIG CLIFF
Oct-84	25000	47600	12100	21500	35700	17100	49000	13300
Nov-84	24800	77400	11700	17400	62200	15500	80600	14900
Dec-84	22600	39200	12100	12500	36800	15400	29600	10800
Jan-85	15400	25900	9810	10200	15400	8870	19500	6770
Feb-85	3540	8640	3140	4430	8950	6820	13100	4390
Mar-85	4330	11100	3470	5450	10900	7350	15900	4860
Apr-85	9800	12800	3350	6110	15000	10900	18000	4710
May-85	19600	32800	7540	17200	17100	8400	57500	13800
Jun-85	19900	37500	8380	19300	19400	7060	52100	12500
Jul-85	8730	26200	6030	14200	12200	5130	23100	5520
Aug-85	6960	28500	7190	7000	10200	4290	18300	4380
Sep-85	21900	20600	5570	17700	5750	3020	43300	10700
Project Total for 1985 Water Year Oct 84- Sep 85	182,600	368,200	90,400	153,000	249,600	109,900	420,000	106,600
System Total for 1985 Water Year		1,680,300 MWH						

*(All units in MWH)

Table B-16 -- Monthly Energy Generated; Cougar Construction; Low Flow Year (Water Year 1977); Based on HEC5 Computer Model Routings

MONTH	HILLS CREEK	LOOKOUT POINT	DEXTER	COUGAR*	GREEN PETER	FOSTER	DETROIT	BIG CLIFF
Oct-76	20500	37300	10100	0	20700	9670	40600	11000
Nov-76	14400	24700	7670	0	19400	8230	40200	12500
Dec-76	10200	11700	3910	0	14100	5840	13800	4860
Jan-77	8200	14200	4920	0	9260	4420	13500	4860
Feb-77	3350	8420	3140	0	8010	4090	11800	4390
Mar-77	3820	9380	3470	0	9510	8100	13400	4860
Apr-77	3930	10200	3350	0	10500	8320	14600	4710
May-77	4430	12200	3460	0	11200	9530	16900	4860
Jun-77	4560	12900	3340	0	11300	3920	17500	4710
Jul-77	9430	26200	7180	0	15400	6440	16500	4380
Aug-77	14900	23100	7190	0	11600	5310	18100	4860
Sep-77	13200	16200	5570	0	5300	2960	17100	4710
Project Total for 1977 Water Year Oct 76- Sep 77	110,900	206,500	63,300	0	146,300	76,800	234,000	70,700
System Total for 1977 Water Year		908,500 MWH		* No Power Generated at Cougar During Construction				

Table B-17 -- Monthly Energy Generated; Cougar Construction; High Flow Year (Water Year 1984); Based on HEC5 Computer Model Routings

MONTH	HILLS CREEK	LOOKOUT POINT	DEXTER	COUGAR*	GREEN PETER	FOSTER	DETROIT	BIG CLIFF
Oct-83	20200	37900	10200	0	20900	9750	41100	11100
Nov-83	24800	45900	11700	0	61200	15500	68500	14900
Dec-83	24000	68600	12100	0	56000	15400	44700	15400
Jan-84	22700	43600	12100	0	36400	15400	50000	15400
Feb-84	5950	17200	5590	0	11000	11400	14700	4850
Mar-84	18400	38800	10300	0	40000	15400	34400	9240
Apr-84	18200	35200	8450	0	17900	10700	23500	5820
May-84	25700	61100	12100	0	39900	15400	60300	14500
Jun-84	24800	65500	11700	0	34600	15200	55300	13200
Jul-84	13400	23900	5330	0	12300	5790	27900	6660
Aug-84	8450	29600	6900	0	10300	4430	18300	4380
Sep-84	22800	27100	6710	0	5910	2850	43900	10800
Project Total for 1984 Water Year Oct 83- Sep 84	229,400	494,400	113,200	0	346,400	137,200	482,600	126,300
System Total for 1984 Water Year		1,929,500 MWH		* No Power Generated at Cougar During Construction				

*(All units in MWH)

Table B-18 -- Monthly Energy Generated; Cougar Construction; Average Flow Year (Water Year 1985); Based on HEC5 Computer Model Routings

MONTH	HILLS CREEK	LOOKOUT POINT	DEXTER	COUGAR*	GREEN PETER	FOSTER	DETROIT	BIG CLIFF
Oct-84	25000	47600	12100	0	35700	17100	49000	13300
Nov-84	24800	77400	11700	0	62200	15500	80600	14900
Dec-84	22600	39200	12100	0	36800	15400	29600	10800
Jan-85	15400	25900	9610	0	15400	8870	19500	6770
Feb-85	3540	8640	3140	0	8950	6820	13100	4390
Mar-85	4330	11100	3470	0	10900	7350	15900	4860
Apr-85	9800	12800	3350	0	15000	10900	18000	4710
May-85	19600	32800	7540	0	17100	8400	57500	13800
Jun-85	19900	37500	8380	0	19400	7080	52100	12500
Jul-85	12100	31000	7180	0	12200	5130	23100	5520
Aug-85	8530	28100	7190	0	10200	4290	18300	4380
Sep-85	21400	20400	5570	0	5750	3020	43300	10700
Project Total for 1985 Water Year Oct 84- Sep 85	187,000	372,400	91,500	0	249,600	109,900	420,000	106,600
System Total for 1985 Water Year		1,537,000 MWH		* No Power Generated at Cougar During Construction				

*(All units in MWH)

Table B-19 -- End of Month Elevations; Base Condition; Low Flow Year (Water Year 1977); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-76	1493.6	871.4	694.0	750.1	770.5	1601.6	1248.9	362.8	964.8	621.6	1501.9
Nov-76	1473.8	850.1	694.0	750.0	770.5	1532.1	1180.1	353.1	942.8	615.1	1450.0
Dec-76	1459.2	850.1	717.2	750.0	770.5	1532.1	1180.1	353.1	922.0	615.1	1443.6
Jan-77	1448.8	838.4	728.0	750.0	770.5	1532.1	1180.1	353.1	911.2	615.1	1436.4
Feb-77	1450.6	829.9	728.0	750.0	770.5	1516.1	1180.0	353.0	903.6	615.1	1429.6
Mar-77	1461.3	840.2	788.3	774.9	811.7	1539.0	1276.6	362.7	938.3	615.1	1448.0
Apr-77	1479.7	862.1	811.9	780.9	824.8	1581.8	1334.8	363.7	965.9	615.1	1486.9
May-77	1504.4	891.7	829.7	789.9	831.7	1635.4	1350.2	364.7	991.8	615.1	1516.5
Jun-77	1513.3	895.8	829.7	789.3	831.7	1649.8	1350.2	364.3	993.0	635.6	1529.4
Jul-77	1513.5	873.7	824.7	787.5	829.7	1617.5	1325.4	363.1	977.2	636.7	1526.0
Aug-77	1495.7	854.4	817.3	785.6	827.6	1586.1	1293.3	361.9	964.9	636.7	1520.9
Sep-77	1474.9	845.6	764.5	775.9	809.7	1552.5	1272.6	361.5	956.9	636.7	1515.3

*(All units in FT, NGVD)

Table B-20 -- End of Month Elevations; Base Condition; High Flow Year (Water Year 1984); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-83	1493.6	871.4	694.0	750.1	770.5	1601.6	1248.9	362.8	964.8	621.6	1501.9
Nov-83	1473.8	850.1	694.0	750.1	770.5	1532.1	1180.1	353.1	942.8	615.1	1450.0
Dec-83	1459.2	837.8	728.0	750.1	770.5	1564.3	1180.1	353.1	922.0	615.1	1450.0
Jan-84	1448.0	825.0	728.0	750.1	770.5	1574.3	1180.1	353.1	922.0	615.1	1450.0
Feb-84	1498.5	878.5	789.9	764.8	794.3	1612.2	1290.0	364.9	969.7	615.1	1505.7
Mar-84	1516.8	901.0	809.6	776.4	811.7	1648.9	1320.3	371.1	988.6	615.1	1538.4
Apr-84	1533.2	919.9	824.9	785.3	824.8	1680.3	1343.8	373.5	1004.9	615.1	1560.1
May-84	1541.0	926.0	829.7	789.9	831.7	1690.0	1350.2	373.5	1010.0	615.1	1563.5
Jun-84	1541.0	926.0	829.7	789.9	831.7	1690.0	1350.2	373.5	1010.0	636.7	1563.5
Jul-84	1541.0	926.0	829.7	789.9	831.7	1690.0	1350.2	373.3	1003.5	636.7	1563.5
Aug-84	1541.0	907.0	814.9	788.4	829.6	1690.0	1349.8	372.8	994.3	636.7	1563.4
Sep-84	1519.3	900.8	777.9	775.9	809.7	1650.1	1312.3	371.5	969.4	636.7	1536.5

Table B-21 -- End of Month Elevations; Base Condition; Average Flow Year (Water Year 1985); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-84	1493.6	871.4	694.0	750.1	770.5	1601.6	1248.9	362.8	964.8	621.6	1501.9
Nov-84	1473.8	850.1	694.0	750.1	770.5	1532.1	1180.1	353.1	942.8	615.1	1450.0
Dec-84	1459.2	837.8	728.0	750.1	770.5	1532.1	1180.1	353.1	922.0	615.1	1450.0
Jan-85	1448.0	825.0	728.0	750.1	770.5	1532.1	1180.1	353.1	922.0	615.1	1450.0
Feb-85	1476.3	850.5	782.3	764.8	794.3	1566.7	1265.5	364.9	941.3	615.1	1468.3
Mar-85	1496.5	869.0	809.5	776.4	811.7	1598.1	1314.2	371.1	965.3	615.1	1497.4
Apr-85	1533.2	914.1	824.9	785.3	824.8	1668.1	1343.8	373.4	1004.9	615.1	1559.8
May-85	1541.0	926.0	829.7	787.6	830.6	1690.0	1350.2	373.5	1010.0	615.1	1563.5
Jun-85	1541.0	926.0	829.7	789.9	831.7	1690.0	1350.2	373.5	1010.0	636.7	1563.5
Jul-85	1539.7	912.2	826.8	788.3	829.4	1676.5	1332.5	372.8	1000.1	636.7	1563.5
Aug-85	1539.1	885.9	814.9	786.3	826.7	1676.6	1311.1	372.4	989.9	636.7	1562.7
Sep-85	1517.2	885.5	777.9	775.9	809.7	1650.1	1288.5	371.5	966.7	636.7	1536.5

*(All units in FT, NGVD)

Table B-22 -- End of Month Elevations; Cougar Construction; Low Flow Year (Water Year 1977); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-76	1493.6	871.4	694.0	750.1	770.5		1248.9	362.8	964.8	621.6	1501.9
Nov-76	1473.8	850.1	694.0	750.0	770.5		1180.1	353.1	942.8	615.1	1450.0
Dec-76	1459.2	850.1	717.2	750.0	770.5		1180.1	353.1	922.0	615.1	1443.6
Jan-77	1448.8	838.4	728.0	750.0	770.5		1180.1	353.1	911.2	615.1	1436.4
Feb-77	1450.6	829.9	728.0	750.0	770.5		1180.0	353.0	903.6	615.1	1429.6
Mar-77	1461.3	840.2	788.3	774.9	811.7		1276.6	362.7	938.3	615.1	1448.0
Apr-77	1479.7	862.1	811.9	780.9	824.8		1324.8	363.7	965.9	615.1	1486.9
May-77	1504.4	891.7	829.7	789.9	831.7		1350.2	364.7	991.8	615.1	1516.5
Jun-77	1513.3	895.8	829.7	789.3	831.7		1350.2	364.3	993.0	635.6	1529.4
Jul-77	1505.3	869.8	824.7	787.5	829.7		1317.4	363.1	977.2	636.7	1526.0
Aug-77	1483.6	849.4	817.3	785.6	827.6		1268.1	361.9	964.9	635.4	1518.5
Sep-77	1460.6	840.6	760.2	774.7	809.7		1240.6	361.5	966.9	636.7	1513.0

Table B-23 -- End of Month Elevations; Cougar Construction; High Flow Year (Water Year 1984); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-83	1493.6	871.4	694.0	750.1	770.5		1248.9	362.8	964.8	621.6	1501.9
Nov-83	1473.8	850.1	694.0	750.1	770.5		1180.1	353.1	942.8	615.1	1450.0
Dec-83	1459.2	837.8	728.0	750.1	770.5		1180.1	353.1	922.0	615.1	1450.0
Jan-84	1448.0	825.0	728.0	750.1	770.5		1180.1	353.1	922.0	615.1	1450.0
Feb-84	1498.5	878.5	789.9	764.8	794.3		1290.0	364.9	969.7	615.1	1505.7
Mar-84	1516.8	901.0	809.6	776.4	811.7		1320.3	371.1	988.6	615.1	1538.4
Apr-84	1533.2	919.9	824.9	785.3	824.8		1343.8	373.5	1004.9	615.1	1560.1
May-84	1541.0	926.0	829.7	789.9	831.7		1350.2	373.5	1010.0	615.1	1563.5
Jun-84	1541.0	926.0	829.7	789.9	831.7		1350.2	373.5	1010.0	636.7	1563.5
Jul-84	1541.0	926.0	829.7	789.9	831.7		1350.2	373.3	1003.5	636.7	1563.5
Aug-84	1541.0	907.0	814.9	788.4	829.6		1349.8	372.8	994.3	636.7	1563.4
Sep-84	1519.3	900.8	777.9	775.9	809.7		1312.3	371.5	989.4	636.7	1536.5

*(All units in FT, NGVD)

Table B-24 -- End of Month Elevations; Cougar Construction; Average Flow Year (Water Year 1985); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-84	1493.6	871.4	694.0	750.1	770.5		1248.9	362.8	964.8	621.6	1501.9
Nov-84	1473.8	850.1	694.0	750.1	770.5		1180.1	353.1	942.8	615.1	1450.0
Dec-84	1459.2	837.8	728.0	750.1	770.5		1180.1	353.1	922.0	615.1	1450.0
Jan-85	1448.0	825.0	728.0	750.1	770.5		1180.1	353.1	922.0	615.1	1450.0
Feb-85	1476.3	850.5	782.3	764.8	794.3		1265.5	364.9	941.3	615.1	1468.3
Mar-85	1496.5	869.0	809.5	776.4	811.7		1314.2	371.1	965.3	615.1	1497.4
Apr-85	1533.2	914.1	824.9	785.3	824.8		1343.8	373.4	1004.9	615.1	1559.8
May-85	1541.0	926.0	829.7	787.6	830.6		1350.2	373.5	1010.0	615.1	1563.5
Jun-85	1541.0	926.0	829.7	789.9	831.7		1350.2	373.5	1010.0	636.7	1563.5
Jul-85	1535.0	909.2	825.1	788.3	829.4		1317.1	372.8	1000.1	636.7	1563.5
Aug-85	1532.0	884.0	810.7	786.3	826.7		1266.8	372.4	989.9	636.7	1562.7
Sep-85	1509.3	883.6	777.9	775.9	809.7		1221.5	371.5	986.7	636.7	1536.5

Table B-25 -- End of Month Elevations; Blue River Construction; Low Flow Year (Water Year 1977); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-76	1493.6	871.4	694.0	750.1	770.5	1601.6		362.8	964.8	621.6	1501.9
Nov-76	1473.8	850.1	694.0	750.0	770.5	1532.1		353.1	942.8	615.1	1450.0
Dec-76	1459.2	850.1	717.2	750.0	770.5	1532.1		353.1	922.0	615.1	1443.6
Jan-77	1448.8	838.4	728.0	750.0	770.5	1532.1		353.1	911.2	615.1	1436.4
Feb-77	1450.6	829.9	728.0	750.0	770.5	1516.1		353.0	903.6	615.1	1429.6
Mar-77	1461.3	840.2	788.3	774.9	811.7	1539.0		362.7	938.3	615.1	1448.0
Apr-77	1479.7	862.1	811.9	780.9	824.8	1581.8		363.7	965.9	615.1	1486.9
May-77	1504.4	891.7	829.7	789.9	831.7	1635.4		364.7	991.8	615.1	1516.5
Jun-77	1513.3	896.8	829.7	789.3	831.7	1649.8		364.3	993.0	635.6	1529.4
Jul-77	1508.1	871.7	824.7	787.5	829.7	1617.5		363.1	977.2	636.7	1526.0
Aug-77	1486.7	851.9	817.3	785.6	827.6	1570.7		361.9	964.9	636.7	1520.9
Sep-77	1464.1	843.1	761.2	775.9	809.7	1516.1		361.5	966.9	636.7	1515.3

*(All units in FT, NGVD)

Table B-26 -- End of Month Elevations; Blue River Construction; High Flow Year; (Water Year 1984); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-83	1493.6	871.4	694.0	750.1	770.5	1601.6		362.8	964.8	621.6	1501.9
Nov-83	1473.8	850.1	694.0	750.1	770.5	1532.1		353.1	942.8	615.1	1450.0
Dec-83	1459.2	837.8	728.0	750.1	770.5	1564.3		353.1	922.0	615.1	1450.0
Jan-84	1448.0	825.0	728.0	750.1	770.5	1574.3		353.1	922.0	615.1	1450.0
Feb-84	1498.5	878.5	789.9	764.8	794.3	1612.2		364.9	969.7	615.1	1505.7
Mar-84	1516.8	901.0	809.6	776.4	811.7	1648.9		371.1	988.6	615.1	1536.4
Apr-84	1533.2	919.9	824.9	785.3	824.8	1680.3		373.5	1004.9	615.1	1560.1
May-84	1541.0	926.0	829.7	789.9	831.7	1690.0		373.5	1010.0	615.1	1563.5
Jun-84	1541.0	926.0	829.7	789.9	831.7	1690.0		373.5	1010.0	636.7	1563.5
Jul-84	1541.0	926.0	829.7	789.9	831.7	1690.0		373.3	1003.5	636.7	1563.5
Aug-84	1541.0	907.0	814.9	788.4	829.6	1690.0		372.8	994.3	636.7	1563.4
Sep-84	1519.3	900.8	777.9	775.9	809.7	1650.1		371.5	989.4	636.7	1536.5

Table B-27 -- End of Month Elevations; Blue River Construction; Average Flow Year (Water Year 1985); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-84	1493.6	871.4	694.0	750.1	770.5	1601.6		362.8	964.8	621.6	1501.9
Nov-84	1473.8	850.1	694.0	750.1	770.5	1532.1		353.1	942.8	615.1	1450.0
Dec-84	1459.2	837.8	728.0	750.1	770.5	1532.1		353.1	922.0	615.1	1450.0
Jan-85	1448.0	825.0	728.0	750.1	770.5	1532.1		353.1	922.0	615.1	1450.0
Feb-85	1476.3	850.5	762.3	764.8	794.3	1566.7		364.9	941.3	615.1	1468.3
Mar-85	1496.5	869.0	809.5	776.4	811.7	1598.1		371.1	965.3	615.1	1497.4
Apr-85	1533.2	914.1	824.9	785.3	824.8	1668.1		373.4	1004.9	615.1	1558.8
May-85	1541.0	926.0	829.7	787.6	830.6	1690.0		373.5	1010.0	615.1	1563.5
Jun-85	1541.0	926.0	829.7	789.9	831.7	1690.0		373.5	1010.0	636.7	1563.5
Jul-85	1537.3	910.7	826.8	788.3	829.4	1665.8		372.8	1000.1	636.7	1563.5
Aug-85	1536.7	884.0	811.6	786.3	826.7	1654.6		372.4	989.9	636.7	1562.7
Sep-85	1514.6	883.6	777.9	775.9	809.7	1650.1		371.5	986.7	636.7	1536.5

*(All units in FT, NGVD)

Table B-28 -- Monthly Average Project Outflows; Base Condition; Low Flow Year (Water Year 1977); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-76	1310	3490	779	283	608	1080	569	872	1370	1730	2260
Nov-76	1040	2740	119	53	108	1230	356	512	1440	1700	2670
Dec-76	763	1350	30	41	78	307	68	54	1120	1210	1000
Jan-77	650	1700	88	52	113	310	94	57	800	915	1000
Feb-77	300	1200	130	68	105	486	117	115	800	939	1000
Mar-77	300	1200	30	75	197	300	50	50	800	1680	1000
Apr-77	300	1200	30	75	377	300	50	50	800	1780	1000
May-77	300	1200	486	102	977	300	165	50	750	1980	1000
Jun-77	300	1200	213	75	199	300	201	50	750	750	1000
Jul-77	300	2000	200	50	100	800	400	56	1000	1070	900
Aug-77	900	2400	250	50	100	700	400	62	800	862	900
Sep-77	1000	2000	1150	193	533	700	250	30	400	537	1000

Table B-29 -- Monthly Average Project Outflows; Base Condition; High Flow Year (Water Year 1984); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-83	1300	3540	789	286	599	1090	567	885	1380	1740	2290
Nov-83	2080	5110	831	495	1290	1690	1030	1240	4500	5940	4540
Dec-83	3060	8250	1430	687	2280	1310	1110	1200	4360	6160	3190
Jan-84	1810	5730	878	281	894	1310	838	681	2980	4480	3570
Feb-84	460	2070	602	584	1540	895	338	1070	887	2520	1000
Mar-84	1180	3570	754	375	1270	772	667	339	2610	4300	1900
Apr-84	1130	3030	667	400	1200	581	274	361	1150	2280	1240
May-84	1890	4810	739	230	868	1290	587	422	2360	3780	2960
Jun-84	1990	5270	957	271	1050	1340	532	181	2100	2900	2810
Jul-84	766	1860	151	50	106	471	109	37	750	960	1370
Aug-84	483	2400	479	50	100	355	50	46	650	735	900
Sep-84	1400	2410	853	220	520	1090	558	198	406	489	2300

*(All units in CFS)

Table B-30 -- Monthly Average Project Outflow; Base Condition; Average Flow Year (Water Year 1985); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-84	1610	4450	1120	345	899	1280	747	947	2340	3070	2730
Nov-84	3240	8600	1880	944	2670	2580	1500	2250	6190	8460	6160
Dec-84	1700	4720	884	520	1250	818	495	1060	2880	3900	2110
Jan-85	1220	3400	450	194	584	668	386	420	1280	1840	1390
Feb-85	300	1200	30	284	800	300	50	231	800	1560	1000
Mar-85	300	1200	30	170	382	300	50	54	800	1520	1000
Apr-85	630	1200	448	166	749	300	540	50	1000	2330	1000
May-85	1140	2620	185	75	190	734	314	101	1030	1740	2840
Jun-85	1170	3010	378	84	436	829	283	112	1190	1350	2540
Jul-85	500	2100	150	50	100	600	300	57	750	851	1130
Aug-85	400	2500	372	50	100	300	300	44	650	711	900
Sep-85	1350	2000	862	183	456	808	300	123	400	519	2270

Table B-31 -- Monthly Average Project Outflows; Cougar Construction; Low Flow Year (Water Year 1977); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR*	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-76	1310	3490	779	283	608	317	569	872	1370	1730	2260
Nov-76	1040	2740	119	53	108	337	356	512	1440	1700	2670
Dec-76	763	1350	30	41	78	299	68	54	1120	1210	1000
Jan-77	650	1700	88	52	113	302	94	57	800	915	1000
Feb-77	300	1200	130	68	105	301	117	115	800	939	1000
Mar-77	300	1200	30	75	197	531	50	50	800	1680	1000
Apr-77	300	1200	30	75	377	823	50	50	800	1780	1000
May-77	300	1200	486	102	977	1080	165	50	750	1980	1000
Jun-77	300	1200	213	75	199	548	201	50	750	750	1000
Jul-77	600	2500	200	50	100	288	500	56	1000	1070	900
Aug-77	1000	2500	250	50	100	263	500	62	800	887	1000
Sep-77	1000	2000	1210	207	533	271	250	30	400	511	1000

* Cougar outflow is equal to inflow during construction

*(All units in CFS)

Table B-32 -- Monthly Average Project Outflows; Cougar Construction; High Flow Year (Water Year 1984); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR*	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-83	1300	3540	789	286	599	325	567	885	1380	1740	2290
Nov-83	2080	5110	831	495	1290	804	1030	1240	4500	5940	4540
Dec-83	3060	8250	1430	687	2280	1670	1110	1200	4360	6160	3190
Jan-84	1810	5730	878	281	894	1420	838	681	2980	4480	3570
Feb-84	460	2070	602	584	1540	1440	338	1070	887	2520	1000
Mar-84	1180	3570	754	375	1270	1340	667	339	2610	4300	1900
Apr-84	1130	3030	667	400	1200	1160	274	361	1150	2280	1240
May-84	1890	4810	739	230	888	1480	587	422	2360	3780	2980
Jun-84	1990	5270	957	271	1050	1340	532	181	2100	2900	2810
Jul-84	766	1860	151	50	106	481	109	37	750	960	1370
Aug-84	483	2400	479	50	100	363	50	46	650	735	900
Sep-84	1400	2410	853	220	520	340	558	198	406	489	2300

* Cougar outflow is equal to inflow during construction

Table B-33 -- Monthly Average Project Outflows; Cougar Construction; Average Flow Year (Water Year 1985); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR*	BLUE RIVER	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-84	1610	4450	1120	345	899	517	747	947	2340	3070	2730
Nov-84	3240	8600	1880	944	2670	1690	1500	2250	6190	8460	6160
Dec-84	1700	4720	884	520	1250	809	495	1060	2880	3900	2110
Jan-85	1220	3400	450	194	584	661	386	420	1280	1840	1390
Feb-85	300	1200	30	284	800	730	50	231	800	1560	1000
Mar-85	300	1200	30	170	382	701	50	54	800	1520	1000
Apr-85	630	1200	448	166	749	1450	540	50	1000	2330	1000
May-85	1140	2620	185	75	190	1150	314	101	1030	1740	2840
Jun-85	1170	3010	378	84	436	632	283	112	1190	1350	2640
Jul-85	700	2500	200	50	100	349	500	57	750	851	1130
Aug-85	500	2500	429	50	100	300	500	44	650	711	900
Sep-85	1350	2000	751	183	456	331	300	123	400	519	2270

* Cougar outflow is equal to inflow during construction

*(All units in CFS)

Table B-34 -- Monthly Average Project Outflows; Blue River Construction; Low Flow Year (Water Year 1985); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER*	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-76	1310	3490	779	283	608	1080	42	872	1370	1730	2260
Nov-76	1040	2740	119	53	108	1230	91	512	1440	1700	2670
Dec-76	763	1350	30	41	78	307	66	54	1120	1210	1000
Jan-77	650	1700	88	52	113	310	92	57	800	915	1000
Feb-77	300	1200	130	68	105	486	115	115	800	939	1000
Mar-77	300	1200	30	75	197	300	473	50	800	1680	1000
Apr-77	300	1200	30	75	377	300	567	50	800	1780	1000
May-77	300	1200	486	102	977	300	520	50	750	1980	1000
Jun-77	300	1200	213	75	199	300	202	50	750	750	1000
Jul-77	500	2300	200	50	100	800	57	56	1000	1070	900
Aug-77	1000	2500	250	50	100	900	39	62	800	862	900
Sep-77	1000	2000	1190	193	533	894	74	30	400	537	1000

* Blue River outflow is equal to inflow during construction

Table B-35 -- Monthly Average Project Outflows; Blue River Construction; High Flow Year (Water Year 1984); Based on HEC5 Computer Model Routings

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER*	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-83	1300	3540	789	286	599	1090	40	885	1380	1740	2290
Nov-83	2080	5110	831	495	1290	1690	767	1240	4500	5940	4540
Dec-83	3060	8250	1430	687	2280	1310	1100	1200	4360	6160	3190
Jan-84	1810	5730	878	281	894	1310	836	681	2980	4480	3570
Feb-84	460	2070	602	584	1540	895	913	1070	887	2520	1000
Mar-84	1180	3570	754	375	1270	772	990	339	2610	4300	1900
Apr-84	1130	3030	667	400	1200	581	600	361	1150	2280	1240
May-84	1890	4810	739	230	888	1290	682	422	2360	3780	2980
Jun-84	1990	5270	957	271	1050	1340	533	181	2100	2900	2810
Jul-84	766	1860	151	50	106	471	114	37	750	960	1370
Aug-84	483	2400	479	50	100	355	47	46	650	735	900
Sep-84	1400	2410	853	220	520	1090	42	198	406	489	2300

* Blue River outflow is equal to inflow during construction

*(All units in CFS)

Table B-36 -- Monthly Average Project Outflows; Blue River Construction; Average Flow Year (Water Year 1985); Based on HEC5 Computer Model Routing

DATE	HILLS CREEK	LOOKOUT POINT	FALL CREEK	COTTAGE GROVE	DORENA	COUGAR	BLUE RIVER*	FERN RIDGE	GREEN PETER	FOSTER	DETROIT
Oct-84	1610	4450	1120	345	899	1280	219	947	2340	3070	2730
Nov-84	3240	8600	1880	944	2670	2580	1240	2250	6190	8460	6160
Dec-84	1700	4720	884	520	1250	818	493	1060	2880	3900	2110
Jan-85	1220	3400	450	194	584	668	384	420	1280	1840	1390
Feb-85	300	1200	30	284	800	300	442	231	800	1560	1000
Mar-85	300	1200	30	170	382	300	487	54	800	1520	1000
Apr-85	630	1200	448	166	749	300	938	50	1000	2330	1000
May-85	1140	2620	185	75	190	734	408	101	1030	1740	2840
Jun-85	1170	3010	378	84	436	829	284	112	1190	1350	2640
Jul-85	600	2300	150	50	100	800	54	57	750	851	1130
Aug-85	400	2500	454	50	100	500	35	44	650	711	900
Sep-85	1350	2000	777	183	456	396	57	123	400	519	2270

* Blue River outflow is equal to inflow during construction

***(All units in CFS)**

Table B-37 -- Monthly Energy Generated at Power Plants; Blue River Construction; Low Flow Year (Water Year 1977)

MONTH	HILLS CREEK	LOOKOUT POINT	DEXTER	COUGAR	GREEN PETER	FOSTER	DETROIT	BIG CLIFF
Oct-76	20500	37300	10100	21500	20700	9670	40600	11000
Nov-76	14400	24700	7670	17600	19400	8230	40200	12500
Dec-76	10200	11700	3910	4720	14100	5840	13800	4860
Jan-77	8200	14200	4920	4760	9260	4420	13500	4860
Feb-77	3350	8420	3140	6530	8010	4090	11800	4390
Mar-77	3820	9380	3470	4530	9510	8100	13400	4860
Apr-77	3930	10200	3350	4920	10500	8320	14600	4710
May-77	4430	12200	3460	5900	11200	9530	16900	4860
Jun-77	4560	12900	3340	6230	11300	3920	17500	4710
Jul-77	7900	24300	6610	16700	15400	6440	16500	4380
Aug-77	15100	23300	7190	16900	11600	5190	16300	4380
Sep-77	13400	16600	5570	13800	5300	3130	17300	4710
Project Total for 1977 Water Year Oct 76- Sep 77	109,800	205,100	62,700	124,100	146,300	76,900	232,400	70,200
System Total for 1977 Water Year		1,027,500 MWH						

***(All units in MWH)**

Table B-38 -- Monthly Energy Generated at Power Plants; Blue River Construction; High Flow Year (Water Year 1984)

MONTH	HILLS CREEK	LOOKOUT POINT	DEXTER	COUGAR	GREEN PETER	FOSTER	DETROIT	BIG CLIFF
Oct-83	20200	37900	10200	21500	20900	9750	41100	11100
Nov-83	24800	45900	11700	17500	61200	15500	68500	14900
Dec-83	24000	68600	12100	16900	56000	15400	44700	15400
Jan-84	22700	43600	12100	18100	36400	15400	50000	15400
Feb-84	5950	17200	5590	15600	11000	11400	14700	4850
Mar-84	18400	38800	10300	16000	40000	15400	34400	9240
Apr-84	18200	35200	8450	12800	17900	10700	23500	5820
May-84	25700	61100	12100	24600	39900	15400	60300	14500
Jun-84	24800	65500	11700	23800	34600	15200	55300	13200
Jul-84	13400	23900	5330	11300	12300	5790	27900	6660
Aug-84	8450	29600	6900	8550	10300	4430	18300	4380
Sep-84	22800	27100	6710	23300	5910	2850	43900	10800
Project Total for 1984 Water Year Oct 83- Sep 84	229,400	494,400	113,200	210,000	346,400	137,200	482,600	126,300
System Total for 1984 Water Year		2,139,500 MWH						

Table B-39 -- Monthly Energy Generated at Power Plants; Blue River Construction; Average Flow Year (Water Year 1985)

MONTH	HILLS CREEK	LOOKOUT POINT	DEXTER	COUGAR	GREEN PETER	FOSTER	DETROIT	BIG CLIFF
Oct-84	25000	47600	12100	21500	35700	17100	49000	13300
Nov-84	24800	77400	11700	17400	62200	15500	80600	14900
Dec-84	22600	39200	12100	12500	36800	15400	29600	10800
Jan-85	15400	25900	9810	10200	15400	8870	19500	6770
Feb-85	3540	8640	3140	4430	8950	6820	13100	4390
Mar-85	4330	11100	3470	5450	10900	7350	15900	4860
Apr-85	9800	12800	3350	6110	15000	10900	18000	4710
May-85	19600	32800	7540	17200	17100	8400	57500	13800
Jun-85	19900	37500	8380	19300	19400	7080	52100	12500
Jul-85	10400	28600	6610	18700	12200	5130	23100	5520
Aug-85	6910	28300	7190	11200	10200	4290	18300	4380
Sep-85	21800	20400	5570	8420	5750	3020	43300	10700
Project Total for 1985 Water Year Oct 84- Sep 85	184,100	370,200	91,000	152,400	249,600	109,900	420,000	106,600
System Total for 1985 Water Year		1,683,800 MWH						

*** (All units in MWH)**

Figure B-1 -- Cougar Elevation 1977; Low Flow Water Year

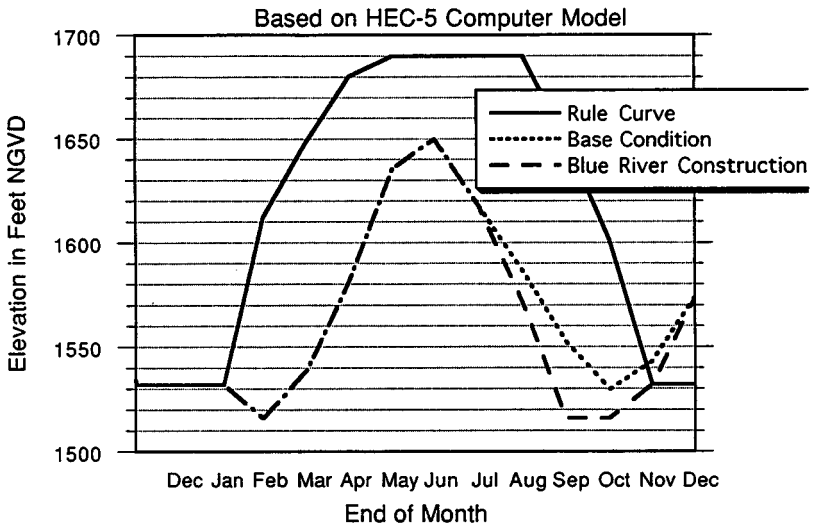

Figure B-2 -- Cougar Elevation 1984; High Flow Water Year

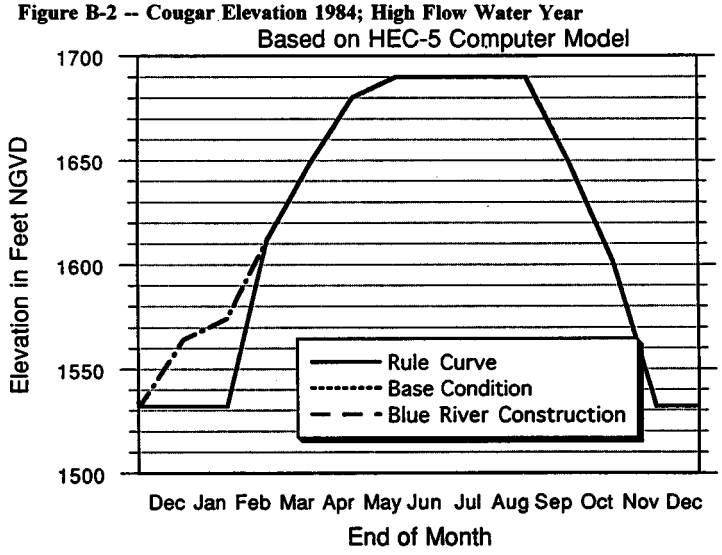

Figure B-3 -- Cougar Elevation 1985; Average Flow Water Year

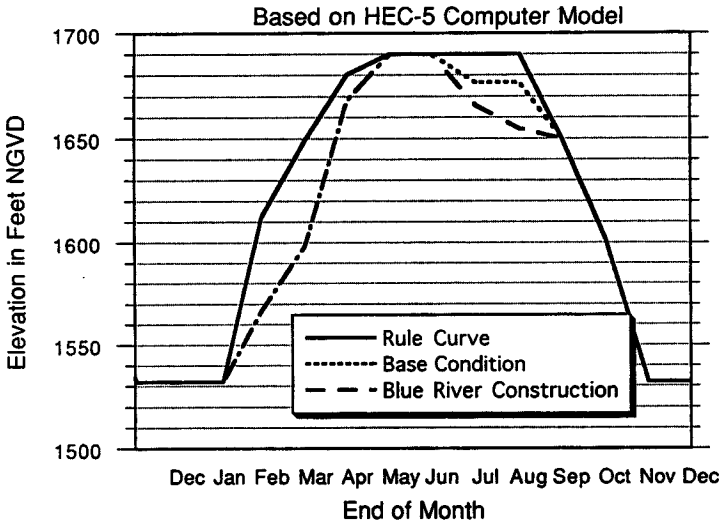

Figure B-4 -- Blue River Elevation 1977; Low Flow Water Year

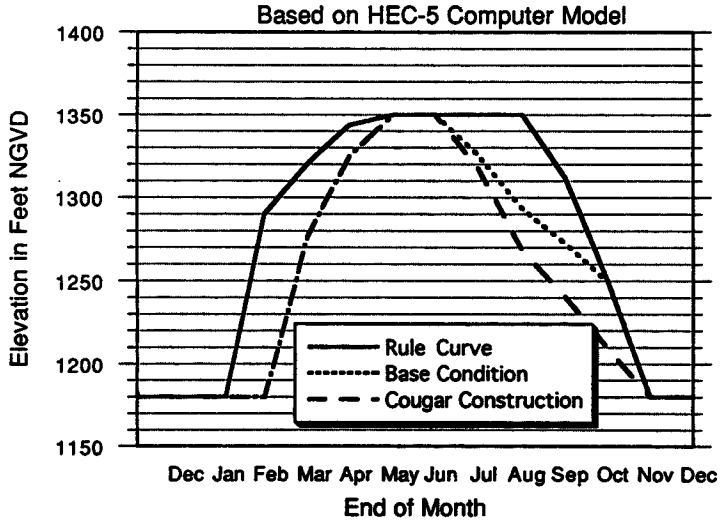

Figure B-5 -- Blue River Elevation 1984; High Flow Water Year

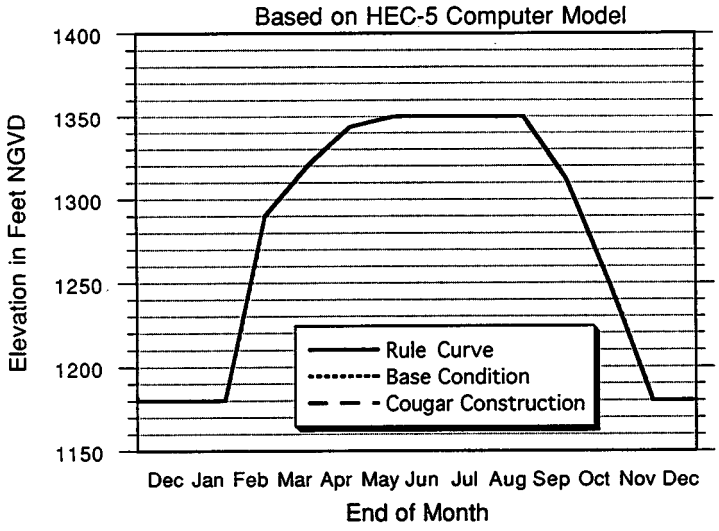

Figure B-6 -- Blue River Elevation 1985; Average Flow Water Year

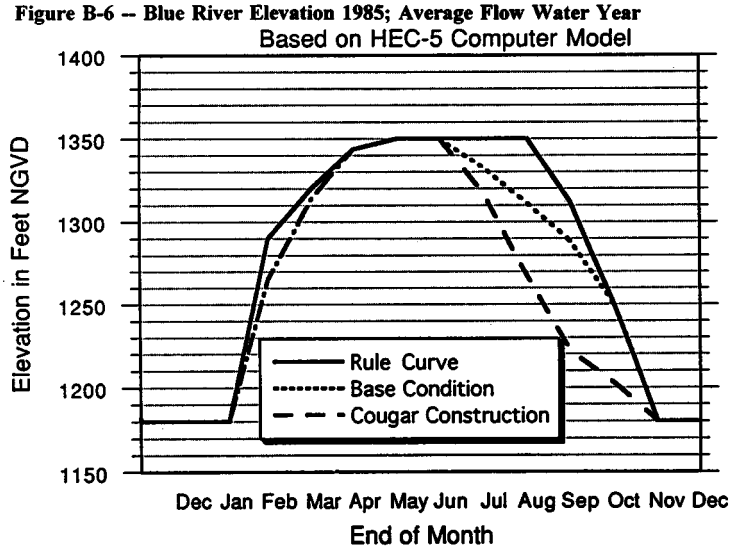

Figure B-7 -- Hills Creek Elevation 1977; Low Flow Water Year

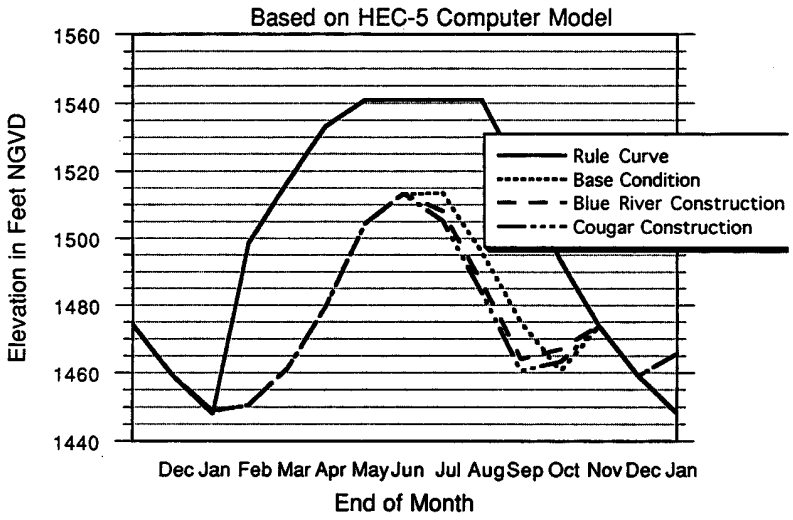

Figure B-8 -- Hills Creek Elevation 1984; High Flow Water Year

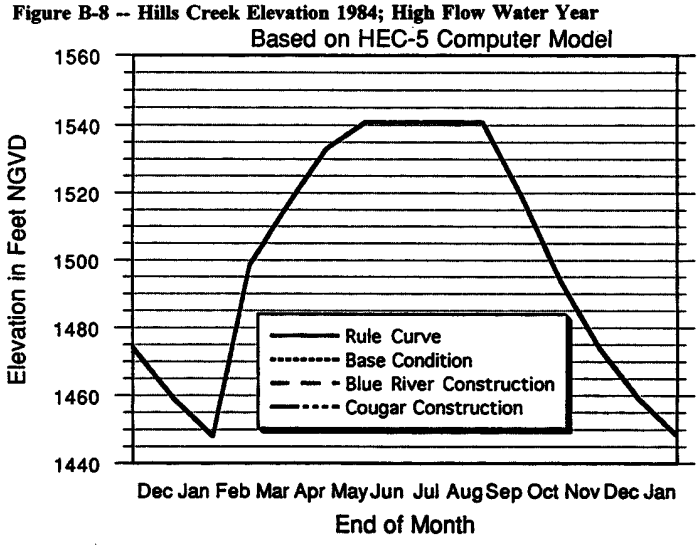

Figure B-9 -- Hills Creek Elevation 1985; Average Flow Water Year

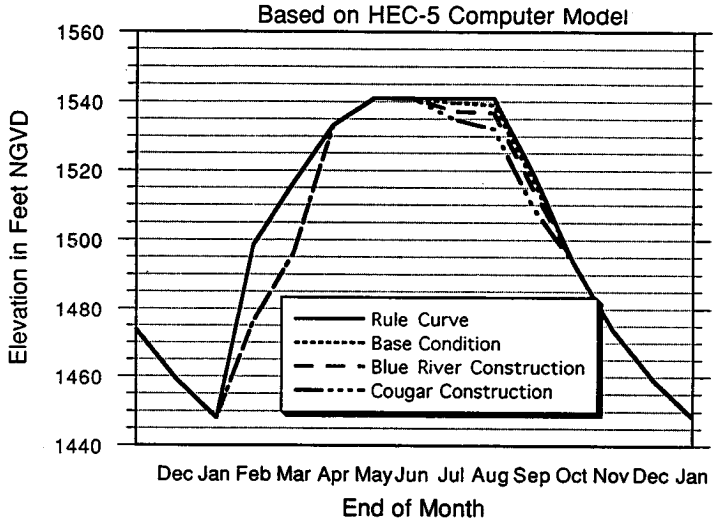

Figure B-10 -- Lookout Point Elevation 1977; Low Flow Water Year

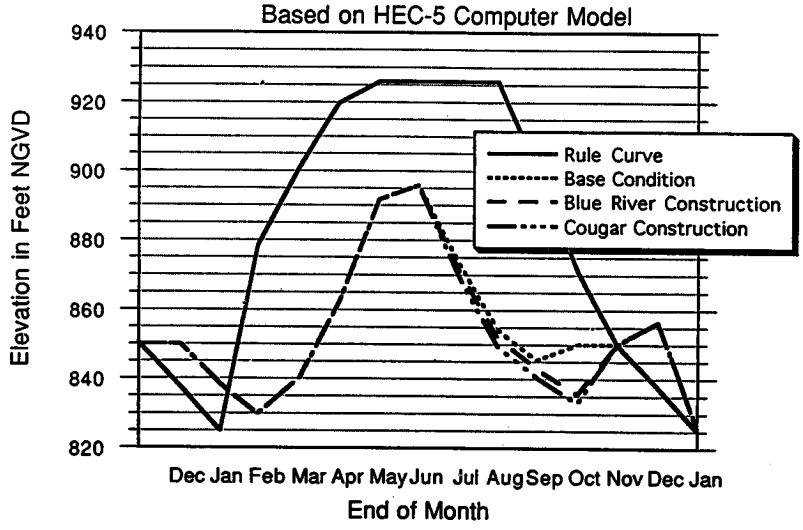

Figure B-11 -- Lookout Point Elevation 1984; High FLow Water Year

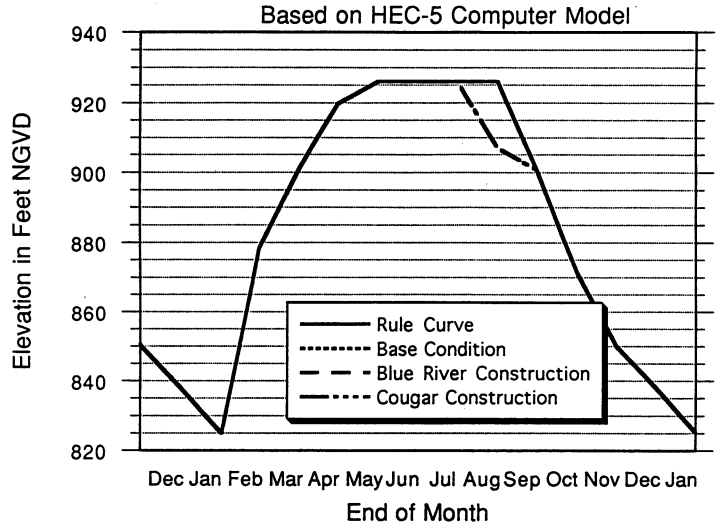

Figure B-12 -- Lookout Point Elevation 1985; Average Flow Water Year

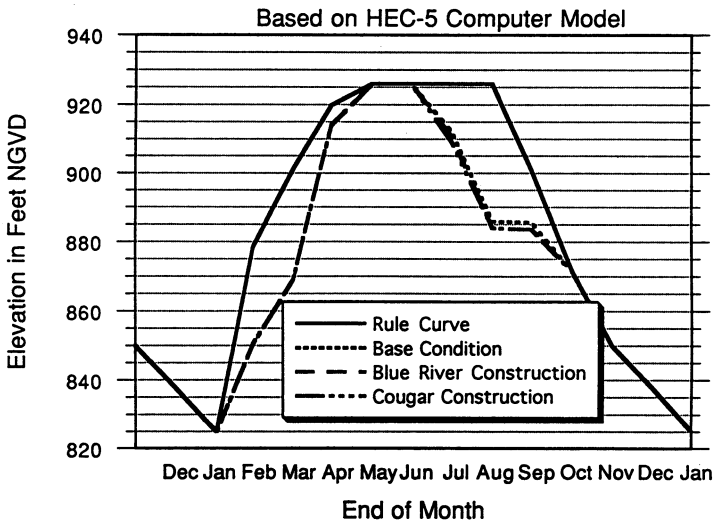

Figure B-13 -- Fall Creek Elevation 1977; Low Flow Water Year

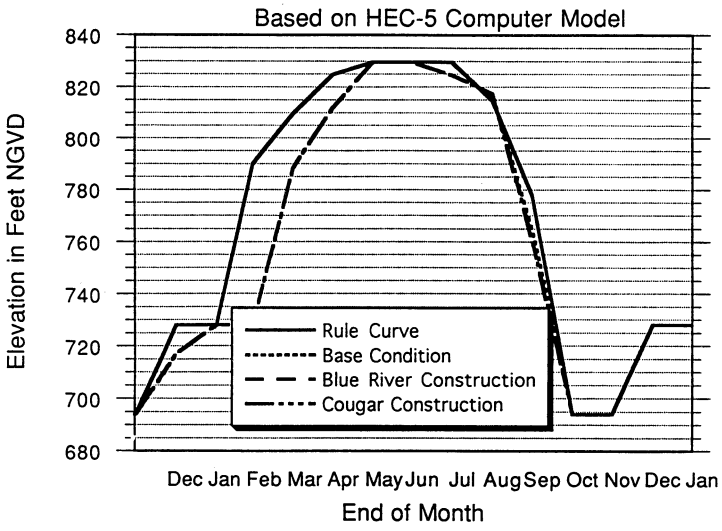

Figure B-14 -- Fall Creek Elevation 1984; High Flow Water Year

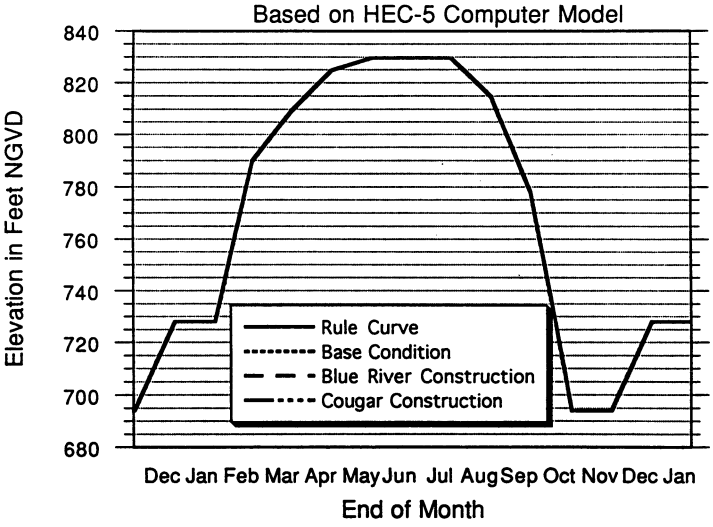

Figure B-15 -- Fall Creek Elevation 1985; Average Flow Water Year

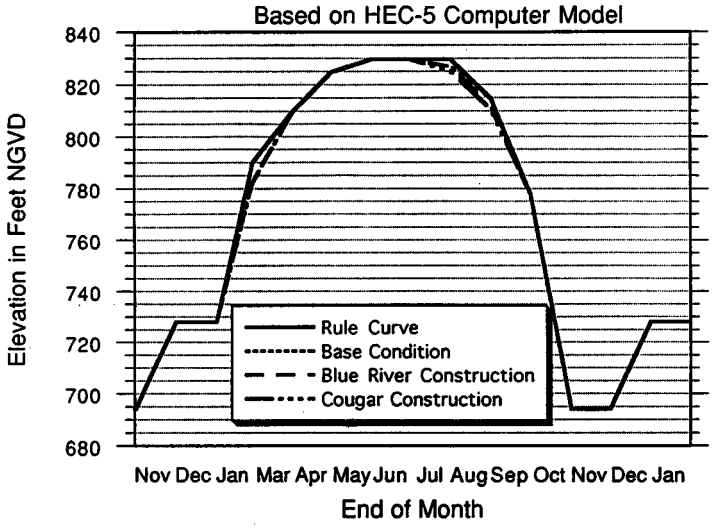

Exhibit C
Correspondence

WILLAMETTE TEMPERATURE CONTROL FEASIBILITY STUDY
CORRESPONDENCE

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DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2946
PORTLAND, OREGON 97208-2946

APR 18 1995

Reply to
Attention of:

Planning and Engineering Division

Mr. John E. Lowe
Regional Forester
Department of Agriculture
Forest Service
333 SW 1st Ave.
Portland, Oregon 97204

Dear Mr. Lowe:

This letter is in reply to your letter of March 15, 1995, expressing your draft findings with regards to the impacts of the Willamette River Temperature Control project on the wild and scenic study river sections of the South Fork McKenzie River. We and have met with members of your staff and the interagency Bull Trout Working Group to review your concerns. We have cooperatively developed the following measures to minimize the construction impacts on fisheries resources upstream and downstream of Cougar reservoir.

Downstream Impacts

In your evaluation of the construction-related impacts to the South Fork McKenzie River downstream of Cougar dam, you indicated that spring chinook, resident rainbow trout and bull trout could be effected. You indicated that higher water temperatures and increased sediment loading could effect spawning habitat, and reduced flows could reduce available spawning and rearing habitat.

These concerns were evaluated in the Environmental Impact Statement and have subsequently been discussed with other state and Federal resource agencies. In general, the conclusion is that conditions in the area downstream from Cougar are currently so poor that changes associated with project construction, including any small change in flows that may occur, will have only a minor effect, if any, on this area. Dave Anderson from the Oregon Department of Fish and Wildlife (ODFW) has indicated "that spring chinook survival is almost nonexistent in this section of the river due to the current temperature regime". The warmer than normal river temperatures in the fall cause the fry to emerge

early, which greatly reduces survival. Fry that do survive do not appear to rear in this reach and are apparently moving downstream soon after emergence which may also effect survival. ODFW has collected fry as early as December in the trap operated at Leaburg dam.

In regards to resident rainbow and bull trout, spawning and growth rate in this reach is severely limited. As discussed in the U.S. Fish and Wildlife Services'(USFWS) Coordination Act Report, the temperature of the water released from Cougar reservoir is too warm in the fall for successful spawning and too cold in the spring and summer for successful rearing. Consequently, any impact on the downstream area during construction will not likely affect resident rainbow or bull trout populations in the McKenzie.

As indicated in the EIS, it is expected that turbidity levels downstream from Cougar will be highest during initial drawdown and then become much reduced after the river settles into a channel in the drawdown zone. It is also expected that most of the suspended sediment will settle out in the upstream residual pool and that only colloidal material will be carried downstream to increase turbidity levels. Colloidal material will not settle out in the South Fork and will therefore, not impact spawning or rearing areas.

Sediment control measures will also be utilized in the reservoir drawdown zone to further reduce turbidity during construction. Consequently, it is expected that turbidity levels downstream of Cougar dam will, after initial drawdown, be similiar to what occurs now.

Based on the above discussion, it is not likely that the fishery values described in your letter for the South Fork below Cougar dam will be diminished beyond what currently occurs. Both ODFW and the USFWS support this conclusion.

Upstream Impacts

As indicated in your letter, upstream effects are limited to impacts to the adfluvial bull trout population upstream of Cougar dam. Concerns include suitability of the residual pool as bull trout habitat, migration of bull trout from the residual pool to upstream spawning areas, lack of food supply in the residual pool due to decreased productivity and increased predation.

As was discussed in the EIS, we met with the bull trout working group prior to release of the draft report to discuss ways to minimize impacts to the bull trout population. The general consensus was that bull trout should be kept in the upstream area rather than to pass them downstream. The group felt that this population was unique, and that it was possible that bull trout would not survive downstream passage through the diversion tunnel. Consequently, as indicated in the EIS, a

screening device is to be constructed over the diversion tunnel inlet to block bull trout passage.

A second meeting was held with the bull trout working group after your letter was received to discuss your concerns and to develop methods to mitigate impacts. At the meeting it was apparent that there is considerable difference of opinion between the concerns of your staff and what ODFW and USFWS feel the level of impact will be to the bull trout population during construction. This discrepancy is likely due to the uncertainty about what impacts will actually occur during construction, including weather conditions. This uncertainty is the primary reason that we are planning to have an interagency coordinating committee deal with construction-related impacts. It was decided at the meeting, however, that some contingency measures should be developed based on projected construction related impacts. Consequently, the following measures were developed and agreed to by the Bull Trout Working Group.

Suitability of the Residual Pool as Habitat for Bull Trout

Modeling of projected temperatures has indicated that, on average, temperatures will not exceed the upper limit of what bull trout can accommodate. Daily maximum temperatures may exceed these limits, depending upon weather conditions. There should be enough stratification in the residual pool, for a thermocline to form with the colder water providing a refuge for the bull trout. Recent information has also indicated that bull trout populations can occur in areas with temperatures greater than the 58 F that was originally thought to be the upper limit. Bob Hooten from ODFW indicated that "populations in southern Oregon occur in areas with temperatures up to 65-70 F".

It was suggested by your staff, however, that the original modeling of temperatures in the reservoir did not adequately deal with the heating that would occur as the South Fork flowed through the drawdown zone.

An additional modelling analysis was performed to consider the effects of warming in the unwatered portion in the original channel (from the upstream gage to the residual pool). This information is discussed below and has been added to the final feasibility report.

Enclosure 1 shows the maximum daily temperatures in the South Fork McKenzie at USGS gage sites above and below Cougar (6.5 miles apart) during original construction in the early 1960's. The temperature increase would be at a maximum when the reservoir had been cleared of vegetation, removing any shading which might moderate any heat gain just prior to completion of construction. During construction of the temperature control modification, there will be a return to a unwatered and unshaded river leading to the head of the residual pool. This leaves about 4.7 miles, or 72 percent of the distance between the gages

that would return to a condition similar to just prior to completion of the original construction.

As a result of less exposure, however, there should be a smaller heat gain than that observed during original construction.

Inflow temperatures to the residual pool were increased to account for the entire originally unshaded and unwatered river (enclosure 2). Daily mean stream temperatures entering the residual pool may rise to a little more than 60°F on the hottest days, which occur in August. The warmest daily maximum temperatures flowing into the residual pool could reach 65°F. The model was rerun using these corrected inflow temperatures. Results show that the warmest daily mean outflow temperature from the residual pool in early August would be about 63°F. This amounts to an increase in the river's daily mean temperature of about 3°F as it passes through the residual pool. There likely would be little diurnal variation in the temperature of the outflow since the release occurs from the bottom of the residual pool where the coolest water is found (enclosure 3). Although surface temperatures could reach as high as 70°F in early August, the residual pool would be thermally stratified and would provide much cooler temperatures lower in the pool. Consequently, although these temperatures levels may reduce growth during the late summer, it is unlikely that they will render the residual pool unsuitable for bull trout survival.

Turbidity levels in the residual pool are expected to be highest during the initial drawdown, but will disperse rapidly once the stream establishes a channel. A variety of sediment control methods will be used to stabilize the drawdown zone and reduce turbidity levels in the residual pool. Consequently, it is expected that turbidity, though initially high during drawdown, will not effect feeding behavior of fish once the residual pool is stabilized and turbidity levels are reduced.

Blocking of Passage of Bull Trout out of the Residual Pool

Possible passage problems include both physical barriers as well as water quality conditions. A braided channel could occur as the South Fork flows across the sediment wedge that could occur at the head of the reservoir. Braided channels generally do not have sufficient water depth to allow fish to pass or may erode differentially creating water falls or velocity barrier areas. Possible solutions include dredging out a single channel, placing structures to reduce velocity barriers and creating pool areas for resting. High velocity areas, that will block migration, may also form in the channel area downstream of the sediment wedge. Structure may also need to be placed in these areas to make them passable to bull trout.

Water temperature or turbidity could also block passage for short periods of time. It is possible that during warm weather daily maximum temperatures could exceed the limit for bull trout

migration. Daily temperature fluctuations can be as much as 8 to 10° F during August and it is assumed fish will pass when temperatures return to an acceptable level. Temperature refuges could also be provided by artificially shading some of the pools created for passage. High turbidity levels could also block migration. This, however, will likely only occur during a storm event, as it does now, and when turbidity levels return to normal passage will be restored. Suitable physical conditions will be provided for passage of bull trout from the residual pool through the drawdown zone.

Food Supply and Predation in the Residual Pools

Food supply in the reservoir is expected to be lower than what is available now since much of the productive area of the reservoir will be out of water during the spring and summer when productivity is highest. Loss of this productivity will directly effect the small fish and invertebrates that adult and sub-adult bull trout use as a food supply. It is proposed to provide supplemental food for the bull trout in the residual pool. ODFW has suggested that adult spring chinook could be transported upstream of Cougar to spawn. It is anticipated that fry and juveniles would provide a food supply in the residual pool as they move downstream. Hatchery rainbow trout could also be directly stocked in the residual pool. Either of these methods will assist in providing the food supply necessary for bull trout survival.

Predation of sub-adult and juvenile bull trout by adult bull trout may be increased by concentrating the fish in a smaller area. Supplemental feeding is expected to reduce this to some extent. In addition it is also proposed to place structures, such as old Christmas trees, for cover for sub-adults and juveniles in the residual pool to further reduce predation.

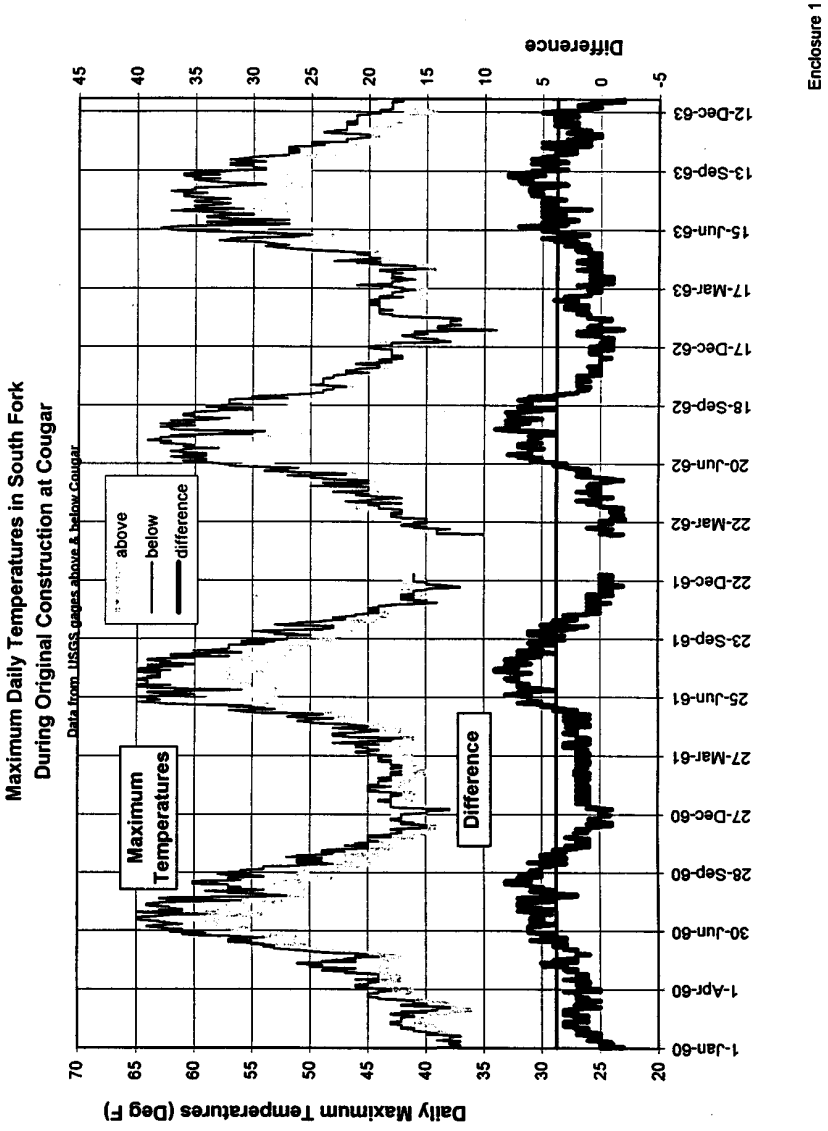
Incorporating the above measures into a contingency plan for construction-related effects will minimize the short term impacts that may occur to the bull trout population upstream of Cougar reservoir. This, plus the use of an interagency coordinating committee to resolve unforeseen problems, should ensure the survival of the upstream bull trout population during the construction and therefore, not diminish the fishery values of the South Fork McKenzie above Cougar Reservoir. It should be recognized that construction of the temperature control modifications will positively benefit fishery resources of the McKenzie River. In fact the USFWS representative believes that temperature control is one of factors necessary for the recovery of bull trout populations in the South Fork McKenzie River.

If you need any additional information please contact Mr. Kim Larson of my staff at (503) 326-6483.

Sincerely,

FOR Steven L. Stockton P.E.
Chief, Planning and Engineering Division

3 Encls


Maximum Daily Temperatures in South Fork
During Original Construction at Cougar
Data from USGS gages above & below Cougar
Maximum Temperatures
above
below
difference
Difference
Daily Maximum Temperatures (Deg F)
Difference
70
65
60
55
50
45
40
35
30
25
20
45
40
35
30
25
20
15
10
5
0
-5
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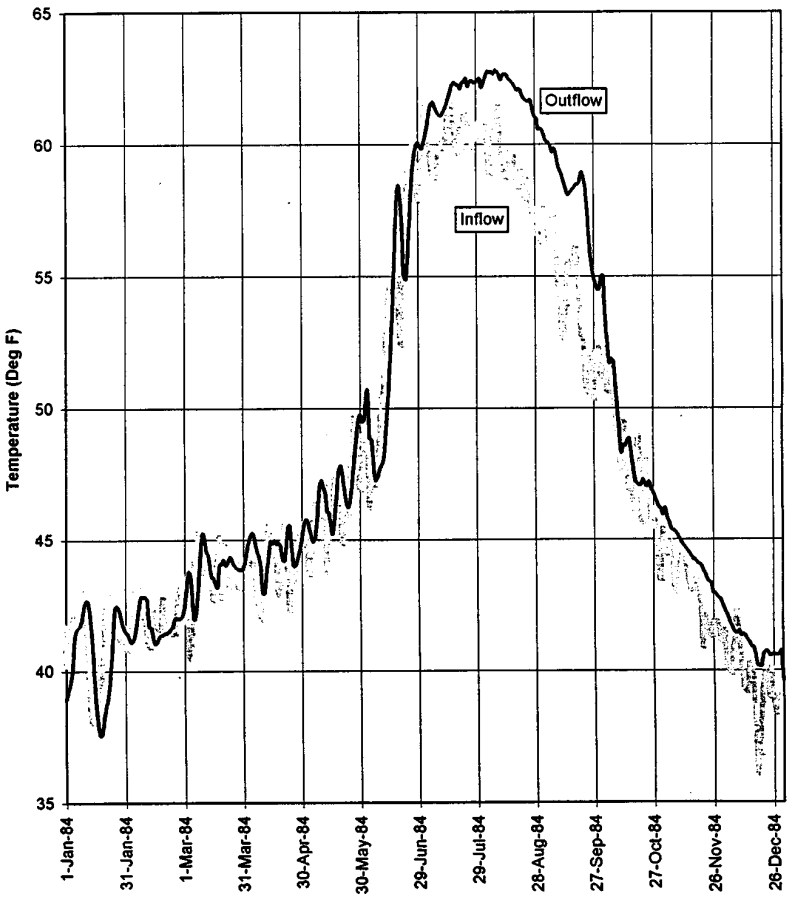
22-Dec-61
22-Mar-62
20-Jun-62
18-Sep-62
17-Dec-62
17-Mar-63
15-Jun-63
13-Sep-63
12-Dec-63

Enclosure 1

Inflow and Outflow Temperatures for the Residual Pool at Cougar Lake

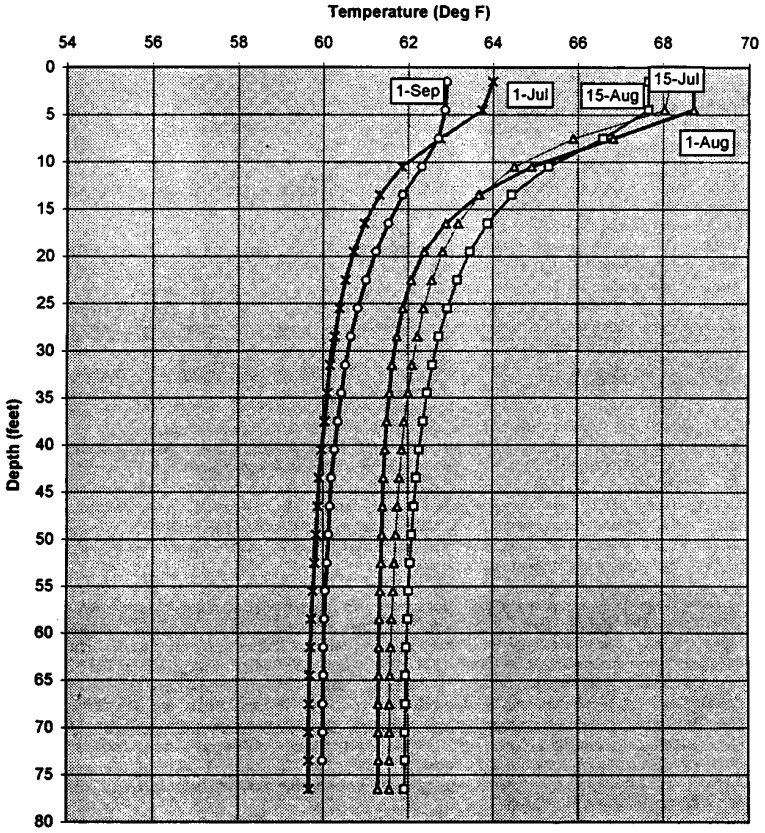
Heating between USGS gages above & below the project



Enclosure 2

Temperature Profile of Residual Pool at Cougar Lake

1984 Hydrometeorology



Enclosure 3

United States Department of Agriculture | Forest Service | Pacific Northwest Region | P.O. Box 3623 Portland, OR 97208-3623 333 S.W. First Avenue Portland, OR 97204

Reply To: 2350

Date: March 15, 1995

Colonel Timothy L. Wood
Commanding Officer
U.S. Army Corps of Engineers
PO Box 2946
Portland, OR 97208-2946

Dear Colonel Wood:

Enclosed is our findings regarding the effects of the Willamette River Temperature Control project on the Blue and South Fork McKenzie congressionally-authorized study rivers. The Wild and Scenic Rivers Act (W&SR's) specifies that developments below or above a potential W&SR "not invade the area or diminish the scenic, recreational, and fish and wildlife values present in the potential wild, scenic, or recreational river area on the date of the designation of the river for study..." The Blue River was determined ineligible (refer to enclosure, page 1). Two segments of the South Fork McKenzie study river, located above Cougar Reservoir, and a 4.5 mile segment located between the Dam and the river's confluence with the mainstem McKenzie has been determined eligible.

Therefore, my staff evaluated the potential for diminishment of the four values specified in the statute within the downstream and upstream segments of the South Fork McKenzie study river. Given that the temperature control tower will not be placed directly into the eligible river nor change the reservoir size, the project will not invade the study area. For scenic, recreational, and wildlife values, any negative short term, construction-related consequences are limited in magnitude and duration. Thus, these values were not found to be diminished by the proposed project.

However, both downstream and upstream of the Dam and Reservoir, the fisheries value of the South Fork McKenzie has the potential to be affected by negative short term, construction-related consequences from the proposal. During the eligibility process, the overall diversity of fish, anadromous and bull trout populations, and existing and potential habitat contributed to the finding that "fish" is an outstandingly remarkable value. Based upon my staff's review of the Willamette River Temperature Control Draft Feasibility Report and Environmental Impact Statement (U.S. Army Corps of Engineers) and other data sources, there is not sufficient information to make a finding relative to fish. In the Section 7(b) Report, we have identified additional information needed to make a finding.

Our analysis and suggested information needs have been discussed with your staff and I appreciate their responsiveness to our concerns. Specifically, reconvening the bull trout working group will facilitate a common understanding of resource conditions and potential short and long-term effects from the proposed project. These, and additional, efforts will provide a basis for completing our determination responsive to the W&SR's Act for the Final Environmental Impact Statement.

I support any effort to enhance aquatic ecosystem resources. However, I am required to weigh the projected long-term, downstream benefits with consequences from project construction that may diminish the fisheries resource of the South Fork McKenzie in either the short or long term.

for Richard W. Fenn

JOHN E. LOWE
Regional Forester

Enclosures

SECTION 7(b) DRAFT DETERMINATION
WILD AND SCENIC RIVERS ACT

Willamette River Temperature Control Project; Blue River and Cougar Dams
Willamette National Forest

PURPOSE

This report addresses the potential for a water temperature control project to diminish the scenic, recreational, fish and wildlife values of the South Fork McKenzie and Blue Rivers. This determination is responsive to the *Willamette River Temperature Control Draft Feasibility Report and Environmental Impact Statement.*

INTRODUCTION

The U.S. Army Corps of Engineers (COE) has completed a Draft Environmental Impact Statement (DEIS) for temperature control towers at Cougar and Blue River Dams. The structures will regulate water temperature and volume, returning the downstream temperature regime nearer to pre-construction temperatures. The proposed temperature regulation is designed to improve downstream fish and aquatic habitat.

The South Fork McKenzie (SF) River and Blue River were authorized for study as potential additions to the W&SR System via the Omnibus Oregon Wild and Scenic Rivers (W&SR) Act of 1988. In 1992, the Willamette National Forest completed an eligibility study for both rivers; finding the SF eligible and Blue River ineligible. A suitability study remains to be completed for the SF.

The ineligibility finding for Blue River has been transmitted to the USDA Forest Service WO, though not yet forwarded to Congress. Blue River was found to have no outstandingly remarkable values. Given this current status, Forest staff considered the potential for construction at Blue River Dam to affect scenery, recreational, fish and wildlife values in the upstream study segment. The project was determined to have no upstream effects to any of the values, including fish, as bull trout has not been identified in the system. The remainder of this preliminary determination is, consequently, for the South Fork McKenzie.

Cougar Reservoir separates eligible segments 2 and 3 of the SF. The upper study segment, segment 1, begins at the river's headwaters, in the Three Sister Wilderness. It ends 5.2 miles downstream at the wilderness boundary. From the wilderness boundary, 16.0 miles downstream to the slackwater of Cougar reservoir, is segment 2. Study segment 3 begins below Cougar Dam. It is approximately 4.5 miles long, terminating at the SF's confluence with the mainstem McKenzie River. (Refer to enclosed map, after page 13.)

The USDA Forest Service is responsible for protecting the values identified in the W&SR study process. Under section 7(b) of the W&SR's Act, the administering agency is required to determine if a development below or above a congressionally-authorized study river will:

> "invade the area or diminish the scenic, recreational, fish and wildlife values present in the area at the date of designation of a river for study..."

BACKGROUND: for South Fork McKenzie

Existing Project Description and Operation: Cougar dam and reservoir was constructed by the Corps of Engineers in 1963. The project area is located about 42 miles east of Eugene, Oregon. The dam is an earth and rock-filled embankment about 1500 feet long and 452 feet high (DEIS, p. 9). The resulting reservoir is about 6 miles long, and 0.7 miles wide, separating study segments two and three.

Cougar dam is used for power generation and flood control in the McKenzie drainage. Starting in the spring, water is held in the reservoir until it is full, around Memorial Day weekend in May. Beginning Labor Day weekend in September, the water in the reservoir starts to be released. By November, the reservoir is at its lowest and provides storage for winter rains. Cougar dam and reservoir is in the McKenzie drainage which is part of the larger Willamette system.

Based on the current operation of the facility, the temperature of the water released below the dam is either too warm or too cool in relation to the inflow into the reservoir. More specifically, from May to September, the water temperature stratifies in the reservoir and, subsequently, the cooler water drawn from the bottom is released from the reservoir. These temperatures are cooler than what was measured historically, and so delay fish migration upstream.

From late September to early December, water released from the dam is warmer than water entering the reservoir. By this time the deeper cooler water has already been released from the reservoir, leaving the warmer surface water. These warmer temperatures effect spawning and egg incubation, by advancing emergence and increasing mortality.

Proposed Project Description and Operation: The COE, Portland District, has completed a DEIS on the impacts of the proposed temperature control towers. Construction of the Cougar dam tower would start about May 1998, and last up to four years. When construction is underway, flows in the Willamette System will be augmented by drawdown from other reservoirs. Construction will terminate in the fall so flood control operation can be effective during winter months.

During the May to October construction period, the reservoir will be at run-of-river and maintain an 80 acre pool (about 6% of full pool area) above Cougar Dam. This residual pool is to help reduce sediment transport out of the reservoir, reduce turbidity in the water released from the project during construction, and provide refuge habitat for resident fish and aquatic organisms. There will be a turn-over rate of about 4 to 6 days. (DEIS, p. 87).

In order to begin construction, the diversion tunnel that was used during the initial construction will be reopened. Reopening this tunnel will occur the year before construction begins. Explosives will be required to reopen the tunnel. A fish barrier screen will be installed at the diversion tunnel once it is opened prior to the initial drawdown. The objective is to prevent fish in the reservoir from passing downstream through the dam. If fish pass through the dam, the potential for mortality is high.

The staging area originally used for dam construction will be used for disposal of rock and sediment. It's estimated that 1300 cubic yards (cy) of sediment will need to be removed from construction of the exit tunnel. Sediment will be hauled to the staging area. About 2,600 cy of riprap will need to be hauled to the construction site for erosion protection (DEIS, p. 66). An increase in turbidity below the dam is predicted.

South Fork McKenzie Wild and Scenic Study River: The eligibility determination for the SF found four values outstandingly remarkable (ORV); specifically: recreation, scenery, fish, and pre-historic.

> ***Recreation*** - The river and its corridor are regionally known for diverse recreation opportunities and facilities. There are a number of prime developed campgrounds and undeveloped campsites distributed along segments 2 and 3, utilized by people from within and outside Oregon. Overnight and day hikes to the Three Sisters Wilderness are within a short distance from the river and Aufderheide Scenic Byway parallels the study river along all of segment 3, and most of segment 2.
>
> ***Scenery*** - The corridor's mature and old growth vegetation, combined with the beauty of the river, offer outstanding scenery to local visitors and many from outside the region. The area's vegetative diversity (e.g., color, size and texture) creates a highly visual backdrop. The Aufderheide Drive National Scenic Byway, designated in 1988, is recognized outside the region for its scenery. The river and its corridor are its predominant features.
>
> ***Fish*** - Populations within the South Fork include cutthroat trout, hatchery rainbow trout, bull trout, white fish and non-game species. All species are naturally occurring except the hatchery rainbow trout. Segment 3 below the dam, also contains runs of spring chinook and summer steelhead. Segments 1 and 2, which are above the dam, support populations of all the mentioned species except the anadromous fish.
>
> Numerous tributaries in segments 1 and 2 above the dam provide abundant spawning and rearing habitat. The potential exists to improve bull trout habitat in all segments of the SF.
>
> The river's overall diversity of fish, anadromous and bull trout populations, and existing and potential habitat, are exemplary compared to similar rivers within SCORP region 8.
>
> ***Pre-historic*** - Three sites within the river's corridor are eligible for the National Register of Historic Places. Two undisturbed rock shelters have been found and are excellent examples of long-term, multi-occupancy dwellings. One of the structures represents the only tested and dated rock shelter within the McKenzie Basin. The South Fork McKenzie corridor is known to have been extensively used and occupied by aboriginal tribes.

SECTION 7 REQUIREMENTS

Congressionally-authorized study rivers are protected by statute [Section 7(b)]. Specifically:

> Developments below or above a potential wild, scenic or recreational river may occur as long as the project "will not invade the area or diminish the scenic, recreational, and fish and wildlife values present in the potential wild, scenic, or recreational river area on the date of the designation of the river for study as provided in section 5 of this Act."

Portions of the South Fork McKenzie have been designated as a study river above *and* below the dam and reservoir.

The initial question to be addressed is whether or not the proposed project invades the designated river. The term invade is defined as encroachment or intrusion upon.

The remaining portion of the standard has been defined as:

> Does the proposed water temperature control project cause diminution of the scenic, recreational, and fish and wildlife values of the study river (as present at the date of designation of the river for study)? A project with long term, positive benefits which greatly outweigh very short term diminishment of stated values may be determined acceptable. However, the river's eligibility; i.e., its identified outstandingly remarkable values, free-flow and water quality, as well as its inventoried classification must be maintained in the short and long term.

RATIONALE FOR DETERMINATION

This report was formulated from review of the U.S. Army Corps of Engineers *Willamette River Temperature Control Draft Feasibility Report and Environmental Impact Statement*, a recent Watershed Analysis completed by the Forest Service on the South Fork McKenzie, and the *Eligibility Determination for the South Fork McKenzie River* (Willamette NF).

In addition, the Forest Service utilized staff specialists and other available additional data as described in the accompanying Section 7(b) Report.

DETERMINATION

Invade: The temperature control tower will not be placed directly into the eligible river nor will the project change the reservoir size; therefore, the project will not "invade" the study river area.

This determination accepts the estimated beneficial effects of the proposed project to fish habitat downstream from the dam. The concerns are focused upstream and downstream from the project during the construction phase.

Findings for each of the specifically identified values in Section 7(b) are as follows:

Scenery:

Turbidity below the dam was the only factor identified that may affect scenery. The South Fork McKenzie may be seen briefly by vehicle occupants and by river users, mainly during the summer months, when turbidity would be low.

The project will not diminish the scenic resource.

Recreation:

The factors that were identified that could affect diminishment include displacement of users, turbidity, and a change in recreation opportunities.

The displacement of recreation users from the river would be minimal with only short term consequences. Most of the displacement would be people boating and fishing in the reservoir. Their displacement would likely be to other reservoirs outside the study area. Turbidity effects would occur below the dam, where limited fishing and boating occur. The only change in opportunity would occur from reduced flows below the dam which may result in a different boating or fishing experience for the short term.

The project will not diminish the recreation resource.

Wildlife:

The factors identified that could affect wildlife are disturbance and changes to habitat.

During the opening of the diversion tunnel, blasting would create disturbance to wildlife. It is recommended that standardized protocol for great grey owls surveys and eagle watches be completed before the project begins. A seasonal restriction from March 1 to September 30 may be necessary if surveys identify nesting spotted owls within 1/2 mile of the blasting area. The U.S. Fish and Wildlife (USFWS) would make this determination.

Habitat will be affected by the drawdown of the reservoir. Osprey and other birds could be temporally displaced because of the increase in flight distance to foraging. Big game habitat could see an increase in forage if the reservoir is stabilized with grass seeding. Completion of this project would result in water temperatures below Cougar Dam which would benefit native amphibians and invertebrates.

The effects to disturbance and changes to habitat are primarily short-term throughout the construction period. It is unknown if longer term displacement impacts may occur.

The project will not diminish the wildlife resource.

Fish:

The factors identified that could affect the value of fish include temperature, sediment, productivity, food, and predation. The discussion is focused around spring chinook, rainbow trout, and bull trout.

Spring Chinook - below the dam.

Spring Chinook occupy habitat downstream of the proposed project. These fish will experience higher water temperatures during project construction, increased sediment loading that could affect spawning habitat, and reduced habitat space and cover from lowered water levels during run-of-river in the reservoir. Use of additional information as provided in the attached specialist's report, applica-

tion of additional analytic tools, and consideration of possible mitigation will assist the Forest Service in making a determination in the final EIS.

There is insufficient information from which to make a finding.

Rainbow Trout - below the dam

Concerns for rainbow trout are similar to those of spring chinook. The populations downstream of the project would have eggs incubating during the pool-draining period, and redds would be at risk from sediment deposition. Increased water temperatures may reduce growth and quantity of fingerlings.

There is insufficient information from which to make a finding.

Bull Trout - above the dam

Bull trout populations occur above and below Cougar Dam, with the above populations using the reservoir as a foraging area and refugia. USFWS estimates bull trout population at 50 to 100 mature adults, most of which use the reservoir. Changes within the reservoir will have the greatest impact on bull trout. Sediment movement is expected to partially fill the 80 acre residual pool. Water temperature of the in-reservoir channel and the residual pool will exceed adult preference criteria for extended periods. These environmental conditions that exceed norms may stress the fish, increase incidence of disease and stimulate the fish to move further downstream. Movement upstream would be to shallow pools where they would be subject to human and avian predation. The food supply normally available within the reservoir will be reduced due to a decrease in primary productivity within the smaller 80 acre residual pool.

The negative effects predicted as a consequence of project construction will drive this population to lower levels and may trigger population collapse.
The upcoming bull trout working group meeting will facilitate a better understanding of these concerns and provide an opportunity to identify supplemental information necessary to make a finding in the final EIS.

for _____ 3/15/95
REGIONAL FORESTER, JOHN E. LOWE (Date)

SECTION 7(b) REPORT
SOUTH FORK MCKENZIE RIVER

for the Willamette River Temperature Control
McKenzie Subbbasin, Oregon
February 1995

This Section 7(b) report provides a basis for the determination as to whether the Willamette River temperature control project will invade the SF McKenzie congressionally-authorized study river or diminish its scenic, recreational, fish and wildlife values.

SCENERY

Description: Portions of the river are paralleled by the Aufderheide Scenic Byway, including the study segments below the Dam and above the Reservoir to the Wilderness boundary. The Byway was designated, in part, to highlight the scenic qualities of the South Fork McKenzie (SF) corridor. The river is part of this attraction with evidence of pools, riffles, and meandering channels. Vegetative diversity (texture, color, etc.) also adds to the scenic qualities of the study segments.

Evaluation Factors: The only factor that was identified to have potential to impact scenery of downstream or upstream study segments was turbidity.

Project Evaluation: Turbidity will not be effected above the Reservoir by project construction. While turbidity will be increased below the dam during project construction, the affect on scenery will be limited. There is only one place below the dam where the river is viewed from the road; also, the several dispersed camping areas adjacent to the river do not receive heavy use. Finally, the season when the turbidity would be most visible, (April-May) is outside the principal recreation season from June to September.

Summary: There will be no long term diminishment of scenery from completion of the project nor significant short term consequences during construction.

RECREATION

Description: Recreation opportunities in the study river, above and below the reservoir, include developed and dispersed camping. Segment 1 is within the wilderness. The majority of day and overnight hiking occurs above the reservoir. Other opportunities include boating, driving for pleasure, and fishing. Boating use is by kayakers above the reservoir, and by rafters below the dam. Scenic driving is from Aufderheide Scenic Byway which parallels the SF below the dam and for most of segment 2 above the dam. Fishing is popular both above and below the dam. The Oregon Department of Fish and Wildlife stocks the river with rainbow trout above the reservoir with Aufderheide Scenic Byway creating ready access to a network of user developed trails to the river. Spring chinook and summer steelhead exist below Cougar Dam.

Evaluation Factors: The factors identified to determine if diminishment would occur for recreation include displacement of users, turbidity, and changes in recreation opportunities.

Project Evaluation: The question of displacement, or movement out of an area for recreation users, has resulted in speculation as to where people will, or will not go, during the construction period. Though outside the scope of this W&SR determination which is focused on the study river, most of the displacement will be from those who boat and fish in the reservoir during the summer. It is anticipated that their use will shift to another reservoir.

Below the dam, the majority of fishing use is from the banks. With lower flows, opportunity to access the river may be increased. Displacement of forest visitors below the dam is expected to be low. Similarly, there is not a displacement concern above the reservoir. The effects of project construction will be limited to the visitor's trip to the upstream segments. Those forest visitors who have traditionally used the area are predicted to continue to do so.

The visual effects of the project will only be seen along the reservoir, a small portion of the drive, and not in the study area. Some impacts would be expected to scenic byway users from the increase in truck traffic hauling rock and sediment. There will also be forest visitors who will be curious about the project and may drive Aufderheide because of the construction. This indicates there is an opportunity for interpretation at the dam or along the reservoir during construction. Displacement of Aufderheide Scenic Byway use is expected to be minimal.

Turbidity is expected to be present below the dam during the construction years. If any decrease of fishing or camping occurs from turbidity, it's expected to only be short term, during the life of the project.

Changes in recreation opportunities are minor below the dam and not anticipated above the reservoir.

Summary: Therefore, no long term diminishment of recreation will occur from the project.

WILDLIFE

Description: Elk, deer, bobcat, coyotes, hawks, stellar jays, Townsend chipmunks, and Douglas squirrels represent a small sample of the fauna using the South Fork corridor.

Above the reservoir, valuable winter range for big game exists. A small portion of the area below the reservoir includes summer elk meadows, which may be calving habitat. Herds of elk and deer spend winter in the South Fork drainage as they seek lower elevation as the winter snows deepen.

Other, less common species that use the corridor include red-legged frogs, northern spotted owls, and bald eagles. Field studies indicate the area below the dam is host to federally sensitive species, the red-legged frog. The northern spotted owl is listed as a threatened species by the U.S. Fish and Wildlife Service and the State of Oregon. Pairs of owls exist in the vicinity and may forage within the mature and old growth habitat the corridor provides. Though no known nesting sites have been identified, bald eagle sightings at Cougar reservoir have been recorded.

Evaluation Factors: Factors identified that could affect wildlife include disturbance and changes to habitat.

Project Evaluation: The Biological Assessment for northern spotted owls only considers known sites and makes no reference to whether protocol surveys have been conducted and would still be valid at the time of implementation of this project. In a letter to the COE dated November 29, 1994, it was

noted that not all suitable northern spotted owl habitat within 1 mile of the project area had been surveyed to protocol standards. The project area is entirely within an Adaptive Management Area, which may determine the need to meet spotted owl protocol requirements. Current U.S. Forest Service direction requires six visits over a two year time period, which are valid for three years. For this project, surveys could be conducted in 1997 and 1998. The Biological Assessment implies that the nearest northern spotted owl activity center is located greater than 1.5 miles from Cougar Dam. The current habitat activity center, based on a 1994 location, is located 0.75 miles from the dam. A 1992 location for this same pair was approximately 0.5 miles from the dam. Nesting raptors on the Willamette National Forest are protected based on standards/guidelines in the Forest Plan. For northern spotted owls, seasonal operating restrictions between March 1 and September 30 are recommended for noise disturbance activities until the pair is determined to be non-nesting. For blasting activities, this seasonal restriction would generally extend out 1 mile from the activity.

Recent direction from the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (April 1994) include great grey owls as a species of concern. Noise from blasting activities has potential to impact great grey owls if they nest near the dam. During January 1995, a great grey owl was sighted 2 miles north of the dam. A standardized protocol for great grey owl surveys should be implemented by April 1995, and surveys for nest locations should be conducted.

Cougar reservoir and the adjacent South Fork McKenzie River are suitable bald eagle habitat, and blasting noise due to this project may affect nesting eagles. In April 1994, an aerial nest survey was conducted which included the project area, and no bald eagles were seen. Additional ground protocol eagle watches during early June are recommended until this project is implemented.

Harlequin ducks, listed as sensitive on the Regional Forester's List and a Federally listed category 2 species, have been sighted on the SF below Cougar dam. Harlequin ducks and other waterfowl which use the SF below Cougar dam may be indirectly impacted by reduced aquatic insect levels if this project results in increased sedimentation. Macroinvertebrate levels may also fluctuate in quantity or species composition if water temperatures change. Waterfowl, such as mergansers or Canada geese, are occasionally seen on Cougar Reservoir, and may be displaced to other bodies of water during the duration of the drawdown period.

Amphibian habitat in reservoir side channels would be temporarily reduced, but sensitive amphibians have not been documented in the reservoir area. In contrast, side channels of the McKenzie River below the dam would show increased water flows at certain times which may benefit amphibians.

Osprey are protected under the Raptor Protection Act. Eight osprey nest locations are known directly adjacent to Cougar Reservoir. Although initially the reservoir drawdown would concentrate fish and may benefit osprey foraging, over the life of the project the temporary drawdown may cause displacement of some of these nesting osprey. Some of the nests located near the southern portion of the reservoir might still be used, although flight distance to foraging areas would be increased. Displaced osprey would fish the river more intensively.

Summary: All of the above disturbance and habitat effects to wildlife are primarily short-term in duration throughout the construction period of the project. It is unknown if longer term displacement impacts may occur. Completion of this project would result in water temperatures below Cougar Dam which would benefit not only native fish, but also native amphibians and invertebrates. Therefore, no long-term diminishment will occur to wildlife from implementation of this project.

FISH

Description: Spring Chinook, Rainbow Trout and Bull trout are fish species of interest found within the study river area. All species are found below the dam, while only bull and rainbow trout are within the upper section (in and above the reservoir). These species use the study river segments for all or part of their life history requirements. The completed project proposes to enhance aquatic resource conditions downstream of the reservoir by creating flow releases with temperatures that mimic natural, or pre-project conditions.

Evaluation Factors: Evaluation factors identified to make a determination were changes in temperature, sediment delivery and routing, habitat quantity and quality, and increased mortality. Locally available information, augmented by published literature, was used in addition to that provided in the DEIS to draw conclusions regarding probable cumulative effects upon the key species. Each species was addressed separately in this analysis, and evaluated both on upstream and downstream conditions where applicable. The collection of these three species, and existing and potential habitat, represent the identified outstanding remarkable value for fisheries.

Project Evaluation:

Spring chinook: Spring chinook currently only occupy habitat downstream of the proposed project so individual year-classes would be affected by short-term consequences of project implementation and long-term consequences of project operation.

It is predicted for the four-year construction period, the temperatures downstream of the dam will be more typical of what the species endures in other parts of the McKenzie River system, except for summer rearing when elevated temperature conditions will occur. This is a result of increased solar radiation and convection on the stream flowing through 6 1/2 miles of channel in the de-watered reservoir and a 3-6 day retention time of that water in the construction pool, prior to its release downstream. From USGS records above Cougar dam, and COE predictions of probable temperature increase through the project area, there may be an average of 15 consecutive days per year in which daily water temperatures exceed 61 to 64°F, with peaks as high as 70°F. Probable response of stream invertebrates and juvenile salmonids cannot be predicted with the information provided. With increased temperature, growth rates would decline and ultimately cease above 68 degrees (Reiser and Bjornn, 1979). Also, above 68 degrees, adult chinook may be discouraged from migrating to spawning areas in SF.

De-watering the conservation pool to expose the construction site will expose 555 acres of pool bottom to precipitation and wind erosion for the first time in more than 30 years and allow active streamflow over a sediment wedge estimated at 1.4 to 2.9 million cubic yards. As late spring streamflow and rainstorms sort deposited material and mobilize particulate matter, it will move downstream, and heavier particles will fill the construction pool. Lighter particles will be swept through the bottom drain and into the channel below the dam where decreased velocity and increased channel roughness will allow sediment to deposit in spawning beds and insect production areas. Most of this will occur in March, April, and May before meaningful erosion control treatments, within the exposed reservoir bed, can become effective. During the month or more that it will take to drain the conservation pool to the construction pool, there will be prolonged periods when juvenile chinook foraging may be disrupted. The extent to which this combination of sedimentation and feeding disruption affects each of the four successive year-classes of juvenile chinook cannot be determined from the available information.

As late summer flow quantity below the dam approaches pre-dam conditions, area for rearing will be reduced from the amount historically available because of channel down-cutting that has occurred since dam operation. Habitat will include less shallow, peripheral area and significant side-channel habitat will be de-watered, further reducing the quantity and quality of juvenile rearing habitat. Reduction in cover provided by channel-side riparian vegetation will make juvenile fish more vulnerable to predation and reduce the food supply from terrestrial sources (ibid.)

Adult salmon that attempt to spawn during the years of construction may be forced to select sites more associated with the thalweg (main energy part of the channel) because of the reduced wetted channel area. Over 90 percent of each year's spawning may occur before fall freshets raise the river to the entire low-flow channel. Doing so will expose their redds to higher energy flows during the winter high-flow season, increasing the risk of scour and egg destruction. Superimposition of redds may also reduce spawning success. Use of an Instream Flow Incremental Methodology study would allow these probable consequences to be analyzed and results predicted.

In summary, short-term impacts on four successive year-classes of spring chinook cannot be quantified, but are expected to occur. These could jeopardize the productivity of the year-classes present during the construction period, as well as impact post-project habitat of at least one more cycle of full stocking. Information in the DEIS does not provide the specificity needed to establish or disprove diminishment of the spring chinook stock. Subsequent information or analysis should include: additional temperature modelling; a more detailed analysis of sediment characteristics and routing, information on rearing habitat with lower flows; and, information on the quantity and quality of spawning habitat.

Native rainbow trout: Native rainbow trout are known to inhabit the SF above and below Cougar dam as well as the reservoir itself. The DEIS does not contain sufficient information on native rainbow use of the affected habitats to conclude an evaluation of diminution or non-diminution.

If we assume that native rainbow spawn in the SF below Cougar dam, the eggs would be incubating during the pool-draining period and redds would be at risk of sediment deposition. This might preclude emergence and cause reduced fry survival. Newly emerged fry would be exposed to atypically warm water in simplified habitat where avian-induced mortality would likely be higher. Growth would be inhibited and fingerling density would be reduced. The combination of increased temperature, sedimentation and reduced fry prey availability, may preclude rainbow trout habitat occupancy during the construction phase of this project.

Bull trout: Two known population segments of bull trout occur in the SF. Below the dam, the adult phase exhibits a fluvial life history pattern. The population above Cougar Dam historically exhibited this pattern, but modified to an adfluvial behavior when the dam blocked emigration to the McKenzie Basin. Thus the reservoir became surrogate habitat for the mainstem McKenzie River which had provided foraging area and winter refugia.

Bull Trout (below the dam): Although USFS inventories are not conclusive regarding fish use of the SF, the bull trout downstream of the dam appear to be sub-adults or adults of the mainstem McKenzie River population. Average length of the fish reported caught between 1988 and 1993 was 18.3 inches with the smallest fish measuring 13 inches. No juvenile bull trout were observed during habitat surveys completed by Oregon State University in 1988; nor during diving probes of side channel habitat-improvement projects in 1993 and 1994.

It is speculated that reduced habitat area, warmer summer temperatures and increased turbidity below the dam during the construction period could discourage sub-adults and adults from using the

area. Long-term consequences are probably not significant because of the extensive foraging habitat of the mainstem McKenzie River.

DEIS information regarding bull trout use and habitat below Cougar Dam, angler information from Oregon Department of Fish and Wildlife (ODFW) and recent USFS inventories do not provide sufficient information to support a finding of diminution or non-diminution for bull trout below the dam.

Bull Trout (above the dam): Available information about the population segment isolated above Cougar Dam is consistent with a fluvial turned adfluvial life-history strategy. Based upon volunteer angler reports, Oregon State University inventory, ODFW pool surveys, and USFS probes for juvenile bull trout, bull trout appear to spawn in Roaring River and rear there for a year or two. They next surface in Cougar reservoir as 11 to 13 inch fish in January to February. Larger fish are reported from the reservoir except for the period from early May through mid-September. Adult-sized fish appear in angler reports in the SF from May 5 through September 3, but most have been reported during July and August.

Presuming that the limited information at hand adequately describes the life history strategy of the above-reservoir population segment, and the habitat requirements listed in the DEIS represent those necessary to sustain a bull trout population, the determination of diminishment focuses upon the changes in the in-reservoir conditions. Abundance, temperature, living space, food supply, predation and egress to spawning habitat are the key factors considered.

There is no objective information regarding the numbers of bull trout occupying the 1,280 acres of full pool reservoir, the 105 acres of main river channel and 3 acres of known spawning area available. The ODFW speculates the total population size ranges from 100 to 500, while USFWS estimates there are 50 to 100 mature fish. Volunteer angler reports of 1986 to 1994 include 68 sub-adult and adults captured. Assuming half of the fish actually captured were reported, and a 20 to 30 percent exploitation rate, the population segment expected to use Cougar reservoir is between 150 to 75 fish respectively. Further, assuming half of these fish make up the reproductive cohort, there are between 37 and 75 adults whose genetic make-up direct the future of this population.

Water temperature of the in-reservoir channel and the 80 acre residual construction pool will exceed "adult preference" criteria for extended periods and will occasionally exceed the "adults present" criteria of the DEIS. This is based upon COE predictions of 3 to 6°F increases in temperature as water flows down the exposed channel. Environmental conditions that exceed norms may stress the fish, increase incidence of disease and stimulate the fish to move downstream through the dam (where they could be injured at the screen) or move upstream into the 6.5 miles of exposed channel where they would be subject to human and avian predation, increased stream temperature, and sub-optimal habitat conditions.

The food supply available to sustain the bull trout population in the reservoir will be constrained by: ODFW inability to stock fingerling rainbow trout; a 94% reduction in reservoir surface area reducing phytoplankton/zooplankton production; and several miles of newly exposed stream channel will allow downstream aquatic insect drift and juvenile fish areas in which to pioneer before they become available to the bull trout. Assuming a predator biomass of 225 to 450 pounds (i.e., mean length of 19 inches and mean weight of 3 pounds) and a 5 percent body weight daily ration, 12.5 to 25 pounds of prey per day would be consumed. Assuming Cougar reservoir is capable of producing 20 pounds of fish flesh per acre per year, the 80 acre residual pool planned by COE would only provide 1600 pounds total. If half of that becomes prey for bull trout, there is still a deficit of 1000 to 3000 pounds of prey that would be needed to support the population during the five-month construction season.

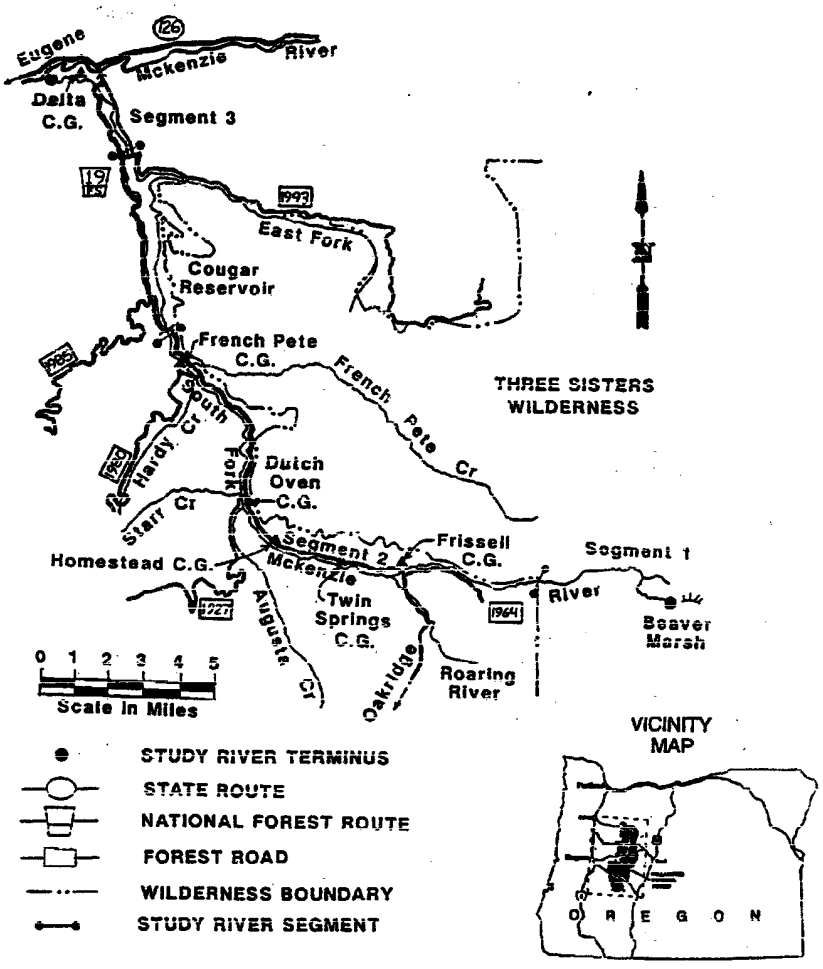
Concentrating a strongly predatory population of varying size and age (3 to 9-year olds) that normally is one fish per ten acres of reservoir (full pool) to between 1 and 2 fish per acre in the construction pool (of even more simplified habitat) will increase the likelihood of bull trout predation upon itself. This problem may be exacerbated by the large quantity of sediment that will translocate into the residual pool and will reduce its assumed volume of 3,000 acre feet. This will result in higher densities than those identified above. At the increased density, legal angling can be expected to injure some fish and illegal angling will lead to some increased mortality.

As adult fish prepare to migrate to the spawning area, movement may be impaired. A sediment deposit estimated at 1.4 to 2.9 million cubic yards has been deposited in the conservation pool. Most of it, including larger bedload materials are expected to be in the old river channel just below elevation 1530. Experience at Hills Creek Reservoir demonstrated that the river may flow over, and rework some of the sediment, or it may abandon the old river channel and flow around the deposit. Either way, the mid-summer streamflow may be across insurmountable terrain, or at least over conditions that could cause delays and stress to the migrants.

Project implementation, as described will have adverse impacts on the isolated population of bull trout already approaching or below the threshold of genetic viability. This results from decreased habitat area and quality, and is compounded by an inadequate forage base and increased mortality. Subsequent information or analysis should include: improved estimates of population; information on how the residual pool will support subadult and adult populations including temperature concerns; and, an evaluation of the sediment wedge and its potential to create a barrier to upstream adult passage in the summer.

Summary: Provided by species.

SOUTH FORK McKENZIE RIVER
WILD AND SCENIC STUDY RIVER
WILLAMETTE NATIONAL FOREST



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Oregon

DEPARTMENT OF
FISH AND
WILDLIFE

OFFICE OF THE
DIRECTOR

December 29, 1994

Colonel Tim Wood
District Engineer, Portland District
Army Corps of Engineers
P. O. Box 2946
Portland, OR 97208 2946

Dear Colonel Wood:

I support the conclusions of your Portland District staff listed in the December 1994 Draft Feasibility Report and EIS for Willamette Temperature Control in the McKenzie subbasin. This document describes the maximum production potential of a naturally producing stock of Willamette spring chinook in the McKenzie River watershed.

The data provided to your modeler for analysis in the Feasibility Report came from ODFW and FWS, working in close cooperation with the Portland District COE. We appreciate this cooperative approach to resource management.

Willamette Basin management goals for spring chinook include sustaining a wild population for the future. Such natural production is generally accepted as the key to salmon restoration and recovery of the declines that are leading to more and more listings of salmon species under the Endangered Species Act (ESA). The McKenzie watershed is the most significant Willamette sub-basin habitat with potential for restoration. Control of reservoir discharge temperatures to mimic pre-project temperatures and timing has the potential to return some thirty thousand adult spring chinook and also increase production of bull trout, which is a candidate for listing under ESA. Willamette temperature control facilities will produce fishery benefits, however the risks of construction of these facilities may have environmental impacts to bull trout. We are aware of such potential short-term impacts and will work with your staff and other resource agencies to examine impacts relative to benefits.

I thank you and your staff for your time and cooperation on this important study which we hope will result in authorization of the needed temperature control structure.

Sincerely ,

RUDOLPH A. ROSEN
Director

2501 SW First Avenue
PO Box 59
Portland, OR 97207
(503) 229-5406
FAX (503) 229-6134

December 9, 1994

Colonel A.W. Hines
District Engineer, Portland District
Army Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208-2946

Dear Colonel Hines:

The Columbia Basin Fish and Wildlife Authority (CBFWA) is a regional association of the Columbia Basin's fish and wildlife managers, comprising two federal and four state agencies and twelve Indian tribes. This organization enables the agencies and tribes to work in concert with the Northwest Power Planning Council (NPPC) to attain restoration of fish and wildlife resources in the Columbia Basin.

The CBFWA Members have reviewed the U.S. Fish and Wildlife Service's June 3, 1994, draft Fish and Wildlife Coordination Act report for the McKenzie River Temperature Control Project and concur with its analysis and conclusions regarding the effects of the Blue and Cougar projects in the McKenzie River Basin, Oregon. The McKenzie River provides exceptional resident trout fisheries and is the remaining major tributary for naturally producing spring chinook salmon in the Willamette River Basin. Hypolimnetic releases from the reservoir result in unnatural thermal pulsing and a modified temperature regime in the South Fork and mainstem McKenzie rivers. Mitigation for the projects' deleterious impacts on McKenzie River fish production has long been sought by the state and federal fishery agencies.

We fully support the Corps moving forward with the multi-level intake temperature control facilities as described in the September 1994 Draft Feasibility Report and Environmental Impact Statement - Willamette River Temperature Control, McKenzie River Subbasin, Oregon.

Sincerely,

John R. Donaldson
Executive Director

cc: CBFWA Members
Angus Duncan, NPPC
Randy Hardy, BPA
House Committee on Natural Resources
Martha Pagel, OWRD
USFWS-Portland Regional Office
Ron Garst, USFWS-Portland Field Station
Barbara Scott-Brier, USDI-Solicitor's Office
NOAA-GCNW
NMFS-Portland-HCB

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Oregon

DEPARTMENT OF
FISH AND
WILDLIFE

NORTHWEST
REGIONAL OFFICE

November 21, 1994

Colonel Tim Wood
District Engineer, Portland District
Army Corps of Engineers
P.O. Box 2946
Portland OR 97208 2946

Dear Colonel Wood:

Appropriate staff of the Oregon Department of Fish and Wildlife have extensively reviewed the U.S. Fish & Wildlife service's June 14, 1994, draft Fish and Wildlife Coordination Act Report for the McKenzie River Temperature Control Project and wholeheartedly concur with its analysis and conclusions regarding the effects of the Blue River and Cougar projects on temperatures in the McKenzie River Basin, Oregon.

The McKenzie River provides exceptional resident trout fisheries and is the remaining major Willamette River tributary producing spring chinook salmon naturally. Hypolimnetic releases from the reservoirs result in unnatural thermal pulsing and a modified temperature regime in the South Fork and mainstem McKenzie Rivers. Mitigation for the mortality, hence reduced production and other negative effects has long beeen sought by ODFW and other fishery agencies.

We fully concur with the USFWS Coordination Act Report.

In harmony with nature,

Nancy M. MacHugh

Nancy M. MacHugh
Interagency Fish & Wildlife Coordinator

7118 NE Vandenberg Ave.
Corvallis, OR 97330-9446
(503) 757-4186
FAX (503) 757-4252

OCT 24 1994

Programs and Project
Management Division

Honorable Mark O. Hatfield
United States Senator
121 S.W. Salmon Street, Suite 1420
Portland, Oregon 97204-1321

Dear Senator Hatfield:

This is a final response to your inquiry, dated June 22, 1994, on behalf of the McKenzie Watershed Council concerning temperature control facilities at Blue River and Cougar Reservoirs.

As you are aware, Portland District is in the process of completing a feasibility study which will determine the Federal interest in constructing water temperature control facilities at Blue River and Cougar Dams, located in the McKenzie River sub-basin. These facilities are intended to restore downstream water temperatures to pre-project conditions to benefit anadromous and resident fish species.

After a review of the cost sharing issues associated with this project, the Corps is proceeding in a manner which supports installation of water temperature control facilities as project modifications to mitigate for the fish and wildlife impacts resulting from initial construction of the two dams. The cost of these facilities must be repaid according to the allocations among the original project purposes. For Blue River and Cougar projects, the costs allocated to the hydropower and irrigation purposes would be the only costs to be repaid. This is in accordance with the guidance set forth in the Conference Report accompanying Public Law 103-316, the Energy and Water Development Appropriations Act of 1995.

If you need any further information, I will be pleased to provide it.

Sincerely,

Timothy L. Wood
Colonel, U.S. Army
Commanding

Copy Furnished:
Honorable Mark O. Hatfield, U.S. Senate
711 Senate Hart Office Building
Washington, DC 20510-3701

CENPD-PA, CENPP-PA, CECW-ZW

Directorate of Planning
and Engineering

OCT 7 1994

Honorable Barbara Roberts
Governor of Oregon
Salem, Oregon 97310-0370

Dear Governor Roberts:

This is a final response to your letter of June 15, 1994, regarding Corps policy requiring non-federal cost sharing for water temperature control facilities (WTC) at Cougar and Blue River Dams.

As you are aware, the Portland District is in the process of completing a feasibility study which will determine the Federal interest in constructing WTC facilities at Cougar and Blue River Dams, located within the McKenzie River sub-basin. These facilities are intended to restore downstream water temperatures to pre-project conditions to benefit anadromous and resident fish species.

After a review of the cost sharing issues associated with this project, the Corps is proceeding in a manner which supports installation of water temperature control facilities as project modifications to mitigate for the fish and wildlife impacts resulting from the initial construction of the two dams. The cost of these facilities must be repaid according to the allocations among the original project purposes. For Cougar and Blue River projects, the costs allocated to the hydropower and irrigation purposes would be the only costs to be repaid. This is in accordance with guidance set forth in the Conference Report accompanying Public Law 103-316, the Energy and Water Development Act of 1995.

Please contact Mr. Dennis Wagner of my staff at (503) 326-3822, if you have additional questions.

Sincerely,

SIGNED
Ernest J. Harrell
Major General, U.S. Army
Division Engineer

OCT 7 1994

Directorate of Planning
and Engineering

Mr. Ted Bottiger, Chairman
Northwest Power Planning Council
851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1337

Dear Mr. Bottiger:

This is a final response to your letter of March 15, 1994, regarding Corps policy requiring non-federal cost sharing for water temperature control facilities (WTC) at Cougar and Blue River Dams.

As you are aware, the Portland District is in the process of completing a feasibility study which will determine the Federal interest in constructing WTC facilities at Cougar and Blue River Dams, located within the McKenzie River sub-basin. These facilities are intended to restore downstream water temperatures to pre-project conditions to benefit anadromous and resident fish species.

After a review of the cost sharing issues associated with this project, the Corps is proceeding in a manner which supports installation of water temperature control facilities as project modifications to mitigate for the fish and wildlife impacts resulting from the initial construction of the two dams. The cost of these facilities must be repaid according to the allocations among the original project purposes. For Cougar and Blue River projects, the costs allocated to the hydropower and irrigation purposes would be the only costs to be repaid. This is in accordance with guidance set forth in the Conference Report accompanying Public Law 103-316, the Energy and Water Development Act of 1995.

Please contact Mr. Dennis Wagner of my staff at (503) 326-3822 if you have additional questions.

Sincerely,

SIGNED

Ernest J. Harrell
Major General, U.S. Army
Division Engineer

October 7, 1994

DEPARTMENT OF
FISH AND
WILDLIFE

NORTHWEST
REGIONAL OFFICE

Mr. Kim Larson
Portland District, Corps of Engineers
P.O. Box 2946
Portland, OR 97208

Dear Kim:

This letter is in response to your request for criteria that the Corps should meet in modifying Cougar Reservoir to meet the temperature control goal of replicating pre-project temperatures. Meeting this goal should improve spawning success and fry survival of spring chinook as well as increase habitat utilization and growth of resident trout species.

The categories of criteria of most concern to ODFW are turbidity, temperature and passage. Specific comments follow.

Turbidity
The guideline used by our Habitat Conservation Division for water projects is to try to not exceed turbidity levels more than 10% above background. We recognize this may not be achievable as the reservoir is drawn down because of wave action on unconsolidated sediments and downcutting in the old stream channel. Without information on the sediment wedge, it is difficult to provide more criteria than do what you can.

Temperature
The time period of most concern re. elevated temperatures is July - September, when the pool is lowest. If you can achieve a 3,000acft pool, we prefer approximately 80surface acres to allow deep water refuge for bull trout. Bull trout are the species of most concern, and have the coolest temperature requirements (adults not to exceed 54 F/ juveniles not to exceed 48 F (literature)).

If a HOT year,like 1992 or 1994, we ask the Corps to notify natural resource agencies immediately upon seeing stressed fish, to allow agencies to implement methodology to address the situation. A number of alternatives exist to evaluate and choose the desired action.

Mark Wade of our Springfield district suggested a novel idea that your engineers might evaluate. Since the flow during

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drawdown will be from the bottom of the pool and the pool will only be 3,000 acft, the pool will likely exceed our criteria regardless of the water year. One solution may be to erect a standpipe at the discharge intake so that warm surface water is discharged and cool hypolimnetic water is kept in the pool.

Passage
The above standpipe idea may integrate with passage concerns also. If you are still looking at screening, the screen would need to be permanent during installation of temperature control facilities (2-4 yrs). The screen design must be sufficient to exclude adult bull trout and prevent impingment velocities. We do not desire to intentionally bypass fish, only to increase their safety.

We reserve the right to review your design based on these and others' criteria.

At the August 10 meeting, a number of things were promised but have not been seen to date, e.g., Information on the sediment wedge and trash rack/screen ideas.

We desire the benefits of Willamette temperature control facilities as unmitigated downstream effects of operating Corps projects, however the risks of construction of these facilities as environmentsl impacts to the already petitioned bull trout, require that we take all contingencies into consideration and plan for them such that temperature control facilities can precede a petition for listing of wild Willamette spring chinook.

Thank you for meeting with natural resource agency folks. ODFW looks forward to this project with positive anticipation.

In harmony with the river,

Nancy

Nancy M. MacHugh
Interagency Fish & Wildlife Coordinator

OREGON FISH & WILDLIFE
REVIEW DRAFT

300. CONSERVATION:

ODFW recognizes the inherent values of waterways to society. To maintain an environment beneficial to society and apply sound policies of conservation, ODFW will evaluate any proposal that has the potential to damage fish and wildlife resources. The following standards are the minimum criterion recommended by ODFW to ensure waterway alterations conform to sound policies of conservation.

301. Unless modified by the appropriate local District Biologist, ODFW will recommend timing for all waterway alteration projects based on Oregon Guidelines For Timing Of In-water Work To Protect Fish And Wildlife Resources (ODFW 1987) to minimize impact to fish and wildlife populations, and public use of these resources. (See Appendix B)

302. Water quality, including turbidity levels, shall be maintained. At a minimum, ODFW will recommend no more than a 10% temporary cumulative increase in turbidity above background levels at the time of operation as measured 100 feet below the project site.

303. Disturbed soil areas on all waterway alteration projects pose a potential sedimentation threat; therefore, recommendations shall stipulate revegetating disturbed areas with compatible plant species. Use of native species is preferred and shall be planted for maximum regeneration.

400. COORDINATION:

ODFW shall coordinate and consult with government agencies or private sectors planning waterway alterations before a final proposal is submitted. Alternative interests and priorities shall be considered in planning waterway alteration projects.

500. EDUCATION:

ODFW will promote and disseminate to government agencies and the general public information about the values of waterways as important fish and wildlife habitat as well as the need to protect, restore, and enhance waterways.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Portland Field Office
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266
(503) 231-6179 Fax: (503)-231-6195

RECEIVED
NOV 15 1994
REG & ENV RES BR

November 14, 1994

In reply refer to: 1-7-94-I-515

Robert E. Willis
Chief, Resource Protection and Fish and Wildlife Section
Corps of Engineers, Portland District
P.O. Box 2946
Portland, OR 97208-2946

RECEIVED
NOV 1 19[illegible]
REG & ENV RES BR

Subject: McKenzie Temperature Control Projects

Dear Mr. Willis:

This is in response to your letter dated September 15, 1994, transmitting your evaluation of the impacts on Peregrine Falcon (*Falco peregrinus*), Bald Eagle (*Haliaeetus leucocephalus*), Northern Spotted Owl (*Strix occidentalis caurina*), Oregon chub (*Oregonichthys crameri*), and bull trout (*Salvelinus confluentus*) from the proposed McKenzie Temperature Control Projects at Cougar and Blue River Dams. Your correspondence was received in this office on September 16, 1994.

The project was described in the biological assessment. Essentially, the project involves the construction of structures to allow dam outflow water temperature to approximate historical temperatures. The purpose of the project is to improve stream conditions for aquatic organisms by simulating pre-dam stream temperatures.

BALD EAGLE

There are no known nesting eagles on the McKenzie Basin, but occasional wintering eagles do occur in the vicinity of the proposed project. The proposed project will reduce fish populations in the reservoirs and provide fewer prey resources for wintering eagles during the construction period. However, the loss will affect very few eagles, and fish populations are expected to rebound after the construction period. The Service concurs with the Corps' determination that the proposed project is not likely to adversely affect bald eagles.

PEREGRINE FALCON

Two aeries occur within the vicinity of Cougar Dam. The closest of the two is over nine miles from the project area. As stated in the biological assessment, few peregrine falcon prey are associated with the proposed project. Although resident falcons may occasionally occur in the vicinity of the proposed project, they are not dependent on the area for roosting, foraging, or nesting. Blasting will be associated with construction at Cougar Dam. However, the distance from the nest site and the topography between the

nest site and construction area will minimize disturbance due to blasting noise. We concur with the Corps' determination that the proposed project is not likely to adversely affect peregrine falcons.

SPOTTED OWL

The project will not remove spotted owl nesting, roosting, foraging, or dispersal habitat; does not occur within critical habitat; and is located over 1.5 miles from activity centers nearest Blue River or Cougar Dams. Disturbance due to blasting is low due to distance and topography. We concur with the Corps' determination that the proposed project is not likely to adversely affect spotted owls.

OREGON CHUB

Oregon chub do not occur in the McKenzie River Basin. Therefore, as stated in the biological assessment, we do not anticipate any effects on Oregon chub as a result of construction or operation of the project.

BULL TROUT

Bull trout within the South Fork McKenzie River (including Cougar Reservoir) are considered to be at moderate risk of extinction. Although specific information on bull trout numbers in Cougar Reservoir is not available, the population is suspected to contain from fifty to one hundred mature fish. The drawdown of Cougar Reservoir may cause mortality of individuals. Habitat will be reduced during drawdown. Breeding and rearing habitat above the reservoirs will not be affected by the proposed project. Short term losses within the reservoir may reduce population size and distribution. However, implementation of the proposed project will attempt to restore historical stream temperature conditions below the dams, which should benefit bull trout occurring downstream in the McKenzie Basin. In addition, the reservoirs will be filled according to current schedules after construction. Fish populations within the reservoirs are expected to rebound once construction is complete.

We concur with the Corps' determination that ultimately, the proposed project is likely to benefit bull trout. However, individual mortality may occur during project construction. Bull trout are presently a category one candidate species that warrant listing, but listing has been precluded by other higher priority listing actions. However, bull trout may be proposed and listed prior to project completion. If so, the Corps must conference/formally consult on the impacts to bull trout expected to occur as a result of the proposed project.

Based upon information in the biological assessment, we concur with the Corps's determination that the proposed action is not likely to adversely affect Peregrine Falcon, Bald Eagle, Northern Spotted Owl, and Oregon chub.

The requirements established under section 7(a)(2) and 7(c) of the Endangered Species Act of 1973, as amended (16 USC 1531 et. seq.), have been met, thereby concluding the consultation process. If you have any questions or need more information, please contact Laura Todd or Ron Rhew at (503)231-6179.

Sincerely,

for Russell D. Peterson
State Supervisor

B:\94I515.CE

cc:
ODFW (Nongame)

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P O BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

September 15, 1994

Planning and Engineering Division

Mr. Russell D. Peterson
Field Supervisor
U.S. Fish and Wildlife Service
2600 SE. 98th, Suite 100
Portland, Oregon 97266

Dear Mr. Peterson:

Pursuant to the requirements of the Endangered Species Act, we are providing your agency with a biological assessment for listed species potentially impacted by the Willamette Temperature Control Project, Cougar and Blue River Projects, McKenzie River system, Oregon.

Your letter of August 23, 1994 (reference 1-7-94-SP-412) listed peregrine falcons, bald eagles, northern spotted owls, and Oregon chub. Additionally, bull trout, occur in this system and because of their status, we have also addressed this species.

We have concluded that the construction and operation of temperature control facilities at Cougar and Blue River Projects is not likely to adversely effect peregrine falcons, bald eagles or northern spotted owls. Oregon chub do not occur in the project area and the proposed actions would have no effect on this species. Bull trout are present in the McKenzie River system. Construction related impacts may adversely effect bull trout; ultimately, the post-construction stream temperature improvements may beneficially effect bull trout.

If you have any questions, or need further information concerning this proposal, please contact Geoff Dorsey of my staff at 326-6481.

Sincerely,

Robert E. Willis
Chief, Resource Protection and
Fish and Wildlife Section

Enclosure

CF:
Karen Bahus CENPP-PE-PF
Lynne Hamilton CENPP-PE-RPE
Jim Athearn CENPD-PE-ER

BIOLOGICAL ASSESSMENT

BALD EAGLES, NORTHERN SPOTTED OWLS, PEREGRINE FALCONS,

OREGON CHUB AND BULL TROUT

WILLAMETTE TEMPERATURE CONTROL PROJECT

COUGAR AND BLUE RIVER PROJECTS

PROJECT DESCRIPTION

The Willamette Temperature Control Project will entail the construction of multi-level, ported intake towers at Blue River and Cougar Projects. Blue River Project is located on the Blue River just upstream from its confluence with the McKenzie River (Figure 1). Cougar Project is located on the South Fork McKenzie River (Figure 1). The towers will be used to regulate temperature of water released from Blue River and Cougar Reservoirs. The objective of temperature regulation is to better mimic pre-project stream temperatures and thereby improve stream productivity for spring chinook salmon, rainbow trout, bull trout and other aquatic species.

Construction activities at Blue River Project will occur in portions of [redacted]. Construction activities at Cougar Project will occur in portions of [redacted] and [redacted]. Construction actions are not concurrent. Temperature control facilities will be completed at one project prior to initiation at the other. The projects will continue to operate for flood control purposes during the construction period. Thus, construction site flooding during the flood control season limits the construction season from about June through October, depending on rainfall, and may extend the construction period to four years for each project.

The reservoir under construction will be operated as run-of-river, with inflow equal to outflow. This operational scenario is necessitated by the need to draw the reservoirs down for construction of the towers. Cougar Reservoir will be drawn down to elevation 1,350; Blue River will be drawn down to elevation 1,132 feet. Residual minimum pools will be maintained at these elevation to eliminate sediment transport out of the reservoirs, reduce turbidity in the water released from the projects during construction, and provide refuge habitat for resident fish in the reservoirs.

Construction actions will cease each fall with the advent of flood control operations. Cougar Lake is currently operated for

flood control purposes at a minimum flood control pool elevation of 1,532 feet. During construction at Cougar, the project will be operated to a lower pool elevation during the winter season (1,350 feet). Cougar Lake is in [redacted]

Blue River Lake will be operated during the winter season to 1,180 feet (the same as minimum flood control pool). Blue River Lake is in [redacted] and [redacted]. The portion of Blue River that would be affected by the project is in [redacted].

During construction of the Cougar and Blue River Lake temperature control facilities, there may be times in August and September when the flows in the South Fork will fall below minimum flows of 300 cfs and the Blue River below minimum flows of 50 cfs. The South Fork McKenzie River is located in T16S, R4E and R5E. We are currently investigating whether these flow deficits, due to a lack of storage during construction, could be offset by special regulation of releases from the project not under construction.

For the mainstem McKenzie near Vida, summer flows will be reduced by about 10 to 20 percent out of the 2,500 to 3,000 cfs currently available in the summer months. These reduced flows are associated with construction actions at each project.

Construction actions will include blasting to open the old outlet tunnel at Cougar. All blasting will occur in the immediate vicinity of the dam. Blasting is tentatively planned to occur in May 1999, March 2000 and July - September 2000. Blasting will be used to remove approximately 1,800 cy of material. This construction activity would occur at the base of the existing dam. The initial shot would be subterranean in nature and would be used to open a plug in the old diversion tunnel. Subsequent efforts would be surface shots for rock excavation and removal of the trash rack. Surface blasting efforts would occur in the bottom of a basin at the base of Cougar Dam (forebay side). The dam and banklines form steep walls on the north, west and south side of this basin; the basin opens to the east into the forebay of Cougar Reservoir. Elevation of the blasting is 1,290 feet and less as excavation proceeds; top of dam is at elevation 1705 feet.

No blasting will occur for the intake tower at Blue River; removal of concrete at this structure can be accomplished by mechanical means. The majority of construction actions will occur within the existing pool boundaries at these projects.

PEREGRINE FALCONS

Two peregrine falcon aeries occur in the general project area with Cougar Project being the closest project to either aerie. The [redacted] pair is nearest the project and is [redacted] miles distant from Cougar Dam with numerous intervening mountains and ridgelines between the aerie and project location. The [redacted] location is even further distant. The exact location of these aeries is not provided in the biological assessment because of the sensitive nature of the information. If township, range and section information for these aeries is not held by the U.S. Fish and Wildlife Service, it can be obtained by contacting Geoff Dorsey at Portland District (503-326-6481) or Martin Nugent, Oregon Department of Fish and Wildlife (503-229-5454; x461). The distance from the projects to the aeries and the present of intervening mountains and ridges precludes impacts associated with blasting at the structures.

Peregrine falcons may occasionally forage in the project vicinity. This species has the ability to forage over an expansive area. The areal impact of the proposed projects is minor compared to the extensive area over which peregrine falcons could forage near Cougar and Blue River Projects. Cougar Lake, the nearest project to the aeries, does not support substantial populations of waterfowl or shorebirds. Operation of the projects for flood control purposes negates establishment of wetlands which would attract waterfowl. Falcons present in the Cascades are probably dependent upon the avifauna of forested habitats rather than waterfowl and shorebirds. Summer drawdown of the reservoirs to facilitate project construction is not expected to impact the prey base available for peregrine falcons.

Conclusion: Few peregrine prey species and individuals are associated with these projects. The areal extent associated with project-related construction is minor compared to the area within a peregrines foraging range. We conclude that the proposed action is not likely to adversely affect peregrine falcons.

BALD EAGLE

We have reviewed Isaacs and Anthony (1994) to determine if nesting bald eagles occur in the vicinity of either Cougar or Blue River Projects. Their records indicate that no nesting pairs occur at either project. Records of the Midwinter Eagle Counts maintained by the Oregon Eagle Foundation (Unpub. memo, 1994) demonstrate minimal occurrence by wintering bald eagles in

the McKenzie River Drainage. One wintering bald eagle was recorded along the upper McKenzie River in 1989 and again in 1994; no eagles were recorded for other years for the count period of 1988 through 1994. One to four eagles were recorded wintering along the lower McKenzie River for the period 1990 through 1994. The project area is in the upper McKenzie River drainage.

Drawdown of each pool for four years during the separate and consecutive construction periods will reduce the number of fish present in each reservoir. Trout stocking at these projects is not expected to occur during construction. Many of the trout previously stocked were harvested by anglers. A residual population of stocked and wild trout will remain in the reservoirs during the construction period. The lack of resident bald eagles and the very minimal occurrence of wintering bald eagles in the McKenzie River system is an indication that construction-related impacts to the fisheries prey base will have virtually no effect on bald eagles. Project-related impacts to other potential prey resources such as waterfowl will also be minimal. Project operations during the construction period winters will be comparable to present winter time operations for flood control purposes.

Conclusion: The proposed action is not likely to adversely effect bald eagles.

Literature Cited:

Isaacs, F. B. and R. G. Anthony. 1993. Bald eagle nesting locations and history of use in Oregon 1971 through 1993. Oreg. Coop. Wildl. Res. Unit, Oreg. State Univ., Corvallis. 14pp, 5 tables, 1 figure.

NORTHERN SPOTTED OWLS

Construction actions will not result in the reduction of old growth forested habitat for northern spotted owls. Construction actions will primarily occur within the existing pools at each project; the pools would be drawn down for construction purposes. At Blue River, a 1.4 acre site immediately downstream of the dam would be used for construction equipment staging/storage and other construction related needs. A 5.7 acre construction laydown area would be used at Cougar Reservoir; the site (Strube Flats) is the same area used for construction equipment when Cougar Dam was constructed. Vegetation at the construction laydown areas is primarily grasses, forbs and shrubs. A few trees may be present. Drawdowns at each project during the

construction period will have no effect on forested habitats abutting each reservoir. Nor are higher instream flows below the projects considered to have an impact on forested areas potentially inhabited by northern spotted owls.

The USFWS listing letter of August 23, 1994 (ref. 1-7-94-SP-412) indicated that northern spotted owls occurred near Blue River Dam in [redacted]. Sections [redacted] and [redacted] are greater than 1.5 miles distant from the structure. No impacts to owls in Sections [redacted] and [redacted] are anticipated from project construction and operation. Blue River Dam is located in Section [redacted] which is also is an identified area for northern spotted owls. Implementation of construction means other than blasting to remove concrete from the existing intake tower at Blue River will negate any potential for project associated impacts to northern spotted owls.

Given that no blasting will occur at Blue River Dam and that construction activities will not occur in owl habitat, no impacts to the species would be anticipated from project construction and operation.

Three spotted owl activity areas were noted in the USFWS listing letter for the area near Cougar Dam. One activity area was identified for [redacted]. The nearest edge of Section [redacted] is greater than 1.5 miles distant from Cougar Dam. [redacted] Mountain and other intervening high ridges effectively screen blasting noise from this activity area.

Spotted owls occurring in Section [redacted] are a minimum of [redacted] miles from the construction area at Cougar Dam. Blasting associated noise appears to be the only issue of potential concern for these owls. As noted in the project description, blasting for foundation rock excavation will occur in the bottom of a deep basin at the base of Cougar Dam. The initial subterranean blast to open the old diversion tunnel is not considered an issue of concern because of the blast's depth underground. Blast noise from foundation rock excavation will be directed primarily upward and eastward by existing landforms and Cougar Dam. Some blast noise would be expected to travel up the [redacted] which lies west and immediately upstream of Cougar Dam. [redacted] would tend to direct blast noise [redacted] away from Section [redacted]. The edge of Section [redacted], which includes an activity area for northern spotted owls is upslope of both [redacted] and the [redacted]. The slope from the construction area (elevation 1290') to the east edge of Section [redacted] (elevation 2,400 to 2,800 feet) rises steeply and is forested. Trees present in [redacted] drainage and on the slopes adjacent to the construction area will further attenuate blast noise.

Northern spotted owls occurring in [redacted] are greater than one mile distant from the blasting/construction area for Cougar Dam water control structure. The landform slopes steeply to a maximum elevation of 3,000 feet on the western edge of Section 33. The area is forested. Distance and the forested nature of the area are expected to attenuate blast noise.

Conclusion: We have concluded that the proposed action is not likely to adversely effect northern spotted owls.

OREGON CHUB

Oregon chub (*Oregonicthys crameri*) are indigenous to the Willamette Valley of Western Oregon and were listed as an Endangered Species under the Endangered Species Act on November 17, 1993. The chub is a small member of the minnow family that was once distributed throughout the Willamette River system in off-channel habitats such as beaver ponds, oxbows, backwater sloughs, and flooded marshes.

The Oregon chub prefers shallow sloughs and slackwaters once common along the Willamette River and its tributaries. Chub habitat includes shallow (generally less than 2 meters) water with abundant vegetation and cover. Substrate is usually sediment with a high percentage of fines. Adults average approximately 50 mm in length and feed mainly in the water column on insect larvae. Spawning generally occurs during late spring throughout the summer. Water temperatures during spawning range from 16 - 20C and spawning activity appears to be greatest during midday (Markle et al. 1991). Fecundity ranges from 145 to 670 eggs per female, and it is thought that females may spawn more than once during the spawning season. Throughout the life history, Oregon chub (as most minnows) appear to feed primarily on plankton, but also prey on insect larvae within the water column.

Oregon chub populations are now restricted to approximately 15 miles along the middle fork of the Willamette river, with most populations being found in or around Dexter and Lookout Point Reservoirs. No populations have been identified in the McKenzie River system. The low water temperatures of the McKenzie River have probably precluded this species from inhabiating the system. The Oregon chub does not occur in the project area (or areas affected by the project).

Conclusion: We have concluded that the proposed action will have no effect to Oregon chubs.

Literature Cited:

Markle, D. F., T. N. Pearsons, and D. T. Bills. 1991. Natural history of **Oregonicthys** (Pisces:Cyprinidae), with a description of a new species from the Umpqua River of Oregon. Copeia 1991(2):227-293.

BULL TROUT

Bull trout are known to be present in Cougar Reservoir. They do not occur in Blue River Reservoir.

Bull trout populations in the South Fork and mainstem Mckenzie River are expected to respond positively to proposed temperature changes post-construction. Improved food supplies and growth conditions for resident trout, and improved fry survival for chinook fry, would mean improved food sources for adult bull trout, which are known to prey on these fish. There may also be more exchange of adult bull trout between the South Fork and mainstem populations as habitat conditions (temperature ranges) become more favorable in the South Fork downstream of Cougar Dam. Bull trout recruitment may be improved in the South Fork and mainstem McKenzie with temperature control structures inplace and the ability to mimic pre-project stream temperatures.

It is unknown if the specialized habitat conditions for spawning or fry and juvenile rearing for bull trout exist in the South Fork. If they do, then temperature changes associated with the project will favor their use by bull trout, compared to existing conditions. For the period of September through November, which includes adult migration, spawning, and early egg incubation, temperatures are reduced by 5 to 12°F with the project inplace. These temperatures are within the range of suitable temperatures for those life stages.

Cougar Reservoir will be drawn down during construction of the proposed project. This drawdown will reduce the amount of available habitat for use by the reservoir population of bull trout. It is anticipated that there may be a potential for loss of some bull trout within Cougar Reservoir. Bull trout within Cougar Reservoir may survive in the residual pool held behind Cougar Dam during the construction period or move upstream into the South Fork McKenzie River. Some fish are expected to pass through the project during drawdown. It is expected that construction period impact will be temporary and the pool will still be large enough to maintain the population in the reservoir.

Conclusion: There is a potential for a temporary impact to bull trout populations in Cougar Reservoir during construction. However, there will be an overall and long term beneficial effect to bull trout due to improved temperature conditions in the McKenzie River system downstream of Cougar Project due to the project. Construction related impacts may adversely effect bull trout; post-construction stream temperature improvements may beneficially effect bull trout populations in the South Fork and mainstem McKenzie Rivers.

United States Department of Agriculture | Forest Service | Willamette NF Supervisor's Office | 211 East 7th Avenue
Eugene, OR 97401
FAX 503-465-6717
Contact 503-465-6494

Reply To: 2350
Date: September 29, 1994

Karen L. Bahus
U.S. Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, OR 97208-2946

Dear Ms. Bahus:

This is to follow up previous written correspondence and meetings between our agencies concerning the Corps' proposal to install temperature control structures in Cougar and Blue River reservoirs. To date, we have discussed the need to address a number of issues in the environmental impact statement (EIS) being prepared by the Corps. Among them is our concern for protection of river-related values in the South Fork McKenzie and Blue River, both of which were designated Wild and Scenic "Study" rivers by Congress in 1988.

My purpose for writing this letter is to inform you of Section 7(b) of the Wild and Scenic Rivers Act, which directs that for developments below or above a congressionally-authorized study river (or on streams tributary thereto), in which there is federal assistance, the administering agency is responsible to determine if the project "will invade the area or diminish the scenic, recreational, and fish and wildlife values present in the area on the date of designation of a river for study..."

The Forest Service's preference is to make a preliminary Section 7 determination based on the alternatives presented in the draft environmental analysis, reserving the right to revise the determination upon completion of the final EIS. Our determination, to be completed between the draft and final EIS, will provide timely information to the Corps of Engineers, particularly if the Forest Service recommends measures to eliminate adverse effects. We believe that through this process the possibility of an unfavorable Section 7 determination at authorization or request to construct will be avoided.

The preliminary Section 7 evaluation will be prepared by the Willamette National Forest; the final determination will be made by the Regional Forester of the Pacific Northwest Region.

In our July 11 letter, we requested the Corps address a number of issues, including the effects of the project on fish, wildlife, recreation, and potential Wild and Scenic River values. The letter did not, however, point out specific concerns related to the Section 7(b) evaluation. Here are some specific issues that should be considered and analyzed in the EIS to aid the Forest Service in making a determination. Analysis should be in the context of change between the existing situation and that proposed under an alternative.

Ms. Karen Bahus 2

I. South Fork McKenzie:

1) *Fish*: Will sediment diminish fish habitat and populations long term? Specifically, what is the expected number of days the water quality below the dam will be reduced by sediment (turbidity that exceeds 15 NTU)?

How much sediment is stored behind the dam (cubic yards)? How much stored sediment will pass through the dam to the lower section of the South Fork? What is the time frame in which it will occur and for how long? How long will it be retained in the lower section?

We are concerned about the loss of fish from the reservoir. What will be done to prevent fish from leaving the reservoir during and after drawdown? What kind of modification of the outlet will be done to prevent damage to fish?

Will there be a fish trap in place below the dam to facilitate movement of fish into the reservoir for a number of years following completion of the project?

Temperature: What is the expected weekly maximum water temperature at the outlet throughout the project?

2) *Wildlife*: Analyze the effects of noise and construction activity on Bald Eagle and Northern Spotted owl nesting (blasting, etc.).

What is the total time of reservoir draw-down? Analyze the effect of pool reduction on Bald Eagle foraging habitat (during and after draw-down).

3) *Recreation*: What effect will water turbidity below the dam have on recreation? Specifically, address the timing and duration that water turbidity will affect anglers.

How will construction activities affect recreation traffic, primarily during the summer? What measures will be taken to insure public safety? How much additional traffic will be generated by construction activity?

4) *Scenery*: What effect will water turbidity have on sightseers (duration and extent of turbidity)?

II. Blue River: The Wild and Scenic River Study segment is above the reservoir; we have not identified any specific issues at this time.

As stated in the July 11 letter, Lynn Burditt, Blue River District Ranger is your primary contact. Rick Ley, also from Blue River District, is available for routine coordination, as is Steve Sorseth, Wild and Scenic Rivers coordinator in the Supervisors Office (phone 465-6494).

Thank you in advance for your assistance.

Sincerely,

DARREL L. KENOPS
Forest Supervisor

EWEB

Eugene Water & Electric Board

500 East 4th Avenue
Post Office Box 10148
Eugene, Oregon 97440-2148 **503-484-2411**

September 2, 1994

Mr. Russell Davidson
Army Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208-2946

Dear Russell:

I spoke with Steve Blair regarding some of the implications we may observe if the Corps chooses to significantly draw down the discharge level at Blue River and/or Cougar Reservoirs. As you know, we have preliminary data on these reservoirs from samples collected at the one meter depth, ten meter depth and at one meter from the bottom. In general, these samples indicate there are often fairly notable algal blooms at different sample layers in these reservoirs. These blooms can cause significant taste and odor problems to us at Hayden Bridge.

The water quality issues surrounding drawing the water from the surface of these reservoirs can be characterized by: a change in turbidity if sludge were to enter the river; dissolved oxygen demand (either biological or chemical); algal blooms and carry-over; and algal die-out which typically cause organic loading and taste and odor problems for us.

At the very least, introducing algae or silt-laden water into the McKenzie River will drive up the expense of treating the water with a corresponding impact on all rate payers in Eugene, River Road, Santa Clara, Glenwood, and the Willamette Water District. Although we can treat the river water with powdered activated carbon to reduce the amount of taste and odor problems, it is virtually impossible to remove all of the taste and odor producing compounds from the water, which makes the water quality seem poor even though it is safe by all standards that we can measure.

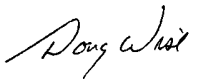
I believe the highest potential risk from changing the drawing level of the reservoirs is that additional organic loading may drive up organic precursors which, combined

with the chlorination processes we use for disinfection, could cause significant additional disinfection by-products like trihalomethanes or haloacetic acids in our finished water. If the concentrations of these compounds exceed existing or expected regulations under the Safe Drinking Water Act, EWEB would be in the position of building expensive treatment process additions to meet regulations.

One of the true benefits we've derived from the McKenzie River over the years is the clarity and contamination-free quality of this source. Plentiful, safe water has been a real boon to our community. Further evidence of our outstanding resource is accumulating as we monitor the Total Organic Carbon (TOC) and total trihalomethane formation potential in the raw water. This background information should provide a solid baseline which, in conjunction with the Watershed Management Plan, will allow us to improve the water quality over the coming years.

In summary, I believe that the proposed changes, as I understand them, could pose significant risks to EWEB's drinking water supply in terms of water quality perception, water quality treatment expense, and possible compliance with water quality regulations. For these reasons, I would request that more studies be performed before such changes are made to provide assurance that these risks can be effectively reduced, eliminated or mitigated.

Cordially,



Doug Wise
Water Supply & Treatment Supervisor
Hayden Bridge Filtration Plant
3957 Hayden Bridge Road
Springfield, OR 97477
(503) 341-8500 (Phone)
(503) 341-1881 (FAX)

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Portland Field Office
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266
(503) 231-6179 Fax: (503)-231-6195

August 23, 1994

Ref: 1-7-94-SP-412

Robert Willis
Department of the Army,
Portland District, Corps of Engineers
PO Box 2946
Portland, OR 97208-2946

Dear Mr. Willis:

This is in response to your letter, dated 26 July 1994, requesting information on listed and proposed endangered and threatened species that may be present within the area of the Blue River and Cougar Temperature Control Projects in Lane County. The U.S. Fish and Wildlife Service (Service) received your letter on 26 July 1994.

We have attached a list (Attachment A) of threatened and endangered species that may occur within the area of the Blue River and Cougar Temperature Control Projects. The list fulfills the requirement of the Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). Corps of Engineers (COE) requirements under the Act are outlined in Attachment B.

The purpose of the Act is to provide a means whereby threatened and endangered species and their ecosystems on which they depend may be conserved. Under section 7(a)(1) and 7(a)(2) of the Act and pursuant to 50 CFR 402 *et seq.*, COE is required to utilize their authorities to carry out programs which further species conservation and to determine whether projects may affect threatened and endangered species, and/or critical habitat. A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) which are major Federal actions significantly affecting the quality of the human environment as defined in NEPA (42 U.S.C. 4332 (2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to the Biological Assessment be prepared to determine whether they may affect listed and proposed species. Recommended contents of a Biological Assessment are described in Attachment B, as well as 50 CFR 401.12.

If COE determines, based on the Biological Assessment or evaluation, that threatened and endangered species and/or critical habitat may be affected by the project, COE is required to consult with the Service following the requirements of 50 CFR 402 which implement the Act.

Attachment A includes a list of candidate species under review for listing. These candidate species have no protection under the Act but are included for consideration as it is possible candidates could be listed prior to project completion. Thus, if a proposed project may affect candidate species, COE is not required to perform a Biological Assessment or evaluation or consult with the Service. However, the Service recommends addressing potential impacts to candidate species in order to prevent future conflicts. Therefore, if early evaluation of the project indicates that it is likely to adversely impact a candidate species, COE may wish to request technical assistance from this office.

Your interest in endangered species is appreciated. The Service encourages COE to investigate opportunities for incorporating conservation of threatened and endangered species into project planning processes as a means of complying with the Act. If you have questions regarding your responsibilities under the Act, please contact Laura Todd at (503) 231-6179. For questions regarding anadromous fish, please contact National Marine Fisheries Service, 911 N.E. 11th Ave., Room 620, Portland, Oregon (503) 230-5420. All correspondence should include the above referenced case number.

Sincerely,

for Russell D. Peterson
Field Supervisor

Attachments
SP 412
cc: PFO-ES
ODFW (nongame)

ATTACHMENT A

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED BLUE RIVER AND COUGAR TEMPERATURE CONTROL PROJECTS
1-7-94-SP-412

LISTED SPECIES[1,2]

Birds		
Peregrine falcon	*Falco peregrinus*	LT
Bald eagle	*Haliaeetus leucocephalus*	LT
Northern spotted owl	*Strix occidentalis caurina*	CH LT
Fish		
Oregon chub	*Oregonichthys crameri*	LE

PROPOSED SPECIES

None

CANDIDATE SPECIES[3,4]

Mammals		
White-footed vole	*Arborimus albipes*	C2
California wolverine	*Gulo gulo luteus*	C2
Pacific fisher	*Martes pennanti pacifica*	C2
Pacific western big-eared bat	*Plecotus townsendii townsendii*	C2
Birds		
Northern goshawk	*Accipiter gentilis*	C2
Harlequin duck	*Histrionicus histrionicus*	C2
Amphibians and Reptiles		
Northwestern pond turtle	*Clemmys marmorata marmorata*	C2
Northern red-legged frog	*Rana aurora aurora*	C2
Foothill yellow-legged frog	*Rana boylii*	C2
Cascades frog	*Rana cascadae*	C2
Spotted frog (western OR)	*Rana pretiosa*	C1
Fish		
Bull trout	*Salvelinus confluentus*	C1
Plants		
Tall bugbane	*Cimicifuga elata*	C2
Howell's montia	*Montia howellii*	C2

Attachment A

(LE) - Listed Endangered *(LT) - Listed Threatened* *(CH) - Critical Habitat has been designated for this species*
(PE) - Proposed Endangered *(PT) - Proposed Threatened* *(PCH) - Critical Habitat has been proposed for this species*
(S) - Suspected *(D) - Documented*

(C1)- Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(C2)- Category 2: Taxa for which existing information indicates may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

(3A)- Category 3A: Taxa for which the Service has persuasive evidence of extinction.

(3B)- Category 3B: Names that on the basis of current taxonomic understanding do not represent taxa meeting the Act's definition of "species."

(3C)- Category 3C: Taxa that have proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat.

* *If a vertebrate or plant, a single asterisk indicates taxon is possibly extinct. If an invertebrate, a single asterisk indicates a lack of information for the taxon since 1963.*

** *Consultation with National Marine Fisheries Service required.*

1/ *U. S. Department of Interior, Fish and Wildlife Service, August 23, 1993, Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 and 17.12.*

2/ *Federal Register Vol. 57, No. 10, January 15, 1992, Final Rule-Critical Habitat for the Northern Spotted Owl*

3/ *Federal Register Vol. 56, No. 225, November 21, 1991, Notice of Review-Animals*

4/ *Federal Register Vol. 58, No. 188, September 30, 1993, Notice of Review-Plants*

ATTACHMENT B

FEDERAL AGENCIES RESPONSIBILITIES UNDER SECTIONS 7(a) and (c)
OF THE ENDANGERED SPECIES ACT

SECTION 7(a) - Consultation/Conference

Requires: 1) Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2) Consultation with FWS when a Federal action may affect a listed endangered or threatened species to insure that any action authorized, funded or carried out by a Federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of Critical Habitat. The process is initiated by the Federal agency after they have determined if their action may affect (adversely or beneficially) a listed species; and

3) Conference with FWS when a Federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed Critical Habitat.

SECTION 7(c) - Biological Assessment for Major Construction Projects [1/]

Requires Federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify any proposed and/or listed species which are/is likely to be affected by a construction project. The process is initiated by a Federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, the accuracy of the species list should be informally verified with our Service. No irreversible commitment of resources is to be made during the BA process which would foreclose reasonable and prudent alternatives to protect endangered species. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct an on-site inspection of the area to be affected by the proposal which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or for potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within FWS, National Marine Fisheries Service, State conservation departments, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures and (6) prepare a report documenting the results, including a discussion of study methods used, any problems encountered, and other relevant information. The BA should conclude whether or not a listed or proposed species will be affected. Upon completion, the report should be forwarded to our Portland Office.

[1/] A construction project (or other undertaking having similar physical impacts) which is a major Federal action significantly affecting the quality of the human environment as referred to in NEPA (42 U.S.C. 4332.(2)c). On projects other than construction, it is suggested that a biological evaluation similar to the biological assessment be undertaken to conserve species influenced by the Endangered Species Act.

United States Department of Agriculture | Willamette National Forest | Blue River Ranger District
Cascade Center for Ecosystem Management
Blue River OR 97413 (503) 822-3317

Caring for the Land and Serving People

Reply To: 1500
Date: August 24, 1994

Karen L. Bahus
U.S. Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, OR 97208-2946

Dear Ms. Bahus:

I want to thank you for coordinating our visit in Portland on August 3, 1994. It was a beneficial discussion and an excellent opportunity to visit with you and other staff members about the analysis for temperature control structures in Cougar and Blue River reservoirs. It was useful to have the draft responses you had developed as a starting point for our conversation. I would appreciate receiving copies of any notes that you may have summarized for your files as a result of our meeting.

As promised, I am enclosing a copy of the Blue River Ranger District NEPA mailing list for your use on this project. This includes the names of individuals or organizations who have expressed an interest in being informed and/or involved in the environmental analysis for all activities that occur on the district. As we discussed, we continue to recommend an active public participation and involvement strategy. The lack of responses to your scoping efforts tend to reinforce that this project and the impacts of the construction phase have not been very visible to the general public at this point. Recognizing the stage of your analysis, I appreciate your offer to, at a minimum, share planning information and announcements through our mailing list as a means to get a wider awareness of the proposal to potentially affected or interested persons. It would be beneficial to further discuss a comprehensive involvement plan and we remain willing to provide input into that effort.

As followup to some of your questions: (a) I discussed the possible need for a storage area for rock with our district road maintenance coordinator. He feels there would be some possibility that we could agree upon a location. (b) I've asked the district law enforcement and recreation managers to discuss further the potential needs associated with patrols and people management which might occur. (c) We are coordinating with Jackie Diedrich regarding our responsibilities related to Section 7 of the Wild and Scenic Rivers Act. As I mentioned at the 8/3 meeting, we may not have adequate staffing or funds to respond to the expectations and timeline you described.

You had indicated that you would get back in touch with me about the information and analysis related to our discussion about sedimentation. Do you have a sense on when that might occur?

Please contact me or Rick Ley if you have questions or need further information.

LYNN BURDITT
District Ranger

United States Department of Agriculture | Forest Service | Willamette NF Supervisor's Office | 211 East 7th Avenue
Eugene, OR 97401
(PO Box 10607 97440)
FAX #503-465-6717
Contact #503-465-6494

Reply To: 1500
Date: July 11, 1994

Karen L. Bahus
U.S. Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, OR 97208-2946

Dear Ms. Bahus:

I want to thank you for your interest in hearing from the Willamette National Forest and other agencies regarding the Corps of Engineers' proposal to install temperature control structures in Cougar and Blue River reservoirs. The briefing you held for agencies in April helped us understand the purpose of the project, the environmental impact statement process and timeline, and enough details about the alternatives being considered that we can identify the issues important to the Forest Service.

Before I address our resource-related concerns, I want to encourage you to develop a public participation/information strategy that covers not only the planning process, but extends into the construction phase should the proposal move forward. Both reservoirs and the rivers flowing to and from them are surrounded by National Forest lands. Regardless of whose project it is, the Forest Service will be asked first for information about recreation facilities, river flows and water quality, all of which would be affected during construction. So the manner in which the public is informed and allowed to participate will have a great deal to do with our ability to respond later. Once a decision is made to move forward, the public and agencies that manage adjacent lands would benefit from a comprehensive plan that explains the project, its objectives, the short term effects, and long term benefits. We would be willing to provide input to that plan.

My sensing is that although some key agencies and groups are aware of the project, the general public is not informed. The process has not been very visible so far. If you have not received much input to date, I recommend you consider more outreach and publicity. I expect that given a chance, the local inhabitants would give you plenty of feedback, particularly about the construction phase. There are dozens of professional guides that owe a portion or all of their livelihood to the McKenzie River, much of it in the section below Cougar reservoir. The methods of construction and impacts could greatly affect them.

Here are some specific concerns we hope you will address as part of the environmental impact statement process.

1. MEMORANDA OF UNDERSTANDING:

a. The Forest Service and Corps of Engineers have signed a memorandum of understanding (MOU) for Blue River Dam and reservoir; the MOU for Cougar Dam and reservoir has yet to be signed. It appears that under both documents, the Willamette National Forest has virtually all the responsibility for administering lands behind the dams once draw-down is complete. This would result in our having to deal with unique management problems for about 2,800 acres, previously inundated with water. Under current funding and staffing, and the Corps of Engineers' proposed timeline, we do not have the resources or time to do the studies required by law or Forest Service direction, nor do we have people or funds to follow through with actions identified in the study phase. I recommend we come to an understanding of the agencies' roles and responsibilities and a realistic assessment of impacts to this organization.

2. RECREATION/ACCESS:

a. The long duration of the reservoir draw-down will have an effect on recreation users, mainly during the summer months. The effect will be reduced if both reservoirs are not drawn down at the same time. Two Forest Service recreation facilities are being operated by a special use permittee (Mona on Blue River, Slide Creek on Cougar); both have boat ramps that will be inoperable, which would affect their expected fee receipts. Echo picnic area, on Cougar Reservoir, also has a boat launch, the use of which will be affected.

b. Cougar Hot Springs is located across Forest Road 19 from the reservoir. Associated with its use is a considerable amount of overnight camping at the upper end of the reservoir. People will be drawn to the exposed areas that were once inundated (camping, walking, ORV use). Consider the need for safe routes for vehicles or hikers, or insure unsafe routes are adequately closed and signed. Access to some areas within the reservoirs may need to be closed because of potential resource damage or because fish may be vulnerable.

c. The sight (and possibly offensive odor) of a drawn-down reservoir during summer months may be a shock to people who do not expect it. This may be minimized by scoping and a public notification strategy (signs, etc.). Aufderheide Scenic Byway on Forest road 19 is heavily promoted by the Forest Service, and use is increasing every year. There would be many opportunities to interpret the project during and after the construction phase. The need for information and interpretation about the project should be addressed in the comprehensive plan mentioned earlier.

3. FISH/WATER QUALITY:

a. Currently, Cougar Reservoir serves as a cold water refuge for bull trout (Category 1, proposed for listing under the Endangered Species Act) as evidenced by their migration from the main South Fork into the reservoir where their presence has been documented through recreation fishing catches. The virtual elimination of the reservoir during the construction phase may affect the bull trout population and other native species, mainly due to reduced habitat (100 acres reduced from 1,280 acres), and increased temperatures caused by a lack of streamside vegetation. This temporary warming could affect the lower South Fork and main stem of the McKenzie. Consider the effect on bull trout, Chinook salmon, and other species that use the reservoir segment and segments downstream.

b. The initial flushing caused by draw-down may have drastic effects on fish. Once draw-down has occurred, fish may be trapped in isolated pools, making them vulnerable to anglers and predators, and high temperature. Mortality from these factors should be considered in project planning, and methods to alleviate mortality should be designed into the project.

c. The release of sediment caused by draw-down and during the construction phase may affect fish and other aquatic species. The timing of activities which will cause increased sediment loads should be conducted to minimize effects to spring chinook, native rainbow trout, and bull trout fry and incubating eggs. This is an important item to be monitored over time (see 5 a.).

d. Mercury used in the upper Blue River watershed hard rock mine sites may be stored in Blue River Reservoir sediment. Methods to minimize or avoid the release of mercury should be implemented and subsequently monitored.

e. The timing of draw-down should be closely coordinated with Oregon Department of Fish and Wildlife to avoid impacts on migrating, spawning, incubating, and rearing fishes (e.g. bull trout, spring chinook, native rainbow trout).

f. Sediment release from draw-down and during construction may affect municipal water systems. Involve Eugene Water and Electric Board and Springfield Utility Board early in the process.

g. If Cougar reservoir is drawn down for 3-4 years during construction, consider the establishment of juvenile fish passage. This is an opportunity to meet Northwest Power Planning, and State of Oregon objectives to provide fish passage at this site. The type of passage structure in place at Green Peter dam should be considered at Cougar dam. It does not seem reasonable to undertake this construction project and then duplicate the effort in the near future.

4. WILDLIFE:

a. The elimination of the reservoir during construction may affect wildlife species, such as amphibians that annually use the shoreline riparian areas, and migratory waterfowl that use it for resting and feeding. Osprey and Bald eagle are known to use the reservoir. Consider the short and long-term effects of the project on these and other wildlife species, particularly the Bald eagle, protected by the Endangered Species Act.

5. WILD AND SCENIC RIVER VALUES:

a. The entire South Fork McKenzie (excluding the dam and reservoir) to its confluence with the main stem McKenzie River was designated a Wild and Scenic Study river by the United States Congress in 1988. It is eligible for inclusion into the national Wild and Scenic River system, so the values for which it would be designated must be protected or enhanced. Its free flowing condition must be maintained as well. Section 7 of the Wild and Scenic Rivers Act mandates agencies to insure the values and free-flowing condition are maintained. The Corps of Engineers must consider the short and long-term effects on the "outstandingly remarkable" values identified by the Willamette National Forest in its Eligibility Determination Report. I understand you already have a copy of that document.

b. The South Fork McKenzie River has also been designated a State Scenic Waterway by the State of Oregon. Oregon State Parks and Recreation Department administers this and other Scenic Waterways. It is important to seek the State's input early in this process.

6. MONITORING:

a. The short and long-term effects of construction and the effects of the temperature control structures, once installed, must be evaluated. With the involvement of other agencies, develop a monitoring plan (including responsibilities, funding, schedule). We are particularly concerned about long-term effects on bull trout and spring Chinook populations. There are many parameters that must be considered, however.

7. CONSTRUCTION STAGING/LOGISTICS:

a. One or more staging areas will be used during construction. Consider the effects of the location, duration, and uses of the area on the environment. Are there operational needs that may affect river-related values (roads, etc.)

b. Consider the potential for exposure of existing hazardous material sites that were created during the Cougar dam construction.

c. Forest Road 19 (Aufderheide Scenic Byway) is very popular, especially during the summer when construction traffic would be greatest. A need exists to develop a traffic safety plan for all public roads. I am enclosing our 1993 traffic count data for the segment of Road 19 that passes by Cougar dam.

8. ARCHAEOLOGICAL SITES:

a. The project will expose previously inundated archaeological sites for a long duration, potentially resulting in damage and/or theft of significant archaeological resources. Per the National Historic Preservation Act (36 CFR, part 800), steps must be taken to insure surveys are conducted and known sites are protected.

9. MISCELLANEOUS:

a. The use of temperature control structures of the type being considered appears to be setting a precedent for Willamette River system reservoirs. This points up the need for good public participation for this and other projects. There is concern that by addressing temperature alone, other important issues (e.g. channel changes caused by dams) may not receive adequate attention.

b. If the project is found to be viable, it needs to move forward and , hopefully will not be hampered by possible lack of funding from local, state and federal agencies.

c. If the Blue River project is found to be feasible, consider an opportunity to coordinate draw-down and construction with Eugene Water and Electric Board's retrofit for hydropower.

d. During the draw-down of both reservoirs, consider the benefit of taking aerial photographs of the areas to help determine sediment storage that has occurred. That information might help evaluate the effects of sediment release over time.

Lynn Burditt, Blue River District Ranger, will be your primary contact for issues related to policy or commitment of Forest Service resources. She has asked Rick Ley, also at Blue River Ranger District, to facilitate information sharing or routine coordination between the District and Supervisors Office.
Please identify people in other agencies who will be working with you and share their names with us.

Thank you in advance for considering our comments and recommendations.

Sincerely,

DARREL L. KENOPS
Forest Supervisor

Enclosure

cc: Districts
EWEB
ODFW
OSP&R
SUB
RO F/WL/REC

SITE [illegible] FOREST Willamette

YEAR 1994 SUMMARY

MONTH	* ADT	WEEKEND ADT	PERCENT CLASSIFICATION COMMERCIAL TRUCKS	RECREATION VEHICLES	PASS CARS/ LT TRUCKS
JANUARY	190	214			
FEBRUARY	180	228			
MARCH	260	345			
APRIL	290	366			
MAY	370	546			
JUNE					
JULY					
AUGUST					
SEPTEMBER					
OCTOBER					
NOVEMBER					
DECEMBER					

Comments:

Report Number 2

* About 90% of this count is up & back.

PERMANENT SURVEILLANCE SITE SUMMARY

SITE 19BR FOREST Willamette

YEAR 1993 SUMMARY

MONTH	* ADT	WEEKEND ADT	ADT [Log trucks] COMMERCIAL TRUCKS	CLASSIFICATION RECREATION VEHICLES	CLASSIFICATION PASS CARS/ LT TRUCKS
JANUARY	No counts				
FEBRUARY					
MARCH					
APRIL					
MAY		—			
JUNE	489	658	13		
JULY	643	852	5		
AUGUST					
SEPTEMBER	494	648	11		
OCTOBER	377	481	16		
NOVEMBER	241	275	9		
DECEMBER	227	194	5		

July & August together

Comments:

Report Number 2

[redacted] STREET N.E., SUITE 305
SALEM, OR 97301

MARK O. HATFIELD
ONE WORLD TRADE CENTER
121 S.W. SALMON STREET, SUITE 1420
PORTLAND, OR 97204

United States Senate
WASHINGTON, DC 20510-3701

June 22, 1994

Colonel A.W. Hines
District Engineer
Army Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208

Dear Colonel Hines:

Enclosed is a copy of recent correspondence which I have received from the Co-Chairs of the McKenzie Watershed Council regarding temperature control devices on the Cougar and Blue River Reservoirs.

As you will note, the McKenzie Watershed Council supports these temperature controls, providing the cost/benefit analysis is supportive, but would like to have the local cost share for installation removed.

I would appreciate your review of and comment on the letter from the McKenzie Watershed Council.

Please respond to my Portland Office, One World Trade Center, 121 SW Salmon, Suite 1420, Portland, Oregon 97204.

With best regards.

Sincerely,

Mark O. Hatfield
United States Senator

MOH:aw

McKenzie Watershed Council

June 2, 1994

The Honorable Mark O. Hatfield
United States Senate
153 Dirksen Office Building
Washington, DC 20510

Dear Senator Hatfield:

At its May 12, 1994 meeting the McKenzie Watershed Council agreed by consensus to request assistance from you with regard to installation of temperature control devices at the Army Corps of Engineers Cougar and Blue River Reservoirs in the McKenzie Watershed.

The McKenzie Watershed Council is an advisory body established in 1993 with the purpose of helping to address management issues in the McKenzie River watershed and to provide a framework for coordination and cooperation among key interests. The mission of the 20 member council is to foster stewardship of the McKenzie River watershed resources, deal with issues in advance of resource degradation, and ensure sustainable watershed health, function and uses.

The council supports installation of temperature control devices at Cougar and Blue River if the cost benefit analysis supports moving forward and we hope that you will assist in securing the necessary funding when the time arrives.

The council is concerned however about the Corps' requirement for a 25% local cost share for installation of the temperature control devices at these two projects. This appears to be yet another barrier to mitigating what has long been recognized as a problem for fish migration in the McKenzie River- releases from the projects that result in river water temperature being too cold or too warm for fish migration.

We are seeking your assistance in removing this latest barrier to mitigating these projects. We thank you for your assistance in this matter and look forward to hearing from you in the future.

Sincerely,

George Grier
Co-chair

Louise Bilheimer
Co-chair

cc: MWC Partners

BARBARA ROBERTS
GOVERNOR

OFFICE OF THE GOVERNOR
STATE CAPITOL
SALEM, OREGON 97310-0370
TELEPHONE: (503) 378-3111
TDD (503) 378-4859

June 15, 1994

Major General Ernest J. Harrell
Division Engineer
U.S. Army Corps of Engineers
North Pacific Division
P.O. Box 2870
Portland,I OR 97208-2870

Dear General Harrell:

The State of Oregon is deeply concerned about a preliminary Corps of Engineers determination that it would require non-federal cost-sharing as a condition to construction of temperature control facilities at Cougar and Blue River dams in the McKenzie River Basin in Oregon. I frankly do not understand why the cost-sharing should be required of this project when non-federal cost-sharing has not been required in the past for salmon passage facilities at mainstem hydropower projects or similar temperature control facilities presently being installed in another federal project in the Columbia Basin.

The current situation Cougar and Blue River reservoirs results in in discharge flows with temperature profiles that increase prespawning mortality of adult spring chinook, increase fry mortality, and hamper adult spring chinook passage and timing through key locations in the watershed. Correction of these unnatural temperature profiles is vital to protect and enhance the largest remaining stock of naturally spawning chinook in the Willamette River Basin. These fish are also valuable to ocean and freshwater fisheries in the Columbia, Willamette and McKenzie rivers. The Willamette River spring chinook run is a major portion of the total spring chinook run in the Columbia Basin.

At a January 25, 1994 meeting with natural resource agencies, Portland District Corps' staff indicated that its Washington D.C. office policy will require non-federal cost-sharing for implementation of temperature control facilities at these two McKenzie River Corps projects. I do not believe this is consistent with either congressional direction or with prior Corps' policy regarding funding of mitigation projects laid out in the Northwest Power Planning Council's Columbia Basin Fish and Wildlife Program.

These fish protection measures, proposed as mitigation in the McKenzie Basin, should move forward as have other mitigation projects within the Columbia Basin. I urge the Corps to proceed with the McKenzie project without a cost-sharing requirement.

Thank you for the consideration.

Sincerely,

Barbara Roberts
Governor

cc: Sen. Mark Hatfield
Rep. Peter DeFazio
Ted Hallock, NWPPC
Angus Duncan, NWPPC
Doug Marker, NWPPC
Jill Zarnowitz, ODFW

Directorate of Planning and
Engineering

Honorable Barbara Roberts
Governor of Oregon
Salem, Oregon 97310-0370

Dear Governor Roberts:

This is an interim response to your letter of 15 June, regarding Corps policy requiring non-federal cost sharing for water temperature control facilities at Cougar and Blue River Dams.

As you are aware, the current requirement for project cost sharing is driven primarily by budgetary constraints. Such constraints have made it necessary to cost share virtually all environmental restoration projects initiated subsequent to enactment of the Water Resources Development Act of 1986.

However, we are currently in the process of reviewing the specific issues relating to cost sharing for this project, along with the reasons for proposing that this project be 100 percent Federally funded. When this policy review is completed, we will provide a further response.

Sincerely,

Bartholomew B. Bohn II
Colonel, Corps of Engineers
Deputy Division Engineer

PETER A. DeFAZIO
4TH DISTRICT, OREGON

NATURAL RESOURCES
SUBCOMMITTEE
NATIONAL PARKS, FORESTS AND PUBLIC LANDS
FISHERIES AND WILDLIFE, CONSERVATION AND THE ENVIRONMENT
OVERSIGHT AND INVESTIGATIONS

PUBLIC WORKS AND TRANSPORTATION
SUBCOMMITTEE ON AVIATION
SURFACE TRANSPORTATION

Congress of the United States
House of Representatives

PLEASE RESPOND TO:
WASHINGTON OFFICE:
☐ 1323 Longworth House Office Building
Washington, DC 20515-3704
(202) 225-6416
HOME OFFICES:
☐ 211 East 7th Avenue
Eugene, OR 97401
(503) 465-6732
TOLL FREE
1-800-944-9603
☐ 218 Sauvie Island Road
Suite 6
Coos Bay, OR 97420
(503) 269-2900
☐ 512 S.E. Jackson St.
Suite 8
P.O. Box 2440
Roseburg, OR 97470
(503) 440-3523

May 4, 1994

The Honorable Douglas Applegate
Chairman
Subcommittee on Water Resources
B-370 A Rayburn HOB
Washington, D.C. 20515

Dear Doug:

I want to call your attention to a problem with U.S. Army Corps of Engineers policy toward financing fish passage improvements on its McKenzie River Basin dams in Oregon.

The Pacific Northwest is currently struggling with the monumental task of restoring native fish runs to the Columbia, Snake and Willamette River systems. The McKenzie River, which flows into the Willamette, is a vital component of that effort.

Over a decade ago, the Northwest Power Planning Council started pushing the Corps to undertake temperature control improvements on its McKenzie River dams. The improvements were sought to improve spawning conditions for one of the last remaining native salmon runs in the region. Eleven years of study later, the Corps is still contesting an interpretation of the non-federal cost sharing requirements stipulated by the 1986 Water Resources Development Act. I've enclosed a letter from the Council outlining these concerns.

Mr. Chairman, I cannot overstate the importance of these improvements to the region. The clock is ticking for these native salmon runs and we cannot afford to keep bickering with the Corps over Byzantine concerns. If the Corps does not make significant progress on this issue in the months ahead, I fully intend to push for a legislative remedy.

Thank you very much for your consideration of this matter. I will keep you informed about any progress we make.

Sincerely,

PETER DeFAZIO
Member of Congress

enclosures

R. TED BOTTIGER
CHAIRMAN
Washington

Ken Casavant
Washington

Ted Hallock
Oregon

Angus Duncan
Oregon

NORTHWEST POWER PLANNING COUNCIL
851 S.W. SIXTH AVENUE, SUITE 1100
PORTLAND, OREGON 97204-1337

Phone: 503-222-5161
Toll Free: 1-800-222-3355
FAX: 503-795-3370

JAY L. WEBB
VICE CHAIRMAN
Idaho

Robert (Bob) Saxvik
Idaho

Stan Grace
Montana

John N. Eichart
Montana

March 15, 1994

Major General Ernest J. Harrell
Division Engineer
U.S. Army Corps of Engineers
North Pacific Division
P.O. Box 2870
Portland, Oregon 97208-2870

Dear General Harrell:

The Council is deeply concerned about a reported Corps policy to require non-federal cost-sharing as a condition to construct temperature control facilities at Cougar and Blue River dams in the McKenzie River Basin in Oregon. Operation of these federal projects produces colder than normal stream flows in the summer and warmer streamflows during the fall and early winter.

The Northwest Power Planning Council initially called for studies to evaluate adverse temperature and flow effects of federal Willamette Basin projects in its original Columbia River Basin Fish and Wildlife Program in 1982. The Council requested studies on ways to control or mitigate for project-related water temperature effects. Such measures were called for because they could greatly benefit the ability of wild spring chinook salmon to spawn and rear naturally in the watershed. Such improvement is vital for several reasons: 1) this is the largest remaining stock of naturally spawning chinook in the Willamette River Basin; 2) there is adequate spawning habitat available if more favorable temperatures can be provided; and 3) this stock of chinook is an important source of brood stock for a hatchery program in the basin.

Spring chinook are a valuable native species that contribute to ocean and freshwater fisheries in the Columbia, Willamette and McKenzie rivers. The Willamette River spring chinook run is a major portion of the total spring chinook production in the Columbia River Basin. The natural component of this run, much of which originates in the McKenzie River Basin, is only about 5-15 percent of the total run.

Unfortunately, the Corps, after taking more than 11 years to study this issue, now appears to be trying to kill this temperature control project by requiring local cost-sharing. The Council urges the Corps to reconsider this approach. As you are aware, there is a strong level of Council, constituent, resource agency and Congressional interest in temperature control improvements at Corps projects in the Willamette Basin.

At a January 25, 1994, meeting, Portland District-Corps staff indicated that its Washington, D.C. office policy will require non-federal cost-sharing for implementation of temperature control facilities at these two McKenzie River Corps projects. Moreover, since no local sponsor has been identified to date, it was implied by Corps staff that the McKenzie River Basin temperature control feasibility study may not even be completed and sent to resource agencies and the Council for review.

The Council submits that cost-sharing will be provided in this case through the Bonneville Power Administration's reimbursable portion of hydropower costs to the U.S. Treasury. That is, the region's ratepayers are already repaying roughly one-third of the cost of any fish protection facilities at the Cougar project. The Corps should consider this substantial regional commitment as satisfying its "local" cost-sharing requirement.

The Council questions whether cost-sharing should be required for these temperature control facilities for a number of reasons. First, non-federal cost-sharing has not been required in the past for salmon passage facilities at mainstem federal hydropower projects, although a large share of the cost of such facilities is reimbursed through Bonneville by the region's ratepayers. Second, similar temperature control facilities are presently being installed at Hungry Horse Dam, another federal project in the Columbia Basin, without the requirement for non-federal cost-sharing. Third, temperature control facilities were installed at the Corps' Lost Creek and Applegate dams in the Rogue River Basin in southern Oregon without the requirement for cost-sharing. Why should proposed fish protection measures at federal projects in the McKenzie Basin, which are part of the Columbia River Basin, require a different cost-sharing policy than at other federal projects in the region? This is particularly puzzling since the Council first called for studies to mitigate adverse temperature effects at these projects in 1982, well before passage of the Water Resources Development Act of 1986, which the Corps is using to justify its cost-sharing policy in this case.

The Council urges the Corps to reconsider its cost-sharing approach at these projects as soon as possible. Accordingly, the Council would like to discuss this issue further with the Corps at the Council's annual Progress Review meeting on March 30, and at the April 12-14 Council meeting in Eugene, Oregon, if necessary. Also, since so much regional effort has already gone into the McKenzie River Basin temperature control feasibility study, the Council strongly urges the

Corps to complete this study on schedule this year and submit it for regional review and comment.

The Council believes this issue must be resolved prior to the feasibility review conference on the McKenzie Basin temperature control study, presently scheduled for fall, 1994.

Sincerely,

R. Ted Bottiger
Chairman

cc: Sen. Mark Hatfield
Rep. Peter DeFazio

W:\JR\WW\COMTRHAR.DOC

Val Rapp
P.O. Box 158
Blue River, Oregon 97413

Daytime phone: (503) 822-3381 Home phone: (503) 822-3348

District Engineer
US Army Engineer District, Portland
Attn.: CENPP-PE-RPE (Kurkoski)
P.O. Box 2946
Portland, OR 97208-2946

March 20, 1993

To the district engineer,

I'm writing to comment on the scope of the draft environmental impact statement (DEIS) that will study the effects of proposed temperature control facilities at Blue River and Cougar Dams.

I strongly support the proposed facilities, and I hope the project is feasible. I believe it will benefit the McKenzie River fisheries, especially the spring chinook.

My comments on the scope of the DEIS:

- The scope should be broad enough to consider establishing spawning channels or fish passage facilities at both dams. Both dams were built without any fish passage or mitigation measures for this loss, and together Blue River and Cougar Dams cut off the spring chinook's access to many miles of prime spawning habitat. Of course, fish passage is the preferable mitigation measure. However, if passage is not economically feasible, spawning channels should be built as a mitigation for the habitat loss.
- Requirements should be established for minimum water flows below the dams during and after spawning season. I saw a pair of chinook spawning in Blue River below the dam in fall 1992, off the end of a gravel bar. A few days after they finished spawning, the water level dropped drastically, leaving their redd high and dry. The eggs probably never had a chance to hatch. Minimum flows during and after spawning season (insofar as possible, considering natural water levels) would prevent these needless losses.
- The DEIS should study the effects of the proposal on amphibians. The amphibian populations in lower Blue River, and possibly the McKenzie as well, have changed dramatically since the early 1960's, presumably because of the dams (although that is not known for sure). Long-time residents of the communities tell me there used to be lots of frogs in the river before the dam. There don't seem to be any frogs now, but there is a huge population of rough-skinned newts in and near the river.
- Finally, the DEIS should study the socio-economic effects of the project on the local community. Unemployment is high in the Blue River area, due to the loss of timber industry jobs. The proposal should look into hiring as many local workers as possible for project construction.

Thanks for the opportunity to comment on your project proposal.

Sincerely,

Val Rapp

Eugene Water & Electric Board
EWEB
500 East 4th Avenue
Post Office Box 10148
Eugene, Oregon 97440-2148 503-484-2411

RECEIVED
MAR 22 1993
Fax 503-484-2762
REG & ENV RES BR

March 18, 1993

District Engineer
U.S. Army Engineer District, Portland
Attn: CENPP-PE-RPE (Kurkoski)
P.O. Box 2946
Portland OR 97208-2946

Dear Mr. Kurkoski:

The Eugene Water & Electric Board (EWEB) appreciates the opportunity to provide input to the scope of the Environmental Impact Statement (EIS) for temperature control facilities at Blue River dam. EWEB **strongly** encourages the Corps to evaluate and construct permanent multi-level-ported, withdrawal-type facilities at the dam as soon as practical.

We expect that operation of these facilities will considerably benefit fishery resources in the McKenzie River. Within the Willamette basin, the upper McKenzie River is the best remaining area for natural production of spring chinook salmon. Restoring the natural temperature regimes to the COE dam-affected upper McKenzie should improve the chances to increase the runs of naturally-produced spring chinook. This diminishes the likelihood that this species might be listed as sensitive, threatened or endangered.

Elevation in water temperatures in the fall as the result of warm water releases from COE projects causes salmon eggs to hatch too early. As a result, EWEB's Leaburg screen must be operated in a manner to protect extremely vulnerable life stages of migrating salmon much earlier in the year than would be necessary under normal fall river temperature regimes. This means that EWEB runs Leaburg canal at 90% of its capacity for an additional 1.5 to 2 months each year.

Some of the delays experienced by adult salmon in passing EWEB's Leaburg Dam have been ascribed to low water temperatures during the normal peak of migration. Correction of the temperature problem might help stimulate adults to pass Leaburg Dam in early to mid June, perhaps rectifying this problem.

As you are aware, EWEB is proceeding with its design to retrofit Blue River dam to provide for generation. We are committed to coordinating our planning activities with the Corps to ensure that the retrofit and temperature control projects respectively proceed smoothly.

Please feel free to contact me at 341-8525 if you have any questions on this matter.

Sincerely,

Laurie Power
Environmental Manager

THOMAS E. TINSLEY, JR.
443 Riverview Boulevard
Springfield, Oregon 97477
503 / 726-9029

RECEIVED
MAR 19 1993
REG & ENV RES BR

District Engineer,
U.S. Army Engineer District
Attention: Kurkoski
P.O. Box 2946
Portland, Oregon 97208-2946

March 15, 1993

RE: Cougar & Blue River Reservoirs

"Not all dams are bad" nor "all dams created equal." Dams built on the White River, Delaware, Green, Missouri, Big Horn, and other river systems have reduced flooding, provide power, water for irrigation and in the process created exceptional tail water fisheries.

Dams do come with their share of problems. They cut off fish migration, cause dewatering, and in the case of the Yellowtail Dam on the Big Horn, cause the water to be supersaturated with nitrogen. In the case of Cougar and Blue River Reservoirs, the most significant problem is water temperature. This must be mitigated. There are other problems, however, associated with the McKenzie River water that have yet to be identified. One of them is the inadequate aquatic vegetation in the river. This may or may not be attributable to water temperature. Most tail water fisheries with constant cold flows have lush aquatic growth and relatively productive invertebrate populations that sustain a fine fishery. The McKenzie, by comparison, is relatively sterile.

The study(s) you propose should include a very detailed water, vegetative, and invertebrate analysis. What is dissolved in the water (chemicals, gasses, and ph etc.) and the subsequent relationship to vegetative and invertebrate populations needs to be established. The study area should be the water shed above and below the dams. This information will be useful for the present situation and be invaluable as base line data for the future. Be assured that balancing the water temperature is the first problem to be solved but not the last to restore the McKenzie to a viable fishery. I hope that what I am presenting is helpful to you.

I am pleased the Army Corp has chosen to take on this task so the problems associated with the dams can proceed to a solution.

Sincerely,

Thomas E. Tinsley Jr.

Thomas E. Tinsley Jr. Ph.D.

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

FEB 22 1993

Planning and Engineering Division

SUBJECT: Initiation of Environmental Impact Statement for the Willamette River Temperature Control Feasibility Study

TO ALL INTERESTED PARTIES:

Portland District, U. S. Army Corps of Engineers, is beginning preparation of an Environmental Impact Statement (EIS) as part of a study evaluating the feasibility of constructing temperature control facilities at Blue River and Cougar Dams in the McKenzie River Subbasin of the Willamette River Basin, Oregon.

The purpose of this letter is to initiate the scoping process for this EIS in accordance with the regulations of the Council on Environmental Quality (40 CFR 1501.7). This letter describes the proposal, presents a preliminary outline of the impacts to be addressed in detail in this EIS, and shows the schedule for the EIS. Comments on the scope of this EIS are invited from all interested persons and organizations.

THE PROPOSED ACTION

The proposed action to be evaluated in this feasibility study and EIS is the installation of temperature control facilities at Blue River and Cougar Projects. These facilities would allow the selective withdrawal of warm or cool water as needed from various elevations within the reservoirs to control the temperature of releases from these projects.

Blue River Lake, which began operation in 1969, is located on the Blue River at River Mile (RM) 1.7 (see enclosed map). It provides more than 89,000 acre-feet of storage. Cougar Lake is located on the South Fork of the McKenzie River at RM 4.5, and provides 219,000 acre-foot of storage. It has been in operation since 1963. Both projects provide flood control during the winter season. During the low-water season, supplemental releases furnish downstream flows for irrigation, navigation, fisheries, pollution abatement, and recreation. Power generation is included at Cougar Lake; construction of power generation facilities at Blue River Lake is planned by the Eugene Water and Electric Board (EWEB), a non-Federal entity. A license for power development by EWEB was obtained from the Federal Energy Regulatory Commission (FERC) on November 16, 1989.

PURPOSE AND NEED

The purpose of installing temperature control facilities is to provide the flexibility needed to achieve approximate pre-project water temperatures in releases from Cougar and Blue River Projects. The purpose of controlling water temperatures is to improve habitat for anadromous and resident fish species, including spring chinook salmon, rainbow trout, and bull trout in the McKenzie River downstream of the projects.

Temperature control is needed because the operation of Cougar and Blue River projects has altered the flow and temperature of the South Fork McKenzie River, Blue River, and the mainstem McKenzie River downstream from the projects. In general, when compared to preproject conditions, flows and temperatures are decreased in the spring and summer when the reservoirs are

filled and releases are made from deep in the reservoir pool, and they are increased in the late summer and fall during reservoir draw-down to flood control pool. These changes are most noted in the South Fork McKenzie and Blue Rivers, and moderated in the mainstem by flows above their confluences.

Temperature and flow changes are believed to cause delays in upstream migration of adult spring chinook. Incubation and rearing life stages of spring chinook are also of concern; accelerated incubation and premature fry emergence are associated with increased water temperatures in the fall during reservoir drawdown. Early emerging fry are presumed to be at a severe disadvantage for survival.

The feasibility study will identify specific fishery needs relating to temperature control releases at Blue River and Cougar projects and examine the ability of alternative temperature control structures to meet those needs under typical climatic and hydrologic conditions.

ALTERNATIVES TO BE CONSIDERED

At least two structural plans will be evaluated for each project. Alternative design concepts are currently being developed. The design goal of each plan will be to provide a facility which will be able to meet release temperatures recommended by fishery agencies under a range of climatic and flow conditions. Plan evaluation will consider the alternatives of both individual and joint operation of the projects for temperature control.

This feasibility study will evaluate structural rather than operational alternatives. Structural modification is needed in order to provide the capability to withdraw water from different levels within the reservoirs to achieve significant temperature control effects.

The alternative of no action will also be considered in this EIS.

TOPICS TO BE ADDRESSED IN THE EIS

The following elements of the environment will be addressed in the EIS. The existing conditions and the effects of the proposed action and alternatives for each element will be described.

Physical Environment

- Geology and Soils
  - Topography
  - Geology
  - Soils
- Hydrology
- Water Quality

Biological Environment

- Fisheries
- Vegetation
- Wildlife
- Threatened and Endangered Species

Cultural Environment

Recreation
Social and Economic Conditions
Visual Resources
Land Use
Historic and Archaeologic Resources

POTENTIALLY SIGNIFICANT EFFECTS TO BE ADDRESSED IN DETAIL

Effects of alternatives on downstream water temperatures.

Effects of alternatives on populations and habitat of spring chinook and resident fish, including rainbow trout and bull trout, a candidate for listing as an endangered species.

Temporary changes in project operations during construction of temperature control facilities, and the effects of these changes on reservoir levels, downstream flows, biological resources, and human uses of the projects and downstream areas.

EIS SCHEDULE

The Draft EIS is scheduled to be published and distributed for public review and comment in October 1994. The final EIS is scheduled for publication in April 1995.

QUESTIONS AND COMMENTS

Questions regarding the EIS can be directed to David Kurkoski, Portland District, U. S. Army Corps of Engineers, at (503) 326-6094.

Written comments on the scope of this EIS should be mailed to:

District Engineer
U. S. Army Engineer District, Portland
Attn: CENPP-PE-RPE (Kurkoski)
P.O. Box 2946
Portland, Oregon 97208-2946

Scoping comments should be received by Portland District no later than March 26, 1993.

Steven L. Stockton, P.E.
Chief, Planning and Engineering
Division

Enclosure

Reference KL:sb

March 13, 1985

Colonel Robert L. Friedenwald, District Engineer
Portland District, Corps of Engineers
P. O. Box 2946
Portland, Oregon 97208

Dear Colonel Friedenwald:

An interagency meeting was held on December 5, 1984 to discuss temperature and flow criteria for the McKenzie Basin for use in the Willamette System Temperature Control Study (WSTCS). It was decided at the meeting that the temperature ranges which had previously been presented to your agency (letter dated September 14, 1984) would be used in the study model. However, information on flows was needed to determine if the specified temperatures could be met with present reservoir operations at Cougar and Blue River Dams.

The data in Table 1 are provided for use as "sideboards" in the WSTCS model. Maximum and minimum flow ranges for fish are shown for various life cycle needs (spawning, incubation, and rearing).

Table 1. Recommended Maximum and Minimum Flow Ranges for Fish Downstream of Blue River and Cougar Dams.

	Spawning Sept 10 - Oct 10	Incubation Oct 1 - Mar 15	Rearing All Year
Cougar Damsite			
Minimum Flow (cfs)	400	400	250
Maximum Flow (cfs)	1,100		
Blue River Damsite			
Minimum Flow (cfs)			50
McKenzie River			
at Vida Gage			
Minimum Flow (cfs)	2,500	2,000	
Maximum Flow (cfs)	3,700		

The above figures represent the input and preliminary views of the Oregon Department of Fish and Wildlife, National Marine Fisheries Service and Fish and Wildlife Service. We would like to emphasize that these figures are only general flow guidelines, i.e., they do not eliminate the need for detailed instream flow studies to determine specific flow criteria for the McKenzie River.

Please keep us informed as to the WSTCS model predictions based on the flow and temperature guidelines we have provided. We trust that these data will satisfy your needs at this time for continuation and further development of the WSTCS.

Sincerely,

Oregon Department of Fish & Wildlife

National Marine Fisheries Service

U.S. Fish & Wildlife Service

RECEIVED
NPP PL-FW
F/NWR5

September 14, 1984

Colonel Robert Friedenwald
District Engineer, Portland District
Corps of Engineers
P.O. Box 2946
Portland, OR 97208

Dear Colonel Friedenwald:

Reference is made to a letter of July 23, 1984 from your Planning Division regarding the Willamette System Temperature Control Study (WSTCS) and the comments provided by National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (FWS), and Oregon Department of Fish and Wildlife (ODFW) on June 15, 1984. The referenced letter requested further definition of temperature and flow guidelines to be used by the Corps of Engineers (Corps) for modeling reservoir operations in the Willamette Basin and their effects on river systems downstream. The following are the unified recommendations of the FWS, ODFW, and NMFS.

McKenzie River Temperature Guidelines

Biologists from our respective staffs have analyzed existing available pre-Cougar and pre-Blue River temperature data (attached figures). We recommend that the Corps attempt to model the McKenzie River to achieve water temperatures that fall within the range of average monthly minimums and maximums displayed in these figures. For reference points, we have chosen Blue River at its confluence with the McKenzie, South Fork McKenzie at the Rainbow Gage, (.6 mile downstream from Cougar), and Vida gauge near Vida (RM 47.7).

It is evident that no range of temperatures is indicated in some months, especially during the winter season. We realize, however, that during the modeling process, as in nature, that temperatures will vary around the average that is displayed in these figures. We would also indicate to you that these figures are based on the very limited data that is available for pre-project conditions. We expect that as the study progresses, closer scrutiny of recent inflow temperatures to Blue River and Cougar Reservoirs will be made to compare with data displayed here. Ultimately, temperature and flow guidelines that cover a seven day period should be used rather than the present monthly interval.

McKenzie River Flow Guidelines

The Northwest Power Planning Council's Fish and Wildlife Program (Program) has a specific measure that deals with flows in the Willamette Basin [Section 704(b)(6)]. This measure directs the Corps and Bureau of Reclamation to consult with the fish and wildlife agencies on the conduct of studies to establish flow guidelines for the spawning, incubation, and rearing of salmon and steelhead in the Willamette Basin. The agencies originally recommended

that this study be done because of a lack of information on the flow requirements of anadromous fish in the Willamette River and tributaries. Because the comprehensive flow study that the agencies seek has not been completed, we have no confidence in our ability to make flow recommendations to you at this time.

For the purposes of the WSTCS, we therefore suggest that the Corps consider water temperature as the critical element in its modeling analysis of the McKenzie River sub-basin and, for the interim, let flow vary to meet the above temperature guidelines. When studies are completed in the future and data on flow requirements for fish life has been generated, we will be able to present more definite flow criteria.

Management Objectives and Cost-Benefit Analysis

Management goals for fish in the McKenzie River have not been formalized. However, preliminary short-term goals include:

A. Spring chinook: Target annual river entry of 22,500 chinook (half of target Willamette Falls passage of 45,000 chinook); 4,000 to 5,000 of these will be hatchery-produced and the residual 17,500-18,500 will be produced naturally either as the result of wild spawning or offstation release of hatchery adults and/or fingerlings. One-third of the escapement above harvest and hatchery collections will pass above Leaburg Dam. 2,500 adults will be harvested by McKenzie River anglers annually.

B. Summer steelhead: Minimum annual river entry of 6,000 adults, at least half of which will ascend Leaburg Dam.

C. Resident trout: Maintain current catch and catch rate (1983 intensive creel survey data are currently in the OSU computer). Catch is currently comprised of both wild-produced and hatchery trout. Attempt to increase the percentage of wild trout in the total population. The McKenzie River is one of Oregon's most heavily fished trout streams, and in fact, is "world famous."

On the subject of cost and benefit analysis, your letter indicates that temperature and flow criteria will be used as the basis of system modeling to determine if measures implemented will be cost effective. At the November 22, 1983 coordination meeting, it was stated by Corps staff that WSTCS results were to be applied and implemented to mitigate for Willamette Project effects that were not anticipated when the project was authorized. This work is properly termed mitigation or compensation and therefore need not be subjected to cost and benefit analysis that might be applied to an enhancement project. We concur with your staffs' earlier findings and do not approve of applying any cost and benefit criteria for work that may be proposed as a result of WSTCS findings.

We trust that this information satisfies your needs at this time for continuation of the WSTCS. When any additional data or information needs to be exchanged between our agencies we suggest that it be done in a "working group" forum composed of representatives of our respective agencies. We offer that

this will speed the process of WSTCS development and facilitate a better working relationship among our staffs. If you agree with this philosophy, please let us know.

Sincerely,

National Marine Fisheries Service

U.S. Fish and Wildlife Service

Oregon Department of Fish and Wildlife

Enclosures (3)

cc: Peterson (FWS)
Donaldson (ODFW)
Fredd (ODFW)
Korn (ODFW)
Hutchison (ODFW)
Wagner (ODFW)
NPPC

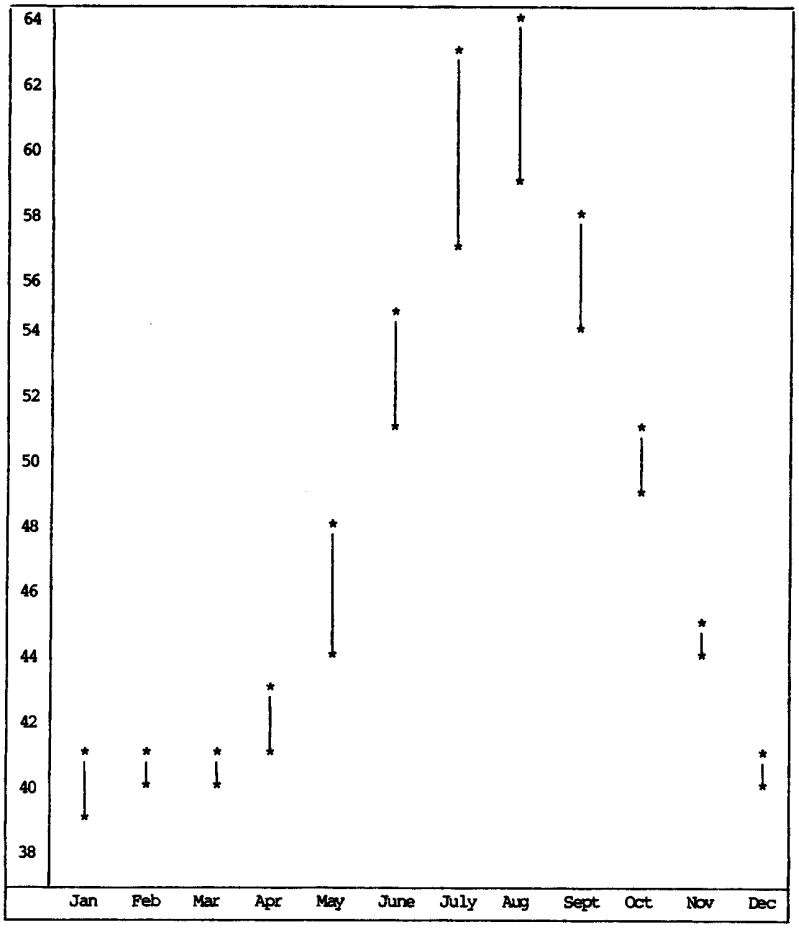


Figure 1. Blue River Below Tidbits Creek, near Town of Blue River Average Maximum and Minimum Temperatures in Degrees Fahrenheit by Month During the Period October 1963 to September 1967

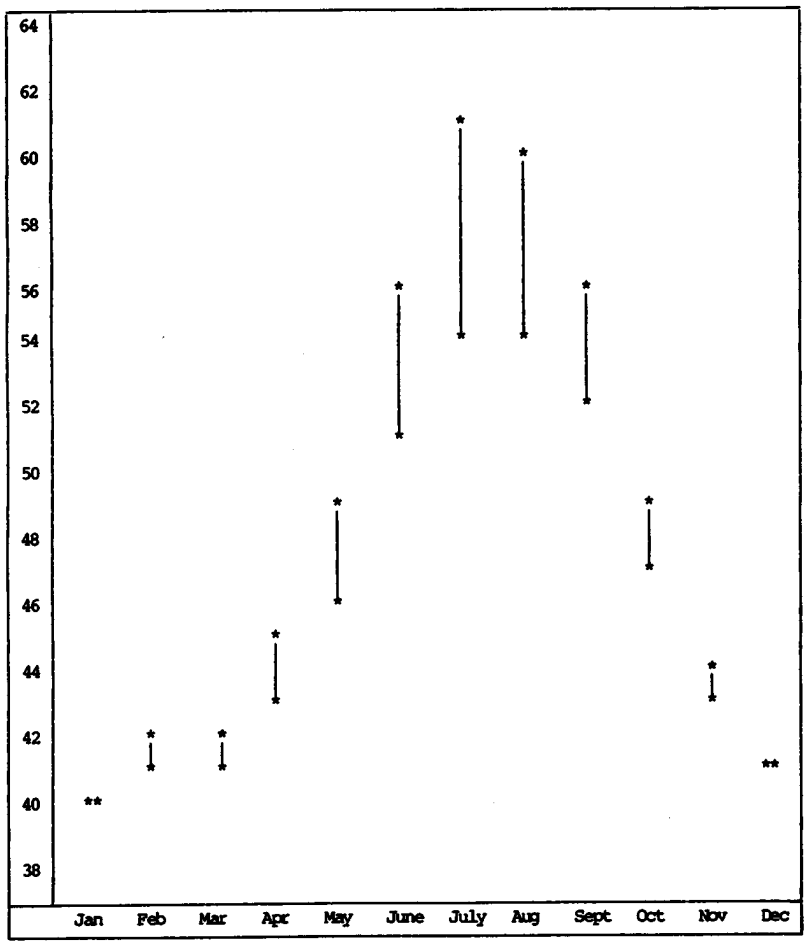


Figure 2. South Fork McKenzie River .6 mile Below Cougar Dam, Average Maximum and Average Minimum Temperatures in Degrees Fahrenheit by Month During the Period October 1955 to September 1963

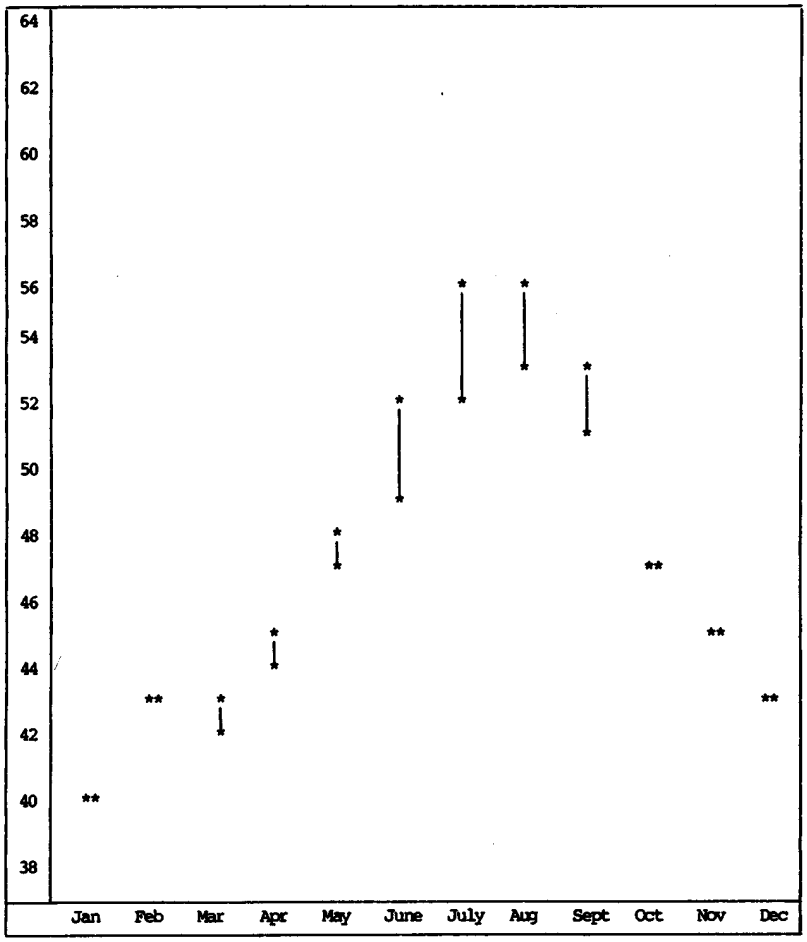


Figure 3. McKenzie River near Vida at River Mile 47.7 - Average Maximum and Average Minimum Temperatures in Degrees Fahrenheit by Month During the Period October 1961 to September 1963