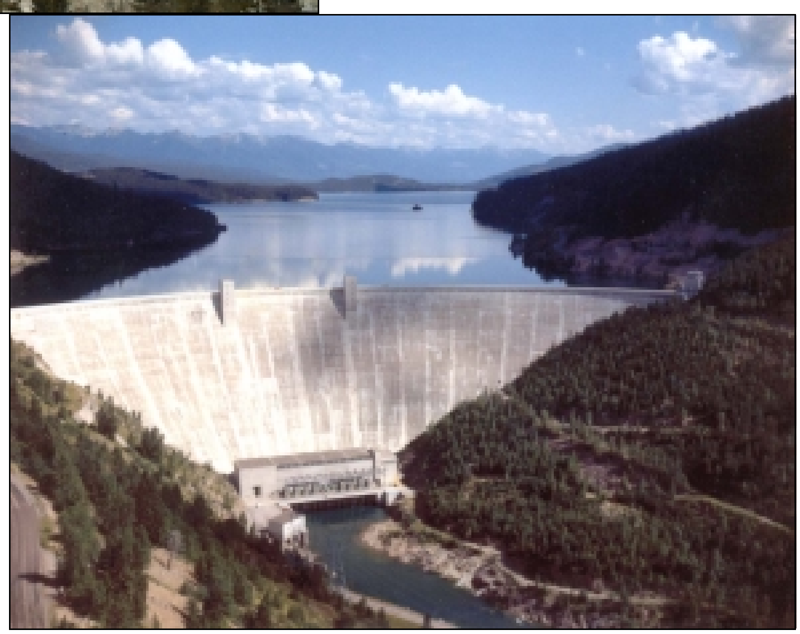
Upper Columbia Alternative Flood Control and Fish Operations Interim Implementation

Libby and Hungry Horse Dams
Montana, Idaho, and Washington

Final Environmental Assessment

December, 2002



Upper Columbia Alternative Flood Control and Fish Operations Interim Implementation Libby and Hungry Horse Dams Montana, Idaho, and Washington

Final Environmental Assessment December, 2002

Responsible Agencies: The responsible agencies for this project are the Seattle District, U.S. Army Corps of Engineers (Corps) and the Pacific Northwest Region, Bureau of Reclamation (Reclamation).

Abstract: This final environmental assessment (EA) evaluates the impacts of interim implementation of variable discharge (or VARQ, with Q representing engineering shorthand for discharge) flood control (FC) operations at Libby and Hungry Horse Dams and for the flow augmentation in the Kootenai, Flathead, and Columbia Rivers that such alternative flood control would facilitate, prior to the completion of an environmental impact statement (EIS). The EIS will enable a decision on possible long-term implementation of VARQ FC and fish flows (currently scheduled in time for the 2005 water year and fish migration season). VARQ FC and fish flows is the preferred alternative, and is intended to benefit various fish stocks listed as threatened and endangered. It is believed that endangered Kootenai River white sturgeon will benefit from increased reliability of spring spawning flows, threatened bull trout in the Kootenai and Flathead rivers will benefit from increased reliability of minimum instream flows, and listed populations of salmon and steelhead in the Columbia River will benefit from increased reliability of summer outmigration flows in the lower Columbia River. Primary effects of interim implementation of VARQ FC and fish flows include a small increase in risk of flooding for the Kootenai River and involuntary spill from Libby Dam, a possible increase in risk of agricultural groundwater seepage along the Kootenai River, benefits to recreational interests along Lake Koocanusa in most years, re-distribution of U.S. power production from winter months to the spring and summer, and reduction of power generation and revenues in Canada. Implementation of VARQ FC and the fish flows are actions the Corps and Reclamation are taking as part of "reasonable and prudent alternatives" to comply with Sections 7 and 9 of the Endangered Species Act of 1973, as amended, as detailed in the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions of December 2000 concerning operation of the Federal Columbia River Power System and associated Incidental Take Statements.

THE OFFICIAL COMMENT PERIOD ON THE DRAFT ENVIRONMENTAL ASSESSMENT OCCURRED FROM NOVEMBER 14 TO DECEMBER 14, 2002.

The draft and final environmental assessments are available online under "Upper Columbia Alternative Flood Control and Fish Operations" at:

http://www.nws.usace.army.mil/ers/doc_table.cfm

Please send questions and requests for additional information to:

Evan R. Lewis
Environmental Resources Section
U.S. Army Corps of Engineers
P.O. Box 3755
Seattle, Washington 98124-3755
evan.r.lewis@usace.army.mil *or* telephone (206) 764-6922

EXECUTIVE SUMMARY

This final environmental assessment (EA) evaluates the effects of interim implementation of operational actions at Libby Dam on the Kootenai River in Montana and Hungry Horse Dam on the South Fork Flathead River in Montana intended to provide reservoir and flow conditions that will benefit threatened and endangered anadromous and resident fish species while maintaining system flood control. This final EA considers potential effects of implementation of alternative operational actions in the interim prior to completion of an environmental impact statement on long-term implementation of variable discharge (or VARQ, with Q representing engineering shorthand for discharge, where discharge is greater than minimum flow of 4,000 cfs during May through June) flood control (FC) and fish flows. The EIS is currently scheduled for completion in late 2004.

Alternatives that are evaluated in the EA are the current operation (Standard FC) and the alternative flood control operation of VARQ FC, both with fish flows that include sturgeon discharges from Libby Dam up to 26,000 cubic feet per second. Implementation of VARQ FC with fish flows is a reasonable and prudent alternative of the 2000 FCRPS Biological Opinions issued by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service in December, 2000. Under either of the flood control operations, flows for sturgeon, bull trout, and salmon would be provided from water stored in Lake Koocanusa, also in accordance with the 2000 FCRPS Biological Opinions, as clarified in a letter to the US Fish and Wildlife Service August 23, 2002. In years when the water supply forecast at Libby is expected to be from about 80% to 120% of average, VARQ FC would not draft Lake Koocanusa as deep as Standard FC during the winter drawdown period. VARQ FC enables the operating agencies to more reliably supply flows for fish downstream of headwater projects like Libby and Hungry Horse Dams. The intent is that VARQ FC can provide higher dam discharges required for conservation and recovery of threatened and endangered species while maintaining system flood control and improving the chance of reservoir refill. In years when the seasonal runoff forecast is high (above 120% of the average volume at Libby), VARQ FC and Standard FC are roughly equivalent, with similar storage space requirements and outflows during refill. Hungry Horse Dam began interim VARQ FC implementation in 2002, based on a voluntary environmental assessment documenting the impacts of VARQ FC at Hungry Horse Dam only. Some results of the Hungry Horse evaluation for the Flathead/Clark Fork/Pend Oreille Rivers are included in the main text of this EA. However, the reader is referred to the Bureau of Reclamation's March 2002 "Voluntary Environmental Assessment and FONSI 02-02:Interim Operation of the VARQ Flood Control Plan at Hungry Horse Dam, MT" describing the effects of implementation of VARQ at Hungry Horse alone on the Flathead/Clark Fork/Pend Oreille river system. That EA did not account for combined effects of Libby and Hungry Horse operation under VARQ in the Columbia below its confluence with the Pend d'Oreille[1] River, nor did it account at all, as the EA at hand does, for effects of Libby operation on the Kootenai system. Key observations of interim implementation of VARQ FC at both Libby and Hungry Horse Dams are summarized below.

[1] Canadian spelling is Pend d'Oreille; US spelling is Pend Oreille.

Flood Control and Hydrology–

Model results indicate that VARQ FC provides a similar level of system flood protection in the lower Columbia River as compared to the Standard FC. *[See Section 5.1.2.3 on p.68]*

Daily modeling of 60 years of flood control operations only and 10 years of fish flow and flood control indicate that VARQ FC would increase the river elevations at Bonners Ferry, Idaho under most runoff conditions, including those above the flood stage of 1,764 feet (above sea level). *[See Section 0 on p.54 and Section 5.1.2.1.4.4 on p.59]*

The modeling also showed a likelihood of higher lake levels at Kootenay Lake, British Columbia. *[See Section 5.1.2.1.3.4 on p.54 and Section 5.1.2.1.4.5 on p.59]*

Although results of modeling indicate that VARQ FC increases flood risk by some increment over Standard FC, they do not account for real-time adaptive management or the other tools available to water managers. Adjustment by water managers of operations made in response to changing conditions and new information is called "adaptive management." It is a deliberate and necessary process. The hydrologic modeling performed for this EA allowed operational decisions and changed strategies only once per month during the refill season. In actual operations, water managers receive input daily and may adjust operational strategies as often as daily. For that reason, and also as a result of analysis of model sensitivity to forecasts, we believe that flood risk is not significantly increased for the Kootenai River or Kootenay Lake. *[see Section 2.4.2 on p.10, Section 5.1.2.1.1 on p.45, and Section 0 on p.65]*

VARQ FC would improve the chance of refill of Lake Koocanusa. *[See Section 5.1.2.1.4.2 on p.50, Section 5.1.2.1.4.2 on p.59, and Section 0 on p.65]*

Libby Dam outflows would generally be decreased in the winter under VARQ FC and outflows from Libby Dam would be increased in the spring. *[See Section 5.1.2.1.3.2 on p.50 and Section 5.1.2.1.4.3 on p.59]*

Natural Resources–

VARQ FC would increase the likelihood of being able to provide flows for sturgeon, bull trout, and salmon and steelhead, particularly in slightly-below-average to average water years. *[See Section 0 on p.65, Section 5.2.2 on p.78, and Section 5.2.4 on p.83]*

VARQ FC is expected to increase spawning success and larval survival of Kootenai River white sturgeon by more reliably providing water to supplement flows during the spawning period. *[See Section 5.2.4.1 on p.83]*

VARQ FC results in higher spring and summer flows in the Columbia River downstream of Chief Joseph Dam for the benefit of threatened and endangered Columbia River salmon and steelhead, but does not appear to increase the probability of meeting flow targets specified by the National Marine Fisheries Service. *[See Section 5.2.4.4 on p.86]*

VARQ FC may assist in burbot spawning in the Kootenai River due to lower January flows. *[See Section 5.2.4.5 on p.88]*

Model results indicate that VARQ FC may increase overall fish entrainment at Libby Dam due to increased possibility of an involuntary spill event. *[See Section 5.1.2.1.4.6 on p.59 and Section 5.2.2.1 on p.78]*

Compared to Standard FC, effects on resident fish in Lake Roosevelt (behind Grand Coulee Dam in Washington State) are similar under VARQ FC. *[See Section 5.2.2.3.1 on p.80]*

Water, Sediment, and Air Quality–

One of the modeling studies indicates VARQ FC slightly increases the chance that there may be periodic involuntary spill for flood control at Libby Dam. This may generate total dissolved gas levels above the current Montana State water quality standard of 110%. However, as with flood control, real-time adaptive management and variable refill timing are expected to decrease this risk, and spill is not necessarily harmful to aquatic organisms unless total dissolved gas levels exceed 120% for prolonged periods. *[See Section 5.1.3.1 on p.74]*

During the winter and early spring in the Lake Roosevelt drawdown zone, it is estimated that VARQ FC will increase the duration of exposure of sediment, some of which contains contaminants. *[See Section 5.1.4.3 on p.77]*

Cultural and Historic Resources–

VARQ FC may result in greater impacts to some cultural and historic resource sites because they may be exposed more often to erosion or freezing impacts. Some sites at Lake Koocanusa may be exposed less often and therefore experience less erosional impacts. At Hungry Horse, the number of sites affected will increase slightly according to current data. The area of greatest potential impacts is in the drawdown zone at Lake Roosevelt where at least 15% of the total number of known sites may experience greater exposure. *[See Section 5.3.1 on p.89, Section 5.3.2 on p.90, and Section 5.3.3 on p.92]*

Land Use–

Based on ten years of daily modeling of flood control and fish flows, land use in the Kootenai basin, in most cases, is not expected to be affected by VARQ FC in comparison to Standard FC. The exception would be the agricultural land in the floodplain from around Bonners Ferry, Idaho, to Kootenay Lake. In that area, the ten years of daily modeling of flood control and fish flows shows higher river elevations under VARQ FC for fish flows relative to Standard FC, which could increase groundwater seepage in the valley. *[See Section 5.4.1.1 on p.96]*

Recreation–

Most recreational interests along Lake Koocanusa would benefit under VARQ FC since the refill probability and peak elevation of the reservoir are increased. VARQ FC also increases reliability of fish flows to the benefit of resident fish stocks and fishermen on the Kootenai River, but may make the river less accessible to boating and fishing during the summer for longer periods in some years. *[See Section 5.4.4.1 on p.98]*

Power–

Hydropower modeling indicates that VARQ FC redistributes average monthly power generation for projects in the United States, with losses in January, February, and April and gains in other months, with a small (less than 0.5 percent) increase in average annual power generation. *[See Section 5.4.6.1.2 on p.101]*

Analysis by BC Hydro indicates that VARQ FC with fish flows may shift Canadian hydropower generation into lower value periods and reduce generation due to increased spill. *[See Section 5.4.6.1.2 on p.101]*

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

ABBREVIATION INDEX

AAQS: ambient air quality standards

AOP: Assured Operating Plant

BiOp: Biological Opinion

BPA: Bonneville Power Administration

CCT: Confederated Tribes of the Colville Indians

CFR: Code of Federal Regulations

cfs: cubic feet per second

CRT: Columbia River Treaty of 1964

CSKT: Confederated Salish and Kootenai Tribes

CVWMA: Creston Valley Wildlife Management Area

DOP: Detailed Operating Plan

DPS: distinct population segment

EA: environmental assessment

ESU: evolutionarily significant unit

FC: flood control

FCOP: flood control operating plan

FCRPS: Federal Columbia River Power System

FELCC: federal firm energy load carrying capability

FERC: Federal Energy Regulatory Commission

FONSI: Finding of No Significant Impact

FWCA: Fish and Wildlife Coordination Act

GBD: gas bubble disease

HGH: Hungry Horse Dam

HHAPI: Hungry Horse Archaeological Project Investigation

HPO: Historic Preservation Office

HYSSR: Hydro System Seasonal Regulation

IJC: International Joint Commission

kaf: thousand acre-feet (an acre-foot equals the volume that would cover 1 acre to a depth of 1 foot, equal to 43,560 cubic feet or 325,804 gallons)

kcfs: thousand cubic feet per second

K-M: Kuehl-Moffit (water supply forecast methodology)

LCA: Libby Coordination Agreement

maf: million acre-feet

MDEQ: Montana Department of Environmental Quality

MFWP: Montana Department of Fish, Wildlife, and Parks

msl: mean sea level

MW: megawatt

NEPA: National Environmental Policy Act

NMFS: National Marine Fisheries Service

NOI: Notice of Intent

NPPC: Northwest Power Planning Council

NWPP: Northwest Power Pool

OAHP: Office of Archaeology and Historic Preservation

PBERP: Pacific Bald Eagle Recovery Plan

PNCA: Pacific Northwest Coordination Agreement

PUD: public utility district

RFC: River Forecast Center

RM: river mile

RPA: reasonable and prudent alternative

SAIC: Science Applications International Corporation

SRD: storage reservation diagram

STI: Spokane Tribe of Indians

TDG: total dissolved gas

TMT: Technical Management Team

URC: upper rule curve

U.S.: United States

USDI: United States Department of the Interior

USFS: United States Forest Service

USFWS: United States Fish and Wildlife Service

USGS: United States Geological Survey

USC: United States Code

VARQ: variable discharge (“VAR" is short for variable and "Q" is an engineering symbol representing discharge)

W-M: Wortman-Morrow (water supply forecast methodology)

1. INTRODUCTION

In accordance with the National Environmental Policy Act (NEPA), this final environmental assessment (EA) assesses the potential effects of the proposed interim implementation of an alternative Columbia River system flood control (FC) operation, variable discharge (also called variable Q or VARQ, with Q representing engineering shorthand for discharge) FC, at Libby (Figure 1) and Hungry Horse Dams (Figure 2) on the Kootenai River and South Fork of the Flathead River, respectively, and for the flow augmentation in the Kootenai, Flathead, and Columbia Rivers that such alternative flood control would facilitate. Evaluation of an interim implementation of VARQ FC is in response to requirements in the Incidental Take[2] Statement and Reasonable and Prudent Alternative of the United States Fish and Wildlife Service (USFWS) Biological Opinion on "Effects to Listed Species from Operations of the Federal Columbia River Power System (FCRPS)," issued December 20, 2000 (USFWS 2000 FCRPS BiOp); and in the Reasonable and Prudent Alternative in the National Marine Fisheries Service (NMFS) Biological Opinion "Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin," issued on December 21, 2000 (NMFS 2000 FCRPS BiOp).

In accordance with the Endangered Species Act (ESA), the U.S. Army Corps of Engineers (Corps), U.S. Bureau of Reclamation (Reclamation) and Bonneville Power Administration (BPA) initiated Section 7 consultation by submitting a Multi-Species Biological Assessment of the Federal Columbia River Power System to NMFS and USFWS in December 1999 (BPA *et al.*, 1999). VARQ FC is a flood control operation that was a proposed action included in the 1999 Biological Assessment. VARQ FC procedures reduce the flood control draft elevations at Libby and Hungry Horse Dams in January through April. To maintain system flood control, an effect of changing Libby and Hungry Horse elevation is to operate Grand Coulee (Figure 3) at a lower elevation within its existing rule curves. The proposed alternative flood control operation ensure a higher likelihood of spring and summer refill at the upstream projects (Libby and Hungry Horse Dams), thus providing greater assurance of available water for fish flow augmentation for fish species listed as threatened or endangered under the ESA, in the Kootenai, Flathead, and Columbia rivers.

The USFWS and NMFS 2000 FCRPS BiOps contained a Reasonable and Prudent Alternative (RPA) calling for implementation of VARQ FC. The USFWS RPA 8 calls for implementation of VARQ FC for the listed Kootenai River White Sturgeon beginning water year 2001 (October 1, 2000 – September 30, 2001). (RPA 8.1.c. & d.). On January 25, 2001, the USFWS issued an amendment to the 2000 FCRPS BiOp which included an Incidental Take Statement (ITS) provision for the Kootenai River white sturgeon, 9.A.2. The ITS noted:

> *Take is likely because of many factors, including the following: (1) many of the measures contained in the RPAs cannot be initiated immediately, including VarQ… Notwithstanding the uncertainties described above, we believe that the extent and effect of incidental take*

[2] Under the Endangered Species Act, take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (USFWS and NMFS, 1998).

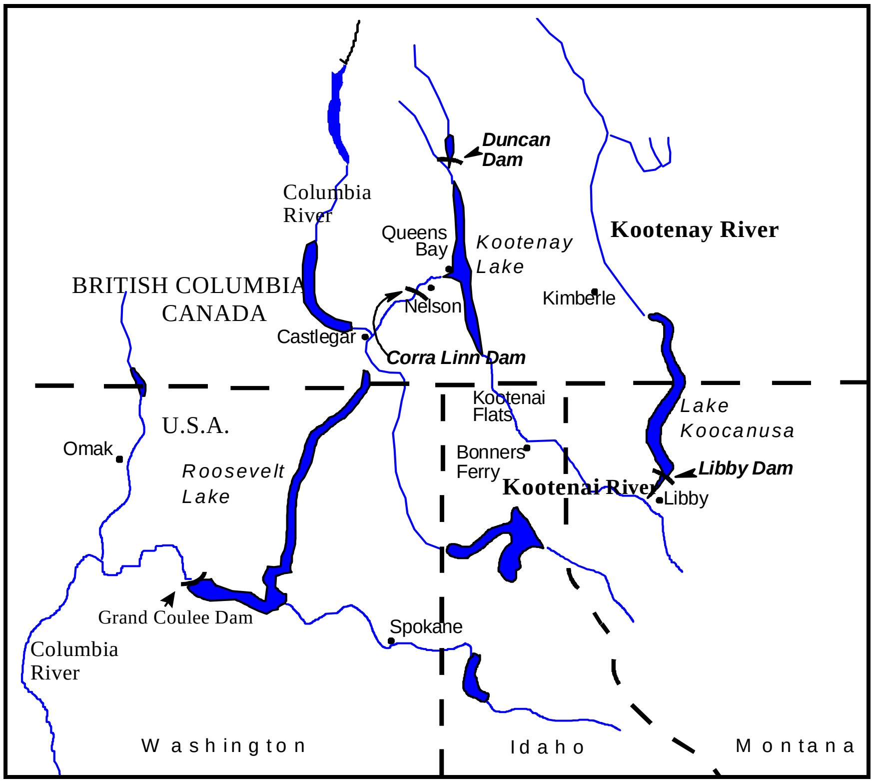


Figure 1. Libby Dam and the Kootenai River system

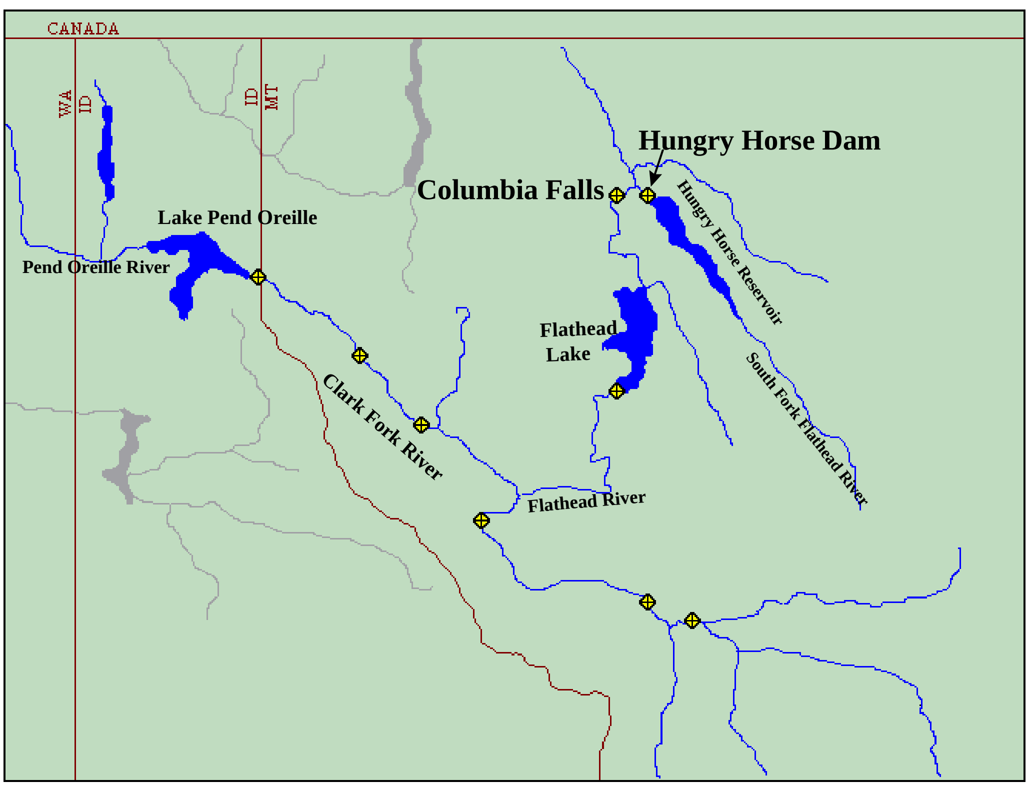


Figure 2. Hungry Horse Dam and the Flathead River system

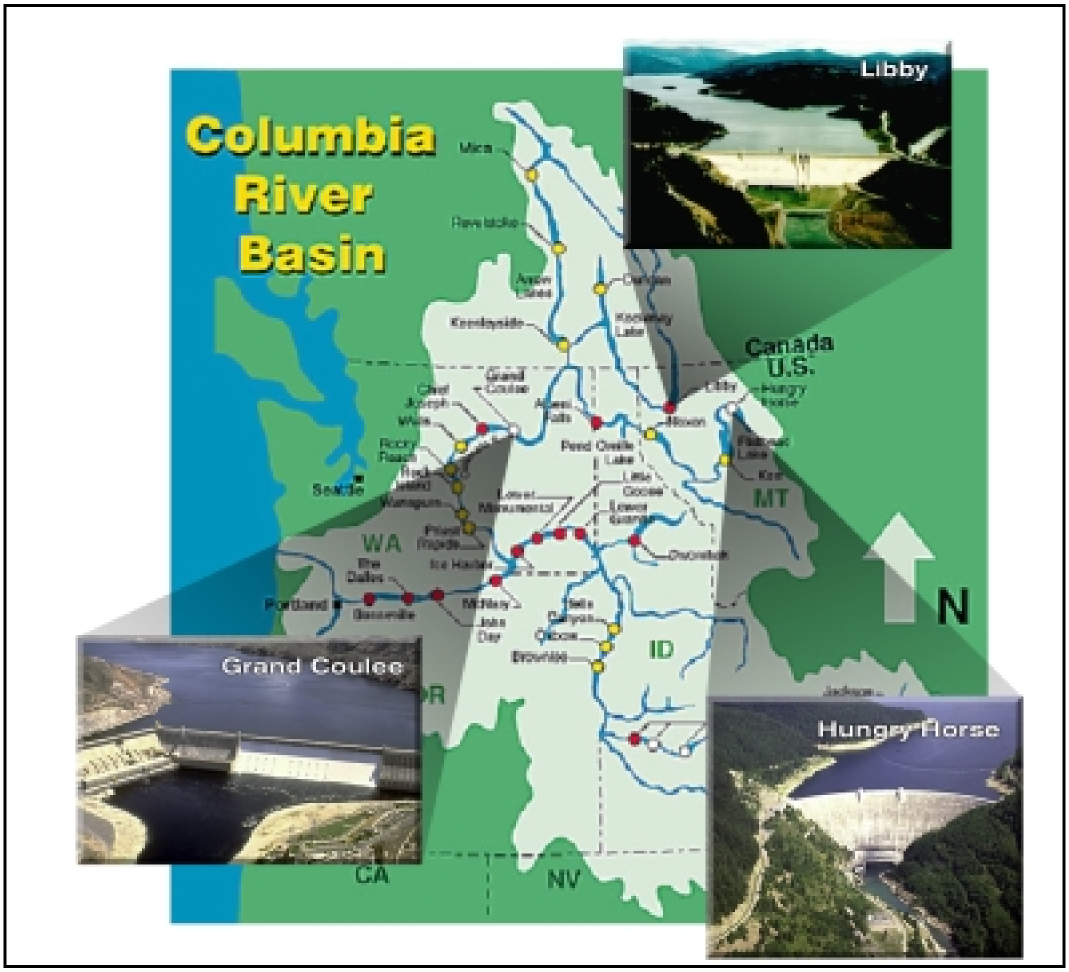


Figure 3. Map of Columbia River Basin

> *likely to occur is inversely correlated with timely implementation of the RPAs. In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or adverse modification of critical habitat when the reasonable and prudent alternatives are implemented.*

The Corps did not implement VARQ FC in accordance with the schedule in the USFWS 2000 FCRPS BiOp, however, in coordination with the USFWS and other fishery managers, the Corps has provided the flows requested by the USFWS for Kootenai sturgeon since, as well as for several years prior to the issuance of the 2000 BiOp. In a letter from the USFWS to the Corps, dated July 10, 2002, the Service stated: “If the Corps proceeds with VarQ in December 2002, the change in implementation schedule will not reduce the ability to meet the intent of the RPA contained in the FCRPS BiOp.”

The NMFS 2000 FCRPS BiOp calls for implementation of VARQ FC at Libby Dam in Action 19 and Action 22 of RPA 9.6.1.2.3 by October 2001. The NMFS BiOp requires the Action Agencies (Corps, Reclamation, and BPA) to submit an annual Progress Report. NMFS then issues a “Findings Letter,” in which NMFS assesses consistency with the BiOp and makes recommendations or adjustments as necessary. In the NMFS Findings Letter dated July 31, 2002, VARQ FC is included in the Category 3 list of Actions requiring resolution in order to meet the 2003 and future mid-point evaluations. NMFS states:

> *Recently, the Corps has informed NMFS Libby is likely to refill in July 2002, which is the NMFS objective for VarQ operation. Therefore, the schedule change for this Action will not affect this summer's fish passage flow operations. If the Corps proceeds with VarQ in December 2002, the change in schedule will not reduce the likelihood of substantially meeting expectations in 2003, 2005, and 2008…NMFS recommends that the Corps and Reclamation proceed with the amended schedule outlined above and adopt VarQ before the 2003 fish passage season.*

The Corps operates Libby Dam, and Reclamation operates Hungry Horse and Grand Coulee Dams. However the Corps is responsible to develop flood control strategies for all dams in the Northwest including Hungry Horse and Grand Coulee. This is a joint EA. During the review of the draft EA that occurred from November 14 to December 14, 2002, the Corps and Reclamation provided an opportunity for the public to comment on the potential impacts of an interim VARQ FC operation and fish flow implementation. Comments received during the comment period are addressed in Appendix C and changes are incorporated into the final EA as appropriate.

Reclamation prepared a "Voluntary Environmental Assessment and FONSI 02-02: Interim Operation of the VARQ Flood Control Plan at Hungry Horse Dam, MT," March 2002 Reclamation (2002a) to document effects of operation of Hungry Horse Dam alone under VARQ. . This document is available on the internet at:

www.pn.usbr.gov/project/salmon/pdf/VARQFONSI.pdf

This EA incorporates some of those results, but focuses on the effects of a combined Libby-Hungry Horse operation under VARQ, and on the effects of Libby VARQ operation particular to the Kootenai system.

2. BACKGROUND

The Corps and Reclamation are jointly preparing an EIS to evaluate long-term flood control and other long-term operational strategies at Libby and Hungry Horse Dams to provide recommended flows and habitat conditions for threatened and endangered anadromous and resident fish. The Corps issued an EA on September 18, 2001 announcing a decision to do an Environmental Impact Statement (EIS), in conjunction with the Bureau of Reclamation, on the effects associated with long-term implementation of VARQ FC as recommended in the USFWS and NMFS BiOp RPAs referenced above. The September 2001 EA included a list of impacts that required further analysis and that the Corps viewed as important to the decision making process for long-term implementation of VARQ FC. The Notice of Intent (NOI) to prepare the EIS was published in the Federal Register on October 1, 2000.

Scoping of issues and alternatives for the EIS analysis has been initiated. The EIS will analyze the coordinated and cumulative impacts of proposed long-term flood control operational changes at both dams as well as other operational actions at Libby and Hungry Horse Dams called for in the 2000 FCRPS BiOps. Completion of the EIS is scheduled for 2004 with possible long-term implementation of a VARQ FC operation and fish flows, or other preferred alternative, starting in 2005.

Since the issuance of the September 2001 EA, the Corps, with the assistance of others, has obtained information and conducted studies and modeling analyses that provide sufficient information on environmental effects associated with an interim VARQ FC operation, including those to listed resident and anadromous fish species, to make a decision by the end of 2002, while continuing further analyses for a long-term decision in the EIS scheduled for completion sometime late 2004.

In 2002, Reclamation concluded that interim implementation of the VARQ FC operation at Hungry Horse Dam is not a major Federal action, in and of itself, nor is it a departure from historic operational limits or operational flexibility of the dam (Reclamation, 2002a). To document the potential effects of the proposed interim or short-term implementation of the VARQ FC operation at Hungry Horse Dam, alone, Reclamation voluntarily prepared an EA (Reclamation, 2002a). Reclamation's EA did not address the potential impacts of simultaneous interim implementation of VARQ FC at both Hungry Horse and Libby Dams. In the EA at hand, the Corps and Reclamation evaluate the potential impacts of interim implementation of VARQ FC and fish operations at Hungry Horse and Libby Dams. The EA provides an evaluation of potential environmental impacts that will support decisions by late 2002 on whether to proceed with short-term interim implementation of VARQ FC and fish operations at both projects in January 2003. The interim operation would extend until the completion of the EIS and a decision on possible long-term implementation of a VARQ FC operation and fish operations (currently scheduled for late 2004).

The USFWS and NMFS have indicated that failing to implement VARQ FC at both Hungry Horse and Libby Dams prior to 2005 may result in an unanticipated take of threatened and endangered species.

2.1. Project Authority

Changes in operations at Libby and Hungry Horse Dams are part of a number of actions the Corps and Reclamation are implementing to comply with Sections 7 and 9 of the Endangered Species Act of 1973, as amended. In December 2000, the NMFS and USFWS issued FCRPS BiOps on the operation of the Federal Columbia River Power System (FCRPS). These FCRPS BiOps call for the Corps and Reclamation to undertake various actions at their 14 main FCRPS dams to assist in recovery of fish species listed under the ESA. Among these actions is implementation of the VARQ FC and specific fish flow releases at Libby and Hungry Horse Dams. The work is being carried out under the Corps' Operations and Maintenance funding authority.

2.1.1. Libby Dam Authorization

Libby Dam on the Kootenai River, Montana, was authorized for multiple purposes by Public Law 516, the Flood Control Act of 17 May 1950, 81st Congress, Second Session, in accordance with the plan set forth in House Document 531, 81st Congress, Second Session. The dam was constructed and is operated in accordance with the treaty between the United States and Canada relating to international cooperation in water resources development of the Columbia River

Basin. The reservoir created by Libby Dam was designated Lake Koocanusa (a combination of the first syllables of the words Kootenai and Canada, and initials USA) by Public Law 91-625 dated 31 December 1970. The authority for public use development is derived from the Flood Control Act of 1944, Public Law 78-534, as amended.

2.1.2. Hungry Horse Dam Authorization

Under Public Law 329, 78th Congress, Second Session, approved 5 June 1944, the Secretary of the Interior was authorized to "proceed as soon as practicable with the construction, operation, and maintenance of the proposed Hungry Horse Dam (including facilities for generating energy), to such height as may be necessary to impound not less than one million acre-feet[3] of water" and Hungry Horse Dam was subsequently constructed on the South Fork of the Flathead River in Montana. In coordination with Reclamation, the Corps of Engineers has responsibility for flood control operations at Hungry Horse Dam under Section 7 of the Flood Control Act of 1944.

2.2. Need

Flood control and hydropower operations at Libby, Hungry Horse, and Grand Coulee dams have altered the natural river hydrology of Columbia Basin. These reservoirs store the spring snowmelt runoff to control floods, and they release higher-than-natural flows in the fall and winter. Threatened and endangered fish populations in the Columbia Basin (Kootenai River white sturgeon, Columbia Basin bull trout, and several Columbia River salmon and steelhead stocks) require high spring flows, which historically were provided by snowmelt. The U.S. Fish & Wildlife Service and the National Marine Fisheries Service have recommended actions in their 2000 FCRPS BiOps for operation of the Federal Columbia River Power System, which would modify flows for the conservation and recovery of listed species. In order to help recover listed fish populations, the Corps of Engineers and Reclamation must determine alternative methods of operating Libby, Hungry Horse and Grand Coulee dams and reservoirs.

2.3. Purpose

The purpose of the proposed action is to implement, prior to the completion of an environmental impact statement on long-term implementation of VARQ FC and fish flows, interim operational actions at Libby Dam that will provide reservoir and flow conditions for threatened and endangered anadromous and resident fish.

The EIS for long-term implementation is currently scheduled for completion in late 2004 and in time for the 2005 water year and fish migration season. One of the interim actions under consideration is an interim VARQ FC operation described in Section 2.4.1. VARQ FC is a flood control operation, which provides more assurance of fish flow augmentation in May and June, improves the probability of refill, and provides for more reliable salmon flow augmentation in July and August.

2.4. Flood Control Planning Strategy in the Columbia River Basin

The objectives for the Columbia River system flood control operations are to regulate the total reservoir system to minimize flooding at potential flood-prone areas in Canada and the United

[3] An acre-foot equals the volume that would cover 1 acre to a depth of 1 foot, equal to 43,560 cubic feet or 325,804 gallons.

States, when possible; and in very large water years, to regulate flow at The Dalles, Oregon, to prevent storage reservoirs from filling too soon and causing the system to be in an uncontrolled situation. Elements of development of annual flood control strategies include development of seasonal runoff forecasts, use of storage reservation diagrams, determination of the Initial Control Flow (which determines when system refill begins), regulation of projects to avoid jeopardizing refill, if possible, and local flood control operating criteria and project operating limits (Corps, 1999a).

In the context of system flood control operations, storage reservoirs throughout the Columbia River Basin operate during January through April using guidance provided by a storage reservation diagram (SRD). A SRD shows how much water storage space is required for the current seasonal runoff forecast. In January, water supply forecasts are developed for each sub-basin and for the entire Columbia River system to The Dalles. Based on the water supply forecast, and using the SRD as guidance, the Corps will calculate the end of January through April upper storage limit at each reservoir that will provide for meeting flood control objectives at The Dalles. In February, a new water supply forecast is used to develop updated end of February through April upper storage limits. The process repeats for each month through April.

In May through June, the refill of reservoirs is guided by upper flood control elevation limits, which vary each year. The May-June upper limits are dependent upon the natural flow at The Dalles, the amount of runoff that may remain in the system, the amount of storage available in the system, and the forecast of weather conditions.

2.4.1. VARQ Flood Control

VARQ FC was first introduced as a possible alternative to the current flood control procedures (referred to as Standard FC) for Libby in the 1995 Columbia River System Operation Review (BPA *et al.*, 1995). By re-allocating some of the flood control draft upstream of Grand Coulee from January through April, VARQ FC provides equal flood protection as measured at The Dalles, Oregon, as Standard FC. Under VARQ FC, Libby and Hungry Horse may be more full at the end of April. This could result in Grand Coulee being drafted more deeply at the end of April to provide, with either VARQ FC or Standard FC, the same level of flow at The Dalles during the spring snowmelt period.

Since Libby and Hungry Horse reservoirs may be more full under a VARQ FC operation than they would have been under a Standard FC operation at the end of April, the dams release flow greater than minimum flow in May and June. The outflow that is greater than minimum flow is dependant upon the remaining expected inflow and the remaining storage to fill at the respective reservoirs. The outflow greater than minimum flow during the refill period is the origin of the name VARQ.

At Libby and Hungry Horse, a VARQ FC operation does not have any fish flow operations embedded in the operating strategy; however, VARQ FC does enable the operating agencies to more reliably supply spring flow for fish in the Kootenai and Flathead Rivers immediately downstream of headwater projects. The assumption is that VARQ FC can provide higher dam discharges required for conservation and recovery of threatened and endangered species while maintaining flood protection and improving the chance of reservoir refill. In addition to benefits to threatened and endangered fish species, discharges facilitated by VARQ FC are expected to either benefit or not adversely affect other resident fish such as rainbow trout or burbot.

Implementation of VARQ FC would be accomplished by operating Libby and Hungry Horse to storage reservations diagrams (SRD) from January through April that vary based on the water supply forecast and do not draft the reservoirs as deeply as they would otherwise under Standard FC in years with water supply forecasts between about 80% and 120% of average.[4] The current SRD for Libby and the pre-VARQ FC SRD for Hungry Horse are provided in Figure 4 and Figure 5, respectively. The VARQ FC SRD for both projects are shown in Figure 6 and Figure 7, respectively. Unlike Standard FC, which assumes the outflow during the refill period of May through July is the minimum flow requirement, VARQ FC assumes dam discharge varies during refill. Each year, the variable outflow is dependent on the seasonal volume forecast. In years where the water supply forecast at Libby is expected to be about 80% to 120% of average, the VARQ FC refill outflow may be greater than minimum flow of 4,000 cfs during the refill period of May through July. Higher releases from Libby during May and June are a result of higher elevations at the start of the refill period than would have been under the Standard FC SRD. In years where the seasonal runoff forecast is high (above 120% of the average volume at Libby), VARQ FC flood control rule curves are the same as Standard FC, with similar storage space requirements and outflows during refill.

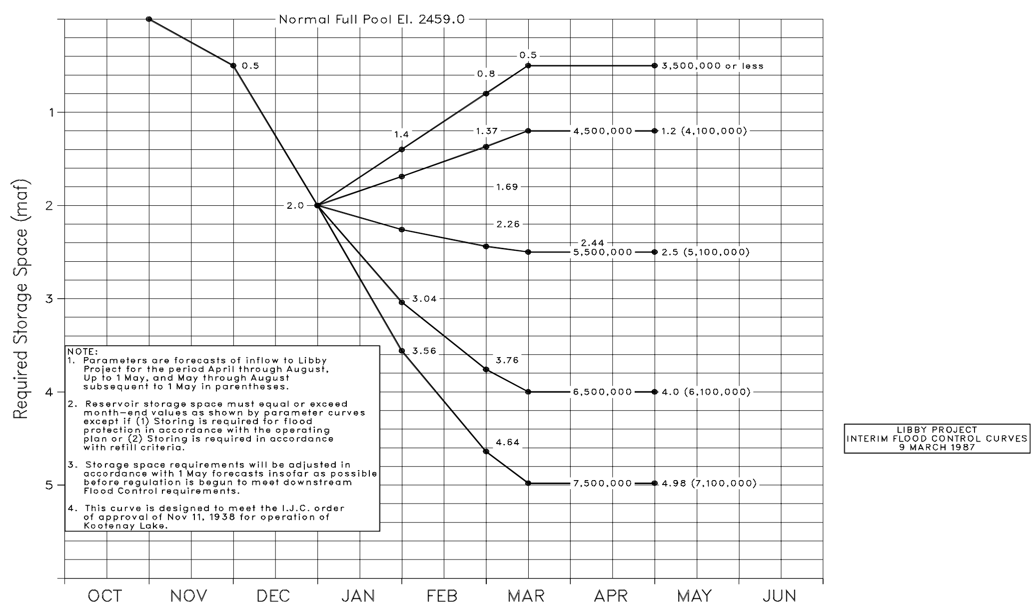


Figure 4. Standard Flood Control Storage Reservation Diagram at Libby Dam.

[4] Due to physical constraints on dam operation and volume of reservoir inflow, the flood control operations for years with water supply forecasts greater than about 120% of average or between 60 and 80% of average would be the essentially the same for both VARQ FC and Standard FC. For example, although the SRDs for VARQ FC and Standard FC are slightly different in years with water supply forecasts between 60 and 80% of average, maintaining minimum required outflows from the dam would likely result in the same end-of-month reservoir elevations under VARQ FC or Standard FC.

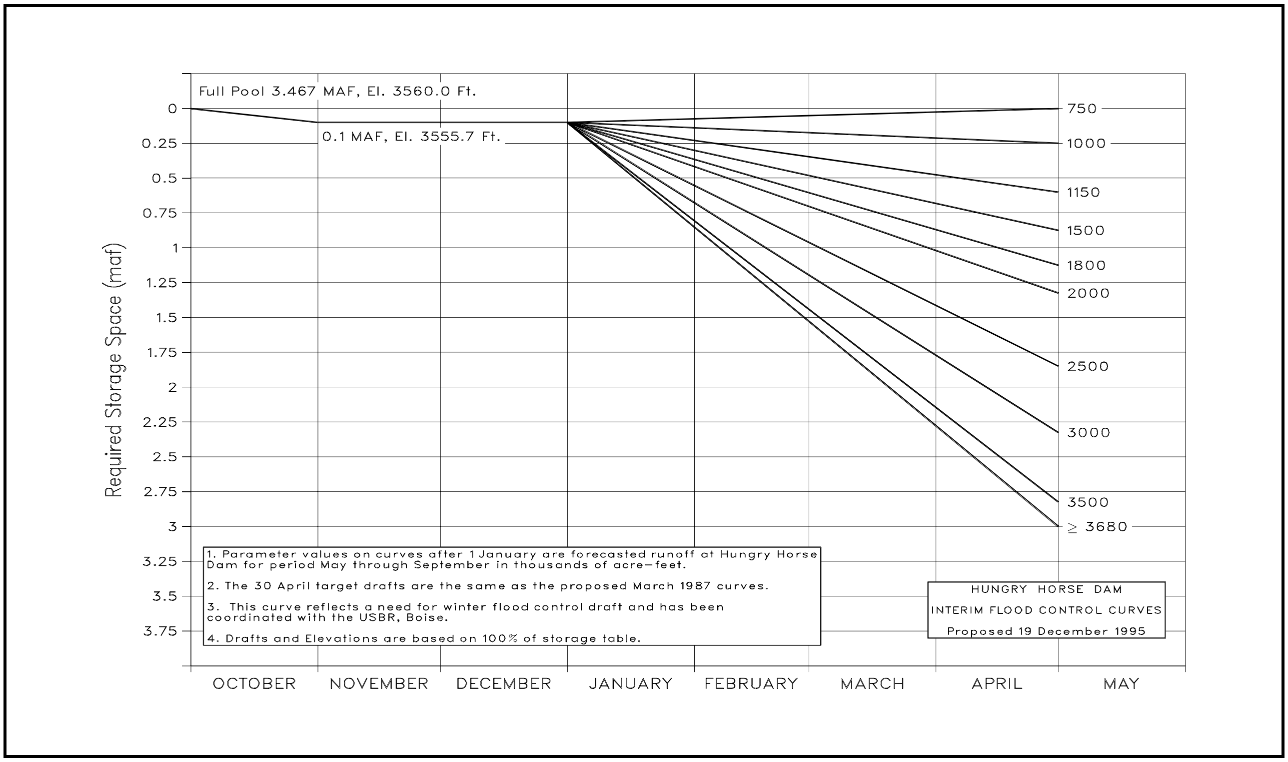


Figure 5: Pre-VARQ FC Storage Reservation Diagram, Hungry Horse Dam

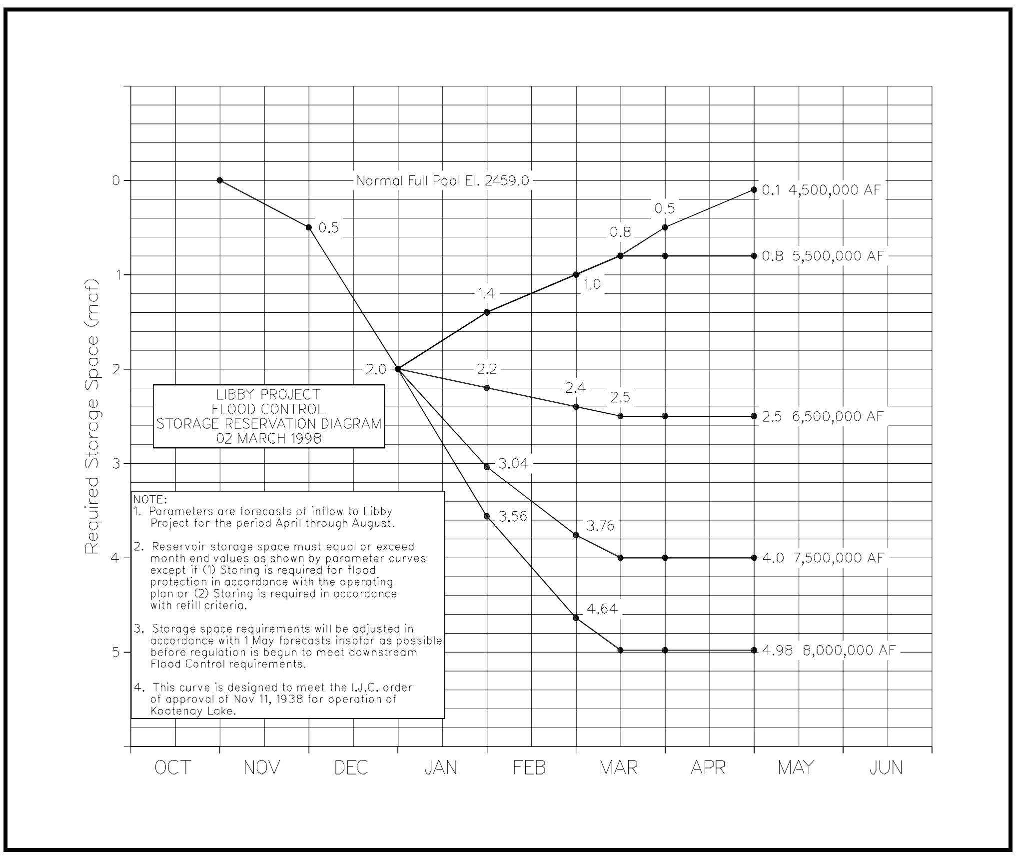


Figure 6. VARQ FC Storage Reservation Diagram at Libby Dam.

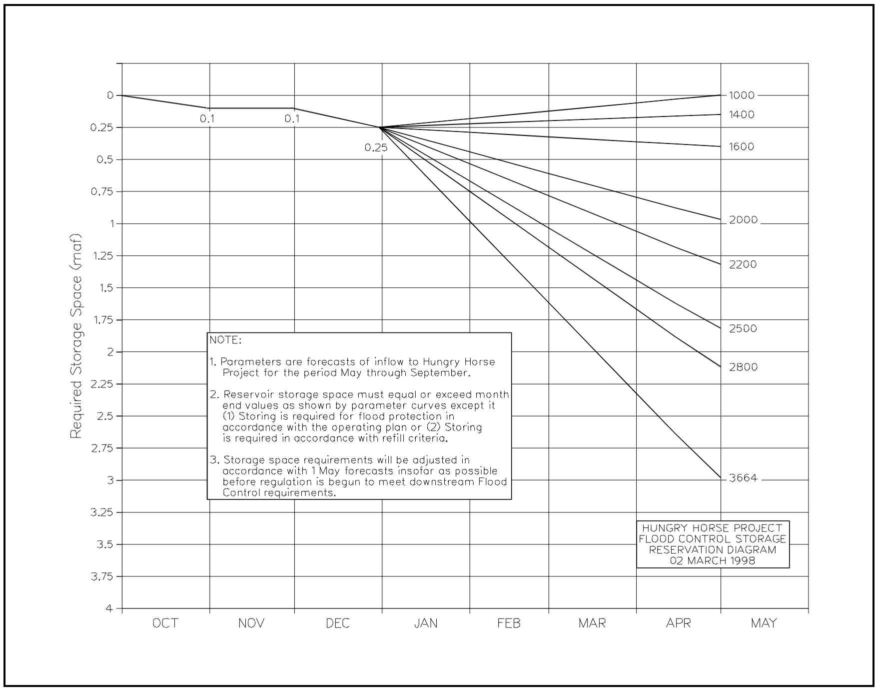


Figure 7: VARQ FC Storage Reservation Diagram, Hungry Horse Dam

2.4.2. Flood Control Operations in Real-Time

In addition to providing water storage for system flood control, water storage behind Libby and Hungry Horse Dams also provides local flood control for the river reaches closer to the projects. Each reservoir's fall and winter drawdown schedule is designed to provide space for storing both rainfall and snowmelt runoff. Storage of snowmelt runoff for system flood control provides protection for local areas as well. Operations for local flood protection occur on a real-time basis and are provided by individual project operations (see Section 5.1.2.1.1 for more discussion of real-time flood control operations).

Generally, Libby is operated to maintain flow in the Kootenai River below flood stage at Bonners Ferry, Idaho, of elevation 1764 feet.[5] Similarly Hungry Horse is operated to try to maintain the gage reading for the Flathead River at Columbia Falls, Montana, below 13 feet[6] (2977.67 feet msl) . In some cases when high volume inflow forecasts persist well into the spring season, it may be necessary to regulate dam releases in the interest of local flood control at high levels for extended periods of time. Although operators desire to maintain flow below flood stage at Bonners Ferry or Columbia Falls, there will be occasions when flood stage will be exceeded under Standard FC or VARQ FC.

Operating under either Standard FC or VARQ FC, there may be some occasions where the actual reservoir elevations may be higher than the flood control rule curve. For example, high runoff events during the winter due to rainfall or warm periods may require a dam to reduce outflows to moderate downstream river flows, resulting in an increase in reservoir elevation. After the end

[5] Unless otherwise noted, all elevations in this document are referenced to the National Geodetic Vertical Datum of 1929 (mean sea level or msl).
[6] The flood stage at the Columbia Falls gage is 14.0 feet (2987.67 feet msl), but, when possible, Reclamation regulates to 13.0 feet (2986.67 feet msl).

of the runoff event, the water that was stored during the runoff event would be released in an attempt to bring the reservoir back to the elevation defined by the flood control rule curve. In another example, the International Joint Commission (IJC) Order of 1938 requires lowering of Kootenay[7] Lake in Canada to specific upper limit elevations during the winter months of January through March. Libby Dam releases flow into Kootenay Lake. There are times from January through March when releases from Corra Linn Dam (and the natural constriction at Grohman Narrows) at the outlet of Kootenay Lake are not enough to meet the upper limit elevation. When this occurs, the outflow from Libby Dam is reduced so that Kootenay Lake will not go above the upper limit elevation. The result is that Lake Koocanusa may be above its flood control rule curve by the end of March. The Columbia River Treaty (CRT) acknowledges the operation of the storage by the United States shall be consistent with the 1938 IJC Order on Kootenay Lake.

3. EXISTING CONDITIONS

Much of the following discussion is taken from the Final Environmental Impact Statement for the Columbia River System Operation Review (BPA *et al.*, 1995). Where applicable, other references are noted.

For organizational purposes, separate discussion of Libby Dam, Hungry Horse Dam, and Columbia River sections is presented for applicable evaluation factors. The Libby and Hungry Horse Dam sections include both up- and downstream areas. For example, any discussion of the Flathead, Clark Fork, or Pend Oreille Rivers is included in the Hungry Horse Dam section. Discussion of the existing environment relating to Hungry Horse Dam is included for reference, realizing that Reclamation's 2002 voluntary EA (Reclamation, 2002a) discusses interim implementation at Hungry Horse Dam in more detail.

3.1. Physical Characteristics

The Columbia River is the fourth largest river in North America. It originates at Columbia Lake in the Rocky Mountains of British Columbia, Canada, and flows 1,214 miles to the Pacific Ocean. From its source, the river flows northwest for approximately 200 miles, then reverses course and travels south for nearly 300 miles through mountainous terrain in southeastern British Columbia. The Columbia River crosses into the U.S. near the northeastern corner of Washington State and continues south through highlands before bending westward. After looping again to the east, the river turns westward and flows for over 300 miles between Washington and Oregon to the sea.

The Columbia River basin drains over 259,000 square miles and produces an average annual runoff at The Dalles of about 134 million acre-feet. The Snake, Kootenai, and Pend Oreille-Clark Fork systems are the largest tributaries of the Columbia River.

The Kootenay River originates in British Columbia, flowing southward into northwestern Montana. Located about 40 miles south of the international boundary, Libby Dam impounds Lake Koocanusa at river mile (RM) 222. Lake Koocanusa is 90 miles long at full pool (48 miles within the U.S.) and has a useable storage capacity of 4.98 million acre-feet. At the town of Libby (RM 204), the river turns westward, then north near Troy (RM 186) and back into British

[7] The American spelling is Kootenai. The Canadian spelling is Kootenay.

Columbia at RM 106. The river enters Kootenay Lake about 25 miles north of the international boundary, draining through West Arm near Nelson, British Columbia, and into the Columbia River near Castlegar, British Columbia. The Kootenay River basin encompasses 19,300 square miles, including 8,985 square miles above Libby Dam. About 75% of the basin lies within British Columbia.

The Flathead River is a headwater tributary within the Pend Oreille River basin that originates near the continental divide in the Northern Rocky Mountains. Hungry Horse Dam is located at RM 5 of the South Fork of the Flathead River. The Middle and South Forks join the North Fork a few miles upstream of Columbia Falls, Montana. The Flathead River downstream of Columbia Falls flows through meandering channels in wide floodplain and enters Flathead Lake about 20 miles downstream of Kalispell. From Kerr Dam at the Flathead Lake outlet near Polson, Montana, the Flathead River continues southward to the Clark Fork River. The Clark Fork River flows northwesterly into Idaho and Lake Pend Oreille. The Lake Pend Oreille outlet continues west for about 40 miles, then turns north to loop into British Columbia for the last 16 miles before its confluence with the Columbia River just upstream of the international boundary. The confluence of the Pend Oreille and Columbia Rivers is about 30 miles downstream of the Kootenay confluence with the Columbia River. The Flathead River watershed covers 7,100 square miles above Kerr Dam. The larger Pend Oreille-Clark Fork drainage basin encompasses 26,000 square miles.

3.1.1. Geology

The drainage areas of the Kootenai and Flathead Rivers originate in the Northern Rocky Mountain physiographic province – an uplifted, naturally dissected, and heavily glaciated area. Topography is primarily controlled by bedrock structure modified by glacial erosion and sedimentation. The region is characterized by high, rugged, forested northwest-trending mountain ranges separated by narrow linear valleys. Elevations rise from 2000 feet in the lowest valleys to more than 10,000 feet on many of the peaks.

In northern Idaho, northwestern Washington, and southern British Columbia, the Kootenai, Pend Oreille, and Columbia River basins flow through the Columbia Mountains/Okanogan Highlands physiographic province – a complex of high, glaciated mountains to the north, and lower, semi-arid mountains and narrow plateaus to the south. The Okanogan Highlands are an area of relatively low, semi-arid mountains between the Northern Rockies and Cascade Mountains. Elevations range from about 1000 feet at the lowest point of the Columbia River to nearly 8,000 feet at some peaks in British Columbia. Grand Coulee Dam is located at the southern edge of this province. South of Grand Coulee Dam, the Columbia River flows through the Columbia Plateau/Columbia Basalt Plain, then through the Cascade Mountains, before a short section through the Willamette Lowlands before entering the Pacific Ocean.

3.1.2. Climate and Hydrology

The climate of the Kootenai and Flathead River basins is a combination of a modified west coast marine and continental climate. Summers are sometimes hot and dry and winters are cold. Mean annual precipitation averages approximately 30 inches for the basin, generally increases with increasing altitude, and varies from 14 inches in drier parts of British Columbia, to an estimated 60 inches on some of the higher mountains. Annual snowfall varies from about 40 inches in the lower valleys to an estimated 300 inches in some mountain areas. Most of the snow falls during the November-March period, but heavy snowstorms can occur as early as mid-September or as late as early May. Much of the annual runoff occurs in spring with the snowmelt. Thus, the flood control operations at Libby and Hungry Horse Dams are formulated to allow for flood storage by the end of the winter, to attempt to control excessive spring runoff

The climate in the Columbia River Basin ranges from mild maritime conditions near the river's mouth to near desert conditions in some inland valleys. The Cascade Mountains separate the coast from the interior of the basin and divide Washington and Oregon into two distinct climatic regions. The coastal climate is mild and wet. East of the Cascades, the interior climate has far greater extremes. Relatively large amounts of precipitation occur in the mountains, primarily as snowfall, and many of the higher peaks in the basin retain glaciers.

Since most of the basin hydrology is driven by snow accumulation, the Columbia River is primarily a snow-fed system. Snow accumulates in the mountains from November to March, then it melts and produces runoff during the spring and summer. Runoff and stream flows normally peak in early June. In late summer and fall, rivers recede. Typically, runoff levels are lowest in the fall and remain low until the snowmelt runoff season begins in April.

Under its current configuration and organization, hydrology in the Columbia River Basin is managed, to the extent possible, by a coordinated system designed to provide for multiple uses within the system.

3.1.2.1.1. Groundwater

In the Libby and Troy area, numerous wells and septic systems are located adjacent to the Kootenai River. There are approximately 1000 privately held parcels adjacent to the Kootenai River channel between the mouth of the Fisher River (RM 218) and the Idaho border (RM 172). Two-thirds of these parcels are currently developed. Many of the developed parcels have private drinking water wells, many of them shallower than 60 feet. Additionally, there are at least eleven active public drinking water wells flanking the Kootenai River in Montana. These systems access subsurface aquifers with an unknown degree of continuity with the river. Throughout 2002, the Corps conducted sampling during a range of flows to determine any relationship between river flow and well water quality. Results indicate that high river flows (up to a Libby Dam discharge of 40,000 cfs) are not correlated with adverse impacts to drinking water wells in the area (see Section 5.1.2.1.7).

3.1.2.2. Water Quality

3.1.2.2.1. Libby Dam

In the winter, water temperatures in Lake Koocanusa and the river generally range between 36°F (2°C) and 46°F (8°C). In the summer, Lake Koocanusa stratifies, with the shallow layers of the reservoir reaching temperatures up to 68°F (20°C). The temperature of water released by Libby Dam is controllable within a range that varies over the year in accordance with an agreement with the State of Montana. Near the dam, dissolved oxygen levels are generally ample for aquatic life and pollutant levels low. Total dissolved gas (TDG) levels in Lake Koocanusa are generally about 100% saturation. Involuntary spill from Libby Dam can happen but has generally been avoided by prudent real-time water management since spills of greater than 5,000 cfs generate TDG levels above 130% saturation in areas just downstream of the spillway's stilling basin. Kootenai Falls (RM 193) also increases TDG levels to about 116%.

Inflow from the Fisher River, with higher loads of suspended sediment and summer temperatures resulting from logging activities, road building, and past forest fires in the basin, adversely affects overall Kootenai River water quality. Historic inputs from land use in the basin have caused increases in pollutant and contaminant levels that are most apparent in the Kootenai Flats area near Bonners Ferry, Idaho. Since the 1980's, land use activities that degraded water quality in the 1960's and 1970's have been controlled and the subsequent adverse impacts decreased. However, contaminants from historic inputs persist in the system. The effects of elevated contaminants in the system are unknown.

3.1.2.2.2. Hungry Horse Dam

As with the Kootenai River, water quality in the Flathead River is generally very good in the upper parts of the Flathead River basin. Hungry Horse Reservoir is low in nutrient input and primary productivity. Elevated nutrient levels in Flathead Lake seasonally result in adverse impacts to water quality. Even further downstream of Hungry Horse Dam, in the upper reaches of the Clark Fork River, contamination from mining activities has resulted in elevated levels of heavy metals. Even further downstream for Hungry Horse Dam, reservoirs on the Pend Oreille River help raise summer water temperatures above conditions suitable for many native fish species such as bull trout.

3.1.2.2.3. Columbia River

Water quality in the Columbia River is generally good. The river carries a large volume of relatively unpolluted surface water. Compared to many other rivers in the U.S., there are fewer sources of industrial and municipal wastes. Waste disposal and treatment laws and voluntary efforts have changed discharge practices over the past 20 years. But several types of water quality issues remain today, including non-point source additions, water withdrawal for irrigation, impoundments, and point source effluents. Each of these factors can have adverse individual and/or cumulative impacts on system water quality.

Lake Roosevelt water quality is adversely affected by upstream effluent from smelters in British Columbia. In recent years, water quality has improved as levels of heavy metals and organochlorine compounds in smelter effluent have been reduced. Effluent from upstream mining activities has also resulted in sediment contamination (see Section 3.1.3.1) that is likely to continue to adversely affect water quality independently of the levels of contaminants in smelter effluent.

3.1.3. Sediment Quality

3.1.3.1. Columbia River

Lake Roosevelt bed sediments are contaminated with heavy metals (arsenic, cadmium, copper, lead, mercury, and zinc) that were discharged from a lead-zinc smelter in Canada. The smelter discharged 300 to 400 hundred tons per day of blast furnace slag and effluent into the Columbia River from the 1950s to the early 1990s (USGS, 2001a). Due in part to the studies done in Canada and Washington State, the lead/zinc smelter in Canada stopped discharging slag and reduced its effluent discharge in the early 1990s. While there has been a significant improvement in the loadings of metals to the reservoir, large quantities of contaminated sediments remain in Lake Roosevelt, and therefore, studies are still in progress (USGS, 2001b; USGS, 2001c; USGS, 2001d).

Although metals have received the most attention, organochlorine compounds are also of concern, due to their persistence and established role in causing adverse environmental effects. The organochlorine compounds of greatest concern to human health in the Lake Roosevelt area are dioxins and furans from pulp mill discharge and PCBs from various industrial activities. In 1988 and 1990, Canadian studies reported large concentrations of furans in fish collected in the Columbia River downstream of a pulp mill near Castlegar, British Columbia. The Washington State Department of Ecology (Ecology) confirmed that fish from Lake Roosevelt contained elevated furan concentrations, but that concentrations of dioxins and furans generally decreased as one moves downstream away from Canada. In a 1992 study, the U.S. Geological Survey (USGS) reported that dioxins and furans were present in suspended sediment collected from the Columbia River, but only a few of the targeted isomers were detected. Aside from dioxins and furans, few of the many other organic compounds associated with wood-pulp waste, urban runoff, and industrial activities were detected in the bed sediments of Lake Roosevelt and its major tributaries. There have been no human health statements released from the EPA PCB study. In a follow-up study, the USGS found that concentrations of mercury in walleye have significantly decreased; however, PCBs, dioxins and furans have not decreased (Munn, 2000).

3.1.4. Air Quality

Air quality in the Columbia River Basin generally meets national and state ambient air quality standards (AAQS). However, there are areas on non-attainment in which air pollution concentrations exceed one or more thresholds. Excluding certain urban areas that exceed carbon monoxide thresholds, the most common reason for non-attainment involves particulate matter that can be respired by humans (PM_{10}).

While there are several PM_{10} non-attainment areas identified in the Columbia River Basin, only Sandpoint, Idaho, is located within the area that may be affected by the proposed action (Appendix B, BPA *et al.*, 1995). While not identified as specific non-attainment areas, Lake Koocanusa, Hungry Horse Reservoir, Lake Roosevelt, and other reservoirs within the Federal Columbia River Power System may exceed identified PM_{10} thresholds during drawdown periods. Air quality in the vicinity of reservoirs is adversely affected when high winds combine with exposed reservoir sediments to create dust storms of varying severity. The EPA recently stated that airborne contaminants in Lake Roosevelt area may be of concern to human health and has recommended additional studies (USGS, 2001a). At this time, no studies are available which determine if the PM_{10} are exceeded in these local areas.

3.2. Natural Resources

3.2.1. Vegetation

The riparian zones along the free-flowing Kootenai and Flathead Rivers can be characterized as deciduous shrub and deciduous tree communities with black cottonwood as the primary tree species. Lake Koocanusa and Hungry Horse Reservoir lack well-established riparian zones and backwater areas because of fluctuating water levels. The 36 islands on Hungry Horse Reservoir support conifer and upland shrub habitats. Vegetation communities adjacent to both reservoirs are dominated by mixed conifer forests composed mostly of ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), and spruce (*Picea* spp.). Most of the Pend Oreille River drainage is covered by coniferous forest, with the lower elevations around Lake Pend Oreille primarily in the ponderosa pine vegetation zone. There are substantial areas of emergent wetlands and largely deciduous riparian vegetation around Lake Pend Oreille and a number of islands in the lake itself or in tributary delta areas.

Lake Roosevelt lacks extensive riparian communities. The southern portion of Lake Roosevelt is within the shrub-steppe region of eastern Washington and is subject to periodic drought. Most riparian habitat at the lake is associated with small streams and springs. Riparian vegetation has established in areas of silt accumulation that are subject to infrequent flooding. Lake Roosevelt lacks extensive wetland areas. Those that do occur are located primarily in the northern parts of the reservoir and are dominated by reed canary grass (*Phalaris arundinacea*). From Grand Coulee Dam southward to the Snake River confluence, the Columbia River passes through shrub-steppe, steppe, and ponderosa pine vegetation zones.

3.2.2. Fish

3.2.2.1. Libby Dam

The Kootenai River serves as habitat for a number of resident[8] native and non-native species of fish, including white sturgeon (*Acipenser transmontanus*), kokanee[9] (*Oncorhynchus nerka*), rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*), bull trout (*Salvelinus confluentus*), longnose suckers (*Catostomus catostomus*), mountain whitefish (*Prosopium williamsoni*), and burbot (*Lota lota*).

Construction of Libby Dam created a barrier to upstream fish passage, separating two different aquatic environments – a regulated river downstream from the dam and a fluctuating reservoir upstream from the dam, each with its distinctive fish community. Some downstream passage of fish occurs through the powerhouse. The Kootenai River downstream of Libby Dam has developed into a good rainbow trout fishery. Large Gerrard (Kamloops) rainbow trout can be caught below the dam where they feed on kokanee entrained through the penstocks. In 1997, a world- record rainbow was taken from the river below Libby Dam. Kootenai Falls constitutes a barrier to most upstream fish migration. Some downstream fish movement past the falls does occur.

White sturgeon, kokanee, and burbot occur in Kootenay Lake and migrate up the Kootenai River to spawn. All three species have evidenced substantial decreases in abundance from historical levels.

---

[8] Meaning they reside in the Kootenai basin for their entire life cycle

[9] Kokanee are native to Kootenay Lake but did not occur in the Kootenai River above Kootenai Falls until their introduction to Lake Koocanusa in the late 1970s.

3.2.2.2. Hungry Horse Dam

Hungry Horse Reservoir contains primarily native fish species, including westslope cutthroat trout, mountain whitefish, and bull trout. Hungry Horse Dam has helped isolate the native fish populations in the reservoir from non-native species which occur downstream of the dam.

In addition to the native species that occur in Hungry Horse Reservoir, the Flathead River and Flathead Lake have abundant populations of kokanee, lake trout, yellow perch, and lake whitefish. Introduction of *Mysis* shrimp in the 1980s resulted in a shift in the composition of the fish community in Flathead Lake, with dramatic declines in kokanee, in particular.

Downstream of Flathead Lake extending to Lake Pend Oreille, prominent fish species include mountain whitefish, brown trout, rainbow trout, northern pike, largemouth bass, cutthroat trout, and pikeminnow.

In Lake Pend Oreille, bull trout, mountain whitefish, kokanee, and cutthroat trout are relatively abundant. Important introduced species include lake trout, rainbow trout, brook trout, yellow perch, and large- and smallmouth bass. Downstream of Lake Pend Oreille, the Pend Oreille River is impounded into a series of reservoirs that are dominated by largescale suckers and introduced fish species such as perch and bass.

3.2.2.3. Columbia River

Key fish species in Lake Roosevelt include kokanee, rainbow trout, and walleye, and smallmouth bass. White sturgeon, yellow perch, lake and mountain whitefish, and burbot as well as several non-game species are also present. Perch, suckers, and walleye are the most abundant fish species in the lake based on relative abundance surveys. In 1997, 97% of the fish harvested were kokanee, rainbow trout, and walleye (Cichosz *et al.*, 1999).

With normal drawdowns in Lake Roosevelt, natural rainbow trout reproduction is limited to a few tributary streams, and the fishery is maintained through stocking. The Spokane Tribal Hatchery and cooperative net-pen culture operations located throughout the reservoir raise trout to yearling catchable size then release them to the reservoir in May through June. Over 500,000 rainbow trout are stocked annually. Some natural production of rainbows occurs in reservoir tributaries, however net-pen raised fish have accounted for 90% of the rainbow trout population in relative abundance surveys and make up nearly all of the fish caught by anglers (Cichosz *et al.*, 1999). The majority of net pen rainbows are harvested within 14 months of release.

The native kokanee salmon population is speculated to have originated from anadromous sockeye population that spawned in Lake Roosevelt tributary streams present prior to dam construction. By the 1960's, there was a very popular kokanee fishery in the lake; however, construction and operation of the third power plant in 1974 severely reduced the number of kokanee by decreasing spawning success and increasing entrainment through the turbines and spillway in the spring. There is only limited kokanee spawning in Lake Roosevelt tributaries although non-hatchery fish are being found in the reservoir. Genetic studies are ongoing to determine the origin of wild kokanee.

In an effort to maintain a kokanee fishery, hatchery fish have been stocked in Lake Roosevelt since 1988 with more than 2 million fish, mostly fry, stocked per year during the early 1990's.

Since 1995, stocking has shifted to fewer numbers of yearling fish rather than fry because of better survival for yearlings (Cichosz *et al.*, 1999; Underwood, 2000). The stocking program was relatively successful until a crash in 1996-1997. This was likely due to high entrainment from large flood control releases of water in those years (LeCaire, 1999). Walleye, a primary gamefish popular with anglers, are an exotic species and thrive in the reservoir. They spawn in the Spokane arm in April and May. Spawning success appears to be unaffected by current operation because the main spawning area is below Little Falls Dam which is only slightly affected by drawdowns. Young walleye use areas near the shore associated with woody debris. Adults are commonly found in open water areas during the day and near the mouths of tributaries and bays at night. Yellow perch are primary forage species for walleye and spawn in March and April. Catch and harvest estimates of walleye are quite variable from year to year. This is likely due to a combination of factors including hydropower operations, fishing pressure, and spawning success (Cichosz *et al.*, 1999).

Smallmouth bass are also abundant in the reservoir and spawn primarily from late April to mid May in shallow water areas. The population of this species may be declining due to reservoir operation and predation. Although white sturgeon are present, the population is low and there appears to be poor recruitment and low relative weight (Underwood, 2000).

Anadromous fish species such as salmon, steelhead, sturgeon, and shad occur downstream of Chief Joseph Dam. FCRPS operations have been modified in recent years to improve survival and enhance recovery of anadromous salmonids.

3.2.3. Wildlife

Wildlife in the Northern Rocky Mountains province, including the Kootenai, Flathead, and Pend Oreille-Clark Fork River basins, include white-tailed and mule deer (*Odocoileus virginianus* and *O. hemionus*, respectively), moose (*Alces alces*), elk (*Cervus elaphus*), black bear (*Ursus americanus*), grizzly bear (*U. arctos*), beaver (*Castor canadensis*), muskrat (*Ondatra zibenthica*), mink (*Mustela vison*), river otter (*Lutra canadensis*), bobcat (*Lynx rufus*), mountain lion (*Felis* concolor), and coyote (*Canis latrans*). Bald eagles (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), several species of grouse, a variety of waterfowl, and passerine birds all occur in or along the reservoir and river corridors. The Kootenai River basin is located in the Pacific flyway for migrating birds.

Moving downstream from the Northern Rocky Mountains province, the wildlife assemblage remains similar. Wintering waterfowl are probably the most abundant wildlife resources in the Columbia River Basin. Shorebirds and other non-game species utilize the variety of habitats occurring in riparian and reservoir areas, exploiting different habitats that become available based on reservoir operations.

Factors influencing wildlife distribution in the Columbia River Basin include forestry practices, dam operation, lake management (primarily water level), transportation corridors, recreational use, and natural disturbances (i.e. wildfire).

3.2.4. Sensitive, Threatened and Endangered Species

The Kootenai River white sturgeon is listed as endangered, bald eagle and Columbia River bull trout are listed as threatened, and Kootenai River burbot is a candidate for listing under the Endangered Species Act. Flows from Libby and Hungry Horse Dams affect aquatic species and their habitat downriver in the Columbia River where a variety of salmon and steelhead species are listed as threatened or endangered.

3.2.4.1. Kootenai River White Sturgeon

Kootenai River white sturgeon occur in the river downstream of Kootenai Falls and in Kootenay Lake. No sturgeon are known to occur upstream of the falls. The Kootenai River population of white sturgeon was listed as endangered in September 1994 (USDI, 1994). In 2001, the Kootenai River between RM 141.4 (below Shorty's Island) and RM 152.6 (above the Highway 95 bridge at Bonners Ferry) was designated as critical habitat for Kootenai River white sturgeon (USDI, 2001). Since the early 1990s, spring flows from Libby Dam have been increased in an effort to benefit spawning and larval sturgeon. In 1999, the U.S. Fish and Wildlife Service and the Kootenai River White Sturgeon Recovery Team released the final recovery plan for the Kootenai River white sturgeon (USFWS, 1999).

A primary reason for the protection of white sturgeon is lack of recruitment of young fish to the adult population. Since Libby Dam was finished in 1973, sturgeon have successfully spawned only once, in 1974. The USFWS has identified suitable spring flows as a factor for successful sturgeon spawning and egg and larvae survival. In 2000, the Idaho Department of Fish and Game estimated that that there were about 760 adult sturgeon remaining in the Kootenai River population (V. Paragamian, Idaho Dept. of Fish and Game, pers. comm..). This is down from an estimated 5,000 to 6,000 adults in the early 1980s. These adults are now being lost to natural causes at the rate of 9% per year, leading to a current population estimate of about 660 adults (B. Hallock, USFWS). Based on recently revised aging information, females are not expected to reach sexual maturity until approximately age 30. Thus, there is increasing urgency in restoring the spawning /incubation habitat to again allow the sturgeon to recruit naturally and to begin rebuilding a healthy population structure.

The USFWS has determined that runoff conditions in spring that are closer to natural are beneficial to sturgeon. This is in part because the last year of significant natural recruitment of juvenile sturgeon to the adult population was 1974, a year when flows at Bonners Ferry remained at or above 40,000 cfs for an extended time. High spring flows are the conditions to which sturgeon adapted in their natural environment. Prior to construction of Libby Dam, the average annual peak flow at Bonners Ferry was about 75,000 cfs. Since Libby Dam became operational, the average peak flow has been about 35,000 cfs. Studies are ongoing to quantify benefits of spring flow enhancement on sturgeon spawning and recruitment.

In 2001, critical habitat was designated for the known sturgeon spawning/incubation reach of the Kootenai River at and below Bonners Ferry, Idaho. In the spring, white sturgeon migrate upstream from Kootenay Lake to the spawning reach. Once there, spawning white sturgeon release sinking eggs that adhere to bottom substrates (gravel appears to be the ideal substrate) where they remain until hatching. Then, the sac fry depend on gravel substrates for cover until the yolk sac is absorbed, at which time they must enter the water column in search of food. Most sturgeon spawning in the Kootenai River during last 10 years has occurred over sandy substrates, without gravel. In that time, few naturally recruited juvenile sturgeon have been captured in the intensive monitoring program. The designation of critical habitat acknowledges the important role of high flows in creating enough stream energy to expose gravels now buried under a shallow layer (about 5 feet thick) of sand within the spawning reach between Bonners Ferry and Shorty's Island. The USFWS 2000 FCRPS BiOp recommended implementation of VARQ FC to improve the probability of storage of waters in Lake Koocanusa that can be released to sustain flows needed to both maintain suitable gravel substrates and sustain incubation flows in the range of 40,000 cfs at Bonners Ferry throughout the incubation period.

3.2.4.2. Columbia River Bull Trout

Bull trout of the Columbia River distinct population segment (DPS, which includes Kootenai and Flathead River bull trout) were listed as threatened in 1999 (USFWS, 1999). In general, bull trout populations in the upper Columbia River have declined from historic levels.

3.2.4.2.1. Libby Dam

The adfluvial[10] Lake Koocanusa sub-population represents one of the strongholds of the Columbia River DPS (USFWS, 2000; BPA, *et al*, 1999). Libby Dam now isolates this bull trout sub-population from the Kootenai River sub-population downstream, though there may be downstream movement of the species through Libby Dam. The migratory form of bull trout utilize the reservoir as year-round habitat as sub-adults and adults and some migrate to Grave Creek, the only tributary in the U.S. with documented bull trout spawning. The sub-population below Libby Dam appears to number a few hundred adults and is considered to utilize a fluvial life history[11]. Downstream of Libby Dam, bull trout utilize the mainstem river as sub-adults and adults. Quartz, Pipe, and Libby Creek drainages are the most important spawning tributaries between the dam and Kootenai Falls. Downstream of Kootenai Falls, O'Brien Creek is considered the best spawning tributary.

3.2.4.2.2. Hungry Horse Dam

Hungry Horse Reservoir contains a substantial population of adfluvial bull trout that is stable to increasing in number**.** Dam operational criteria, in place since the 1995 and 1998 Biological Opinions for salmon and steelhead, have reduced the frequency of deep reservoir drawdowns and resulted in maintaining higher pool levels from year to year. Mitigation programs of the BPA have funded habitat restoration and fish passage projects in tributaries to Hungry Horse Reservoir, resulting in increased quantity and quality of spawning and rearing habitat for bull trout residing in the reservoir. Because of the location of bull trout and other fish in the reservoir and in the water column in relation to dam intake structures, dam operations are not thought to result in entrainment of significant numbers of fish from Hungry Horse Reservoir. However, specific studies necessary to verify those assumptions have not been conducted.

---

[10] Adfluvial bull trout rear in tributary streams as juveniles, migrate downstream to live in lakes as sub-adults and adults, and return to tributary streams to spawn.

[11] Fluvial bull trout rear in tributary streams as juveniles, migrate downstream to live in larger rivers as sub-adults and adults, and return to tributary streams to spawn.

Hungry Horse Reservoir flood control, hydropower, and salmon flow augmentation operations can affect reservoir bull trout habitat and food production. Hungry Horse Reservoir can be drawn down 85 feet during this annual cycle, which can diminish the amount of aquatic and terrestrial insect production available to bull trout prey species. General aquatic production, and consequently bull trout forage fish production, can also be decreased by failure to refill the reservoir. Potential adverse effects to bull trout due to decreased prey availability are unknown, however food limitations on bull trout are not suspected in Hungry Horse Reservoir.

3.2.4.2.3. Columbia River

There is very little information on Lake Roosevelt bull trout. Surveys conducted the Spokane Tribe near various tributaries produced 4 bull trout between 1989 and 1995 (Corps *et al.*, 1999). Underwood (2000) reports that bull trout are rarely encountered. Reasons for this include poor habitat and tributary streams used for spawning and rearing, competition from other exotic fish, and possible reduced benthic productivity from reservoir drawdowns. Bull trout are also not extensively found in tributaries to Lake Roosevelt and degraded habitat conditions in those streams may be more of a limiting factor than reservoir operations (Corps *et al.*, 1999).

3.2.4.3. Bald Eagle

The bald eagle is listed as threatened. Bald eagle populations have recovered to the extent that the USFWS has proposed to remove them from the list of endangered and threatened species. Nesting and wintering bald eagles commonly occur along shorelines throughout the Columbia River basin. Bald eagles consume primarily fish, taking both live fish and eating carcasses.

3.2.4.3.1. Libby and Hungry Horse Dams

In general, bald eagle numbers along the Kootenai, Flathead, and Columbia Rivers are stable or on the rise. Migratory and wintering bald eagles occur in the vicinities of Libby and Hungry Horse Dams and impoundments primarily in late fall to early spring (BPA *et al.*, 1995, Appendix N, Wildlife). Recent estimates count 10 pairs of nesting eagles downstream of Libby Dam in Montana. Bald eagles are common along the Kootenai River corridor throughout the year and likely exceed the Pacific Bald Eagle Recovery Plan (PBERP; USFWS, 1996) target of 3 eagle nesting territories above and below Libby Dam.

At least one eagle pair nests on an island in Hungry Horse Reservoir. Areas used for feeding and resting by bald eagles include portions of the South Fork of the Flathead River below the dam and the upper end of the river valley above the reservoir. Further downstream, migrant bald eagles from Glacier National Park feed along stream reaches characterized by numerous shallow riffles, gravel bars, and deep pools. Large numbers of bald eagles pass through the Flathead Lake area each year.

3.2.4.3.2. Columbia River

Bald eagles both breed and winter at Lake Roosevelt. The first surveyed bald eagle nesting territory on the reservoir was recorded in 1987. Since then the number of occupied nesting territories had increased to 21 in 2000 with 35 young produced (Murphy, 2000). Productivity has been relatively good with an average of 1.36 young produced per occupied nesting territory from 1987-2000. These numbers easily exceed the minimum PBERP (USFWS, 1996) goals of 2 breeding pairs at Lake Roosevelt and 1.0 young produced per occupied territory in the Pacific recovery area.

The reasons for this increasing trend in bald eagle nesting is thought to be due to an expansion of the local breeding population with relatively good nesting success; an excess in available nest habitat in certain reaches of Lake Roosevelt, an abundant food base; and low levels of human disturbance in some locales (Murphy, 2000).

Science Applications International Corporation (SAIC, 1996) found that breeding bald eagles feed primarily on fish, both dead and alive, with waterfowl and other birds and small mammals making up the remainder of their diet. Suckers were the most common prey item identified and are the most abundant fishes in the lake but may have been over-represented in prey remains because of their robust size (SAIC, 1996). Other fish species such as carp, kokanee, rainbow trout, whitefish, walleye, and yellow perch were also observed as prey.

Winter surveys of bald eagles conducted by various entities have also showed an increase in use, particularly through the 1980's. Complete surveys conducted by the National Park Service in the mid 1990's found as many as 245 eagles using Roosevelt Lake during the winter (SAIC1996). This compares with the 1996 PBERP wintering population of 40 wintering eagles (USFWS, 1996). Wintering bald eagles also rely predominantly on fish and waterfowl, taken alive or as carrion, for food.

3.2.4.4. Anadromous Fish

In total, 12 threatened or endangered evolutionarily significant units (ESUs) of salmon and steelhead utilize the mainstem Columbia River downstream of Chief Joseph Dam in Washington (Table 1). Refer to the NMFS 2000 FCRPS BiOp for more details on the status of Columbia River anadromous fish stocks.

Table 1. Threatened and Endangered Evolutionarily Significant Units of Salmon and Steelhead in the Columbia River Basin

Species	ESU	Status
Chinook Salmon (*Oncorhynchus tshawytscha*)	Snake River Fall Snake River Spring/Summer Upper Columbia River Spring Lower Columbia River Upper Willamette River	Threatened Threatened Endangered Threatened Threatened
Chum Salmon (*O. keta*)	Columbia River	Threatened
Sockeye Salmon (*O. nerka*)	Snake River	Endangered
Steelhead (*O. mykiss*)	Snake River Upper Columbia River Middle Columbia River Lower Columbia River Upper Willamette River	Threatened Endangered Threatened Threatened Threatened

Historically, natural barriers blocked anadromous fish passage below the Kootenai River and Lake Pend Oreille. No anadromous fish are present or have ever been present in or upstream of Kootenay Lake or Lake Pend Oreille. Currently, fish passage to the upper Columbia River is blocked at Chief Joseph Dam near Bridgeport, Washington. However, use of water stored in headwaters reservoirs like Lake Koocanusa and Hungry Horse Reservoir forms an important component in plans designed to conserve and recover populations of Columbia River anadromous fish. Spring and summer releases from these projects are intended to aid outmigration of juvenile salmonids in the portions of the Columbia River still accessible to anadromous fish. Fall releases benefit spawning chum salmon in areas below Bonneville Dam.

3.2.4.5. Kootenai River Burbot

There is a remnant population of burbot that lives in Kootenay Lake and migrates up the Kootenai River to spawn. Relative to burbot's circumpolar range, this population appears to be adapted to a unique ecological setting. Fewer than 300 adults have been captured in monitoring efforts that began in 1993. Burbot are a large fresh water cod, with exceptionally high fecundity. A single female may release up to a million eggs during a spawning event. The current low numbers of burbot may be a consequence of heavy sport and some commercial harvests in the US and Canada in past years. To address this impact, burbot harvest in both nations has been substantially restricted. However, burbot have not recovered as expected of an animal with such remarkable fecundity. Poor habitat conditions may play a role in continuation of burbot's depressed status.

Studies indicate that burbot in this population are either not capable of sustained migration against even moderate currents, or their migrations are deterred behaviorally by moderate flows. In nine years of monitoring, burbot reached the Bonners Ferry spawning reach only during the drought of 2000/2001 when December and January flows in the Kootenai River below Bonners Ferry were unusually low and frequently in the 6,000 to 8,000 cfs range. Historically, unregulated flows at this time were typically in the 4,000 to 6,000 cfs range, but since the commencement of operation of Libby Dam, flows typically range from 16,000 to 18,000 cfs. Based on monitoring results, high flows during the winter migration and spawning period may adversely affect spawning success of burbot.

The winter high flows are also associated with an increase in winter water temperatures from near 2°F (1°C) to 8°F (4°C). These higher water temperatures may inhibit burbot spawning since burbot appear to prefer colder waters during spawning season and have been observed spawning under ice.

There is an ongoing broad-based effort to conserve this population of burbot through an international candidate conservation agreement. Concurrently, the Fish and Wildlife Service is conducting a court mandated status review to determine if burbot are warranted for listing as threatened or endangered.

3.3. Native American and Cultural Resources

3.3.1. Libby Dam

3.3.1.1. Culture History

3.3.1.1.1. Prehistory

Archaeological studies conducted within the Lake Koocanusa drawdown area show a potential for 9,000-10,000 years of prehistory in this locality. Presently, the oldest known sites in the area date about 8200 years before present (Thoms, 1984). Most of the sites investigated, however, date from the last 1,500 years.

3.3.1.1.2. Ethnography

The Kootenai Indian people lived on lands at Libby Dam and Lake Koocanusa in historic times (Smith, 1984). Today, the Kootenai live on a number of different reserves in Idaho, Montana, and British Columbia. The Confederated Salish-Kootenai Tribes of the Flathead Nation are among the Federally-recognized treaty tribes that claim the area of Libby project lands as part of their former territory. The Kootenai Tribe of Idaho and the Canadian Kootenay bands also have periodically expressed interest in the cultural resource sites.

3.3.1.1.3. Historic Euro-American Period

Historic sites include 20th century homesteads and evidence for agricultural and logging activities. A few sites potentially represent fur trade activities of the 19th century. In all, 27 historic sites are known, and another 53 are superimposed on prehistoric sites.

3.3.1.2. Previous Cultural Resources Surveys

The basic inventory survey for Lake Koocanusa was performed between 1981 and 1984 and was reported by Thoms (1984). The survey identified 249 cultural resource sites. Annual monitoring of the drawdown area by Kootenai National Forest between 1985 and 1993 has identified an additional 88 archaeological sites, for a total of at least 347 known cultural resources.

3.3.1.3. Historic Properties

Based upon subsurface investigations performed at 69 sites, the Middle Kootenai River Archaeological District was proposed for inclusion in the National Register of Historic Places. This district has been determined eligible.

3.3.1.4. Traditional Cultural Properties

In 1997, the Corps of Engineers began working with Confederated Salish-Kootenai Tribes of the Flathead Nation to identify traditional Kootenai place names at Lake Koocanusa. This work has resulted in the identification of trails and places of special significance to the Kootenai people. These properties have not yet been considered for their potential eligibility for the National Register.

3.3.2. Hungry Horse Dam

3.3.2.1. Culture History

3.3.2.1.1. Prehistory

There are no prehistoric cultural resources overviews for the immediate area surrounding the Hungry Horse Reservoir. Prehistoric sites found along the shoreline of the reservoir include 17 lithic scatters indicative of stone tool reduction in short-term camping locations. No dates are currently available for these sites. Occupations are expected to have been larger and more densely distributed in the parkland settings adjacent to the South Fork of the Flathead River, which were rich in riverine and wetland resources (Confederated Salish and Kootenai Tribal Preservation Department, 2001). Many sites were drowned by the flooding of the Hungry Horse reservoir before they could be recorded.

3.3.2.1.2. Ethnographic presence

At c. 1800, the area north of Flathead Lake was primarily associated with the Kootenai Tribe, who now reside at the Flathead Indian Reservation in Montana, and the Kootenai Reservation in northern Idaho. Other local groups include the Pend d'Oreille, certain bands of the Kalispel Tribe, and the Flathead (Salish) Tribe. Blackfeet war parties occasionally made raiding expeditions into the area.

Native peoples used the area around what is now the Hungry Horse reservoir for short-term seasonal occupations related to resource procurement such as trapping, plant harvesting, fishing, and especially deer and elk hunting (Confederated Salish and Kootenai Tribal Preservation Department, 2001). They also used the area extensively as a major travel route between lowland overwintering camps and upland summer camps and fall resource procurement. Several trails are still in excellent condition, and are plainly visible where they cross the reservoir area (Schwab *et al.*, 2000). They continued to be used into the historic period by trappers and hunters and later by the U. S. Forest Service (Confederated Salish and Kootenai Tribal Preservation Department, 2001).

3.3.2.1.3. Historic Euro-American period

Northwestern Montana was one of the last North American regions explored by Euro-Americans (McLeod and Melton, 1986). Fur traders may have been operating south of Hungry Horse as early as 1801 (Ibid), but the Lewis and Clark expedition marks the first documented presence of Euro-Americans. The British fur trade followed close behind, with the Northwest Company, and later the Hudson's Bay Company, monopolizing all of northwestern Montana (Ibid). French fur trappers are known to have operated in the Hungry Horse area as late as the 1890s. Primary fur species targeted were marten and beaver, and pelts from the Hungry Horse area were of unusually high quality (Confederated Salish and Kootenai Tribal Preservation Department, 2001).

Pioneer settlement did not begin in this area until the Flathead Tribe signed the Hellgate Treaty of 1855, and by 1891 immigrants were arriving in a steady stream (Ibid). The first farmers began irrigating in the Ashley Creek area of the Flathead River Valley around 1885, and the Ashley Irrigation District was formed in 1897 (U. S. Department of the Interior, 1981).

The U. S. Bureau of Reclamation conducted drainage basin studies from the 1910s through 1920s, and critical power shortages in the Pacific Northwest during World War II led Congress to authorize the creation of Hungry Horse Dam on June 5, 1944 (Linenberger, 2002). The prime contract for construction of the concrete thick-arch dam was awarded on April 21, 1948 (U. S. Department of the Interior, 1981). Construction continued until President Franklin D. Roosevelt threw the switch on the new power plant on October 1, 1952.

The area around the Hungry Horse Reservoir (South Fork of the Flathead River) was designated the Lewis and Clark National Forest in 1907. In 1908 the area was re-organized into the Flathead National Forest, which continues to administer lands surrounding the reservoir today. Historic trails, fire lookouts, ranger cabins and telephone lines in the vicinity of the reservoir mark the Forest Service's 105-year presence at Hungry Horse.

3.3.2.2. Previous Cultural Resources Surveys

The area around Hungry Horse Reservoir received very limited archaeological investigations prior to the 1990s. No survey was carried out prior to the inundation of the reservoir in 1952, and only limited shoreline reconnaissance was conducted in the 1980s. In 1991, the agencies, tribes, and states involved in cultural resources management for the FCRPS signed a Programmatic Agreement that included Hungry Horse Reservoir. In 1992, the Flathead National Forest agreed to take the lead in cultural resources management for the shoreline of Hungry Horse Reservoir. The two agencies, together with the Bonneville Power Administration, signed an interagency agreement in 1994 for the Hungry Horse Archaeological Project Investigation (HHAPI), together with input from the Confederated Salish and Kootenai Tribes. Section 106 compliance work is co-funded by BPA and Reclamation.

The first phase of the project (1994-1998) involved a comprehensive reservoir survey, and site testing and evaluation (Hamilton, 2000). Supplemental survey and evaluation, as well as site monitoring for erosion and looting, continued until the termination of the HHAPI project in 2001. The Flathead National Forest continues to monitor site locations on the Hungry Horse shoreline at the present time. The Flathead National Forest independently contracted with Kathryn McKay to write a Historic Overview of the forest, which was completed in 1994, and is planning a prehistoric cultural resources overview that includes the reservoir. Ongoing analysis associated with the HHAPI project includes radiocarbon, lithic raw material, and geo-archaeological analyses.

Studies of traditional cultural properties and other traditional use areas of the Native peoples of the Hungry Horse area have been conducted since 1998 by the Confederated Salish and Kootenai Tribes of the Flathead Nation, under a five-year contract to Reclamation and BPA. These data are gathered using information from interviews and field visits to important areas with Tribal Elders, and historic source documents.

3.3.2.3. Historic properties

The historic properties known for the immediate vicinity of the reservoir include eleven prehistoric sites (see Table 2). The eleven undated lithic scatters have all been impacted by the operations of the Hungry Horse reservoir, and most by activities associated with logging, road-building and maintenance, and recreation under Forest Service administration. To date, none of them has been evaluated for National Register eligibility. Please note that the charts in this document are based on data for 11 sites at Hungry Horse, and the data for all 17 sites will be included in the EIS under preparation.

Table 2. Hungry Horse Reservoir Archaeological Sites (USFS records)

Site state no.	Site type	Site elevation	Site condition	NR eligibility
24FH866	Lithic scatter	3490-3505’	Eroded	Uneval.
24FH488	Lithic scatter	3544’	Eroded, deflated	Uneval.
24FH876	Lithic scatter	3560’	Eroded	Uneval.
24FH129	Lithic scatter	3540’	Eroded, deflated	Uneval.
24FH211	Lithic concentration/scatter +subsurf. hearth	3560’	Modern roads and campground nearby	Uneval.
24FH863	Lithic scatter	3500-3550’	Road construction and deflated	Uneval.
24FH912	Lithic scatter w/ bifacial knife	3500-3550’	Heavy erosion and redeposition	Uneval.
24FH867	Lithic scatter	3530’	Eroded, deflated	Eligible
24FH868	Lithic scatter	3542’	Deflated, vehicle impacts	Uneval.
24FH860	Lithic scatter	3558’	Deflated, eroded, camping impacts	Uneval.
24FH862	Lithic scatter	3529’	Recreational impacts	Uneval.

Sites in the Hungry Horse Reservoir area are distributed across elevations ranging from 3495 feet to 3560 feet. Several of the sites span a range of elevations. Figure 8 below shows that about 45% of the sites have components lying between 3530 and 3550 feet. Note that none of the information above reflects portions of the South Fork of the Flathead River downstream of the Hungry Horse Dam. Also, site numbers in the bar chart are not cumulative. See Impacts Analysis for discussion.

3.3.2.4. Traditional Cultural Properties

A consultation meeting between Reclamation and the Confederated Salish and Kootenai Tribes occurred on November 13, 2002. The results of that meeting are addressed in Section 5.3.2.5.

The prehistoric trails associated with the Hungry Horse reservoir area and associated river fords and sites are in the process of National Register nomination by the Confederated Salish and Kootenai tribes. The draft nomination indicates a multi-property or cultural landscape approach, which includes the eleven sites listed above.

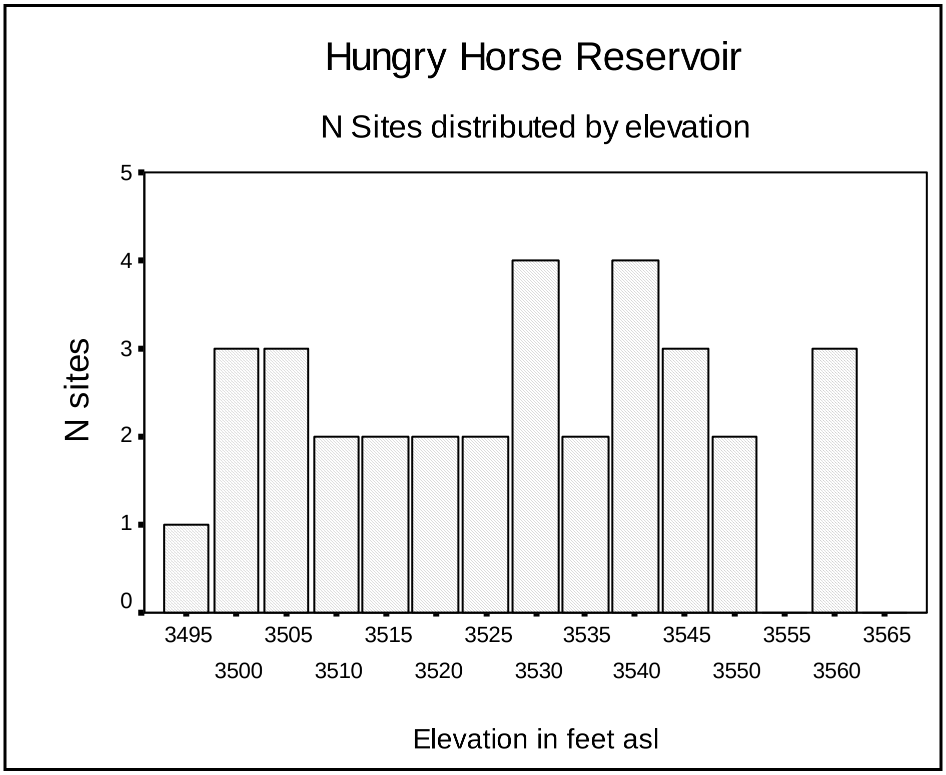


Figure 8. Elevation Distribution of Historic Sites at Hungry Horse Reservoir

3.3.3. Columbia River

3.3.3.1. Culture history

3.3.3.1.1. Prehistory

The area around what is now Lake Roosevelt has seen human occupation since the first Americans hunted and gathered there about 11,000 years ago. Between 10,500 and 7,000 years ago, hunting and gathering populations grew in size, leading to smaller home territories for ethnic groups and a growing focus on fish resources. Emphasis on plants and smaller game indicates that people targeted an increasingly broader variety of foods. From 7,000 to c. 1,500 years ago, fishing became central to subsistence, and fishing locations doubled as important trading centers. Seasonal procurement of resources is evidenced by archaeological remains of large multi-season fish camps, which were supplemented by upland hunting and gathering. Native population levels began to decline in the 16th century A.D. They continued to drop steeply in the mid 19th century as an apparent result of epidemics, land loss and other demographics related to waves of Euro-American immigration.

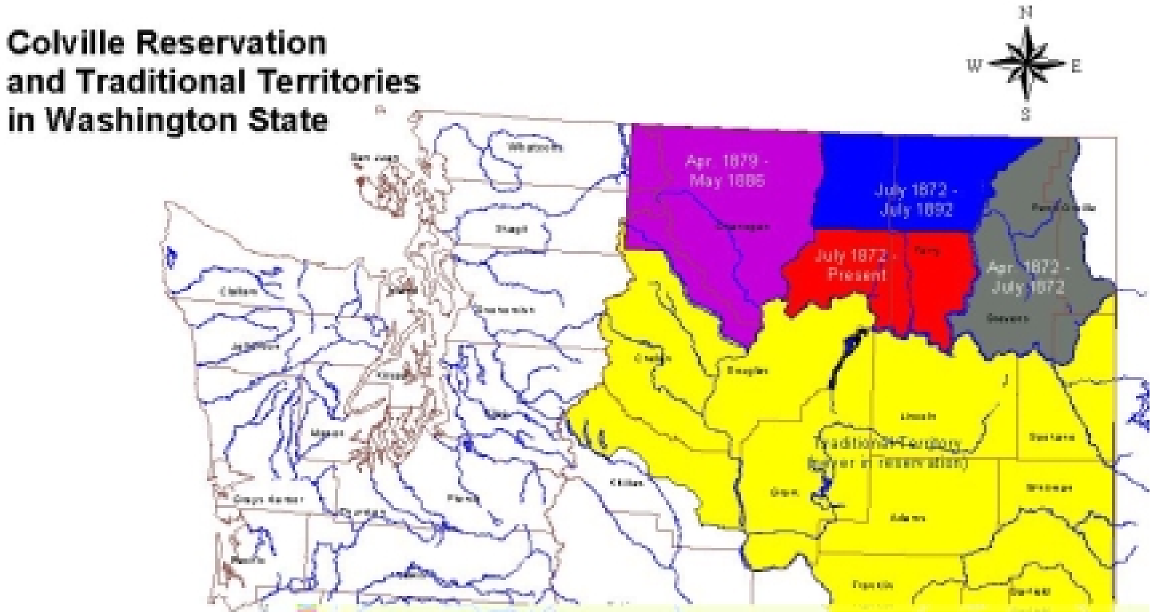


Figure 9. Map of Colville Confederated Tribes Traditional Territories, Washington (Supplied to Reclamation by the Colville Confederated Tribes Historic Preservation Office)

3.3.3.1.2. Ethnographic present

Tribes historically inhabiting the area around what is now Lake Roosevelt include the Wenatchee, Nespelem, Moses-Columbia, Methow, Colville, Okanogan, Palus, San Poil, Entiat, Chelan, Nez Perce, and Lake. Historic observers like David Thompson, an employee of the British North West company and the first Euro-American to visit the area in 1811, were impressed by the seasonal crowds who gathered there to fish, trade, marry, and exchange information (Emerson, 1994a).

Trading at fishing camps provided a wide variety of exotic trade goods, including those of European make. Large fishing camps were usually occupied year-round by a core group, but many left to hunt and gather in the fall, and move to winter camps (Galm and Nials, 1994). Between the mid-19th and early 20th centuries, Native Americans in the Lake Roosevelt area were forcibly settled, which disrupted their seasonal round of subsistence from river to uplands, and their ability to trade with neighbors. At present, the Spokane and the Confederated Tribes of the Colville reside on reservations whose lands directly abut Lake Roosevelt. These tribes continue to maintain strong ethnic and community identity.

3.3.3.1.3. Historic Euro-American period

Fur trade was the impetus for the first European establishment in the Lake Roosevelt area. Fort Spokane was built between 1807 and 1810 at the confluence of the Spokane and Little Spokane rivers, and Fort Colville was established soon afterward at Kettle Falls. By the late 19th century, farmers and loggers had settled widely in central Washington. Chinese immigrant miners and other laborers also found their way to Washington at this time. By the early 19th century, irrigation-dependent farming had increased to the point that a Depression-era drought devastated local economies. A western power shortage associated with World War II led Franklin D.

Roosevelt to authorize the Columbia Basin Project, including Grand Coulee Dam and Banks Lake, a holding reservoir.

3.3.3.2. Previous Cultural Resources Surveys

Archeological investigation of the Lake Roosevelt area dates back to the 1930s, when Native American human remains were moved in preparation for the inundation of the reservoir. Also, the Columbia Basin Archeological Survey undertaken beginning in 1939 for the same purpose, consisting of rapid surveys of archeological sites over a period of less than two years.

From the 1960s to the early 1990s, a series of surveys was conducted by the National Park Service and various universities, documenting a number of new sites as well as some already known.

The Lake Roosevelt Cooperative Management Agreement of 1990 was signed by federal agencies and local tribes, and outlined responsibilities for management of cultural resources and other resources. This led to the Direct Funding Agreement of 1996, under which the U. S. Army Corps of Engineers, the Bureau of Reclamation, and the Bonneville Power Administration agreed to fund cultural resources management at the reservoirs. Subsequent contracts provided management funds to the tribes from the federal agencies under Section 106.

3.3.3.3. Historic properties

Data from the Lake Roosevelt National Recreation Area’s archaeological office (NPS) and the Washington Office of Archaeology and Historic Preservation (OAHP) show a total of 388 sites known for the Lake Roosevelt management area. Of these, approximately 69% are prehistoric sites, 14% historic, and the remaining 17% mixed prehistoric and historic. These sites represent mid-to upper-terrace and upland occupations; the largest, densest sites at the level of the original riverbank are currently under water.

Unlike the graph for Hungry Horse sites, Figure 10 shows only the base elevations of sites. Note that the numbers in the graph are not cumulative. Many sites lie in a range of elevations. For a graph of number of sites impacted by elevation (comparable to Figure 8), see Figure 29 in the Impacts Analysis section.

The majority of sites known for the Lake Roosevelt shoreline are located at elevations between about 1220 and 1320 feet above sea level. The 1280 mark appears to be particularly dense in sites. This pattern may reflect real site distributions, but is likely also influenced by reservoir operations that fluctuate in this zone and therefore reveal cultural resources. Of the site total, 27 are listed on the National Register, 5 are eligible for the register, 47 are ineligible, 290 are unevaluated, and 19 are ‘status unknown.’

The NPS and OAHP databases represent only a portion of known sites for the area. When sites are discovered on land managed by the NPS, they are recorded and the data sent to the NPS and the OAHP. However, when sites are found on tribal lands, data are maintained in a separate tribal database. Therefore it is likely that data for many more sites exist in tribal databases only, and the figure of 388 sites must be considered a minimum.

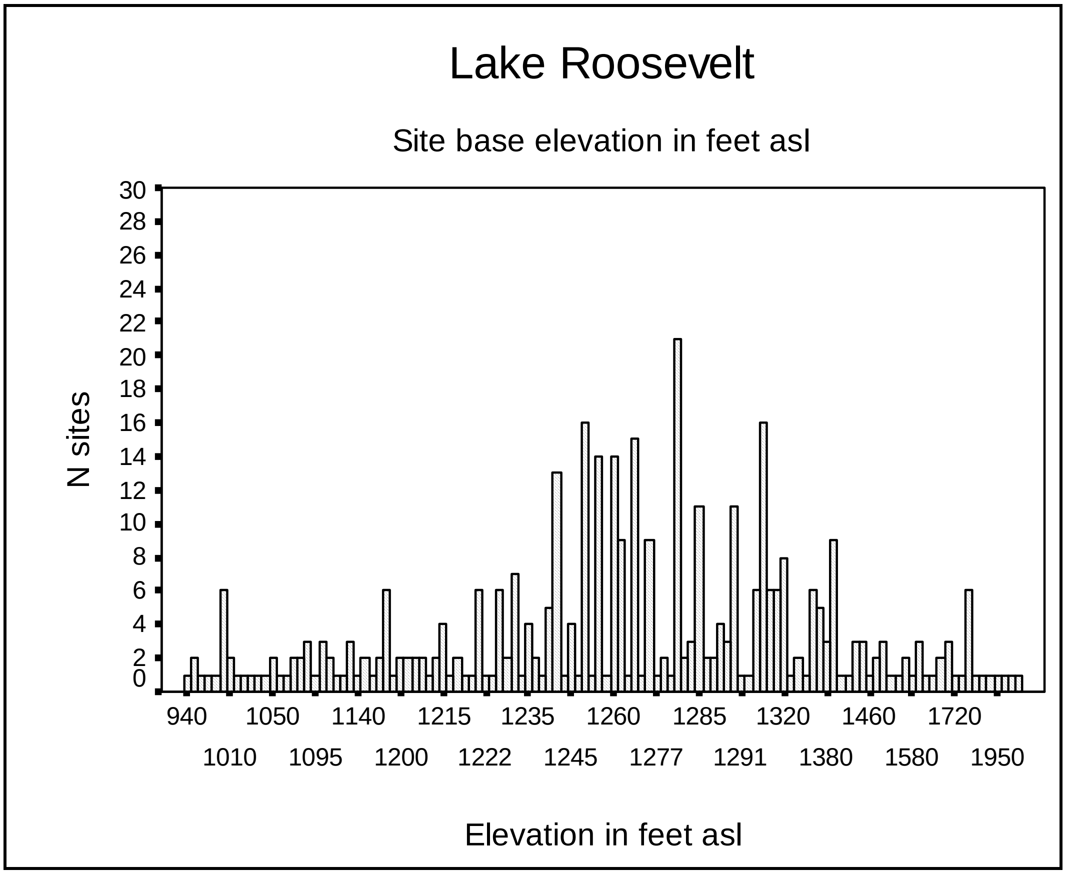


Figure 10. Elevation Distribution of Historic Sites at Lake Roosevelt

Reclamation has jurisdiction over shoreline lands six miles downstream of Grand Coulee Dam, extending to the boundary of Corps of Engineers jurisdiction upstream of Chief Joseph Dam. Several sites along the six-mile downstream stretch below Coulee have been identified in the shoreline or areas immediately upslope. Studies associated with the armoring of the east shore of the downstream area (Bryant, 1978; Leeds *et al.*, 1980; Galm and Lyman, 1988) identified about 50 historic and prehistoric sites at or immediately above the shoreline according to report maps. However, the armoring project buried most of the sites on the east bank.

The Confederated Tribes of the Colville Historic Preservation office contracted survey work more recently on the west bank (Roulette *et al.*, 2001), resulting in the identification of three sites, two new and one previously known. The lack of visibility of additional west bank sites discovered in the 1970s and 1980s surveys indicates that armoring the east bank has possibly altered the erosion patterns, or vegetation cover has increased.

3.3.3.4. Traditional Cultural Properties

The consultation meeting with the Confederated Tribes of the Colville Indians (CCT) took place on November 5, 2002, in Nespelem, WA. Due to the accelerated schedule of this EA, the CCT was unable to provide information on Traditional Cultural Properties, but has agreed to do so on in future consultation. Those results will be included in the EIS in preparation.

The first meeting with the Spokane Tribe of Indians was conducted on September 18, 2002, in Wellpinit, WA. The Spokane Tribe is currently deliberating whether to continue the Section 106 consultation process with Reclamation on the VARQ flood control EA and EIS. Pending that decision, no information is currently available for Spokane Traditional Cultural Properties. That information will be included in the EIS in preparation if the Spokane Tribe decides to proceed with consultation. For more discussion, see Impacts Analysis.

3.4. Socio-Economic Resources

3.4.1. Land Use

3.4.1.1. Libby Dam

In southeastern British Columbia, the Kootenay River corridor occupies a largely forested valley between the Purcell Mountains to the west and the Rocky Mountains to the east. The river is generally paralleled by a provincial highway and passes through several small communities. There are some agricultural lands, particularly around Cranbrook (population 18,476) and to the south.

Lake Koocanusa is located primarily within Crown lands in Canada and the Kootenai National Forest in the U.S. The Corps' project lands adjacent to Libby Dam are managed for dam operational needs as well as recreation and wildlife. There are few intermingled private lands along the reservoir. Private lands are concentrated in the Cranbrook area in Canada and in the northern end of the reservoir within the U.S. Roads parallel both sides of the reservoir in the U.S. while major roads do not bound the Canadian portion of the reservoir.

The towns of Libby (population 2,626, with an additional 9,000 people living outside of city limits in the Libby area) and Troy (population 957), Montana, and Bonners Ferry, Idaho (population 2,515) lie along the Kootenai River downstream of Libby Dam. Land use in the valley in general consists primarily of timber harvest in Montana and timber and agriculture in Idaho (see 3.4.1.1.1 for details). An extensive levee system lines the river in both the U.S. and in Canada (extending into the Kootenay delta where the river enters Kootenay Lake). Highway 2 parallels the Kootenai River from Libby, Montana, to Bonners Ferry, Idaho, from where U.S. 95 and Idaho Highway 1 extend northwards near the river.

Riverbank erosion along the reach between Bonners Ferry and Kootenay Lake is a concern and is regularly monitored by local officials and the Corps. Composition of the levees, lack of maintenance, high flows, and flow fluctuations have all been discussed as contributing to levee erosion. Since the mid-1990's, Libby Dam has not been used for power peaking and, as a result, rapid river level fluctuations, particularly in the winter, relating to dam operation no longer occur in normal operations.[12]

North of the international border, the river passes near Creston (population 4,795) at the southern end of Kootenay Lake, Nelson (population 9,298) at the outlet of Kootenay Lake, and Castlegar (population 7,000) at the confluence with the Columbia River.

[12] Emergency operations resulting from unexpected generation or transmission breakdowns may result in rapid reductions in dam discharge but such emergencies are expected to be infrequent occurrences.

3.4.1.1.1. Agriculture

The most prominent agricultural area along the Kootenai River occurs in the Kootenai Flats from about Bonners Ferry downstream to the Creston area. Crops grown in the valley include winter and spring wheat, barley, canola, timothy seed, and hops. In 1997, approximately 8800 acres of spring wheat, 8600 acres of winter wheat, 6200 acres of barley, and 500 acres of canola were harvested in Boundary County, Idaho. The Elk Mountain Farms, just south of the international boundary, is the largest contiguous hop farm in the world with a total of 1700 acres in production. North of the international border, grains, apples, cherries, and vegetables are important cash crops and livestock farms are also present.

High spring groundwater levels in the Kootenai Flats result in cropland seepage that affects crop production. Local sources indicate that adverse effects from seepage occur when the Bonners Ferry river stage exceeds 1758 feet for more than 3 days. Seepage effects include ponding in fields, high soil moisture content, and alteration of farm operations to work around wet areas.

In 1974, Public Law 93-251 Section 56 authorized payment to compensate drainage districts and property owners in Kootenai Flats, Boundary County, Idaho, for modification to facilities including gravity drains, structures, pumps and additional operational pumping costs made necessary by, and crop and other damages resulting from the duration of higher flows during drawdown operations at Libby Dam. The total dollar amount authorized was $1.5 million. Based on Public Law 93-251, in the late 1970s and early 1980s, the Corps distributed $1.5 million dollars to affected parties. In return, compensated landowners granted a flowage easement and release of claims for damages resulting from altering, changing, and interfering with the water level in, under and upon the land and saturating and percolating and causing erosion, sloughing and sliding in the land in connection with the operation and maintenance of Libby Dam.

3.4.1.2. Hungry Horse Dam

Federal lands used primarily for recreation and timber harvest surround the upper reaches of the Flathead River. Hungry Horse Reservoir is completely surrounded by Federal forest land within the Flathead National Forest. There are no private lands or cabins located along the lake, and there does not appear to be any potential for future private development.

Downstream of the confluence of its three forks, the Flathead River enters the Flathead Valley, which is predominantly cropland. Near Columbia Falls (population 3,645) and Kalispell (population 14,223), land use is more developed and urban in character. South of Kalispell, the river continues through more agricultural land to Flathead Lake. A mixture of forest, rangeland, cropland, orchards, and pasture/meadow areas, as well as residential, commercial, and recreational development surrounds the lake. Prominent communities bordering the lake include Polson (population 4,041) and Bigfork (population 1,421). The Flathead Indian Reservation surrounds the southern portion of the lake.

3.4.1.2.1. Agriculture

Elevated spring river levels and flooding can affect low-lying agricultural areas along the Pend Oreille River in Washington, particularly at tributaries such as Calispell and Trimble Creeks. Throughout Pend Oreille County, there are more than 55,000 acres being used for agriculture. A majority of that acreage is in the valleys near the river where the primary crop is hay. Rough estimates suggest that 15,000 to 20,000 acres of hay is grown in the Cusick area and about 5,000 acres of hay grown further north in the valley near Ione. In 1996, Pend Oreille County produced approximately 42,000 tons of hay. A substantial acreage of pasture grass is also grown throughout the region.

3.4.1.3. Columbia River

General land uses throughout the Columbia River Basin include forest (about 86 million acres), range (about 59 million acres), cropland (about 20 million acres), and urban development (about 3 million acres). While much of the urban land is concentrated in the lower Columbia, Spokane, and Boise areas, a number of smaller cities and communities cluster along rivers throughout the region.

North of the international border, much of the land is forested, with some areas of cropland. Urban land uses occur at several communities including Castlegar and Trail (population 7,575). Provincial highways traverse the valley throughout British Columbia.

The National Park Service manages most of Lake Roosevelt in cooperation with other agencies and tribes. The Colville and Spokane Reservations abut parts of the reservoir. Much of the east and south banks is in private ownership. Lands surrounding the reservoir are generally forested. East of the lake, a mixture of cropland and grassy rangeland occupies the corridor from approximately Northport (population 336) to near the Spokane River, with adjacent hills primarily forested. Range is the dominant land cover along the eastern end of Lake Roosevelt from about the Spokane River to Grand Coulee Dam.

3.4.1.3.1. Agriculture

The Columbia Basin Project currently supplies irrigation water to 557,500 acres. Irrigation requires approximately 2.3 to 2.7 million acre-feet (maf) of water annually. The diversion of 2.3 maf is slightly over 2% of the average total annual flow of the Columbia River at Grand Coulee Dam.

3.4.2. Flood Hazards

3.4.2.1. Libby Dam

The original Columbia River Treaty (CRT) Flood Control Operating Plan (FCOP) for Libby Dam was developed as part of the CRT process in the late 1960's and early 1970's. It prescribed criteria and procedures by which the U.S. would operate Libby Dam to achieve flood control objectives in both the U.S. and Canada. The original flood control study plan was modified in 1991 as described in the *Columbia River and Tributaries Study, CRT-63* and the resulting Standard FC procedure is now used to guide the flood control operation of Libby Dam. The CRT FCOP, dated October, 1999, prescribes criteria and procedures by which the Canadian Entity will operate Canadian Treaty projects. The FCOP also includes utilization of Lake Koocanusa to meet the Treaty requirement through coordination of its operation for flood control protection in Canada. Libby Dam is also operated so as not to conflict with the 1938 IJC Order on Kootenay Lake. Pursuant to the CRT, the United States Entity has been coordinating with the Canadian Entity with respect to the status of ongoing activities during development of the Environmental

Assessment. Consistent with the Treaty and Paragraph V of the Protocol Annex to the Exchange of Notes, the United States may from time to time as conditions warrant adjust the flood control operation at Libby.

The floodplain between Bonners Ferry and Kootenay Lake comprises about 72,000 acres. There are about 190 acres of land in the town of Bonners Ferry within the Kootenai flood plain, including 106 homes, 66 commercial establishments, and 12 public facilities. The floodplain is flat and relatively narrow, with mountainsides rising up along either side. The river meanders considerably within these confines. Historical spring flooding was sometimes extensive. A total of about 100 miles of levees have been built on both sides of the U.S. portion of the river in Idaho, protecting about 35,000 acres of land. Levees have also been constructed on the Canadian portion, protecting additional acreage between the border and Kootenay Lake. This system was started in the 1890s in Canada, and in the 1920s in the U.S. In the U.S., diking districts under county jurisdiction are responsible for dike maintenance, which has been performed to varying degrees of effort and effectiveness. If requested by the counties, the Corps provides emergency flood assistance under Public Law 84-99, and otherwise assesses flood control capabilities as necessary.

Libby Dam and Lake Koocanusa provide approximately 4.98 million acre-feet of usable storage for the purpose of flood hazard reduction. In the Kootenai watershed, spring runoff from snowmelt is the primary cause of flooding. To reduce the risk of spring flooding, drawdown of Lake Koocanusa begins in late August or early September, reducing the pool surface elevation to reach 2411 feet on January 1. The lowered lake provides 2 million acre-feet of storage space for inflow. Through the winter, snowpack is regularly checked, and monthly runoff forecast updates are used to determine storage space requirements in Lake Koocanusa (i.e. how low to draw the lake down) before spring runoff begins. The higher the spring runoff forecast, the deeper the ultimate draft point on March 15 (see Figure 4 and Figure 6 to compare storage volumes under Standard and VARQ FC). Through the spring and early summer, snowmelt and rain gradually fills Lake Koocanusa, typically to the highest elevation of the year by July.

Kootenai River elevations from Bonners Ferry to Kootenay Lake are controlled by two factors: total river discharge, and elevation of Kootenay Lake. Kootenay Lake backs up nearly to Bonners Ferry. Peak Kootenay Lake elevations tend to occur in June, usually slightly after the peak of spring runoff. Elevations for Kootenay Lake at certain times of the year are established by the International Joint Commission (IJC) Order of 1938.

During flood season, Corps reservoir regulators operate Libby Dam to minimize flood impacts by attempting to avoid exceeding river stages in excess of elevation 1764 feet at Bonners Ferry, Idaho. In addition to overbank flooding, other effects of prolonged high river levels include velocity-related bank erosion, elevated water tables, and seepage into agricultural lands (as high river flows elevate the water table near the river).

3.4.2.2. Hungry Horse Dam

The flood control plan (Standard FC) for Hungry Horse Dam was initially described in the 1952 *Reservoir Regulation Manual* (Corps, 1991), and then modified slightly as a result of the 1991 *Review of Flood Control, Columbia River Basin* (Corps, 1991). In 2002, Hungry Horse Dam operations followed the VARQ FC plan (Reclamation, 2002a). The local flood control objective of Hungry Horse Dam is to protect the Columbia Falls area from river flows in excess of 52,000 cfs. The Corps of Engineers has jurisdiction for flood control at Hungry Horse Dam and Reclamation generally operates the project for flood control in coordination with the Corps.

3.4.2.3. Columbia River

Flood damage potential is greatest on the lower Columbia River reach from the Portland-Vancouver area to the mouth of the river. This area suffers winter rainfall floods from the Willamette River as well as snowmelt floods from the Columbia, and it is the most highly developed and populated reach of the river. System flood control is geared to protect the area between Bonneville Dam and the Columbia River mouth from flooding.

On September 16, 1964, the U.S. and Canada ratified the CRT which formed the basis for major hydropower- and flood-control-related developments on the Columbia River system. Under terms of the CRT, four major water storage projects were built: Mica, Arrow, and Duncan in British Columbia, Canada; and Libby in Montana, U.S.[13] The combined active storage of these projects is approximately 25 million acre-feet, which more than doubled the previous storage capacity of the system. This action led to the development of the CRT FCOP completed in draft form in 1968, and finalized in 1972. The FCOP provides the basis for the current Columbia River system flood control operation. The FCOP has undergone subsequent modifications and updates to reflect current knowledge and basin conditions.

The Columbia River at The Dalles, Oregon, is the system control point in the FCOP. The flow objective varies depending on the runoff forecast. In years of low to moderate runoff, the reservoir system can be operated to limit peak flows to a maximum of 450,000 cfs at The Dalles, the level above which significant damage begins to occur. This level of control can be accomplished using a combination of space in Canadian and U.S. storage reservoirs that is provided under the CRT together with the protection afforded by levees. To store extremely high amounts of runoff under the provisions of the CRT, the U.S. Entity may choose to pay for additional water storage in Canadian reservoirs using on-call storage. The on-call storage is not available for routine use and operations.

3.4.3. Dam Safety

3.4.3.1. Libby Dam

Libby Dam is safe and is fully capable of continued operation. In the past, concrete patch repairs were made to portions of the spillway face. These repairs were made under the assumption that the spillway would be infrequently used. During spill events in June and July, 2002, many of the spillway patches dislodged to expose the joints and seams of the underlying spillway facing. Engineers are currently evaluating the areas needing repairs to develop repair plans, specifications, and construction techniques. The design of the spillway repairs will consider the potential for more frequent spillway use to allow Libby Dam to discharge more than powerhouse capacity for sturgeon.

In order to stay within existing state water quality thresholds for TDG, voluntary spillway flows for sturgeon would need to be limited to approximately 1,000 cfs. Spillway flows necessary for

[13] Hungry Horse Dam is not a CRT project.

flood control would likely be more than 1,000 cfs. For example, in 2002, up to 15,000 cfs was discharged via the spillway to accommodate very high inflows to Lake Koocanusa. The spillway surface will require repairs, but the need for repairs does not preclude continued use of the spillway for flood control or fish flow purposes.

3.4.4. Recreation

3.4.4.1. Libby Dam

Lake Koocanusa is an important regional recreational resource on both sides of the international border. There are more than 15 developed recreational sites and a number of dispersed sites associated with the reservoir. Two provincial parks and two recreational areas are located along the lake in British Columbia. With the exception of day-use facilities administered by the Corps, the U.S. Forest Service (USFS) manages all recreational facilities in the U.S. along the reservoir. These facilities are found primarily on the east side of the reservoir. Several private marinas operate on Lake Koocanusa, including one marina in British Columbia, two marinas in the Rexford area, and Lake Koocanusa Resort and Marina a few miles upstream from Libby Dam. Approximately 85% of the recreational use of the reservoir occurs during the summer. Users have expressed concern about the summer draft to elevation 2439 feet for salmon as an impact to reservoir recreation.

Recreational use in the Kootenai River corridor includes fishing, hunting, camping and other outdoor pursuits. Commercial marinas along Lake Koocanusa are dependent on the reservoir filling to within 10 feet of full pool elevation of 2459 feet. Marinas in Montana and British Columbia cater to boaters and anglers during the summer operating season. Average annual visitation for 1987-1993 was 593,200 recreation days (BPA *et al.*, 1995, Appendix J, Recreation).

The Kootenai River downstream of Libby Dam provides an excellent rainbow trout fishery. Although fishing is affected by water level fluctuations caused by dam operation, the fishery is likely superior to that which existed in the free-flowing river prior to dam construction. To the extent possible, dam operations are adjusted to enhance recreational opportunities, including fishing, during the spring and summer.

3.4.4.2. Hungry Horse Dam

Hungry Horse Dam and Reservoir is located in an area rich in opportunities for outdoor recreation. The relatively pristine nature of the area is one of the primary recreational attractions, affording high scenic qualities and the opportunity to see an abundance of wildlife.

At Hungry Horse Reservoir, there are 15 developed recreation sites. Facilities include campsites, picnic areas, boat ramps, and supporting facilities. The primary recreational activities are camping, fishing, boating, hunting, and sightseeing, with peak usage during the summer months. Fluctuation of the reservoir level affects the recreational use, since low reservoir levels preclude easy access to the water.

Along the Flathead River downstream of the dam, the primary recreational activities are fishing, floating, camping, and picnicking. Water level fluctuations in the river can adversely affect recreational opportunities along the river. Dam operations and capabilities have been adjusted in recent years to minimize potential adverse effects on the fishery, most prominently with the addition of a selective withdrawal system that allows the dam to moderate the water temperature of dam discharges.

3.4.4.3. Columbia River

The Columbia River Basin has a diverse landscape that offers a wide variety of outdoor recreation opportunities ranging from wilderness camping to urban waterfront parks. The abundant recreation opportunities help support a tourism industry that is important to the regional economy. Recreational activities in the basin occur year-round but peaks in the late spring through early fall. Where compatible with other project purposes, the system is operated to maintain recreation benefits. Normal operation of the system for FC, power generation, and other purposes may affect optimum conditions for recreation.

The primary attraction for Lake Roosevelt visitors is water-based recreation. Annual visitation exceeds 1.5 million visitor days. The most popular activities are camping, fishing, sightseeing, boating, hiking, picnicking, and swimming. The National Park Service (NPS), the Colville Confederated Tribes, and the Spokane Tribe provide the majority of recreation facilities on Lake Roosevelt. The facilities include a wide array of highly developed campgrounds and day-use areas to primitive sites that can only be accessed by boat. There are also commercial facilities available at several privately run marinas. Rental houseboats are very popular at the marinas. The Lake Roosevelt fishery accounts for 140,000 to 300,000 angler trips annually (Underwood, 2000)

All of the recreation facilities and recreation activities on Lake Roosevelt are affected by reservoir operations. In general, drawdown during the recreation season has a negative impact on recreation use.

Reclamation provides visitor facilities and guided tours at Grand Coulee Dam. A popular laser light show plays nightly across the face of the dam during the tourist season. The dam’s visitor center is open year-round.

3.4.5. Transportation

3.4.5.1. Libby Dam

The only waterborne or other transportation aside from recreational boats (on the reservoir, river, and Kootenay Lake) that is directly affected by Libby Dam is the ferry on Kootenay Lake which traverses northeast across the lake from Balfour to Kootenay Bay. This ferry system operates year-round.

3.4.5.2. Columbia River

Two ferries operate on Lake Roosevelt. The ferries are at (from north to south), Inchelium-Gifford, and Keller. Both the Inchelium-Gifford and Keller ferries carry normal highway traffic and are free.

The ferry between Inchelium and Gifford is managed by the Confederated Tribes of the Colville Indian Reservation, provides access to the Colville Reservation from Washington State Highway 25, and cannot operate at lake elevations below 1225 feet.

The Keller Ferry, part of Washington State Highway 21, crosses the Columbia River at its confluence with the Sanpoil River from Ferry County and the Colville Indian Reservation on the north bank to Lincoln County on the south. It can operate through the operating range of the lake, from elevation 1208 to 1290 feet but, when the normal terminal is affected by low water, the ferry must utilize an old road bed nearby to come ashore.

3.4.6. Power

3.4.6.1. System Coordination

Hydroelectric dams on the Columbia and Snake Rivers are the foundation of the Northwest's power supply; falling water is the "fuel" for power-generating turbines at the dams.

Hydropower accounts for approximately 75% of the Northwest's electricity supply. When there is a surplus, it is an important export product for the region. BPA markets and distributes the power generated by the Corps and Reclamation at the federal projects in the Columbia River Basin, selling power from the dams and other generating plants to public and private utilities in the region, utilities outside the region, and some of the region's largest industries. Power lines originate at generators at the dams and extend outward to form key links in the regional transmission grid. BPA operates the transmission system, which consists of approximately 15,000 circuit miles. The Northwest grid is interconnected with Canada to the north, California to the south, and other states to the east. Power produced at dams in the Northwest serves customers both locally and thousands of miles away.

The CRT and the Pacific Northwest Coordination Agreement (PNCA) guide coordinated planning.

3.4.6.1.1. The Columbia River Treaty

The Treaty requires an Assured Operating Plan for Canadian Treaty storage to be developed for the sixth succeeding operating year from hydro-regulation studies designed to achieve optimum power and flood control benefits in Canada and the U.S. The Assured Operating Plan defines the operating criteria for Mica, Duncan, and Arrow that will be used in actual operations unless otherwise agreed. The Detailed Operating Plan is prepared for the upcoming operating year and includes operating criteria from the Assured Operating Plan with any agreed changes. Information from the Detailed Operating Plan is included in plans developed under the PNCA, as releases from Canadian storage reservoirs are important for coordinated system planning in the United States. Coordination of the operation of Libby Dam between the U.S. and Canada is through the Libby Coordination Agreement.

3.4.6.1.2. The Pacific Northwest Coordination Agreement

The basis for planning power coordination among the hydropower facilities in the Columbia Basin in the United States is the PNCA. Coordinating system operations through annual planning is useful as it enables power generators to plan optimal use of the resource and to use their resources to operate hydro and thermal resources more efficiently. They can produce more power and operate for non-power requirements with greater reliability through coordination than they could by operating independently.

3.4.6.2. Libby Dam

The Libby Dam powerhouse contains 8 generator bays, with 5 units currently in operation (Units 1 through 5) and three partially completed units that are not operational (Units 6 through 8).[14] The maximum discharge capacity of the powerhouse is slightly more than 28,000 cfs under certain reservoir conditions. The routine electrical generating capacity at Libby Dam is 525 megawatts (MW), with a peak generating capacity, under optimal conditions, of 600 MW.

3.4.6.3. Hungry Horse Dam

The Hungry Horse Dam powerhouse contains 4 generating units. The maximum discharge capacity is 12,600 cfs. The routine electrical generating capacity at Hungry Horse Dam is 408 MW, with a peak generating capacity, under optimal conditions, of 428 MW.

3.4.6.4. Columbia River

The Columbia-Snake River system has been heavily developed for hydroelectric power. More than 250 hydroelectric projects have been constructed in the basin. The integrated system of hydroelectric projects in the Columbia River Basin has a total installed generating capacity of more than 36,000 MW. The 14 Federal projects in the FCRPS account for 18,900 MW. Nine Federal and a variety of private and provincial projects are located within areas potentially affected by the proposed action. Table 3 lists some characteristics of selected hydroelectric facilities in the Columbia River Basin.

[14] In units 6 through 8, only the turbines are installed. The generators and electrical control equipment have not been installed but are stored in the powerhouse. Additional funding and possibly additional authorization is required to complete the installation of units 6 through 8.

Table 3. Characteristics of U.S. and Canadian Hydroelectric Projects in Study Area

Project	Operator	Location	Year Completed	Nameplate Electrical Capacity (MW)
Libby	Corps	Kootenai River near Libby, MT	1973	525
Corra Linn	West Kootenay Power	Kootenay River near Nelson, BC	1932	40
Kootenay Plants[a]	West Kootenay Power	Kootenay River near Nelson, BC	various	157
Kootenay Canal	BC Hydro	Off the Kootenay River near Nelson, BC	1975	528
Brilliant	West Kootenay Power	Kootenay River near Castlegar, BC	1944	109
Hungry Horse	Reclamation	S. Fork of the Flathead River, near Hungry Horse, MT	1953	408
Kerr	Montana PPL	Flathead River, near Polson, MT	1938	168
Noxon Rapids	Washington Water & Power	Clark Fork, near Noxon, MT	1959	397
Cabinet Gorge	Washington Water & Power	Clark Fork, near Clark Fork, ID	1953	200
Albeni Falls	Corps	Pend Oreille River, near Newport, WA	1955	42
Box Canyon	Pend Oreille PUD	Pend Oreille River, near Ione, WA	1955	60
Boundary	Seattle City Light	Pend Oreille River, near Metaline Falls, WA	1967	1055
Seven Mile	BC Hydro	Pend Oreille River, near Waneta, BC	1979	607
Waneta	West Kootenay Power	Pend Oreille River, near Waneta, BC	1944	288
Grand Coulee	Reclamation	Columbia River, at Grand Coulee, WA	1942	6494
Chief Joseph	Corps	Columbia River, near Bridgeport, WA	1961	2069
McNary	Corps	Columbia River, near Umatilla, OR	1957	980
John Day	Corps	Columbia River, near Rufus, OR	1971	2160
The Dalles	Corps	Columbia River, at The Dalles, OR	1960	1696
Bonneville	Corps	Columbia River, at Bonneville, OR	1938	1050

[a] Includes Upper Bonnington, Bonnington, Lower Bonnington, and South Slocan projects

SOURCE: Corps of Engineers, 1989.

4. DEVELOPING ALTERNATIVES

Alternatives developed for this EA focus on interim operations at Libby and Hungry Horse Dams. Variables considered in developing these alternatives include flood control operation at Libby Dam, maximum flows discharged from Libby Dam for benefit of Kootenai River white sturgeon, and the maximum Lake Koocanusa draft for benefit of salmon in the Columbia River. The following sections discuss the variables used in developing the alternatives.

4.1. Flood Control Operation

Currently, Libby Dam operates using Standard FC and Hungry Horse Dam operates with VARQ FC. VARQ FC is being considered as an alternative flood control procedure at Libby Dam (See Section 2.4.1). EA Alternatives will include these permutations: Standard FC at Libby Dam and VARQ FC at Hungry Horse Dam; or VARQ FC at Libby and Hungry Horse Dams.

4.2. Libby Dam Sturgeon Flow

The ultimate discharge capacity through all outlets (powerhouse, spillway, sluices) at Libby Dam exceeds 200,000 cfs (Corps, 1984). Powerhouse capacity is currently about 28,000 cfs under certain conditions. The potential powerhouse discharge from Libby Dam depends on the efficiency and capacity of the turbines and the amount of water surface elevation difference between the forebay (the reservoir immediately behind the dam) and the tailrace (the river downstream of the dam). When the reservoir is close to full,[15] maximum powerhouse output at Libby Dam is approximately 25,000 cfs. At lower pool levels or while operating the turbines at lower efficiency at high pool levels, maximum powerhouse discharge can exceed 25,000 cfs.[16] For example, powerhouse discharge reached about 28,000 cfs during the high flow year of 1997.

Since installation of the fifth turbine in 1984, Libby Dam has routinely discharged 25,000 cfs for power production and flood control purposes and, since the early 1990s, powerhouse discharges of up to 25,000 cfs have been released during the late spring/early summer as requested by the USFWS for the benefit of endangered Kootenai River white sturgeon. The USFWS 2000 FCRPS BiOp calls for an increase in the routine dam discharge capacity during the spring and early summer to up to 35,000 cfs, 10,000 cfs above current powerhouse capacity[17] (USFWS, 2000).

Libby Dam discharge for sturgeon flows during the late spring/early summer would be achieved by discharging powerhouse capacity (near 25,000 cfs when the reservoir is close to full) plus the allowable flow through the spillway so as not to cause TDG in the Kootenai River directly

---

[15] The full pool elevation of Lake Koocanusa is 2,459 feet.

[16] The highest possible powerhouse discharge occurs with a combination of lower pool levels (less than 2,437 feet) and maximum power production. While powerhouse discharges greater than 25,000 cfs are possible when the reservoir is close to full, this practice is avoided, as it is likely to lead to mechanical problems.

[17] Dam discharges up to 35,000 cfs for sturgeon are not within the scope of the current EA since controlled releases of 35,000 cfs for sturgeon are not currently achievable with the existing dam configuration. Maximum powerhouse discharge capacity could be increased with installation of additional turbines. Seattle District is investigating the feasibility of additional turbines and transmission capacity at Libby Dam as required by the 2000 USFWS FCRPS BiOp as one way to increase the routine discharge at Libby Dam for benefit of white sturgeon. Sturgeon releases up to 35,000 cfs will be evaluated in the EIS on potential long-term implementation of VARQ FC and fish flows, or other preferred alternative

downstream of the stilling basin to exceed the State of Montana's water quality standard for TDG.[18]. Monitoring completed during spill events in June and July, 2002 indicates that a spillway flow above 1,000 cfs could increase TDG above 110% as measured at the tailrace (immediately downstream of the spillway). Therefore, all alternatives in this EA assume the maximum controlled dam discharge for sturgeon flows is 26,000 cfs (25,000 cfs powerhouse discharge plus 1,000 cfs spillway flow).[19]

4.3. Lake Koocanusa Salmon Draft

Under the NMFS 2000 FCRPS BiOp, certain storage reservoirs (Libby, Hungry Horse, Grand Coulee, Banks Lake, and Dworshak) in the Federal Columbia River Power System (FCRPS) are drafted as necessary within specified limits in an attempt to meet the summer flow objectives and to provide colder water for the benefit of migrating juvenile salmonids (NMFS, 2000a). The summer draft at Dworshak Dam may also benefit adult salmonid passage by moderating temperatures (NMFS, 2000b). To provide the greatest potential benefit, summer flow augmentation, and the corresponding reservoir drafting, occurs in July and August. The timing of the releases is based on fish migration timing since most of the fish pass through the FCRPS by the end of August.

The Corps manages Libby Dam to refill Lake Koocanusa to 2459-feet elevation by July, when possible. After peak reservoir refill or July 1, the NMFS 2000 FCRPS BiOp specifies water releases from Libby Dam to augment Columbia River flows for salmon (NMFS, 2000a). According to the NMFS 2000 FCRPS BiOp, draft for salmon flow augmentation is limited to 2439-feet elevation (20 feet from full pool) by August 31.[20] A draft of 20 feet from full pool at Libby Dam provides up to 891,000 acre-feet of additional water from Lake Koocanusa. In any given year, the timing and magnitude of the summer draft for salmon are coordinated through the in-season management process.[21] This process may address additional releases below the draft limits specified in the NMFS 2000 FCRPS BiOp. The effects of such additional drafts were addressed in the 1995 Columbia River System Operation Review (BPA *et al.*, 1995).

The NMFS 2000 FCRPS BiOp 2439-foot draft limit assumes improved water availability from VARQ FC (NMFS, 2000a). Taking sturgeon and bull trout flows into account, the peak reservoir level would theoretically be higher with VARQ FC than with Standard FC.

4.4. EA Alternatives

There are two alternatives analyzed in this EA (Table 4). The first alternative consists of Standard FC at Libby and VARQ FC at Hungry Horse. This includes sturgeon flows of 26,000 cfs (full powerhouse capacity plus spill that does not generate greater than 110% TDG

---

[18] The Montana State water quality standard for total dissolved gas is 110%.
[19] The Corps is coordinating with the Montana Department of Environmental Quality on issues concerning TDG measurement and reasonable water quality standards for Libby Dam.
[20] If Lake Koocanusa does not fill above 2,439 feet, releases for salmon flow augmentation are not required.
[21] In some years, the salmon draft at Lake Koocanusa may be reduced, with the Lake Koocanusa water exchanged or swapped with water from Canadian reservoirs under the Libby Coordination Agreement.

immediately below the dam)[22] and potential salmon draft to 2439-feet elevation, at Libby Dam. This alternative is considered the base case or No-Action Alternative.

The second alternative consists of implementing an interim VARQ FC at Libby and Hungry Horse Dams. This alternative includes with sturgeon flows up to 26,000 cfs[23] and potential salmon draft to 2439-feet elevation at Libby Dam. This alternative is consistent with the NMFS and USFWS 2000 FCRPS BiOps (NMFS, 2000a; USFWS, 2000).

Due to concerns about high TDG levels resulting from more than about 1,000 cfs of spill, the increase in Libby Dam discharge to 35,000 cfs is not part of any alternatives considered in this EA because we cannot operate at that flow without structural modification to the dam. Such structural modifications cannot be considered in the time required for the decision on interim dam operations.

Reclamation began implementing VARQ FC at Hungry Horse Dam in 2001. In March 2002, Reclamation published a Voluntary Environmental Assessment (Reclamation, 2002a) for interim VARQ implementation, with a Finding of No Significant Impact. Reclamation's Voluntary EA stated that, based on the information available at that time, implementing VARQ FC at Hungry Horse in 2002, 2003, and 2004 was not considered a major federal action in and of itself. All of the EA alternatives have VARQ FC at Hungry Horse, so local effects on Flathead River will not be evaluated in this EA, except where additional information or analysis can supplement Reclamation's 2002 voluntary EA. Please refer to Reclamation's voluntary EA (which can be downloaded from www.pn.usbr.gov/project/salmon/pdf/VARQFONSI.pdf) for details about the effects on the Flathead River system from interim implementation of VARQ at Hungry Horse Dam.

Table 4. Alternatives for flood control and fish operations[a] interim implementation in the upper Columbia basin

Alternative Name	**Flood Control Operation**	**Sturgeon Flow from Libby Dam**	**Potential Libby Salmon Draft [b, c]**
Standard FC with fish flows	Standard FC	Powerhouse Capacity plus 1,000 cfs (~26,000 cfs)	2439 feet
VARQ FC with fish flows	VARQ FC	Powerhouse Capacity plus 1,000 cfs (~26,000 cfs)	2439 feet

[a] For all alternatives, bull trout minimum flows would be provided from Libby and Hungry Horse Dams.

[b] The NMFS2000 FCRPS BiOp specifies that water up to the draft limit could be called for summer flow augmentation (see Section 4.3 for more details).

[c] For all alternatives, potential salmon draft at Hungry Horse Dam would be to 3,540 feet.

4.5. Evaluating the Alternatives

To analyze the effects of these alternatives on the hydrology of the Kootenai, Flathead and Columbia Rivers, simulated hydro-regulations were completed. The model runs completed for

[22] Flows discharged from Libby Dam may exceed the maximum sturgeon flows if necessary for flood control purposes.
[23] Ibid.

the EA were slightly different to the EA alternatives as defined in Section 4.4; the model runs provide information about relative changes between the flood control procedures. More details on the model runs and how they relate to the EA alternatives are provided in Appendices D, E, and F. See Section 5.1.2.1.1 for a discussion of real-time water management and its relation to modeled hydro-regulation.

5. EFFECTS OF THE ALTERNATIVES

Consistent with the discussion of existing conditions, separate Libby Dam, Hungry Horse Dam, and Columbia River sections are presented for most evaluation factors. The Libby and Hungry Horse Dam sections include both up- and downstream areas. For example, any discussion of the Kootenai River or Kootenay Lake is included in the Libby Dam section.

Effects relating to interim implementation at Hungry Horse Dam are discussed in Reclamation's 2002 voluntary EA (Reclamation, 2002a), which is incorporated into this EA by reference. Reclamation's voluntary EA determined that interim implementation of VARQ FC at Hungry Horse would result in small changes in seasonal hydrologic operations that would be within historical ranges. Minor to indiscernible impacts were expected for all resource categories, while there would be immediate benefits to threatened and endangered resident and anadromous fish species. The effects at Hungry Horse Dam and the Flathead River Basin are generally not discussed further here except in cases where new and updated information has become available since Reclamation's voluntary EA. Effects to Lake Roosevelt consider changes resulting from the combined operation of Libby and Hungry Horse Dams.

5.1. Physical Characteristics

5.1.1. Geology

For all alternatives, no impacts to the geology within the project area are anticipated.

5.1.2. Climate and Hydrology

For all alternatives, no impacts to the climate within the project area are anticipated. The different flood control and fish flow scenarios comprising the alternatives would influence hydrology as discussed below. Effects on hydrology in the Flathead, Clark Fork, and Pend Oreille river basins relating to interim implementation at Hungry Horse Dam are discussed in Reclamation's 2002 voluntary EA (Reclamation, 2002a) and are not discussed further here.

5.1.2.1. Libby Dam

5.1.2.1.1. Real-Time Flood Control Operations

5.1.2.1.1.1. General

The Corps in general, and its Reservoir Control Center (RCC) in particular, is responsible for determining river operations for multiple purposes at Corps projects in the Columbia River Basin. As a general principle of flood control operations, during the January through April time period, reservoirs are drafted to create space in preparation for the refill period when the reservoir captures the spring run-off. The flood control operations are based on real-time responses to current conditions. These responses are informed by a variety of available tools. These include water supply forecasts, weather predictions, and the current status of reservoir elevations. It is important to note that these tools provide information and input; however, they are not conclusive. Managing this large river system has many complexities and uncertainties, requiring the Corps to exercise its best professional judgment in making flood control decisions.

In the determination of daily reservoir release decisions, there are many variables to consider:

- long-term weather predictions;
- short-term weather forecasts (temperature and rainfall);
- snowpack;
- expected remaining water supply;
- reservoir storage;
- power system requirements (cold snaps, transmission limitations, power demands);
- CRT requirements; and
- fish needs.

These variables are merely indicators of conditions, as they can and do change. Each day, RCC examines these variables and develops management strategies to meet the multi-purpose uses of the system and individual reservoirs. The strategies must take into account the near-term (three days) conditions, but must also be consistent with longer-range objectives of the next several months. Adjustment by water managers of operations made in response to changing conditions and new information is called "adaptive management." It is a deliberate and necessary process. The ability to change operations and adapt to condition cannot be simulated in a model.

5.1.2.1.1.2. Drawdown

During the drawdown period, January through April, the Corps establishes the appropriate flood control reservoir draft point for all reservoirs, for the end of each of those months. Water supply forecasts are used to determine these end-of-month draft points. The water supply forecasts are developed using estimated or projected future weather conditions. Currently, the water supply forecast used by the Corps to determine end-of-month draft points at Libby for system flood control is the Wortman-Morrow forecast. The National Weather Service's River Forecast Center (RFC) also develops water supply forecasts each month. The RFC forecast provides the Corps with additional input about the potential trend of future forecasts throughout each month. The RFC forecast is usually similar in magnitude to the Corps' monthly official forecast and adds confidence to the assessment of the general magnitude of the water supply forecast.

5.1.2.1.1.3. Refill

Generally, by the end of April, depending on the magnitude of the water supply forecast and expected future run-off, reservoirs reach their maximum draft for flood control for the season, as the snowpack has usually finished accumulating and reached its maximum quantity for the season. Once the snowpack begins to melt, the refill season is triggered and the reservoirs begin to operate for system flood control. During the refill period, generally May through June, in order to make real-time operational decisions, daily monitoring by water managers includes reviewing weather reports, the status of remaining snowpack, the expected remaining water supply, and the remaining available reservoir storage across the Columbia River Basin. The Corps relies upon the National Weather Service and the RFC to develop weather input and inflow forecasts in May and June. The Corps may receive weather briefings from the RFC as often as twice daily during storm events that may have the potential to cause a rapid melt of the remaining snowpack in the basin.

While the Corps monitors the reservoir refill to capture expected remaining inflow, regional discussions in the Technical Management Team (TMT) of the NMFS Regional Forum occur concerning water releases from each reservoir for fish needs downstream. Within this forum, current water supply forecasts and information developed by the RFC regarding potential inflow and weather information are considered, while the salmon managers offer information about current fish needs. Ultimately river operations are developed first to meet flood control requirements, while managing for fish flow needs, and balancing reservoir refill with other project purposes.

5.1.2.1.1.4. Conclusions

Real-time operations and adaptive management continue throughout the year in response to changes in weather variables. In addition, power generation requests and river flow management recommendations for fishery needs are a year-round activity, and at times are in conflict. The most challenging period to manage is the spring snowmelt season of May through July.

It is not possible to model the complexities presented to water managers during real-time operations, and therefore the model results cannot reflect what occurs in real-time. For this reason, the results produced from the models used to inform the EA are better analyzed as relative comparisons, rather than as actual predictions of flow or stage.

5.1.2.1.1.5. Comparison of Modeled Operations to Real-Time Operations During Refill (Sample Year 2002)

The difference between adaptive management and a rigid model template can be demonstrated by comparing the actual 2002 Libby Dam outflows to modeled outflows using a rigid fish flow template to model 2002 hydrology.

For this analysis, the modeler assumed that the Lake Koocanusa reservoir elevations and Libby Dam outflow were the same as the observed operation until the commencement of refill in mid-May. In 2002, the official fish flow request was for 8,000 cfs for bull trout beginning May 15 and full powerhouse for sturgeon at the end of June. To allow meaningful comparison of the modeled results to actual real-time operations, this 2002 fish flow request (rather than the template described in Section 5.1.2.1.4.1 and Appendix A) was modeled as a template and compared to the observed 2002 operations.

On July 2, 2002, actual Libby Dam discharge reached a peak outflow of 40,000 cfs. This was after the Corps managed Libby outflow by increasing discharge twice during refill to regain storage capacity in Lake Koocanusa.

The modeled results showed the computed project outflow would have peaked at nearly 60,000 cfs on June 29 and 30 and remained above 50,000 cfs for four days (Figure 11). This modeled result is attributed to the adherence to the 2002 fish flow request as the model input, whereas the actual observed conditions in 2002 managed by RCC resulted in a peak discharge at Libby substantially below the peak discharge predicted by the model.

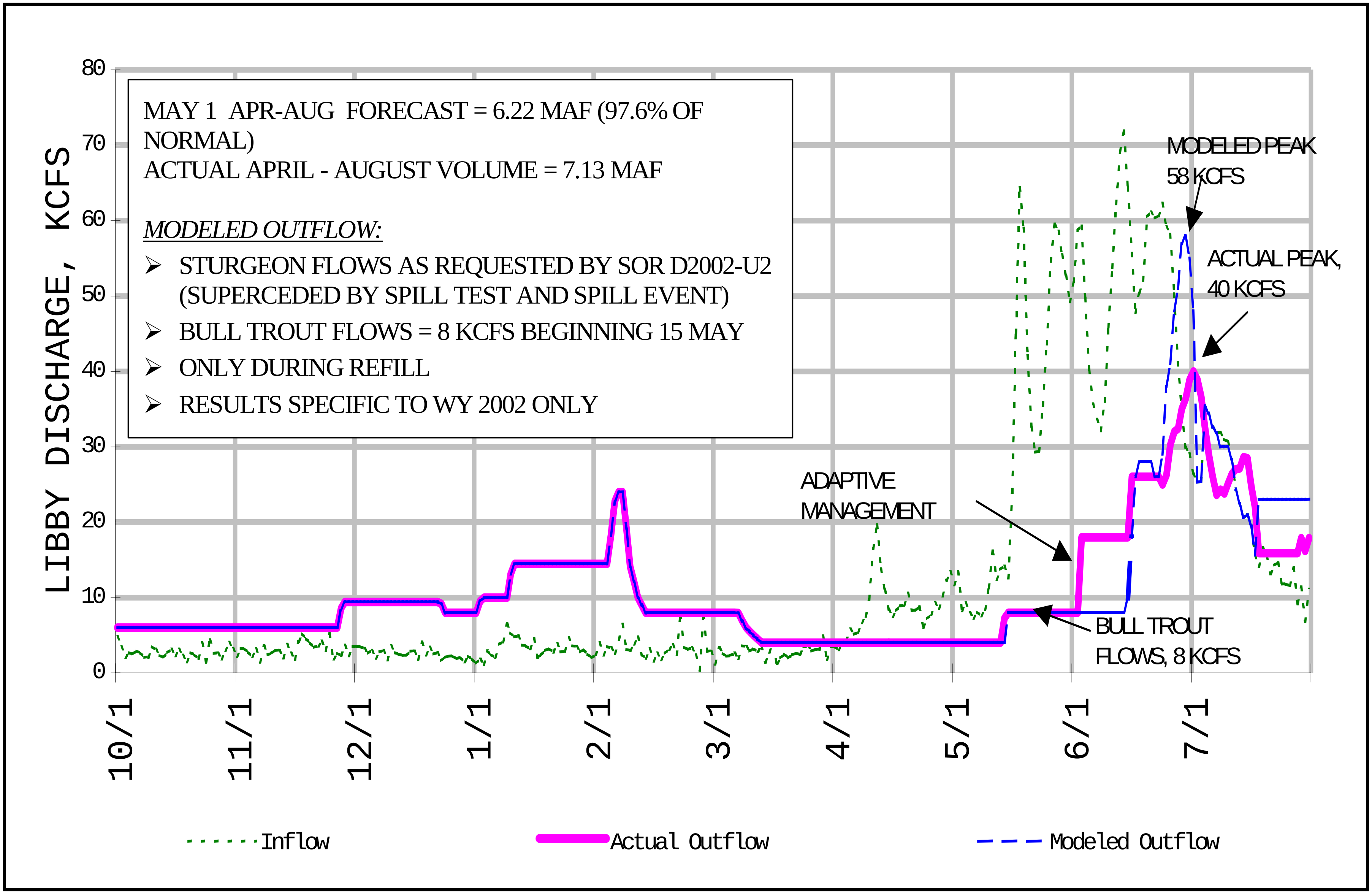


Figure 11. Libby Actual And "Modeled" Operations – Standard Flood Control And Revised Fish Flows For Water Year

5.1.2.1.2. Hydrology Modeling Procedure

Three successive hydrologic modeling studies were used to develop information for this EA and each builds upon the previous one. Detailed descriptions of the modeling studies can be found in Appendices D (Kootenai River Local Flood Control Report), E (Columbia Basin System Flood Control Report), and F (Columbia Basin System Multi-Purpose Hydrology Report).

The hydrology modeling studies rely on a set of assumptions and produce output that allows us to compare conditions under different operational scenarios. The models do not necessarily represent actual conditions that would occur in real-time operations (see Sections 5.1.2.1.1 for more details).

The first set of studies was developed for the entire Columbia River system where the system was operated as a single-purpose system – to meet flood control only – and does not include power drafts or fish flow operations. These studies were prepared to evaluate potential impacts to system flood control and local flood control using daily time-step flows for the entire system above The Dalles, OR. All reservoirs were operated to meet the system flood control criteria defined in the CRT 1999 FCOP. In these sixty-year studies, each year began on October 1 with each reservoir in the system initialized at full or at its October 1 flood control elevation, whichever is lower. All reservoirs were drafted through April on the elevations calculated using storage reservations diagrams (SRDs) and simulated water supply forecasts. This procedure was followed for all projects used for system flood control, including Canadian projects and Snake River projects.

Development of the model scenarios is based on assumptions that may be somewhat subjective. Modelers may take a slightly different approach to a given hydrologic condition. In development of the sixty years modeled using a daily time step for system flood control for this EA, the modeler tried to assume no foreknowledge of runoff or climatological conditions. The system was modeled using both the Standard FC SRDs and VARQ FC SRDs at Libby and Hungry Horse.

The purpose of modeling each of the sixty historic water years using Standard FC and VARQ FC was to refine the upper limit operations at Libby, Hungry Horse, and Grand Coulee during the refill period of May through July. The upper limit flood control elevations at the end of May, June and July could then be used as input to the second study; ten years that were regulated on a daily time step and included fish flow at Libby and Hungry Horse during the spring period (see Section 5.1.2.1.4). These upper limit elevations were also input to the third study; monthly time step multi-purpose models that were developed using the Corps' (Hydro System Seasonal Regulation (HYSSR) model.

It is critical for the reader to understand that while the model results are useful for comparison, they are not necessarily representative of what may actually occur during real-time operation. This means that although the relative differences between Standard FC and VARQ FC are likely accurate, the model output for any given year (such as maximum daily stage, maximum Libby outflow, etc.) is likely different from what would result from real-time water management during a year with the same hydrologic characteristics. The differences between real-time operations and modeled scenarios are discussed further in Section 5.1.2.1.1. The modeled scenarios do not incorporate the project operator's real-time adaptive management decision-making that may change outflow from Libby Dam, nor do they include other system operations such as fish or power operations that would result in different project releases. Such adaptive management may result in less extreme conditions than the models predict (see Section 5.1.2.1.1 for more details). Additionally, the forecasts used in Libby Dam operations are different than those used in the modeled scenarios for this EA (see Section 5.1.2.1.4.1).

5.1.2.1.3. Daily Time Step Hydrologic Model

The daily time step model results can be used to develop frequency curves or exceedance curves that allow comparison of different water management strategies. The daily time step models compare the different flood control strategies and do not incorporate fish flows, power operations, or any other multi-purpose operation of the FCRPS. They allow comparison of how the different flood control strategies perform over the period of record (1929-1989).

To further emphasize Section 5.1.2.1.1, although the data determined from the modeled scenarios may be representative of the trend of outcomes for each scenario, they are not meant to represent definitive expectations or predictions of actual dam operations in the past or future.

The output discussed in this section is a product of the daily time step model scenarios, where the system is regulated for flood control only. Four results of the daily time step model runs for flood control are discussed below: Libby Dam outflows, Lake Koocanusa refill, Bonners Ferry river stage, and Kootenay Lake elevation.

5.1.2.1.3.1. Lake Koocanusa Refill

Simply comparing Standard FC to VARQ FC (without fish flows), the reservoir under VARQ FC is generally not drafted as deeply in the months of January through April as when Standard FC is used. In fact, with VARQ FC the reservoir is above elevation 2400 feet 60% of the time, as compared with Standard FC, when it is only above that elevation 25% of the time. This is shown in the elevation-duration graph shown in Figure 12. During the reservoir refill period in the spring and early summer, VARQ FC leads to higher reservoir elevations than Standard FC in May and June (Figure 13). By July, there is no significant difference in reservoir elevation between flood control methods.

5.1.2.1.3.2. Libby Dam Outflow

Simply comparing Standard FC to VARQ FC (without fish flows), Figure 14 shows a flow frequency curve of the daily maximum outflow from Libby Dam during May, June, and July (the portion of the snowmelt runoff season when floods are most likely to occur). At the onset of refill in average to slightly-below-average runoff years, the reservoir is at a higher elevation with VARQ FC than it would have been with Standard FC. Once refill begins in average to below average runoff years, the reservoir releases under VARQ FC are generally greater than those with Standard FC. For the more common conditions that are expected to occur about 20% of the time (corresponding to a modeled peak outflow of about 15,000 cfs or less), the model indicates that VARQ FC outflows are consistently higher than Standard FC outflows. Modeled releases

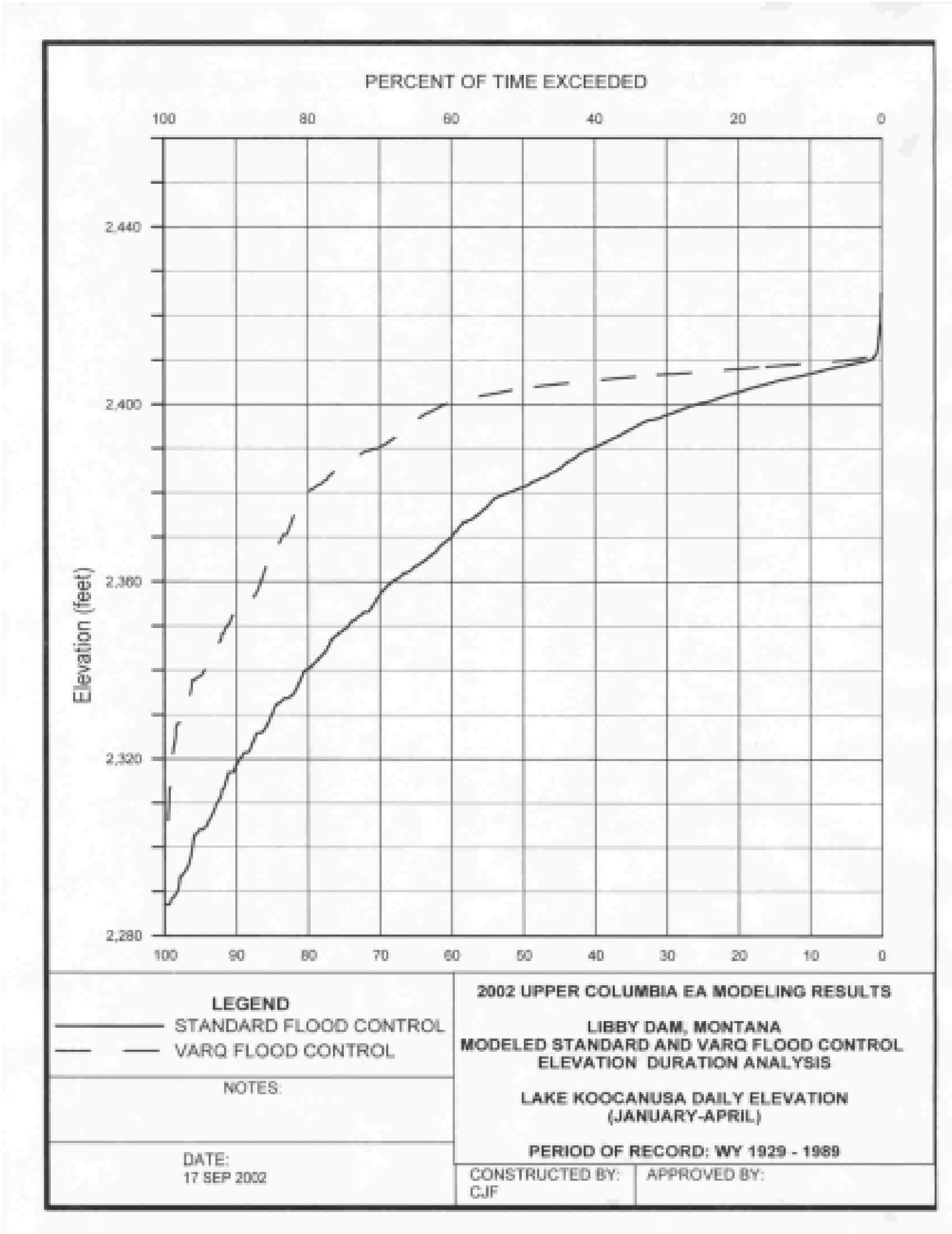


Figure 12. Elevation-Duration Analysis: Lake Koocanusa Daily Elevation (January-April)

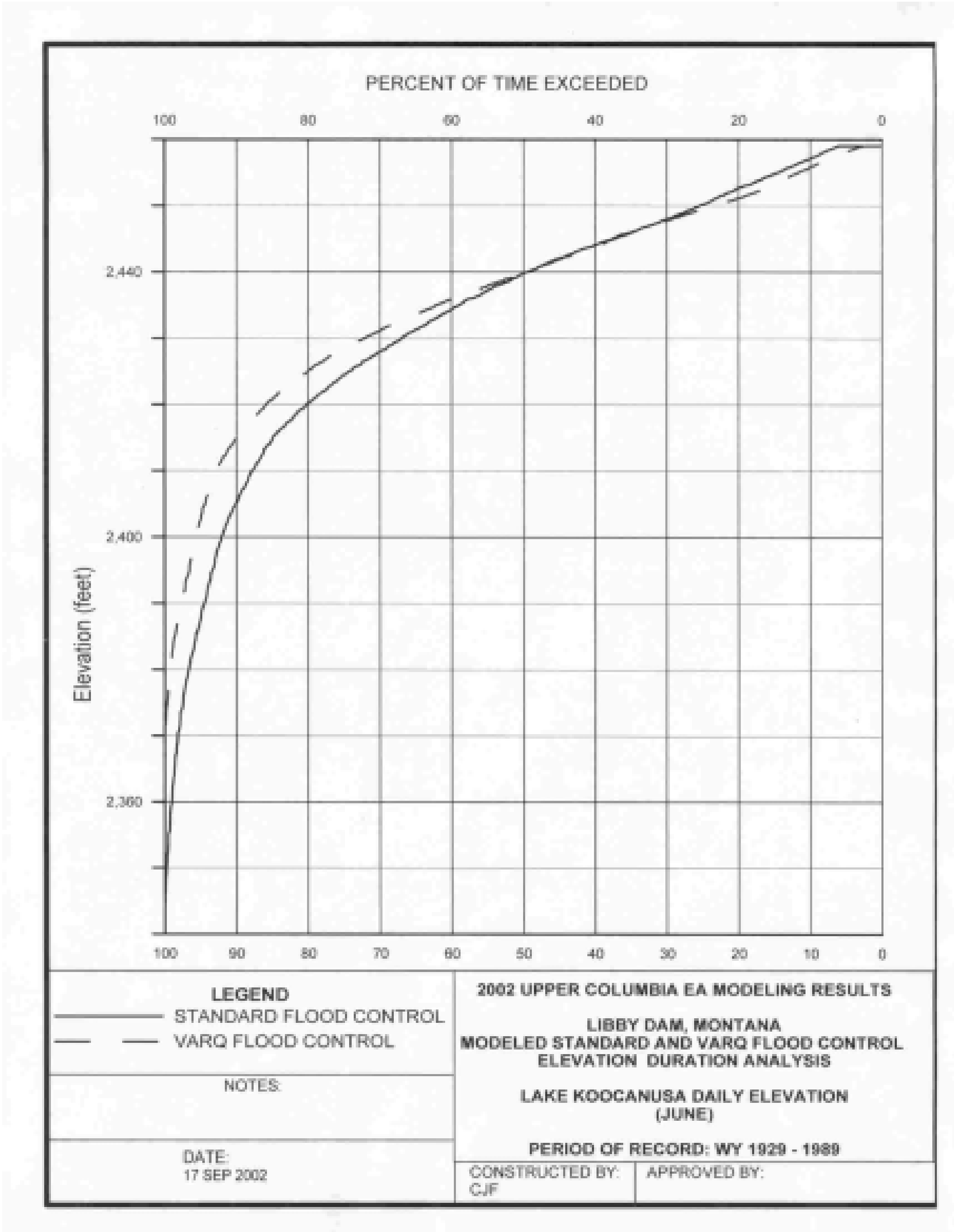


Figure 13. Elevation-Duration Analysis: Lake Koocanusa Daily Elevation (June)

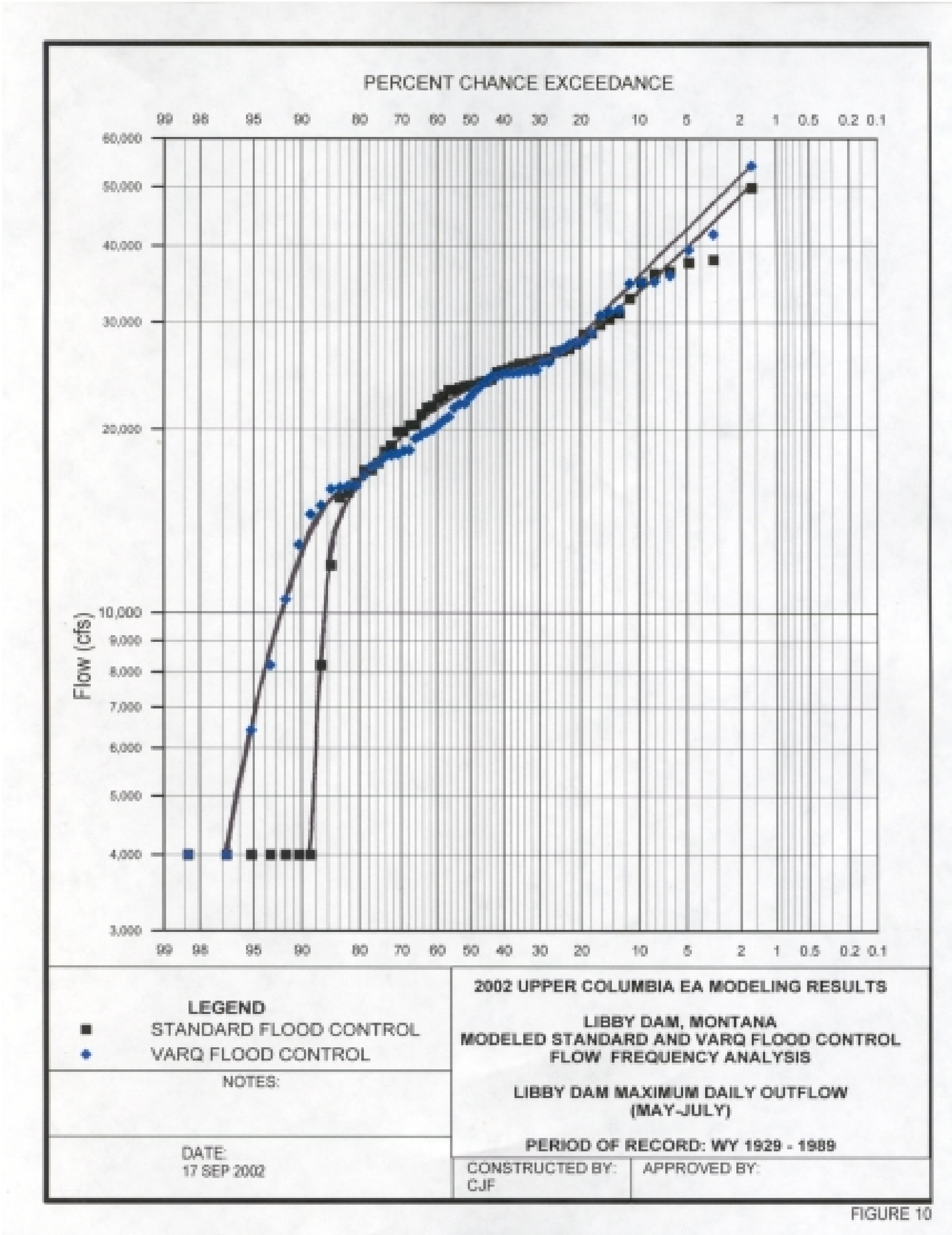


Figure 14. Flow-Frequency Analysis: Libby Dam Maximum Daily Average Outflow (May-July)

between about 16 and 80 percent chance exceedance (corresponding to a modeled outflow of about 30,000 cfs) are similar under both flood control operations. For the years where the expected percent chance of exceedance is about 16-18%, the model indicates that outflow from Libby Dam may exceed 30,000 cfs. In real-time operation, infrequent situations (the right side of Figure 14) with large runoff years tend to have a higher risk of spill from Libby Dam under either Standard FC or VARQ FC, with VARQ FC releases being slightly higher than Standard FC releases.

5.1.2.1.3.3. Bonners Ferry River Stage

If there is a chance of high flows from Libby Dam in large runoff years, there may be a chance of high flows at Bonners Ferry, Idaho, too. In large, infrequent water years, there may be risk that the peak stage of the Kootenai River will exceed flood stage elevation of 1764 feet at Bonners Ferry under either Standard FC or VARQ FC.

Figure 15 shows the comparison of daily maximum river stage at Bonners Ferry during the spring freshet under Standard FC and VARQ FC. The curves represent a regulated frequency curve and therefore have some level of subjective decision-making embedded in the output. Since these scenarios were prepared with strict modeling guidance and no compensation for adaptive management, real-time operations results may vary (see Section 5.1.2.1.1). The model results indicate that river stages under both VARQ FC and Standard FC tend to converge at the flood stage for about 10 percent chance exceedance. At less frequent events, the model indicates that there may be additional risk of exceeding flood stage at Bonners Ferry, Idaho with VARQ FC. However, in-season adaptive management of Libby Dam operations provides more input for water managers to respond to changing conditions than allowed in the rigid assumptions of any hydrologic model. Such adaptive management may result in less extreme conditions than the models predict (see Section 5.1.2.1.1 for more details).

5.1.2.1.3.4. Kootenay Lake Elevation

A daily elevation-frequency curve specific to May through July is provided in Figure 16. The frequency curve shows that when VARQ FC is used, the level increases for Kootenay Lake. The two curves appear to converge around 11 percent chance exceedance (with a modeled lake elevation of 1751 feet), but then split from each other again for lower percent-chance-exceedance events (on the right side of the graph), with the simulated VARQ FC elevation always higher than the simulated Standard FC elevation.

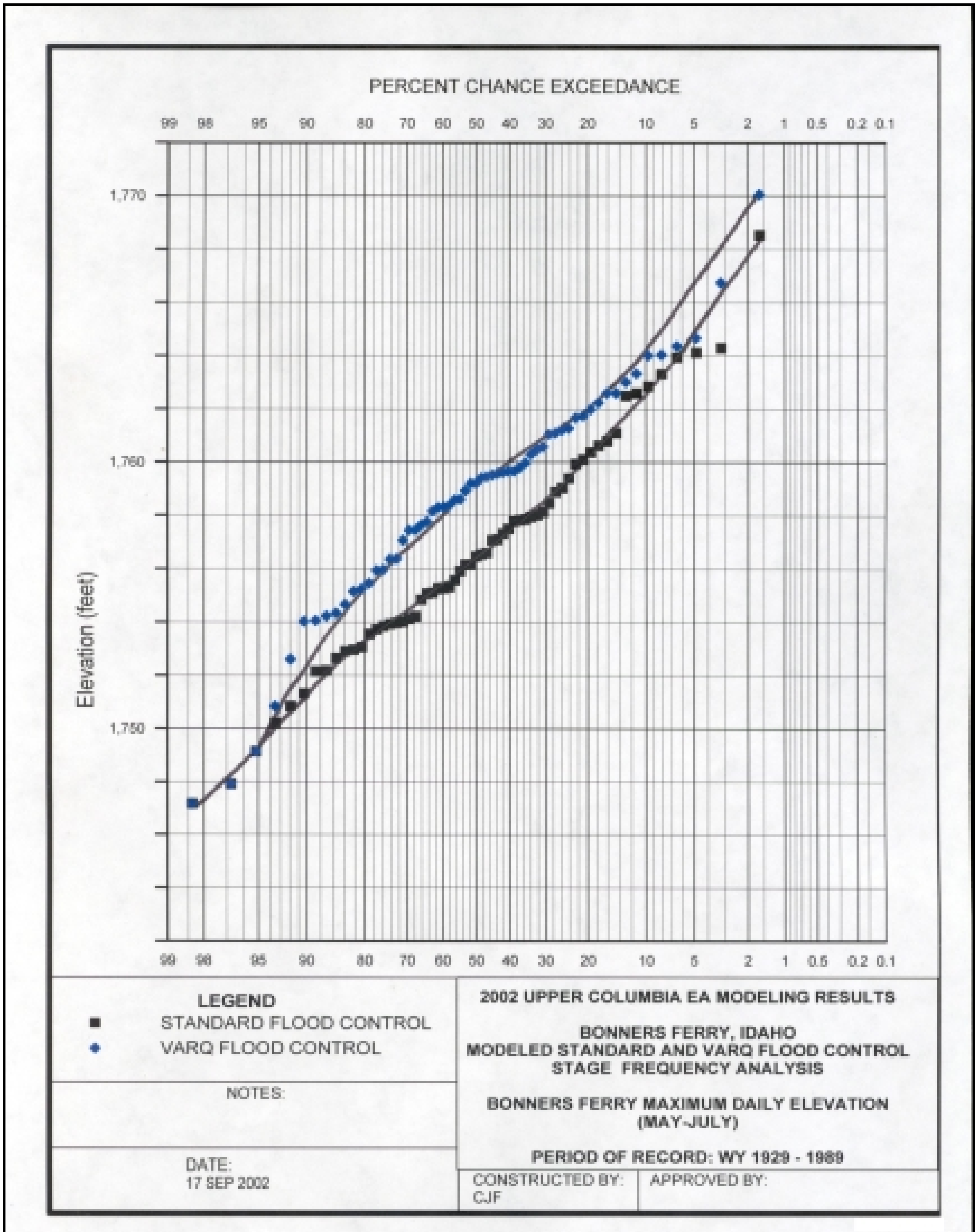


Figure 15. Stage-Frequency Analysis: Bonners Ferry Maximum Daily Elevation (May-July)

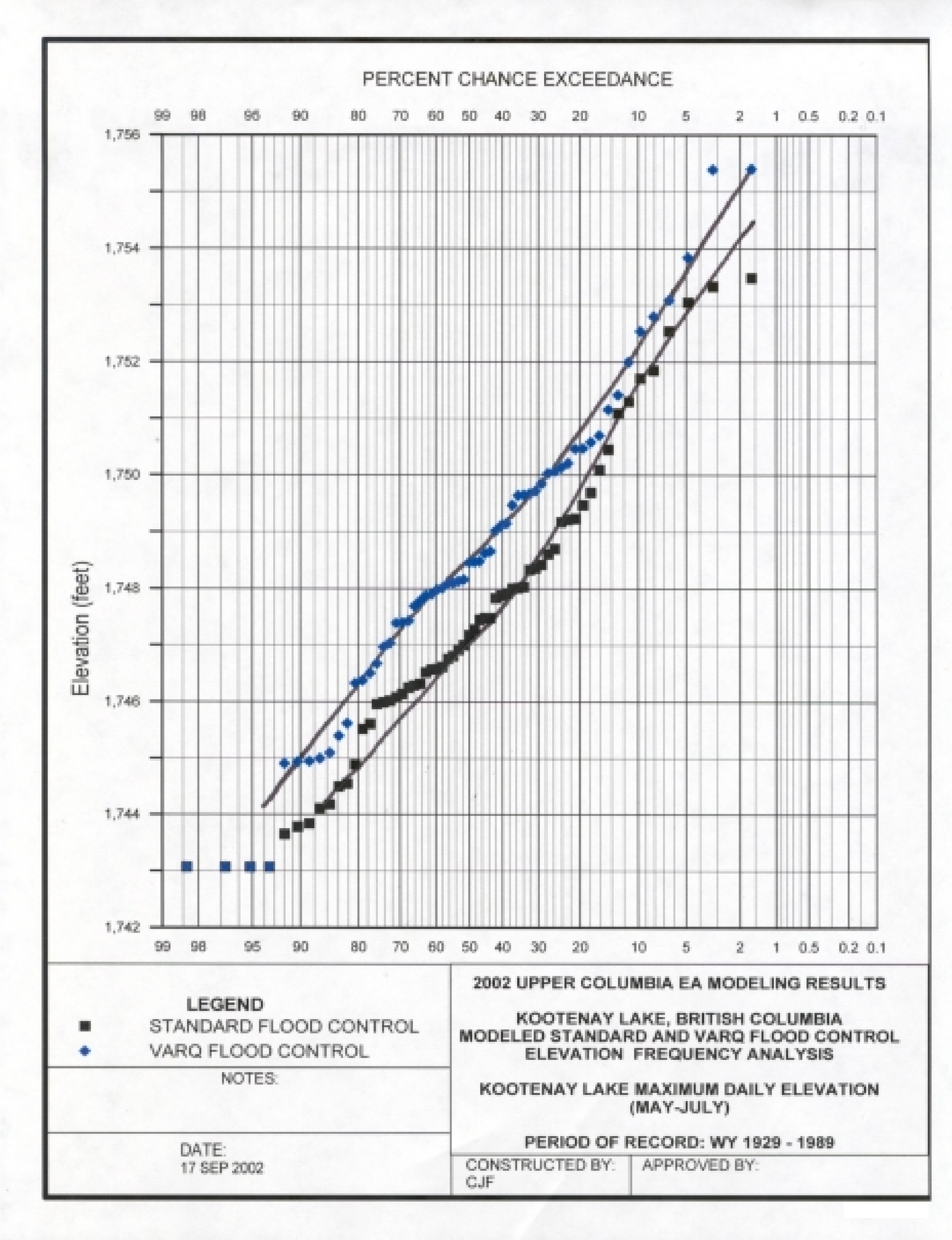


Figure 16. Elevation-Frequency Analysis: Kootenay Lake Elevation

5.1.2.1.4. Ten Year Daily Time Step Hydrologic Model with Fish Flows

The modeling of ten years with a daily time step and fish flows may be used to compare the incremental difference between Standard FC and VARQ FC at various points in the system when fish flows at Libby and Hungry Horse are considered. The results of the daily time step modeling with fish flows provide an opportunity to assess how fish flows affect hydrology in the system. As with the other daily time step modeling discussed in Section 5.1.2.1.3, these models do not incorporate the more conservative Libby Dam forecasts, the project operator's real-time adaptive management decision-making that may change outflow from Libby Dam, or other system operations such as fish or power operations that would result in different project releases.

After the sixty years of daily-time-step flood control modeling was completed, ten of those years were selected for modeling with fish flows based on their potential to influence stages at Bonners Ferry or flood control draft at Grand Coulee Dam. The purpose of this study is to evaluate the effects of VARQ FC on meeting the different fish flows objectives. In addition to this, water supply forecasts that were overestimated or underestimated were considered, as well as early or delayed spring freshets. These criteria were important to measure effects at selected locations such as Libby reservoir and the Kootenai River downstream, and Grand Coulee reservoir elevation. Refer to Appendix D for more details about the criteria used to select the ten years for the ten-year-daily-time-step hydrologic model with fish flows.

It is very important to note that the ten years that are modeled with fish flows are not a statistically random selection. Each of the years was chosen based on a specific methodology (described in Appendix D) designed to highlight events and combinations of events in the historical record where VARQ FC and Standard FC may lead to different hydrologic results. Each of the selected years has a much less than a one in ten chance of occurrence.

5.1.2.1.4.1. Description of Fish Flow Template

Once the ten historic water years were selected, the Columbia River was modeled on a daily time step in each of those ten years for specific fish operations. At Libby, the reservoir was modeled for flood control storage evacuation through April, then was refilled in May through July to elevations no higher than the end of month upper limits determined from the sixty-year daily models for the single purpose of flood control. The sturgeon, bull trout, and salmon flow operations incorporated into the ten water years are described in Table 5 and Appendix A.

Table 5. Sturgeon water volumes to be provided from Libby Dam

April-August Forecast (maf) issued in May	Sturgeon Volume to be provided Above 4 kcfs (maf)
4.80	0.80
5.40	0.80
6.35	1.12
7.40	1.20
8.50	1.20
8.90	1.60

Table 5 shows the volume tiers of water to be provided for sturgeon from Libby Dam. If the April-August water supply forecast is less than 4.8 maf, no sturgeon water is provided. If the forecast is greater than 8.9 maf the amount of water provided for sturgeon is capped at 1.6 maf. The volumes released to maintain the minimum release of 4,000 cfs from Libby Dam is not included in the accounting of sturgeon water.

In practice, the timing and shaping of these volumes would be based on seasonal requests from the USFWS. However, for modeling of the ten water years selected as shown in the previous section, the following guidelines were used: for years when the April-August forecast (issued in May) was between 4.8 and 6.0 maf, ramp-up for the sturgeon flows began on 16 May; for years when the April-August forecast (issued in May) was between 6.0 and 6.7 maf, the ramp-up for sturgeon flows began on 23 May; and finally, for years when the April-August forecast (issued in May) was greater than 6.7 maf, the ramp-up for sturgeon flows began on 1 June. For modeling, the outflow was ramped up to either 25,000 cfs or 35,000 cfs as rapidly as permitted by the USFWS 2000 FCRPS BiOp.

Because maximum outflows of both 25,000 cfs and 35,000 cfs were considered, the fish flow simulations were done twice for each of the ten years. First, Libby's maximum sturgeon outflow was limited to 25,000 cfs, which is approximately equal to the powerhouse capacity. Then, the maximum sturgeon outflow was limited to 35,000 cfs (USFWS, 2000). At the present time, the Corps will not voluntarily discharge more than full powerhouse capacity plus some limited spill (about 1,000 cfs) via the spillway to avoid exceeding the Montana state water quality standard of 110% for TDG. However, the 35,000 cfs sturgeon flows were modeled because this was the flow recommendation in the USFWS 2000 BiOp and these flows will be evaluated in the EIS on potential long-term implementation of VARQ FC and fish flows, or other preferred alternative.[24] Also, model results that apply to sturgeon flows between powerhouse capacity (25,000 cfs) and 35,000 cfs can be interpolated using the model results for 35,000 cfs sturgeon flows.

Immediately following ramp-down from the sturgeon flow augmentation, Libby Dam released a minimum bull trout outflow ranging from 6,000 to 9,000 cfs until at least the end of June (Appendix A). For years when the April-August forecast (issued in June) was less than 4.8 maf, the minimum bull trout flow was 6,000 cfs and did not commence until 1 July. For years when the April-August forecast (issued in June) was between 4.8 and 6.0 maf, the minimum bull trout flow was 7,000 cfs. For years when the April-August forecast (issued in June) was between 6.0 and 6.7 maf, the minimum bull trout flow was 8,000 cfs. For years when the April-August forecast (issued in June) was greater than 6.7 maf, the minimum bull trout flow was 9,000 cfs.

In the modeling for the months of July and August, an attempt was made to provide steady outflow from Libby Dam such that the reservoir would be drafted to elevation 2439 feet by the end of August. The steady outflow operation over the months of July and August was done to avoid the "double peak" that can occur if salmon water is released solely in the month of August following ramp-down from sturgeon flows. In cases where the steady outflow operation called

[24] Results from monitoring the 2002 spill events at Libby Dam indicate that spill greater than about 1,000 cfs result in TDG levels in excess of Montana state water quality standards. Accordingly, dam discharges up to 35,000 cfs for sturgeon are not within the scope of the current EA since releases of 35,000 cfs for sturgeon are not currently achievable with the existing dam configuration (see Section 4.2 for details). Maximum powerhouse discharge capacity could be increased with installation of additional turbines. Seattle District is investigating the feasibility of additional turbines and transmission capacity at Libby Dam itself as required by the 2000 USFWS FCRPS BiOp as one way to increase the routine discharge at Libby Dam for benefit of white sturgeon.

for a lower discharge than the minimum bull trout flow, the minimum bull trout flow was provided.

5.1.2.1.4.2. Lake Koocanusa Refill

For the ten years modeled with Standard FC and fish flows, Lake Koocanusa reservoir does not fill within the top five feet in six of the ten years (Figure 17). When fish flows are added to VARQ FC, four of the ten years do not fill within the top five feet. In years when Lake Koocanusa does not refill, the simulated VARQ FC elevation is always higher than the simulated Standard FC elevation – sometimes by as much as 18 feet.

5.1.2.1.4.3. Libby Dam Outflows

Figure 18 summarizes the modeled changes in Libby Dam outflows (May through July) for Standard FC and VARQ FC with fish flows. The peak daily and sustained outflow is 25 kcfs for both Standard FC and VARQ FC in six out of ten years. These are years when the peak outflow is during the flow releases for sturgeon. VARQ FC tends to increase the peak daily and sustained dam releases from Standard FC in the three out of four years where there is a difference. One year decreased peak outflow (1968). Spill occurred in 4 (1948, 1955, 1968, and 1971) out of 10 years modeled for VARQ FC with fish flows (compared to 3 out of 10 years under Standard FC) and, of those years, VARQ FC increased the levels of spill in only 3 years (in 1968, VARQ FC with fish flows resulted in decreased maximum outflow from Libby Dam compared to Standard FC with fish flows). Of the years where spill occurred under VARQ FC with fish flows, maximum spill exceeded 6,000 cfs only in 1948.

5.1.2.1.4.4. Bonners Ferry River Stage

Modeled VARQ FC with fish flows increased peak daily and sustained stage over Standard FC at Bonners Ferry more than ½ foot in five years, up to six feet (in 1948; Figure 19). In 1948, the modeled peak daily and sustained stage at Bonners Ferry exceeded 1764 feet for VARQ FC with fish flows.

5.1.2.1.4.5. Kootenay Lake Elevation

At Kootenay Lake, compared to Standard FC with fish flows, VARQ FC with fish flows increases Kootenay Lake elevations in nine out of ten modeled years. Four of these years were over ½ foot higher (Figure 20). Modeling of the ten historic water years modeled using a daily time step showed that Kootenay Lake might reach flood stage at elevation 1755 feet in a rare, low frequency event such as 1948.

5.1.2.1.4.6. Spill from Libby Dam

For the ten years that were modeled with fish flows, the earliest any spill occurred was in late May, and spill always ceased before the end of July. Therefore, this analysis is limited to the time period from 16 May through 31 July for each of the ten years modeled.

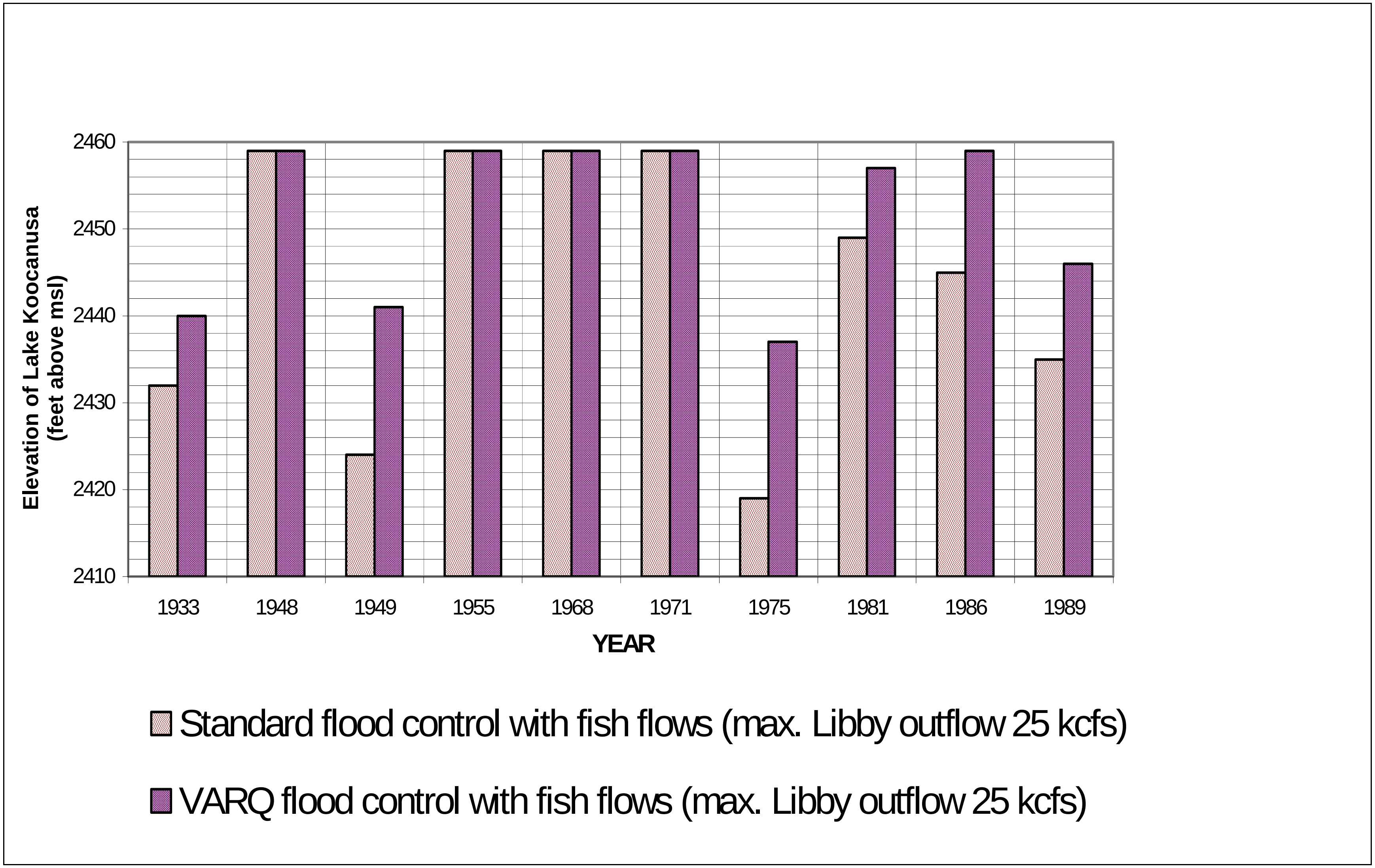


Figure 17. Modeled Maximum Daily Elevation of Lake Koocanusa with Flood Control and Fish Flows Only

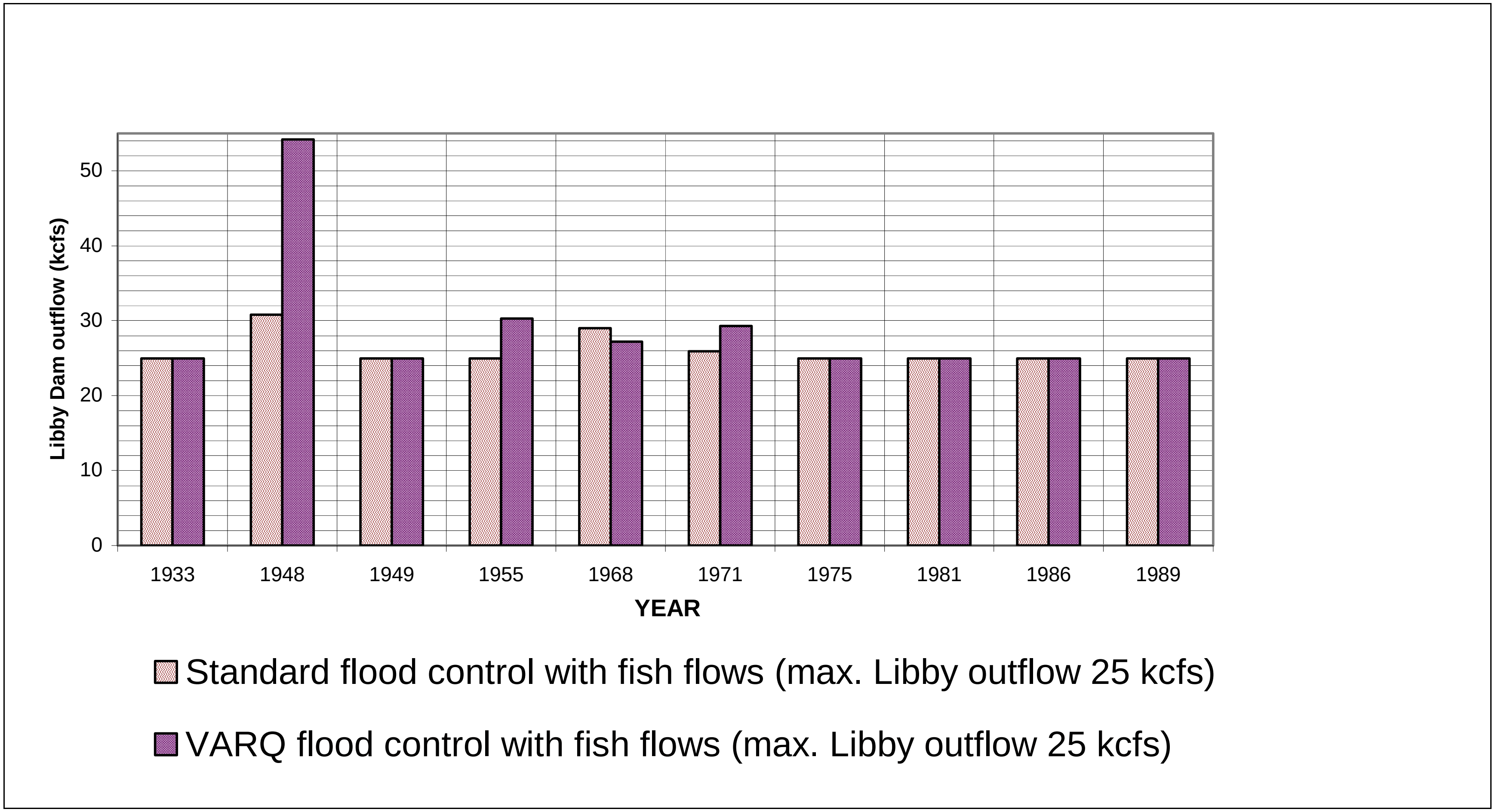


Figure 18. Modeled Maximum Daily Outflow from Libby Dam (May-July) with Flood Control and Fish Flows Only

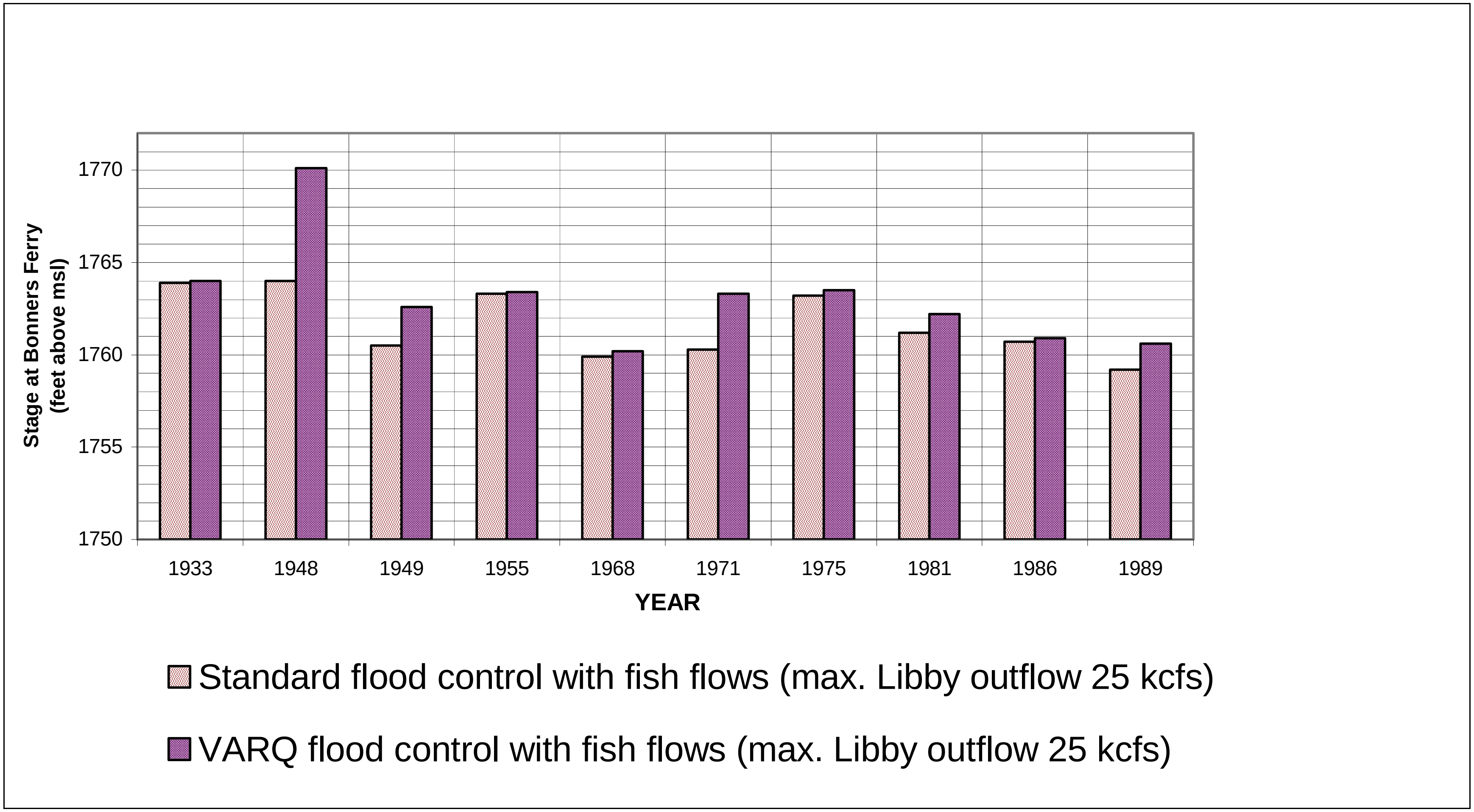


Figure 19. Modeled Maximum Daily Stage at Bonners Ferry (May - July) with Flood Control and Fish Flows Only

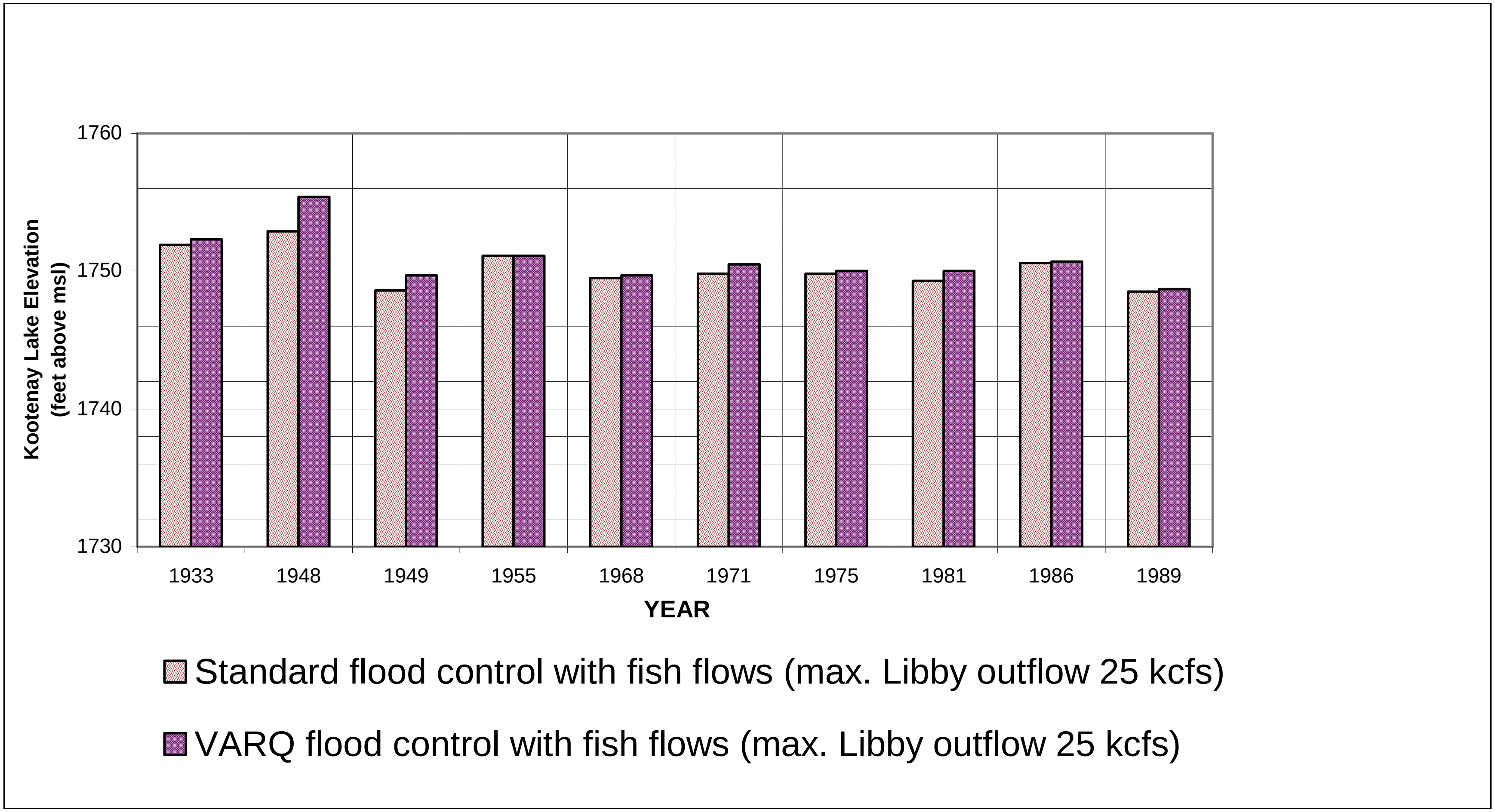


Figure 20. Modeled Maximum Daily Elevation of Kootenay Lake (May-July) with Flood Control and Fish Flows Only

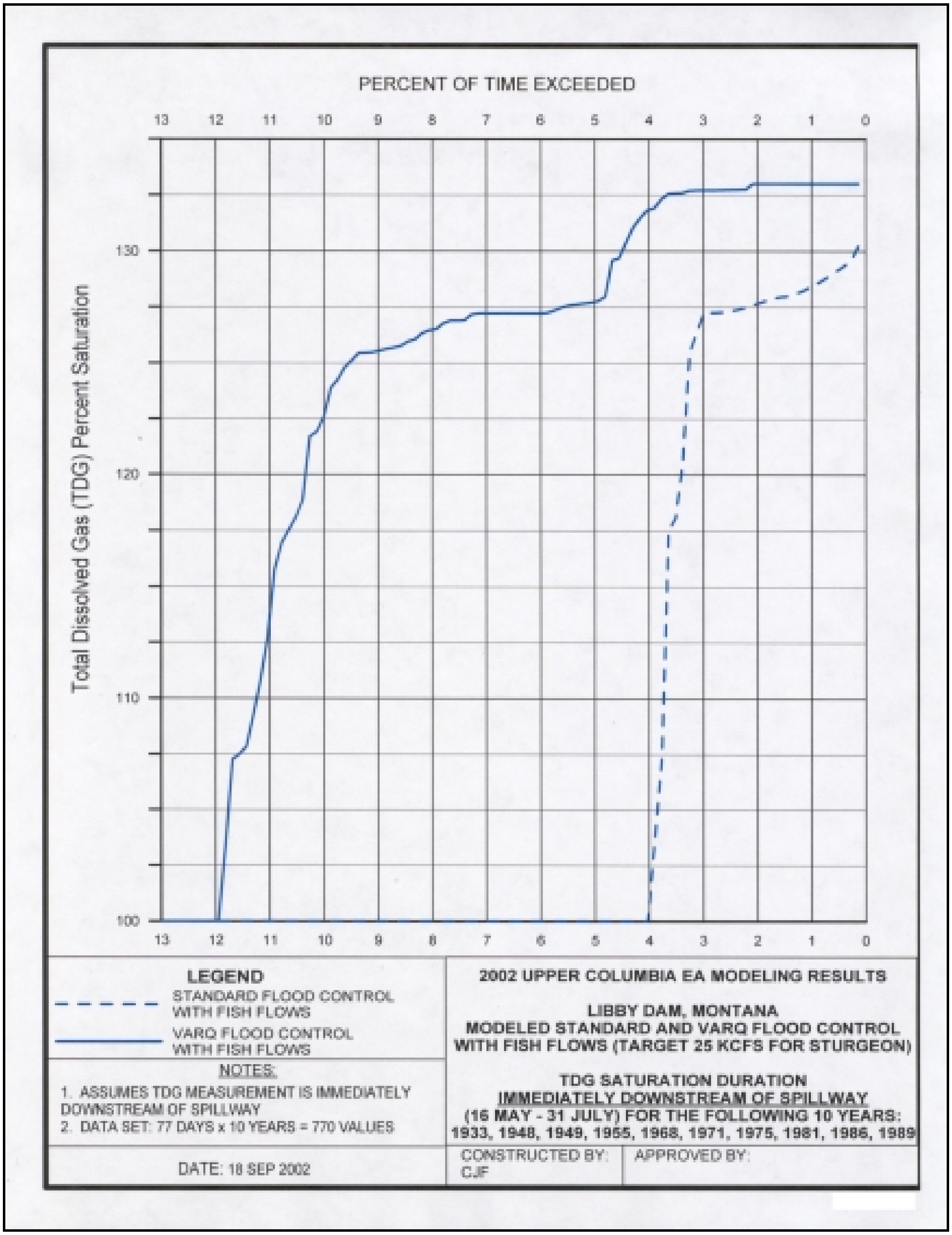


Figure 21. TDG Saturation Duration Analysis: Immediately Downstream of Libby Dam Spillway

TDG saturation-duration curves were developed in order to compare the two methods of flood control as they pertain to dissolved gas downstream of Libby Dam. Figure 21 shows the percent of time that dissolved gas levels were above 100% saturation, assuming that the TDG measurement was immediately downstream of the spillway.[25] The dashed line in the figure shows that 3.7% of the days in the data set (there are 770 days between 16 May and 31 July for the ten years of study) in Standard FC simulations had TDG levels greater than 110%. The solid line in the figure shows that 11.2% of the days in the data set for VARQ FC simulations had TDG levels greater than 110%.

5.1.2.1.5. Libby Reservoir Refill Comparison: Multi-purpose studies

After the daily time step scenarios were completed for sixty years and ten years were modeled with fish flow, the Corps used the end-of-month upper limits for Libby, Hungry Horse, and Grand Coulee to run sixty monthly-time-step evaluations using the HYSSR model (Appendix F). This model developed system multi-purpose operations for the sixty historic water years to meet flood control, power needs, and fish flow. The purpose of these models was to evaluate the effects of VARQ FC on hydropower production and Grand Coulee operations and to estimate on a monthly basis the effects of operating for flood control, power and fish flows.

In these multi-purpose scenarios, in water years with near average water conditions such that the VARQ FC was different than the Standard FC, Libby reservoir began May at higher storage content under VARQ FC than it did under Standard FC. Libby reservoir then operated to meet the sturgeon fish flow template as defined in Section 5.1.2.1.4.1 above. In these scenarios, Lake Koocanusa elevation was higher (closer to full) by the end of June when VARQ FC was used than it was when Standard FC was used. The additional water available on June 30 could then be released in July and August to enhance summer salmon flow in the lower Columbia River. The additional amount of storage available under VARQ is shown in Table 6.

Generally there is more water stored behind Libby at the end of June if the project operates to the VARQ in the January through April period. The additional water at the end of June may be released in July through August for salmon in the lower Columbia River. If Libby follows the Standard FC in January through April, there are several instances where Lake Koocanusa does not refill to an elevation of 2439 feet by the end of June; however, when VARQ FC SRD evacuation is followed, there are more years when Lake Koocanusa refills above an elevation of 2439 feet by the end-of-June.

Table 6 shows the difference in storage in Lake Koocanusa at the end-of-June between Standard FC and VARQ FC operations for January through April. Table 6 also shows the difference for the end-of-June elevation between VARQ FC and Standard FC above elevation 2439 feet.

---

[25] The State of Montana water quality standard for TDG is 110%.

Table 6. Average Libby Dam End of June Storage and Elevation under Standard and VARQ Flood Control

		End of June	
Flood Control Method	**Water Supply Forecast at The Dalles (# of years w/in range)**	**Elevation (ft)**	**Storage (kaf)**
Standard FC	53.5to 79.2 maf (8 years)	2442	5,137
	80.8 to 96.9 maf (12 years)	2436	4,880
	97.1 to 113.5 maf (20 years)	2430	4,621
	113.7 to 156.1 maf (19 years)	2428	4,547
	AVERAGE	*2432*	*4,726*
VARQ FC	53.5to 79.2 maf (8 years)	2447	5,338
	80.8 to 96.9 maf (12 years)	2443	5,163
	97.1 to 113.5 maf (20 years)	2442	5,144
	113.7 to 156.1 maf (19 years)	2440	5,036
	AVERAGE	*2442*	*5,143*
Average Difference (VARQ FC – Standard FC) NOTE: Negative numbers indicate that Standard FC elevations are higher than VARQ FC elevations	53.5to 79.2 maf (8 years)	5	202
	80.8 to 96.9 maf (12 years)	7	284
	97.1 to 113.5 maf (20 years)	13	523
	113.7 to 156.1 maf (19 years)	12	489
	AVERAGE	*10*	*417*
Average Difference above 2439' (VARQ FC – Standard FC) NOTE: Negative numbers indicate that Standard FC elevations are higher than VARQ FC elevations	53.5to 79.2 maf (8 years)	5	202
	80.8 to 96.9 maf (12 years)	4	186
	97.1 to 113.5 maf (20 years)	3	166
	113.7 to 156.1 maf (19 years)	1	58
	AVERAGE	*3*	*166*

5.1.2.1.6. Water Supply Forecasts

The flood control studies done for this EA are based on the Kuehl-Moffit (K-M) forecast for 1929 through 1982, and the Wortman-Morrow (W-M) forecast from 1983 through 1989. All the flood control models conducted for this EA were for the entire Columbia River System, and not limited to local modeling of individual basins. The K-M forecast has been calibrated and used in all previous system flood control modeling. Since 1983 the W-M forecast procedure has been used for the Kootenai River Basin (although it has not been subjected to basin-wise calibration). Both forecast procedures are based on snowpack data and the expectation of average future precipitation, and both have relatively large forecast errors, particularly for early-season forecasts. For example, the K-M forecast for January through July runoff at Libby has a standard error in January of 1.27 maf, while the W-M forecast for January through July runoff has a standard error in January of 1.07 maf (from an average actual runoff at Libby of 6.3 maf).

Since water supply forecasts are used to determine reservoir draft points from January through April, they ultimately influence reservoir outflow from May through June. Therefore, a sensitivity analysis was completed.

5.1.2.1.6.1. Comparison of Forecasts During Flood Control Draft (Sample Year 1948)

The year 1948 was chosen for a sensitivity analysis because 1948 had the largest increase in outflow between Standard FC and VARQ FC model runs. During the water year of 1948, the W-M water supply forecast model input is consistently greater than the K-M forecast model input. Therefore, utilizing the W-M forecast methodology, the model would indicate a deeper draft at Libby reservoir in January through April, and the model would then show Libby reservoir having more storage space available to capture more spring snowmelt, releasing less water during the snowmelt period, resulting in a lower river stage at Bonners Ferry.

Using the K-M forecast as the model input when simulating 1948, the reservoir drafts less and fills sooner, resulting in higher peak outflows from Libby Dam. For example, compared to modeled Standard FC reservoir elevations using the K-M forecast method, the model shows that the beginning-of-April reservoir elevations at Libby Dam would be approximately 55 feet lower using the W-M forecast. When VARQ FC is modeled, the model output shows that beginning-of-April reservoir elevation using the W-M forecast also decreases, in this case to an elevation about 70 feet lower than the model output using the K-M forecast.

This does not imply that one forecast is more accurate than another, nor is the model result more accurate. This sensitivity analysis for 1948 demonstrates that the model results are sensitive to the forecast procedure used as modeling input. However, with either forecast method, modeling of both flood control alternatives indicates an increase in the risk of flooding under VARQ FC. Management of this risk is discussed in Section 5.1.2.1.1.

5.1.2.1.7. Groundwater

Groundwater monitoring completed by the Corps in 2002 has demonstrated that water levels in wells near the Kootenai River in the Libby/Troy area fluctuate in concert with river stage. Given the close proximity of the monitored wells to the river, this is not surprising.

Measurements of groundwater quality in 2002 occurred during Libby Dam discharges as high as 40,000 cfs. Monitoring of water quality in the wells did not reveal any correlation between high river flows and adverse effects on groundwater quality, as evidenced by measurements of temperature, turbidity, coliform bacteria, potassium, ammonia nitrogen, and total nitrogen, as well as supplemental microscopic particle and stable isotope analysis. Since dam discharges for fish flows under both of the alternatives would not exceed 26,000 cfs,[26] well below the 40,000 cfs discharges experienced in 2002, it is reasonable to conclude that none of the alternatives will have an adverse effect on groundwater.

5.1.2.2. Hungry Horse Dam

Effects on hydrology relating to interim implementation at Hungry Horse Dam are discussed in Reclamation's 2002 voluntary EA (Reclamation, 2002a) and are not discussed further here.

5.1.2.3. Columbia River

5.1.2.3.1. Modeling Procedure

As with the local effects analysis for Libby Dam, two sets of models were completed for system flood control. The first set of model runs, comparing Standard FC to VARQ FC without fish flows and power drafts, is intended to indicate the relative difference between the two flood control procedures without the complexity of meeting fish flow requirements or drafting for power. While flood-control-only operations are not EA alternatives, some of these results are included to show relative differences.

The 60-year record, 1929-1989, was selected as the period of study for system flood control evaluation. This period of record has been extensively used in hydropower and water management planning studies and the data are well documented. In this 60-year period, four significant spring floods occurred, in 1948, 1956, 1972, and 1974. The 1948 unregulated peak flow ranks as the second highest peak flow for Columbia River at The Dalles since records began in 1848. The unregulated peak flows of 1972 and 1974 rival the third highest peak flow of record. More details of the system flood control modeling procedure are contained in Appendix E.

System flood control modeling results are discussed in relation to flows at Birchbank, BC; The Dalles, Oregon; and Vancouver, Washington.

5.1.2.3.2. Analysis of Flood Control Methods Combined with Fish Flows and Hydropower Operations

To assess effects when the system is operated to power, flood control, and fish operations, additional model studies were conducted using operating criteria based on the Pacific Northwest Coordination Agreement (PNCA). These studies considered the federal firm energy load carrying capacity from the PNCA final regulation for operating year 2003 computed by the Northwest Powerpool. The multi-purpose hydrologic modeling also considered spill at federal projects for fish based on the NMFS 2000 FCRPS BiOp (NMFS, 2000a). Appendix F details these multi-purpose hydrology studies. Results from the multi-purpose studies are discussed in relation to Lake Roosevelt drafts and Priest Rapids and McNary flow targets since the power and

[26] Flows discharged from Libby Dam may exceed the maximum fish flows if necessary for flood control purposes.

fish operations are likely more representative of actual operating impacts on these parameters. As with local flood control, model results for system and multi-purpose evaluations are not absolute predictors of what will happen; they can show only comparative trends.

5.1.2.3.3. Columbia River Flows at Birchbank, British Columbia

Compared to Standard FC, VARQ FC reshapes the flow pattern, with less during the winter drawdown period and more during the spring runoff period. When fish flows are considered, VARQ FC tends to decrease Birchbank flows during the winter and increase Birchbank flows during the spring.

5.1.2.3.4. Flow-Frequency at Birchbank, British Columbia

The flood level at Birchbank, BC, is 225 kcfs. Based on model results, the chance that the flood level flow will be equaled or exceeded in a given year is 6% for Standard FC and 7% with VARQ FC. The frequencies of occurrence of flows above about 250 kcfs (the 1% exceedance event) are essentially equivalent for Standard and VARQ FC. This reflects the gradual merging of VARQ FC and Standard FC for above-average runoff conditions at Libby.

Compared to Standard FC, the model results indicate that VARQ FC tends to increase peak flows at Birchbank. For the ten years selected for analysis of fishery operations, VARQ FC compared to Standard FC would have slight impacts to Birchbank except for a peak 1-day flow increase of 16,000 cfs in 1948 and a peak 1-day flow decrease of 18,800 cfs in 1986.

5.1.2.3.5. Columbia River Flow at The Dalles, Oregon

Compared to Standard FC, model results indicate that VARQ FC reshapes the flow pattern, with less during the winter drawdown period and more during the spring runoff period. When fish flows are considered, VARQ FC tends to decrease flows at The Dalles during the winter and increase flows at The Dalles during the spring.

5.1.2.3.6. Flow Frequency at The Dalles, Oregon

Compared to Standard FC, model results indicate that VARQ FC slightly increases the frequency of relatively common events but has no discernible effect on the frequency of the very large flow events (less common events with less than 2% chance of exceedance) at The Dalles. The chance that a flood level flow of 450,000 cfs will be equaled or exceeded in a given year increases from 40% for Standard FC to 43% for VARQ FC. The Standard and VARQ FC frequency curves converge in the neighborhood of 1% exceedance. This feature reflects the gradual merging of VARQ FC and Standard FC at both Libby and Hungry Horse for above-average runoff conditions.

When fish flows are considered, VARQ FC tends to increase the peak flow at the Dalles with the maximum increase in peak 1-day flow being 13,800 cfs in 1948.

5.1.2.3.7. Flow Duration at The Dalles, Oregon

In the flood-control-only modeling, a volume duration analysis was conducted to look into the impacts to flow over time at The Dalles. Time periods from one day through 120 days were selected for the analysis. Flow values represent the highest running-mean flow for a specific duration in a given year. Figure 22 depicts the 60-year average of these values for Standard FC and VARQ FC, and for reference purposes also unregulated flows. As shown on the curves, there is a slight increase in mean flow for the VARQ FC operation, less than 10,000 cfs for each increment, which has a negligible impact on system FC.

When fish flows are considered, VARQ FC tends to increase the duration of a given flow, but these increases tend to be very minor in the context of total flow at The Dalles.

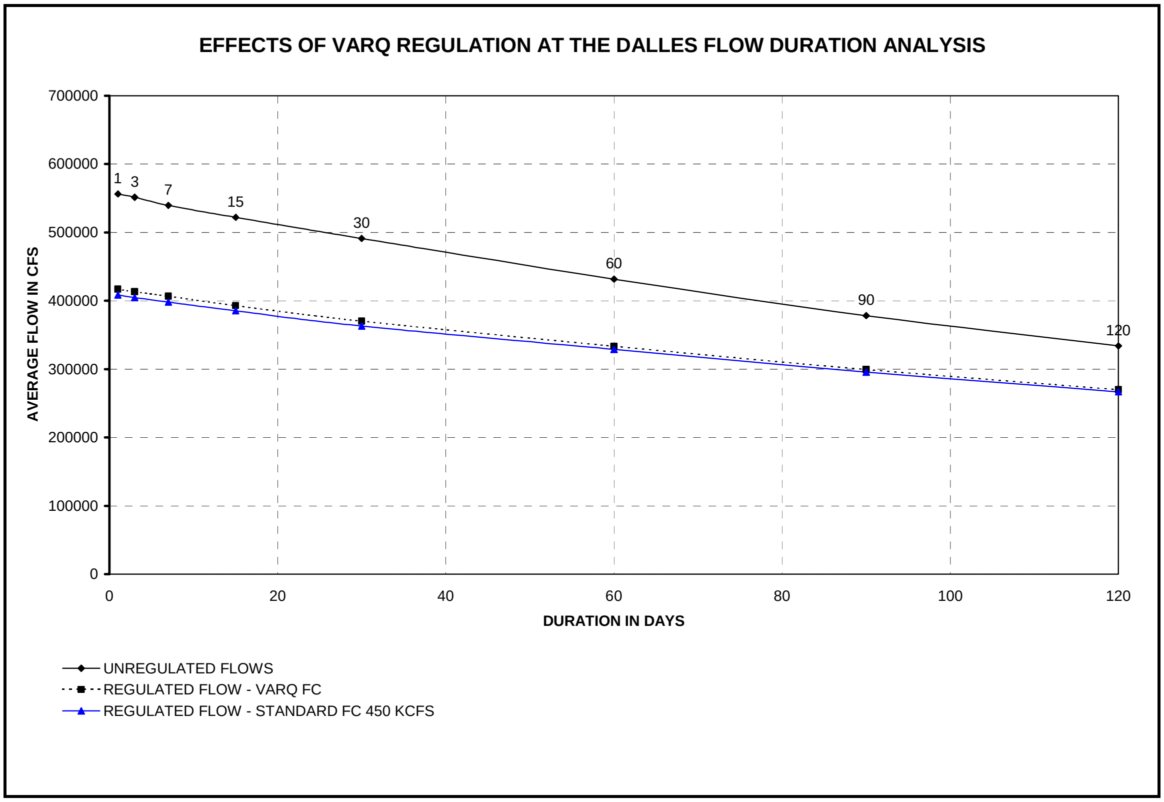


Figure 22. Flow Duration Analysis at The Dalles

5.1.2.3.8. Floods of 1948 and 1972 at The Dalles, Oregon

Figure 23 and Figure 24 demonstrate the effects of VARQ FC on the distribution of flows at The Dalles for two notable floods, 1948 and 1974, respectively. The flood of 1948 is significant not only because it has the highest unregulated peak since 1868, but also because it involved a large water supply forecast error and the resulting floodwaters destroyed the city of Vanport, Oregon. The flood of 1974 is significant because its January-July and April-August runoff volume exceeds all years in the 1929-1989 study period and its unregulated peak is second only to 1948. For both years, there is very little difference at The Dalles between the Standard FC and VARQ FC hydro-regulations. This is due in large part to the similarity of flood control operations for VARQ FC and Standard FC alternatives for above-average runoff conditions. The re-regulating effects of Grand Coulee and the natural attenuation of flow also contribute to minimize the influence of VARQ FC at The Dalles. For comparison, the unregulated flow hydrographs for the 1948 and 1974 floods are also depicted in Figure 23 and Figure 24, respectively.

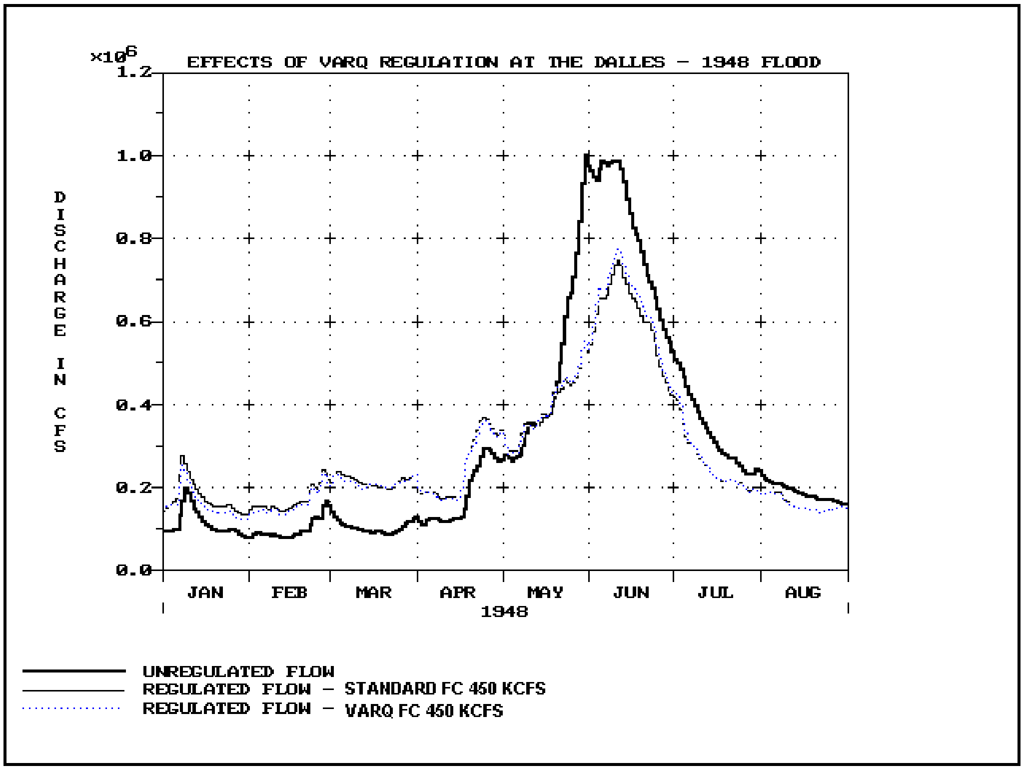


Figure 23. 1948 Flood Hydrograph at The Dalles

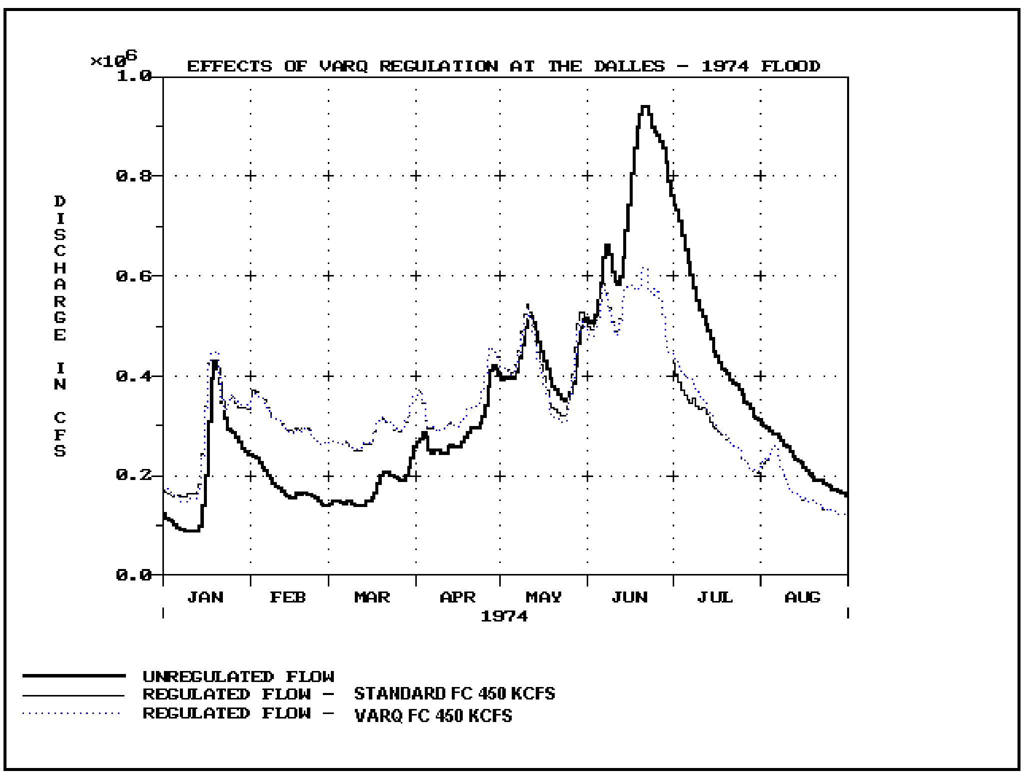


Figure 24. 1974 Flood Hydrograph at The Dalles

5.1.2.3.9. Columbia River at Vancouver, Washington

The effect of VARQ FC in the Portland/Vancouver harbor can be estimated from historical flows. Figure 25 is the stage frequency curve for Vancouver, Washington, for the flood-control-only models. The effects of VARQ FC are small, only 0.2 feet difference on average for the 1929-1989 period of record. The chance that flood stage of 16 feet will be equaled or exceeded in a given year increases from 44% for Standard FC to 46% for VARQ FC. Again, the frequency curves converge, in this case, as exceedance levels approach 5%.

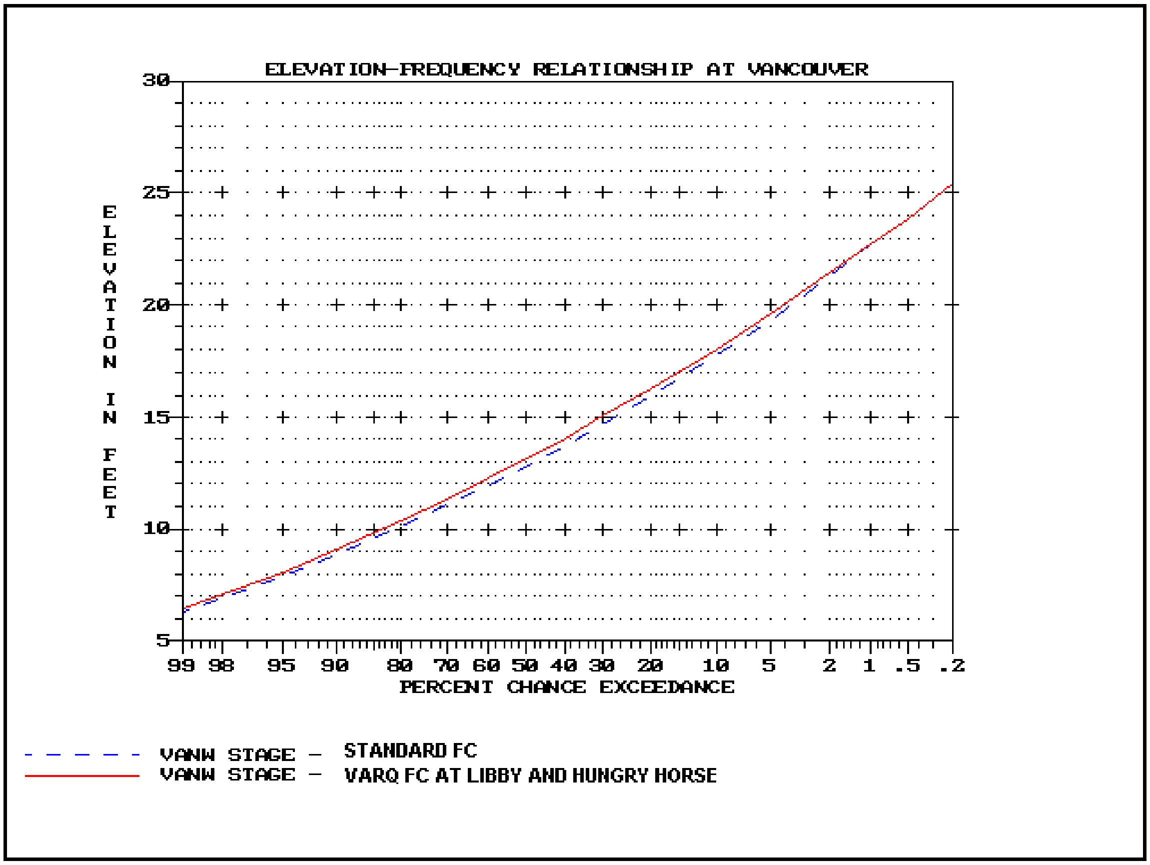


Figure 25. Stage Frequency Curve for Vancouver, Washington

When fish flows are considered, VARQ FC tends to increase the peak Columbia River stage at Vancouver compared to Standard FC. In general, the increases are small, with a maximum rise of 0.48 feet (in 1948) for the 10 years modeled with fish flows.

5.1.2.3.10. Lake Roosevelt Elevation

Under VARQ FC Grand Coulee Dam would continue to be operated to meet the project purposes of flood control, power generation, and irrigation. Releases from the dam would also be influenced by flow requirements for downstream threatened and endangered salmon and steelhead as specified in FCRPS BiOps.

There is not a one-to-one relationship between the additional water in Hungry Horse and Libby and the additional flood control draft at Grand Coulee. In fact, power needs and releases for endangered species can influence reservoir operations during the winter and spring as much, if not more, than flood control requirements. For example, in 2001, a drought year, the end-of-April flood control requirement at Grand Coulee in both the VARQ FC and Standard FC scenarios was elevation 1283 feet. Lake Roosevelt was actually drafted to elevation 1220 feet on 30 April (63 feet below flood control) for power generation and flow augmentation for endangered species. In 2001, the flood control needs at Grand Coulee were dwarfed by the needs for power and salmon. Accordingly, the VARQ FC operation at Hungry Horse had no effect on Grand Coulee in 2001.

Compared to Standard FC alternatives, the model results indicate that VARQ FC would generally result in higher flood control releases and slightly lower reservoir pool levels during the spring flood control draft in average to moderately dry water years. As shown in Table 7, maximum and minimum late winter and spring end-of-month water surface elevations, which typically occur during very dry and very wet years, respectively are no lower under VARQ FC. Differences are apparent for average end-of-month elevations, and these range from 0.3 feet to 1.3 feet with the greatest difference at the end of April, when the lowest elevation in Lake Roosevelt normally occurs. As shown in Figure 26, the probability of exceeding 2 feet of elevation difference between Standard FC and VARQ FC at the end of April is approximately 28% and the probability of exceeding 4 feet is approximately 8%. Probabilities decline sharply after 4 feet. The end-of-April difference in elevations is most pronounced between elevations 1250 and 1270 (Figure 27).

Table 7. Lake Roosevelt Maximum, Minimum, and Average Monthly Elevations for Standard and VARQ FC

	JAN	FEB	MAR	APR	MAY
STD MAX	1290	1290	1283.1	1280	1290
STD MIN	1257	1250	1225.3	1209.1	1209.1
STD AVE	1265.7	1264.78	1263.14	1248.46	1261.33
VARQ MAX	1290	1290	1283.1	1280	1290
VARQ MIN	1257.3	1250	1225.2	1209.1	1209.1
VARQ AVE	1265.72	1264.85	1262.12	1247.20	1261.03

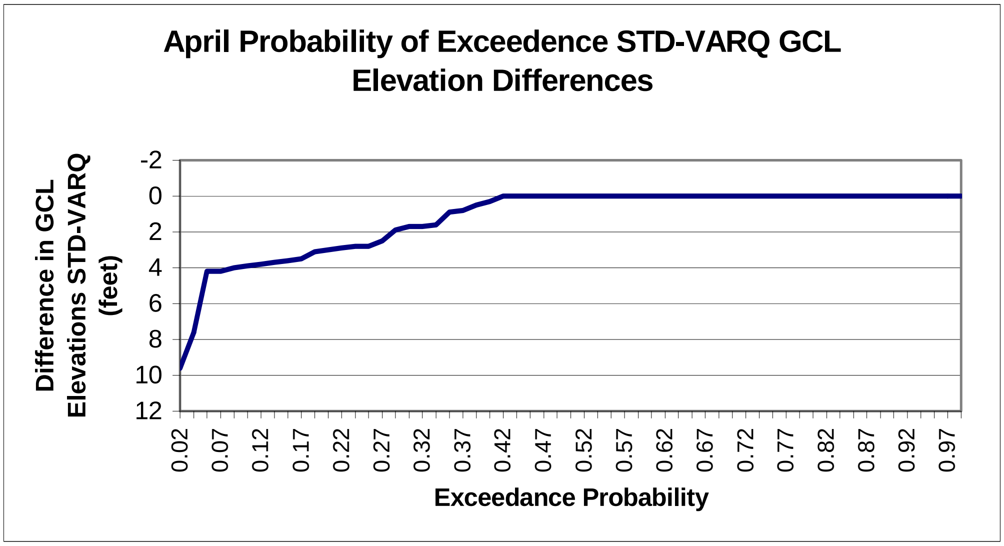


Figure 26. April Grand Coulee Dam/Lake Roosevelt Elevation Differences

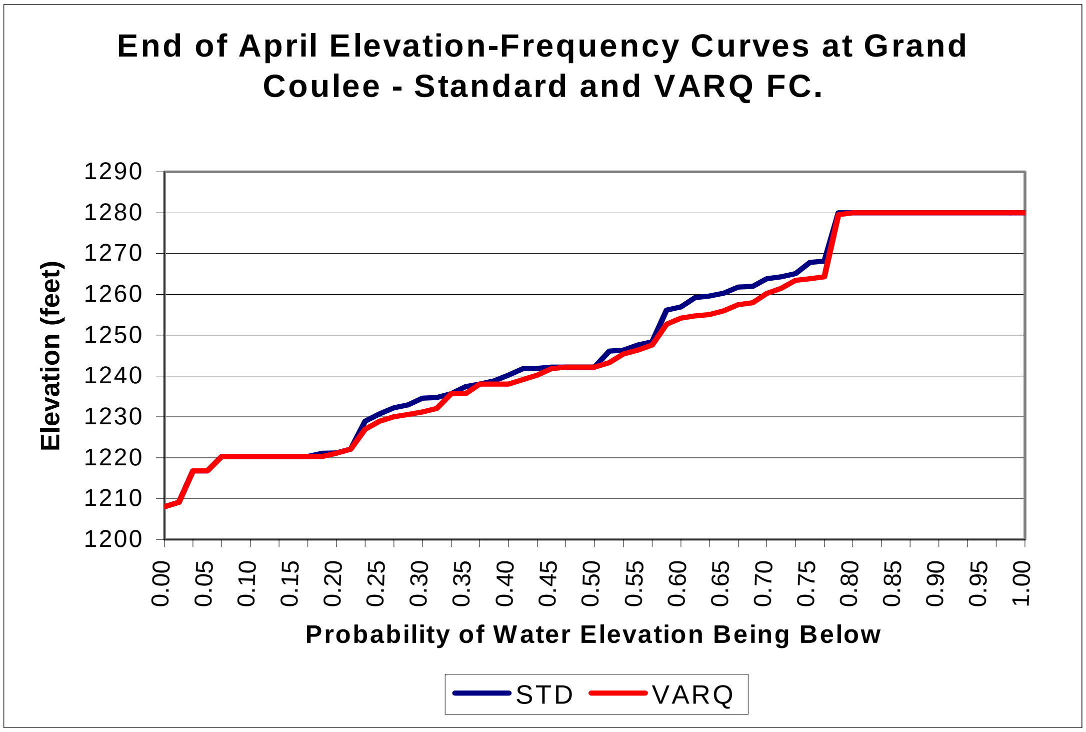


Figure 27. End-of-April Elevation-Frequency Curves at Grand Coulee/Lake Roosevelt

5.1.3. Water Quality

5.1.3.1. Libby Dam

Under both of the alternatives, there would be no appreciable change in Lake Koocanusa water quality nor would there be any appreciable change in the temperature regime below Libby Dam because releases from the dam are temperature controlled.

Under both alternatives, spill to augment flows for sturgeon would be discharged during most years provided that such spill remained within the current State of Montana water quality standards. It is estimated that 1,000 cfs of spill would result in TDG of no higher than 110% just downstream of the dam's stilling basin. Typically, TDG levels at or below 110% are not considered harmful of aquatic life or water quality. Accordingly, such a low spillway flow does not have adverse effects on water quality.

Compared to the no-action alternative, model results indicate that VARQ FC appears to increase the likelihood of an involuntary spill in any given year. Involuntary spills are dependent upon a variety of uncontrollable factors such as reservoir inflow and would likely exceed the 1,000 cfs threshold (see previous paragraph). Compared to Standard FC with fish flows, the modeling indicates that VARQ FC with fish flows appears to increase the number of days where 110% TDG would be exceeded over the modeled 10 years (from 3.7% to 11.2% of days between May 16 and July 31 for the 10 years modeled with fish flows, see Figure 21). Since only 10 years were modeled with fish flows, the results may overstate the increase in risk of high TDG from involuntary spills. Using the 2002 data from the site immediately downstream of the stilling basin as a point of reference, modeling the full period of record would likely indicate that VARQ FC with fish flows increases the risk of high TDG, but not by as much as indicated by the 10 selected years. Even at TDG levels above 110%, the likelihood of reaching a specific gas supersaturation is higher under VARQ FC than Standard FC. For example, Figure 21 indicates that the likelihood of reaching 130% TDG saturation under VARQ FC is about 4.5%, which compares to essentially no chance under Standard FC.

Adverse effects that might occur from TDG levels of 110% or higher are difficult to quantify. Research on fish on the Columbia River mainstem indicates that symptoms of gas bubble disease (GBD) in some fish are likely as TDG levels approach 120%. In laboratory studies, persistent TDG saturation of 120% or higher for weeks, has been observed and predicted to cause GBD symptoms in up to 16% of fish (Backman *et al*., 1999). However, field studies of juvenile salmonids and resident fish have measured lower rates of GBD at high TDG saturations than would be expected based on controlled laboratory experiments (Weitkamp, 2000; Cochnauer, 2001).

Compared to the Columbia River, the Kootenai River is relatively shallow and may therefore not allow organisms as much deep water "refuge." Since the likelihood of spill causing TDG levels above 110% increases under VARQ FC, the likelihood that fish will experience adverse effects from TDG supersaturation also increases. Observations by the Montana Department of Fish, Wildlife, and Parks (MFWP) during the prolonged 2002 spill events documented a high incidence of gas bubble disease symptoms.[27] Although the monitoring did not document fish mortality in resident fish,[28] it is likely that some level of adverse effects occurred due to delayed onset of disease, cumulative effects of injury such as cataracts caused by gas bubbles in the eyes, or possibly unobserved mortality.

[27] Preliminary results from MFWP monitoring indicates that 100% of captive fish exhibited symptoms of GBD, while about GBD symptoms were observed in up to 71% of bull trout, 83% of mountain whitefish, and 80% of rainbow trout captured by electrofishing below Libby Dam. Note that the percentages of fish with observed GBD symptoms varied with location of sampling and date of sampling.
[28] Mortality was observed for kokanee, most likely originating in Lake Koocanusa, entrained through the powerhouse or spillway.

The modeling indicates that levels of spill that generate harmful levels of TDG will not happen in most years, so impacts of elevated TDG would likely be sporadic enough to allow organisms to recover between high-TDG events. Monitoring of the 2002 spill events by Montana Department of Fish, Wildlife, and Parks (MFWP) observed that healing of trauma from GBD symptoms began as early as 1 week after cessation of spill at Libby Dam. However, the MFWP study may not have been sufficient to document adverse effects on fish relating to an increased susceptibility to fungal and bacterial infections resulting from GBD trauma.

In a letter dated December 9, 2002, the USFWS acknowledged that VARQ FC increases the likelihood of an involuntary spill at Libby Dam. However, the USFWS further stated that real-time water management with variable refill dates will likely help decrease the risk of involuntary spills and the associated increases in the magnitude and duration of elevated TDG events. Accordingly, the USFWS stated that they do not expect to see substantial adverse effects to bull trout if VARQ FC is implemented. The USFWS also noted that their 2000 FCRPS BiOp considered the potential effects of increased spill on bull trout when recommending adoption of VARQ FC at Libby Dam. As with bull trout, the increased risk of involuntary spill under VARQ FC should not pose undue risk of adverse effects to other resident fish populations in the Kootenai River.

5.1.3.2. Hungry Horse Dam

There would be no appreciable change in Hungry Horse Reservoir water quality under any of the alternative analyzed. There would be no appreciable change in the temperature regime below the dam because releases from Hungry Horse Dam are temperature controlled.

5.1.3.3. Columbia River

Potential effects to water quality elsewhere in the Columbia River Basin also involve TDG increases due to increased spillway flows, particularly at non-Federal and Canadian projects. The potential for increased spill at other projects is being studied for the proposed long-term VARQ FC operation that will be evaluated in the EIS.

5.1.4. Sediment Quality

5.1.4.1. Libby Dam

Under the VARQ FC alternative, Lake Koocanusa elevations will be higher than the Standard FC alternative, and sediments in the drawdown zone will not be exposed as often or for as long. These sediments, particularly in the northern part of the reservoir, can become airborne during high winds. While human exposure to sediments is likely decreased for the VARQ FC alternatives, the quality of those sediments is not expected to change under any alternative since the sources and sinks of contaminants will not be affected by the flood control operation of Lake Koocanusa. In any case, no effects from human exposure to Lake Koocanusa sediments have been documented.

5.1.4.2. Hungry Horse Dam

VARQ FC at Hungry Horse does not appreciably affect sediment quality in the Flathead Basin.

5.1.4.3. Columbia River

Compared to the Standard FC alternatives, VARQ FC would have the greatest potential impact on sediment quality at Lake Roosevelt where lake elevation changes affect the exposure and transport of contaminated sediment in the upper end of the lake. Lower lake levels expose more contaminated sediment to wind transport.

In general, VARQ FC with fish flows results in lower average Lake Roosevelt elevations between March and May than those under Standard FC with fish flows. The greatest differences occur in April and May when average Lake Roosevelt elevations are slightly more than 3 feet lower with the VARQ FC operation. In about 1 year out of every 20, minimum Lake Roosevelt elevations can be more than 6 feet lower with VARQ FC than with Standard FC (Figure 26). VARQ FC operation will expose more sediment in the drawdown zone, some of which contains contaminants and toxic substances that have the potential to affect public health.

The presence of toxic substances in the lake drawdown zone, their potential public health hazard (i.e. potential for becoming airborne), and the effects of different reservoir operation on sediment quality and public health are being studied in more detail for the proposed long-term VARQ FC operation that will be evaluated in the EIS.

5.1.5. Air Quality

5.1.5.1. Libby Dam

Compared to Standard FC, VARQ FC would benefit air quality by keeping Lake Koocanusa higher for longer durations, thereby decreasing the amount of windblown dust in the upper reservoir areas.

5.1.5.2. Hungry Horse Dam

VARQ FC at Hungry Horse does not appreciably affect air quality in the Flathead Basin.

5.1.5.3. Columbia River

As shown in Table 7 (in Paragraph 5.1.2.3.10) detailing the maximum, minimum, and average monthly elevations of Lake Roosevelt for both Standard and VARQ FC, VARQ FC would cause a greater potential for the exposure of contaminated sediments to wind-borne erosion primarily during the months of March and April. This is due to the potential increase of exposed land mass and the frequency of wind storm events during this time of year. Presently, there are no studies available to determine the impact on ambient air quality standards in potential non-attainment areas such as Sandpoint, Idaho, (see Section 3.1.4). However, it is not likely that the influence of VARQ FC would significantly affect these areas beyond the impacts of Standard FC.

Localized affects of wind-borne erosion have not been determined. Target groups may include nearby residents and others frequenting the Lake Roosevelt National Recreation Area. The USGS, in cooperation with Reclamation and the Lake Roosevelt Water Quality Forum, is presently conducting air emission studies of contaminated river/lake sediments entrained during windstorm events. This study will attempt to determine the potential for respiration and ingestion of contaminated sediments at pre-selected receptor sites and will aid in the performance of risk analysis at a later date. Completion of the air emissions study is expected by 2006.

5.2. Natural Resources

5.2.1. Vegetation

5.2.1.1. Libby Dam

Compared to Standard FC alternatives, VARQ FC would reduce annual fluctuation of Lake Koocanusa in average to slightly-below-average water years. Since reservoir operation under both VARQ FC and Standard FC is similar in more extreme water years, under either flood control operation, vegetation established during average years will likely die during the more extreme years due to inundation or lack of water. VARQ FC results in higher reservoir levels more often and may increase the difficulty in establishing vegetation in the upper part of the reservoir since these areas will likely be inundated more frequently and longer than under Standard FC. However, the cycles of inundation and exposure in the reservoir drawdown zone have made establishment of vegetation very difficult in any case, so VARQ FC is unlikely to make an appreciable difference. Downstream vegetation may also be relatively unaffected by VARQ FC.

5.2.1.2. Hungry Horse Dam

As at Libby, VARQ FC at Hungry Horse should not appreciably affect vegetation in Hungry Horse Reservoir, or elsewhere in the Flathead Basin.

5.2.1.3. Columbia River

Fluctuation at Lake Roosevelt would increase with VARQ FC in some years since VARQ FC will require increased drawdown to provide the same level of overall system flood control by compensating for reduced flood control space behind Libby and Hungry Horse dams. There would likely be little or no impact to vegetation since most of the drawdown zone has very little vegetation established.

5.2.2. Fish

5.2.2.1. Libby Dam

Compared to the Standard FC alternatives, VARQ FC would provide reservoir conditions and flows that would benefit resident fish populations above and below Libby Dam. Fish stocks in Lake Koocanusa are expected to benefit from the typically higher and more stable reservoir elevation, particularly during the spring and early summer. Fish downstream of Libby Dam will benefit from more reliable and stable flows during the spring and summer. VARQ FC with fish flows results in a more normative hydrograph for the Kootenai River system. With a more normal hydrograph, particularly during the spring, habitat-forming processes from higher flow events will be promoted and will presumably benefit resident fish populations.

Due to a higher risk of involuntary spill under VARQ FC compared to the Standard FC alternatives, VARQ FC increases the chance of experiencing harmful effects due to elevated TDG levels in any given year. Considering the interim nature of possible VARQ FC implementation, the risk of experiencing involuntary spill in any given year is small (see Section 5.1.3.1), but the risk under the Standard FC alternatives would be somewhat lower.

Libby Dam releases in the spring and early summer are provided for sturgeon and also help provide for spring flow targets for salmon in the Columbia River. The Kootenai River White Sturgeon Recovery Plan (USFWS, 1999) and the USFWS 2000 FCRPS BiOp (USFWS, 2000) identify low peak flows as a primary limiting factor for sturgeon reproduction and recruitment. Under the alternatives considered in this EA, the benefit of providing maximum sturgeon releases of 26,000 cfs from Libby Dam are difficult to quantify on both a physical and biological basis. Nonetheless, the USFWS has determined that increasing the potential Libby Dam discharge for sturgeon, where feasible based on an evaluation of benefits and impacts, will benefit sturgeon and provide information about sturgeon biology. This conclusion is based on the Kootenai River White Sturgeon Recovery Plan and on-going sturgeon research aimed at more precisely defining limiting factors to sturgeon recovery.

VARQ FC increases the maximum reservoir elevation in any given year, and thus, the likelihood of being able to provide beneficial flows for sturgeon, bull trout, salmon, and steelhead. It increases the likelihood of providing the tiered volumes allocated for sturgeon according to runoff forecast in any given year. See Paragraph 5.2.4 for more detailed discussion.

Since the volume of water released for fish flows is essentially equivalent for both alternatives, fish entrainment through the powerhouse and the spillway is not expected to substantially change as a result of routine operation of the dam. However, since VARQ FC with fish flows increases the likelihood of involuntary spill, it is reasonable to conclude that VARQ FC may increase overall fish entrainment at Libby Dam. Kokanee entrainment by Libby Dam can have a demonstrable effect on the age and size composition of reservoir kokanee (from Skaar *et al.*, 1996; Maiolie and Elam, 1998). In years with large kokanee populations, some loss of fish via entrainment may actually promote stock health by reducing competition for food and thus increasing the average size and health of individuals in the stock. In other years, when entrainment is high or kokanee populations are low, loss of fish from Lake Koocanusa can result in depressed populations for several years. In addition to kokanee, other fish may be entrained, most notably bull trout. In years with involuntary spills, low numbers of bull trout will be entrained (Skaar *et al.*, 1996) and likely will be killed or injured. As discussed, the potential effect of increased entrainment under VARQ is expected to be small since involuntary spills are expected to be infrequent under either alternative (see Section 5.1.3.1).

Releasing water from Lake Koocanusa in August for Columbia River salmon deviates from natural conditions for the Kootenai River. Although in-season management of releases attempts to smooth out the transition from spring runoff to the summer salmon flow augmentation, natural river flows likely would have been much lower than those provided for salmon in August with either alternative. Smoothing the transition between sturgeon spawning flow releases and summer salmon flow augmentation is intended to avoid impacts to habitat for aquatic insects and possibly juvenile fish, including bull trout, that could result from a double peak in flow. Pending more study, the effects of this prolonged higher flow period on resident fish may be discussed in more detail in the EIS for the potential long-term VARQ FC implementation.

5.2.2.2. Hungry Horse Dam

Impacts to fish associated with operation of Hungry Horse Dam are addressed in Reclamation's voluntary EA on interim implementation of VARQ FC at Hungry Horse.

5.2.2.3. Columbia River

See Section 5.2.4.4 for a discussion of effects on anadromous fish in the mainstem Columbia River downstream of Chief Joseph Dam.

5.2.2.3.1. Grand Coulee Dam/Lake Roosevelt

Increased spring drawdown under VARQ FC at Libby and Hungry Horse Dams could result in small reductions in spawning success for smallmouth bass, yellow perch, and shoreline spawning kokanee already impacted by spring flood control drafts under Standard FC. The most probable increase in drafts under VARQ FC during the interim operating period would be relatively minor compared to the average end of April and end of May drafts of approximately 41 and 29 feet, respectively under Standard FC. Walleye spawning is not likely to be affected by increased drawdowns because they spawn upstream in areas that are only slightly affected by drawdowns.

As productive littoral zones are exposed, additional drafts under VARQ FC in some years could also have a minor effect on reservoir productivity and of fish inhabiting shallow water fish habitat. As a whole, the relatively small increases in drawdown are unlikely to cause major reductions in food availability and fish growth rates in Lake Roosevelt. There is no evidence that spring drawdowns affect white sturgeon in Lake Roosevelt and it is unlikely implementation of VARQ FC would have any effect on this species.

Entrainment through Grand Coulee Dam probably is the most important limiting factor in the Lake Roosevelt kokanee and rainbow trout fishery, and water retention time is the most important predictor of entrainment (Underwood, 2000). Entrainment increases as water retention time falls below 30 days, especially if it occurs in late spring after net pen and hatchery fish are released. Under VARQ FC, average water retention time would decrease by less than 1 day for any given month from March through September (Table 8). In April and May, months when flood control releases are usually highest and reservoir levels and retention time lowest, the average difference between Standard FC and VARQ FC is only 0.2 days. These differences are so minor that any increase in entrainment and adverse affect to the rainbow and kokanee fisheries would likely not be measurable. In very high water years, when flood control operations require large releases and deep drafts, and fish entrainment is highest, there would be no difference in reservoir, elevation, water retention times or entrainment rates between Standard FC and VARQ FC.

Zooplankton levels are also impacted by water retention time; however, the small differences between Standard FC and VARQ FC and the evidence that zooplankton are not an overriding limiting factor in Lake Roosevelt (Underwood, 2000) would indicate that retention time reduction under VARQ FC would not result in impacts to zooplankton populations.

Table 8. Average Monthly Retention Time in Days for Water in Lake Roosevelt - Multi-Purpose Operation with Standard FC and with VARQ FC25*

	March	April	May	June	July	August	Sept.
Standard FC	45.2	28.2	22.6	29.4	39.1	39.9	68.6
VARQ FC	44.5	28.0	22.3	28.8	38.3	39.4	68.2
Difference	0.7	0.2	0.2	0.6	0.8	0.5	0.4

*Retention time was computed using reservoir outflow and total reservoir storage at a given elevation (active, inactive, and dead pool) for comparisons with values used in resident fish studies.

5.2.3. Wildlife

5.2.3.1. Libby Dam

Wildlife around Lake Koocanusa generally is unlikely to be significantly affected by VARQ FC as opposed to Standard FC. Loss of wildlife habitat due to inundation of Lake Koocanusa has already been documented and addressed through the Wildlife Mitigation Agreement for Libby and Hungry Horse Dams signed by the State of Montana and Bonneville Power Administration. The agreement provides for a trust account used to mitigate for operations of Libby Dam as they affect the fluctuating level of Lake Koocanusa. To the extent that VARQ FC aids aquatic productivity and fish populations, then terrestrial fish predators (such as eagles, osprey and furbearers) may benefit, but it is not clear that these species are food-limited, so the benefit to their populations may be slight.

5.2.3.1.1. Creston Valley Wildlife Management Area

Higher water levels resulting from springtime sturgeon flow augmentation could inundate waterfowl nests in the Creston Valley Wildlife Management Area (CVWMA) in the Kootenay River delta at the south end of Kootenay Lake in Canada. Duck Lake project, within the CVWMA, is directly adjacent to the Kootenay River at the upstream end of Kootenay Lake and is isolated from the river and lake by a system of dikes. The exterior dikes that isolate Duck Lake from the Kootenay River and Kootenay Lake have a crest elevation of 1766 feet. The project is separated in two parts, a northern area of approximately 3,150 acres and a southern nesting area of approximately 850 acres. An interior dike with crest elevation of 1748 feet separates the two parts. The water level in the northern area is controlled by a system of gravity drains and pumps. The water level in the southern area is similarly controlled by a system of gravity drains and pumps which empty in to the northern area of Duck Lake. Water levels in the project are limited according to the provisions of International Joint Commission (IJC) Orders of Approval issued in 1949, 1950, 1956 and 1970.

In all but the lowest runoff years, runoff from Duck Creek and local areas would cause Duck Lake to overfill and encroach on the freeboard of the dike that separates the northern area from the southern nesting area. Pumps are available at the northeast corner of Duck Lake to facilitate pumping in to Kootenay Lake to limit the Duck Lake water surface elevation in the northern area. Pumping in the 2002 spring runoff period approximates average conditions. During 2002, two 30,000 gal (U.S.)/minute capacity pumps each were run 625 hours to pump approximately 6,900 acre-feet of water. Cost of pumping was approximately $2,400 U.S.

Bird species directly affected by high water levels include a variety of waterfowl and shorebirds such as Canada geese, mallards, western grebes (red listed in British Columbia), American avocet (red listed), long billed curlew (red listed), Forster's tern (red listed). Bird species that do not nest on sites vulnerable to flooding but who may experience indirect adverse effects include osprey, great blue heron (blue listed), American white pelican (red listed), and double crested cormorant (red listed). Nests are established in the early spring and the incubation season goes through early summer.

Increased water levels may also adversely affect amphibians and reptiles, most notably western painted turtles (red listed) and northern leopard frogs (red listed). The CVWMA is the last area in British Columbia in which the northern leopard frog exists. Sudden 3 to 6 feet increases in water levels could adversely impact egg masses in leopard frog re-introduction areas and introduce predatory fish. However, based on Figure 16 and Figure 20, the predicted increase in peak Kootenay Lake elevation is expected to be much less than 3 feet, and real-time adaptive management in operation of Libby Dam may reduce it further.

Flow augmentation for sturgeon generally begins by mid May, but can start as early as April, depending on water temperature and runoff patterns. As a result of sturgeon flows paired with VARQ FC, water levels in the river adjacent to the refuge may rise slightly in most years, but as much as several feet in some extreme years. Effects of that augmentation are among the subjects of this environmental assessment. However, it is important to note that historic (pre-dam) flows were generally much higher than present-day spring flows, even those augmented for sturgeon reproduction. Delta wetlands, as well as other parts of the floodplain, were likely in many years to be inundated for several weeks at a time, which suggests that the waterfowl were adapted to high spring flows. VARQ FC would not result in greater sturgeon flow augmentation than has been seen since 1992, when such augmentation was initiated.

Peak Kootenay Lake elevation under VARQ FC would likely increase compared to Standard FC, although, when outflow at Libby Dam includes fish flows, increases under VARQ FC would typically be 1 foot or less in most years. The increased water levels may require more pumping at the CVWMA to maintain water levels in the preferred range within areas protected by dikes and levees; however, many years may not reach levels that would require pumping. Dikes generally protect the CVWMA from flooding when Kootenay Lake is below 1752.5 feet. Although VARQ FC with fish flows slightly increases the peak elevation of Kootenay Lake, most years the lake level would remain well below flood thresholds for the CVWMA. Under real-time water management operations, peak lake elevations in more extreme years under either flood control operation may not be as high as the models indicate (see Section 5.1.2.1.1).

Kootenay Lake elevation is expected to be approximately 1.5 feet higher in near average runoff years and about 1.0 foot higher in high runoff years. Operation with VARQ FC may increase the period of pumping required to prevent Duck Lake from overfilling and increase the average head the pumps will be working against. The impact is expected to be approximately a 40% increase in average annual pumping cost to the Creston Valley Wildlife Management Authority. Provided pumping continues, adverse effects to birds, reptiles, and amphibians are not expected to be substantially greater under the VARQ FC alternative.

5.2.3.2. Hungry Horse Dam

VARQ FC at Hungry Horse does not appreciably affect wildlife in the Flathead Basin, though predators that depend on fish may benefit from healthier fish populations in Hungry Horse Reservoir and the Flathead River.

5.2.3.3. Columbia River

VARQ FC would have no measurable effect to wildlife at Lake Roosevelt. The relatively minor changes to drawdown and retention time are not likely to affect fish-dependent wildlife species.

5.2.4. Sensitive, Threatened and Endangered Species

5.2.4.1. Kootenai River White Sturgeon

In their 2000 FCRPS BiOp, the USFWS required, as a reasonable and prudent alternative to avoid jeopardy to Kootenai River white sturgeon and as part of their incidental take statement, that the Corps implement VARQ FC at Libby Dam during the 2002 water year (October 2001 to September 2002). As of this date, the Corps has not implemented VARQ FC at Libby Dam.

While VARQ FC has not yet been implemented, the Corps has provided flows requested by the USFWS for Kootenai River white sturgeon since issuance of the USFWS 2000 FCRPS BiOp. The 2001 water year was a drought year when sturgeon flows were not requested by the USFWS. For the 2002 water year, the sturgeon flows requested by the USFWS from Libby Dam were met coincident with flood control operations at Libby Dam during the spring and summer. Therefore, although VARQ FC has not yet been implemented, the biological needs of sturgeon have been met by the Corps' operation of Libby Dam since issuance of the USFWS 2000 FCRPS BiOp (USFWS, 2000).

The EA at hand is intended to evaluate the potential impacts of an interim implementation of VARQ FC until completion of the EIS for long-term decision-making.

The VARQ FC operation is intended to increase the reliability of having water available for fish flow augmentation, including sturgeon flows, in years of average to below-average runoff. Provision of water to augment flows during the sturgeon spawning period is a linchpin of the USFWS 2000 FCRPS BiOp to improve recruitment of juvenile sturgeon into the Kootenai River population. The critical sturgeon spawning reach is located in the vicinity of Bonners Ferry. When sturgeon last produced a significant year class in 1974, base flows at Bonners Ferry were near 40,000 cfs. VARQ FC would more reliably provide enough water to approach the 40,000 cfs flow at Bonners Ferry that is targeted in the USFWS 2000 FCRPS BiOp. With sturgeon flows in the spring and early summer, VARQ also more reliably provides enough water to meet bull trout and salmon augmentation flows later in the summer.

Survival benefits that VARQ FC confers on white sturgeon presumably include increased spawning success, increased fry survival, and increased recruitment of juvenile sturgeon into the population. During sturgeon flow operations over the past decade, large numbers of fertilized and developing eggs have been recovered. During that time, only 2 larvae and a few empty egg cases (indicating successful hatching) have been found, and only one young-of-the-year sturgeon has been found. Since hatchery reared juvenile sturgeon appear to survive in the river, high levels of mortality are likely occurring to eggs, larvae, and possibly young-of-the-year sturgeon.

Monitoring with set lines and gill nets has captured of approximately 30 juveniles greater than 3 years of age which are known to have been naturally recruited. Since only 11% of all hatchery juveniles have been captured since their release it is reasonable to assume that there are more than this 30 naturally recruited sturgeon associated with experimental flows since 1991. However, no year class has yet reached the level of significant natural recruitment which is defined in the Kootenai River White Sturgeon Recovery Plan as the detection of 20 fish from a given year class with standard monitoring techniques.

The 2002 spill events resulted in high flows at Bonners Ferry in late June and early July. During the 2002 sturgeon spawning season, Idaho Department of Fish and Game captured a total of 297 eggs and all of those were captured before the spill occurred. Even though the flows during the spill event appeared to have occurred after sturgeon spawning, the high flows associated with the spill may have enhanced habitat conditions for sac fry or free swimming juvenile sturgeon resulting from eggs previously released. Because of sampling limitations, it will take about three years (when sampling gear is able to capture juvenile fish that resulting from the 2002 sturgeon spawning) to get data on the degree of success for the 2002 sturgeon spawning event.

Factors that may contribute to the poor success of sturgeon recruitment include poor quality substrate in the critical spawning reach, loss of side channel rearing habitat, flow fluctuations, and backwater effects from regulation of Kootenay Lake. Studies to date appear to indicate that flow augmentation, when taken alone, is not sufficient to increase sturgeon recruitment. Work to identify other potential limiting factors is continually ongoing and will be factored into future requests for sturgeon flow augmentation. Nevertheless, compared to Standard FC, VARQ FC clearly results in a more reliable source of water for sturgeon flow augmentation in average to below-average water years. In extremely wet or dry years, both VARQ FC and Standard FC would provide the same volume of water for sturgeon flow augmentation.

Although a captive broodstock program for sturgeon provides a stopgap measure to supplement sturgeon productivity, reproduction in the wild is essential for species recovery and long-term survival. Recent studies indicate that the existing Kootenai River sturgeon population is older than previously thought, adding urgency to species recovery efforts since the existing fish may reach reproductive senescence much sooner than estimated in the USFWS 2000 FCRPS BiOp (USFWS, 2000). Compared to the Standard FC alternatives, the potential interim implementation of VARQ FC would somewhat reduce risk of extinction by allowing Libby Dam operations to be better adjusted for the benefit of sturgeon (within constraints presented by project authorizations), while more reliably providing for reservoir refill.

5.2.4.2. Columbia River Bull Trout

5.2.4.2.1. Libby Dam

Both of the alternatives provide bull trout flows required in the USFWS 2000 FCRPS BiOp (USFWS, 2000), thereby benefiting bull trout populations in the Kootenai River downstream of Libby Dam. Fish flow operations provide a more normative hydrograph for the Kootenai River system that enhances habitat-forming processes to the benefit of resident fish populations, including bull trout.

Compared to the Standard FC alternatives, VARQ FC tends to reduce fluctuation of Lake Koocanusa water levels and better assure refill in average to slightly-below-average water years. The more stable lake levels under VARQ FC would benefit reservoir bull trout populations by providing better access to tributaries and enhancing lake productivity.

As discussed in Section 5.1.2.1.4.6, VARQ FC increases the likelihood of involuntary spills and, when involuntary spills do happen, increases the maximum spillway flow. Accordingly, VARQ FC will increase the rate of entrainment of fish, including bull trout, at Libby Dam. Bull trout entrained at Libby Dam will likely be killed or injured. Such take of bull trout is unavoidable if VARQ FC is implemented. Based on requirements of the USFWS 2000 FCRPS BiOp (USFWS, 2000), the Corps has scheduled an assessment of the extent of bull trout entrainment at Libby Dam during 2004-2005 and, if such entrainment is substantial, to explore ways to reduce bull trout entrainment.

As discussed in Section 5.1.3.1, the USFWS acknowledges the potential increased risk of involuntary spill under VARQ FC but does not anticipate substantial adverse effects on bull trout.

5.2.4.2.2. Hungry Horse Dam

None of the alternatives would result in changes that affect bull trout at Hungry Horse Dam. Refer to Reclamation's 2002 voluntary EA for details of the effects on bull trout resulting from interim implementation of VARQ FC at Hungry Horse.

5.2.4.2.3. Columbia River

With the exception of the analysis above, effects on bull trout in other areas of the Columbia River basin are not expected to differ between the alternatives. The bull trout population in Lake Roosevelt appears very small to practically non-existent. Habitat conditions in rearing streams appear to be the major limiting factor. The relatively minor increases in flood control draft under VARQ FC are not likely to have any effect on bull trout that may inhabit Lake Roosevelt.

5.2.4.3. Bald Eagle

5.2.4.3.1. Libby Dam

Effects to bald eagles will vary in relation to the extent that the different alternatives affect fish populations. At Libby Dam, substantial numbers of bald eagles congregate immediately downstream of the dam and feed primarily on entrained kokanee. While VARQ FC with fish flows may slightly increase the rate of fish entrainment in some years, effects on the numbers or health of eagles in the area are not anticipated due to the localized nature of the entrainment. Effects further downstream in the Kootenai River Basin are expected to be minimal.

5.2.4.3.2. Hungry Horse Dam

At Hungry Horse Dam, the VARQ FC operation is not a substantial departure from historic operational limits or operational flexibility of the project (Reclamation, 2002a). Accordingly, none of the alternatives are expected to result in adverse effects to eagles in the Flathead system.

5.2.4.3.3. Columbia River

At Lake Roosevelt, fish are the primary prey item for bald eagles and the different alternatives are not expected to differ in their effects on fish populations. Waterfowl, another important prey item, would not likely be affected as well. The increasing numbers of nesting bald eagles, good productivity, and substantial numbers of wintering birds suggest prey (primarily fish and waterfowl) is abundant and not a limiting factor for bald eagles (Murphy, 2000; SAIC, 1996). Compared to Standard FC, the relatively small average increase in drawdown and reduction in retention time in Lake Roosevelt Lake as a result of VARQ FC would not cause major impacts to fish (Section 5.2.2.3.1). The different alternatives would have very similar effects on bald eagles.

5.2.4.4. Anadromous Fish

One of the primary effects of VARQ FC is to increase the reliability and volume of water available for the August salmon flow augmentation from Libby and Hungry Horse Dams in average to slightly-below-average water years. Releases from storage reservoirs such as Libby and Hungry Horse are based on the premise that managing flows of the lower Columbia River to threshold levels improves the quality of juvenile migration habitat (both riverine and/or near ocean environment) and improves the survival of these salmonids (NMFS, 2002; NMFS, 2000b). The summer flow augmentation season extends from June 21 to August 31. During this time, Lake Koocanusa and Hungry Horse Reservoir are drafted as necessary to specific draft limits recommended in the NMFS 2000 FCRPS BiOp (NMFS, 2000a) in an attempt to meet summer flow objectives. The highest observed numbers of returning adult salmon occur with average McNary flows during outmigration of at least 200 kcfs (Giorgi *et al.*, 1990; NMFS, 2002), supporting the hypothesis that smolt-to-adult return rates are greater under high flows.

The effect of the different alternatives on meeting flow objectives at Priest Rapids and McNary Dams were evaluated

The Priest Rapids flow objective, as required by the NMFS 2000 FCRPS BiOp, is 135 kcfs from April 10 through June. The flow targets set to provide water for the benefit migrating juvenile salmonids. Compared to the Standard FC with fish flow alternatives, VARQ FC with fish flows would slightly increase the chance of meeting the spring flow targets at Priest Rapids Dam during June but not April or May (Table 9).

Table 9. Number of Years Out of the 60-year Period of Record that Priest Rapids Flow Targets Were Met

Alternative	Ap1*	Apr	May	Jun
Standard FC	43	32	48	47
VARQ FC	43	32	48	48

*Ap1 represents the first half of April.

In years when the flow target is missed, Standard FC with fish flows tends to have higher average April flows but VARQ FC with fish flows slightly increases the average flows in May and June. Overall, the differences in average flows (Table 10) between the two flood control methods with fish flows are small, with a maximum difference of 1,300 cfs in the monthly average flow (about 1% of the flow objective of 135 kcfs).

Table 10. Average Amount By Which Priest Rapids Flow Targets Were Missed (kcfs)

Alternative	Ap1*	Apr	May	Jun
Standard FC.	15.9	33.6	12.2	16.9
VARQ FC	15.8	34.9	11.6	16.7

*Ap1 represents the first half of April.

The flow objective for McNary Dam, as required by the NMFS 2000 FCRPS BiOp (NMFS, 2000a), varies, based on the water supply forecast, between 220 kcfs and 260 kcfs from April 10 through June. The flow objective at McNary Dam is 200 kcfs from July 1 to August 31. Compared to Standard FC with fish flows, VARQ FC with fish flows would slightly increase the chance of meeting flow targets in May, June, and July, and would not increase the likelihood of meeting the August flow objectives at McNary Dam (Table 11).

Table 11. Number of Years Out of 60-year Period of Record that McNary Flow Targets Were Met

Alternative	Ap1*	Apr	May	Jun	Jul	Ag1*	Aug
Standard FC	52	25	46	40	20	14	1
VARQ FC	52	25	47	42	23	14	1

*Ap1 and Aug1 represent the first half of April and August, respectively.

In years when the flow target is missed, Standard FC with fish flows tends to have higher average flows in April, May, June, and July, but VARQ FC with fish flows tends to have slightly higher average flows in August. Overall, the differences in average flows (Table 12) between the two flood control methods with fish flows are small, with a maximum average difference of 2,400 cfs in August (no more than 1% of the lowest possible flow target).

Table 12. Average Amount By Which McNary Flow Targets Were Missed (kcfs)

Alternative	Ap1*	Apr	May	Jun	Jul	Ag1*	Aug
Standard FC	10.1	59.5	29.4	38.7	43.7	40.7	61.6
VARQ FC	10.3	60.9	30.5	39.6	45.9	37.8	59.2

*Ap1 and Aug1 represent the first half of April and August, respectively.

When averaged over the fish migration season at McNary (April 10 through August 31), model results indicate that VARQ FC with fish flows would provide approximately 2,400 cfs more flow at McNary than Standard FC with fish flows. In August, when Libby and Hungry Horse Dams draft to provide water for salmon flow augmentation, the greatest difference between VARQ FC with fish flows and Standard FC with fish flows results in up to 10,000 cfs more flow at McNary Dam in certain years (see Appendix F, Chart 13).

The flow objectives are based on biological criteria, not the ability of the hydrosystem to meet those objectives. Accordingly, even though the target is missed in most years under all of the alternatives, VARQ FC with fish flows increases flows compared to Standard FC with fish flows, bringing the system closer to the flow target.

Evidence for a survival benefit for salmonids in the Columbia River Basin is supported by research results (NMFS, 2000b, 2002). Data sets for summer migrants consistently demonstrate strong relationships between flow and survival, and temperature and survival. Study results suggest that flow management, in conjunction with other fish protection measures, has had a beneficial effect on smolt survival in the basin.

5.2.4.5. Kootenai River Burbot

Burbot migrate up the Kootenai River in the winter and spawn in January and February. Since burbot are very weak swimmers, high flows during the migration and spawning period may inhibit or even prevent spawning. In cooperation with the Idaho Department of Fish and Game and the Kootenai Tribe of Idaho, the Corps is considering changes in Libby Dam operational protocols to decrease dam discharges during the burbot migration and spawning period. To the extent that VARQ FC affects flood control drafts, winter flows under VARQ FC, when compared to Standard FC, may be slightly less, resulting in lower dam discharges that could benefit burbot spawners in some years with a average to slightly-below-average runoff forecast.

Based on the monthly time step models scenarios using sixty years of historic data, Table 13 demonstrates the difference in monthly average outflow from Libby Dam in December and January when the reservoir is operated on Standard FC and VARQ FC in January.

In the scenarios described in Table 13, Libby Dam operation was modeled to meet varying regional power demands in the September through December period. Although the December outflow from Libby Dam was slightly higher in the 60-year monthly model scenario using VARQ FC, the small variation in changed outflow in December may be shaped within the month in real operations (similar to the real-time flood control operations discussed in Section 5.1.2.1.1). The potential to shape flow within the month of December may make the low flow burbot operation more easily accommodated in some years. In both the Standard FC and VARQ FC scenarios above, Lake Koocanusa was modeled to be at elevation 2411 feet at the end of December. In January, Libby operated to its end of January flood control elevation calculated on either Standard FC or VARQ FC. Since the VARQ FC elevations are generally higher at the end of January, the resultant outflow from Libby Dam is somewhat lower in January, which may benefit burbot.

Even with VARQ FC, adjustments during January and February would likely be necessary to shape outflows from Libby Dam to maximize potential benefits to burbot migration and spawning. Additionally, operations to benefit burbot, combined with VARQ FC, would likely reduce the real-time operational flexibility of Libby Dam water management. More detailed analysis and evaluation of the potential opportunities and risks resulting from burbot-specific considerations are being developed. Early forecasting technology is also being developed in hopes of having tools to allow reservoir drawdown decisions to be made beginning during fall rather than having to wait until January of each year to develop strategies.

Table 13. Average Libby Dam Discharge in December and January under Standard and VARQ Flood Control

		Average Monthly Flow (cfs)	
Flood Control Method	**Water Supply Forecast at The Dalles (# of years w/in range)**	**December**	**January**
Standard FC	53.5to 79.2 maf (8 years)	9221	7813
	80.8 to 96.9 maf (12 years)	10337	13732
	97.1 to 113.5 maf (20 years)	9459	17743
	113.7 to 156.1 maf (19 years)	12333	21197
	AVERAGE	*10448*	*16508*
VARQ FC	53.5to 79.2 maf (8 years)	9,969	4,546
	80.8 to 96.9 maf (12 years)	11,830	7,391
	97.1 to 113.5 maf (20 years)	9,702	9,386
	113.7 to 156.1 maf (19 years)	12,640	11,197
	AVERAGE	*11,053*	*8,812*
Average Flow Difference (Standard FC-VARQ FC) NOTE: Negative numbers indicate that Standard FC flows are higher than VARQ FC flows	53.5to 79.2 maf (8 years)	605	-7,696
	80.8 to 96.9 maf (12 years)	748	-3,268
	97.1 to 113.5 maf (20 years)	1,493	-6,341
	113.7 to 156.1 maf (19 years)	243	-8,358
	AVERAGE	*-307*	*-10,000*

5.3. Native American and Cultural Resources Sites

5.3.1. Libby Dam

5.3.1.1. Area of Potential Effect

The primary area of potential effect is behind Libby Dam within Lake Koocanusa.

5.3.1.2. Lake Koocanusa

At this time, analysis cannot separate effects of current routine reservoir operations from potential effects of VARQ FC. Detailed impact analyses are underway. At least 347 cultural resources have been identified within the drawdown area. Many of these sites may be affected by VARQ FC with fish flows.

5.3.1.3. Downstream Effects

Potential downstream effects are noted below Libby Dam at sites in the Libby—Jennings Archaeological District, and at Kootenai Falls Archaeological District between Libby, Montana and Bonners Ferry, Idaho.

5.3.1.4. Mitigation Measures

Mitigation measures for adverse effects to cultural resources in Lake Koocanusa cannot be determined until present impact analyses are completed.

5.3.1.5. Consultation and Coordination

Presentations regarding the effects of VARQ FC were made October 30, 2002, to the Libby Dam-Lake Koocanusa Cultural Resources Cooperating Group, including representatives of Confederated Salish-Kootenai Tribes and Kootenai National Forest. Formal consultations with Tribes and the Montana State Historic Preservation Office are being scheduled.

5.3.2. Hungry Horse Dam

Information on Native American and cultural resources relating to Hungry Horse Dam is provided as an update from Reclamation's 2002 voluntary EA for interim VARQ FC implementation at Hungry Horse Dam.

5.3.2.1. Area of Potential Effect

The area of potential effect at Hungry Horse reservoir for VARQ FC is defined as the portion of the reservoir shoreline that is impacted by the operations of VARQ FC. In some years, the water would be held higher during the months of January through May with VARQ FC than would have been the case with Standard FC.

VARQ FC is projected to hold water as much as 27 feet higher at Hungry Horse than Standard FC in years with water supply forecasts between 80% and 120% of average (Reclamation, 2002a). This maximum would most likely occur in the months of March and April, according to preliminary hydrologic analysis by the Corps of Engineers. In high water years, the difference between VARQ FC and Standard FC high-pool levels would be significantly lower (Reclamation, 2002a). In low water years, VARQ FC would not affect reservoir levels at Hungry Horse. The area of potential effect for VARQ FC at Hungry Horse reservoir is described as shoreline elevations between 3,456 and 3,560 feet.

This EA will compare the differences in impacts to cultural resources at Hungry Horse using Standard FC and VARQ FC

5.3.2.2. Hungry Horse Reservoir

For the purposes of cultural resources management, Standard FC, as the no-action alternative, would not affect the current degree of impacts to cultural resources at Hungry Horse.

The area of potential effect for VARQ FC at Hungry Horse is contained within historic operating limits. Historic operating parameters at Hungry Horse include the elevations of 3,336 to 3,560 feet, with an average winter draft, including power drafts, to 3500 feet. Under VARQ FC, the average maximum draft will rise from 3,528[29] to 3,535 feet during January through May. The reservoir will continue to refill to 3,560 feet by the end of June. This changes the proportion of time that sites from 3,520 to 3,540 feet are exposed to ice movement and wave action. These processes may increase impacts from erosion or freezing to Sites 24FH129, 24FH862, 24FH863, 24FH867, 24FH868, and 24FH912 (Figure 28). It is expected the effects of wasting and slumping to upslope sites (24FH211, 24FH860, and 24FH876) will not vary from Standard FC. This analysis addresses data for 11 Hungry Horse sites, and full data for the 17 sites will be analyzed under the EIS under preparation.

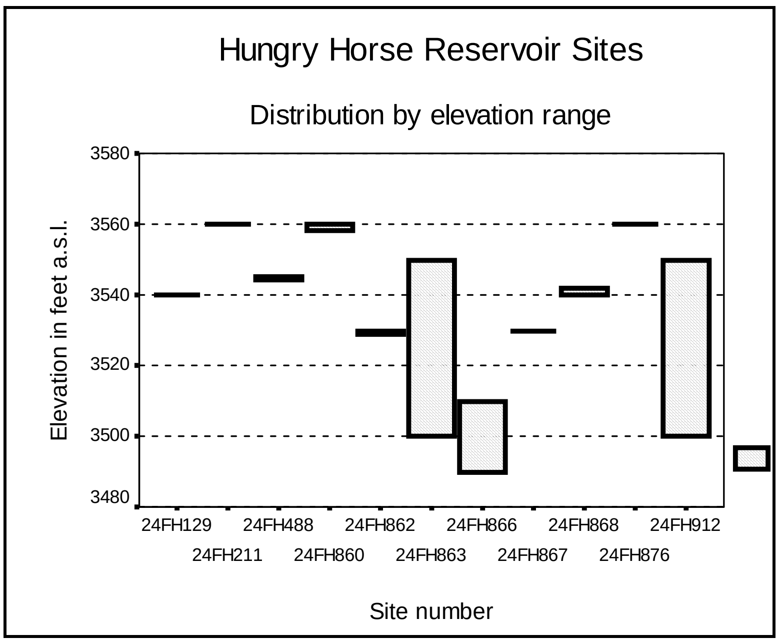


Figure 28. Elevation Distribution of Historic Sites at Hungry Horse Reservoir

5.3.2.3. Downstream effects

Discharges from Hungry Horse Dam under VARQ FC rule curves would be generally higher in March, May, and June, and lower in January, February, and April. There would be less month-to-month variation than under the Standard FC (Reclamation, 2002a). Reclamation does not currently have access to data for cultural resources located downstream of Hungry Horse Dam, and cannot evaluate impacts under this EA.

[29] The modeled average draft of 3,528 feet is higher than the historic 3,500 foot average draft since the historic draft includes draft for power below the upper rule curve. Based on FCRPS BiOp requirements, Hungry Horse operations no longer include power drafts below the upper rule curve, hence the reservoir would be drafted less.

5.3.2.4. Mitigation Measures

Sites 24FH129, 24FH862, 24FH863, 24FH867, 24FH868, and 24FH912 should be monitored in March to measure impacts related to higher water levels in that season. Discovery of new sites or site components, or effects to already-impacted sites, will continue to be mitigated under the current cultural resources management program at Hungry Horse. Mitigation may include documentation, collection of artifacts, or more intensive data recovery. There should be no need for additional Archaeological Resource Protection Act patrols during key recreation seasons.

Reclamation will coordinate with the Flathead National Forest to identify downstream cultural resources and mitigate impacts as needed under the current program. More detailed information will be included in the EIS in preparation.

5.3.2.5. Consultation and Coordination with Native American Tribes and other interested parties

The first consultation meeting between Reclamation and the Confederated Salish and Kootenai Tribes (CSKT) of the Flathead Nation was held in Pablo, Montana, on November 13, 2002. CSKT staff members Tim Ryan and Dave Schwab representing the Tribal Historic Preservation Officer attended the meeting. The CSKT expressed concerns that the reservoir banks might erode at an accelerated rate due to the more rapid rate of drawdowns under VARQ. Concerns also included that underwater sites may be affected by the dynamics associated with higher flow rates. The CSKT staff has no objections to the Area of Potential Effect defined by Reclamation at Hungry Horse. The CSKT said there should be no Archaeological Resources Protection Act concerns, because recreation at Hungry Horse Reservoir normally starts in May to June.

For the EIS in preparation, the CSKT would like to see a general statement concerning bank impacts associated with operations of the reservoir. The statement would cover soil and landform types, and give predicted effects. This would serve as a guide for what we might expect given certain conditions.

As of December, 2002, the Flathead National Forest has reviewed the EA and agrees with the Area of Potential Effect. The Forest, which currently manages cultural resources along the Hungry Horse Reservoir shoreline, will coordinate with Reclamation to monitor and mitigate effects associated with VARQ flood control actions.

5.3.3. Columbia River

5.3.3.1. Area of Potential Effect

The area of potential effect at Lake Roosevelt for VARQ FC is defined as the portions of the reservoir and adjacent lands that are impacted by the operations of VARQ FC. During some years, the reservoir will be drafted lower for VARQ FC (up to 9.5 feet) than it would have been under Standard FC. There will be no difference in the draft at Grand Coulee during wet winters (above 120% of average run-off), or dry winters (below 80% of average run-off). Historic operating parameters at Grand Coulee include the elevations of 1208 to 1290 feet, with an average spring draft of 1248 feet and a maximum spring draft of about 1210 feet. VARQ FC would potentially impact elevations between 1220 and 1280 feet along the Lake Roosevelt shoreline. Effects of erosion from wave action range upslope of water level, and it is not possible to predict an upper limit for slumping, wasting, and other upslope effects of erosion. In certain cases, secondary effects of erosion may occur above the take line of 1310 feet, and archaeological sites and other cultural resources do exist above that elevation. The area of potential effect for VARQ FC at Grand Coulee/Lake Roosevelt, which is contained within historic operating limits, is defined as ranging from the 1220 to the 1310-foot elevation. Impacts to cultural resources above the 1310-foot line will be addressed on a case-by-case basis.

Erosional effects are not limited to the former course of the Columbia River, but may also affect tributaries for some distance upstream. However, Reclamation does not have currently specific data for the upstream extent of those effects. The area of potential effect will also include portions of tributary drainages to be determined in the field.

The differences between Standard FC and VARQ FC will be compared for impacts analysis to Lake Roosevelt cultural resources, since the other alternative components do not affect Lake Roosevelt operation.

5.3.3.2. Lake Roosevelt

For the purposes of cultural resources management, Standard FC are equivalent to 'No Action' and would not affect the degree of impacts to cultural resources at Lake Roosevelt.

VARQ FC will increase the amount of time the reservoir will be held at lower elevations. Hydrological projections indicate that the largest elevation differences (of up to 9.5 feet lower to 11 feet higher) under VARQ FC would occur between 1240 and 1286 feet, and particularly between 1245 and 1265 feet.

End of April Elevation-Percent Non-Exceedance
(percent chance of bank exposure) at Grand Coulee – Standard and VARQ

Elevation (feet)	Percent Chance of Non-Exceedance Standard FC	Percent Chance of Non-Exceedance VARQ FC
1280	0.78	0.80
1270	0.78	0.78
1260	0.64	0.69
1250	0.58	0.58
1240	0.39	0.42
1230	0.24	0.27
1220	0.07	0.07
1210	0.02	0.02

Table 14. End of April Elevation-% Non-Exceedance at Grand Coulee/Lake Roosevelt

Table 14 shows the percent-chance of bank exposure by elevation in 10-foot increments. The elevations of 1230 to 1260 are depicted as having between 3% and 5% average chance of increased exposure under VARQ FC from Standard FC. Note that these are probabilities and do not reflect maximum exposures possible.

Average water years will require the greatest differences between VARQ FC and Standard FC drafts at Lake Roosevelt. In high and low water years, VARQ FC drafts will not substantially differ from Standard FC drafts. Available data for archaeological sites show that 142 known sites, or 36% of the total (N=388), will be affected at water levels between 1240 and 1286 feet. Between 1245 and 1265 feet, 59 known sites or 15% of the total will be affected. These numbers do not represent all sites that are located on tribal land and therefore not in NPS or state records. Also, several sites do not have current elevation information. Therefore the above impacts assessment represents a minimum estimate.

5.3.3.3. Downstream effects

Of the circa 50 historic and prehistoric sites previously known for the shoreline in the six-mile tailrace downstream of the dam, only three sites (two prehistoric and one historic) were located in a recent survey by Applied Archaeological Research. The sites are at elevations between 1030 and 1160 feet. The current status of the other sites is not known. Armoring the east bank has possibly altered erosion patterns, or vegetation cover has increased, resulting in the loss or decreased visibility of sites.

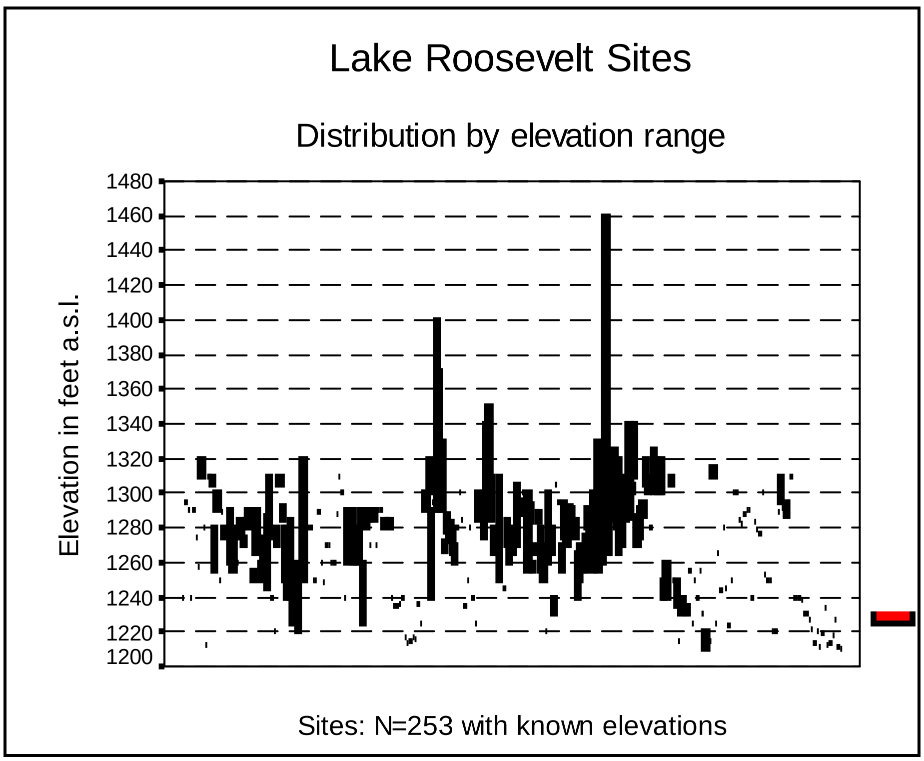


Figure 29. Elevation Distribution of Historic Sites at Lake Roosevelt

Hydrologic data on the effects of VARQ FC immediately downstream of the dam are not currently available, and it is not possible to evaluate impacts to downstream cultural resources at this time.

5.3.3.4. Mitigation Measures

If the flood control draft under VARQ FC in a given year is projected to exceed those under Standard FC, the Lake Roosevelt shoreline should be monitored during March and April for impacts to known cultural resources. Discovery of new sites or site components, or impacts to known sites, will continue to be mitigated under the current cultural resources management program at Lake Roosevelt. Mitigation may include documentation, collection of artifacts, or more intensive data recovery. There should be no need for additional Archaeological Resource Protection Act patrols during key recreation seasons.

If VARQ FC is determined to affect elevations between 1030 and 1160 feet in the six-mile tailrace below the dam, Reclamation will mitigate impacts to known downstream cultural resources, including but not limited to data recovery. Mitigation will be conducted under the existing cultural resources management program. More detailed information on downstream issues will be included in the EIS in preparation.

5.3.3.5. Consultation with tribes and other interested parties

The first consultation meeting with the Tribal Historic Preservation Officer and Historic Preservation Office staff of the Confederated Tribes of the Colville Indians (CCT HPO) took place on November 5, 2002, in Nespelem, WA. CCT's tribal archaeologist believes that the scheduling of additional drawdowns related to VARQ FC flood control operations should allow the current Colville shoreline site monitoring program to address the effects of VARQ FC. The CCT HPO expressed concern for sites downstream of Grand Coulee, in particular those at Chief Joseph Dam area. The tribe requested that Reclamation coordinate with the Corps to include those data in the EIS under preparation.

The CCT HPO stated that the effects of VARQ FC on cultural resources will be very hard to separate from the cumulative effects of the multipurpose operations of the reservoir, and they feel that cumulative effects are not being addressed at the programmatic level under the current cultural resources program.

Also, the CCT HPO expressed concern with the compressed scheduling of this EA, and that the decision to implement VARQ FC appears to have been made in advance of the NEPA process. The CCT HPO said that if VARQ FC is not a discretionary action, then the NEPA process, including Section 106 consultation, may not be appropriate. However, the CCT Tribal Historic Preservation Officer will continue to consult with Reclamation, and will provide additional data on impacts to historic properties and sacred sites for the EIS under preparation.

The first consultation meeting with the Spokane Tribe of Indians (STI) took place on September 18, 2002. Since government-to-government consultation had not yet taken place, this meeting is defined by the STI cultural staff as a technical meeting. Section 106 consultation will take place once government-to-government consultation has begun.

In the technical meeting, the Tribal Historic Preservation Officer expressed strong concern that the consultation process has been compromised by accelerated scheduling (see Section 5.3.3.2). He stated that VARQ has been implemented in advance of any consultation. More discussion of this issue will be pursued in the government-to-government level consultations to be scheduled. It should be noted that the cultural resources segments of this EA do not reflect any tribal input as of this writing, and traditional cultural properties and sacred sites are not yet included.

5.4. Socio-Economic Resources

5.4.1. Land Use

5.4.1.1. Libby Dam

In most cases, land use in the Kootenai basin would not be expected to be affected by VARQ FC in comparison to Standard FC. The exception would be the agricultural land in the floodplain from around Bonners Ferry, Idaho, to Kootenay Lake. In that area, based on the ten-year modeling analysis, there is some likelihood of increased groundwater seepage due to higher river elevations under VARQ FC with fish flows relative to Standard FC with fish flows. For the EIS for long-term decision-making, further studies are being conducted to understand the relationship between groundwater seepage and river stage and duration. According to Harp (2001), river stages above 1758 feet (at Bonners Ferry) sustained for a week or more produce enough seepage to affect crop production for some farms. As the river levels rise and/or are sustained for longer periods, seepage increases. Harp (2001) estimated that agricultural costs due to seepage in 1997, a high runoff water year, amounted to $1.2 million dollars. Lost hop production amounted to an additional $379,000 in 1997. In the average year, compared to pre-fish-flow conditions, fish flows increase adverse affects to Kootenai Flats farmers by approximately $515,000 (Corps, 1998), not including impacts to hop production.

The ten-year modeling studies at this point show that the river stage at Bonners Ferry is higher for VARQ FC with fish flows than for Standard FC with fish flows during the May to July period (see Sections 5.1.2.1.4.4). Actual peak water levels may be managed to lower stages than shown in the model results (see Section 5.1.2.1.1). Nevertheless, agricultural impacts under VARQ FC with fish flows may be greater than those that would occur under Standard FC with fish flows because flow from Libby Dam is expected to be greater than minimum flow for longer periods of time under VARQ FC.

While VARQ FC may increase agricultural impacts along the Kootenai River to some degree, the differences between VARQ FC and Standard FC in more common years are small when fish flows are considered for both flood control operation scenarios.

The Corps currently has no authority to compensate landowners for seepage impacts related to river stage, as such authority has not been provided by Congress.

5.4.1.2. Hungry Horse Dam

VARQ FC at Hungry Horse does not appreciably affect land use in the Flathead Basin.

5.4.1.3. Columbia River

Compared to Standard FC, interim implementation of VARQ FC would not appreciably affect land use in areas of the Columbia River Basin downstream of the Kootenai River confluence.

5.4.2. Flood Hazards

5.4.2.1. Libby Dam

5.4.2.1.1. Bonners Ferry

The sixty years of daily modeling with flood control operations only (see Section 5.1.2.1.3) shows flood stage of 1764 feet might be reached or exceeded at Bonners Ferry in six out of 100 years for Standard FC, and in about 10 out of 100 years for VARQ FC (Figure 15). The ten-year daily modeling with flood control and fish flows indicates that VARQ FC with fish flows resulted in the Bonners Ferry stage reaching a maximum stage of 1770 feet in 1948, while Standard FC with fish flows results in a peak Bonners Ferry stage of 1764 feet. 1948 was an extremely big water year when forecast error and an anomalous weather pattern resulted in a low early-season forecast that proved inaccurate. While modeling of 1948 represents a worst-case-scenario for a rare event, the model results appear to indicate an increased risk of flooding along the Kootenai River for VARQ FC with fish flows, particularly for rare years where the circumstances are similar to 1948. Use of more conservative operational decision-making in conjunction with the use of more frequent forecasting tools in real-time water management would likely indicate a better level of flood control than shown by the modeling of VARQ FC with fish flows (see Section 5.1.2.1.1).

The ten-year modeling with flood control and fish flows indicates that VARQ FC operation would increase the potential flood damages along the Kootenai River corridor in unusually large water years with inaccurate early season forecasts. In these years, while flooding may still have occurred with the Standard FC operation, the model results indicate that river stages in excess of flood stage would be higher for longer duration with VARQ FC. In more average runoff years, VARQ FC would result in river levels below flood stage that are higher and last longer than Standard FC. However, with the exception of potential impacts to agricultural areas discussed in Section 5.4.1.1, impacts to land use in more common years are not likely from interim implementation of VARQ FC with fish flows.

The longer-term economic value of the impacts related to VARQ FC will be addressed in the EIS.

The model results do not take into account real-time operational changes that could be taken to minimize flood risks. More detailed hydrologic modeling may be available for and incorporated into the EIS being prepared for long-term decision-making.

5.4.2.1.2. Kootenay Lake

The 1972 CRT FCOP states that “damage commences at Nelson when Kootenay Lake reaches elevation 1755 feet and major damage stage is elevation 1759 feet” (COE, 1972). VARQ FC appears to increase the lake elevation by about 2 feet in any given year. When fish flows are considered, where there is a difference between VARQ FC and Standard FC, the increase in peak lake elevation appears to about 1 foot for most years except for rare events like 1948.

The hydrology modeling indicates that the duration of lake levels higher than about 1750 feet is similar for both flood control procedures, but peak elevations appear to be higher under VARQ FC. The increased likelihood of reaching high lake elevations under VARQ FC may lead to increased impacts from high water. Adjustment by water managers of operations made in response to changing conditions and new information is called “adaptive management.” It is a deliberate and necessary process. The ability to change operations and adapt to condition cannot be simulated in a model. The longer-term economic value of the impacts related to VARQ FC will be addressed in the EIS.

5.4.2.2. Hungry Horse Dam

VARQ FC at Hungry Horse does not appreciably affect flood hazards in the Flathead Basin.

5.4.2.3. Columbia River

Under all the alternatives, system flood control modeling results indicate only negligible changes in flood risk and magnitude along the Columbia River (see Section 5.1.2.3).

5.4.3. Dam Safety

5.4.3.1. Libby Dam

None of the alternatives will have an effect on dam safety at Libby Dam since the operation of the dam under the different alternatives is well within the dam’s specifications and current capabilities (see Section 3.4.3.1).

5.4.4. Recreation

5.4.4.1. Libby Dam

Compared to Standard FC alternatives, VARQ FC results in an increase in Lake Koocanusa refill reliability. In years when full pool elevations are not reached, the maximum lake elevation is always higher with VARQ FC than with Standard FC (see Sections 5.1.2.1.3.4 and 5.1.2.1.4.2 for details). Accordingly, VARQ FC increases the reliability of usable pool elevations during summer for marina operators. Figure 17 shows that in 6 years out of the 10 years examined for VARQ FC with fish flows, the reservoir fills to within 5 feet of the full pool elevation of 2459 feet, compared to 4 years out of the 10 for Standard FC with fish flows. Boat launch users on Lake Koocanusa would see a slight improvement in usability of launches with VARQ FC in some years when VARQ FC results in higher reservoir elevation. However, both operations would allow boat launches to be used during the boating season in most years. To the extent that decreased drafting and increased biological productivity in the reservoir result from VARQ FC, fishermen may benefit from better fish production in Lake Koocanusa.

While summer drafts for flow augmentation would target the same 2439 foot elevation under either alternative, VARQ FC, with the higher peak reservoir elevation, would likely increase the amount of time in August that Lake Koocanusa remains within the top 20 feet of full pool, to the benefit of recreational interests along Lake Koocanusa. The end-of-August lake elevation would be very similar under both alternatives since flow augmentation draft targets the same August 31 draft point under both scenarios, and recreational users have expressed concern about the drawdown occuring during the summer recreation season. The end-of-August target is based on fish migration timing that typically takes most of the salmon and steelhead through the FCRPS by the end of August.

Under both Standard FC and VARQ FC, Libby Dam discharges would incorporate flows for sturgeon and bull trout. In general, boaters on the Kootenai River would not see any change in operation strictly as a result of VARQ FC, compared to Standard FC, during those periods when the river is usable. However, increased reliability of fish flows for sturgeon (in the spring and early summer) and salmon (in late July and August) under VARQ FC may make the river less accessible to boating and fishing for longer periods in some years, compared to Standard FC.

The "tiered volumes" for sturgeon would be the same for both Standard FC and VARQ FC, but VARQ FC would make those volumes more reliably available by not drawing the reservoir down as far in winter, and thus better assuring refill. With a higher likelihood of sturgeon flows under VARQ FC, the river may be less usable to boaters and fishermen in spring.

During the August salmon draft, river flows may be higher than ideal for fishing and boating. Compared to Standard FC, VARQ FC would likely result in more prolonged higher August flows in the Kootenai River. Depending on the year, releases from Libby Dam may be higher than 20,000 cfs for the entire month of August in order to draft the reservoir to 2439 feet by August 31 (as specified in the NMFS 2000 FCRPS BiOp). Fishing guides prefer river flows in the range of 7,000 to 10,000 cfs for fishing. Compared to Standard FC, higher August flows resulting from VARQ FC will likely adversely affect fishing access and success in the Kootenai River in the Libby area. These adverse effects may translate to impacts to the success of guide services in the Libby Area. However, fish flows should also provide benefits to fishermen in terms of better productivity of resident fish. It is difficult to quantify if the potential productivity benefits would offset adverse effects on fishing from higher August flows. Considering the relatively small incremental differences between the different alternatives (that both include fish flows), the potential adverse effects of the August fish flows on fishing and other recreation are expected to be similarly small.

5.4.4.2. Hungry Horse Dam

None of the alternatives would result in changes that affect recreation in the Flathead River Basin.

5.4.4.3. Columbia River

The effects of VARQ FC at Lake Roosevelt would occur mainly during the winter drawdown, outside of the primary recreation season at Lake Roosevelt. Accordingly, impacts to recreation resulting from possible deeper flood control drafts at Grand Coulee are not anticipated.

5.4.5. Transportation

5.4.5.1. Libby Dam

Although VARQ FC may increase Kootenay Lake levels by 1 to 2 feet relative to Standard FC, impacts to the Balfour-Kootenay Bay ferry are not anticipated since the lake level fluctuations under both of the alternatives are within the established operating range for Kootenay Lake and the ferry.

5.4.5.2. Columbia River

Compared to Standard FC, ferries on Lake Roosevelt would not be affected by changes in Lake Roosevelt draft due to VARQ FC. The Keller Ferry can operate through the entire range of lake level fluctuations. While the Inchelium Ferry is inoperable at lake elevations below 1225 feet, the different alternatives do not differ in the frequency at which such low lake elevations would be realized.

5.4.6. Power

5.4.6.1. Columbia River System

5.4.6.1.1. Procedure for Hydropower Studies

Hydropower studies were prepared by the Corps of Engineers, North Pacific Division. The studies include the regulation of projects in the Columbia River coordinated hydropower system that consist of federal, private, and public utility projects in the Columbia and Snake River Basins. The Pacific Northwest reservoir system was modeled using the Corps' Hydro System Seasonal Regulation (HYSSR) model. The multi-purpose model runs considered different flood control alternatives,[30] hydropower operations,[31] fish operations of Columbia and Snake River projects,[32] and Canadian Treaty project operations.[33] For the purposes of the power evaluation, the differences between Standard FC and VARQ FC are compared since the other alternative components have little effect on system power requirements and capabilities. As stated previously, in addition to flood control operations, the hydropower analysis considers multi-purpose operation of the system for fish, Canadian Treaty, and other requirements. See Appendix F for more details on the multi-purpose model assumptions and results.

Except where explicitly stated, the analysis of hydropower generation does not include effects to projects in Canada or non-Federal projects in the U.S.

---

[30] A hydroregulation was made using either Standard FC or VARQ FC (depending on the alternative) as upper reservoir elevation limits. Reservoir storage contents from this hydroregulation contain a draft for power operation, and the reservoir storage contents for projects upstream of Grand Coulee are then used to compute adjusted upper rule curves for Grand Coulee. This procedure results in the adjusted Grand Coulee flood control curves to be higher than the original flood control curves. The original Grand Coulee curves are replaced by the adjusted curves and a new hydroregulation is run. The process is repeated until there are no changes to upstream power drafts.   The purpose of this procedure is to provide modeling results that reflect real operations, and to show the impacts to Grand Coulee's operation resulting from the upper rule curve adjustments.

[31] The load will be the federal firm energy load carrying capability (FELCC) from the Pacific Northwest Coordination Agreement (PNCA) 2002-2003 (operating year 2003) Final Regulation computed by the Northwest Power Pool (NWPP; the NWPP prepares studies for the PNCA parties). The federal FELCC is the generation capability of the federal system in the low water year of August 1936 through July 1937. The FELCC reflects a regulation with Hungry Horse VARQ, but not Libby VARQ. This FELCC is the load used for all 60 years. The regulation includes unlimited secondary generation.

[32] In addition to the fish flows from Hungry Horse and Libby Dams, fish-related operational requirements for flow, draft limits, and spill at Grand Coulee, Brownlee, Dworshak, the lower Columbia River projects, and the lower Snake River projects were considered.

[33] Canadian Treaty projects, Mica, Duncan and Arrow, are considered to be on their 2003 Assured Operating Plan (AOP03) operations including changes agreed to by the U.S. and Canadian Entities as described in the 2003 Detailed Operating Plan (DOP03). The AOP and DOP are developed in accordance with the Columbia River Treaty, an agreement between the United States and Canadian governments to coordinate the operation of the Columbia River.   The Canadian Treaty projects are fixed to the operation resulting from the 60-year DOP Treaty Storage Regulation.

5.4.6.1.2. Results

Compared to Standard FC, VARQ FC results in an average annual increase in federal system power generation of 8 average annual MW, an increase of less than 0.5 percent. However, VARQ FC redistributes monthly power generation, with losses in generation in January, February, and April and gains in other months (see Appendix F, Table 10 for the yearly breakdown of the modeled power differences). The greatest increase in generation with VARQ FC occurs in June with an average increase of 268 MW-months. The greatest decrease in generation with VARQ FC occurs in January with an average decrease of 531 MW-months, a decrease of approximately 5%. Table 15 shows the difference in monthly generation between VARQ FC and Standard FC for FCRPS projects.

The redistribution of power under VARQ FC will affect power revenues since winter power values are normally higher than spring power values. The economic effects of the different alternatives will be analyzed in more detail in the EIS for long-term decision-making.

Table 15. Difference in Generation (MW-months) between VARQ FC and Standard FC at Federal projects in the U.S.

NOTE: Negative entries indicate less generation under VARQ FC

	MONTH														
Project	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Ap1***	**Apr**	**May**	**Jun**	**Jul**	**Ag1***	**Aug**	**Sep**	**AVERAGE**
Libby	9	3	13	-134	-28	2	19	23	109	20	60	46	53	18	12
Hungry Horse	0	0	0	-37	-12	11	-36	-91	28	72	14	0	0	0	1
Albeni Falls	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0
Grand Coulee	6	6	3	-145	-70	0	-11	-36	15	79	54	55	57	8	-1
Chief Joseph	3	2	1	-78	-40	1	0	-12	12	38	26	28	30	4	-1
McNary	1	1	0	-23	-14	0	0	-6	3	12	4	11	12	1	0
John Day	2	1	0	-52	-25	1	0	-8	8	23	15	11	12	1	-1
The Dalles	1	1	0	-38	-18	0	0	-6	6	16	10	6	8	1	-1
Bonneville	1	0	0	-20	-10	0	-1	-4	3	8	7	9	9	0	0

*Ap1 and Aug1 represent the first half of April and August, respectively.

Table 16 shows the number of years when Federal projects were unable to meet the Federal Firm Energy Load Carrying Capability (FELCC) for each month. The federal FELCC was developed based on the final regulation by the Northwest Power Pool (coordinating group for Pacific Northwest Coordination Agreement activities) that included Hungry Horse VARQ, but not Libby VARQ. The final regulation does not include adjustments at Grand Coulee for upstream power drafts. If the FELCC were instead developed based on the assumptions made for the hydropower modeling, the number of years that FELCC would not be met would be less than as shown in Table 16. Nevertheless, considering the hydropower studies, hydropower generation under VARQ FC has no effect on the ability of the system to meet the FELCC in most months, but appears to slightly improve the ability to meet the FELCC in December, July, and the first part of August, while slightly decreasing the ability to meet the FELCC in March.

Table 16. Number of Years out of 60 FELCC is Not Met

lternative	Oct	Nov	Dec	Jan	Feb	Mar	Ap1*	Apr	May	Jun	Jul	Ag1*	Aug	Sep

Standard FC	0	0	3	9	1	5	8	8	8	4	6	2	9	0
VARQ FC	0	0	2	9	1	6	8	8	8	4	5	1	6	0

*Ap1 and Aug1 represent the first half of April and August, respectively.

Of the years that FELCC was not met, the average amount by which FELCC was not met is shown in Table 17. The FELCC is also shown in Table 17. If FELCC is not met in a month, VARQ FC tends to result in missing FELCC by a larger amount than Standard FC.

Table 17. Average Amount by which FELCC was not met (MW-months)

	Dec	Jan	Feb	Mar	Ap1*	Apr	May	Jun	Jul	Ag1*	Aug
FELCC	**7551**	**7538**	**4824**	**5346**	**5958**	**6284**	**9260**	**8006**	**6924**	**7308**	**6276**
Alternative											
tandard FC	402	1376	136	218	712	1255	1200	691	521	42	272
VARQ FC	505	1371	136	204	725	1376	1167	606	910	203	335

*Ap1 and Aug1 represent the first half of April and August, respectively.

For non-Federal projects, effects are similar to those for the FCRPS, with a small change in annual generation between VARQ FC and Standard FC (Table 18).

Table 18. Difference in Generation (MW-months) between VARQ FC and Standard FC at selected non-Federal projects

NOTE: Negative entries indicate less generation under VARQ FC

	MONTH														
Project	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Ap1***	**Apr**	**May**	**Jun**	**Jul**	**Ag1***	**Aug**	**Sept**	**AVERAGE**
Kerr	0	2	-3	-7	-3	-2	-4	-13	-1	-1	0	0	-4	-1	-2
Thompson Falls	0	0	-1	-2	-1	0	-1	-2	0	0	0	0	-1	0	-1
Noxon	0	2	-3	-6	-3	-2	0	-11	-1	10	4	0	-4	-1	-1
Cabinet Gorge	0	1	-2	-4	-2	-1	-1	-6	0	0	1	0	-2	0	-1
Box Canyon	0	0	0	-1	0	0	0	-1	0	-1	0	0	0	0	0
Boundary	0	3	-6	-10	-5	-3	-4	-17	0	8	6	0	-6	-2	-2
Wells	1	0	0	-24	-14	0	0	-4	3	10	8	9	10	1	0
Rocky Reach	1	1	0	-37	-19	0	0	-7	5	16	11	11	14	1	-1
Rock Island	0	0	0	-14	-8	0	0	-3	2	6	4	4	6	0	0
Wanapum	1	1	0	-27	-18	0	-1	-7	5	13	7	5	6	1	-1
Priest Rapids	1	1	0	-21	-16	0	0	-4	4	12	7	6	7	1	0

*Ap1 and Aug1 represent the first half of April and August, respectively.

In general, compared to Standard FC alternatives, VARQ FC results in less hydropower generation from January through April, and an increase in generation in May through September. This finding is not surprising since VARQ FC stores more water during the winter months and discharges more during reservoir refill in the spring and summer.

BC Hydro's analysis of the possible effects on Canadian hydropower production indicates that the VARQ FC and fish operations would shift generation into lower value periods and reduce generation due to increased spill. In their comment letter dated December 11, 2002, BC Hydro stated that "on average the increased sturgeon and salmon flows facilitated by the revised flood control operation, would reduce the expected Canadian generation downstream of Libby by approximately 80 gigawatt-hours per year, for an annual loss in value approaching C$5 million."

An economic study of the longer-term hydropower impacts will be conducted for the EIS.

6. CUMULATIVE EFFECTS

The NEPA defines cumulative effects as the impact on the environment which results from the incremental impact of a proposed action, such as the possible interim implementation of VARQ FC, when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions (40 CFR §1508.7). The effects of different alternatives on Lake Roosevelt from the combined operation of Libby and Hungry Horse Dam are discussed in Paragraph 5.

Many past actions in the Columbia River Basin involving development of land and resources have cumulatively led to declines in native fish populations. Implementation of VARQ FC with fish flows would benefit native fish populations by restoring habitat conditions in the basin.

6.1. Flathead Drought Management Plan

The US Bureau of Indian Affairs has been working with the Federal Energy Regulatory Commission (FERC) and PPL Montana and the Confederated Salish-Kootenai Tribes (owners of Kerr Dam on Flathead Lake in Montana) to develop a drought management plan for Flathead Lake. As its name implies, this drought management plan is intended to improve operations during drought years, by allowing dam managers to meet minimum fisheries flows below the dam and improve both refill and the ability to maintain higher pool elevations through August. Implementation of VARQ at Hungry Horse could improve the probability of refill at Flathead Lake by moving releases from Hungry Horse from winter to the spring refill period. Reclamation does not anticipate the drought management plan to have any effects on implementation of VARQ at Hungry Horse. The drought management plan may also affect system flood control, and as more information is available, it will be analyzed for the potential long-term VARQ FC operation that will be evaluated in the EIS.

6.2. Endangered Species Act Compliance

The 2000 FCRPS BiOps from NMFS (2000a) and USFWS (2000) contain a number of requirements and recommendations for FCRPS projects to the benefit of threatened and endangered fish species in the Columbia River Basin. The stipulations of the 2000 FCRPS BiOps are designed to protect and recover anadromous fish species on both the short- and long-term.

For many proposed Federal actions, Endangered Species Act consultation is necessary along with compliance under NEPA and other regulations. However, interim implementation of alternative flood control and fish operations are intended specifically to comply with the Endangered Species Act, and thus no separate Biological Assessment or consultation is required. In particular, the intent of this environmental assessment is to address the requirement to implement VARQ at Libby, which is found in both FCRPS BiOps. They state:

> USFWS Reasonable and Prudent Measure 8.1.b: By January 2001, the action agencies shall develop a schedule of all disclosures, NEPA compliance and additional Canadian coordination necessary to implement VarQ flood control/storage at Libby Dam. The action agencies shall complete coordination with Canada and NEPA compliance, and implement VarQ by October 2001.
>
> NMFS Action 19: The Action Agencies shall implement VARQ…as a flood control operations strategy by October 1, 2001, and upon completion of coordination with appropriate Canadian entities.

The decision on long-term implementation of VARQ or another alternative for flood control operation will be based on an analysis in the EIS currently being prepared by the Corps and Reclamation and scheduled for completion in 2004. In the meantime, the Endangered Species Act requirements in the FCRPS BiOps must be addressed to avoid jeopardy or unauthorized take of Kootenai River white sturgeon, Columbia basin bull trout in the Kootenai and Flathead, and Columbia river salmon and steelhead stocks. This EA will be used in making the decision whether to implement VARQ on an interim basis until the long-term decision can be made.

The USFWS 2000 FCRPS BiOp also requires that Libby Dam outflow capacity must be increased within total dissolved gas standards to benefit sturgeon reproduction in the Kootenai. Spill test data from 2002 at Libby indicate limited capacity to use the spillway to augment sturgeon flows without structural modification, but at present, this is the only means to increase outflow capacity for sturgeon. The alternatives in the EA account for that as much as possible at this time in their characterization of maximum outflow at 26,000 cfs, which, again, is based on monitoring of the 2002 spill events. It is not within the scope of the EA at hand to evaluate effects of increasing Libby Dam discharges for sturgeon to 35,000 cfs as specified in the USFWS 2000 FCRPS BiOp; increasing sturgeon discharges to 35,000 cfs will be further addressed in the EIS for decision-making for potential long-term VARQ FC implementation.

6.3. Upland Land Uses

Upland development may alter land use or runoff characteristics in basins that may be affected by the flood control operation of Libby and Hungry Horse Dams.

For example, the flood stage at Kootenay Lake is 1755 feet as described in the CRT Flood Control Operating Procedure (Corps, 1999a). Encroaching development may result in flood impacts at lake elevations lower than 1755 feet. Such encroaching development may be vulnerable to dam operations that remain within authorized limits.

Levee along the Kootenai River in the Kootenai Flats area must be maintained to function. Since construction of Libby Dam, many levees have deteriorated to the extent that flooding may occur in certain areas at river stages that did not previously pose any threat when the levees where in good condition. With VARQ FC, river levels will likely be higher on a more frequent basis. Increased river levels may adversely affect poorly maintained levees and the lands they were constructed to protect even if the river does not reach the official flood stage.

7. IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF RESOURCES

No federal resources would be irreversibly and irretrievably committed to the changes in dam operations until this EA is finalized and the appropriate decision document has been approved. Implementation of VARQ FC with fish flows would not result in permanent loss or commitment of resources if dam operations were returned to the Standard FC with fish flows at Libby at the end of the interim period.

8. ENVIRONMENTAL COMPLIANCE

8.1. National Environmental Policy Act

Section 1500.1(c) and 1508.9(1) of the National Environmental Policy Act of 1969 (as amended) requires federal agencies to “provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact” on actions authorized, funded, or carried out by the federal government to ensure such actions adequately address “environmental consequences, and take actions that protect, restore, and enhance the environment". This EA evaluates environmental consequences of interim implementation of alternative flood control and fish operations at Libby and Hungry Horse Dams.

While it was previously determined that an EIS was necessary for the long-term implementation, interim implementation is being considered under this EA due to the anticipated benefits that could accrue to the listed species in the short-term, provided that the individual and cumulative impacts to the human environment from interim implementation are not significant. Issues raised in the EA for the EIS decision may be of a lesser impact in the short-term than they are in the longer-term implementation.

The final EA was subject to a 30-day comment period between November 14, 2002, and December 13, 2002. Comments received during the comment period are addressed in Appendix C.

8.2. Endangered Species Act

In accordance with Section 7(a)(2) of the Endangered Species Act of 1973, as amended, federally funded, constructed, permitted, or licensed projects must take into consideration impacts to federally listed or proposed threatened or endangered species. The NMFS and USFWS 2000 FCRPS BiOps call for implementation of VARQ FC at Libby and Hungry Horse Dams as an element of the reasonable and prudent alternatives to avoid jeopardizing the continued existence of Kootenai River white sturgeon. The USFWS’ FCRPS biological opinion also authorizes an indeterminate level of incidental take of bull trout that may result from the activities specified in the biological opinion (including implementation of VARQ). Potential effects to bald eagles from FCRPS operations were addressed in the 1995 USFWS biological opinion.[34] Thus, no additional consultation is required under the Endangered Species Act.

8.3. Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA, 16 USC 470) requires that wildlife conservation receive equal consideration and be coordinated with other features of water resource development projects. This goal is accomplished through Corps funding of USFWS habitat surveys evaluating the likely impacts of proposed actions, which provide the basis for recommendations for avoiding or minimizing such impacts. A FWCA Report is not required for this action, since the FWCA applies to new projects rather than changes in the operation of existing projects.

8.4. National Historic Preservation Act

The National Historic Preservation Act (16 USC 470) requires that the effects of proposed actions on sites, buildings, structures, or objects included or eligible for the National Register of Historic Places must be identified and evaluated. Such effects are addressed, based on the best available information, in Section 5.3.

8.5. Clean Water Act Compliance

The Corps and Reclamation will operate Libby and Hungry Horse Dams, respectively, in compliance with the Clean Water Act with implementation of Standard FC with fish flows or VARQ FC with fish flows . Dam operations that include voluntary spill for fish will be coordinated with the State of Montana and consider the applicable Montana state water quality standards.

8.6. Environmental Justice

Executive Order 12898 directs federal agencies to identify and address disproportionately high and adverse human health or environmental effects of agency programs and activities on minority and low-income populations. No disproportionately adverse effects to minority or low-income populations would result from the implementation of either of the alternatives.

8.7. Transboundary Effects

Effects occurring in Canada have been analyzed to the maximum extent possible at this time. Coordination with the Canadian government and other interests is ongoing to ensure that potential changes in operation of the Columbia River system complies with all treaties, agreements, and other international commitments.

8.8. Pacific Northwest Electric Power Planning and Conservation Act

The Pacific Northwest Electric Power Planning and Conservation Act created the Northwest Power Planning Council (NPPC), an interstate agency with members from Idaho, Montana, Oregon, and Washington. The council is responsible for adopting a Fish and Wildlife Program

[34] The FCRPS operations addressed by the 2000 USFWS biological opinion will not change in such a way to substantially alter the effects or conclusions regarding bald eagles of the 1995 USFWS biological opinion. Therefore, the 1995 USFWS biological opinion stands for bald eagles.

for restoring and protecting fish and wildlife populations in the basin. The Fish and Wildlife Program is updated periodically. During consultation, the Corps and other Federal agencies coordinated with the NPPC in their Multi-Species Framework Project which was developing visions, strategies, and alternatives for recovering fish and wildlife in the basin. The Federal agencies and Project Framework staff jointly evaluated alternatives for system operations and configuration. The Corps will continue to coordinate implementation of actions identified in the 2000 FCRPS BiOps with the NPPC and provide input into periodic updates of their Fish and Wildlife Program.

In the management and operation of Libby and Hungry Horse Dams, the Corps and Reclamation, respectively, will exercise their responsibilities consistent with applicable provisions of the Northwest Power Planning Act and other applicable laws, to adequately protect, mitigate, and enhance fish and wildlife in a manner that provides equitable treatment for fish and wildlife with the other authorized project purposes.

8.9. Water Resources Development Act of 1990

The NEPA process satisfies the requirements of Section 310(b) of the Water Resources Development Act of 1990, which requires public participation in developing or revising changes to reservoir operation criteria.

8.10. Floodplain Management

Executive Order 11988 requires agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid the direct and indirect support of floodplain development whenever there is a practicable alternative. Under either of the two alternatives, there is a risk of flooding in floodplain areas affected by operation of Libby and Hungry Horse Dams. The alternatives considered in this EA do not support, encourage, or facilitate the occupation, modification, or development of floodplains.

8.11. Protection of Wetlands

Executive Order 11990 requires agencies to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities. Neither of the alternatives would result in loss, destruction, or adverse effects to wetlands. By restoring river flows closer to natural patterns during certain times of the year, interim implementation of VARQ FC with fish operations may help preserve and enhance wetlands in riparian areas along affected river reaches.

8.12. Native American Coordination

The Corps and Reclamation have coordinated informally with affected tribes on the potential effects of interim implementation of VARQ FC and fish operations and anticipate future formalization of the coordination via government-to government meetings. Tribal consultations will continue throughout the development of the EIS being prepared for decision-making on potential long-term implementation of VARQ FC and fish operations, or other preferred alternative. Tribes were afforded an opportunity to comment on the draft EA and all comments received were considered according to NEPA requirements. Comments received from tribes and tribal organizations are addressed in Appendix C.

9. REFERENCES

Backman, T.W.H., A.F. Evans, and M.A. Hawbecker. 1999. Symptoms of gas bubble trauma induced in salmon (*Onchorhynchus* spp.) by total dissolved gas supersaturation of the Snake and Columbia rivers, USA. Columbia River Inter-Tribal Fish Commission. Draft report to Bonneville Power Administration, Portland, OR. Project 93-008-02.

Battelle Laboratories. 1974. Final Study Plan, Libby Dam Dissolved Gas. Prepared for the U.S. Army Corps of Engineers, Seattle District, Seattle, Washington.

Bennett, D.H., T.J. Dresser, Jr., and M.A. Madsen. 1994. Evaluation of the effects of the 1992 test drawdown on the fish communities in Lower Granite and Little Goose reservoirs, Washington. Univ. of Idaho, Completion Report to U.S. Army Corps of Engineers, Walla Walla District, Walla Walla, WA.

Bigcrane, J., D. Birnie, M. Rogers, T. Ryan, T. Smith, and D. Schwab. 2001. *Hungry Horse Reservoir Traditional Cultural Use Study FY 2001 Annual Report*. Confederated Salish and Kootenai Tribal Preservation Department. Pablo, Montana.

Bonneville Power Administration, Bureau of Reclamation, and U.S. Army Corps of Engineers. 2001. The Columbia River System Inside Story. Second Edition. April, 2001.

Bonneville Power Administration, Bureau of Reclamation, and U.S. Army Corps of Engineers. 1999. Multi-species biological assessment of the Federal Columbia River power system.

Bonneville Power Administration, Bureau of Reclamation, and U.S. Army Corps of Engineers. 1995. Columbia River System Operation Review, Final Environmental Impact Statement. DOE/EIS-0170. November, 1995.

Bryant, Richard L.1978. Cultural resource investigation: Grand Coulee Third Power Plant extension. Volume 1. Eugene, OR: Pro-Lysts, Inc.

Cichosz, T.A., J.P. Shields, K. Underwood. 1999. Spokane Tribe of Indians, Lake Roosevelt Monitoring/Data Collection Program 1997 Annual Report, Report to Bonneville Power Administration, Contract No. 1994BI32148, Project No. 199404300, 182 electronic pages (BPA Report DOE/BP-32148-3)

Cochnauer, T. 2001. Summarization of gas bubble trauma monitoring in the Clearwater River, Idaho, 1995-1999. Prepared for Bonneville Power Administration, Contract 97BI31259. 12 pp.

Confederated Salish and Kootenai Tribal Preservation Department. 2001. *Hungry Horse Reservoir Traditional Cultural Use Study FY 2000 Annual Report*. Confederated Salish and Kootenai Tribal Preservation Department. Pablo, Montana.

Confederated Salish and Kootenai Tribal Council. 2002. Website address is http://tlc.wtp.net/salish.htm

Dalbey, S. and B. Marotz. 1997. Fisheries mitigation and implementation plan for losses attributable to the construction and operation of Libby Dam- draft report. Prepared for Montana Dept. of Fish, Wildlife, and Parks, Kalispell, MT. November 1997.

Eckerle, W. 2001. *Geoarchaeological Evaluation of 10 Priority Sites at Hungry Horse Reservoir, Flathead County, Montana, 2000-2001*. Western GeoArch Research. Prepared for the Flathead National Forest. Kalispell, Montana.

Emerson, Stephen. 1994a. Effects of cross-cultural contact. *In* A Design for Management of Cultural Resources in the Lake Roosevelt Basin of Northeastern Washington, Jerry Galm, ed. Pp. 6.1-6.42. Eastern Washington University Reports in Archaeology and History 100-83. Cheney: Eastern Washington University.

Emerson, Stephen. 1994b. Constructing Grand Coulee Dam. *In* A Design for Management of Cultural Resources in the Lake Roosevelt Basin of Northeastern Washington, Jerry Galm, ed. Pp. 9.1-9.16. Eastern Washington University Reports in Archaeology and History 100-83. Cheney: Eastern Washington University.

Fickeisen, D.H. and J.C. Montgomery. (undated-1976?). Dissolved gas supersaturation: bioassays of Kootenai River organisms. Battelle Pacific Northwest Laboratories, Final Report to U.S. Army Corps of Engineers, Seattle District, Seattle, WA. 23 pp.

Fidler, L.E., B.L. Antcliffe, I.K. Birtwell, and C.A. Pinney. 1999. Biological effects of total gas pressure on fish and aquatic biota and outstanding research needs, draft. http://www.nwd-wc.usace.army.mil/TMT/1999/tbdry/research_needs0127.htm, U.S. Army Corps of Engineers, Northwest Division, Portland, OR. 29 pp.

Fish Passage Center. 2000. 1999 Annual Report to the Oregon Department of Environmental Quality, February 25, 2000. www.fpc.org/misc_reports/1999_ODEQ_annualreport.pdf, Fish Passage Center, Portland, OR.. 41 pp.

Galm, Jerry, ed. 1994. A Design for Management of Cultural Resources in the Lake Roosevelt Basin of Northeastern Washington. Cheney, WA: Eastern Washington University reports in Archaeology and History 100-83.

Galm, Jerry, and R. Lee Lyman. 1988. Archaeological investigations at river mile 590: the excavations at 45DO189. Eastern Washington University Reports in Archaeology and History 100-61. Cheney, WA: EWU Archaeological and Historical Services.

Galm, Jerry, and Fred Nials. 1994. Modeling prehistoric land use in the Lake Roosevelt Basin. *In* A Design for Management of Cultural Resources in the Lake Roosevelt Basin of Northeastern Washington, Jerry Galm, ed. Pp. 4.1-4.73. Eastern Washington University Reports in Archaeology and History 100-83. Cheney: Eastern Washington University.

Graham, P.J. 1979. Kootenai Falls Aquatic Environment Study Final Report. Prepared for Northern Lights, Inc. and Montana Dept. of Natural Resources and Conservation. Montana Dept. of Fish and Game. May, 1979.

Hamilton, J. T. 2001. *Hungry Horse Archaeological Project Investigation FY 2000 Annual Report*. Flathead National Forest. Kalispell, Montana.

Hamilton, J. T. 2000. *Hungry Horse Archaeological Project Investigation Management Summary Review Period 1994-1998 Phase I*. Flathead National Forest. Kalispell, Montana. Hauer, F.R. and J.A. Stanford. 1997. Long-term influence of Libby Dam operation on the ecology of macrozoobenthos of the Kootenai River, Montana and Idaho. Prepared for Montana Department of Fish, Wildlife, and Parks, Helena, MT. 68 pp.

LeCaire, Richard. 1999. Draft Chief Joseph Kokanee Enhancement Project: 1999 Annual report and final report on Entrainment. Report to Bonneville Power Administration, Portland, OR. Project No. 9501100.

Leeds, Leon L., Jerry V. Jermann, and Linda A. Leeds. 1980. Cultural resource reconnaissance for the proposed Downstream Riverbank Stabilization Program, Grand Coulee Dam, Washington. Reconnaissance Report No. 35. Seattle: University of Washington's Office of Public Archaeology.

Linenberger, Toni Rae. 2002. *Dams, Dynamos, and Development.* Washington: U. S. Department of the Interior.

Luttrell, Charles T. 1994a. Development of agricultural settlements in the Upper Columbia Region. *In* A Design for Management of Cultural Resources in the Lake Roosevelt Basin of Northeastern Washington, Jerry Galm, ed. Pp. 7.1-7.29. Eastern Washington University Reports in Archaeology and History 100-83. Cheney: Eastern Washington University.

Luttrell, Charles T. 1994b. Mining and lumbering along the Upper Columbia River. *In* A Design for Management of Cultural Resources in the Lake Roosevelt Basin of Northeastern Washington, Jerry Galm, ed. Pp. 8.1-8.21. Eastern Washington University Reports in Archaeology and History 100-83. Cheney: Eastern Washington University. Maiolie, M.A. and S. Elam. 1998. Kokanee entrainment losses at Dworshak Reservoir, Dworshak Dam impacts assessment and fisheries investigation project, annual progress reports – period covered: January-December 1996. Prepared for the Bonneville Power Administration, Contract No. 1987BP35167, Project No. 198709900. Idaho Dept. of Fish and Game, Boise, ID.

McKay, Kathryn L. 1994. Trails of the Past: Historic Overview of the Flathead National Forest, Montana, 1800-1960. Flathead National Forest. Kalispell, Montana.

McLeod, C. Milo, and Douglas Melton. 1986. The prehistory of the Lolo and Bitterroot National Forests: an overview. U. S. Department of Agriculture, Lolo National Forest, Missoula.

Mesa, M.G., L.K. Weiland, and A.G. Maule. 2000. Progression and severity of gas bubble trauma in juvenile salmonids. Transactions of the American Fisheries Society. 129: 174-185.

Montana Bull Trout Scientific Group. 1996. Middle Kootenai River drainage bull trout status report (between Kootenai Falls and Libby Dam). Prepared for the Montana Bull Trout Restoration Team, Helena, MT. February, 1996.

Munn, M.D., 2000, Contaminant trends in sport fish from Lake Roosevelt and the upper Columbia River, Washington, 1994 to 1998: U.S. Geological Survey Water-Resources Investigations Report 00-4024, 14 p.

Murphy, Maureen. 2000. Bald eagle nest production, Lake Roosevelt Washington 1987-2000. Final Report under grant no. 1425-7-FG-10-03000 to U.S. Bureau of Reclamation, Pacific Northwest Region, Boise ID.

National Marine Fisheries Service (NMFS). 2000a. Endangered Species Act Section 7 Biological Opinion on the Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin. Seattle, Washington.

National Marine Fisheries Service (NMFS). 2000b. Salmonid travel time and survival related to flow in the Columbia River Basin. March, 2000; Seattle, Washington.

National Marine Fisheries Service (NMFS). 2002. Salmonid survival related to summer flow in the Columbia and Snake Rivers, an update by the NMFS Hydro Program. July 12, 2002; Seattle, Washington.

Paragamian, V.L. 1995a. Burbot (*Lota lota)*. Prepared for the Idaho Chapter, American Fisheries Society, 1995 Rare Fishes Status Review Workshop Results. March 15, 1995; Boise, Idaho.

Paragamian, V.L. 1995b. Kootenai River Fisheries Investigation: stock status of burbot and rainbow trout and fisheries inventory, annual progress report January 1, 1995 to December 31, 1995. Idaho Dept. of Fish and Game, IDFG 96-7. Report to Bonneville Power Administration, Portland, OR. Project 88-65.

Paragamian, V.L. 1994. Kootenai River Fisheries Investigation: stock status of burbot and rainbow trout and fisheries inventory, annual report 1993. Idaho Dept. of Fish and Game. Report to Bonneville Power Administration, Portland, OR. Project 88-65.

Paragamian, V.L. and V. Whitman. 1998. Kootenai River fisheries investigation: stock status of burbot, annual progress report January 1, 1997 to December 31, 1997. Idaho Dept. of Fish and Game, IDFG 99-08. Report to Bonneville Power Administration, Portland, OR. Project 88-65.

Roulette, Bill R., Aimee A. Finley, Paul S. Solimano, Julia J. Wilt, and Charlie Hodges. 2001. Results of a cultural resources inventory survey of Lake Roosevelt between elevations 1289 and 1310 feet above mean sea level and the tailrace terrace. Portland: Applied Archaeological Research.

Ryan, B.A. and E.M. Dawley. 1998. Effects of dissolved gas supersaturation on fish residing in the Snake and Columbia Rivers, 1997. National Marine Fisheries Service. Report to Bonneville Power Administration, Portland, OR. Project 96-02-00.

Science Applications International Corporation. 1996. Lake Roosevelt Bald Eagle Study. Final Report under contract no.125-3-CS-10-12990 to U.S. Bureau of Reclamation, Pacific Northwest Region, Boise, ID.

Simmons, M.A., McKinstry, C.A., Simmons, C.S., LeCaire, R., Johnson, R.L., Angela, S.M., Thorsten, S.L., and S. Francis. 2002. Strobe Light Deterrent Efficacy Test and Fish Behavior Determination at Grand Coulee Dam Third Powerplant Forebay. BPA Contract No. DE-AC06-76RL01830., Portland, OR.

Skaar, D., J. DeShazer, L. Garrow, T. Ostrowski, and B. Thornburg. 1996. Investigations of fish entrainment through Libby Dam, 1990-1994. Montana Dept. of Fish, Wildlife, and Parks, Prepared for Bonneville Power Administration, Project Number 83-467, Portland, Oregon.

Smith, Alan H. (1984). Kootenai Indian Subsistence and Settlement Patterns, Northwest Montana. Project Report Number 2 (Volume 2), Center for Northwest Anthropology, Washington State University, Pullman, Washington.

Thoms, A. V., editor. 1984. Environment, archaeology, and land use patterns in the Kootenai River Valley, Vol. I, Washington State University, Center for Northwest Archaeology, Project Report No. 2. Pullman.

Underwood, Keith. 2000. Draft Lake Roosevelt Subbasin Summary, Prepared for the Northwest Power Planning Council. Columbia Basin Fish and Wildlife Authority, Portland OR. www.cbfwf.org/files/province/intermtn/subsum/Roosevelt.PDF

U.S. Army Corps of Engineers (Corps). 1999a. Revised FCOP. Northwestern Division, Portland, Oregon.

U.S. Army Corps of Engineers (Corps). 1999b. Status Report: Work to Date on the Development of the VARQ Flood Control Operation at Libby Dam and Hungry Horse Dam. Northwestern Division, Portland, Oregon.

U.S. Army Corps of Engineers (Corps). 1998. Kootenai River Flood Control Study, Analysis of Local Flood Control Impacts of the Proposed VARQ Flood Control Plan. Seattle District, Seattle, WA.

U.S. Army Corps of Engineers (Corps). 1991. Review of Flood Control, Columbia River Basin, Columbia River and Tributaries Study, CRT-63. June 1991. North Pacific Division, Portland, Oregon.

U.S. Army Corps of Engineers. 1989. Columbia River and Tributaries Review Study – Project Data and Operating Limits. Report Number 49. North Pacific Division. Portland, Oregon. July 1989.

U.S. Army Corps of Engineers (Corps). 1984. Water Control Manual, Libby Dam and Reservoir, Kootenai River, Montana. Seattle District, Seattle, Washington.

U.S. Army Corps of Engineers (Corps). 1971. Kootenai River water quality investigations for water year 1970. Seattle District, Seattle,. Washington. October 1971.

U.S. Army Corps of Engineers (Corps). 1952. Hungry Horse Dam Reservoir Control Manual. December, 1952. Seattle District, Seattle, Washington.

U.S. Bureau of Reclamation (Reclamation). 2002a. Voluntary Environmental Assessment, FONSI 02-02; Interim operation of the VARQ flood control plan at Hungry Horse Dam, MT. Pacific Northwest Region, Boise, Idaho.

U.S. Bureau of Reclamation (Reclamation). 2002b. Hydrologic Analysis of the VARQ flood control plan at Hungry Horse Dam. Boise: U. S. Bureau of Reclamation Pacific Northwest Region.

U.S. Bureau of Reclamation (Reclamation). 1993. Continued Development of the Columbia Basin Project, Washington: Supplement to the Draft Environmental Impact Statement. U. S. Department of Interior, Bureau of Reclamation, Pacific Northwest Region, Boise, Idaho.

U.S. Bureau of Reclamation (Reclamation). 1981. Water and Power Resources Service Project Data. Denver: Water and Power Resources Service, Engineering and Research Center, Denver Service Center.

U.S. Bureau of Reclamation (Reclamation). 1950. Hungry Horse Annual Project History Vol VI. Columbia Falls, MT: U. S. Bureau of Reclamation. On file at U. S. Bureau of Reclamation's Pacific Northwest Regional Office, Boise, ID.

U.S. Department of the Interior (USDI). 2001. Endangered and threatened wildlife and plants: Final designation of critical habitat for the Kootenai River population of the white sturgeon. U.S. Fish and Wildlife Service. Federal Register Vol. 66:46548-46561. September 6, 2001.

U.S. Department of the Interior (USDI). 2000. Endangered and threatened wildlife and plants: 12-month finding for an amended petition to list the westslope cutthroat trout as threatened throughout its range. U.S. Fish and Wildlife Service. Federal Register Vol. 65:20120-20123. April 14, 2000.

U.S. Department of the Interior. 1999. Endangered and threatened wildlife and plants: determination of threatened for bull trout in the coterminous U.S., final rule. U.S. Fish and Wildlife Service. Federal Register Vol. 64:58909. November 1, 1999.

U.S. Department of the Interior (USDI). 1998. Endangered and threatened wildlife and plants: 90-day finding and commencement of status review for a petition to list the westslope cutthroat trout as threatened. U.S. Fish and Wildlife Service. Federal Register Vol. 63:31691-31693. June 10, 1998.

U.S. Department of the Interior. 1994. Endangered and threatened wildlife and plants: determination of endangered status for the Kootenai River population of the white sturgeon. U.S. Fish and Wildlife Service. Federal Register Vol. 59:45989-46002. September 6, 1994.

U.S. Fish and Wildlife Service (USFWS). 2000. Biological opinion; effects to listed species from operations of the Federal Columbia River power system. Portland, Oregon. 97 pp. plus appendices.

U.S. Fish and Wildlife Service (USFWS). 1999. Recovery plan for the white sturgeon (*Acipenser transmontanus*): Kootenai River population. Portland, Oregon. 96 pp. plus appendices.

U.S. Fish and Wildlife Service (USFWS). 1986. Pacific bald eagle recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. 160pp.

U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 1998. Endangered species consultation handbook; procedures for conducting consultation and conference activities under Section 7 of the Endangered Species Act.

U.S. Geological Survey (USGS). 2001a. Occurrence and Distribution of Trace Elements in Lake Roosevelt Beach and Bank Sediments, http://wa.water.usgs.gov/wadmin/Projects/summary.449.htm

U.S. Geological Survey (USGS). 2001b Toxics-Related Water Quality of Lake Roosevelt, Washington Roosevelt Lake (USGS WA384 Summary Page), http://wa.water.usgs.gov/wadmin/Projects/summary.384.htm

U.S. Geological Survey (USGS). 2001c Development of a Sediment Quality Program for the Upper Columbia River and Lake Roosevelt (USGS WA42701 Summary Page), http://wa.water.usgs.gov/wadmin/Projects/summary/42701.htm

U.S. Geological Survey (USGS). 2001d. Bioaccumulation of Mercury in Walleye, FDR Lake, Washington (USGS WA392 Summary Page), http://wa.water.usgs.gov/wadmin/Projects/summary.392.htm

Venditti, D.A., T.C. Robinson, J.W. Beeman, B.J. Adams, and A.G. Maule. 2001. Gas bubble disease in resident fish below Grand Coulee Dam, 1999 annual report of research. U.S. Geological Survey, Cook, Washington. June 26, 2001.

Weitkamp, D.E. 2000. Total dissolved gas supersaturation in the natural river environment. Prepared for Chelan County Public Utility District No. 1, Wenatchee, WA. 19 pp.

Weitkamp, D.E. and M. Katz. 1980. A review of dissolved gas supersaturation literature. Transactions of the American Fisheries Society. 109:659-702.

APPENDIX A

Volume and Flow Tiers for Bull Trout and Sturgeon from USFWS 2000 FCRPS Biological Opinion

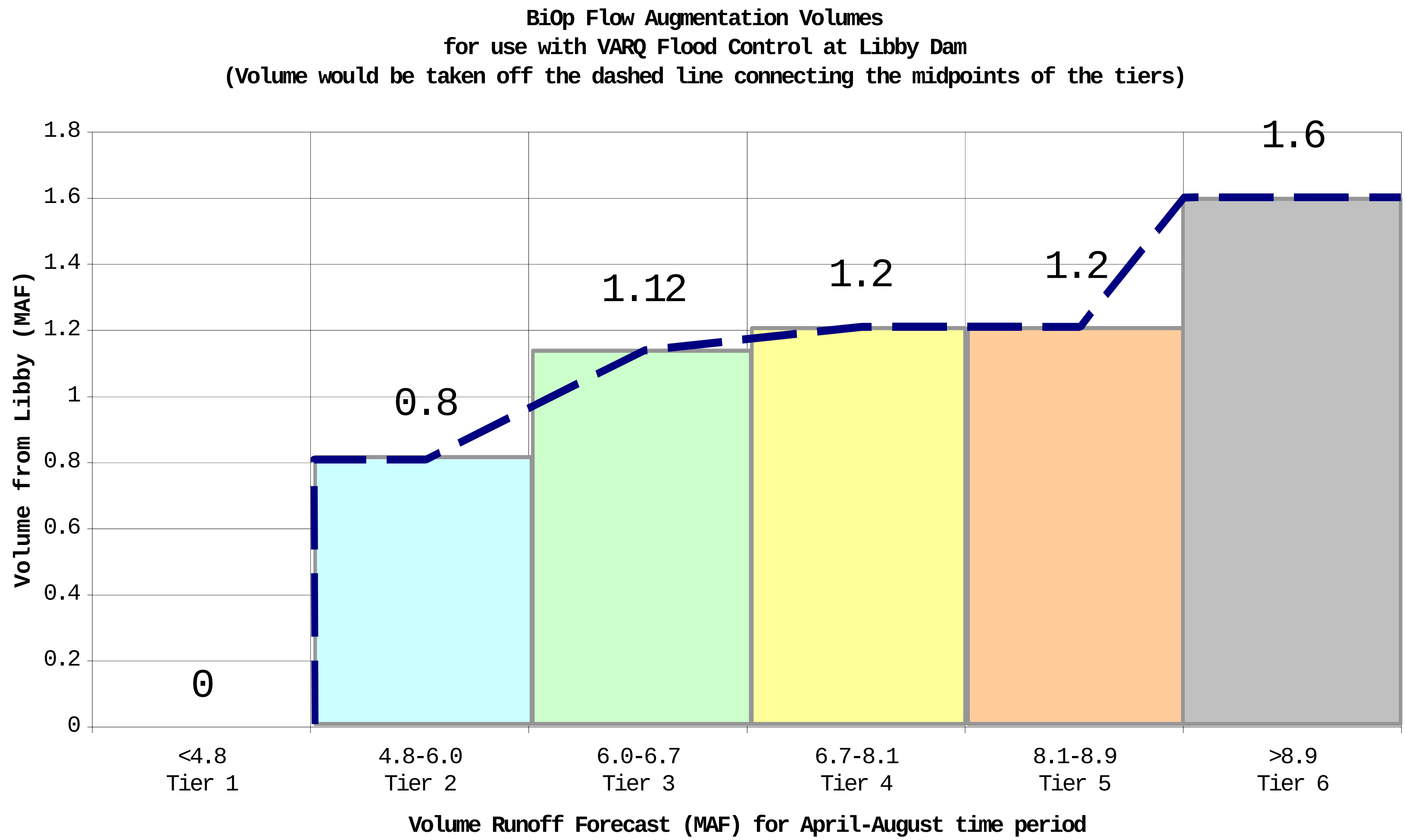


Figure A-1. Volumes to be provided for Sturgeon from Libby Dam/Lake Koocanusa

Volumes are in addition to flows for listed bull trout, salmon, and the 4,000 cfs minimum release from Libby Dam. Flows released from Libby Dam to benefit sturgeon will generally be initiated between mid-May and the end of June.

Table A-1. Bull trout flows to be provided from Libby Dam between end of sturgeon flows and beginning of salmon flow augmentation

Forecast Runoff Volume at Libby (maf)	Minimum Bull Trout Flow
0.0<forecast<4.8	6 kcfs [a]
4.8<forecast<6.0	7 kcfs
6.0<forecast<6.7	8 kcfs
6.7<forecast	9 kcfs

[a] If Lake Koocanusa is below 2439 feet on July 1 and salmon augmentation will not occur for that year, the minimum bull trout flow is 6000 cfs during July and August

<u>Hungry Horse Minimum Flows</u>: The minimum flow below Hungry Horse Dam is determined based on the March runoff forecast for Hungry Horse Reservoir for the period of April 1 to August 31. The minimum flows shall be:

- If the April-August forecast is greater than 1,790 kaf, then the minimum flow is 900 cfs.
- If the April-August forecast is less than 1,190 kaf, then the minimum flow is 400 cfs.
- If the April-August forecast is between 1,190 and 1,790 kaf, then the minimum flow shall be linearly interpolated between 400 and 900 cfs.
- Minimum flow in the South Fork of the Flathead River can be lowered to 145 cfs when the river reaches flood stage (13 feet) at Columbia Falls.

The minimum flow measured at the USGS gage at Columbia Falls will be determined monthly starting with the January forecast, with final flows based on the March final runoff forecast for Hungry Horse Reservoir for the period of April 1 to August 31.

- If the April-August forecast is greater than 1,790 kaf, then the minimum flow is 3,500 cfs.
- If the April-August forecast is less than 1,190 kaf, then the minimum flow is 3,200 cfs.
- If the April-August forecast is between 1,190 and 1,790 kaf, then the minimum flow shall be linearly interpolated between 3,200 and 3,500 cfs.

APPENDIX B—Authors and Contributors

Authors:

Carolyn Fitzgerald, Hydraulic Engineer, U.S. Army Corps of Engineers, Seattle WA
Jeff Laufle, Fisheries Biologist, U.S. Army Corps of Engineers, Seattle WA
Evan Lewis, Fisheries Biologist, U.S. Army Corps of Engineers, Seattle WA
Amy Reese, Hydraulic Engineer, U.S. Army Corps of Engineers, Seattle WA
David Rice, Archaeologist, U.S. Army Corps of Engineers, Seattle WA
Eric Braun, Fisheries Program Manager, U.S. Army Corps of Engineers, Portland OR
Cindy Henriksen, Hydraulic Engineer, U.S. Army Corps of Engineers, Portland OR
Gayle Lear, Attorney, U.S. Army Corps of Engineers, Portland OR
Dave Ponganis, Endangered Species Act Program Manager, U.S. Army Corps of Engineers, Portland OR

Steve Dunn, Fisheries Biologist, Bureau of Reclamation, Boise ID
Bob Christensen, Environmental Specialist, Bureau of Reclamation, Boise ID
Lori Postlethwait, Hydraulic Engineer, Bureau of Reclamation, Boise ID
Pei Lin Yu, Archaeologist, Bureau of Reclamation, Boise ID

Contributors and Reviewers:

<u>Hydrology and Power</u>

Ken Barnhart, Bonneville Power Administration, Portland OR
Roger Schiewe, Bonneville Power Administration, Portland OR

<u>Hydrology, Anadromous Fish,</u>

Chris Ross, National Marine Fisheries Service, Portland OR
Jim Ruff, National Marine Fisheries Service, Portland OR

<u>Hydrology, White Sturgeon, Bull Trout, Burbot, Flood Hazards</u>

Bob Hallock, U.S. Fish and Wildlife Service, Spokane WA

<u>General Review</u>

Jim Fodrea, Acting Regional Administrator, Bureau of Reclamation, Boise ID
Pat McGrane, Hydraulic Engineer, Bureau of Reclamation, Boise ID
Greg Hoffman, Fisheries Biologist, U.S. Army Corps of Engineers, Libby MT
Col. Ralph Graves, District Engineer, U.S. Army Corps of Engineers, Seattle WA
Steve Martin, Ecologist, U.S. Army Corps of Engineers, Seattle WA
Larry Merkle, Hydraulic Engineer, Contractor to the U.S. Army Corps of Engineers, Seattle, WA
Siri Nelson, Attorney, U.S. Army Corps of Engineers, Seattle WA
Marian Valentine, Hydraulic Engineer, U.S. Army Corps of Engineers, Seattle WA
Mark Ziminske, Ecologist, U.S. Army Corps of Engineers, Seattle WA
Witt Anderson, Fisheries Office Chief, U.S. Army Corps of Engineers, Portland OR

Patricia Etzel, Hydraulic Engineer, U.S. Army Corps of Engineers, Portland OR
Chan Modini, Hydraulic Engineer, U.S. Army Corps of Engineers, Portland OR
Rebecca Ransom, Attorney, U.S. Army Corps of Engineers, Portland OR
Ken Soderlind, Hydraulic Engineer, U.S. Army Corps of Engineers, Portland OR

APPENDIX C

COMMENTS AND RESPONSES

APPENDIX D

Hydrologic Analysis of Upper Columbia Alternative Operations, Local Effects of Alternative Operations at Libby Dam

APPENDIX E

Hydrologic Analysis of Upper Columbia Alternative Flood Control and Fish Operations On Columbia River System including the VARQ Flood Control Plan at Libby and Hungry Horse Projects

APPENDIX F

Hydropower Impacts Analysis of Upper Columbia Alternative Flood Control and Fish Operations and Detailed Plan Scenarios including Hydropower Considerations and VARQ on the Columbia River System

APPENDIX G

Finding of No Significant Impact

Upper Columbia Alternative Flood Control and
Fish Operations Interim Implementation
Libby and Hungry Horse Dams

Montana, Idaho, and Washington

FINDING OF NO SIGNIFICANT IMPACT

1. An Environmental Assessment (EA) has been prepared by the U.S. Army Corps of Engineers (Corps) and the U.S. Bureau of Reclamation under the National Environmental Policy Act, for interim implementation of VARQ FC with fish flows at the Libby and Hungry Horse projects, on the Kootenai and South Fork Flathead rivers, respectively. No significant impacts to the human environment were determined to be likely for the proposed project.

2. The project has been undertaken in response to the National Marine Fisheries Service's (NMFS) and the U.S. Fish and Wildlife Service's (USFWS) Biological Opinions of 2000 on effects of the operation of the Federal Columbia River Power System (FCRPS) on fish species listed as threatened and endangered under the Endangered Species Act (ESA) in the Columbia River Basin. The EA was prepared in response to the Corps' and the other Action Agencies' (Bonneville Power Administration and U.S. Bureau of Reclamation) responsibilities under the Endangered Species Act. The USFWS Biological Opinion (BiOp), RPA 8.1.b., c. & d., and the NMFS BiOp, Actions 19 and 22 of RPA 9.6.1.2.3, called for implementation of VARQ for the 2002 fish migration season to ensure the survival and recovery of listed species. This EA informs decision-making on interim implementation of VARQ FC with fish flows while an environmental impact statement is being prepared to inform a decision on long-term implementation of VARQ FC with fish flows and associated operations.

3. Alternatives that are evaluated in the EA include the current operation, Standard flood control (Standard FC) and variable discharge flood control (or VARQ[1] FC). Both flood control operations were evaluated in conjunction with flow augmentation for fish (which include releases for sturgeon up to 26,000 cubic feet per second from Libby Dam, bull trout minimum flows, and summer flow augmentation for salmon from both Libby and Hungry Horse dams). VARQ FC with fish flows is the preferred alternative. Although VARQ FC with fish flows has already been implemented at Hungry Horse Dam, and documented with a Voluntary Environmental Assessment and FONSI 02-02: Interim Operation of the VARQ Flood Control Plan at Hungry Horse Dam, MT in March 2002, this EA documents effects of the simultaneous implementation of VARQ FC with fish flows at both Libby and Hungry Horse.

4. VARQ FC with fish flows provides more assured reservoir refill at Libby and Hungry Horse, while also providing better assurance of needed volumes of water for downstream flow augmentation for threatened and endangered fish. Listed fish species directly affected by the project include the Kootenai River white sturgeon (*Acipenser transmontanus*), the Columbia Basin distinct population segment of bull trout (*Salvelinus confluentus*), and several evolutionarily significant units of various salmon species as well as steelhead (*Oncorhynchus*

[1] "Q" is engineering shorthand for discharge.

spp.) in the Columbia River. A number of other fish and aquatic invertebrates are also affected. Sturgeon are expected to benefit from increased reliability of spring spawning flows, bull trout from increased reliability of minimum instream flows, and salmon and steelhead from increased reliability of summer outmigration flows in the Columbia River.

5. Impacts identified for VARQ FC with fish flows relative to Standard FC with fish flows are not considered to be significant to the human environment. Significance in this analysis pertains to environmental and human safety issues. Potential economic impacts of interim implementation of VARQ FC with fish flows are disclosed in the EA; however, they are not environmental effects, and are not intended by themselves to require preparation of an EIS (40 CFR 1508.14). Some economic impacts such as those related to agricultural groundwater seepage and river recreation, are associated primarily with provision of the fish flows themselves, to which the Corps committed in its May 15, 2001, Record of Consultation and Statement of Decision (ROCASOD). However, VARQ FC may increase their duration of these effects.

6. In particular, the following impacts were of primary concern in the EA. System flood control under VARQ FC with fish flows is not expected to differ from that under Standard FC with fish flows. The risk of flooding along the Kootenai River in any given year is small with either standard FC or VARQ FC (both with fish flows), and given real-time management, the increase in risk of flooding with VARQ FC is not considered significant. The risk of experiencing involuntary spill in any given year is small with either standard FC or VARQ FC (both with fish flows), and given real-time management, the increase in risk of involuntary spill and exceedance of Montana's total dissolved gas standards with VARQ FC is not considered significant. The USFWS has indicated that the increased risk of involuntary spill is not a significant effect to bull trout, and is warranted in order to increase the likelihood of providing flows to benefit the listed species. Exposure of contaminated sediments along Lake Roosevelt may increase. Native American artifacts along Lake Roosevelt may be at somewhat greater risk of exposure and loss to erosion. Exposure of sediment and artifacts already occurs under Standard FC with fish flows and any increases under VARQ FC with fish flows are not considered significant. Recreation on Lake Koocanusa and Hungry Horse Reservoir would benefit from better refill likelihood associated with VARQ FC, but recreational use downstream of the dams, particularly Libby, may be adversely affected by the increase associated with spring and summer flow augmentation. Groundwater seepage in the Bonners Ferry area along the Kootenai River may increase under VARQ FC with fish flows and impact agricultural production. Electric power generation would shift to some extent from winter to spring, with a very small net increase in annual Federal system generation.

7. Under the preferred alternative, VARQ FC with fish flows would be implemented in the interim prior to completion of the EIS for long-term implementation of VARQ FC with fish flows and associated operations. The EIS is currently scheduled for completion in late 2004. In making a determination of nonsignificance for interim implementation of VARQ FC with fish flows, I have considered the interim nature of the preferred alternative, its benefits and its impacts, and the fact that implementation of VARQ FC is an action that can be changed in subsequent years if additional information becomes available to warrant re-consideration. In the ROCASOD signed May 15, 2001, the Corps committed to providing fish flows, and any impacts

and benefits associated with them would likely continue in the event a decision were made to alter implementation of VARQ FC.

8. This project has been coordinated with state and federal agencies (including the USFWS and NMFS), Canadian interests, and the interested public. It has also been coordinated through informal consultations with Native American Tribes. Formal government-to-government consultation with Tribes is being addressed through the EIS process.

9. The EA and FONSI for this project will be available by mail by contacting the environmental coordinator:

Mr. Evan Lewis
US Army Corps of Engineers, Seattle District
PO Box 3755
Seattle, WA 98124-3755

The documentation will also be available at the project site on the internet at http://www.nws.usace.army.mil/ers/varq_web.htm.

8. Based on the analysis described above and provided in more detail in the EA, I believe this project is not a major federal action significantly affecting the human environment, and therefore does not require preparation of an Environmental Impact Statement.

31 Dec 2002
Date

Ralph H. Graves
Colonel, Corps of Engineers
District Engineer