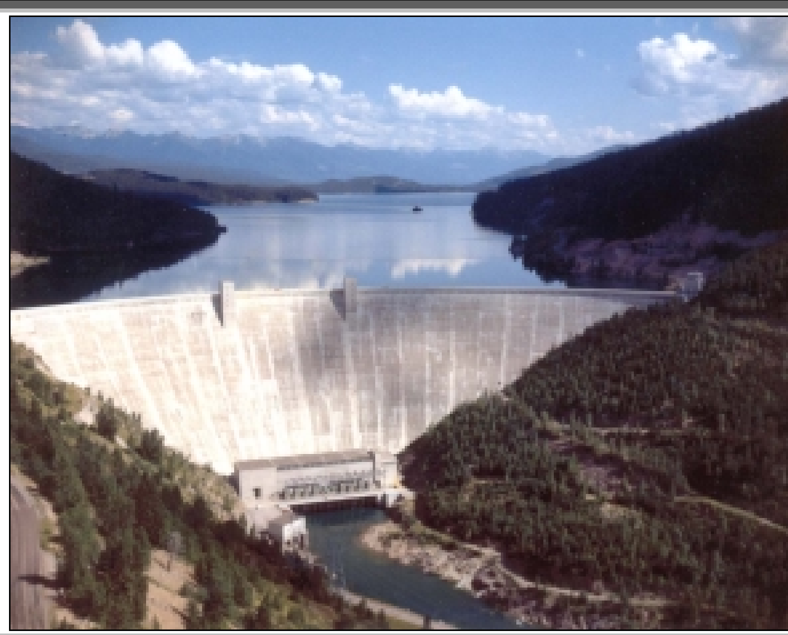
Upper Columbia Alternative Flood Control and Fish Operations Interim Implementation

Libby and Hungry Horse Dams
Montana, Idaho, and Washington

Draft Environmental Assessment
November, 2002



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Responsible Agency: 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 draft environmental assessment evaluates the impacts of interim implementation of alternative flood control operations at Libby and Hungry Horse Dams and for the flow augmentation in the Kootenai, South Fork of the Flathead, and Columbia Rivers that such alternative flood control would facilitate. One of the alternatives, the proposed variable discharge (VARQ, with Q representing engineering shorthand for discharge) flood control operation and fish flows, is intended to benefit various fish stocks listed as threatened and endangered. This draft EA evaluates the potential impacts of VARQ FC and fish flow implementation in the interim before an environmental impact statement (EIS) is completed. The EIS will enable a decision of possible long-term implementation of a VARQ FC operation and fish flows (currently scheduled in time for the 2005 water year and fish migration season). Implementation of VARQ FC and the fish flows are actions the Corps and Reclamation are required to take as "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 Biological Opinion, Effects to Listed Species from Operations of the Federal Columbia River System Power System (USFWS, 2000) and the National Marine Fisheries Service (NMFS) Endangered Species Act Section 7 Biological Opinion on the Reinitiation of Consultation on Operation of the Federal Columbia River Power System (NMFS, 2000).

THE OFFICIAL COMMENT PERIOD ON THIS DRAFT ENVIRONMENTAL ASSESSMENT ENDS ON DECEMBER 13, 2002.

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EXECUTIVE SUMMARY

This draft 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 draft EA considers effects that may occur if alternative operational actions are implemented prior to completion of an environmental impact statement, currently scheduled for late 2004, on long-term implementation of variable discharge flood control (or VARQ FC, with Q representing engineering shorthand for discharge) and fish flows. Alternatives that are evaluated are the current operation (Standard FC) and the alternative flood control operation of VARQ FC. 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. In years when the water supply forecast at Libby is expected to be from 80% to 120% of average, VARQ FC would not draft Lake Koocanusa as deep as Standard FC during the winter drawdown period. VARQ FC does enable the operating agencies to more easily 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. Key observations of interim implementation of VARQ FC at both Libby and Hungry Horse Dams are summarized below.

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. Daily modeling of both 60 years of flood control operations only and 10 years of fish flow and flood control indicate that VARQ FC would increase the river stages at Bonners Ferry, Idaho for all river stages including those above the flood stage of 1,764 feet (above sea level). The modeling also showed that the likelihood of exceeding the level of 1,750 feet (above sea level) at Kootenay Lake, British Columbia, is increased.

VARQ FC would improve the chance of refill of Lake Koocanusa. Libby Dam outflows would generally be decreased in the winter under VARQ FC and outflows from Libby Dam would be increased in the spring.

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-normal to normal water years. 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. VARQ FC results in higher spring and summer flows in the Columbia River downstream of Chief Joseph Dam for 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

VARQ FC may assist in burbot spawning in the Kootenai River due to lower January flows. Model results indicate that VARQ FC may increase overall fish entrainment at Libby Dam due to increased possibility of an involuntary spill event. VARQ FC and Standard FC are expected to have similar effects on resident fish in Lake Roosevelt (behind Grand Coulee Dam in Washington State).

Water, Sediment, and Air Quality–

One of the modeling studies indicates VARQ FC increases the chance that there may be periodic involuntary spill for flood control. This may generate dissolved gas levels above the current Montana water quality standard of 110%. 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.

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 headwaters reservoirs of Libby and Hungry Horse Dams may be exposed less often and therefore experience less erosional impacts. 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.

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.

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.

Power–

Hydropower modeling indicates that VARQ FC redistributes average monthly power generation, with losses in January, February, and April and gains in other months, with a negligible effect on average annual power generation. Over the period of record, VARQ FC increases the chance of meeting power requirements in December, July, and the first part of August, and decreases that chance in March.

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

ACRONYM INDEX

AOP: Assured Operating Plant

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 1963

CVWMA: Creston Valley Wildlife Management Area

DOP: Detailed Operating Plan

DPS: distinct population segment

DSI: direct service industries

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

FWCA: Fish and Wildlife Coordination Act

GBD: gas bubble disease

HGH: Hungry Horse Dam

HPO: Historic Preservation Office

IJC: International Joint Commission

kcfs: thousand cubic feet per second

LCA: Libby Coordination Agreement

maf: million 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)

MDEQ: Montana Department of Environmental Quality

MFWP: Montana Department of Fish, Wildlife, and Parks

MW: megawatt

NEPA: National Environmental Policy Act

NMFS: National Marine Fisheries Service

NWPP: Northwest Power Pool

PBERP: Pacific Bald Eagle Recovery Plan

PNCA: Pacific Northwest Coordination Agreement

RM: river mile

SRD: storage reservation diagram

TDG: total dissolved gas

URC: upper rule curve

U.S.: United States

USFWS: United States Fish and Wildlife Service

USC: United States Code

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

1. INTRODUCTION

In accordance with the National Environmental Policy Act (NEPA), this draft environmental assessment (EA) is to assess 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. Evaluation of an interim implementation of VARQ FC is in response to requirements in the Incidental Take[1] 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," 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. VARQ FC is a flood control operation that was a proposed action included in the 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. Another effect of this proposed alternative flood control operation that ensures a higher likelihood of spring and summer refill at the upstream projects (Libby and Hungry Horse Dams), is providing greater assurance of available water for fish flow augmentation for migrating fish species listed as threatened or endangered under the ESA, in the Kootenai, South Fork of the Flathead, and Columbia rivers.

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 RPA's referenced above. The September 2001 EA included a list of environmental impacts that required further analysis and that the Corps viewed as important to the decision making process for long-term implementation of VARQ FC. 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 this year, while continuing further analyses for a long-term decision in the EIS scheduled for completion sometime late 2004.

[1] 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.

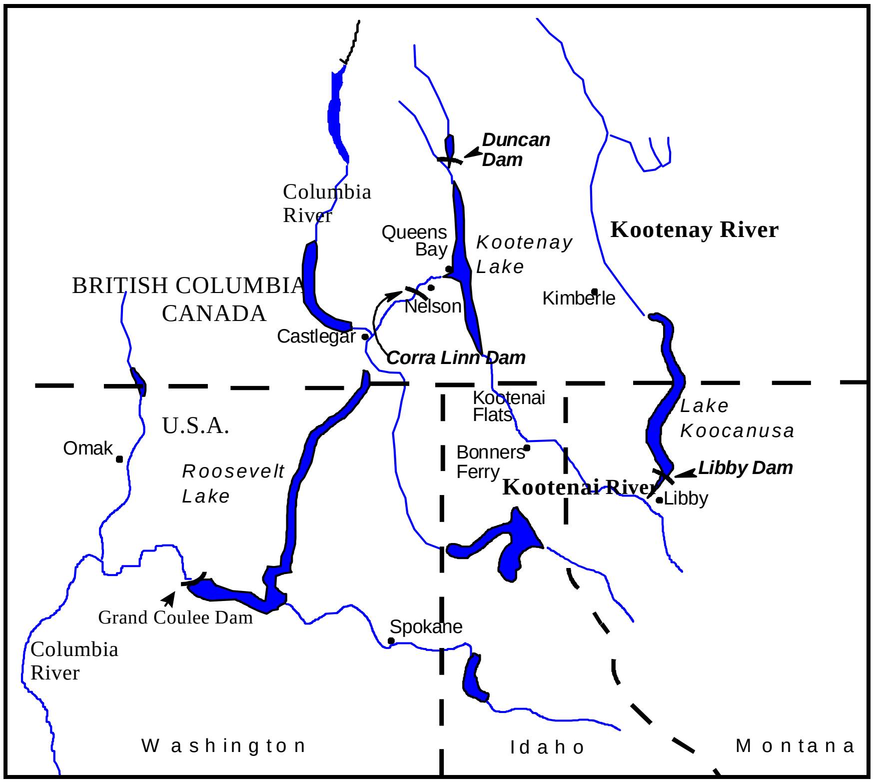

Figure 1. Libby Dam and the Kootenai River system

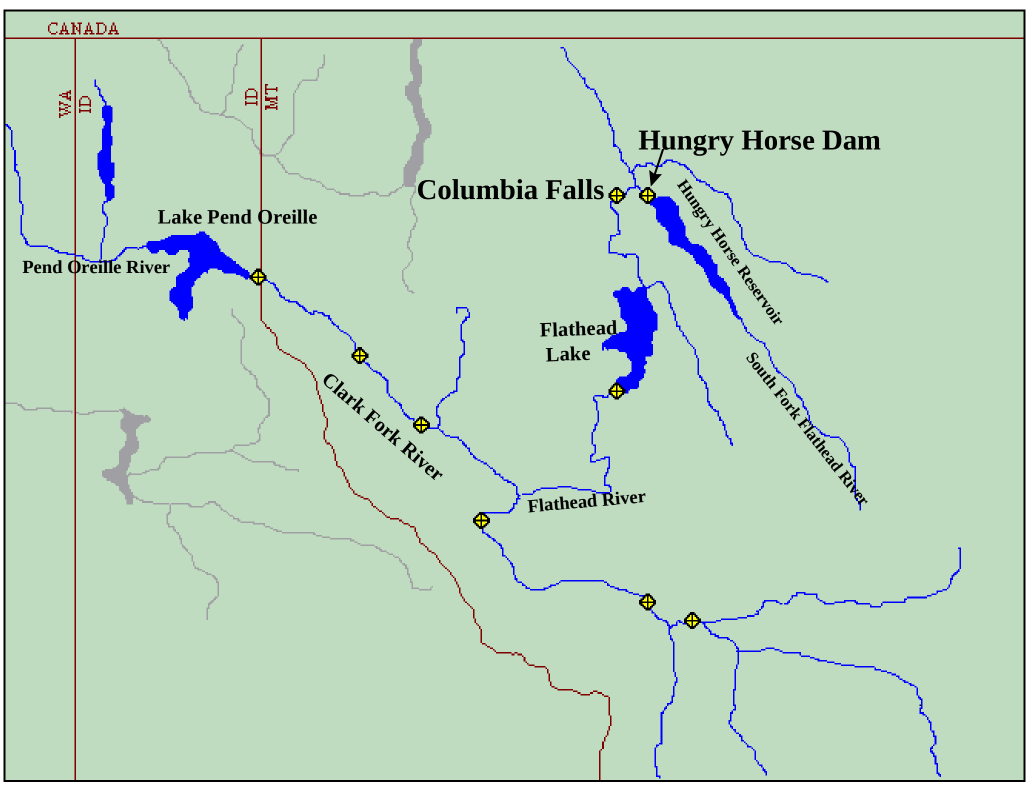

Figure 2. Hungry Horse Dam and the Flathead River system

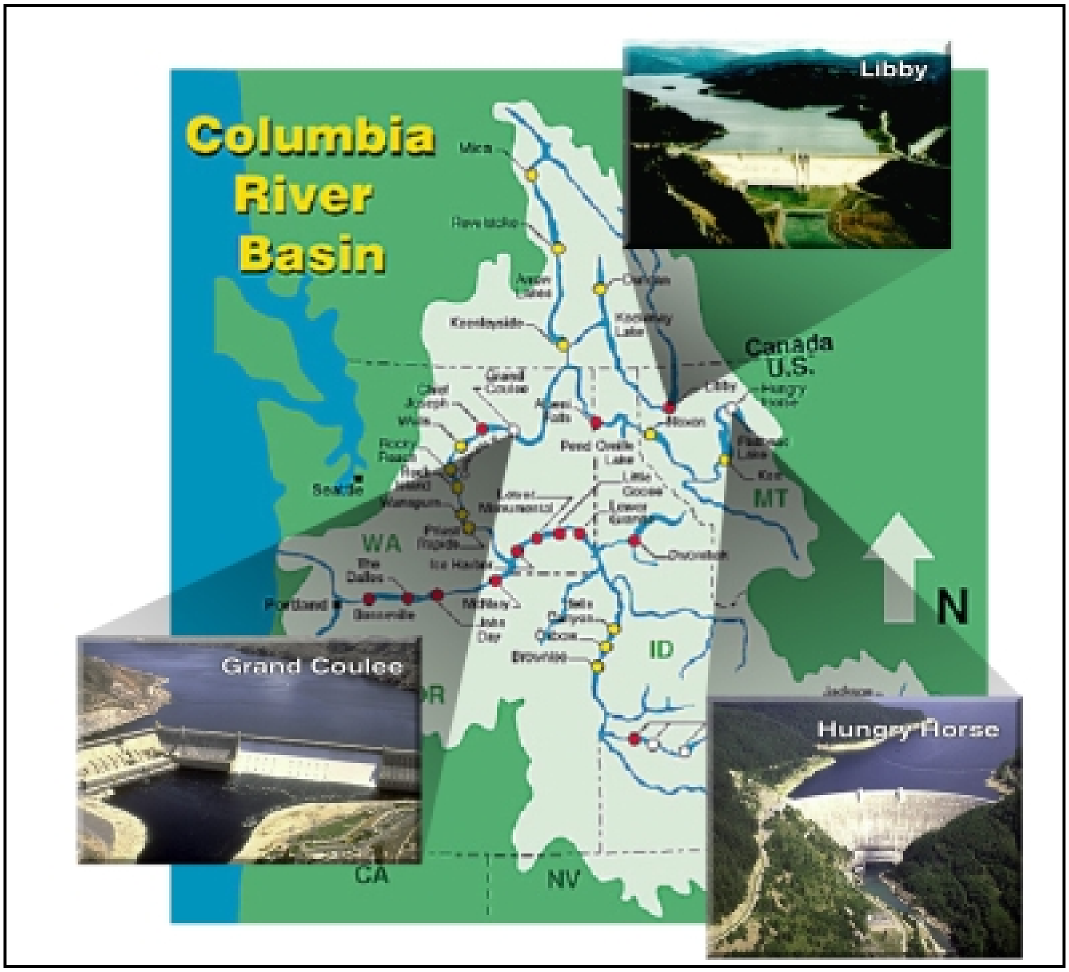

Figure 3. Map of Columbia River Basin

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 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 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. This is a joint EA. The Corps and Reclamation are providing this opportunity for the public to comment on the potential impacts of an interim VARQ FC operation and fish flow implementation as discussed in this EA.

2. BACKGROUND

The Corps and Reclamation are jointly preparing an EIS to evaluate flood control and other operational strategies at Libby and Hungry Horse Dams to provide recommended flows and habitat conditions for threatened and endangered anadromous and resident fish. 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 starting in the 2005 fish migration season.

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. The EA did not address the potential impacts of VARQ FC implementation at both Hungry Horse and Libby Dams.

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. In this EA, the Corps and Reclamation evaluate the potential impacts of interim implementation of VARQ FC and fish flow implementation 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 at both projects in January 2003.

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 strategy at Libby and Hungry Horse.

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 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[2] 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 headwaters. These reservoirs store the spring snowmelt runoff to control floods, and they release higher-than-natural flows in the fall and winter for power production. Listed fish populations in the Columbia Basin (Kootenai River white sturgeon, Columbia Basin bull trout, and several Columbia River salmon and steelhead

[2] 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.

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 that will benefit threatened and endangered anadromous and resident fish. The EIS for long-term implementation is currently scheduled for completion in time for the 2005 water year and fish migration season. One of the interim actions under consideration is an interim VARQ FC operation which is 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 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 using guidance provided by a storage reservation diagram (SRD) from January through April. A storage reservation diagram (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.

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 dependant 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

The variable discharge flood control operation (VARQ FC, with Q representing engineering shorthand for discharge) was first introduced as a possible alternative to the current flood control procedures (Standard FC) for Libby in the 1995 Columbia River System Operation Review (SOR; BPA *et al.*, 1995). The objective of the VARQ FC strategy is to minimize flood damages as measured at The Dalles to the same level as the standard CRT63 flood control strategy, by re-allocating some of the flood control draft upstream of Grand Coulee from January through April. 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 the same level of flow at The Dalles during the spring snowmelt period when operating to VARQ FC or Standard FC. 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 easily 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 is 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 current operations. The current SRD for Libby and the pre-VARQ FC SRD for Hungry Horse are provided in Figure 4 and Figure 5. The VARQ FC SRD for both projects are shown in Figure 6 and Figure 7. 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. Reclamation implemented VARQ FC at Hungry Horse for the first time in 2001.

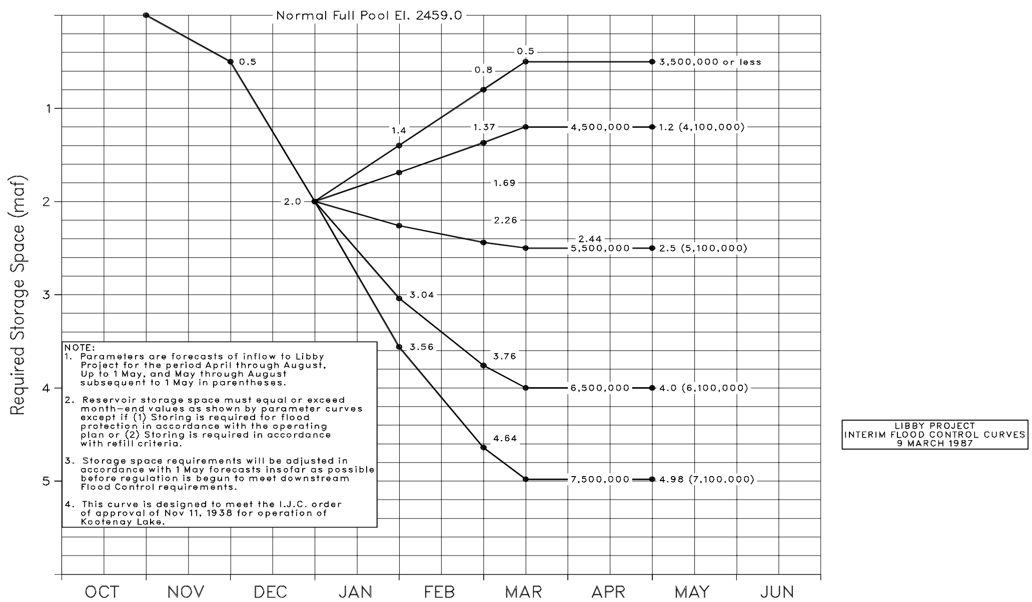

Figure 4. Standard Flood Control Storage Reservation Diagram at Libby Dam.

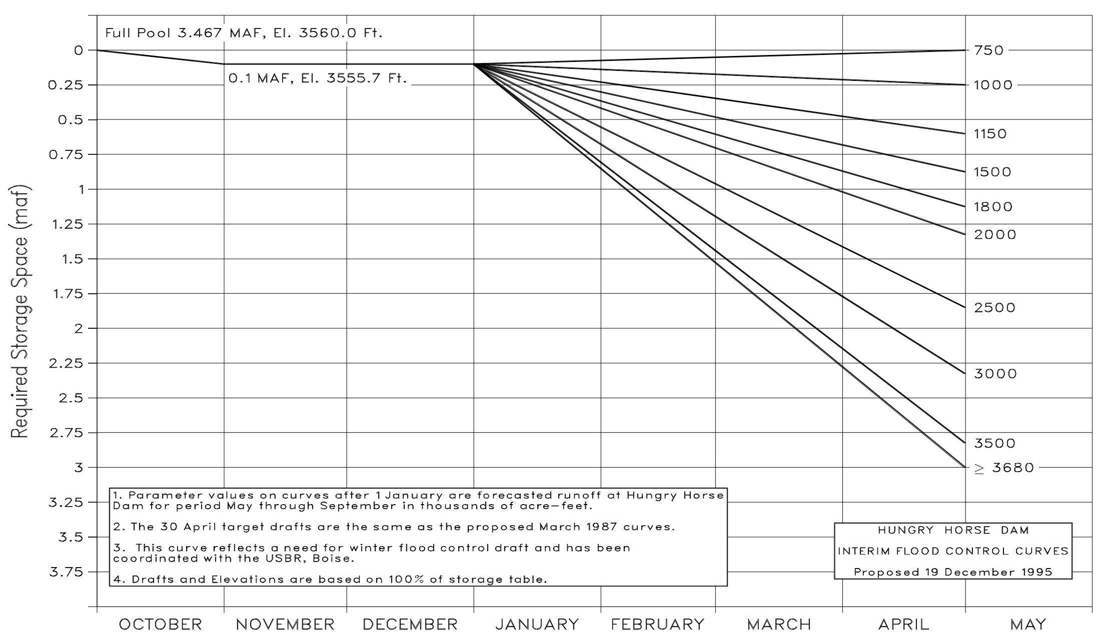

Figure 5: Pre-VARQ FC Storage Reservation Diagram, Hungry Horse Dam

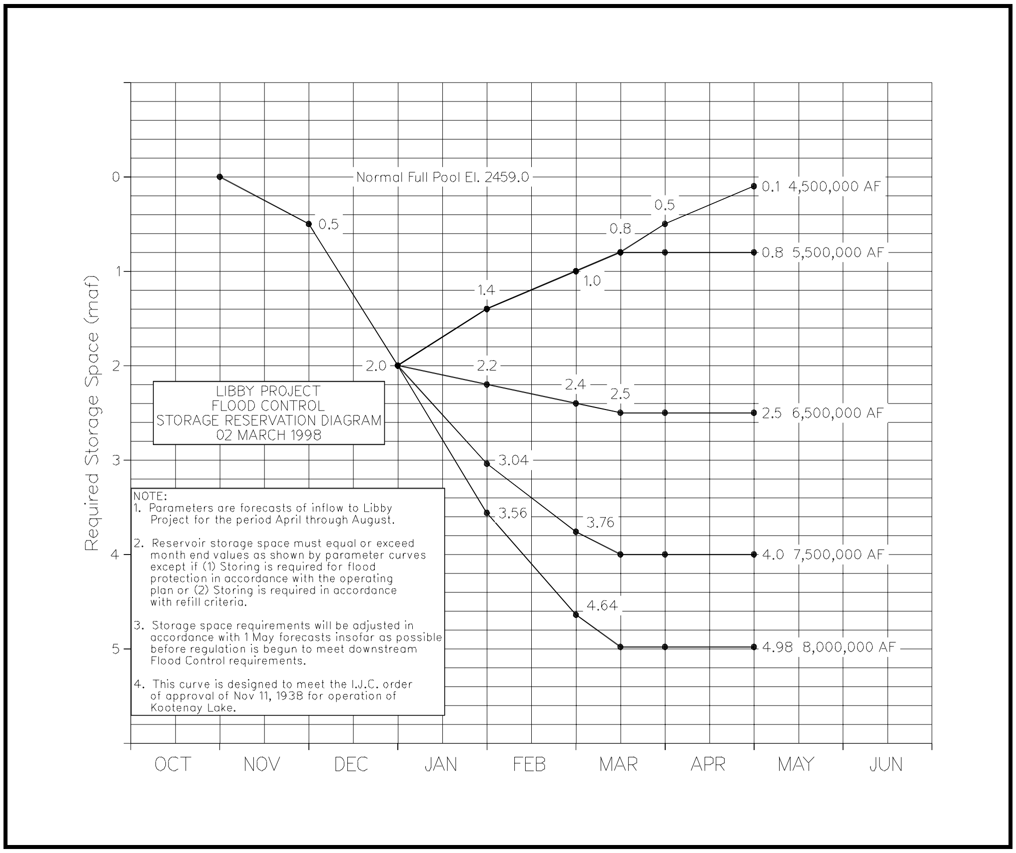

Figure 6. VARQ FC Storage Reservation Diagram at Libby Dam.

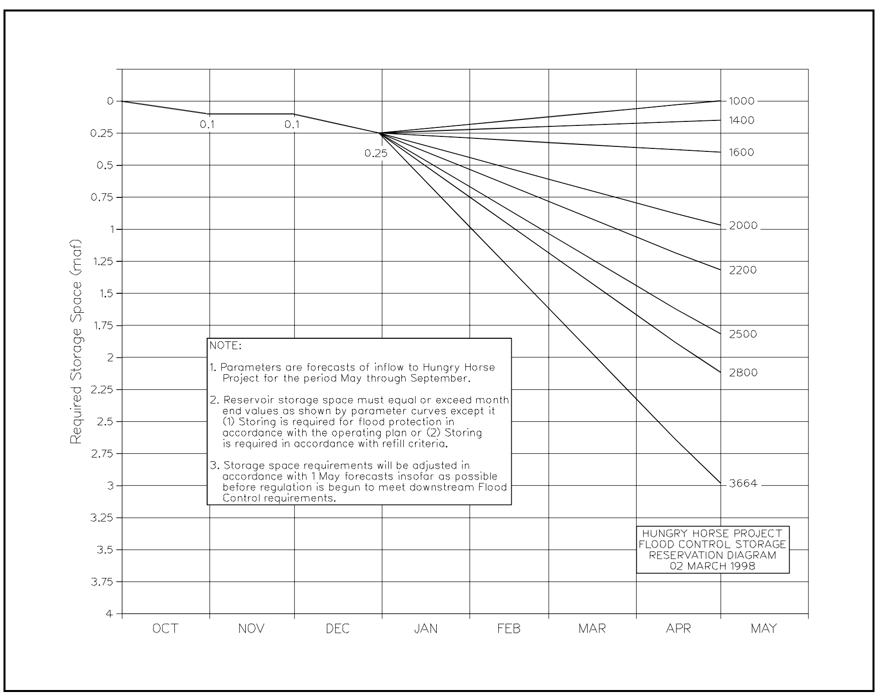

Figure 7: VARQ FC Storage Reservation Diagram, Hungry Horse Dam

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. Generally, Libby is operated to maintain flow in the Kootenai River below flood stage at Bonners Ferry of elevation 1,764 feet.[3] Similarly Hungry Horse is operated to try to maintain Columbia Falls gage reading below 13 feet. 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 of the runoff event, water releases would increase 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 Lake in Canada during the winter to elevations specified by its flood control rule curve. Releases from Libby Dam flow into Kootenay Lake, and there are times when the elevation of Lake Koocanusa, the reservoir behind Libby Dam, will exceed the flood control rule curve because reducing Libby Dam discharges is required to prevent Kootenay Lake from going above its flood control rule curve.[4]

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 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 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.

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[3] Unless otherwise noted, all elevations in this document are referenced to the National Geodetic Vertical Datum of 1929 (mean sea level).

[4] The Columbia River Treaty requires that the Libby project not cause a violation of the 1938 IJC Order on Kootenay Lake in British Columbia.

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[5] 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 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 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

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

sedimentation. The region is characterized by high, rugged, forested northwest-trending mountain ranges separated by narrow linear valleys. Elevations rise from 2,000 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 1,000 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 climactic 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 streamflows 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.

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. Sampling by the Corps conducted during a range of flows in 2002 is being analyzed to determine any relationship between river flow and well water quality. Preliminary results indicate that high river flows (up to 40,000 cfs) are not correlated with adverse impacts to drinking water wells in the area (see Section 5.1.2.1).

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 upper layers 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 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 involuntary spill from Libby Dam is unusual but can result in TDG levels up to 135% saturation just downstream of the dam. 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 intensive logging activities in the basin, adversely affects overall Kootenai River water quality. Historic and ongoing agricultural and industrial inputs to the Kootenai system have caused increases in pollutant and contaminant levels that are most apparent in the Kootenai Flats area near Bonners Ferry, Idaho. 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 has been no human health statements release 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 which can be respired by humans (PM_{10}).

While there are several PM_{10} non-attainment areas already 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[6] native and non-native species of fish, including white sturgeon (*Acipenser transmontanus*), kokanee[7] (*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*).

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

[7] 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.

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, long considered "blue ribbon" by the State of Montana. 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.

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 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 draw-downs 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.

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 powerplant 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 per year, mostly fry, stocked 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 (LeCaire, 1999).

Walleye, a primary gamefish, 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 main spawning grounds 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, bull trout and bald eagle are listed as threatened, and 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 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. There are currently only about 660 adult sturgeon remaining in this population. 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. 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. White sturgeon release sinking eggs that promptly adhere to gravel substrates where they remain until hatching. Then, the sac fry continue to have dependence on gravel substrates for cover until the yolk sac is absorbed, and 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 of sand within the spawning reach. 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[8] 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[9]. 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. 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**.** 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

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[8] 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.

[9] 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.

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 have not been noted to result in entrainment of significant numbers of fish from Hungry Horse Reservoir. However, specific studies have not been conducted and are necessary to verify those assumptions.

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

3.2.4.3.1. Libby Dam

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.

3.2.4.3.2. 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 pair of eagles 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.

3.2.4.3.3. 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 and an abundant food base; and low levels of human disturbance at least 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 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. Refer to the NMFS 2000 FCRPS BiOp for more details on the status of Columbia River anadromous fish stocks.

Historically, natural barriers blocked anadromous fish passage to 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. 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.

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 the species range around the Pacific, this population appears to be adapted to a unique ecological setting. Less 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. To a large extent, the low numbers of burbot are attributed to heavy sport and some commercial harvests in the US and Canada and burbot harvest in both nations has been substantially restricted. 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 once during the drought of 2000/2001 when flows in the Kootenai River below Bonners Ferry during December and January 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. These high flows are associated with an increase in winter water temperatures from near 1 degree C to 3-4 degrees C which may also adversely affect burbot migration and spawning. 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 Reservation 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 beteen 1981-84 and reported by Thoms (1984). The survey identified 249 cultural resource sites. Annual monitoring of the drawdown area by Kootenai National Forest between 1985-93 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 Reservation 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 historic 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 Hellgate Treaty of 1855 was signed by the Flathead Tribe, 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 '20s, 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 USBR 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 1). 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 1. 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 ~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.

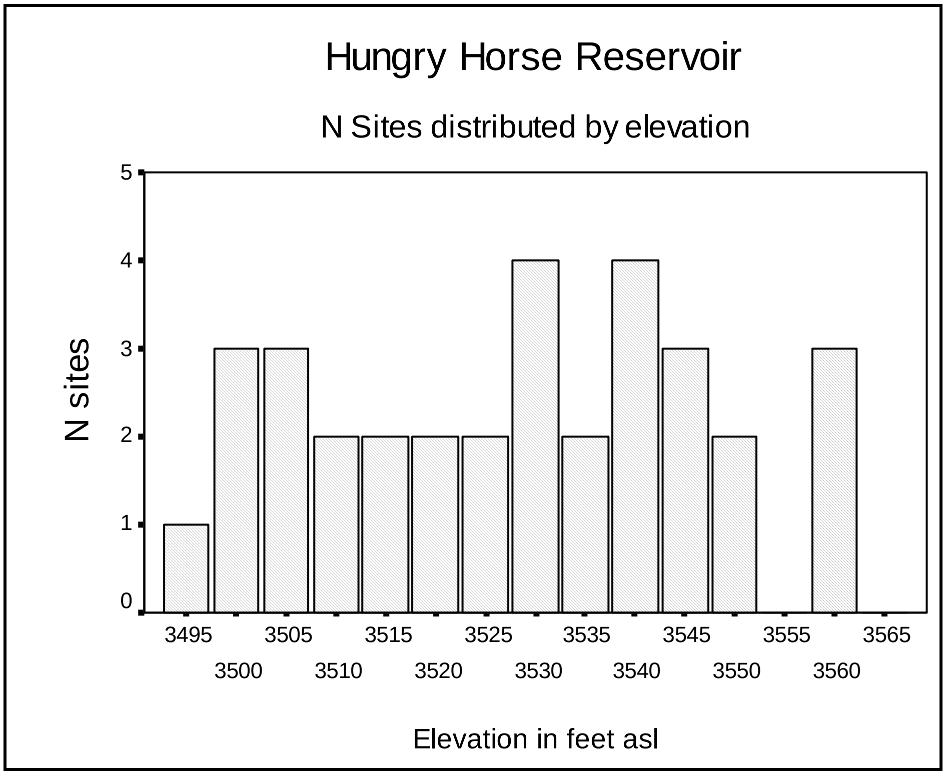

Figure 8. Elevation Distribution of Historic Sites at Hungry Horse Reservoir

3.3.2.4. Traditional Cultural Properties

A consultation meeting between Reclamation and the Confederated Salish and Kootenai Tribes is scheduled for November 13, 2002. Due to the accelerated schedule of this EA, the results of that meeting, including any information on traditional cultural properties or sacred sites from the Confederated Salish and Kootenai tribes, will be included in the final EA. See Impacts Analysis for further discussion.

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.

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.

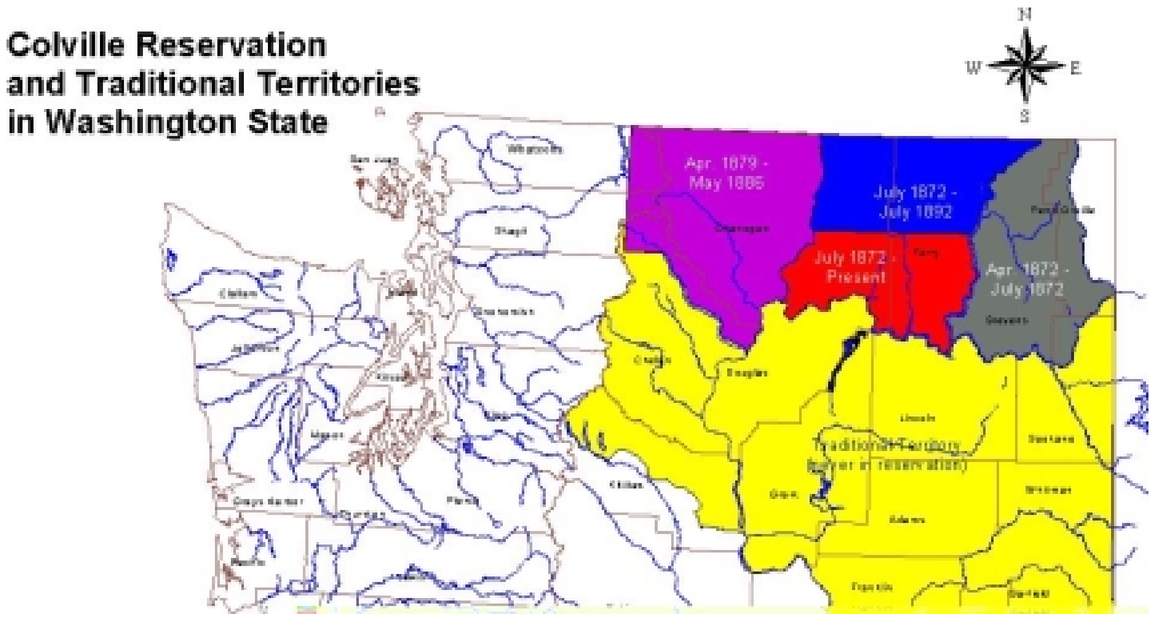

Figure 9. Map of Colville Confederated Tribes Traditional Territories, Washington (Supplied to USBR by the Colville Confederated Tribes Historic Preservation Office)

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 21st 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 Colvile 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 (CBAS) 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.

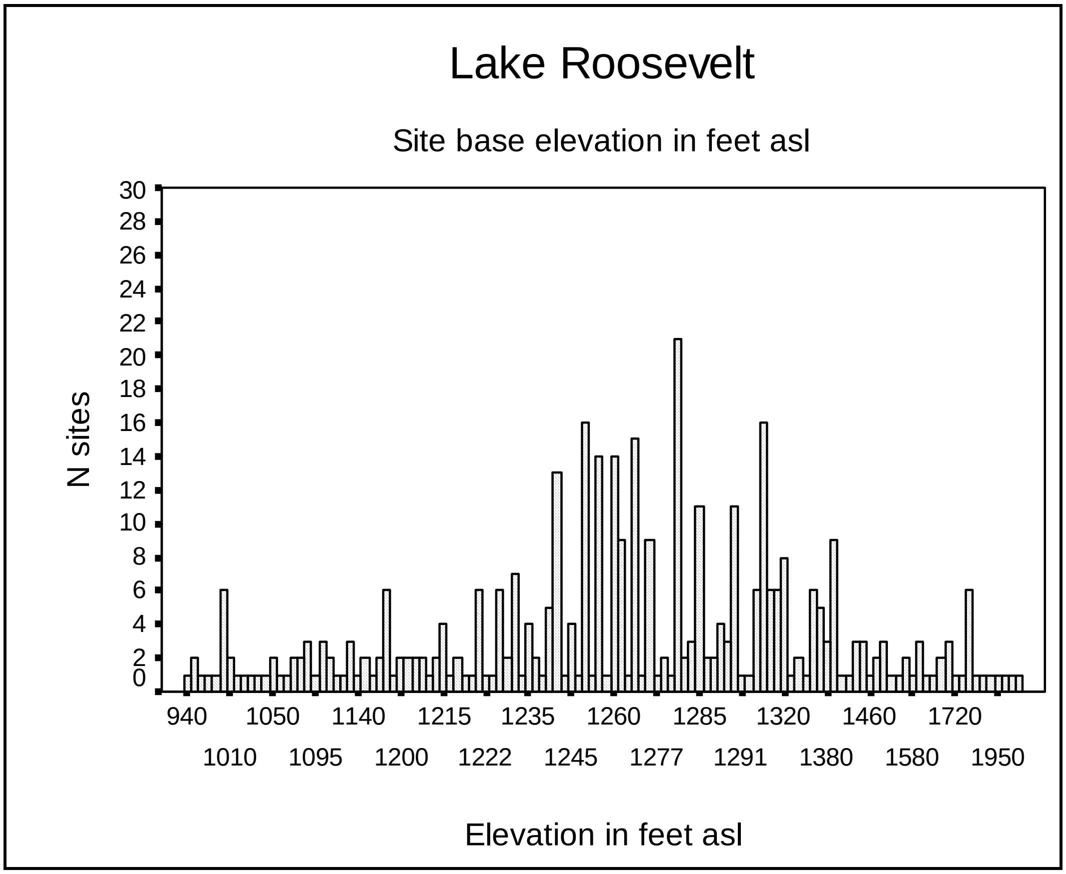

Figure 10. Elevation Distribution of Historic Sites at Lake Roosevelt

Unlike the graph for Hungry Horse sites, Figure 10 only shows 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 the Impacts Analysis section of this document.

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.

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 '80s 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 took place on 11/5/02 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 USBR 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. Road parallel both sides of the reservoir in the U.S. while the Canadian portion of the reservoir is not bounded by major roads.

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. Cattle are pastured and a variety of crops are cultivated; the harvest crops include wheat, barley, hops, clover seed, timothy seed, and hay. 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 extend northwards near the river.

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.

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 results 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.

3.4.1.2. Hungry Horse Dam

Federal lands 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 predominately 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 agricultural areas along the Pend Oreille River in Washington state. 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 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 flood control operating plan (FCOP) for Libby Dam was developed as part of the Columbia River Treaty 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. Libby Dam is operated to minimize river stages in excess of elevation 1764 feet at Bonners Ferry, Idaho (Corps, 1999a).

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. The Corps provides emergency flood assistance if requested by the counties 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 2,411 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. 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. The maximum levels of Kootenay Lake 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 current 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.

3.4.2.3. Columbia River

Flood damage potential is greatest on the lower Columbia River 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 Columbia River Treaty (CRT), which formed the basis for major hydropower- and FC-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. 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 Flood Control

Operating Plan (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. Hungry Horse Dam is not a CRT project.

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 Columbia River Treaty together with the protection afforded by levees. To store extremely high amounts of runoff, the U.S. may choose to pay for additional water storage in Canadian reservoirs.

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 total dissolved gas, voluntary spillway flows for sturgeon would need to be limited to approximately 1,000 cfs. Spillway flows necessary for 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 current spillway condition will need repairs, but 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.

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 2,459 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 fishing opportunities 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. Total 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. Excessive 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 1,225 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 1,208 to 1,290 feet but, when the normal terminal is affected by low water, they 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 owns and 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 Utah and other states to the east. Power produced at dams in the Northwest serves customers both locally and thousands of miles away.

The Columbia River Treaty 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 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.

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).[10] 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.

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[10] 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 is required from Congress or an alternative source to complete the installation of units 6 through 8.

Table 2 lists some characteristics of some hydroelectric facilities in the Columbia River Basin.

Table 2. Characteristics of U.S. and Canadian Hydroelectric Projects in Study Area

Project	Operator	Location	Year Completed	Nameplate Electrical Capacity
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 Orielle 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 operates using Standard FC and Hungry Horse 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 (see next paragraph) and, in recent years, 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 ESA listed 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, well above current powerhouse capacity (USFWS, 2000).

Powerhouse discharge is the preferred method for passing water at Libby Dam since the powerhouse does not cause an increase in TDG levels. Once the powerhouse discharge has been maximized,[11] the water is passed over the spillway or through the sluices. 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. When the reservoir is close to full,[12] 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. [13] For example, powerhouse discharge reached about 28,000 cfs during the high flow year of 1997.

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 total dissolved gas in the Kootenai River directly downstream of the stilling basin to exceed the State of Montana's water quality standard for total dissolved gas. [14]. Monitoring completed during spill events in June and July, 2002

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[11] Maximum powerhouse discharge capacity could be increased with installation of additional turbines. Seattle District is investigating the feasibility of additional turbines 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.
[12] The full pool elevation of Lake Koocanusa is 2,459 feet.
[13] 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.
[14] The Montana State water quality standard for total dissolved gas is 110%.

indicate spillway flow above 1,000 cfs could increase total dissolved gas above 110% as measured at the tailrace (?). Therefore, all Alternatives in this EA assumes the maximum controlled flow for sturgeon flows is 26,000 cfs (25,000 cfs powerhouse discharge plus 1,000 cfs spillway flow).

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 DworshakDam may also benefit adult salmonid passage by moderating temperatures (NMFS, 2000b).

The Corps manages Libby Dam to refill Lake Koocanusa to 2,459-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 2,439-feet elevation (20 feet from full pool) by August 31.[15] A draft of 20 feet from full pool at Libby Dam provides up to 891 thousand 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. 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 (SOR; BPA *et al.*, 1995).

The NMFS 2000 FCRPS BiOp 2,439-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 3). The first alternative consists of Standard FC at Libby and VARQ FC at Hungry Horse with sturgeon flows to full powerhouse capacity plus allowable spill (about 26,000 cfs)[16] and potential salmon draft to 2,439-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 with sturgeon flows up to 26,000 cfs[17] and potential salmon draft to 2,439-feet elevation at Libby Dam. This alternative is consistent with the NMFS and USFWS 2000 FCRPS BiOps.(NMFS, 2000a; USFWS, 2000).

Reclamation began implementing VARQ FC at Hungry Horse Dam in 2001. In March 2002, Reclamation published a Voluntary Environmental Assessment (Reclamation, 2002a) for this action, with a Finding of no Significant Impact. Reclamation's Voluntary EA stated that, based

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[15] If Lake Koocanusa does not fill above 2,439 feet, releases for salmon flow augmentation are not required.
[16] Flows discharged from Libby Dam may exceed the maximum sturgeon flows if necessary for flood control purposes.
[17] Ibid.

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. Please refer to Reclamation's 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 3. 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)	2,439 feet
VARQ FC with fish flows	VARQ FC	Powerhouse Capacity plus 1,000 cfs (~26,000 cfs)	2,439 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 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 how the model runs and how they relate to the EA Alternatives are provided in Section 5.1.2.1.1 for Libby Dam.

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 Flathead, Clark Fork, or Pend Oreille Rivers is included in the Hungry Horse Dam section.

Effects relating to interim implementation at Hungry Horse Dam are discussed in Reclamation's 2002 voluntary EA (Reclamation, 2002a), which has been 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 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 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. Hydrology Modeling Procedure

Three modeling studies were used to develop information for this EA and each builds upon one another. The models provide an indication of what conditions would be under different scenarios for comparison purposes. The models do not necessarily represent actual conditions that would occur in real-time operations.

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 flow for the entire system above The Dalles, OR. All reservoirs were operated to meet the system flood control criteria defined in the Columbia River Treaty 1999 Flood Control Operating Plan. In these sixty-year studies, each year was initialized 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 drafted through April on the elevation 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 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 5.1.2.1.3). These upper limit elevations were also input to the third study; monthly time step multi-purpose models that were developed using the Corps of Engineers' HYSSR model.

5.1.2.1.2. Daily Time Step Hydrologic Model

The daily time step model results may be used to develop frequency curves or exceedance curves, yet they are not representative of what may actually occur during real-time operation. For instance, the forecasts used in Libby Dam operations are more conservative than those used in the modeling discussed below. Also, 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. 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 as a result of the models.

The output discussed below 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.

5.1.2.1.2.1. Lake Koocanusa Refill

Simply comparing Standard FC to VARQ FC (without fish flows), the VARQ FC reservoir 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 11. 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 12). By July, there is no significant difference in reservoir elevation between flood control methods.

5.1.2.1.2.2. Libby Dam Outflow

The daily time step models, where the system was operated for the single purpose of flood control, were used to develop a Flow Frequency curve as the Daily Maximum outflow from Libby Dam (Figure 13). Figure 13 represents the daily maximum outflow during May, June, and July (the portion of the snowmelt runoff season when floods are most likely to occur since the spring freshet is a system flood control concern). These model scenarios do not include fish flow operations. At the onset of refill, the reservoir is generally at a higher elevation with VARQ FC than it would have been with Standard FC in normal to below normal runoff years. Accordingly, the reservoir releases during refill under VARQ FC are generally greater than those with Standard FC. For the more common conditions where releases are less than about 15,000 cfs, VARQ FC outflows are consistently higher than Standard FC outflows. The frequency of occurrence of releases between about 15,000 cfs and 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 outflow from Libby Dam may exceed 30,000 cfs. In real-time operation the years with large runoff tend to have a higher risk of spill from Libby Dam under either Standard FC or VARQ FC; with VARQ FC being slightly higher than Standard FC.

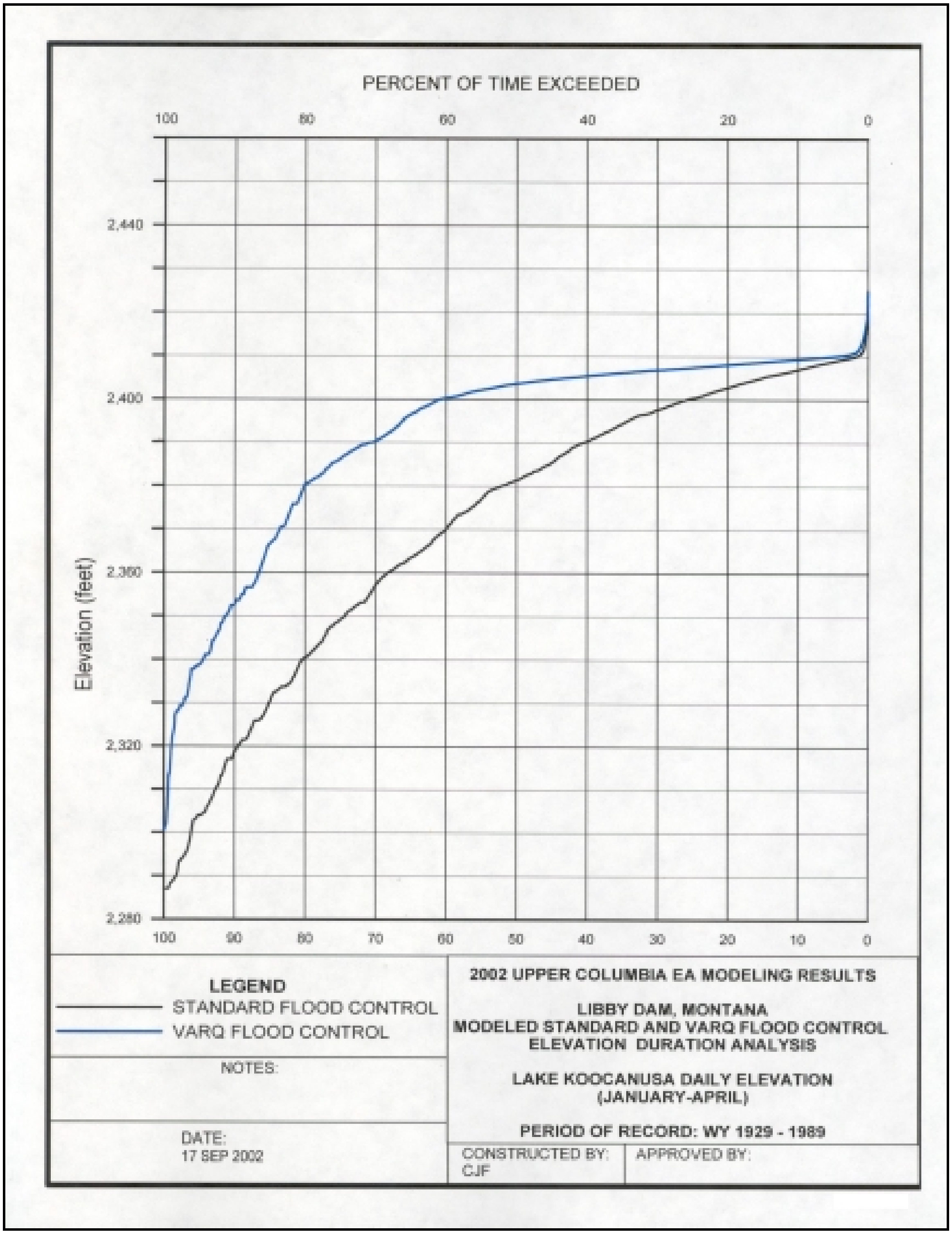

Figure 11. Elevation-Duration Analysis: Lake Koocanusa Daily Elevation (January-April)

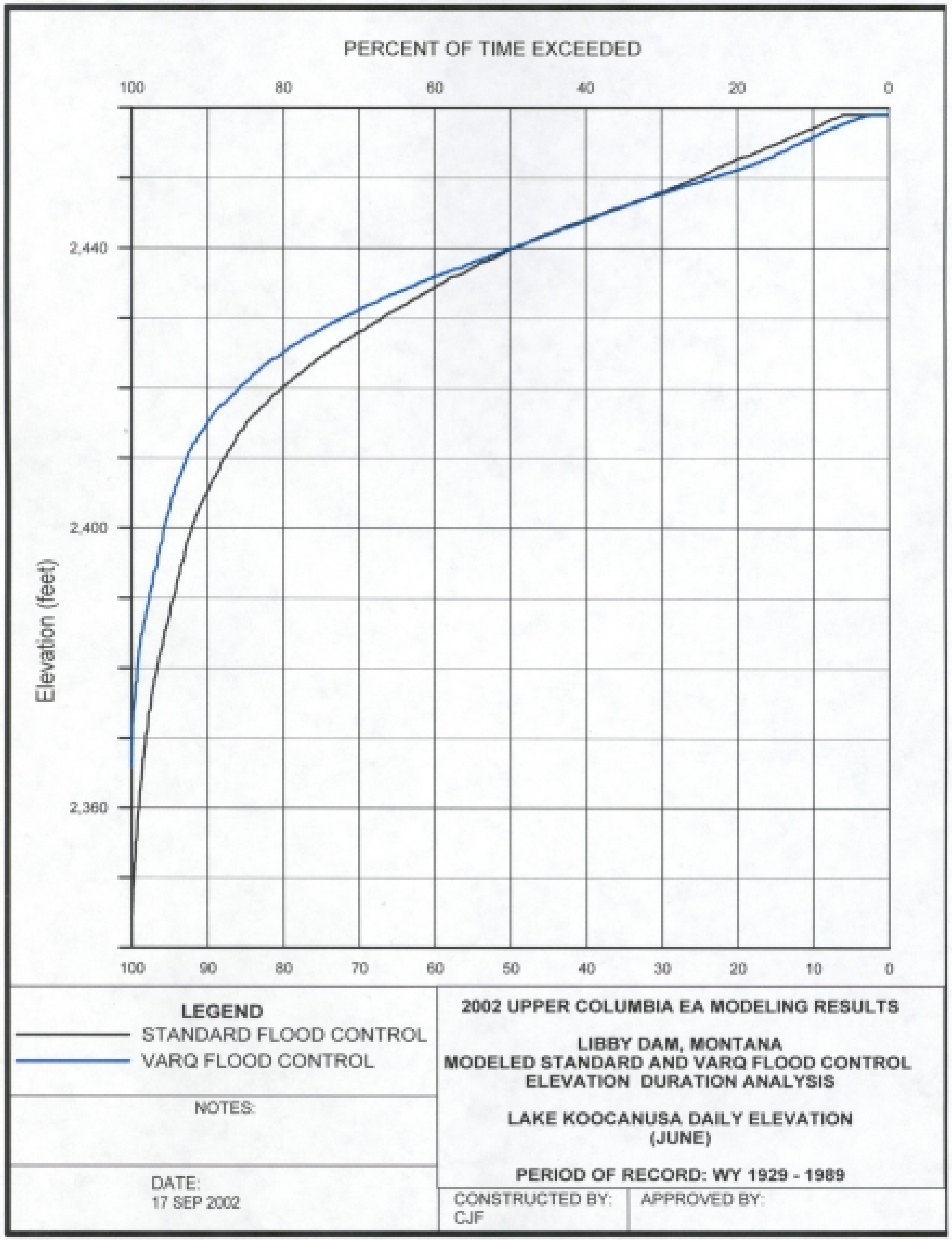

Figure 12. Elevation-Duration Analysis: Lake Koocanusa Daily Elevation (June)

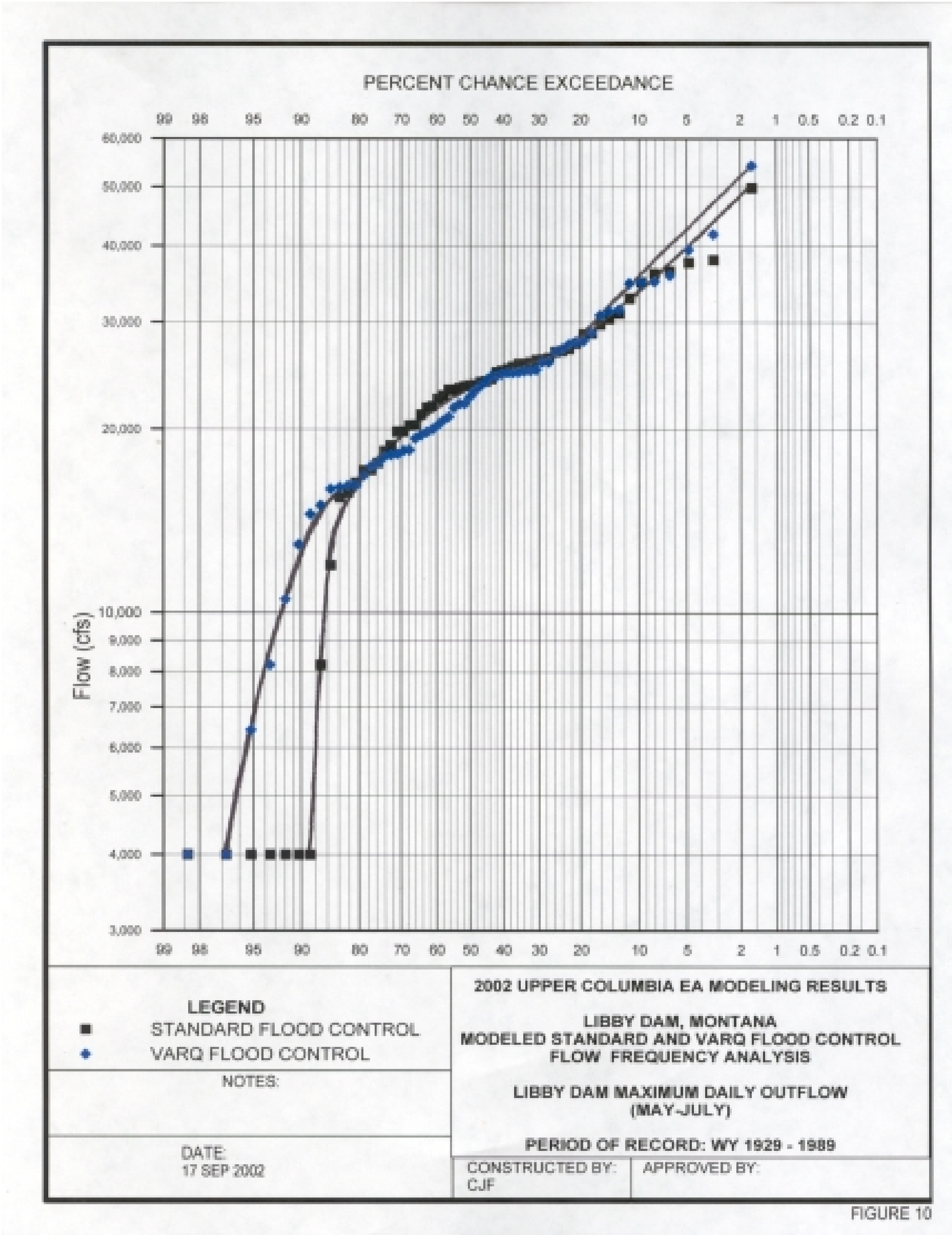

Figure 13. Flow-Frequency Analysis: Libby Dam Maximum Daily Average Outflow (May-July)

5.1.2.1.2.3. 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. Figure 14 shows the comparison of daily maximum flow at Bonners Ferry during the spring freshet under Standard FC and VARQ FC. In large, infrequent water years, there may be risk of flow that exceeds flood stage elevation of 1,764 feet at Bonners Ferry. 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. Generally in large water years that were under-forecast, there may be additional risk to exceed flood stage at Bonners Ferry, Idaho with VARQ FC.

5.1.2.1.2.4. Kootenay Lake Elevation

A daily elevation-frequency curve specific to May through July is provided in Figure 15. The frequency curve shows that when VARQ FC is used, the level increases for Kootenay Lake. The two curves appear to converge around elevation 1751 feet, but then split from each other again for the low 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.

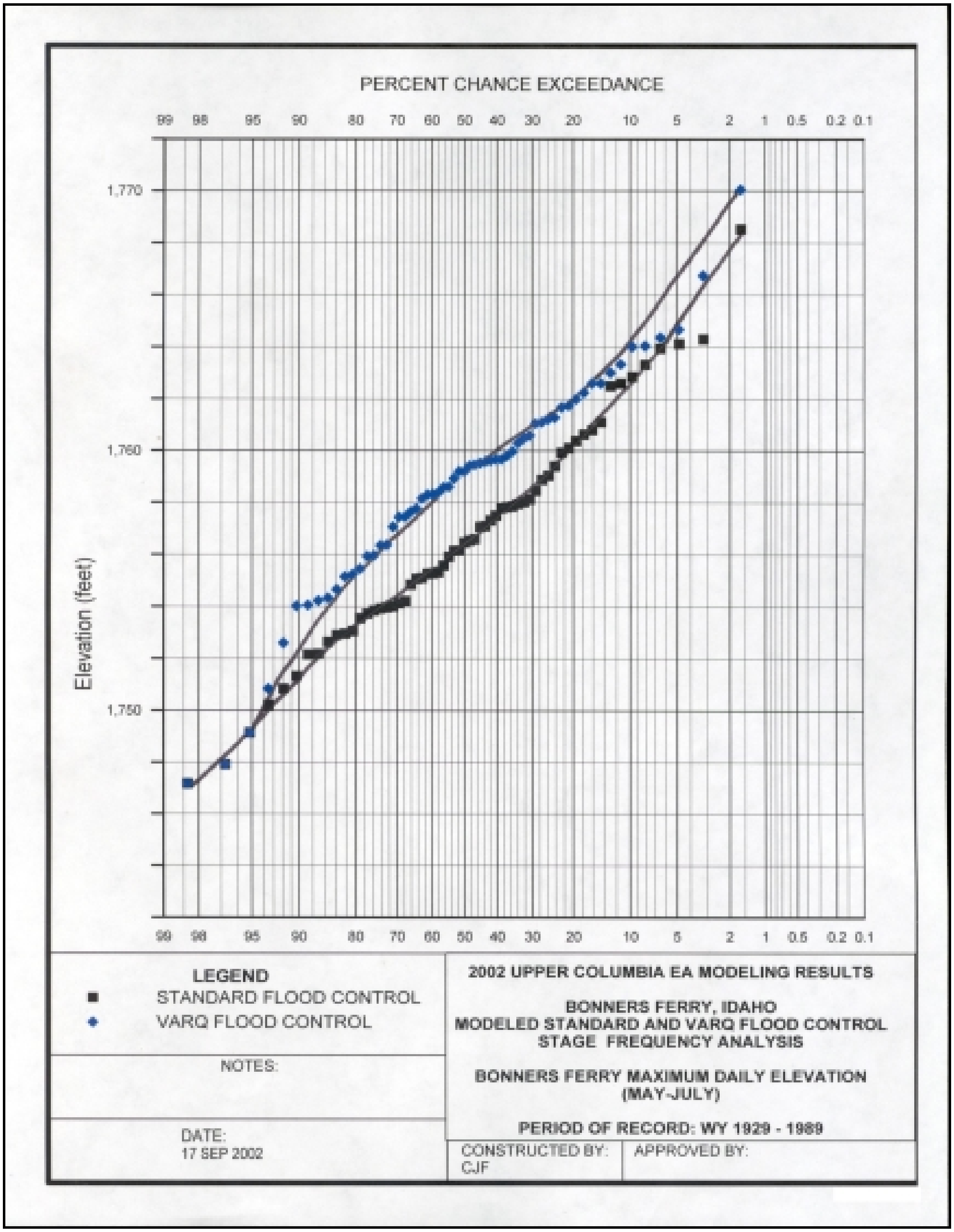

Figure 14. Stage-Frequency Analysis: Bonners Ferry Maximum Daily Elevation (May-July)

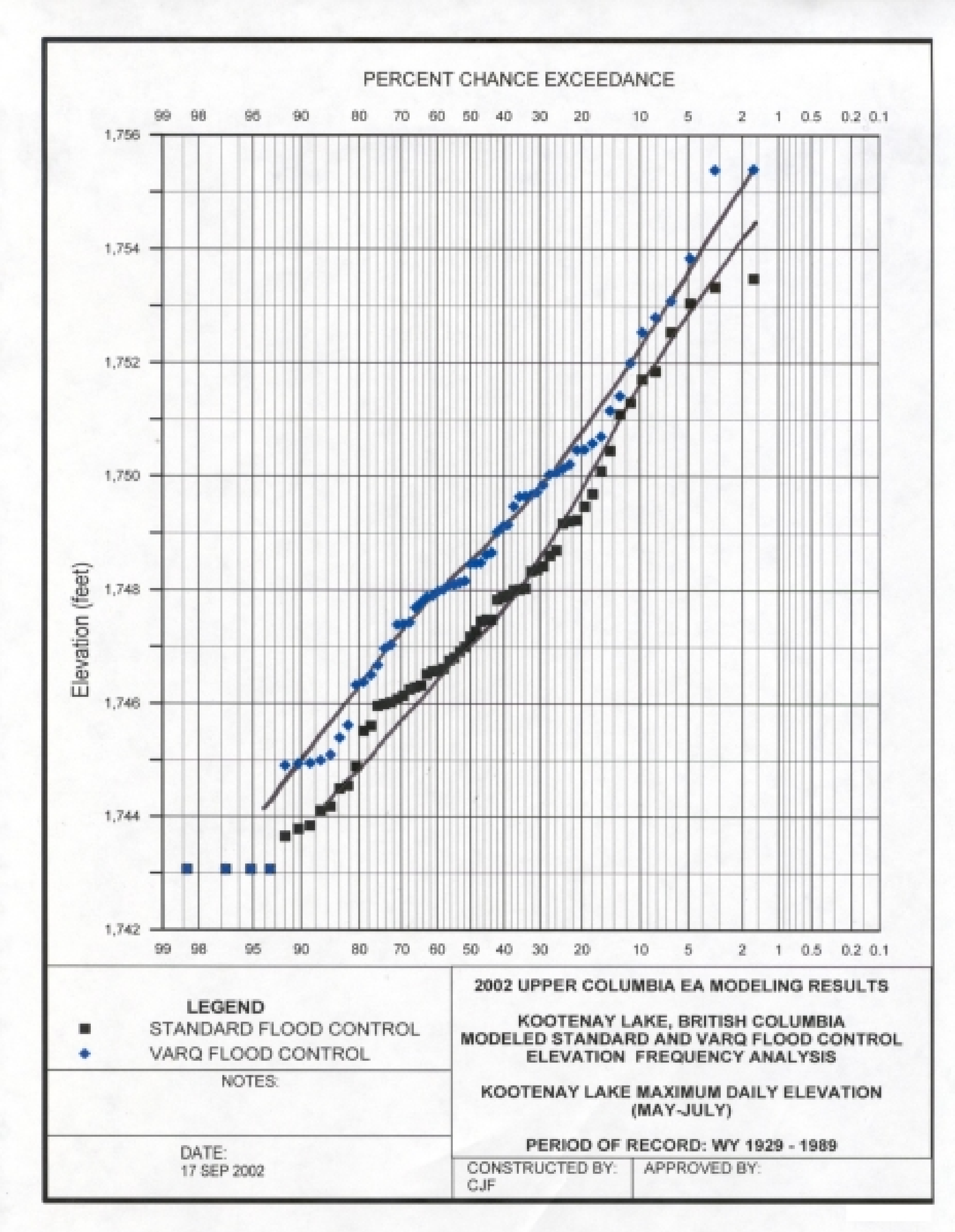

Figure 15. Elevation-Frequency Analysis: Kootenay Lake Elevation

5.1.2.1.3. 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. As with the other daily time step modeling discussed in Section 5.1.2.1.2, 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 over estimated or underestimated were considered, as well as early or delayed spring freshets. These criteria were important to measure effects at select locations such as Libby reservoir and the Kootenai River downstream, and Grand Coulee reservoir elevation. The criteria below were developed to select the ten years for this study.

Each of the ten years met all of the following three criteria:

1. VARQ FC end of April draft points had to be different from the Standard FC draft points; this generally occurs in water years where the April through August forecast is less than 125% of average. Therefore, the April-August Libby inflow forecast volumes (issued in May) needed to be less than 8.0 MAF.
2. The April through August volume forecast at Libby had to be large enough so that sturgeon release volumes would be provided. Therefore, the April through August Libby inflow forecast volumes (issued in May) needed to be greater than 4.8 MAF.
3. The maximum stage at Bonners Ferry for the VARQ flood-control only simulations had to be between 1757 and 1765 feet. The low end of this range was selected as 1757 feet because groundwater seepage into agricultural areas may occur near that river stage. The high end of 1765 feet was selected because it is slightly above flood stage at Bonners Ferry of 1764 feet.

Each of the ten years also met at least one of the following criteria:

1. The forecast representing the April through August Libby inflow volume (as issued in May) had to be over-forecasted by at least 1 MAF or under-forecasted by at least 1 million acre-feet (MAF). This way, the impact of forecast errors could be assessed.
2. The Initial Controlled Flow at The Dalles had to be reached early enough so that refill was initiated in April (considered early), or late enough so that refill did not begin until after 15 May (considered normal to later than normal).
3. The average June, unregulated flows at The Dalles had to be greater than 625 kcfs – thereby indicating a large, late freshet.
4. In the daily time-step sixty-year system simulations where the system was operated for the single purpose of flood control, the draft at Grand Coulee Dam had to be at least four feet deeper with VARQ FC than with Standard FC.

Sixty-one years (1929-1989) were narrowed down to ten by using the above criteria. However, even though 1942 met the screening criteria, it was not chosen because it was a low volume year with minimal flood control draft at Grand Coulee Dam and an initial control flow less than 220 kcfs. The criteria and the actual years selected are summarized in Table 4:

Table 4. Years to be modeled for flood control simulations with fish flows

Criteria	1933	1948	1949	1955	1968	1971	1975	1981	1986	1989
Forecast* less than 8.0 MAF	X	x	x	x	x	X	x	x	x	X
Forecast* greater than 4.8 MAF	X	x	x	x	x	X	x	x	x	X
Bonners Ferry stage 1757-1765 ft	X	x	x	x	x	X	x	x	x	X
Forecast* at least 1 MAF lower than obs.		x			x	X		x		
Forecast* at least 1 MAF higher than obs.			x				x			
Refill begins before 1May			x							X
Refill begins after 15May	X			x					x	
June flow at the Dalles > 625kcfs	X	x				X				
Difference in GCL draft at least 4 feet			x	x				x	x	X
* Volume forecast for Libby Dam issued in month of May										

5.1.2.1.3.1. 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.

If the 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 minimum release of 4,000 cfs from Libby Dam is not included in the accounting of sturgeon water.

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

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 total dissolved gas (TDG). However, the 35,000 cfs sturgeon flows were modeled because this was the flow recommendation in the USFWS 2002 BiOp. A release of this magnitude may require installation of additional generating unit(s).

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. 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.

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. In cases where the steady outflow operation called for a lower discharge than the minimum bull trout flow, the minimum bull trout flow was provided.

5.1.2.1.3.2. 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 16). 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.

5.1.2.1.3.3. Libby Dam Outflows

Figure 17 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).

5.1.2.1.3.4. 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 18). In 1948, the modeled peak daily and sustained stage at Bonners Ferry exceeded 1764 feet for VARQ FC with fish flows.

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 19). 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.

5.1.2.1.3.5. 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.

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 20 shows the percent of time that dissolved gas levels were above 100% saturation, assuming that the TDG measurement was immediately downstream of the spillway.[18] 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%.

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

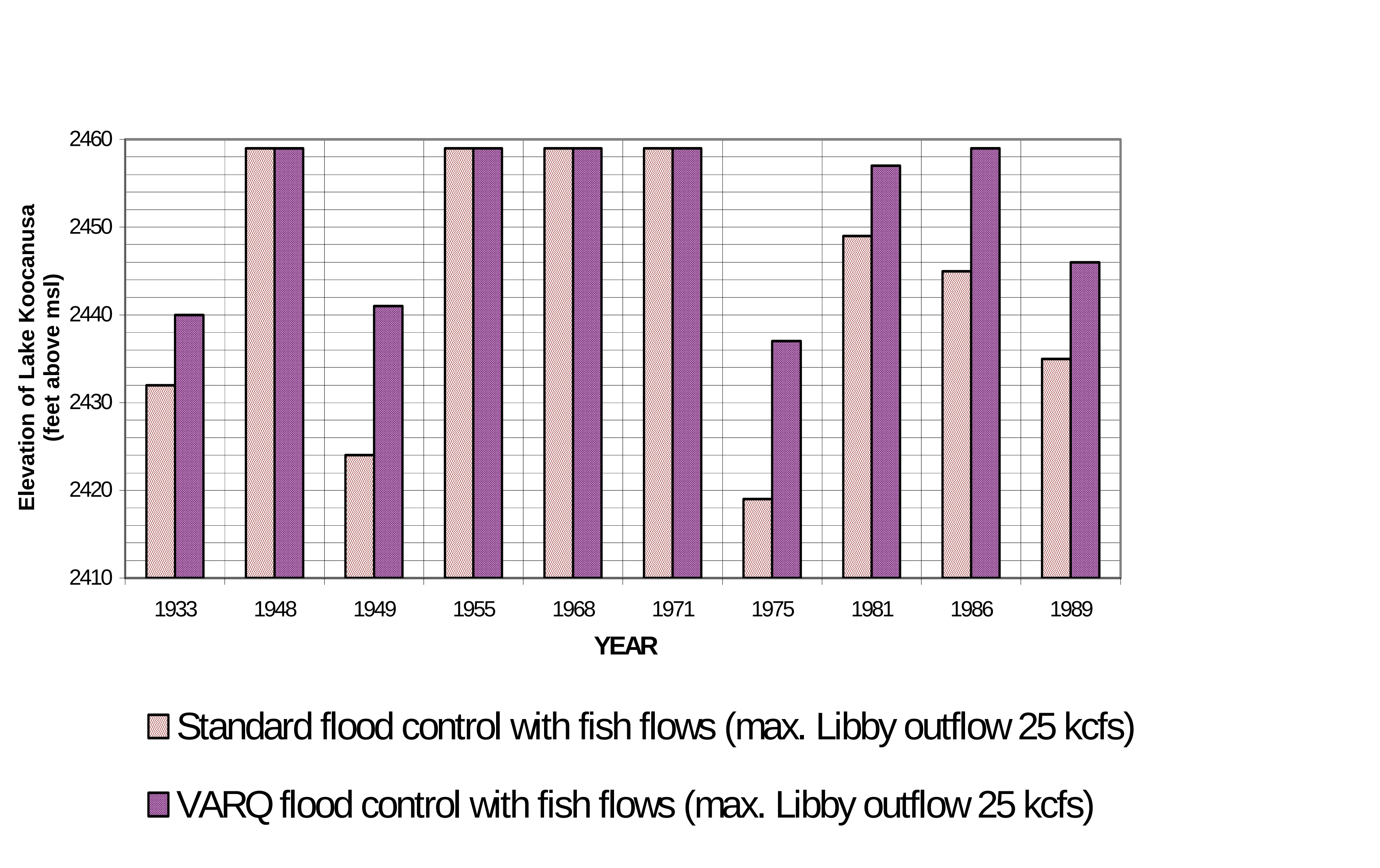

Figure 16. Modeled Maximum Daily Elevation of Lake Koocanusa with Flood Control and Fish Flows Only

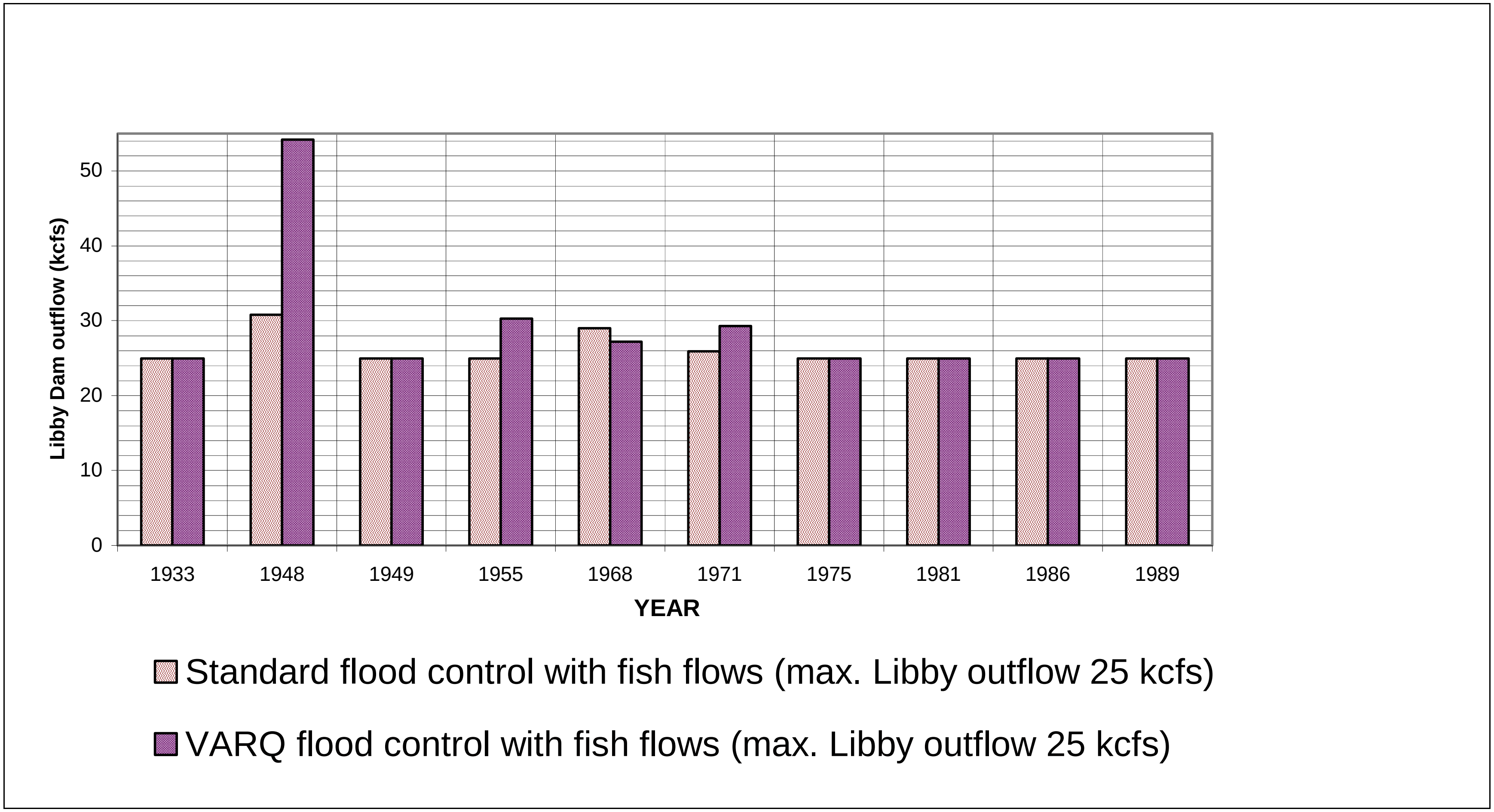

Figure 17. Modeled Maximum Daily Outflow from Libby Dam (May-July) with Flood Control and Fish Flows Only

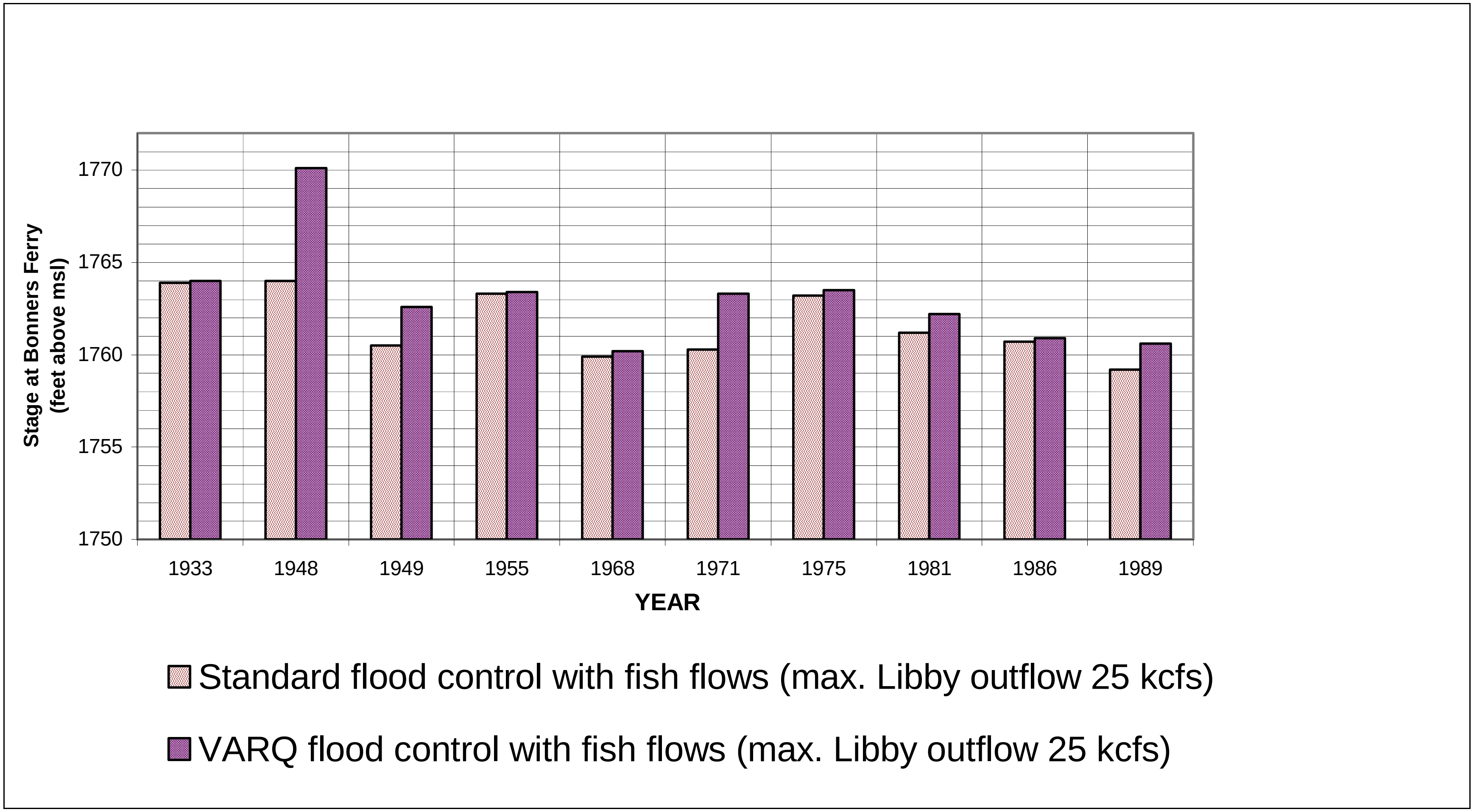

Figure 18. Modeled Maximum Daily Stage at Bonners Ferry (May - July) with Flood Control and Fish Flows Only

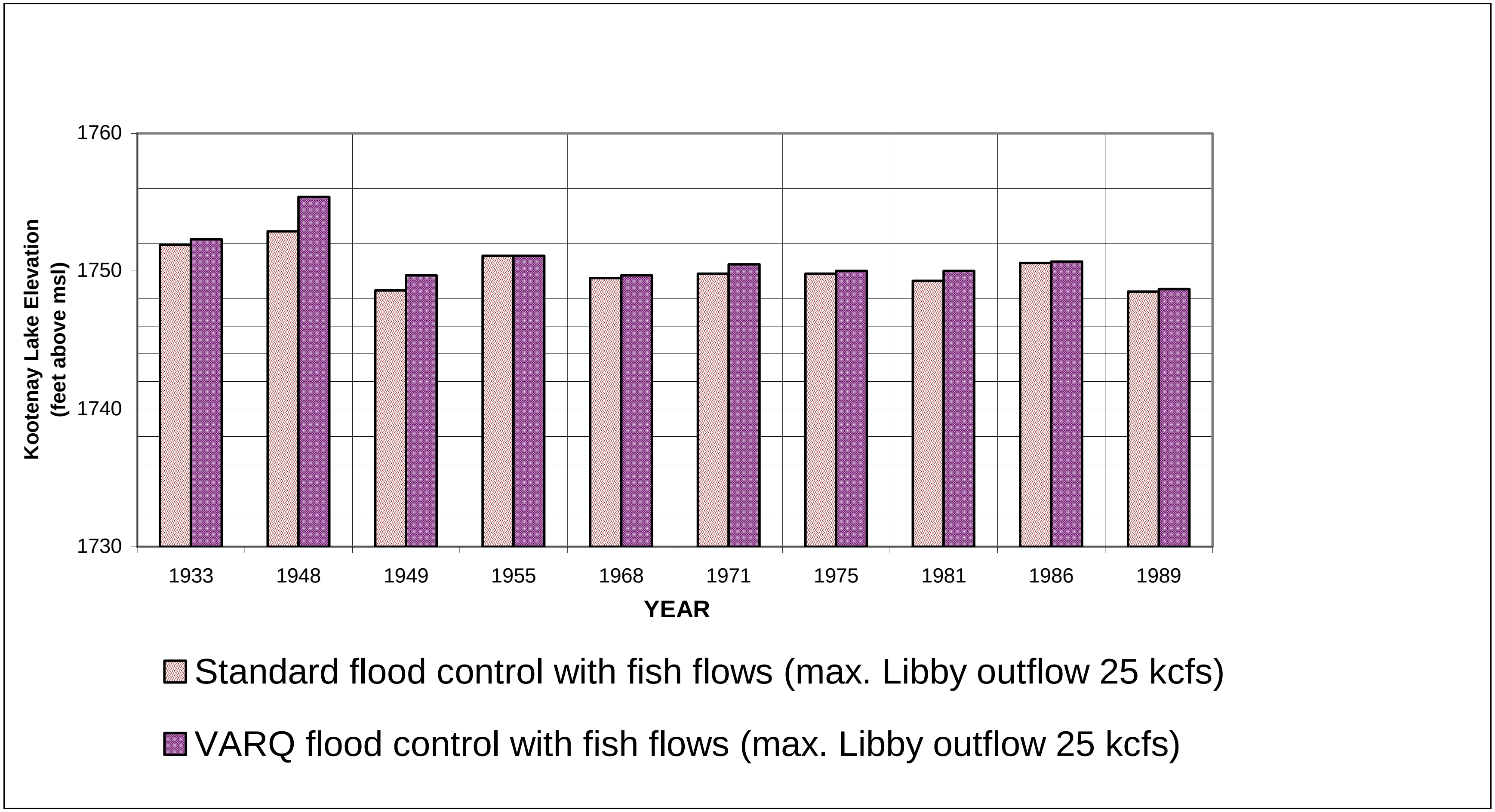

Figure 19. Modeled Maximum Daily Elevation of Kootenay Lake (May-July) with Flood Control and Fish Flows Only

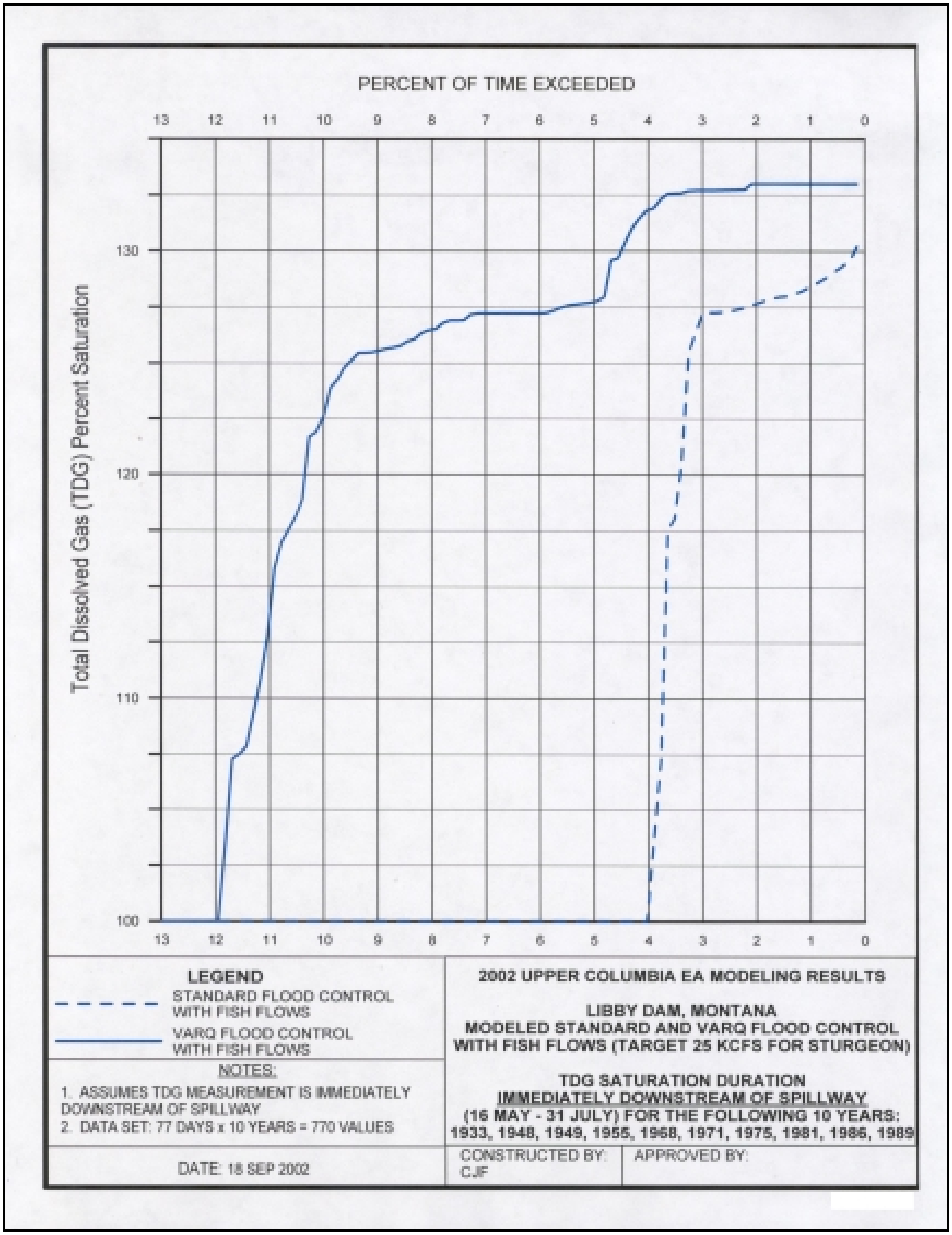

Figure 20. TDG Saturation Duration Analysis: Immediately Downstream of Libby Dam Spillway

5.1.2.1.4. 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 model sixty monthly time step models using the HYSSR model. This model develop 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 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 5.1.2.1.3.1 above. In these scenarios Libby filled more by the end of June when VARQ FC was used than it did when Standard FC was used. The additional storage amount available on June 30 may 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 below.

Generally there is more storage in Libby at the end of June if the project operates to the VARQ in the January through April period. The additional storage 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 Libby does not refill to elevation 2439 feet by the end of June, however when VARQ FC SRD evacuation is followed, there are more years when Libby refills above elevation 2439 feet by the end of June.

Table 6 shows the difference in storage 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.

5.1.2.1.5. 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.

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. Measurements of groundwater quality in 2002 occurred during Libby Dam discharges as high as 40,000 cfs. Since dam discharges for fish flows under both of the alternatives would not exceed 26,000 cfs,[19] it is reasonable to conclude that none of the alternatives will have an adverse effect on groundwater.

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

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)	2,442	5,137
	80.8 to 96.9 MAF (12 years)	2,436	4,880
	97.1 to 113.5 MAF (20 years)	2,430	4,621
	113.7 to 156.1 MAF (19 years)	2,428	4,547
	AVERAGE	*2,432*	*4,726*
VARQ FC	53.5to 79.2 MAF (8 years)	2,447	5,338
	80.8 to 96.9 MAF (12 years)	2,443	5,163
	97.1 to 113.5 MAF (20 years)	2,442	5,144
	113.7 to 156.1 MAF (19 years)	2,440	5,036
	AVERAGE	*2,442*	*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*

5.1.2.2. 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 is well documented. In this 60-year period four significant spring floods occurred, 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.

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, FC, and fish operations, additional studies were conducted using operating criteria based on the Pacific Northwest Coordination Agreement (PCNA). 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 power modeling also considered spill at federal projects for fish based on the NMFS 2000 FCRPS BiOp (NMFS, 2000a). Results from the power studies are discussed in relation to Lake Roosevelt drafts and Priest Rapids and McNary flow targets since the power and fish operations are likely more representative of actual operating impacts on these parameters.

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, the VARQ FC tend 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. 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-normal runoff conditions at Libby Dam.

Compared to Standard FC, 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, 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, the VARQ FC tend 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, 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 one-% exceedance. This feature reflects the gradual merging of VARQ FC and Standard FC at both Libby and Hungry Horse for above normal 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 increase of 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 21 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 negligible in the context of total flow at The Dalles.

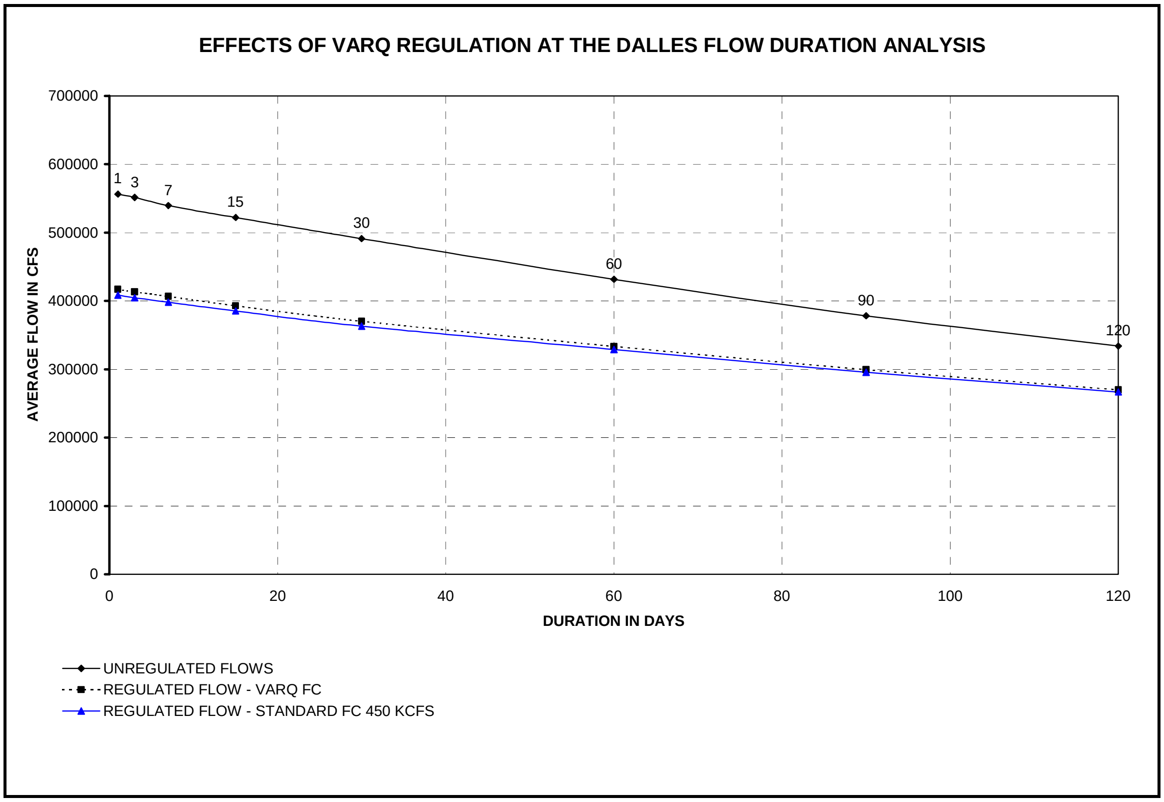

Figure 21. Flow Duration Analysis at The Dalles

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

Figure 22 and Figure 23 demonstrate respectively the effects of VARQ FC on the distribution of flows at The Dalles for two notable floods, 1948 and 1974. 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. 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 normal 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 are also depicted in Figure 22 and Figure 23 for respectively the 1948 and 1974 floods.

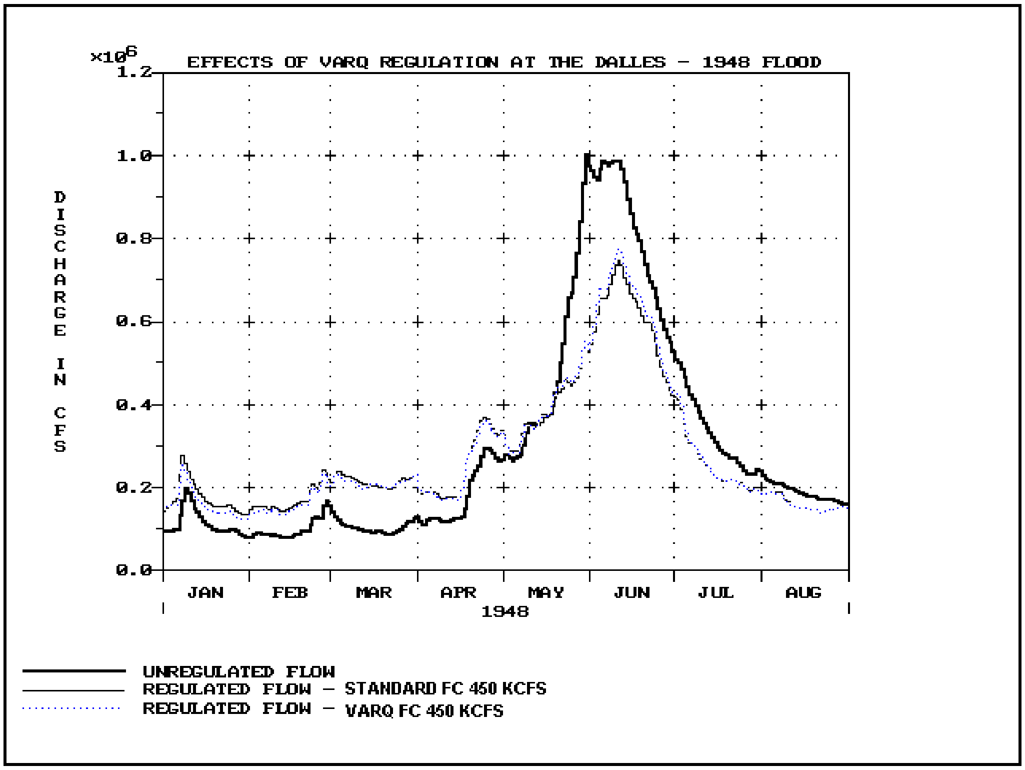

Figure 22. 1948 Flood Hydrograph at The Dalles

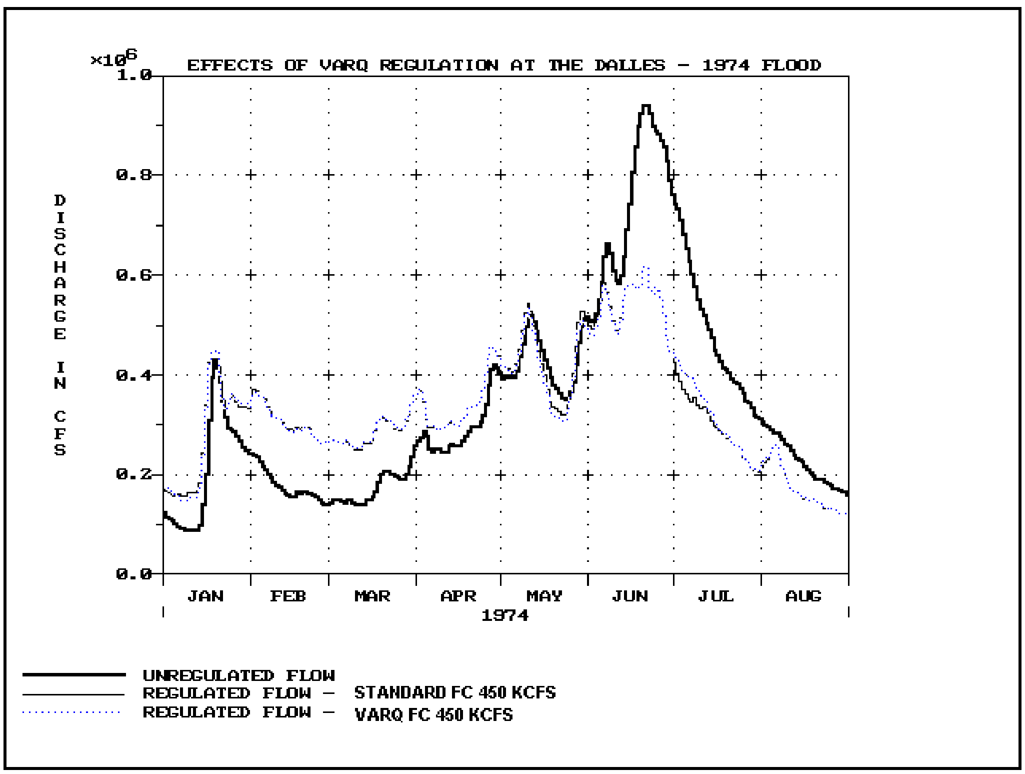

Figure 23. 1974 Flood Hydrograph at The Dalles

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 24 is the stage frequency curve for Vancouver, WA 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 five%.

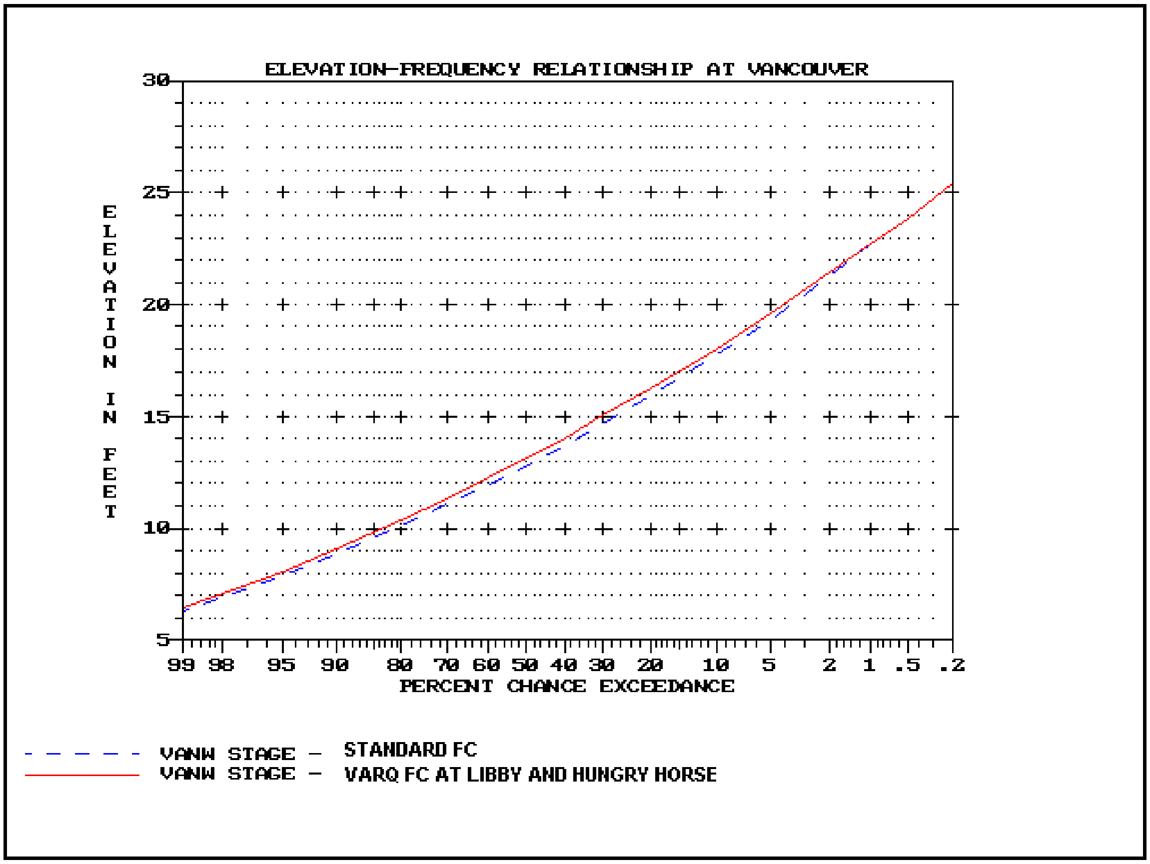

Figure 24. Stage Frequency Curve for Vancouver, Washington

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 ESA listed 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, 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 drafted to elevation 1220 feet on 30 April (63 feet below flood control) for power generation and endangered species. The flood control needs at Grand Coulee were dwarfed by the needs for power and salmon. The VARQ FC operation at Hungry Horse had no effect on Grand Coulee in 2001.

Compared to Standard FC alternatives, VARQ FC would generally result in higher flood control releases and slightly lower reservoir pool levels during the spring flood control draft in normal 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 25, 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 26).

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

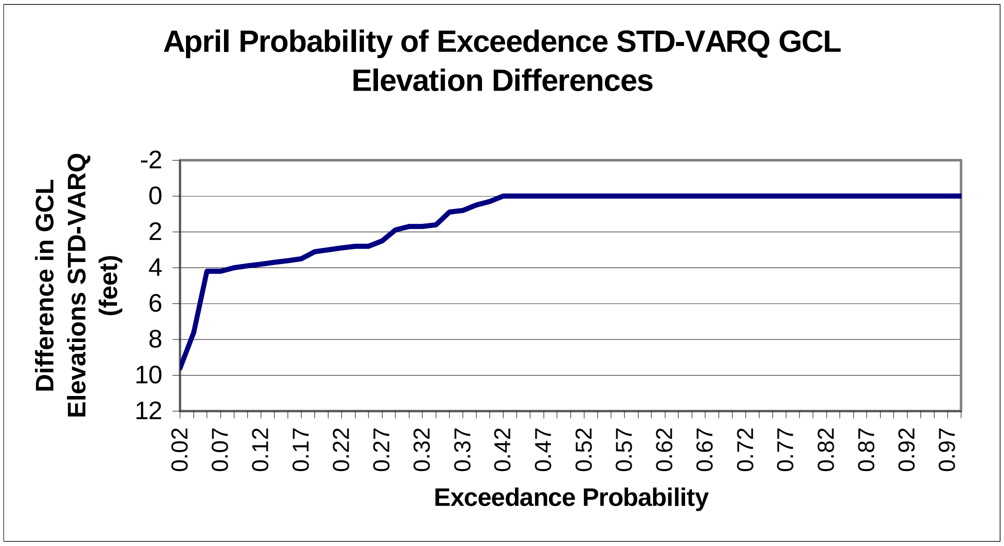

Figure 25. April Grand Coulee Dam/Lake Roosevelt Elevation Differences

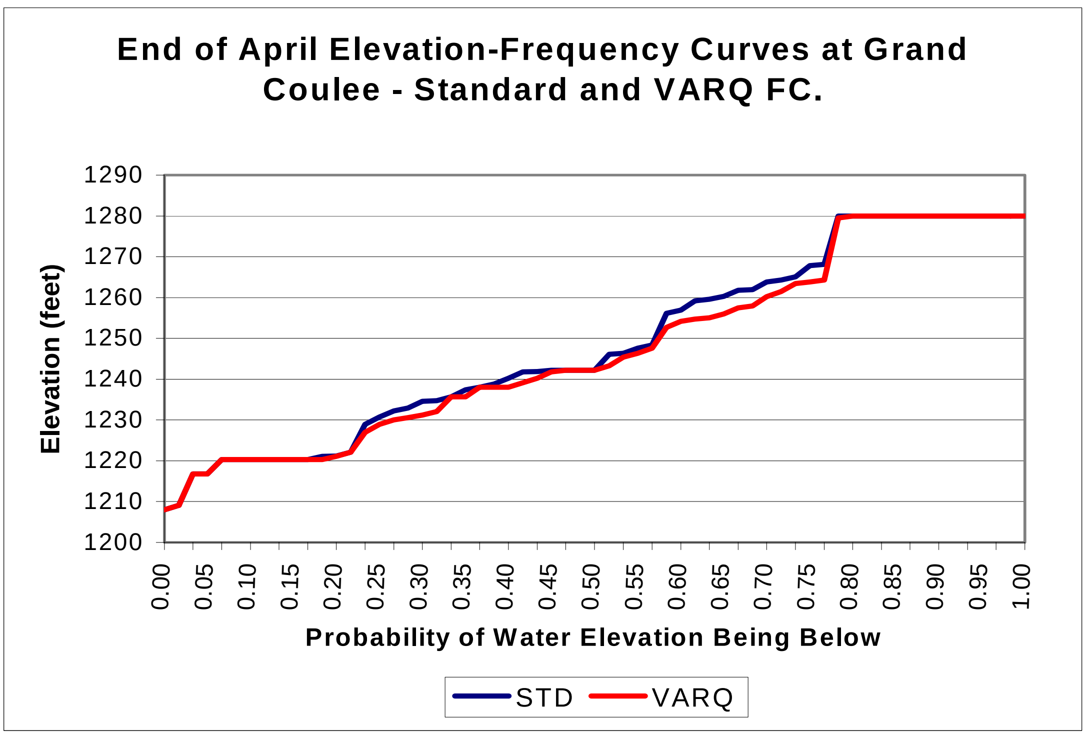

Figure 26. End of April Elevation-Frequency Curves at Grand Coulee/Lake Roosevelt

5.1.2.3.11. Flow at Priest Rapids Dam

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. Standard FC with fish flows and VARQ FC with fish flows provide the same likelihood of meeting the flow target in April and May (Table 8). VARQ FC slightly increases the chance of meeting the flow target in June (Table 8).

Table 8. Number of Years Out of the 59-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 9) between the two flood control methods with fish flows are negligible, with a maximum difference in monthly average of 1,300 cfs (about 1% of the flow objective of 135 kcfs).

Table 9. 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.

5.1.2.3.12. Flow at McNary Dam

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 McNary flow objective from July through August is 200 kcfs. Compared to Standard FC with fish flows, VARQ FC with fish flows slightly increases the chance of meeting the flow targets in May, June, and July (Table 10). In April and August, both Standard FC and VARQ FC have the same likelihood of meeting the flow target (Table 10).

Table 10. Number of Years Out of 59-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 11) between the two flood control methods with fish flows are negligible, with a maximum average difference of 2,400 cfs in August (no more than 1% of the lowest possible flow target).

Table 11. 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.

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 will there be any appreciable change in the temperature regime below Libby Dam because releases from the dam are temperature controlled.

Under the no-action alternative, no spill would be required for benefit of sturgeon. For the other alternative, 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 110%. Such a low spillway flow does not have adverse effects on water quality since TDG levels at that spill flow would not likely exceed 110%. Typically, TDG levels at or below 110% are not considered harmful of aquatic life or water quality.

Compared to the no-action alternative, VARQ FC appears to increase the likelihood of a 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. Compared to Standard FC with fish flows, VARQ FC with fish flows appears to increase the number of days where 110% TDG would be exceeded (from 3.7% to 11.2% of days between May 16 and July 31 for the 10 years modeled with fish flows). This equates to about 9 additional days when 110% TDG supersaturation would be exceeded under VARQ FC with fish flows. Since only 10 years where modeled with fish flows, the results may overstate the increase in TDG risk from involuntary spills. Modeling the full period of record would likely indicate that VARQ FC with fish flows increase the TDG risk but not by 3 times.

Adverse effects that might occur from this level and duration of exposure are difficult to quantify. Research on fish on the Columbia River mainstem indicates that symptoms of gas bubble disease in some fish are likely as TDG levels approach 120%. 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 saturation 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.” Under VARQ FC, the likelihood that fish will experience adverse effects from TDG supersaturation increases. Observations during the prolonged 2002 spill events documented a high incidence of gas bubble disease symptoms.

Although the monitoring did not document fish mortality in resident fish,[20] it is likely that some level of adverse effects occurred due to unobserved mortality, delayed onset of disease, or cumulative effects of injury such as cataracts caused by gas bubbles in the eyes. However, levels of spill that generate harmful levels of TDG will not happen in most years, so impacts of elevated TDG would be sporadic enough to allow organisms to recover between large spill events. For example, spill occurred in 4 (1948, 1955, 1968, and 1971) out of 10 years modeled for VARQ FC with fish flows 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 the maximum outflow from Libby Dam compared to Standard FC with fish flows).

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 in more detail 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 Standard FC alternatives, Lake Koocanusa elevations will be lower than the VARQ FC alternative, and sediments in the drawdown zone will be exposed more often. These sediments, particularly in the northern part of the reservoir, can become airborne during high winds. While human exposure to sediments is likely increased for the Standard 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 than Standard FC with fish flows between March and May. The greatest differences occur in April

[20] Mortality was observed for kokanee, most likely originating in Lake Koocanusa, entrained through the powerhouse or spillway.

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 25). 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 GCL 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 Existing Conditions Section). 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 wind storm 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 the year 2006.

5.2. Natural Resources

5.2.1. Vegetation

5.2.1.1. Libby Dam

Compared to Standard FC alternatives, VARQ FC would provide reduce annual fluctuation of Lake Koocanusa in normal to slightly-below-normal water years. Since reservoir operation under both VARQ FC and Standard FC is similar in more extreme water years, vegetation established during normal 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.

5.2.1.2. Hungry Horse Dam

VARQ FC at Hungry Horse does not appreciably affect vegetation 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 compensate for reduced flood control space behind Libby and Hungry Horse dams, thereby providing the same level of overall system FC. 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 will provide flows that will 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 minimum 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, but the risk under the Standard FC alternatives would be 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 maximum potential Libby Dam discharge, 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.

Fish entrainment through the powerhouse and the spillway is not expected to substantially change as a result of routine operation of the dam under both of the alternatives. However, since VARQ FC with fish flows increases the likelihood of involuntary spill andit 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 increasing the average size and health of 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.

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. 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 proposed long-term VARQ FC operation.

5.2.2.2. Hungry Horse Dam

As with Libby Dam, VARQ FC promotes higher and more stable reservoir elevations which should benefit fish in the reservoir. Fish in the Flathead River downstream of Hungry Horse Dam benefit from more reliable minimum flows during the spring and summer.

Releasing water from Hungry Horse Reservoir in August for Columbia River salmon deviates from natural conditions for the Flathead 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. 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 proposed long-term VARQ FC operation.

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 could further reduce spawning success to a small degree for smallmouth bass, yellow perch, and shoreline spawning kokanee already impacted by spring flood control drafts under Standard FC. The increase in drafts most probable 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.

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 productive littoral zones are exposed. The relatively small increases in drawdown are unlikely to cause major reductions in food availability and fish growth rates in Lake Roosevelt as a whole. There is no evidence that spring drawdowns affect white sturgeon 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 12). 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 12. 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 predators (such as eagles, osprey and furbearers) on fish may benefit, but it is not clear that these species are food-limited, so the benefit to their populations may be slight.

Higher water levels resulting from springtime sturgeon flow augmentation could inundate waterfowl nests in the Creston Valley Wildlife Management Area in the Kootenay River delta at the south end of Kootenay Lake in Canada. Species affected may include Canada geese, mallards, red-necked and western grebes. Nests are established in the early spring and the incubation season goes through early summer. 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.

5.2.3.2. Hungry Horse Dam

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

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 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 2000 USFWS 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 normal to below-normal runoff. Provision of water to augment flows during the sturgeon spawning period is a lynchpin 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. Base flows at Bonners Ferry were near 40,000 cfs when sturgeon last produced a significant year class in 1974. VARQ FC would more reliably provide more water for sturgeon to approach the 40,000 cfs flow at Bonners Ferry that is targeted in the USFWS 2000 FCRPS BiOp (USFWS, 2000). 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 no young-of-the-year sturgeon have 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 resulted in capture 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.

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 normal to below-normal 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

All of the alternatives provide bull trout flow 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 normal to slightly below normal 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 5.2.2.1, 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 fiscal year 2005 and, if such entrainment is substantial, to explore ways to reduce bull trout entrainment.

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 Reclamations 2000 voluntary EA for details of the effects on bull trout resulting from 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 near 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 is not likely to have any effect on bull trout that may inhabit Lake Roosevelt.

5.2.4.3. Bald Eagle

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 during certain parts of the year, 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.

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.

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 normal to slightly-below-normal 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 in an attempt to meet summer flow objectives recommended in the NMFS 2000 FCRPS BiOp (NMFS, 2000a).

The flow objective at McNary Dam on the Columbia River is 200 kcfs from July 1 to August 31. 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 also evaluated (see Paragraphs 5.1.2.3.11 and 5.1.2.3.12).

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.

At McNary Dam, VARQ FC with fish flows results in slightly higher flows than Standard FC with fish flows and a salmon draft at Libby Dam to 2,439 feet. Compared to Standard FC with fish flows and a salmon draft at Libby Dam to 2,439 feet, 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.

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 a salmon draft to 2,439 feet at Libby Dam, bringing the system closer to the flow target.

When averaged over the fish migration season at McNary (April 10 through August 31), VARQ FC with fish flows would provide an average of approximately 2,400 cfs more flow at McNary than Standard FC with fish flows that limit the salmon draft at Libby Dam to 2,439 feet. In August, when Libby and Hungry Horse Dams draft to provide water for salmon flow augmentation, VARQ FC with fish flows results in up to 10,000 cfs more flow at McNary Dam than the Standard FC alternative with fish flows that limit the salmon draft at Libby Dam to 2,439 feet.

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 a salmon draft to 2,439 feet at Libby Dam, 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 normal to slightly-below-normal runoff forecast. Quantification of the potential benefit of VARQ FC for burbot is not possible at this time, but, compared to the Standard FC alternatives, VARQ FC appears to have promise in lowering winter flows to the benefit of Kootenai River burbot migration and spawning.

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.

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*

In the scenarios described in Table 13, Libby Dam operated 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. 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 operated to be at elevation 2,411 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 reduce flows to the extent that burbot successfully spawn. Additionally, operations to benefit burbot, combined with VARQ FC, would likely reduce the real-time operational flexibility of Libby Dam water management, which could, if weather or other circumstances combine in inopportune ways, reduce refill probability or increase flood risk. 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.

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, which extends 90 miles upstream from Libby Dam on the Kootenai River. The first 48 miles are located in northwestern Montana. The northern 42 miles extend into the Canadian province of British Columbia.

5.3.1.2. Lake Koocanusa

At this time analysis cannot separate effects of current routine reservoir operations from potential effects of VARQ proposed operations. 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 proposals 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. 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 of 80% to 120% projected run-off (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 3456 and 3560 feet.

This EA will compare the differences in impacts to cultural resources at Hungry Horse using standard FC and VARQ FC, since the other alternative components do not affect the operation of Hungry Horse reservoir.

5.3.2.2. Hungry Horse Reservoir

For the purposes of cultural resources management, Standard FC is equivalent to 'No Action' and would not affect the 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 3336 to 3560 feet, with an average winter draft, with power drafts, to 3500 feet. Under VARQ FC, the average maximum draft will rise from 3528[21] to 3535 feet during January through May. The reservoir will continue to refill to 3560 feet by the end of June. This changes the proportion of time that sites from 3520 to 3540 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 27). It is expected the affects 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 analysed under the EIS under preparation.

[21] The modeled average draft of 3528 feet is higher than the historic 3500 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.

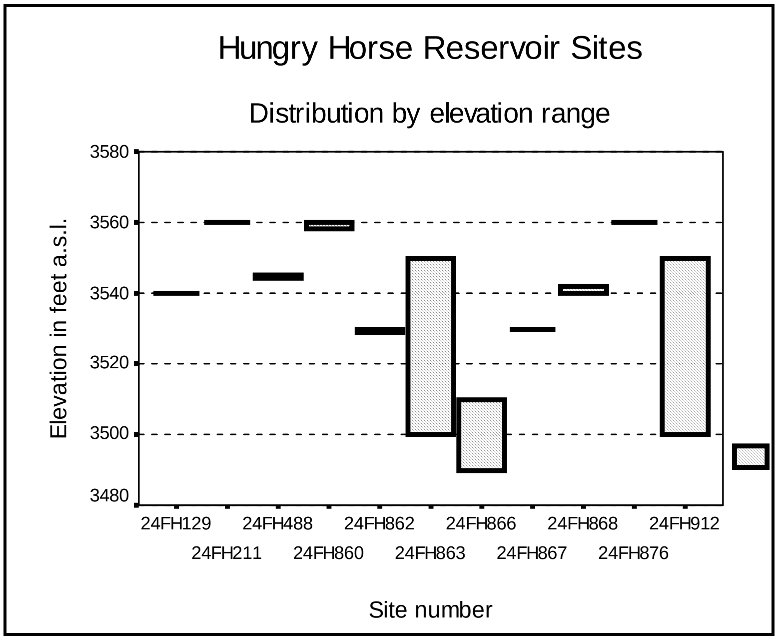

Figure 27. Elevation Distribution of Historic Sites at Hungry Horse Reservoir

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.

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 Confederated Salish and Kootenai Tribes include all the primary tribes historically associated with the area around the Hungry Horse reservoir. The schedule of this Environmental Assessment does not allow Reclamation to obtain information from consultation with these tribes in time to include it here. 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. The first consultation meeting with these tribes is scheduled for November 13, 2002.

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 normal run-off), or dry winters (below 80% of normal 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 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% 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.

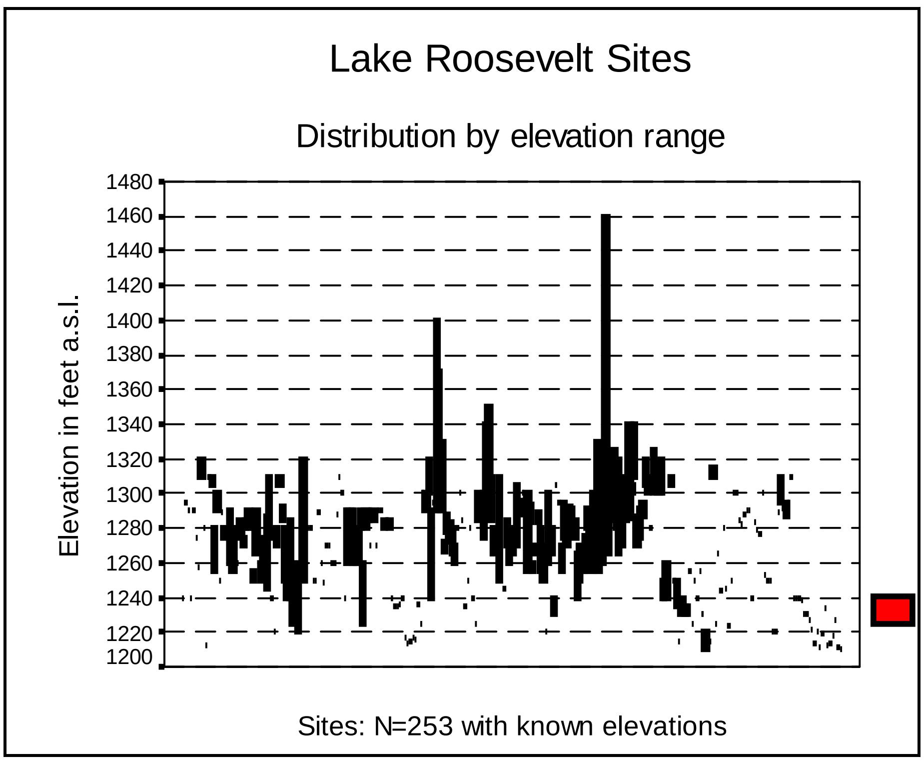

Figure 28. Elevation Distribution of Historic Sites at Lake Roosevelt

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 1,030 and 1,160 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.

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 1,030 and 1,160 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 11/5/02 in Nespelem, WA. The Colville'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 USBR coordinate with the Corps of Engineers 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 USBR, 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 took place on September 18, 2002. During the meeting, the STI Tribal Historic Preservation Officer expressed strong concern with the NEPA process and said that Section 106 consultation has been compromised by accelerated scheduling (see Section 5.3.3.2 above). To date, he has not received direction from the Spokane Tribal Council regarding the continuation of Section 106 consultation with Reclamation. The schedule of this Environmental Assessment does not allow Reclamation to obtain further information from consultation with the Spokane tribe in time to include it here. 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 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, based on the ten year modeling analysis, groundwater seepage due to higher river elevations under VARQ FC for fish flows would probably increase relative to Standard FC. 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. In the average year, compared to pre-fish-flow conditions, fish flows increase adverse affects to Kootenai Flats farmers by approximately $515,000 (Harp, 2001).

The ten year modeling studies at this point show that the river stage at Bonners Ferry is higher for VARQ FC than for Standard FC during the May to July period (see Section 5.1.2.1.3.4). Actual water levels would likely be managed to lower stages than shown in the model results. Nevertheless, applying the existing modeling results, agricultural damages under the VARQ FC operation are likely higher than those that would occur under Standard FC because the ten year modeling results indicate that river stages that are higher for longer periods of time under VARQ FC.

The precise relationship between actual real-time dam operations and river stage and duration is not presently known. Additional hydrologic modeling will likely be done using updated forecasting methodology that will attempt to more realistically predict the Bonners Ferry river stage. Additionally, ongoing groundwater monitoring in the Kootenai Flats area will better quantify how river stage affects groundwater and agricultural seepage. Using the results of the updated hydrologic modeling and the groundwater modeling, groundwater modeling will allow better quantification of seepage relating to different river stages and durations. These studies are being conducted to ascertain the effects of dam operations on river flows and agricultural seepage for the EIS for long-term decision making.

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 5.1.2.1.2) shows Flood stage of 1,764 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 14). 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 of 1,770 feet in 1948, while Standard FC with fish flows results in a peak Bonners Ferry stage of 1,764 feet. Modeling of 1948 represents a worst-case-scenario for a rare event. VARQ FC with fish flows appears to increase the risk of flooding magnitude and severity along the Kootenai River, particularly if early season runoff volume forecasts substantially underestimate the actual runoff volume.

Use of more conservative forecasting methods 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, in part because 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.

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, river stages in excess of flood stage would be higher for longer duration with VARQ FC. In more normal 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 those years are not anticipated.

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 Columbia River Treaty Flood Control Operating Plan (FCOP) states that "damage commences at Nelson when Kootenay Lake reaches elevation 1755 feet and major damage stage is elevation 1759 feet" (COE, 1972). However, damage now appears to begin around elevation 1750 feet due to development along the shores of Kootenay Lake. Compared to Standard FC, the results of the hydrologic modeling show that the probability of exceeding 1750 feet does increase under VARQ FC. Relative to Standard FC, VARQ FC increases the likelihood of reaching 1,750 feet from about 18% to about 28% in any given year. Looked at another way, VARQ FC appears to increase the lake elevation by about 2 feet in any given year, even at lake elevations above 1,750 feet.

Although the hydrology modeling indicates that there is almost no difference between the two flood control procedures in influencing the duration of lake levels higher than 1750 feet, due to encroaching development along Kootenay Lake, the increased likelihood of exceeding 1,750 feet lake elevation will lead to increased flood hazards and damages under VARQ. The economic value of the damages related to VARQ FC will be further quantified 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 5.1.2.2).

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.

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 VARQ FC maximum lake elevation is always higher with VARQ FC than with Standard FC (see Section 5.1.2.1.3.2 for details). Accordingly, VARQ FC increases the reliability of usable pool elevations during summer for marina operators. Figure 16 (on page 55) 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 2,459 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 where 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.

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, particularly in late summer when water is released from Libby for salmon flow augmentation, 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 by not drawing the reservoir down as far in winter, and thus better assuring refill. Thus, VARQ FC might make the river less usable to boaters and fishermen in spring. VARQ FC would also result in salmon flows being provided in more years, thus making the river less accessible to boating in the late summer during those times.

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 2,439 feet by August 31. 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. 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, 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 this lake level fluctuations under both of the alternatives are within the established operating range for Kootenay Lake.

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 1,225 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. HYSSR is a FORTRAN model with a monthly time step. There are 14 periods, one period for each month except April and August, which are split in half months. Model runs of the multi-purpose Columbia River system operation cover a 59-year period covering October, 1928 through September, 1987. The multi-purpose model runs considered different flood control alternatives,[22] hydropower operations,[23] fish operations of Columbia and Snake River projects,[24] and Canadian Treaty project operations.[25] 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.

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.

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[22] 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.

[23] 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 will be the load used for all 59 years. The regulation will include unlimited secondary generation.

[24] 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.

[25] Canadian Treaty projects, Mica, Duncan and Arrow, will 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 59-year DOP Treaty Storage Regulation.

5.4.6.1.2. Study Results

Compared to Standard FC, VARQ FC results in an average annual increase in system power generation of 8 average annual MW, a negligible difference. VARQ FC redistributes monthly power generation, with losses in generation in January, February, and April and gains in other months. 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 loss of approximately 5%.

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 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 15. 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 15. Number of Years out of 59 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 16. The FELCC is also shown in Table 16. If FELCC is not met in a month, VARQ FC tends to result in missing FELCC by a larger amount than Standard FC.

Table 16. 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 negligible change in annual generation between VARQ FC and Standard FC (Table 17).

Table 17. 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.

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 to 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 proposed 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.

The intent of this environmental assessment is to address the requirement to implement VARQ at Libby by 2001, 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 to 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 dissolved gas standards to benefit sturgeon reproduction in the Kootenai. Spill test data from 2002 at Libby indicate limited capacity to use the spillway without modification, but at present, this is the only means to increase outflow capacity without further study and physical modifications to the dam. The alternatives in the EA account for that in their characterization of maximum outflow at 26,000 cfs, which, again, is based on spill results.

6.3. Upland Land Uses

Upland land 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.

Encroachment of development into floodplain areas has occurred in certain areas. For example, while the 1938 IJC agreement allows Kootenay Lake elevations up to 1,755 feet, encroaching development now results in flood damages when the lake elevation exceeds 1,750 feet. Such development limits the flexibility in dam operations.

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 used to pose any threat when the levees where in good condition. With VARQ FC, river levels will likely be higher on a more frequent basis. Poorly maintained levees and lands they used to protect may be adversely affected by the increased river levels even if the river does not reach the official flood stage.

6.4. Duck Lake

Duck Lake project is in British Columbia about 20 miles north of the B.C.-Idaho border. It 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 dykes. The exterior dykes that isolate Duck Lake from the Kootenay River and Kootenay Lake have a crest elevation 1,766 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 1,748 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 dyke 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.

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 is expected to 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 will be approximately a 40% increase in average annual pumping cost to the Creston Valley Wildlife Management Authority.

7. IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF RESOURCES

No federal resources would be irreversibly and irretrievably committed to the changes in dam operations until this Environmental Assessment 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 and salmon draft to 2,439 feet 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 insure such actions adequately address "environmental consequences, and take actions that protect, restore, and enhance the environment". This assessment 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. 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 draft EA will be issued on November 13, 2002, for a 30-day review period that will close on December 13, 2002. Comments will be addressed in the final EA which is scheduled to be available by December 31, 2002.

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 2000 NMFS and USFWS 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.[26] 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

[26] 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.

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.

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 and VARQ FC with fish flows . Dam operations that include voluntary spill for fish will be coordinated with the State of Montana and comply with 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 both 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 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 wich 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.

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APPENDIX A

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

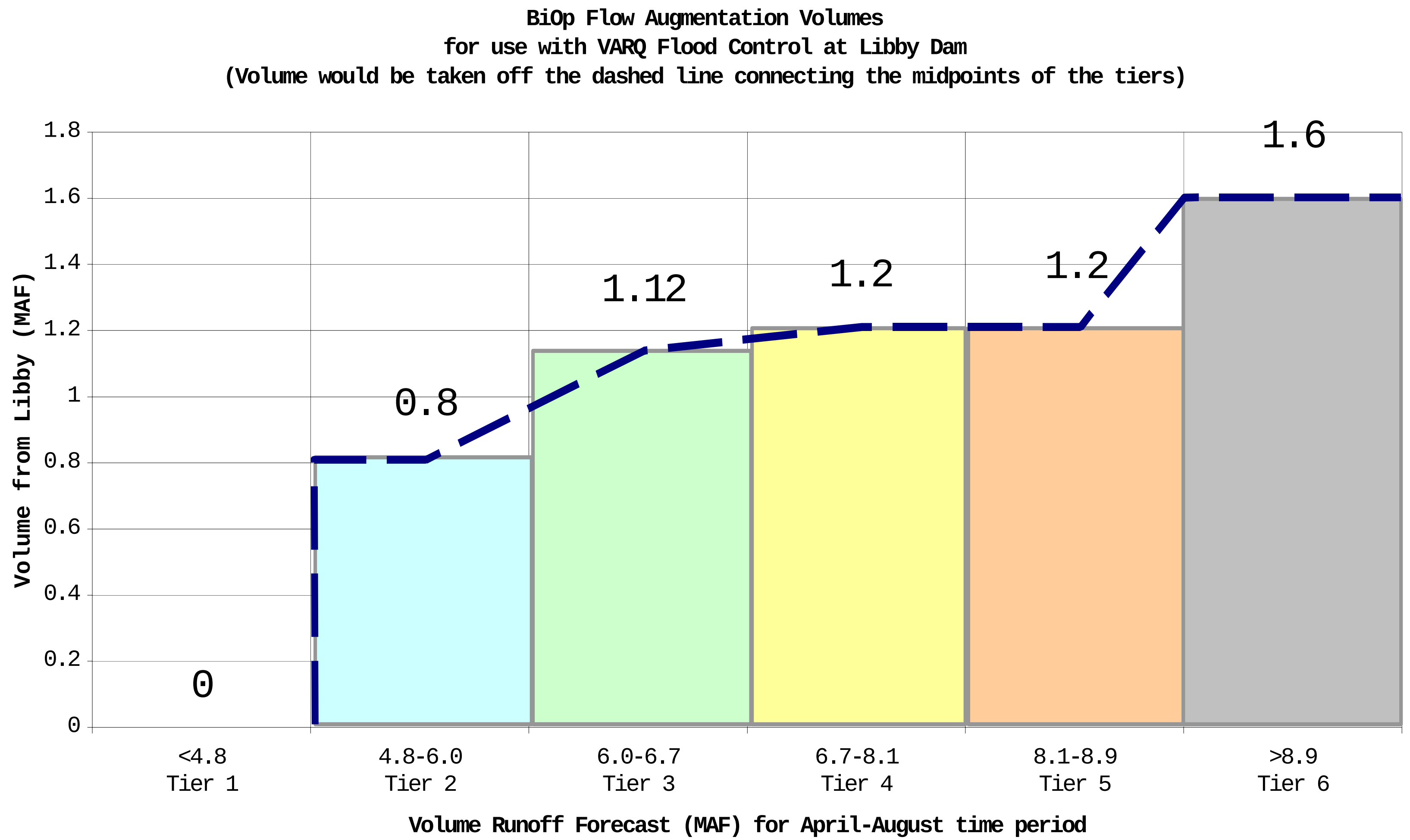

Figure A-1. Volumes to be provided for Sturgeon from Libby Dam/Lake Koocanusa

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 2,439 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

Hungry Horse Minimum Flows: 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.

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