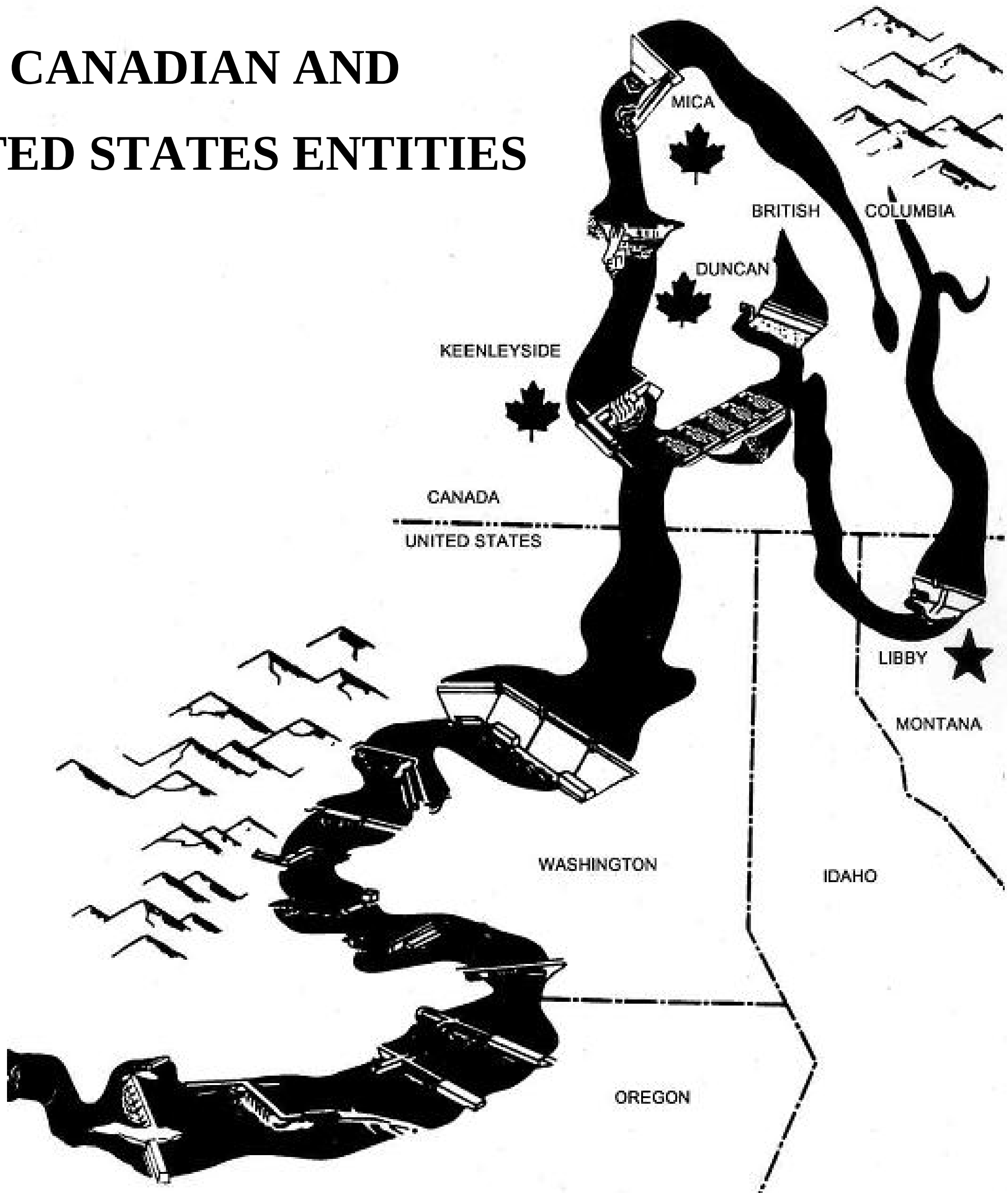
# ANNUAL REPORT

## OF THE

## COLUMBIA RIVER TREATY

## CANADIAN AND

## UNITED STATES ENTITIES




**FOR THE PERIOD**

**1 OCTOBER 2007 – 30 SEPTEMBER 2008**

**Revised 6 February 2009**

**for corrected metric values in Executive Summary,**

**System Operation, Table 5, and**

**numerous format problems.**

## For any feedback and comments:


Barbara D. L. Miller, USACE
Barbara.d.miller@usace.army.mil

Anthony G. White, BPA
agwhite@bpa.gov

Doug A. Robinson, BC Hydro
Douglas.Robinson@bchydro.com

# EXECUTIVE SUMMARY

## General

The Canadian Treaty projects, Mica, Duncan and Arrow were operated during the 1 August 2007 – 30 September 2008 reporting period according to the 2007-08 and 2008-09 Detailed Operating Plans (DOPs), the 2003 Flood Control Operating Plan (FCOP), and several supplemental operating agreements described below. The Libby project was operated according to the Libby Coordination Agreement (LCA) dated February 2000, including the 21 April 2006 update to the Libby Operating Plan (LOP), and U.S. requirements for power and guidelines set forth in the U.S. Fish and Wildlife Service (USFWS) and U.S. National Marine Fisheries Service (NMFS) 2000 and 2004 Biological Opinions (BiOps). Canadian Entitlement power was delivered to Canada in accordance with the DOPs, the Entity Agreement on Aspects of the Delivery of the Canadian Entitlement dated 29 March 1999 and Entitlement related agreements described below.

## Entity Agreements

Agreements approved by the Entities during the period of this report include:

- Columbia River Treaty Entity Agreement on the Assured Operating Plan (AOP) and Determination of Downstream Power Benefits for the 2012-13 Operating Year, signed 18 February 2008;
- Columbia River Treaty Entity Agreement on the Detailed Operating Plan for Canadian Storage 1 August 2008 through 31 July 2009, signed 19 June 2008; and
- Columbia River Treaty Entity Agreement on Preparation of Joint Studies Relating to the 2014/Post-2024 Columbia River Treaty Review, signed 21 July 2008.

## Columbia River Treaty Operating Committee Agreements

The Columbia River Treaty Operating Committee (CRTOC) completed four agreements during the reporting period:

- Columbia River Treaty Operating Committee Agreement on the Provisional Storage for the Period 22 September 2007 through 5 April 2008, signed 28 September 2007;

- Columbia River Treaty Operating Committee Agreement on Operation of Treaty Storage for Nonpower Uses for 15 December 2007 through 31 July 2008 signed on 12 December 2007;
- Agreement of the Columbia River Treaty Operating Committee on the Operation of Canadian Treaty and Libby Storage Reservoirs for the Period 2 August 2008 through 31 December 2008 signed on 11 August 2008; and
- Columbia River Treaty Operating Committee Agreement on the Provisional Storage for the Period 1 September 2008 through 3 April 2009, signed 9 September 2008.

## System Operation

Under the 2007-08 and 2008-09 DOPs, Canadian storage was operated according to criteria from the 2007-08 and 2008-09 AOPs, except for several changes defined in the DOP's, the most notable is a maximum limitation to Arrow January outflows of 80 kcfs.

Canadian storage began the operating year below the DOP levels (by 101 cubic hectometers ($hm^3$) or 82 thousand acre-feet (kaf)) determined in the Treaty Storage Regulation (TSR) study, primarily due to inadvertent draft. During August and September 2007, Canadian storage was operated to forecasted TSR levels, except for a small provisional draft and return authorized by the LCA. In accordance with a fall Supplemental Operating Agreement (SOA), Canadian storage filled in October 2007, ending the month 1,190 $hm^3$ (965 kaf) above TSR levels. In November and December, Canadian storage was operated in accordance with the SOA with releases in both months. The Canadian Entity exercised the option to provisionally draft Arrow the second time 274 $hm^3$ (222 kaf) in December, although some inadvertent draft also occurred in December 2007, with Canadian storage ending the month 661 $hm^3$ (536 kaf) above the TSR. The December 11th TSR was revised to include updated hydro independent generation and all calculations from December forward were updated. In accordance with a second Supplemental Operating Agreement, Canadian storage filled to about 1,760 $hm^3$ (1,427 kaf) above the TSR in January 2008, with all of the fall storage released by February. Canadian storage remained above the TSR through May, and returned to near TSR levels in July.

## Canadian Entitlement

During the reporting period, the U.S. Entity delivered the Canadian Entitlement to downstream power benefits from the operation of Mica, Duncan and Arrow reservoirs to the Canadian Entity, at existing points of interconnection on the Canada-U.S. border. The amount returned, not including transmission losses and scheduling adjustments, was 482.8 average megawatts (aMW) at rates up to 1241 MW during 1 August 2007 through 31 July 2008, and 464.9 aMW at rates up to 1,245 MW during 1 August 2008 through 30 September 2008.

During the course of the Operating Year, one-hour curtailment of Canadian Entitlement occurred in May 2008 due to transmission constraints, totaling six MWh, which were delivered to Canada within seven (7) days of the constraint.

## Treaty Project Operation

At the beginning of the 2007-08 operating year, 1 August 2007, actual Canadian storage was at 19.1 $km^3$ (15.4 Maf) or 99.6 percent full. Canadian storage ended the operating year on 31 July 2008, at 17.6 $km^3$ (14.2 Maf) or 91.8 percent full.

The Mica (Kinbasket) reservoir reached a maximum elevation of 754.3 m (2,474.8 ft) on 10 August 2007, 0.06 m (0.2 ft) below full pool. The reservoir was drawn down during the fall and winter to meet power demands and to prepare for the expected high runoff, reaching a minimum level of about 718.1 m (2,356.1 ft) on 5 May 2008, later than normal due to the delayed freshet. This level was 6.2 m (20.3 ft) lower than the 2007 minimum level of 724.3 m (2,376.3 ft). Reservoir releases were then reduced in mid May through early July in response to lower power demands and system constraints. This condition combined with high freshet inflows caused the reservoir to refill quite significantly across the same period. The reservoir continued to fill through early September to reach a maximum elevation of 750.4 m (2,461.9 ft), 4.0 m (13.1 ft) from full.

The Arrow reservoir reached a maximum elevation of 438.6 m (1,439.0 ft) on 7 July 2007, 1.5 m (4.9 ft) from full pool. As inflows continued to recede throughout the fall and winter period and outflows increased to meet Treaty requirements, the reservoir drafted steadily reaching a minimum level of 430.8 m (1,413.4 ft) on 12 May 2008, much later than normal due to the delayed freshet. Influenced by relatively good runoff conditions combined with Non-Treaty Storage Agreement (NTSA) and Treaty Flex operations, the reservoir refilled to its Treaty flood control level (maximum possible level) in May and June. The reservoir continued to refill across early July to reach a maximum elevation of 440.0 m (1,443.6 ft) on 5 July 2008, 0.15 m (0.5 ft) from full pool.

Duncan reservoir refilled to 576.7 m (1,892.0 ft), slightly above full pool on 21 July 2007. From September 2007 through April 2008, Duncan discharge was used to supplement inflow into Kootenay Lake and to provide spawning and incubation flows for fish. B.C. Hydro sought and received variance for February flood control to 552.5 m (1,812.6 ft). This was reached on 28 February 2008, and 551.0 m (1,807.7 ft) was reached on 12 March 2008. The reservoir drafted to empty at elevation 546.87 m (1,794.2 ft) on 28 April 2008. Reservoir discharge was reduced to a minimum of 3 $m^3/s$ (0.1 kcfs) on 18 May 2008 to initiate reservoir refill. The reservoir refilled to a maximum elevation of 576.53 m (1,891.5 ft), 0.15 m (0.5 ft) below full pool on 11 August 2008. A second similar peak level was reached on 21 August 2008 due to a significant precipitation event in the area.

The Libby (Kookanusa) Reservoir began July 2007 at elevation 746.7 m (2,449.7 ft), 2.9 m (9.5 ft) from full and drafted through the fall and winter period. By 31 December, the reservoir was at elevation 734.87 m (2,411.0 ft) and operated during the winter to the VarQ storage reservation diagram. The reservoir drafted to its lowest elevation of 730.03 m (2395.1 ft) on 13 April. During the refill period, Libby Dam operated in strict accordance to the VarQ operating procedures and provided 1.28 $km^3$ (1.04 Maf) of storage for sturgeon releases. The reservoir filled to its maximum elevation of 745.21 m (2444.9 ft) on 18 July 2008, 4.30 m (14.1 ft) from full pool. The project reached elevation 744.23 m (2441.7 ft) on 31 August, which stored 143.37 hm3 (58.6 ksfd) due to the Libby Canadian storage agreement.

# Columbia Basin Map

*2008 Report of the Columbia River Treaty Entities*

# Table of Contents

# Acronyms and Abbreviations

AER............................Actual Energy Regulation
aMW ..........................Average Megawatts
AOP............................Assured Operating Plan
B.C. Hydro .................British Columbia Hydro and Power Authority
BiOp...........................Biological Opinion
BG..............................Brigadier General
BPA............................Bonneville Power Administration
CEPA .........................Canadian Entitlement Purchase Agreement
COL............................Colonel
cfs...............................Cubic feet per second
CRC............................Critical Rule Curve
CROHMS...................Columbia River Operational Hydromet Management System
CRT............................Columbia River Treaty
CRITFC......................Columbia River Inter-Tribal Fish Commission
CRTHC ......................Columbia River Treaty Hydrometeorological Committee
CRTOC ......................Columbia River Treaty Operating Committee
CSPE..........................Columbia Storage Power Exchange
DDPB.........................Determination of Downstream Power Benefits
DOP............................Detailed Operating Plan
DRL............................Duncan River below the Lardeau confluence)
FCOP..........................Flood Control Operating Plans
ft.................................feet
$hm^3$ .............................Cubic hectometers
in ................................inch
ICF .............................Initial Controlled Flow
IJC..............................International Joint Commission
kaf ..............................Thousand acre-fee
kcfs.............................Thousand cubic feet per second
$km^3$ ............................Cubic Kilometer (one million cubic meters)

## Acronyms and Abbreviations (continued)

ksfd............................Thousand second-foot-days (= kcfs x days)

LCA............................Libby Coordination Agreement

LOP............................Libby Operating Plan

m ................................Meter

$m^3/s$ ............................Cubic meters per second

Maf.............................Million acre-feet

MW ............................Megawatt

NMFS.........................National Marine Fisheries Service

NRCS .........................National Resource Conservation Service

NOAA F.....................NOAA Fisheries, formerly NMFS

NTSA .........................Non-Treaty Storage Agreement

NWPCC .....................Northwest Planning and Conservation Council

ORC ...........................Operating Rule Curve

OY..............................Operating Year

PEB ............................Permanent Engineering Board

PEBCOM...................PEB Engineering Committee

PNCA.........................Pacific Northwest Coordination Agreement

PNW...........................Pacific Northwest

POP ............................Principles and Procedures

SOR............................System Operational Requests

TMT ...........................Technical Management Team

TSR ............................Treaty Storage Regulation

U.S. ...........................United States

USACE ......................U.S. Army Corps of Engineers

USFWS ......................U.S. Fish and Wildlife Service

VARQ ........................Variable discharge flood control

VRC ...........................Variable refill curves

WSF ...........................Water Supply Forecast

WUP...........................Water Use Plan

WY.............................Water Year

# I – INTRODUCTION

This annual Columbia River Treaty Entity Report is for the 2008 water year (WY), 1 October 2007 through 30 September 2008, with additional information on the operation of Mica, Arrow, Duncan, and Libby reservoirs during the reservoir system operating year, 1 August 2007 through 31 July 2008. The power and flood control effects downstream in Canada and the U.S. are described. This report is the 42nd of a series of annual reports covering the period since the ratification of the Columbia River Treaty (CRT) in September 1964.

Duncan, Arrow, and Mica reservoirs in Canada were constructed as required under the CRT, and Libby reservoir in the U.S. was constructed as provided for by the CRT. Treaty storage in Canada (Canadian storage) is operated for the purposes of flood control and increasing hydroelectric power generation in Canada and the U.S. In 1964, the Canadian and the U.S. governments each designated an Entity to formulate and carry out the operating arrangements necessary to implement the CRT. The Canadian Entity for these purposes is B.C. Hydro. The Canadian Entity for the limited purpose of making arrangements for disposal of all or portions of the Canadian Entitlement within the United States is the government of the Province of British Columbia. The U.S. Entity is the two positions of the Administrator/Chief Executive Officer of Bonneville Power Administration (BPA) and the Division Engineer of the Northwestern Division, U.S. Army Corps of Engineers (USACE).

The following is a summary of key features of the CRT and related documents:

1. Canada was to provide 19.12 cubic kilometers ($km^3$) (15.5 million acre feet (Maf)) of usable storage. This has been accomplished with 8.63 $km^3$ (7.0 Maf) in Mica, 8.78 $km^3$ (7.1 Maf) in Arrow, and 1.73 $km^3$ (1.4 Maf) in Duncan.

2. For the purpose of computing downstream power benefits, the U.S. base system hydroelectric facilities will be operated in a manner that makes the most effective use of the improved stream flow resulting from operation of the Canadian storage.

3. The U.S. and Canada are to share equally the downstream power benefits generated in the U.S. resulting from operation of the Canadian storage.

4. The U.S. paid Canada a lump sum of the $64.4 million (U.S.) for one half of the present worth of expected future flood control benefits in the U.S. to September 2024, resulting from operation of the Canadian storage.

5. The U.S. has the option of requesting the evacuation of additional flood control space above that specified in the CRT, for a payment of $1.875 million (U.S.) plus power losses for each of the first four requests for this "on-call" storage. No requests under this provision have been made to date.

6. The U.S. had the option (which it exercised) to construct Libby Dam with a reservoir that extends 67.6 kilometers (42 miles) into Canada and for which Canada agreed to make the land available.

7. Both Canada and the U.S. have the right to make diversions of water for consumptive uses. In addition, since September 1984, Canada has had the option of making, for power purposes, specific diversions of the Kootenay River into the headwaters of the Columbia River.

8. Differences arising under the Treaty which cannot be resolved by the two countries may be referred to either the International Joint Commission (IJC) or to arbitration by an appropriate tribunal.

9. The Treaty shall remain in force for at least 60 years from its date of ratification, 16 September 1964, after which either Government has the option to terminate most sections of the Treaty with a minimum of 10 years advance notice.

10. In the Canadian Entitlement and Purchase Agreement (CEPA) of 13 August 1964, Canada sold its entitlement to downstream power benefits (Canadian Entitlement) to the Columbia Storage Purchase Exchange (CSPE - a consortium of U.S. utilities) for 30 years beginning at Duncan on 1 April 1968, Arrow on 1 April 1969, and Mica on 1 April 1973. That sale has now expired and all Canadian Entitlement has reverted to British Columbia provincial ownership and is being either delivered to the Canada-U.S. border or sold directly in the United States.

11. Canada and the U.S. each appointed Entities to implement Treaty provisions and are to jointly appoint a joint Permanent Engineering Board (PEB) to review and report on operations under the CRT.

# II - TREATY ORGANIZATION

## Entities

There was one meeting of the CRT Entities (including the Canadian and U.S. Entities and Entity Coordinators) during the year on the morning of 22 March 2008 in Portland, Oregon.

The members of the two Entities at the end of the period of this report were:

| UNITED STATES ENTITY | CANADIAN ENTITY |
| --- | --- |
| Mr. Stephen J. Wright, Chairman<br>Administrator & Chief Executive Officer<br>Bonneville Power Administration<br>Department of Energy<br>Portland, Oregon | Mr. Robert G. Elton, Chair<br>President & Chief Executive Officer<br>British Columbia<br>Hydro and Power Authority<br>Vancouver, British Columbia |
| Brigadier General William E. Rapp, Member<br>Division Engineer<br>Northwestern Division<br>U.S. Army Corps of Engineers<br>Portland, Oregon | |

Brigadier General (BG) William E. Rapp replaced Colonel (COL) Steven R. Miles on 30 May 2008, who in turn had replaced BG Gregg Martin on 2 November 2007.

The Entities have designated alternates to act on behalf of the primaries in their absence; appointed in the U.S. by a Memorandum of Agreement between Bonneville and Corps of Engineers, and in Canada by the B.C. Hydro Board of Directors. Mr. Wright's alternate is Bonneville Deputy Administrator, Steven G. Hickok; Mr. Elton's Deputy position is Chris K. O'Riley, Senior Vice President for Engineering, Aboriginal Relations & Generation; and BG William E. Rapp's alternate is COL Miroslav P. Kurka (Deputy Division Engineer).

The Entities have appointed Coordinators, Secretaries, and two joint standing committees to assist in CRT implementation activities that are described in subsequent paragraphs. The primary duties and responsibilities of the Entities as specified in the CRT and related documents are to:

1. Plan and exchange information relating to facilities used to obtain the benefits contemplated by the CRT;

2. Calculate and arrange for delivery of hydroelectric power to which Canada is entitled and the amounts payable to the U.S. for standby transmission services (the latter is no longer in effect);

3. Operate a hydrometeorological system;

4. Assist and cooperate with the PEB in the discharge of its functions;

5. Prepare and implement Flood Control Operating Plans (FCOPs) for the use of Canadian storage;

6. Prepare Assured Operating Plans (AOP) for Canadian storage and determine the resulting downstream power benefits that Canada is entitled to receive; and

7. Prepare and implement Detailed Operating Plans (DOPs) that may produce results more advantageous to both countries than those that would arise from operation under AOPs.

Additionally, the CRT provides that the two governments, by exchange of diplomatic notes, may empower or charge the Entities with any other matter coming within the scope of the CRT.

## Entity Coordinators & Secretaries

The Entities have appointed Coordinators from members of their respective staffs to help manage and coordinate CRT related work, and Secretaries to serve as information focal points on all CRT matters within their organizations.

Those personnel are:

UNITED STATES ENTITY
COORDINATORS
Stephen R. Oliver
Vice President, Generation Supply
Bonneville Power Administration
Portland, Oregon

G. Witt Anderson *
Director, Civil Works & Management
Northwestern Division
U.S. Army Corps of Engineers
Portland, Oregon

CANADIAN ENTITY
COORDINATOR
Renata Kurschner
Director,
Generation Resource Management
B.C. Hydro
Burnaby, British Columbia

* G. Witt Anderson replaced Allen Chin as Corps Coordinator on 30 January 2008.

UNITED STATES ENTITY
SECRETARY
Dr. Anthony G. White
Regional Coordination
Power and Operations Planning
Bonneville Power Administration
Portland, Oregon

CANADIAN ENTITY
SECRETARY
Douglas A. Robinson
Generation Resource Management
B.C. Hydro
Burnaby, British Columbia

## Columbia River Treaty Operating Committee

The Columbia River Treaty Operating Committee (CRTOC) was established in September 1968 by the Entities, and is responsible for preparing and implementing operating plans as required by the CRT, making studies and otherwise assisting the Entities as needed. The CRTOC consists of eight members as follows:

UNITED STATES SECTION
Richard M. Pendergrass, BPA, Alt. Chair
James D. Barton, USACE, Alt. Chair
Cathy Hlebechuk, USACE *
John M. Hyde, BPA

CANADIAN SECTION
Kelvin Ketchum, B.C. Hydro, Chair
Dr. Thomas K. Siu, B.C. Hydro
Gillian Kong, B.C. Hydro
Herbert Louie, B.C. Hydro

* Ms. Cathy Hlebechuk was appointed to replace Ms. Cindy Henriksen on 1 October 2007.

The CRTOC met during the reporting period to exchange information, approve work plans, discuss issues, agree on operating plans, and brief the PEB and PEB Engineering Committee (PEBCOM). There were six regular meetings held every other month alternating between Canada and the U.S., plus two meetings with the PEB/PEBCOM, and one meeting to discuss Libby VarQ flood control operation. During the period covered by this report, the CRTOC:

- Coordinated the operation of the CRT storage in accordance with the current hydroelectric operating plans and FCOP;
- Coordinated changes to procedures and reviewed scheduled delivery of the Canadian Entitlement according to the CRT and related agreements;
- Completed studies and documents for the 2012-13 AOP/Determination of Downstream Power Benefits (DDPB) and completed studies, but not the document, for the 2013-14 AOP/DDPB;

- Completed the 1 August 2008 through 31 July 2009 DOP;
- Completed four supplemental operating agreements for Canadian storage;
- Implemented the Libby Coordination Agreement (LCA) including the 21 April 2006 update to the Libby Operating Plan (LOP) which involved scheduling of provisional draft, delivery of one average MW of power, and analysis and monitoring of Canadian power effects from VarQ flood control operation at Libby;
- Briefed the PEBCOM on Entity activities, and completed the 2007 Entity Annual Report; and
- Further developed work on the 2014/Post-2024 CRT Review work. The Phase 1 Narrative (describing the approaches, assumptions, and studies in Phase 1) and the Work Plan were completed and presented to the PEB and the PEBCOM on 20 March 2008. Work Plan implementation began in the early spring and continued through 2008. A written progress report was provided to the PEB and PEBCOM on 25 June 2008. In addition to technical work, the Entities agreed on how the results of the Joint Technical Studies and confidential data/information will be handled. The Entities Agreement on the Preparation of Joint Studies was agreed to on 4 July 2008.

These aspects of the CRTOCs work are described in following sections of this report, which have been prepared by the CRTOC with the assistance of others.

The photo below was taken at the 40th Anniversary meeting of the Operating Committee on 17 September 2008.

Pictured from left to right: Cathy Hlebechuk (USACE, Member), James Barton (USACE, U.S. Alt. Chair), Kelvin Ketchum (B.C. Hydro, Canadian Chair), Doug Robinson (B.C. Hydro, Canadian Entity Secretary), John Hyde (BPA, Member), Rick Pendergrass (BPA, U.S. Alt. Chair), Tom Siu (B.C. Hydro, Member), Tony White (BPA, U.S. Entity Secretary), Herbert Louie (B.C. Hydro, Member), and front center: Gillian Kong (B.C. Hydro, Member)

## Columbia River Treaty Hydrometeorological Committee

The Hydrometeorological Committee was established in September 1968 by the Entities and is responsible for planning and monitoring the operation of data facilities in accordance with the Treaty and otherwise assisting the Entities as needed. The Committee consists of four members as follows:

| UNITED STATES SECTION | CANADIAN SECTION |
|---|---|
| Brian Kuepper*, BPA Co-Chair | Stephanie Smith, B.C. Hydro, Chair |
| Peter Brooks, USACE Co-Chair | Doug Smith, B.C. Hydro, Member |

* Robert Allerman replaced Nancy Stephan as BPA Co-Chair on 2 March 2008 for a 6-month period, and was then in turn replaced by Brian Kuepper effective 15 September 2008

The Columbia River Treaty Hydrometeorological Committee (CRTHC) had limited activity in 2008 and managed all work via email communication and with two conference calls. The CRTHC is behind on completing their Annual Reports for 2006 and 2007 and is working to complete these two reports, in addition to the 2008 report by the end of 2008. The Committee plans to return to regularly scheduled semi-annual meetings in 2008-09 with the next meeting of the committee taking place in November 2008.

**Forecasting**

There were no changes to any of the forecasting procedures in 2008. There were two further updates to Principles and Procedures (POP) for the procedures updated last year. The first update was a correction to the storage values (in thousand second-foot-days (ksfd)) for errors and hedges listed in Table 1 for the June forecast for Dworshak. The second update was to add Arrow Local volume distribution factors to Table 2 in POP. Both updates were approved by CRTOC and implemented into POP.

**Data Exchange**

B.C. Hydro adopted a new routing procedure for calculating the inflows to Kootenay Lake by implementing a 30-hour delay in the outflows from Libby effective 26 March 2008. Previously there was no delay assumed for the travel time for water released from Libby, which caused inaccuracies in the Kootenay Lake inflow calculations. The new routing delay significantly improves the inflow calculation for the project. The change was implemented during a time when Libby discharges were constant.

**Stations**

The CRTHC dealt with a number of station closure notifications in 2008:

- Environment Canada notified B.C. Hydro of the termination of contracts for two climate stations in the Columbia River Basin in 2008, neither of which was a Treaty station. The Grand Forks climate observer retired after 50 years of service as a climate observer and the Wasa observer decided to continue to operate the station on a voluntary basis for the time being.

- The Natural Resource Conservation Service (NRCS) in the state of Washington completed a review of their Snotel network and notified BPA of the potential for nine snow station closures in Washington and Oregon. Currently NRCS is consulting with water management agencies in the region, including the members of CRTHC to determine whether stations should continue to be operated. B.C. Hydro is not impacted by the potential closures, and BPA is following up.

- The Seattle office of the Corps, BPA and B.C. Hydro are coordinating to install two new water temperature sensors in the Kootenay River at Fort Steele and Elk River at Fernie hydrometric gauging stations to aid in water temperature modeling for Koocanusa reservoir. The Corps is providing the sensors, BPA will pay for the operating costs, and B.C. Hydro will arrange for installation and maintenance by Water Survey of Canada at the sites.

## Permanent Engineering Board

Provisions for the establishment of the Permanent Engineering Board (PEB) and its duties and responsibilities are included in the CRT and related documents. The members of the PEB at present are:

| UNITED STATES SECTION | CANADIAN SECTION |
| --- | --- |
| Stephen L. Stockton, Chair<br>Washington, D.C. | Tom Wallace, Chair<br>Ottawa, Ontario |
| Edward Sienkiewicz, Member<br>Newberg, Oregon | Tim Newton, Member<br>Vancouver, British Columbia |
| Dr. Robert A. Pietrowsky, Alternate<br>Washington, D.C. | James Mattison, Alternate<br>Victoria, British Columbia |
| George E. Bell, Alternate<br>Portland, Oregon | Ivan Harvie, Alternate<br>Calgary, Alberta |

The following serve as Secretary to the Board:

| | |
| --- | --- |
| Jerry W. Webb, Secretary<br>Washington, D.C. | Darcy Blais, Secretary<br>Ottawa, Ontario |

Under the CRT, the PEB is to assemble records of flows of the Columbia River and the Kootenay River at the international boundary. The PEB is also to report to both governments if there is substantial deviation from the hydroelectric or flood control operating plans, and if appropriate, include recommendations for remedial action. Additionally, the PEB is to:

- Assist in reconciling differences that may arise between the Entities;
- Make periodic inspections and obtain reports as needed from the Entities to assure that CRT objectives are being met;
- Prepare an annual report to both governments and special reports when appropriate;
- Consult with the Entities in the establishment and operation of a hydrometeorological system; and
- Investigate and report on any other CRT related matters at the request of either government.

The Entities continued their cooperation with the PEB during the past year by providing copies of Entity agreements, operating plans, CRTOC agreements, updates to hydrometeorological documents, personnel appointments, pertinent correspondence, and the annual Entity report to the Board for their review. The annual joint meeting of the PEB and the Entities was held on 20 March 2008 in Portland, Oregon, where the Entities briefed the PEB on the preparation and implementation of operating plans, the delivery of the Canadian Entitlement, and other topics requested by the Board.

## PEB Engineering Committee

The PEB has established the PEBCOM to assist in carrying out its duties. The members of PEBCOM at the end of the period of this report were:

| UNITED STATES SECTION | CANADIAN SECTION |
|---|---|
| Jerry W. Webb, Chair<br>Washington, D.C. | Roger S. McLaughlin, Chair<br>Victoria, British Columbia |
| Michael S. Cowan, Member<br>Lakewood, CO | Darcy Blais, Member<br>Ottawa, Ontario |
| Kamau B. Sadiki, Member<br>Washington, D.C. | Ivan Harvie, Member<br>Calgary, Alberta |

D. James Fodrea, Member
Cascade, ID

Dr. G. Bala Balachandran, Member
Victoria, British Columbia

The PEBCOM met with the CRTOC on 24 October 2007 in Vancouver, BC.

## International Joint Commission

The International Joint Commission (IJC) was created under the Boundary Waters Treaty of 1909, between Great Britain (on behalf of Canada) and the U.S. Its principal functions are rendering decisions on the use of boundary waters, investigating important problems arising along the common frontier not necessarily connected with waterways, and making recommendations on any question referred to it by either government. If the Entities or the PEB cannot resolve a dispute concerning the CRT, that dispute may be referred to the IJC for resolution.

The IJC has appointed local Boards of Control to insure compliance with IJC orders and to keep the IJC informed. There are three such boards west of the continental divide. These are the International Kootenay Lake Board of Control, International Columbia River Board of Control, and International Osoyoos Lake Board of Control. The Entities and IJC Boards conducted their CRT activities during the period of this report so that there was no known conflict with IJC orders or rules.

The U.S. Section Chair is Ms. Irene B. Brooks of Seattle, Washington. The Canadian Section Chair is The Right Honorable Herb Gray of Ottawa, Canada. Canadian members are Mr. Jack P. Blaney, Vancouver, B.C., and Mr. Pierre Trepanier, Montreal, Quebec. U.S. members are Mr. Allen I. Olson, Edina, Minnesota and Dr. Samuel W. Speck of Ohio.

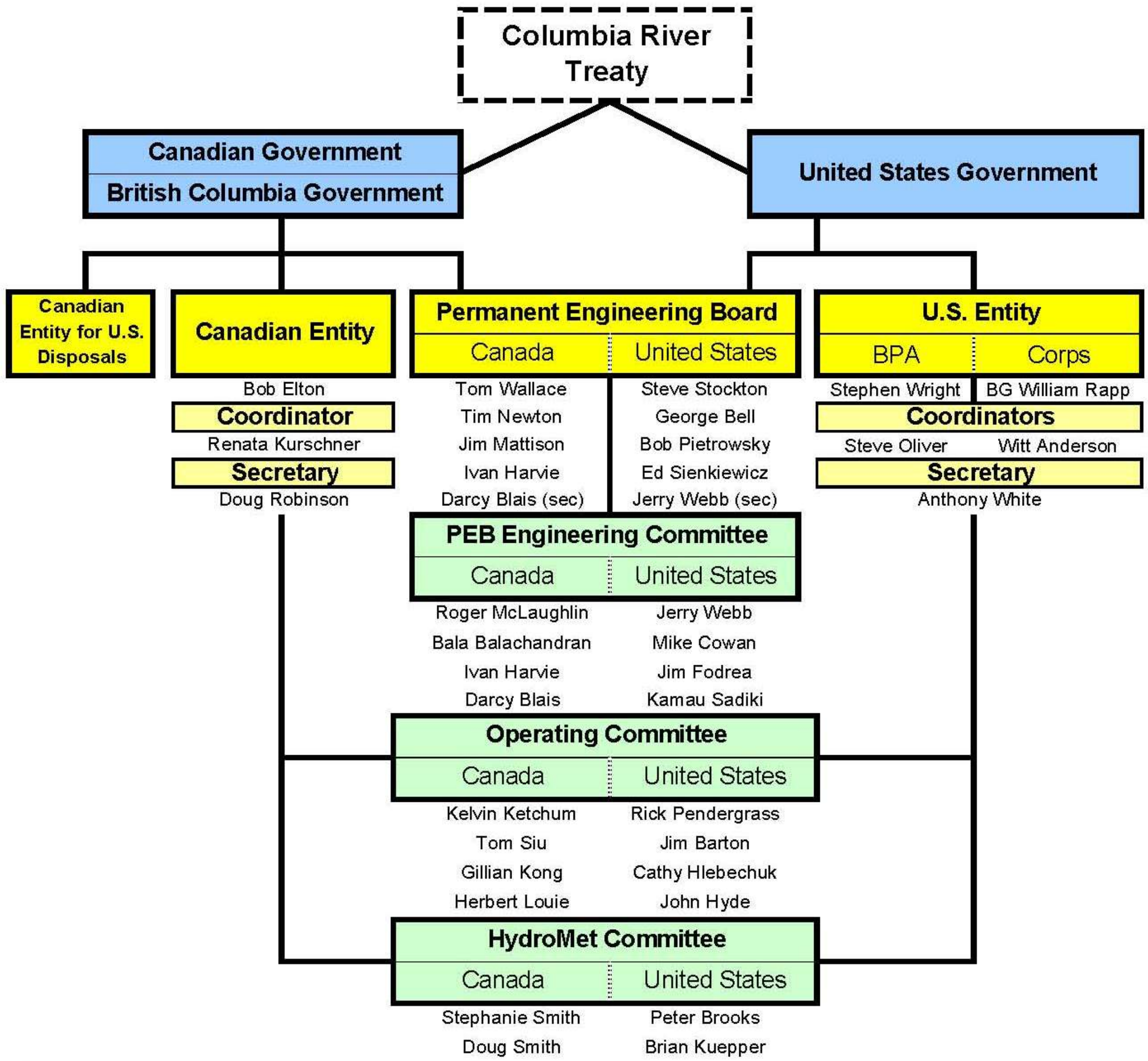
During the reporting period, members of the Operating Committee exchanged letters and met with the Kootenay Lake Board of Control on questions concerning potential constraints on the operation of Libby and Duncan when water levels in Kootenay Lake may exceed the reference elevations specified under the 1938 IJC Order. No conclusions were reached, and these discussions are expected to continue.

## Presentations

During the period covered by this report, CRT personnel made presentations about the history, structure, operations, challenges and communications associated with the CRT to visitors and inquirers from professional, environmental, academic and civic groups and individuals; new employees; Northwest Power Planning Council staff; Columbia Basin Trust staff; and foreign visitors from Vietnam, Laos, Thailand, Cambodia and Kyrgyzstan.

## Columbia River Treaty Organization

### Organization Chart for the Columbia River Treaty




Notes:
1) The Entities and the PEB are creations of the Treaty, and all report directly to their respective governments.
2) The Operating Committee and the HydroMet Committee report to the Entities; the PEBCOM reports to the PEB.
3) CRT XIV2(f): The Entities are tasked with "*assisting and cooperating with the PEB*".
4) CRT XV2(c): Similarly, the PEB is directed to *"assist in reconciling differences concerning technical or operational matters that may arise between the entities"*.

# III - OPERATING ARRANGEMENTS

## Power and Flood Control Operating Plans

The CRT requires that the reservoirs constructed in Canada be operated pursuant to flood control and hydroelectric operating plans. Annex A of the CRT:

1. Stipulates that the U.S. Entity will submit FCOPs;
2. States that the Canadian Entity will operate in accordance with flood control storage diagrams or any variation which the Entities agree will not reduce the desired aim of the flood control plan; and
3. Provides for the development of assured hydroelectric operating plans for Canadian storage for the sixth succeeding year of operation. Article XIV.2.k of the CRT provides that a DOP be developed that may produce results more advantageous than the AOP. The Protocol to the CRT provides further detail and clarification of the principles and requirements of the CRT.

The "Principles and Procedures for the Preparation and Use of Hydroelectric Operating Plans for Canadian Treaty Storage", signed December 2003 (as amended), together with the "Columbia River Treaty Flood Control Operating Plan" dated May 2003 (as revised), establish and explain the general criteria used to develop the AOP and DOP and operate CRT storage during the period covered by this report.

The planning and operation of CRT Storage as discussed on the following pages are for the operating year, 1 August 2007 through 31 July 2008. The operation of Canadian storage was determined by the 2007-08 DOP and supplemental operating agreements. The DOP required a semi-monthly Treaty Storage Regulation (TSR) study to determine end-of-month storage obligations prior to any supplemental operating agreements. The TSR included all operating criteria from, and was based on, the Step I Joint Optimum Power Hydroregulation Study from the 2007-08 AOP, with agreed changes. Most of the hydrographs and reservoir charts in this report are for a 14-month period, August 2007 through September 2008.

## Assured Operating Plans

During the reporting period, the Entities completed the 2012-13 AOP and completed studies for the 2013-14 AOP. The 2012-013 AOP used the streamline procedures described in Appendix 6 of the 2003 POP and is based on the 2011-12 AOP/DDPB hydroregulation studies.

The 2012-13 AOP establishes Operating Rule Curves (ORCs), Critical Rule Curves (CRCs), Mica and Arrow Project Operating Criteria, and other operating criteria included in the Step I Joint Optimum Power Hydroregulation Study, to guide the operation of Canadian storage. The ORCs were derived from CRCs, Assured Refill Curves (ARC), Upper Rule Curves (Flood Control Rule Curves), Variable Refill Curves (VRC) and Operating Rule Curve Lower Limits (ORCLL), consistent with flood control requirements, as described in the 2003 POP. They provide guidelines for draft and refill under a wide range of water conditions. The Flood Control Rule Curves conform to the 2003 FCOP, and are used to define maximum reservoir levels for the operation of Canadian storage. The 2012-13 AOP uses the 5.03/4.44 $km^3$ (4.08/3.6 Maf) Mica/Arrow flood control allocation. The CRCs are used to apportion draft below the ORC when the TSR determines additional draft is needed to meet the Coordinated System firm energy load carrying capability. Because of the use of the streamline procedure, the 2012-13 AOP operating criteria is a direct carry-over from the 2011-12 AOP.

## Determination of Downstream Power Benefits

For each operating year, the DDPB resulting from Canadian storage operation is made in conjunction with the AOP according to procedures defined in the CRT, Annexes, and Protocol and except as noted in the AOP/DDPB documents, the 2003 Principles and Procedures agreement. For the 2012-13 DDPB, the Entities agreed to use the optional streamline procedures described in Appendix 6 of the 2003 POP. The 2012-13 DDPB results showed a 13.6 MW increase in the capacity benefit and a 42.8 aMW decrease in the energy benefit compared to the previous year DDPB. This larger than usual decrease in the energy benefit from the prior year was mainly due to an increase in the forecasted PNW Area annual firm load and the thermal displacement market. The total CRT downstream power benefits as a result of the operation of Canadian storage for the 2012-13 operating year were determined to be 1,009.0 aMW of annual usable energy and 2,641.7 MW of dependable capacity.

## Canadian Entitlement

For the period 1 August 2007 through 31 July 2008, the Canadian Entitlement amount, before losses, was 482.8 aMW of energy, scheduled at rates up to 1,241 MW, and from 1 August 2008 through 30 September 2008, the amount, before losses, was 464.9 aMW of energy, scheduled at rates up to 1,245 MW. The Canadian Entitlement obligation was determined by the 2007-08 and 2008-09 AOP/DDPB's.

During the course of the Operating Year, there was one-hour curtailment of Canadian Entitlement deliveries due to transmission constraints. This occurred on 5 May 2008 and resulted in the curtailment of six MWh of energy, which was rescheduled for delivery within seven days of the curtailment.

## Detailed Operating Plans

During the period covered by this report, the CRTOC used the 1 August 2007 through 31 July 2008 "Detailed Operating Plan for Columbia River Treaty Storage," dated July 2007, and the 1 August 2008 through 31 July 2009 DOP, dated June 2008, to guide Canadian storage operations. These DOPs established criteria for determining the ORCs, proportional draft points, and include other operating criteria for use in actual operations. The 2007-08 and 2008-09 DOPs were based respectively on the 2007-08 AOP and 2008-09 AOP loads and resources, rule curves, and other operating criteria with agreed changes for both Canadian and U.S. projects. The 2007-08 and 2008-09 AOPs included a flood control allocation of 4.43 $km^3$ (3.6 Maf) in Arrow and 5.03 $km^3$ (4.08 Maf) in Mica. The 2007-08 DOP and 2008-09 DOP operating criteria with agreed changes were used to develop the Treaty Storage Regulation (TSR) studies for implementation of Canadian storage operations. The changes were mainly updates to hydro-independent data, addition of a maximum January outflow limit at Arrow of 2265 $m^3/s$ (80 kcfs), incorporation of updated forecast errors and distribution factors, and updated Grand Coulee pumping estimates.

The TSR studies were updated twice monthly throughout the reporting period for current inflow forecasts, flood control curves and VRCs, and actual unregulated inflows for the previous month. The TSR and supplemental operating agreements, defined the end-of-month draft rights for Canadian storage. The VRCs and flood control requirements subsequent to 1 January 2008 were determined on the basis of seasonal volume runoff forecasts during actual operation. The VRC calculations for Canadian reservoirs and Libby for the 2007-08 operating year are shown in Tables 2 through 5. The tabular calculation in Table 5 for Libby's VRCs was used in the TSR study only and is not used in real-time operations.

The CRTOC directed the regulation of the Canadian storage, on a weekly basis throughout the year, in accordance with the applicable DOPs, the Libby Coordination Agreement (LCA), and supplemental operating agreements.

## Libby Coordination Agreement

During the period covered by this report, the LCA procedures allowed the Canadian Entity to provisionally draft Arrow reservoir and exchange power with the U.S. Entity, and required delivery to the U.S. Entity of one (1) aMW, shaped flat, over the entire Operating Year. Provisional draft operations under the LCA are discussed in Section VI.

The most recent Libby Operating Plan (LOP) is dated 21 April 2006. However, a new one is being written to reflect the new NOAA Fisheries Biological Opinion dated 5 May 2008. It is expected to be completed by the end of the calendar year.

## Entity Agreements

During the period covered by this report, three joint U.S.-Canadian agreements were approved by the Entities:

| Date Signed by Entities | Description of Agreement |
|---|---|
| 18 Feb 2008 | Columbia River Treaty Entity Agreement on the Assured Operating Plan and Determination of Downstream Power Benefits for the 2012-13 Operating Year |
| 19 Jun 2008 | Columbia River Treaty Entity Agreement on the Detailed Operating Plan for Canadian Storage 1 August 2008 through 31 July 2009. |
| 21 Jul 2008 | Columbia River Treaty Entity Agreement on Preparation of Joint Studies Relating to the 2014/Post-2024 Columbia River Treaty Review |

## Columbia River Treaty Operating Committee Agreements

During the period covered by this report, the CRTOC approved the following joint U.S.-Canadian storage agreements:

| Date Signed | Description | Authority |
|---|---|---|
| 28 Sep 2007 | Columbia River Treaty Operating Committee Agreement on Provisional Storage for the Period 22 September 2007 through 5 April 2008. | Detailed Operating Plan 1 August 2007 through 31 July 2008, dated 17 July 2007. |
| 12 Dec 2007 | Columbia River Treaty Operating Committee Agreement on Operation of Treaty Storage for Nonpower Uses for 15 December 2007 through 31 July 2008. | Detailed Operating Plan 1 August 2007 through 31 July 2008, dated 17 July 2007. |
| 19 Dec 2007 | Columbia River Treaty Operating Committee Agreement on Changes to Attachment B to the Columbia River Treaty Entity Agreement on Aspects of the Delivery of Canadian Entitlement for 1 April 1998 through 15 September 2024 between the Canadian Entity and the United States Entity, dated 29 March 1999 (Canadian Entitlement Scheduling Guidelines). | Detailed Operating Plan 1 August 2007 through 31 July 2008, dated 17 July 2007. |
| 11 Aug 2008 | Agreement of the Columbia River Treaty Operating Committee on the Operation of Canadian Treaty and Libby Storage Reservoirs for the Period 2 August 2008 through 31 December 2008. | Detailed Operating Plan 1 August 2008 through 31 July 2009, dated 19 July 2008. |
| 9 Sep 2008 | Columbia River Treaty Operating Committee Agreement on Provisional Storage for the Period 1 September 2008 through 3 April 2009. | Detailed Operating Plan 1 August 2008 through 31 July 2009, dated 19 June 2008. |

## Long Term Non-Treaty Storage Agreement

An Entity agreement dated 9 July 1990 approved the contract between B.C. Hydro and BPA relating to the initial filling of non-Treaty storage, coordinated use of non-Treaty storage, and Mica and Arrow refill enhancement. The CRTOC, in accordance with that agreement, monitored the storage operations made under this agreement throughout the operating year to insure that they did not adversely impact operation of CRT storage. The Entity agreement dated 28 June 2002, gave approval for B.C. Hydro and BPA to extend the expiration date of the contract by one year, from 30 June 2003 to 30 June 2004, which was done. Two mid-Columbia parties, Eugene Water and Electric Board and Tacoma Utilities, elected to extend their NTSA Agreement with BPA for the same one year period.

No further extension of the contract was completed, however, and as per contract terms, release rights under the Non-Treaty Storage Agreement (NTSA) terminated effective 30 June 2004. Beginning 1 September 2007, progress was made towards refilling the US account in FY2008. At the end of September 2008 the B.C. Hydro account remained at 88 percent of full, and the U.S. parties accounts stood at 73 percent of full. In the absence of a new agreement, the extended Provisions of the 1990 Agreement require that active Non-Treaty Storage Space in Mica be refilled prior to 30 June 2011.

# IV - WEATHER AND STREAM FLOW

## Weather

The Columbia Basin saw a heat wave in July 2007, with much above average temperatures in B.C., and across the central and eastern U.S. districts. The heat relaxed at the beginning of August, as strong upper air high pressure area flattened and weakened. The resultant cooling across the region was not prolonged, or strong enough to prevent regional temperatures to average near to about 1.7 ºC (3 ºF) above August normal. A series of upper level troughs moved through Oregon and southern Idaho, and brought in cooler air to help a few areas east of the Cascades dip to below average for the month. There were a few high temperature records, occurring mainly mid to late month: Seattle, Washington, at 28.9 ºC (84 ºF) on the 15th, Portland, Oregon, at 35.6 ºC (96 ºF) on the 29th, Astoria, Oregon, 28.3 ºC (83 ºF) also on the 29th, and Pendleton, Oregon, 38.9 ºC (102 ºF) on the 30th. There were also low temperature records, including Eugene, Oregon, 6.1 ºC (43 ºF) on the 10th, Meacham, Oregon, -1.7 ºC (29 ºF) on the 11th, and Ephrata, Washington, 8.3 ºC (47 ºF), on the 20th. Precipitation for August 2007, a usually dry month, was 46 percent of normal at Columbia above Coulee, 65 percent of normal at the Snake River above Ice Harbor, and 56 percent of normal at Columbia above The Dalles.

What turned out to be a long, hot summer came to an end in September 2007, as storms bracketed the month, and the month's end storm had some very chilly air. The respite from the summer's heat came with largely near normal September temperatures, even though a burst of heat brought up temperatures to record levels in some places: Challis, Idaho, had a record high of 33.9 ºC (93 ºF) on the 2nd, and again at 35.0 ºC (95 ºF) on the 3rd. Vancouver, Washington, had record of 34.4 ºC (94 ºF), respectively, on the 10th. The fronts that entered during September resulted in record rainfall. Quillayute, Washington, recorded 3.23 cm (1.27") on the 3rd, breaking a 29-year record for the date, SeaTac, Washington, received 1,017 cm (0.46") the same day, and normally dry Bend, Oregon, received 1.22 cm (0.48") on the 4th, eclipsing the previous 1952 record. Later in the month, Missoula, Montana, recorded 2.57 cm (1.01") on the 23rd, Portland, Oregon, 2.79 cm (1.10") on the 28th, and Eugene, Oregon, 3.00 cm (1.18") on the 30th. Precipitation was 102 percent of normal at Columbia above Coulee, 105 percent of normal at the Snake River above Ice

Harbor, and 96 percent of normal at Columbia above The Dalles. The late month precipitation occurred as the month's fronts finally helped to break down the summer's dominant high pressure ridge.

Cool and wet weather systems moved through the Columbia Basin in October, with a couple of exceptionally wet storms. U.S. sector temperatures departed about -0.3 ºC (-0.6 ºF) from normal, and had a mix of record high and low temperatures. The high temperature records were mainly late in the month, up ahead of the weather system that ultimately brought record cold temperatures in its wake. Some record highs were Portland, Oregon, with 23.9 ºC (75 ºF), Superior, Montana, with 23.3 ºC (74 ºF), and West Glacier, Montana with 18.9 ºC (66 ºF). The record lows were Quillayute, Washington, with 0 ºC (32 ºF), Seattle, Washington, with 3.3 ºC (38 ºF), Whitman Mission, Washington, with -5.6 ºC (22 ºF), and Meacham, Oregon, -10.0 ºC (14 ºF). Some record rainfall fell early in the month, but the more widespread rain occurred mid to late month, with the following records: Pomeroy, Washington, 1.37 cm (0.54"), Yakima, Washington, 0.86 cm (0.34"), Seattle, Washington, with 1.65 cm (0.65"), Idaho Falls, Idaho, 1.09 cm (0.43"), Stanley, Idaho, 5.28 cm (2.08"), which was an all-time calendar day record, and Bend, Oregon, with 3.96 cm (1.56"). As such, October precipitation was 141 percent of normal at Columbia above Coulee, 175 percent of normal at the Snake River above Ice Harbor, and 143 percent of normal at Columbia above The Dalles. At the close of the month high pressure returned to the region, for drying and warming leading into November.

The high pressure system brought some record high temperatures to the region early in the month, with warmer than average weather continuing into mid month even with increased precipitation. Then, toward the close of November, a strong cold front introduced much colder temperatures: cold enough for valley snow accumulation east of the Cascade Range. Record high temperatures occurred on the 4th at The Dalles, Oregon, Yakima and Ephrata, Washington, all with 20.6 ºC (69 ºF). Bend, Oregon, reached 21.7 ºC (71 ºF) on the 9th, and Portland, Oregon, 17.2 ºC (63 ºF), on the 17th. Singe-digit values marked low temperature records later in the month: Meacham, Oregon, with -14.4 ºC (6 ºF) on the 21st and -16.7 ºC (2 ºF) on the 24th, with Joseph, Oregon, at -12.8 ºC (9 ºF), on the same day. Starting off warm, then ending cold, brought the month's regional departure to + 0.1 ºC (+0.2 ºF). With the early month high pressure, conditions were dry. Improvement led to spotty record rainfall about mid month: SeaTac, Washington, recorded 2.77 cm (1.09”) on the 15th, Stanley, Washington, 0.99 cm (0.39”) on the 16th, Troutdale, Oregon, 2.90 cm (1.14”) on the 17th, and Prineville, Oregon, 3.18 cm (1.25”), also on the 19th. Precipitation was 84 percent of normal at Columbia above Coulee, 85 percent of normal at the Snake above Ice Harbor, and 83 percent of normal at Columbia above The Dalles.

The La Niña of 2007 opened with strong storms bringing heavy and in many cases record rain to many areas. December started warmer than normal, with many record high temperatures. Records, mainly set on the 4th, include The Dalles, Oregon, 17.2 ºC (63 ºF), Yakima, Washington, 16.7 ºC (62 ºF), Chelan, Washington, 12.2 ºC (54 ºF), and Plummer, Idaho, 11.1 ºC (52 ºF). Much colder air arrived about mid month, and helped set, or tie, record low temperatures at Boundary Dam, Washington, at -17.2 ºC (1 ºF), and Meacham, Oregon, at -15 ºC (5 ºF), a tied record, set on Christmas Day. Given that the region saw roughly a 5.6 ºC (10 ºF) temperature swing during the month, December ended warmer than normal, departing +0.6 ºC (+1 ºF). On the precipitation side, we tallied 130 percent of normal at Columbia above Coulee, 119 percent of normal at the Snake River above Ice Harbor, and 115 percent of normal at Columbia above The Dalles. Daily records include Seattle’s National Weather Service Office, on the 2nd day 3.76 cm (1.48”), and 10.54 cm (4.15”), on the 3rd, with Olympia, Washington, also back-to-back 5.38 cm (2.12”) on the 2nd and 8.10 cm (3.19”) on the 3rd. Mullan Pass, Idaho, accumulated 7.16 cm (2.82”) on the 3rd, with Sandpoint, Idaho, 6.88 cm (2.71”), Spokane, Washington, 3.00 cm (1.18”), Colville, Washington, 2.41 cm (0.95”), and Wenatchee, Washington, 1.02 cm (0.40”). The very next day, Sandpoint, Washington, logged 3.86 cm (1.52”), another daily record. A mid-month storm brought 1.02 cm (0.40”) to Chief Joseph Dam, and 2.08 cm (0.82”) to Coeur d’Alene, Idaho. The late month cold front brought 1.93 cm (0.76”) to Colville, Washington, as another daily record.

January brought a warm start to 2008, as milder air replaced the late December cold, but it did not last long as a colder air mass returned, via a north to northwest airflow. Reaching out over the extreme northeast Pacific, this flow remained cold but gained moisture, with the result being low snow levels and heavy precipitation. Levels were at the valley floors east of the Cascades, and just above, west of the Cascades, with snow showers reaching even the Oregon beaches. Early month warmth, with a record high at Walla Walla, Washington, on the 4th at 15.6 ºC (60 ºF), changed mid to late month with exceptionally cold air resulting in the following daily records: -36.7 ºC (-34 ºF) at Potomac, Montana, -36.1 ºC (-33 ºF) at Libby, Montana, -28.3 ºC (-19 ºF) at Meacham, Oregon, -21.7 ºC (-7 ºF) at Shoup, Idaho, -34.4 ºC (-30 ºF) at Stanley, Idaho, -3.9 ºC (25 ºF) at Seattle, Washington, -22.2 ºC (-8 ºF) at Boundary Dam, Washington, and -15.6 ºC (4 ºF) at Wenatchee, Washington. The month ended up cold, at -1.2 ºC (-2.1 ºF) from normal. January precipitation was 103 percent of normal at Columbia above Coulee, 115 percent of normal at the Snake River above Ice Harbor, and 106 percent of normal at Columbia above The Dalles. We did see daily record precipitation: 3.71 cm (1.46”) at Winthrop, Washington, 1.17 cm (0.46”) at Wenatchee, Washington, 1.37 cm (0.54”) at Coeur d’Alene, Idaho, all early in the month, but the heavier amounts late: Again Coeur d’Alene, Idaho, with 4.32 cm (1.70”), Mullan Pass, Idaho, 3.58 cm (1.41”), Kellogg, Idaho, 2.41 cm (0.95”), Stanley, Idaho, 1.09 cm (0.43”), and Ritzville, Washington, 1.37 cm (0.54”). Some record, daily precipitation continued into early February, and this was a prelude to mild weather, deeper into February.

Starting out chilly, February 2008 warmed to produce some record high temperatures: Quillayute, Washington, 15.6 ºC (60 ºF), Seattle, Washington, 13.9 ºC (57 ºF) and 16.1 ºC (61 ºF). We did not see record low temperatures. Relative to normal, February departed +0.7 ºC (+1.2 ºF). A ridge of high pressure, that frequently moved far offshore allowing the chilly weather systems from mid December through January to enter, moved in overhead for much of the month bringing warmth. At the bookends, we saw precipitation that set records. Registering on the 3rd, Goldendale, Washington, had 1.14 cm (0.45”), Yakima, Washington, 1.12 cm (0.44”), Sunnyside, Washington, 0.84 cm (0.33”), and Long Creek, Oregon, 0.30 cm (0.12”). At month’s end, and within the region, Winnemucca, Nevada recorded 0.81 cm (0.32”). February precipitation was 92 percent of normal at Columbia above Coulee, 94 percent of normal at Snake River above Ice Harbor, and 89 percent of normal at Columbia above The Dalles.

By March, the La Niña event had peaked but continued to signal higher than normal pressure just off the Pacific Northwest coast. The high kept most areas of the basin drier than normal, except where the northwest flow of the past couple of months edged toward the northern Rockies. Here, persistent precipitation kept snowfall in the headwater drainages nearest the Continental Divide. It was a cool month: -1.2 ºC (-2.2 ºF) was the departure.

March had some record low temperatures: Chief Joseph Dam, Washington, with -3.9 ºC (25 ºF), Yakima, Washington, with -6.7 ºC (20 ºF), Madras, Oregon, with -7.8 ºC (18 ºF), and Redmond, Oregon at -12.2 ºC (10 ºF). It was generally a drier than normal month, with Columbia above Coulee registering 79 percent of normal precipitation, the Snake River above Ice Harbor at 92 percent of normal, and 88 percent of normal at Columbia above The Dalles.

In April, an early period warm spell led to record high temperatures at Boise, Idaho, and Burns, Oregon, each with 26.7 ºC (80 ºF), and tying record high temperatures for Missoula and Kalispell, Montana, at 26.1 and 23.3 ºC (79 and 74 ºF), respectively. Again caused by the position of high pressure, a strengthening offshore brought very cold air into the basin. As such, and given the time of year when very chilly air stands out against an increasing sun angle and warmth, a long list of record low temperatures was observed. A partial list includes Rome, Oregon, with -6.7 ºC (20 ºF), Montague, Oregon, with -7.8 ºC (18 ºF), Monument, Oregon, with -4.4 ºC (24 ºF), McCall, Idaho, with -13.3 ºC (8 ºF), Jerome, Idaho, with -5.6 ºC (22 ºF), Challis, Idaho, with -7.8 ºC (18 ºF), Anaconda, Montana, with -12.8 ºC (9 ºF), and -13.9 ºC (7 ºF) at Butte, Washington. Record low maximum temperatures occurred as well: SeaTac, Washington, with 8.9 ºC (48 ºF), Olympia with 6.7 ºC (44 ºF), and Bellingham, Washington, with 8.3 ºC (47 ºF). Regional temperatures departed -2.4 ºC (-4.4 ºF) from normal. Much cooler than normal weather delayed the snowmelt. Precipitation in April averaged 102 percent of normal at Columbia above Coulee, 106 percent of normal at the Snake River above Ice Harbor, and 103 percent of normal at Columbia above The Dalles.

Spring brought warmer temperatures in May, and the region departed +0.4 ºC (+0.8 ºF), with a run of abruptly warmer than normal weather about mid month. This depleted the lower elevation snowpack, as well as brought snowmelt rises to flood stage on many Columbia Basin tributaries. Some record rainfall fell over southern Oregon this month: Medford saw a daily record of 1.14 cm (0.45”) and Klamath Falls had 1.32 cm (0.52”). For the month, precipitation was 99 percent of normal at Columbia above Coulee, 102 percent of normal at the Snake River above Ice Harbor, and 100 percent of normal at Columbia above The Dalles.

June regional temperatures departed -1.6 ºC (-2.8 ºF), coldest relative to normal in B.C., northeast Washington and in the Willamette Basin. There remained mid through high elevation snow, although mid elevation amounts edged downward. Precipitation was below normal in the most southern U.S. basins, but above normal in western Washington, coastal Oregon, in northern Idaho, northwest Montana, and in B.C. The benefits in Canada offset the U.S. deficits: precipitation was 98 percent of normal at Columbia above Coulee, 99 percent of normal at the Snake above Ice Harbor, and 99 percent of normal at Columbia above The Dalles.

Summer temperatures in July experienced regional departures to +0.7 ºC (+1.2 ºF) from normal. This caused peak runoff conditions especially early to mid month. The warmest temperatures, relative to normal were east of the Cascades. A mid month "heat wave" west of the Cascades just gave Portland a quick run at 32.2 ºC (90 ºF) heat. The high pressure that was once offshore moved inland during the month, and attempted to pull monsoonal moisture northward into the basin. Combined with cool fronts across Canada, the regional precipitation was 95 percent of normal at Columbia above Coulee, 96 percent of normal at the Snake River above Ice Harbor, and 96 percent of normal at Columbia above The Dalles.

A moisture surge from the south occurred in August, as did the hottest temperatures of the summer. High pressure from July was solidly and strongly inland for August, bringing record heat, as well as warm overnight temperatures. The region recorded a +0.8 ºC (+1.5 ºF) departure for the month, and this is noticeable since August is the warmest month of the year for much of Basin. Daily record high temperatures included Portland, Oregon, 38.9 ºC (102 ºF), Medford, Oregon, 42.2 ºC (108 ºF), Pendleton, Oregon, 40.6 ºC (105 ºF), Baker, Oregon, 36.7 ºC (98 ºF), Vancouver, Washington, 38.3 ºC (101 ºF), and Missoula, Montana, 37.8 ºC (100 ºF). Record high overnight temperatures included Portland, Oregon, 20.0 ºC (68 ºF), SeaTac, Washington, 19.4 ºC (67 ºF), Vancouver, Washington, 22.2 ºC (72 ºF), and Stampede Pass, Washington, 22.8 ºC (73 ºF). Record daily rainfall occurred mid to late in the month at Redmond, Oregon, with 1.98 cm (0.78"), and Mullan Pass, Idaho, with 2.72 cm (1.07"). Precipitation was 99 percent of normal at Columbia above Coulee, 95 percent of normal for the Snake River above Ice Harbor, and 97 percent of normal at Columbia above The Dalles.

Upper-level high pressure sat offshore of, yet close enough to, the basin, to bring generally drier than normal weather to the region for September. As such, precipitation was below normal, except in the far northern Upper Columbia, where amounts were near normal. Storms broke through the top of the high mid to late in the month, and brought some isolated daily record rainfall amounts amidst the drier conditions. They include Kalispell, Montana, with 2.2 cm (0.87"), Seattle, Washington, with 1.3cm (0.53"), Boise, Idaho, 2.3 cm (0.90"), and Mullan Pass, Idaho, with 1.6 cm (0.63"). Overall, precipitation was 97 percent of normal at Columbia above Grand Coulee, 92 percent of normal at the Snake River above Ice Harbor, and 95 percent of normal at Columbia above The Dalles.

There were combinations of record low and high temperatures, as the upper high brought cool northwest flow inland at times, as well as intermittently moving inland for warming. The record highs outnumbered the lows: Record daily highs set at Portland, Oregon, 32.8° C (91° F), Omak, Washington, 32.8° C (91° F), Bellingham, Washington, 25.0° C (77° F), Kalispell, Montana, 29.4° C (85° F), and 34.4° C (94° F) at Boise, Idaho. Record low temperatures fell at Rome, Oregon, at 1.1° C (34° F), and Porthill, Idaho, at -5.0° C (23° F). For the region, and despite some of these record high temperatures, departures ended at 0.3° C (+0.5° F) from normal.

## Stream Flow

The observed inflow and outflow hydrographs for the Canadian reservoirs for the period 1 July 2007 through 31 July 2008 are shown on Charts 5-7. Libby hydrographs are shown in Chart 8. Observed flow, as well as computed unregulated flow hydrographs for the same 13-month period for Kootenay Lake, Columbia River at Birchbank, Grand Coulee, and The Dalles are shown on Charts 9-12, respectively. Observed and unregulated flow hydrographs at The Dalles during the April-July 2008 period, including a plot of flows occurring if regulated only by the four Treaty reservoirs, are provided in Chart 13. Composite operating year unregulated stream flows in the Basin above The Dalles were below normal and approximately 0.5 percent above last year's below average stream flows. Month-average unregulated inflows during spring runoff were highest in June 2008 at 110 percent of average at The Dalles. The August 2007 through July 2008 runoff for The Dalles was 151.6 $km^3$ (122.9 Maf), 89 percent of the 1971-2000 average. The peak-unregulated discharge for the Columbia River at The Dalles was 19,576 $m^3/s$ (691.3 kcfs) on 3 June 2008. The 2007-08 average monthly unregulated stream flows and their percentage of the 1971-2000 average monthly flows are shown in the following tables (metric and English) for the Columbia River at Grand Coulee and The Dalles. These flows have been adjusted to exclude the effects of regulation provided by storage reservoirs.

## Columbia River Unregulated Stream Flow

| Time Period | At Grand Coulee cfs | $m^3/s$ | % of Avg. | At The Dalles cfs | $m^3/s$ | % of Avg. |
|---|---|---|---|---|---|---|
| Aug 2007 | 71,357 | 2,021 | 68 | 94,866 | 2,686 | 69 |
| Sep 2007 | 41,194 | 1,166 | 66 | 65,050 | 1,842 | 70 |
| Oct 2007 | 43,815 | 1,241 | 98 | 76,478 | 2,166 | 92 |
| Nov 2007 | 38,086 | 1,078 | 78 | 74,928 | 2,122 | 79 |
| Dec 2007 | 38,125 | 1,080 | 88 | 78,722 | 2,229 | 80 |
| Jan 2008 | 30,435 | 862 | 73 | 65,715 | 1,861 | 64 |
| Feb 2008 | 30,348 | 859 | 64 | 73,404 | 2,079 | 60 |
| Mar 2008 | 38,499 | 1,090 | 62 | 96,313 | 2,727 | 62 |
| Apr 2008 | 56,969 | 1,613 | 47 | 119,767 | 3,391 | 50 |
| May 2008 | 310,562 | 8,794 | 117 | 508,747 | 14,406 | 117 |
| Jun 2008 | 331,514 | 9,387 | 107 | 518,851 | 14,692 | 110 |
| Jul 2008 | 186,886 | 5,292 | 97 | 257,853 | 7,302 | 100 |
| Annual Avg. | 101,898 | 2,885 | 91 | 169,733 | 4,806 | 89 |

## Seasonal Runoff Forecasts and Volumes

April-August 2008 runoff volumes, adjusted to exclude the effects of regulation of upstream storage, are listed below for eight locations in the Columbia Basin:

| Location | Volume in $km^3$ | Volume in Maf | Percent of 1971-2000 Average |
|---|---|---|---|
| Libby Reservoir Inflow | 4.49 | 3.640 | 89 |
| Duncan Reservoir Inflow | 1.59 | 1.289 | 96 |
| Mica Reservoir Inflow | 8.63 | 6.996 | 94 |
| Arrow Reservoir Inflow | 17.31 | 14.033 | 93 |
| Columbia River at Birchbank | 31.03 | 25.156 | 95 |
| Grand Coulee Reservoir Inflow | 48.43 | 39.262 | 99 |
| Snake River at Lower Granite | 19.70 | 15.971 | 106 |
| Columbia River at The Dalles | 75.56 | 61.256 | 100 |

Forecasts of seasonal runoff volume, based on precipitation and snowpack data, were prepared in 2008 for a large number of locations in the Columbia River Basin and updated each month as the season advanced. Table 1 and Table 1M list the April through August inflow volume forecasts for Mica, Arrow, Duncan, and Libby projects as well as The Dalles. The actual runoff volume for these five locations is also given in Tables 1 and 1M. The forecasts for Mica, Arrow, and Duncan inflow were prepared by B.C. Hydro. The forecasts for the lower Columbia River inflows were prepared by the National Weather Service River Forecast Center, in cooperation with the U.S. Army Corps of Engineers, National Resource Conservation Service, Bureau of Reclamation, and B.C. Hydro. The Libby inflow forecast is prepared by the U.S. Army Corps of Engineers. The 1 April 2008 forecast of January through July runoff for the Columbia River above The Dalles was 124.6 $km^3$ (101.0 Maf) and the actual observed runoff was 122 $km^3$ (99.2 Maf).

The following tabulations summarize the monthly forecasts since 1970 of the January-July runoff for the Columbia River above The Dalles compared with the actual runoff volume in $km^3$ and Maf. The average January-July runoff volume for the 1971-2000 periods is 132.4 $km^3$ (107.3 Maf).

# Historic Seasonal Runoff Forecasts and Volumes

## The Dalles, Oregon Volume Runoff Forecasts in $km^3$ (Jan-Jul)

| Year | Jan | Feb | Mar | Apr | May | Jun | Actual |
|---|---|---|---|---|---|---|---|
| 1970 | 101.8 | 122.7 | 115.2 | 116.3 | 117.3 | -- | 118.0 |
| 1971 | 136.8 | 159.7 | 155.4 | 165.3 | 164.1 | 166.5 | 169.6 |
| 1972 | 135.8 | 157.9 | 171.1 | 180.2 | 180.1 | 180.1 | 187.1 |
| 1973 | 114.8 | 111.6 | 104.5 | 102.4 | 99.2 | 97.1 | 87.8 |
| 1974 | 151.7 | 172.7 | 180.1 | 183.8 | 181.3 | 181.3 | 192.8 |
| 1975 | 118.5 | 131.0 | 141.5 | 143.9 | 142.1 | 139.4 | 138.6 |
| 1976 | 139.4 | 143.1 | 149.3 | 153.0 | 153.0 | 153.0 | 151.5 |
| 1977 | 93.4 | 76.7 | 69.0 | 71.7 | 66.4 | 70.8 | 66.4 |
| 1978 | 148.0 | 140.6 | 133.2 | 124.6 | 128.3 | 129.5 | 130.3 |
| 1979 | 108.5 | 97.0 | 114.7 | 107.7 | 110.6 | 110.6 | 102.5 |
| 1980 | 109.7 | 109.7 | 109.7 | 110.6 | 111.8 | 120.5 | 118.2 |
| 1981 | 130.7 | 104.2 | 104.2 | 101.0 | 102.6 | 118.3 | 127.5 |
| 1982 | 135.7 | 148.0 | 155.4 | 160.4 | 161.6 | 157.9 | 160.2 |
| 1983 | 135.7 | 133.2 | 139.4 | 149.3 | 149.3 | 146.8 | 146.4 |
| 1984 | 139.4 | 127.0 | 120.4 | 125.8 | 132.0 | 140.6 | 146.9 |
| 1985 | 161.6 | 134.4 | 129.5 | 121.6 | 121.6 | 123.3 | 108.2 |
| 1986 | 119.4 | 115.1 | 127.0 | 130.7 | 133.2 | 133.2 | 133.6 |
| 1987 | 109.7 | 101.0 | 96.2 | 98.7 | 94.6 | 93.5 | 94.4 |
| 1988 | 97.7 | 92.3 | 89.7 | 91.3 | 93.9 | 92.5 | 90.9 |
| 1989 | 124.6 | 125.8 | 116.2 | 122.7 | 121.6 | 119.5 | 111.8 |
| 1990 | 106.7 | 124.6 | 128.3 | 118.4 | 118.4 | 122.7 | 123.0 |
| 1991 | 143.1 | 135.7 | 132.0 | 130.7 | 130.7 | 128.3 | 132.1 |
| 1992 | 114.2 | 109.9 | 103.0 | 87.8 | 87.8 | 83.6 | 86.8 |
| 1993 | 114.2 | 106.7 | 95.3 | 94.5 | 88.7 | 106.2 | 108.5 |
| 1994 | 98.3 | 94.1 | 96.3 | 90.3 | 93.1 | 94.2 | 92.5 |
| 1995 | 124.7 | 122.9 | 116.3 | 122.9 | 122.9 | 120.8 | 128.3 |
| 1996 | 143.1 | 150.5 | 160.4 | 155.4 | 165.3 | 173.9 | 171.8 |
| 1997 | 170.2 | 178.9 | 175.2 | 183.8 | 188.7 | 196.1 | 196.1 |
| 1998 | 106.6 | 117.4 | 113.1 | 112.0 | 109.9 | 124.6 | 128.3 |
| 1999 | 143.1 | 148.0 | 160.4 | 157.9 | 153.0 | 151.7 | 153.1 |
| 2000 | 129.5 | 130.7 | 129.5 | 129.5 | 129.5 | 125.8 | 120.9 |
| 2001 | 99.2 | 81.9 | 72.3 | 69.2 | 69.7 | 68.5 | 71.8 |
| 2002 | 123.3 | 125.8 | 120.0 | 118.9 | 121.1 | 123.3 | 128.0 |
| 2003 | 99.3 | 93.3 | 92.4 | 105.2 | 111.3 | 110.1 | 108.2 |
| 2004 | 127.0 | 123.3 | 114.6 | 103.9 | 98.1 | 105.0 | 102.3 |
| 2005 | 105.6 | 101.6 | 87.2 | 91.0 | 92.1 | 98.4 | 100.3 |
| 2006 | 125.0 | 137.0 | 132.0 | 132.0 | 136.0 | 137.0 | 141.0 |
| 2007 | 129.5 | 124.6 | 123.3 | 123.3 | 122.2 | 118.9 | 118.1 |
| 2008 | 125.8 | 127.0 | 127.0 | 124.6 | 120.0 | 121.1 | 122.4 |

## The Dalles, Oregon Volume Runoff Forecasts in Maf (Jan-Jul)

| Year | Jan | Feb | Mar | Apr | May | Jun | Actual |
|---|---|---|---|---|---|---|---|
| 1970 | 82.5 | 99.5 | 93.4 | 94.3 | 95.1 | -- | 95.7 |
| 1971 | 110.9 | 129.5 | 126.0 | 134.0 | 133.0 | 135.0 | 137.5 |
| 1972 | 110.1 | 128.0 | 138.7 | 146.1 | 146.0 | 146.0 | 151.7 |
| 1973 | 93.1 | 90.5 | 84.7 | 83.0 | 80.4 | 78.7 | 71.2 |
| 1974 | 123.0 | 140.0 | 146.0 | 149.0 | 147.0 | 147.0 | 156.3 |
| 1975 | 96.1 | 106.2 | 114.7 | 116.7 | 115.2 | 113.0 | 112.4 |
| 1976 | 113.0 | 116.0 | 121.0 | 124.0 | 124.0 | 124.0 | 122.8 |
| 1977 | 75.7 | 62.2 | 55.9 | 58.1 | 53.8 | 57.4 | 53.8 |
| 1978 | 120.0 | 114.0 | 108.0 | 101.0 | 104.0 | 105.0 | 105.6 |
| 1979 | 88.0 | 78.6 | 93.0 | 87.3 | 89.7 | 89.7 | 83.1 |
| 1980 | 88.9 | 88.9 | 88.9 | 89.7 | 90.6 | 97.7 | 95.8 |
| 1981 | 106.0 | 84.5 | 84.5 | 81.9 | 83.2 | 95.9 | 103.4 |
| 1982 | 110.0 | 120.0 | 126.0 | 130.0 | 131.0 | 128.0 | 129.9 |
| 1983 | 110.0 | 108.0 | 113.0 | 121.0 | 121.0 | 119.0 | 118.7 |
| 1984 | 113.0 | 103.0 | 97.6 | 102.0 | 107.0 | 114.0 | 119.1 |
| 1985 | 131.0 | 109.0 | 105.0 | 98.6 | 98.6 | 100.0 | 87.7 |
| 1986 | 96.8 | 93.3 | 103.0 | 106.0 | 108.0 | 108.0 | 108.3 |
| 1987 | 88.9 | 81.9 | 78.0 | 80.0 | 76.7 | 75.8 | 76.5 |
| 1988 | 79.2 | 74.8 | 72.7 | 74.0 | 76.1 | 75.0 | 73.7 |
| 1989 | 101.0 | 102.0 | 94.2 | 99.5 | 98.6 | 96.9 | 90.6 |
| 1990 | 86.5 | 101.0 | 104.0 | 96.0 | 96.0 | 99.5 | 99.7 |
| 1991 | 116.0 | 110.0 | 107.0 | 106.0 | 106.0 | 104.0 | 107.1 |
| 1992 | 92.6 | 89.1 | 83.5 | 71.2 | 71.2 | 67.8 | 70.4 |
| 1993 | 92.6 | 86.5 | 77.3 | 76.6 | 71.9 | 86.1 | 88.0 |
| 1994 | 79.7 | 76.3 | 78.1 | 73.2 | 75.5 | 76.4 | 75.0 |
| 1995 | 101.1 | 99.6 | 94.3 | 99.6 | 99.6 | 97.9 | 104.0 |
| 1996 | 116.0 | 122.0 | 130.0 | 126.0 | 134.0 | 141.0 | 139.3 |
| 1997 | 138.0 | 145.0 | 142.0 | 149.0 | 153.0 | 159.0 | 159.0 |
| 1998 | 86.4 | 95.2 | 91.7 | 90.8 | 89.1 | 101.0 | 104.0 |
| 1999 | 116.0 | 120.0 | 130.0 | 128.0 | 124.0 | 123.0 | 124.1 |
| 2000 | 105.0 | 106.0 | 105.0 | 105.0 | 105.0 | 102.0 | 98.0 |
| 2001 | 80.4 | 66.4 | 58.6 | 56.1 | 56.5 | 55.5 | 58.2 |
| 2002 | 100.0 | 102.0 | 97.3 | 96.4 | 98.2 | 100.0 | 103.8 |
| 2003 | 80.5 | 75.6 | 74.9 | 85.3 | 90.2 | 89.3 | 87.7 |
| 2004 | 103.0 | 100.0 | 92.9 | 84.2 | 79.5 | 85.1 | 83.0 |
| 2005 | 85.6 | 82.4 | 70.7 | 73.8 | 74.7 | 79.8 | 81.3 |
| 2006 | 101.0 | 111.0 | 107.0 | 107.0 | 110.0 | 111.0 | 114.7 |
| 2007 | 105.0 | 101.0 | 100.0 | 100.0 | 99.1 | 96.4 | 95.7 |
| 2008 | 102.0 | 103.0 | 103.0 | 101.0 | 97.3 | 98.2 | 99.2 |

# V - RESERVOIR OPERATION

## General

The 2007-08 operating year began with Canadian storage at 99.2 percent full. Libby reservoir (Lake Koocanusa) was about seven feet from full, elevation 748.85 m (2,452.1 ft), at the start of the operating year and releasing water to meet BiOp objectives for flow augmentation for listed salmon species in the U.S.

The 2007–08 operating year water supply in the Columbia Basin above Grand Coulee and the Snake River at Lower Granite were slightly below average. The stream flow at Grand Coulee in April was only 47 percent of normal because of the cool and dry weather. In May the stream flow was 117 percent of average because of warm and wet weather. The remainder of the snowmelt season through July was characterized by average runoff above Grand Coulee.

The CRTOC signed two operating agreements during the 1 August 2007 – 31 July 2008 operating year. The first was to enhance fishery operations at Arrow early in the year. The second was to enhance non-power uses in both the U.S. and B.C. At the end of the 2007–08 operating year Canadian storage was at 91.8 percent on 31 July 2008.

## Canadian Storage Operation

At the beginning of the 2007-08 operating year on 1 August 2007, actual Canadian storage provided under Article II of the Columbia River Treaty (Canadian storage) was at 19.1 $km^3$ (15.4 Maf) or 99.6 percent full. It drafted to a minimum of 2.4 $km^3$ (1.9 Maf) on 4 May 2008. Canadian composite storage refilled to 17.6 $km^3$ (14.2 Maf) or 91.8 percent full on 31 July 2008.

As specified in the DOP, the release of Canadian storage is made effective at the Canadian-U.S. border. Accordingly, releases from individual Canadian projects can vary from the release required by the DOP TSR plus supplemental operating agreements, so long as this variance does not impact the ability of the Canadian system to deliver the sum of CRT outflows from Arrow and Duncan reservoirs. Variances from the DOP storage operation are accumulated in respective Flex accounts. An overrun in an account occurs when actual project releases are greater (contents are lower) than those specified by the DOP.

Conversely, an underrun occurs when actual project releases are less (contents are higher) than those specified by the DOP. Flex accounts for Mica, Revelstoke, Arrow, and Duncan are balanced at any point in time (i.e. sum to zero) to ensure that under/overruns do not impact the total CRT release required at the Canadian-U.S. border. The terms under/overrun are used in the description of Mica Reservoir operations below.

## Mica Reservoir

As shown in Chart 5, Mica (Kinbasket) reservoir was at elevation 753.68 m (2,472.7 ft) on 31 July 2007. The reservoir continued to refill to reach a maximum elevation of 754.3 m (2,474.8 ft) on 10 August 2007, 0.06 m (0.2 ft) below full pool. As inflows continued to recede throughout the fall and winter period and outflows increased to meet winter load requirements, the reservoir drafted steadily, reaching 738.68 m (2,423.5 ft) on 31 December 2007.

Mica continued to run at high generation rates across April/early May to meet high electrical demand. Low inflows due to the delayed freshet combined with high generation requirements resulted in continued drafting of the reservoir to reach a minimum elevation of 718.1 m (2,355.9 ft) on 5 May 2008, 6.2 m (20.3 ft) lower than the 2007 minimum level of 724.3 m (2,376.3 ft). From mid May through early July, Mica generation was reduced to near zero. This reduction shifted generation to the Peace River powerplants to reduce the risk of spill at Williston Reservoir (Peace River). This condition combined with high freshet inflows caused Kinsbasket to refill quite significantly in May through early July. The reservoir continued to fill through late September to reach a maximum elevation of 752.0 m (2467.1 ft), 2.4 m (7.9 ft) from full on 24 September 2008.

Inflow into Mica reservoir was 84 percent of normal over the period August 2007 to December 2007. Over this same period, Mica outflow varied from a monthly average low of about 623 $m^3$/s (22 kcfs) in September to a monthly average high of about 940 $m^3$/s (33.2 cfs) in December. Inflow into Mica reservoir was about 96 percent of normal over the period January to July 2008. Outflow over this same period varied from a monthly average high of 1,036 $m^3$/s (36.6 kcfs) in January to a monthly average low of 20 $m^3$/s (0.7 kcfs) in June.

The Mica project had an underrun of 1084.8 cubic hectometers ($hm^3$) (443.4 thousand second-foot-days (ksfd)) on 31 July 2007. The maximum underrun for the year was 1,696.0 $hm^3$ (693.2 ksfd) on 30 September 2007 and the minimum was -2538.8 $hm^3$ (-1,037.7 ksfd) on 22 April 2008. The underrun as of 31 July 2008 was 461.2 $hm^3$ (188.5 ksfd).

The B.C. Hydro Non-Treaty Storage Agreement (NTSA) active storage account was at 2,452.8 $hm^3$ (1,002.6 ksfd) on 31 July 2007. The corresponding U.S. NTSA account was at 1,904.1 $hm^3$ (778.3 ksfd). There was no NTSA activity during the 2007-08 operating year. Both accounts remained the same as of 31 July 2008. The combined U.S. and Canada NTSA storage space as of 31 July 2008 was about 78 percent full. The NTSA terminated, with respect to release rights, on 30 June 2004. Under the NTSA Extended Provisions, active storage accounts must be refilled no later than 30 June 2011.

## Revelstoke Reservoir

During the 2007-08 operating year, the Revelstoke project was operated as a run-of-river plant with the reservoir level maintained generally within 0.91 m (3.0 ft) of its normal full pool elevation of 573.02 m (1,880.0 ft). During the spring freshet, March through July, the reservoir operated as low as elevation 571.65 m (1,875.5 ft), or 1.37 m (4.5 ft) below full pool, to provide additional operational space to control high local inflows. Changes in Revelstoke storage levels did not affect CRT storage operations.

## Arrow Reservoir

As shown in Chart 6, the Arrow reservoir was at elevation 437.88 m (1,436.6 ft) on 31 July 2007, 2.26 m (7.4 ft) below full pool. As inflows continued to recede throughout the fall and winter period and outflows increased to meet Treaty requirements, the reservoir drafted steadily reaching 432.97 m (1,420.5 ft) on 31 December 2007, near normal for this date. The reservoir continued to draft to reach its minimum level of the year at elevation 430.8 m (1,413.3 ft) on 12 May 2008, about 3.4 m (11 ft) higher than the 2007 minimum and much later than normal due to the delayed freshet.

Arrow reservoir set some new record high levels this year in March and April. The high Arrow levels were primarily due to higher than normal generation from the Upper Columbia (Mica/Revelstoke) generating stations in the fall/winter period to meet loads and filling of

Non-Treaty storage (in 2006-07) resulted in additional water available in Mica and Arrow.

Operations under the NTSA from the previous operating year (2006-07), and Treaty flex operations combined with high snowmelt runoff in May and June, resulted in the Arrow Lakes reservoir refilling up to its Treaty flood control level (maximum possible level) in May and June. The reservoir reached a maximum elevation for the year of 440.0 m (1,443.5 ft) on 6 July 2008, 0.15 m (0.5 ft) from full pool.

Local inflow into Arrow reservoir was 75 percent of normal over the period August to December 2007. Arrow outflow varied from a monthly average low of approximately 889 $m^3$/s (31.4 kcfs) in October to a monthly average high of 1,880 $m^3$/s (66.4 kcfs) in August. Daily outflows in December reached a peak of 1,331 $m^3$/s (47 kcfs) before ramping down to about 1,133 $m^3$/s (40 kcfs) by the end of the month, in preparation for the start of whitefish spawning. During the same period, a number of ramping tests were conducted when flows were dropped at various rates for a couple of hours per day to assess potential impact on fish. Local inflow into Arrow reservoir was 91 percent of normal over the period January to July 2008. Outflow over this same period varied from a monthly average high of 1,348 $m^3$/s (47.6 kcfs) in January to a monthly average low of 708 $m^3$/s (25 kcfs) in April.

As in past years, the Non-Power Uses agreement was negotiated with the U.S. in order to manage Arrow Lakes Reservoir outflows to protect whitefish and rainbow trout spawning and incubation downstream of the Hugh Keenleyside Dam. As a result, from 1 January 2008 to 19 January 2008, Arrow outflow was held on average 1,274 $m^3$/s (45 kcfs) to maintain low river levels during the whitefish peak spawning period. This operation reduced the number of eggs being dewatered during the incubation and emergence period in February and March 2008. Arrow outflow, from February through March 2008, was held above 708 $m^3$/s (25 kcfs) to help protect deposited eggs. These flow changes resulted in a Tier 1 protection level for whitefish for the 2007-08 operating year. During April and May 2008, Arrow outflows were maintained at or above 425 $m^3$/s (15 kcfs) to ensure successful rainbow trout spawning below Arrow, at water levels that could be maintained until hatch. Storage under this agreement, as well as other supplemental agreements helped to increase the Arrow Lakes Reservoir level during the January through August period.

The CRTOC also negotiated and signed other supplemental operating agreements to improve reservoir and river operations in Canada and the U.S. during 2007-08:

- The Fall Storage Agreement, signed in September 2008, allowed Arrow discharges to be reduced in late September through early November, storing additional water in the Arrow Lakes Reservoir. The two countries shared power and fisheries benefits from the agreement.
- The Libby/Arrow Swap Agreement, signed in August 2008, allowed water exchange between Lake Koocanusa and Arrow Lakes Reservoirs, thereby improving summer recreation levels at Lake Kookanusa in August. This agreement raised the level of the Kookanusa reservoir by about 0.85 m (2.8 ft) and lowered the Arrow Lakes reservoir level by 0.30 (1 ft) at the end of August. Even with this reduction, the Arrow Lakes reservoir remained well within the desirable recreation range through Labor Day.

## Duncan Reservoir

Operation of the Duncan reservoir during the 2007-08 operating year attempted to implement the operational constraints agreed upon in the Duncan Water Use Plan (WUP). The Water License Order for the Duncan WUP was issued on 21 December 2007. As shown in Chart 7, the Duncan reservoir refilled to 576.70 m (1,892.06 ft), slightly above full pool on 21 July 2007. After the reservoir was drafted to approximately 576.38 m (1,891 ft), Duncan reservoir was operated to pass inflows through to mid-August, when discharges were gradually increased to target a reservoir elevation of 575.46 m (1,888 ft) by the end of August.

Discharges were increased to about 198 $m^3/s$ (7 kcfs) across September to facilitate drafting of the reservoir prior to the start of the kokanee and whitefish spawning downstream of Duncan Dam. There were a number of flow ramping tests conducted during the month when flows were dropped at various rates from 7 to 3 kcfs for several hours per day to assess potential impact on fish. For the first 3 weeks of October discharges were reduced to maintain a 73 $m^3/s$ (2.6 kcfs) flow at the Duncan River below the Lardeau confluence (DRL) gauging station to facilitate spawning at lower flows to limit the risk of over-winter dewatering of redds. Discharges were increased in the last week of October to bring DRL to a maximum flow of 110 $m^3/s$ (3.9 kcfs) and maintained until 21 December at which point flows were gradually ramped up to 283 $m^3/s$ (10 kcfs) to help support whitefish flows downstream of Keenleyside Dam. For the first 3 weeks of January 2008, Duncan discharge was kept fairly high near 283 $m^3/s$ (10 kcfs) to draft the Duncan reservoir and to help reduce Arrow flows in aid of whitefish spawning.

B.C. Hydro requested a variance to the Duncan Flood Control Curve for 28 February 2008 from 551.0 m (1,807.7 ft) to 552.4 m (1,812.5 ft), which was subsequently approved by the Corps. The additional storage on 28 February increased the ability to maintain a minimum river flow at DRL of 73 $m^3/s$ (2.6 kcfs) for incubation of fish eggs during the March-April period as agreed to under the Duncan WUP. Flows were reduced and held near 113 $m^3/s$ (4 kcfs) for the balance of January and February in order to target a flood control level of 552.4 m (1,812.5 ft) on 29 February 2008. Discharges in March through early May 2008 were adjusted as required to provide a minimum flow of 73 $m^3/s$ (2.6 kcfs) at the DRL and to empty the reservoir prior to the freshet. The reservoir drafted to empty at elevation 546.87 m (1,794.2 ft) on 28 April 2008. Reservoir discharge was reduced to the minimum of 3 $m^3/s$ (0.1 kcfs) on 18 May 2008 to initiate refill. Duncan reservoir continued to pass the minimum flows until early July when discharges were gradually increased to control the rate of refill and minimize flood levels downstream of the dam. The reservoir refilled to a maximum elevation of 576.53 m (1,891.5 ft), 0.15 m (0.5 ft) below full pool on 11 August 2008. A second similar peak level was reached on 21 August 2008 due to a significant precipitation event in the area. Duncan discharges were adjusted as needed across August to accommodate a debris removal operation and to target a reservoir elevation of 575.46 m (1,888 ft) by the end of August.

## Libby Reservoir

Operation of Libby Dam and Lake Koocanusa is shown in Chart 8 of this document. Lake Koocanusa began July 2007 at elevation 746.7 m (2,449.7 ft), 2.9 m (9.4 ft) from full. Inflow to the reservoir was near 849.5 $m^3/s$ (30 kcfs) at the beginning of July and receded to as low as 113.3 $m^3/s$ (4 kcfs) by the end of August 2007. Outflow from Libby Dam was 489.9 $m^3/s$ (17.3 kcfs) at the beginning of July. The State of Montana submitted a System Operations Request (SOR) to the regional forum Technical Management Team (TMT) on 12 June requesting steady outflow of 424.8 $m^3/s$ (15 kcfs) until 21 July, followed by a reduced outflow to 339.8 $m^3/s$ (12 kcfs) through August and into September to keep Lake Koocanusa pool elevations higher for the benefit of recreation through September. The regional forum did not reach consensus to implement the request. The Montana SOR was discussed numerous times at TMT and raised to the Implementation Team. Ultimately the Montana SOR was brought to the Regional Executive level on 17 July. At the Regional Executive meeting, the Corps decided to continue to draft Libby Reservoir 6.1 m (20 ft) from full by the end of August 2007.

As inflow receded in late August, the outflow from Libby Dam was reduced slightly using the U.S. Fish and Wildlife Service (USFWS) ramp rates, such that the outflow was 254.9 $m^3/s$ (9 kcfs) by 1 September. The elevation of Libby Reservoir was 743.4 m (2,439.1 ft) on 31 August 2007. The outflow continued at 254.9 $m^3/s$ (9 kcfs) until 17 September when it was reduced to 169.9 $m^3/s$ (6 kcfs) where it remained until the end of the month, reaching an end of September elevation was 742.2 m (2,435 ft).

In early October, the outflow from the dam was reduced to 135.9 $m^3/s$ (4.8 kcfs), which is near minimum project outflow of 4.0 kcfs.

In Water Year 2008, the project was operated to strict VarQ and did not include flexibility or deviations to achieve other operational goals. Because of this strict adherence to VarQ operating procedures, the likelihood of achieving reservoir refill, and consequently the volume available for summer fish flows, was reduced compared to recent years because of strict adherence to VarQ operating procedures.

Outflow from Libby Dam remained near 135.9 $m^3/s$ (4.8 kcfs) through October. In November, the outflow was increased and both weekly and daily load shaping occurred, consistent with, the 2006 BiOp. Load shaping was used to maximize power objectives. Weekly load shaping outflows were higher during the week and lower on the weekends. Daily load shaping outflows were higher during the day and lower at night. The average outflow from the dam in November was 203.9 $m^3/s$ (7.2 kcfs). All outflow changes continued to follow the ramp rate restrictions described in the U.S. Fish and Wildlife Biological Opinion. Libby Reservoir ended November at elevation 740.7 m (2,430.1 ft).

In December the outflow from Libby Dam increased, and weekly and daily load shaping continued. The average outflow in December was 424.9 $m^3/s$ (15 kcfs). In early December, the first water supply forecast for the Libby Basin for the April through August season was prepared. The forecast was 7.88 $km^3$ (6.39 Maf), 101 percent of average. Because the forecast was in excess of 94 percent of average, the end of December flood control evaluation quantity was 2.50 km³ (2 Maf), and Libby reservoir was operated to reach an elevation 734.9 m (2,411 ft) by the end of December.

January through April, the dam was operated to target each end of month flood control elevation to meet the objectives of the National Oceanographic and Atmospheric Administration (NOAA) Fisheries Biological Opinion. The January final water supply forecast was 7.75 km³ (6.28 Maf), 99 percent of average. The resultant end of January VarQ flood control upper limit was 734.7 m (2,410.3 ft). After the January final water supply forecast was issued, project releases were set to minimum outflow of 113.3 m³/s (4 kcfs). The end of January reservoir elevation was 734.0 m (2,408.2 ft). The February and March water supply forecasts did not vary much from the January forecast. The February final water supply forecast was 8.02 km³ (6.50 Maf), 103 percent of average and March was 7.94 km³ (6.44 Maf), 102 percent of average. The end of February flood control target was 731.4 m (2,399.5 ft). To reach this end of month flood control elevation, Libby Dam weekly and daily load shaped and released an average of 2,23.7 m³/s (7.9 kcfs). The reservoir ended the month at elevation 731.3 m (2399.2 ft). Based on the March final forecast, the 15 and 31 March flood control upper limits were elevation 731.5 m (2,399.8 ft). The project ramped down to minimum flow for the month and reached 730.4 (2,396.2 ft) on 31 March.

The April final water supply forecast had decreased slightly to 8.62 km³ (6.39 Maf), 101 percent of average. The resultant 15 and 30 April flood control upper limits were 732.2 m (2,402.2 ft). The project was on minimum flow the entire month and reached 730.2 m (2,395.7 ft) at the end of the month. With the cold weather in April creating a delay in the runoff, the Salmon Managers submitted a SOR on 29 April which requested a flow increase from Libby so that 5,097.0 m³/s (180 kcfs) could be reach at McNary. Flows were increased to 254.9 m³/s (9 kcfs) on 2 May in response to this request. On 9 May, project outflows were increased to 390.8 m³/s (13.8 kcfs) to operate to VarQ flood control requirements.

Based on the May final water supply forecast of 7.55 km³ (6.12 Maf), the sturgeon volume was in Tier 4, and the computed volume for release for sturgeon was 1.28 km³ (1.04 Maf). The USFWS requested that releases corresponding to this volume begin on 2 June. The request was full load with 5 units for 2 days, then a decrease to 4 units until the selective withdrawal gate system became operable, then revisit. The selective withdrawal gate system at Libby became temporarily inoperable on 22 May. The project had the ability to control water temperatures from units 1 through 4 but not unit 5.

On 5 June, the functionality of the system was restored to near full utility and the USFWS requested the project increase up to 5 unties at full load (beginning 7 June) for 14 days, then decrease discharge to the summer flat flow level using the remainder of the augmentation volume in a gradually receding shape following BiOp ramp rates. The project decreased to full load 4 units on 20 June and the 1.28 km³ (1.04 Maf) was depleted on 26 June, so the morning of 27 June the project was reduced to 481.4 m³/s (17 kcfs). The 481.4 m³/s (17 kcfs) was the estimated flat flow to draft the project to 743.4 m (2,439.0 ft) by the end of August.

Project outflows were reduced on 12 July to 368.1 m³/s (13 kcfs), on 1 August to 339.8 m³/s (12 kcfs) and on 4 August to 311.5 m³/s (11 kcfs) when the estimate for the flat flow to reach 743.4 m (2,439.0 ft) the end of August changed. On 6 August an Agreement of the Columbia River Treaty Operating Committee on the Operation of Canadian Treaty and Libby Storage Reservoirs for the period 2 August 2008 through 31 December 2008 was signed. This agreement allowed for Libby to be above its end month of August 31 target elevation of 743.4 m (2,439 ft). It also allowed for Arrow and Duncan to be below their combined TSR storage amount to offset Libby's storage amount of 60 ksfd. Libby reduced outflows to 283.2 m³/s (10 kcfs) to achieve the agreed upon 60 ksfd swap amount. Flows were adjusted through 31 August between 226.5 and 339.8 m³/s (8 and 12 kcfs) to reach elevation 744.2 m (2,441.7 ft) which swapped 58.6 ksfd. The evening of 31 August outflow was reduced to 226.5 m³/s (8 kcfs). The elevation of Libby Reservoir was 744.2 m (2,441.7 ft) on 31 August 2007. The outflow continued at 226.5 m³/s (8 kcfs) until it was reduced to 69.9 m³/s (6 kcfs) on 9 September. The end of September elevation was 744.0 m (2,440.8 ft).

## Kootenay Lake

As shown in Chart 9, the level of Kootenay Lake at Queens Bay was at elevation 531.94 m (1,745.2 ft) on 31 July 2007. As runoff receded across August, Kootenay Lake reservoir began to draft and discharges were adjusted to control reservoir levels slightly below the IJC limits. When the Kootenay Lake level measured at Nelson was drafted below the trigger elevation of 531.36 m (1,743.32 ft) on 9 August 2007, discharges were adjusted to keep the lake level at or below the control level until the end of August 2007.

The Brilliant Expansion project was completed and the unit declared available for operation on 6 September 2007. Target minimum flows downstream of Brilliant flows are 18 kcfs from December to September and 16 kcfs during October and November. These minimums are subject to water availability.

By 31 December 2007, Kootenay Lake was at an elevation of 531.78 m (1,744.7 ft), 0.18 m (0.6 ft) below the maximum IJC level. Kootenay Lake drafted from January to early April to remain below the IJC Order level and to meet generation requirements. Due to the delayed freshet, Kootenay Lake drafted lower than normal this year to reach a minimum elevation of 529.7 m (1,737.9 ft), a new record minimum for this project. Brilliant releases were reduced to 10 kcfs in early April, significantly below the minimum target of 18 kcfs to prevent further drafting of Kootenay Lake.

The International Kootenay Lake Board of Control, after consultation with Fortis BC declared the Commencement of Spring Rise for Kootenay Lake on 29 April 2008. Following the declaration of spring freshet, Kootenay Lake was operated in accordance to the IJC lowering formula. Kootenay Lake discharge was increased in accordance with the IJC order for Kootenay Lake. Inflow peaked at 3,016 $m^3/s$ (106.5 kcfs) on 21 May 2008. Discharge from the lake peaked at 1,943 $m^3/s$ (68.6 kcfs) on 4 June 2008. Kootenay Lake reached a peak elevation of 533.29 m (1,749.65 ft) on 4 June 2008.

As runoff receded during June, Kootenay Lake Reservoir began to draft and discharges were adjusted to control reservoir levels slightly below the IJC limits. When the Kootenay Lake level measured at Nelson was drafted below the trigger elevation of 531.36 m (1,743.32 ft) on 27 July 2008, discharges were adjusted to keep the lake level at or below the control level until the end of August.

# VI - POWER AND FLOOD CONTROL ACCOMPLISHMENTS

## General

During the period covered by this report, Duncan, Arrow, and Mica reservoirs were operated for power, flood control, and other benefits in accordance with the CRT and operating plans and agreements described in Section III Operating Agreements. Consistent with all DOPs prepared since the installation of generation at Mica, the 2007-08 and 2008-09 DOPs were designed to achieve optimum power generation at-site in Canada and downstream in Canada and the U.S., in accordance with paragraph 7 of Annex A of the CRT.

Power operations for the whole of Canadian storage are determined by the ORC, CRCs, Mica/Arrow project operating criteria, and nonpower constraints as utilized in the Treaty Storage Regulation study (TSR). The ORC calculation includes the VRCs, which are dependent upon the water supply in any given water year, and the VRC is updated each month with the development of a new water supply forecast. The monthly VRC calculations for Mica, Arrow and Duncan are shown in Tables 2 – 4 and 2M – 4M. The calculations for Libby VRCs are shown in Tables 5 and 5M. Libby VRCs are used in the preparation of the TSR.

During the period covered by this report, Libby operated for power during October through December 2007 as described in the LOP and 2003 CRT FCOP. Libby operated to Principal Component Methodology water supply and flood control draft in December 2007. The December forecast was 101 percent of average, and the recommended draft for Libby reservoir was 2.46 $km^3$ (2 Maf), to elevation 734.9 m (2,411 ft) on 31 December.

Libby was operated to its VarQ (Variable Flow) flood control storage reservation diagram in the January through spring period. Lake Koocanusa was below the end of April flood control elevation because Libby Dam was passing minimum flow from mid-March through the end of April and there was insufficient inflow to fill up to the flood control elevation. During the refill period from late April through June, Libby Dam operated in strict accordance with the VarQ Operating Procedures and released 1.28 $km^3$ (1.04 Maf) sturgeon flow augmentation. The reservoir filled to within 4.3 m (14.1 feet) of full in July 2008.

## Flood Control

The 2008 water supply forecasts averaged slightly below normal across the Columbia River Basin and the upper Columbia Basin, while the Snake River Basin slightly above normal. The reservoir system, including the Columbia River Treaty projects, was required to draft for flood control in preparation for the spring freshet. Inflow forecasts and reservoir regulation modeling were done weekly throughout the winter and spring. Projects were operated according to the May 2003 FCOP. The unregulated peak flow at The Dalles, Oregon, shown on Chart 13, was estimated at 19,576 $m^3$/s (691.3 kcfs) on 3 June 2008, and a regulated peak flow of 11,451 $m^3$/s (404.4 kcfs) occurred on 5 June 2008 as measured at the United States Geological Survey gage at The Dalles, Oregon. The unregulated peak stage at Vancouver, Washington, was calculated to be 7.28 m (23.9 ft) on 4 June 2008, and the highest observed stage was 4.51 meters (m) (14.8 ft) on 22 May 2008.

Chart 14 shows the relative filling of Arrow and Grand Coulee during the filling period and compares the regulation to guidelines provided in Chart 6 of the Columbia River Treaty Flood Control Operating Plan. There were no daily operations specified for Arrow, and the projects were able to meet both fish flow and flood control objectives.

For Duncan, a request to deviate from flood control for the end of February from elevation. 1,807.7 feet to elevation 1,812.5 feet was requested, approved, and implemented. For Arrow, a request to deviate 0.26 Maf, or approximately 0.61 m (2 feet), from the end of March through refill was requested, approved, and implemented.

In operating year 2007-08, the Canadian Entity had elected to operate Mica and Arrow to the flood control storage allocations of 4.4 $km^3$ (3.6 Maf) maximum draft at Arrow and 5.03 $km^3$ (4.08 Maf) maximum draft at Mica, as allowed under the 2003 FCOP. This allocation was first incorporated in the AOP for 2006-07.

Computations of the Initial Controlled Flow (ICF) for system flood control operation were made in accordance with the Treaty Flood Control Operating Plan. For 2008, the computed ICF at The Dalles was 9,247.3 $m^3$/s (326.6 kcfs) based on the January forecast; 9,726.69 $m^3$/s (343,495) based on the February forecast; 10,092.07 $m^3$/s (356.4 kcfs) based on the March forecast; 10,102.58 $m^3$/s (356.8 kcfs) based on the April forecast; and 9,286.82 $m^3$/s (328.0 kcfs) based on the May forecast. As mentioned earlier, the observed daily peak flow at The Dalles was 11,451.33 $m^3/s$ (404.4 kcfs), and occurred on 5 June 2008. Table 6 shows data for the May ICF computation.

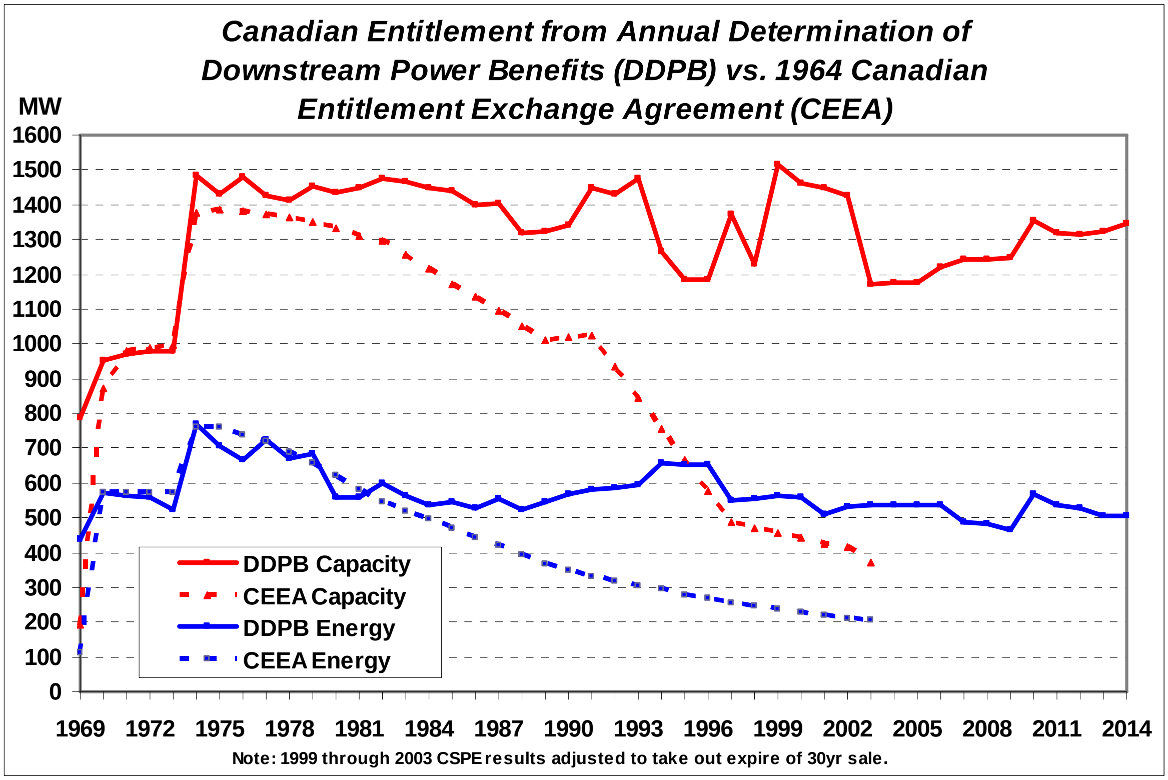
## Canadian Entitlement and Downstream Power Benefits

From 1 August 2007 through 30 September 2008, the U.S. Entity delivered the Canadian Entitlement to downstream power benefits from the operation of Canadian Treaty storage to the Canadian Entity, at existing points of interconnection on the Canada-U.S. border. The amounts returned, not including transmission losses and scheduling adjustments, are listed in Section III Operating Arrangements of this report, under the heading Canadian Entitlement.

No Entitlement power was disposed directly in the U.S. during 1 August 2007 through 30 September 2008, as allowed under specific provisions of the 29 March 1999 Agreement on “Disposals of the Canadian Entitlement within the U.S. for 4/1/98 through 9/15/2024.”

The following Figure 1 shows the historic Canadian Entitlement amounts from the DDPB studies as compared to the estimated amount under the 1964 Canadian Entitlement Exchange Agreement (CEEA).

Figure 1:



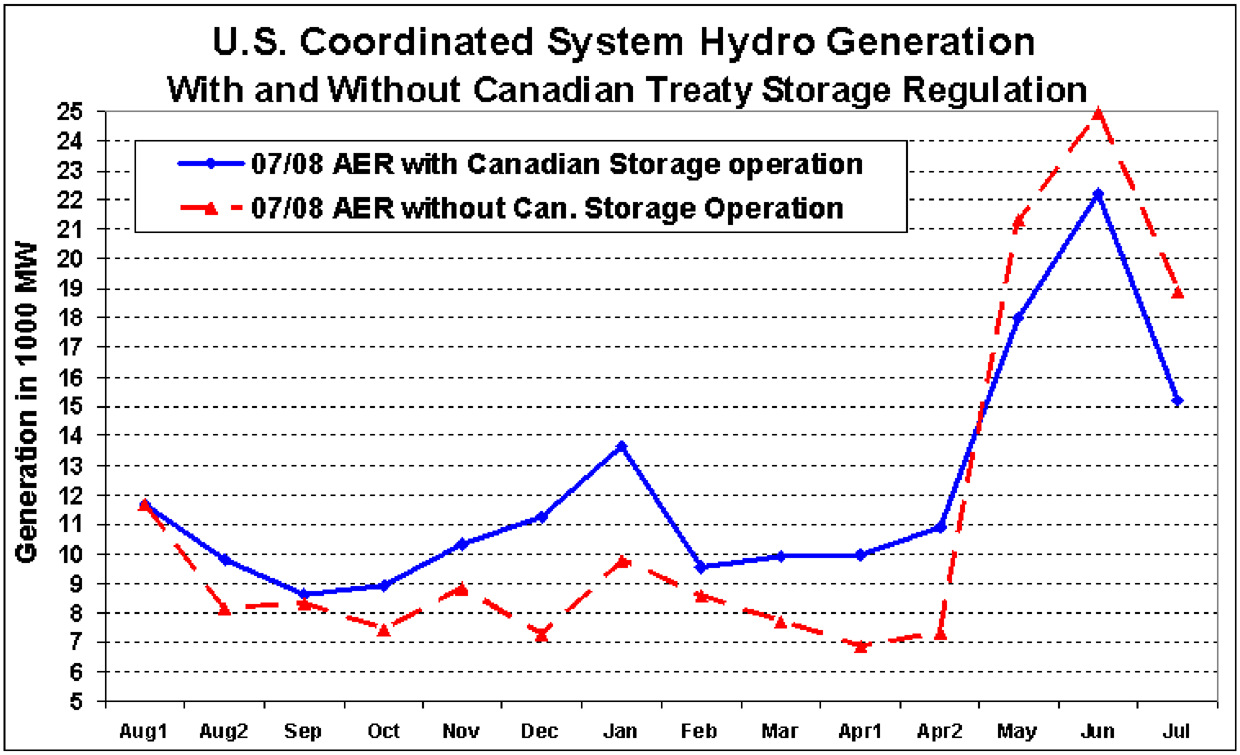
The CEEA estimates of the Canadian Entitlement were based on forecasted load growth that was much higher than the subsequent actual load growth, which is the main reason for the large difference in the Canadian Entitlement between the historic DDPB's and the CEEA estimate.

In accordance with the Canadian Entitlement Allocation Extension Agreement, dated April 1997, the non-federal downstream U.S. projects delivered to BPA their portion of the Canadian Entitlement, and the U.S. Entity granted permission for the non-federal downstream U.S. parties to make use of the U.S. one-half share of the CRT downstream power benefits (U.S. Entitlement).

## Power Generation and Other Accomplishments

Actual U.S. power benefits from the operation of CRT storage are unknown and can only be roughly estimated. Treaty storage has such a large impact on the U.S. system operation that its absence would significantly affect operating procedures, non-power requirements, loads and resources, and market conditions, thus making any benefit analysis highly speculative. Figure 2 shows a rough estimate of the average monthly impact on downstream U.S. power generation during the 2007-08 operating year, with and without the regulation of Canadian storage, based on the Pacific Northwest Coordination Agreement (PNCA) Actual Energy Regulation (AER) that includes minimum flow and spill requirements for U.S. fishery objectives. The increase in average annual U.S. power generation due to the operation of Canadian storage, as measured by the PNCA AER, was 731 aMW. In addition to the increase in average annual U.S. power generation, the Treaty regulation also shifted the timing of generation from the low value freshet period, into higher value winter months. No quantification of this benefit is provided in this report.

Figure 2:




Based on the authority from the 2007-08 and 2008-09 DOPs, the CRTOC completed supplemental operating agreements, described in section III Operating Arrangements, which resulted in power and other benefits both in Canada and the U.S. Other benefits include changes to stream flows below Arrow that enhanced trout and mountain whitefish spawning in Canada and the downstream migration of salmon in the U.S.

In addition, under the Libby Coordination Agreement, the U.S. received one average annual MW from B.C. Hydro. Canada received the benefits of the provisional draft operation at Arrow and related exchanges of power between BC Hydro and BPA, where Arrow was drafted twice beginning the last week in July, continuing in September with a second draft in December.

Figure 3 compares the actual operation of the composite Canadian storage to the results of the DOP TSR study, and the Figure 4 shows the difference in Arrow plus Duncan regulated outflows in the DOP TSR and the actual daily CRT outflows due to these agreements. The daily unregulated stream flow is also shown for comparison purposes.

Figure 3:

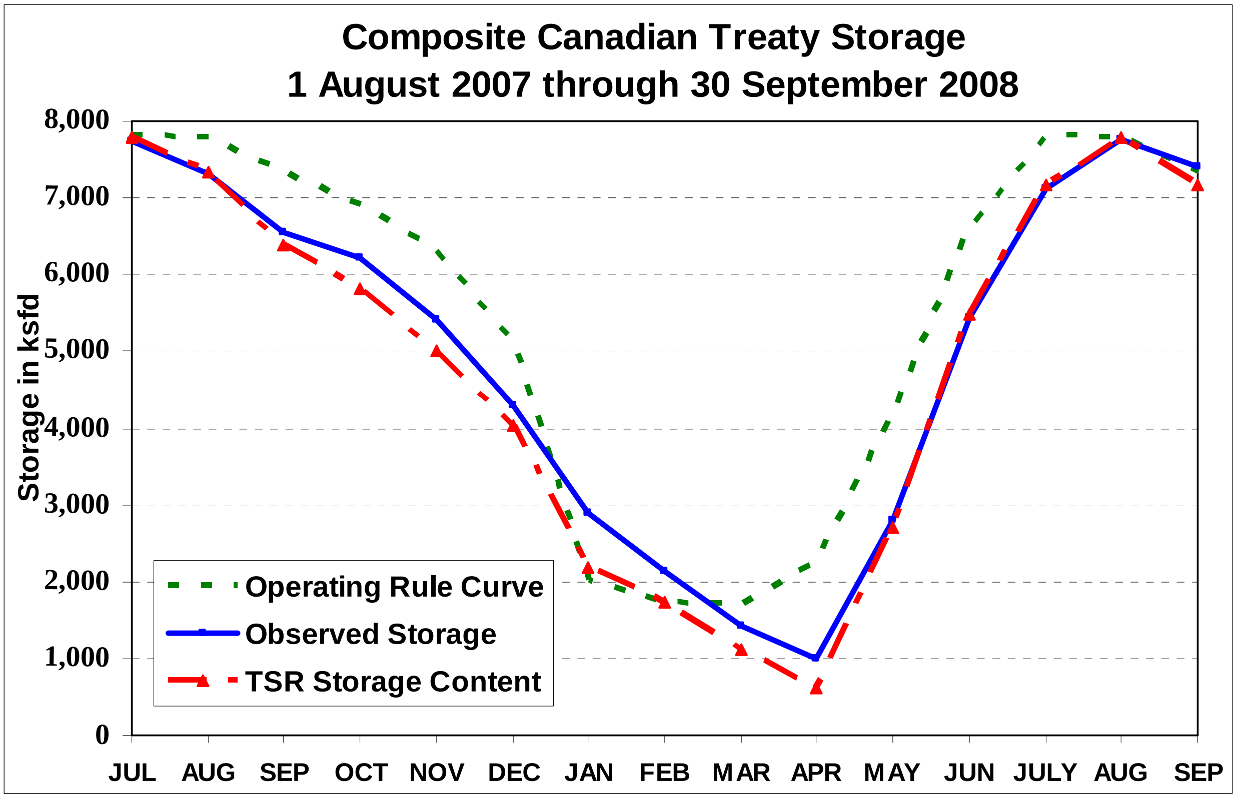
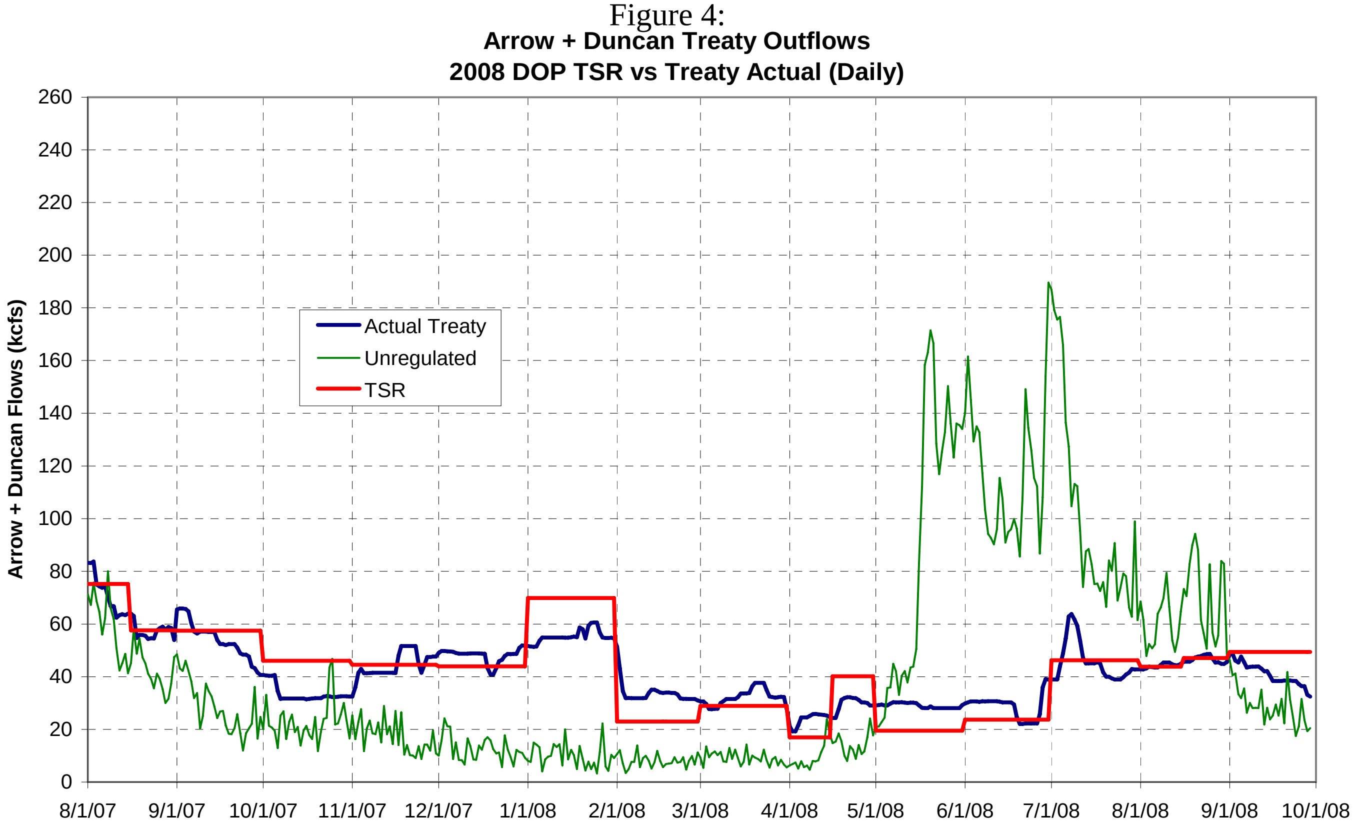



Figure 4:



At the beginning of the 2007-08 operating year, the TSR storage level for Canadian storage was nearly full, and the actual Canadian Treaty storage was about 99.6 percent full. An Entity agreement signed in July 2007 allowed moving the water from the 2007 Operating Year into the 2008 Operating Year. In addition, Non-Treaty space was used during July and August under a letter agreement to smooth Arrow outflows. This resulted in Arrow actual outflows 170 $hm^3$ (6 kcfs) higher than Arrow treaty outflows.

In September, under terms of the LCA, Canada released 206 $hm^3$ (84 ksfd) of LCA provisional draft which was returned by mid November. Beginning in late September and continuing into early November, the U.S. and Canada utilized a supplemental operating agreement to provisionally store above TSR levels (Fall Storage Agreement) by up to 1,113 $hm^3$ (455 ksfd) in November. Canada exercised their LCA provisional draft rights and drafted 274 $hm^3$ (112 ksfd) below TSR by 28 December 2007, with return of the provisional draft beginning in March. Also in December, the U.S. and Canada reached agreement to shape flows from December through July to meet multiple system requirements and fishery needs.

In January 2008, the U.S. stored water for flow augmentation in Mica resulting in an Arrow discharge reduction during the first three weeks of January from 1,727 $m^3/s$ (61 kcfs) to 1,331 $m^3/s$ (47 kcfs) for whitefish spawning. The storage level above TSR reached about 1,762 $hm^3$ (720 ksfd) in January as storage was being managed to maintain smooth flow patterns for whitefish in January, to retain provisional storage, and to store April flow augmentation. In February and March, Arrow actual outflows were reduced to about 850 $m^3/s$ (30 kcfs) to balance the needs of Canadian trout spawning and whitefish. In February all provisional draft was released. With all LCA provisional draft returned by the end of March, the Canadian storage ended the month about 754 $hm^3$ (308 ksfd) above the TSR level. Mica experienced overruns in March through April due to heavy load requirements, causing Arrow to release additional outflow to remain below flood control. A flood control variance was requested and obtained to also maintain flows during fish passage.

During April through late June, Arrow outflows increased from about 651 $m^3/s$ (23 kcfs) to 850 $m^3/s$ (30 kcfs) to balance the needs of B.C. trout spawning, U.S. fisheries, and system load requirements. Flow augmentation releases began in late April and continued through June as inflows receded rapidly, and outflows needed to be maintained at a uniform amount.

In August a Libby Arrow Swap Agreement allowed Arrow to release 147 $hm^3$ (60 ksfd) of storage to be returned by 31 December 2008.

The sum of Canadian storage at the end of July was slightly below DOP TSR amounts (105.2 $m^3$ (43 ksfd)) due to forecast uncertainties during the month. Canadian storage remained slightly below TSR levels through September as the Canadian Entity exercised provisional draft totaling 470 $hm^3$ (192 ksfd) under the LCA and a fall supplemental agreement.

# VII – TABLES

## Table 1: Unregulated Runoff Volume Forecasts

### Most Probable 1-April through 31-August 2008 Forecasts in $km^3$

| First of Month Forecast | Duncan | Arrow | Mica | Libby | Columbia River at The Dalles, Oregon |
|---|---|---|---|---|---|
| January | 2.717 | 29.921 | 14.793 | 7.749 | 108.793 |
| February | 2.576 | 29.152 | 14.459 | 8.015 | 113.234 |
| March | 2.576 | 28.963 | 14.452 | 7.937 | 116.317 |
| April | 2.540 | 28.299 | 14.216 | 7.878 | 116.811 |
| May | 2.445 | 28.316 | 14.226 | 7.544 | 112.123 |
| June | 2.551 | 28.838 | 14.574 | 8.062 | 113.357 |
| Actual | 2.414 | 26.339 | 13.128 | 6.832 | 114.958 |

### Most Probable 1-April through 31-August 2008 Forecasts in Maf

| First of Month Forecast | Duncan | Arrow | Mica | Libby | Columbia River at The Dalles, Oregon |
|---|---|---|---|---|---|
| January | 2.202 | 24.258 | 11.993 | 6.282 | 88.200 |
| February | 2.089 | 23.634 | 11.722 | 6.498 | 91.800 |
| March | 2.088 | 23.481 | 11.716 | 6.435 | 94.300 |
| April | 2.059 | 22.942 | 11.525 | 6.387 | 94.700 |
| May | 1.982 | 22.956 | 11.533 | 6.116 | 90.900 |
| June | 2.068 | 23.379 | 11.816 | 6.536 | 91.900 |
| Actual | 1.957 | 21.353 | 10.643 | 5.539 | 93.198 |

# Table 2M (metric): 2008 Variable Refill Curve for Mica Reservoir

| | | INITIAL | JAN 1 | FEB 1 | MAR 1 | APR 1 | MAY 1 | JUN 1 |
|---|---|---|---|---|---|---|---|---|
| PROBABLE DATE-31JULY INFLOW, km3 | | | 12.3 | 12.0 | 11.7 | 11.2 | 10.9 | 8.8 |
| PROBABLE DATE-31JULY INFLOW, hm3 | ** | | 12270.2 | 12016.0 | 11731.4 | 11227.4 | 10860.5 | 8790.1 |
| 95% FORECAST ERROR FOR DATE, hm3 | | | 1804.7 | 1276.1 | 1115.1 | 1028.3 | 982.9 | 970.5 |
| 95% CONF.DATE-31JULY INFLOW, hm3 | 1/ | | 10465.4 | 10739.9 | 10616.4 | 10199.1 | 9877.6 | 7819.6 |
| ASSUMED FEB1-JUL31 INFLOW, % OF VOL. | | | 100.0 | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, hm3 | 2/ | | 10465.3 | | | | | |
| FEB MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 85.0 | | | | | |
| MIN FEB1-JUL31 OUTFLOW, hm3 | 4/ | | 6410.1 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, hm3 | 5/ | | 4579.3 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, METERS | 6/ | | 742.5 | | | | | |
| JAN31 ORC, m | 7/ | | 741.5 | | | | | |
| BASE ECC, m | 8/ | 741.5 | | | | | | |
| LOWER LIMIT, m | | 732.0 | | | | | | |
| ASSUMED MAR1-JUL31 INFLOW, % OF VOL. | | | 98.0 | 98.0 | | | | |
| ASSUMED MAR1-JUL31 INFLOW, hm3 | 2/ | | 10256.1 | 10525.0 | | | | |
| MAR MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 85.0 | 85.0 | | | | |
| MIN MAR1-JUL31 OUTFLOW, hm3 | 4/ | | 6204.6 | 6204.6 | | | | |
| VRC FEB28 RESERVOIR CONTENT, hm3 | 5/ | | 4583.0 | 4314.1 | | | | |
| VRC FEB28 RESERVOIR CONTENT, METERS | 6/ | | 740.7 | 742.1 | | | | |
| FEB28 ORC, m | 7/ | | 741.4 | 741.4 | | | | |
| BASE ECC, m | 8/ | 741.4 | | | | | | |
| LOWER LIMIT, m | | 730.0 | | | | | | |
| ASSUMED APR1-JUL31 INFLOW, % OF VOL. | | | 95.6 | 95.6 | 97.6 | | | |
| ASSUMED APR1-JUL31 INFLOW, hm3 | 2/ | | 10004.9 | 10267.4 | 10361.6 | | | |
| APR MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 85.0 | 85.0 | 85.0 | | | |
| MIN APR1-JUL31 OUTFLOW, hm3 | 4/ | | 5977.0 | 5977.0 | 5977.0 | | | |
| VRC MAR31 RESERVOIR CONTENT, hm3 | 5/ | | 4606.7 | 4344.2 | 4250.0 | | | |
| VRC MAR31 RESERVOIR CONTENT, METERS | 6/ | | 742.9 | 742.2 | 741.9 | | | |
| MAR31 ORC, m | 7/ | | 740.2 | 740.2 | 740.2 | | | |
| BASE ECC, m | 8/ | 741.4 | | | | | | |
| LOWER LIMIT, m | | 729.7 | | | | | | |
| ASSUMED MAY1-JUL31 INFLOW, % OF VOL. | | | 90.7 | 90.7 | 92.5 | 94.8 | | |
| ASSUMED MAY1-JUL31 INFLOW, hm3 | 2/ | | 9492.1 | 9741.1 | 9820.2 | 9668.7 | | |
| MAY MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 85.0 | 85.0 | 85.0 | 85.0 | | |
| MIN MAY1-JUL31 OUTFLOW, hm3 | 4/ | | 5756.8 | 5756.8 | 5756.8 | 5756.8 | | |
| VRC APR30 RESERVOIR CONTENT, hm3 | 5/ | | 4899.3 | 4650.3 | 4571.2 | 4722.7 | | |
| VRC APR30 RESERVOIR CONTENT, METERS | 6/ | | 743.6 | 743.0 | 742.8 | 743.2 | | |
| APR30 ORC, m | 7/ | | 740.2 | 740.2 | 740.2 | 740.2 | | |
| BASE ECC, m | 8/ | 745.8 | | | | | | |
| ASSUMED JUN1-JUL31 INFLOW, % OF VOL. | | | 71.8 | 71.8 | 73.2 | 75.0 | 79.1 | |
| ASSUMED JUN1-JUL31 INFLOW, hm3 | 2/ | | 7514.2 | 7711.2 | 7771.1 | 7649.3 | 7813.2 | |
| JUN MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 962.8 | 962.8 | 962.8 | 962.8 | 962.8 | |
| MIN JUN1-JUL31 OUTFLOW, hm3 | 4/ | | 5529.3 | 5529.3 | 5529.3 | 5529.3 | 5529.3 | |
| VRC MAY31 RESERVOIR CONTENT, hm3 | 5/ | | 6649.6 | 6452.7 | 6392.7 | 6514.6 | 6350.6 | |
| VRC MAY31 RESERVOIR CONTENT, METERS | 6/ | | 748.1 | 747.6 | 747.4 | 747.7 | 747.3 | |
| MAY31 ORC, m | 7/ | | 744.7 | 744.7 | 744.7 | 744.7 | 744.7 | |
| BASE ECC, m | 8/ | 752.9 | | | | | | |
| ASSUMED JUL1-JUL31 INFLOW, % OF VOL. | | | 36.4 | 36.4 | 37.0 | 37.9 | 40.0 | 50.6 |
| ASSUMED JUL1-JUL31 INFLOW, hm3 | 2/ | | 3809.4 | 3909.4 | 3928.0 | 3865.4 | 3951.0 | 3956.6 |
| JUL MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 1132.7 | 1132.7 | 1132.7 | 1132.7 | 1132.7 | 1132.7 |
| MIN JUL1-JUL31 OUTFLOW, hm3 | 4/ | | 3033.8 | 3033.8 | 3033.8 | 3033.8 | 3033.8 | 3033.8 |
| VRC JUN30 RESERVOIR CONTENT, hm3 | 5/ | | 7859.0 | 7758.9 | 7740.3 | 7802.9 | 7717.3 | 7711.7 |
| VRC JUN30 RESERVOIR CONTENT, METERS | 6/ | | 751.0 | 750.8 | 750.8 | 750.9 | 750.7 | 750.7 |
| JUN30 ORC, m | 7/ | | 751.0 | 750.8 | 750.8 | 750.9 | 750.7 | 750.7 |
| BASE ECC, m | 8/ | 752.9 | | | | | | |
| JUL 31 ORC, m | | | 2470.1 | 2470.1 | 2470.1 | 2470.1 | 2470.1 | 2470.1 |

** FORECAST START DATE IS 1FEB OR LATER. OBSERVED INFLOW FROM 1JAN-DATE IS SUBTRACTED.
1/ PROBABLE INFLOW MINUS (95% ERROR & JAN1-DATE INFLOW).
2/ PRECEEDING LINE TIMES 1/.
3/ POWER DISCHARGE REQUIREMENTS.
4/ CUMULATIVE MINIMUM OUTFLOW FROM 3/,DATE TO JULY.
5/ FULL CONTENT (8634.54 hm3) PLUS 4/ MINUS /2.
6/ ELEV FROM 5/, INTERP FROM STORAGE CONTENT TABLE
7/ LOWER OF ELEV. FROM 6/ OR BASE ECC (INTIAL), NOT LESS THAN LOWER LIMIT, BUT NOT MORE THAN FLOOD CONTROL.
8/ HIGHER OF ARC OR CRC1 IN DOP

# Table 2:  2008 Variable Refill Curve for Mica Reservoir

| | | INITIAL | JAN 1 | FEB 1 | MAR 1 | APR 1 | MAY 1 | JUN 1 |
|---|---|---|---|---|---|---|---|---|
| PROBABLE DATE-31JULY INFLOW, KAF | | | 9947.6 | 9741.6 | 9510.9 | 9102.3 | 8804.8 | 7126.3 |
| PROBABLE DATE-31JULY INFLOW, KSFD | ** | | 5015.2 | 4911.3 | 4795.0 | 4589.0 | 4439.0 | 3592.8 |
| 95% FORECAST ERROR FOR DATE, KSFD | | | 737.7 | 521.6 | 455.8 | 420.3 | 401.7 | 396.7 |
| 95% CONF.DATE-31JULY INFLOW, KSFD | 1/ | | 4277.5 | 4389.7 | 4339.2 | 4168.7 | 4037.3 | 3196.1 |
| ASSUMED FEB1-JUL31 INFLOW, % OF VOL. | | | 100.0 | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, KSFD | 2/ | | 4277.5 | | | | | |
| FEB MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 3000.0 | | | | | |
| MIN FEB1-JUL31 OUTFLOW, KSFD | 4/ | | 2620.0 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, KSFD | 5/ | | 1871.7 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, FEET | 6/ | | 2436.0 | | | | | |
| JAN31 ORC, FT | 7/ | | 2432.7 | | | | | |
| BASE ECC, FT | 8/ | 2432.7 | | | | | | |
| LOWER LIMIT, FT | | 2401.5 | | | | | | |
| ASSUMED MAR1-JUL31 INFLOW, % OF VOL. | | | 98.0 | 98.0 | | | | |
| ASSUMED MAR1-JUL31 INFLOW, KSFD | 2/ | | 4192.0 | 4301.9 | | | | |
| MAR MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 3000.0 | 3000.0 | | | | |
| MIN MAR1-JUL31 OUTFLOW, KSFD | 4/ | | 2536.0 | 2536.0 | | | | |
| VRC FEB28 RESERVOIR CONTENT, KSFD | 5/ | | 1873.2 | 1763.3 | | | | |
| VRC FEB28 RESERVOIR CONTENT, FEET | 6/ | | 2430.0 | 2434.6 | | | | |
| FEB28 ORC, FT | 7/ | | 2432.4 | 2432.4 | | | | |
| BASE ECC, FT | 8/ | 2432.4 | | | | | | |
| LOWER LIMIT, FT | | 2395.0 | | | | | | |
| ASSUMED APR1-JUL31 INFLOW, % OF VOL. | | | 95.6 | 95.6 | 97.6 | | | |
| ASSUMED APR1-JUL31 INFLOW, KSFD | 2/ | | 4089.3 | 4196.6 | 4235.1 | | | |
| APR MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 3000.0 | 3000.0 | 3000.0 | | | |
| MIN APR1-JUL31 OUTFLOW, KSFD | 4/ | | 2443.0 | 2443.0 | 2443.0 | | | |
| VRC MAR31 RESERVOIR CONTENT, KSFD | 5/ | | 1882.9 | 1775.6 | 1737.1 | | | |
| VRC MAR31 RESERVOIR CONTENT, FEET | 6/ | | 2437.2 | 2434.9 | 2434.1 | | | |
| MAR31 ORC, FT | 7/ | | 2428.4 | 2428.4 | 2428.4 | | | |
| BASE ECC, FT | 8/ | 2432.5 | | | | | | |
| LOWER LIMIT, FT | | 2394.1 | | | | | | |
| ASSUMED MAY1-JUL31 INFLOW, % OF VOL. | | | 90.7 | 90.7 | 92.5 | 94.8 | | |
| ASSUMED MAY1-JUL31 INFLOW, KSFD | 2/ | | 3879.7 | 3981.5 | 4013.8 | 3951.9 | | |
| MAY MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 3000.0 | 3000.0 | 3000.0 | 3000.0 | | |
| MIN MAY1-JUL31 OUTFLOW, KSFD | 4/ | | 2353.0 | 2353.0 | 2353.0 | 2353.0 | | |
| VRC APR30 RESERVOIR CONTENT, KSFD | 5/ | | 2002.5 | 1900.7 | 1868.4 | 1930.3 | | |
| VRC APR30 RESERVOIR CONTENT, FEET | 6/ | | 2439.7 | 2437.5 | 2436.9 | 2438.2 | | |
| APR30 ORC, FT | 7/ | | 2428.4 | 2428.4 | 2428.4 | 2428.4 | | |
| BASE ECC, FT | 8/ | 2446.9 | | | | | | |
| ASSUMED JUN1-JUL31 INFLOW, % OF VOL. | | | 71.8 | 71.8 | 73.2 | 75.0 | 79.1 | |
| ASSUMED JUN1-JUL31 INFLOW, KSFD | 2/ | | 3071.3 | 3151.8 | 3176.3 | 3126.5 | 3193.5 | |
| JUN MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 34000.0 | 34000.0 | 34000.0 | 34000.0 | 34000.0 | |
| MIN JUN1-JUL31 OUTFLOW, KSFD | 4/ | | 2260.0 | 2260.0 | 2260.0 | 2260.0 | 2260.0 | |
| VRC MAY31 RESERVOIR CONTENT, KSFD | 5/ | | 2717.9 | 2637.4 | 2612.9 | 2662.7 | 2595.7 | |
| VRC MAY31 RESERVOIR CONTENT, FEET | 6/ | | 2454.3 | 2452.7 | 2452.2 | 2453.1 | 2451.8 | |
| MAY31 ORC, FT | 7/ | | 2443.2 | 2443.2 | 2443.2 | 2443.2 | 2443.2 | |
| BASE ECC, FT | 8/ | 2470.0 | | | | | | |
| ASSUMED JUL1-JUL31 INFLOW, % OF VOL. | | | 36.4 | 36.4 | 37.0 | 37.9 | 40.0 | 50.6 |
| ASSUMED JUL1-JUL31 INFLOW, KSFD | 2/ | | 1557.0 | 1597.9 | 1605.5 | 1579.9 | 1614.9 | 1617.2 |
| JUL MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 40000.0 | 40000.0 | 40000.0 | 40000.0 | 40000.0 | 40000.0 |
| MIN JUL1-JUL31 OUTFLOW, KSFD | 4/ | | 1240.0 | 1240.0 | 1240.0 | 1240.0 | 1240.0 | 1240.0 |
| VRC JUN30 RESERVOIR CONTENT, KSFD | 5/ | | 3212.2 | 3171.3 | 3163.7 | 3189.3 | 3154.3 | 3152.0 |
| VRC JUN30 RESERVOIR CONTENT, FEET | 6/ | | 2464.0 | 2463.2 | 2463.1 | 2463.6 | 2462.9 | 2462.8 |
| JUN30 ORC, FT | 7/ | | 2464.0 | 2463.2 | 2463.1 | 2463.6 | 2462.9 | 2462.8 |
| BASE ECC, FT | 8/ | 2470.1 | | | | | | |
| JUL 31 ORC, FT | | | 2470.1 | 2470.1 | 2470.1 | 2470.1 | 2470.1 | 2470.1 |

** FORECAST START DATE IS 1FEB OR LATER. OBSERVED INFLOW  FROM 1JAN-DATE IS SUBTRACTED.
1/ PROBABLE INFLOW MINUS  (95% ERROR & JAN1-DATE INFLOW).
2/ PRECEEDING LINE TIMES 1/.
3/ POWER DISCHARGE REQUIREMENTS.
4/ CUMULATIVE MINIMUM OUTFLOW FROM 3/,DATE TO JULY.
5/ FULL CONTENT (3529.2 KSFD) PLUS  4/ MINUS /2.
6/ ELEV FROM 5/, INTERP FROM STORAGE CONTENT TABLE
7/ LOWER OF ELEV. FROM 6/ OR BASE ECC (INTIAL), NOT LESS THAN LOWER LIMIT, BUT NOT MORE THAN FLOOD CONTROL.
8/ HIGHER OF ARC OR CRC1 IN DOP

# Table 3M (metric): 2008 Variable Refill Curve for Arrow Reservoir

| | | INITIAL | JAN 1 Total | FEB 1 Total | MAR 1 Total | APR 1 Total | MAY 1 Total | JUN 1 Total |
|---|---|---|---|---|---|---|---|---|
| PROBABLE DATE-31JULY INFLOW, km3 | | | 26.1 | 25.4 | 24.6 | 23.4 | 22.4 | 16.9 |
| & IN hm3 | ** | | 26111.6 | 25386.2 | 24598.6 | 23379.2 | 22413.3 | 16859.5 |
| 95% FORECAST ERROR FOR DATE, IN hm3 | | | 3626.1 | 2680.3 | 2333.3 | 1982.2 | 1767.7 | 1660.2 |
| 95% CONF.DATE-31JULY INFLOW, hm3 | 1/ | | 22485.5 | 22705.9 | 22265.3 | 21397.0 | 20645.6 | 15199.3 |
| | | | | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, % OF VOL. | | | 100.0 | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, hm3 | 2/ | | 22485.5 | | | | | |
| MIN FEB1-JUL31 OUTFLOW, hm3 | 3/ | | 8930.1 | | | | | |
| UPSTREAM DISCHARGE, hm3 | 4/ | | 4551.4 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, hm3 | 5/ | | 21.3 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, METERS | 6/ | | 421.8 | | | | | |
| JAN31 ORC, m | 7/ | | 421.8 | | | | | |
| BASE ECC, m | 8/ | 432.0 | | | | | | |
| LOWER LIMIT, m | | 421.8 | | | | | | |
| | | | | | | | | |
| ASSUMED MAR1-JUL31 INFLOW, % OF VOL. | | | 97.7 | 97.7 | | | | |
| ASSUMED MAR1-JUL31 INFLOW, hm3 | 2/ | | 21968.5 | 22183.6 | | | | |
| MIN MAR1-JUL31 OUTFLOW, hm3 | 3/ | | 8587.6 | 8587.6 | | | | |
| UPSTREAM DISCHARGE, hm3 | 4/ | | 4579.5 | 4579.5 | | | | |
| VRC FEB28 RESERVOIR CONTENT, hm3 | 5/ | | 0.3 | 0.2 | | | | |
| VRC FEB28 RESERVOIR CONTENT, METERS | 6/ | | 420.1 | 420.1 | | | | |
| FEB28 ORC, m | 7/ | | 420.1 | 420.1 | | | | |
| BASE ECC, m | 8/ | 432.2 | | | | | | |
| LOWER LIMIT, m | | 420.1 | | | | | | |
| | | | | | | | | |
| ASSUMED APR1-JUL31 INFLOW, % OF VOL. | | | 94.8 | 94.8 | 97.1 | | | |
| ASSUMED APR1-JUL31 INFLOW, hm3 | 2/ | | 21316.2 | 21525.2 | 21619.6 | | | |
| MIN APR1-JUL31 OUTFLOW, hm3 | 3/ | | 8208.3 | 8208.3 | 8208.3 | | | |
| UPSTREAM DISCHARGE, hm3 | 4/ | | 5032.7 | 5032.7 | 5032.7 | | | |
| VRC MAR31 RESERVOIR CONTENT, hm3 | 5/ | | 682.6 | 473.7 | 379.2 | | | |
| VRC MAR31 RESERVOIR CONTENT, METERS | 6/ | | 422.0 | 421.4 | 421.1 | | | |
| MAR31 ORC, m | 7/ | | 422.0 | 421.4 | 421.1 | | | |
| BASE ECC, m | 8/ | 432.7 | | | | | | |
| | | | | | | | | |
| ASSUMED MAY1-JUL31 INFLOW, % OF VOL. | | | 87.9 | 87.9 | 90.1 | 92.8 | | |
| ASSUMED MAY1-JUL31 INFLOW, hm3 | 2/ | | 19764.9 | 19958.4 | 20060.9 | 19856.4 | | |
| MIN MAY1-JUL31 OUTFLOW, hm3 | 3/ | | 7841.4 | 7841.4 | 7841.4 | 7841.4 | | |
| UPSTREAM DISCHARGE, hm3 | 4/ | | 5032.7 | 5032.7 | 5032.7 | 5032.7 | | |
| VRC APR30 RESERVOIR CONTENT, hm3 | 5/ | | 1867.0 | 1673.5 | 1571.0 | 1775.5 | | |
| VRC APR30 RESERVOIR CONTENT, METERS | 6/ | | 425.2 | 424.7 | 424.4 | 425.0 | | |
| APR30 ORC, Fm | 7/ | | 425.2 | 424.7 | 424.4 | 425.0 | | |
| BASE ECC, m | 8/ | 430.3 | | | | | | |
| | | | | | | | | |
| ASSUMED JUN1-JUL31 INFLOW, % OF VOL | | | 65.3 | 65.3 | 66.9 | 68.9 | 74.3 | |
| ASSUMED JUN1-JUL31 INFLOW, hm3 | 2/ | | 14683.0 | 14826.9 | 14895.4 | 14742.5 | 15339.7 | |
| MIN JUN1-JUL31 OUTFLOW, hm3 | 3/ | | 7462.1 | 7462.1 | 7462.1 | 7462.1 | 7462.1 | |
| UPSTREAM DISCHARGE, hm3 | 4/ | | 3321.7 | 3321.7 | 3321.7 | 3321.7 | 3321.7 | |
| VRC MAY31 RESERVOIR CONTENT, hm3 | 5/ | | 4858.7 | 4714.8 | 4646.3 | 4799.3 | 4202.0 | |
| VRC MAY31 RESERVOIR CONTENT, METERS | 6/ | | 435.3 | 430.0 | 431.6 | 428.6 | 429.1 | |
| MAY31 ORC, m | 7/ | | 432.2 | 431.9 | 431.7 | 432.1 | 430.8 | |
| BASE ECC, m | 8/ | 436.2 | | | | | | |
| | | | | | | | | |
| ASSUMED JUL1-JUL31 INFLOW, % OF VOL. | | | 30.5 | 30.5 | 31.3 | 32.3 | 34.8 | 46.8 |
| ASSUMED JUL1-JUL31 INFLOW, hm3 | 2/ | | 6858.1 | 6925.3 | 6969.1 | 6889.9 | 7185.2 | 7113.2 |
| MIN JUL1-JUL31 OUTFLOW, hm3 | 3/ | | 3792.2 | 3792.2 | 3792.2 | 3792.2 | 3792.2 | 3792.2 |
| UPSTREAM DISCHARGE, hm3 | 4/ | | 775.6 | 875.6 | 894.2 | 831.6 | 917.2 | 922.9 |
| VRC JUN30 RESERVOIR CONTENT, hm3 | 5/ | | 6940.9 | 6900.2 | 6900.2 | 6981.7 | 7132.4 | 7095.7 |
| VRC JUN30 RESERVOIR CONTENT, METERS | 6/ | | 436.6 | 436.5 | 436.5 | 436.7 | 437.0 | 436.9 |
| JUN30 ORC, m | 7/ | | 436.6 | 436.5 | 436.5 | 436.7 | 437.0 | 436.9 |
| BASE ECC, m | 8/ | 437.6 | | | | | | |
| | | | | | | | | |
| JUL 31 ECC, m | | | 1444.0 | 1444.0 | 1444.0 | 1444.0 | 1444.0 | 1444.0 |

** FORECAST START DATE IS 1FEB OR LATER. OBSERVED INFLOW FROM 1JAN-DATE IS SUBTRACTED.
1/ PROBABLE INFLOW MINUS (95% ERROR & JAN1-DATE INFLOW).
2/ PRECEEDING LINE TIMES 1/.
3/ CUMMULATIVE MINIMUM OUTFLOW FROM DATE TO JULY, USING POWER DISCHARGE REQUIREMENTS
4/ UPSTREAM DISCHARGE REQUIREMENT.
5/ MAXIMUM(FULL CONTENT (8757.85 hm3 ) MINUS 2/ PLUS 3/ MINUS /4 OR LOWER LIMIT)
6/ ELEV. FROM 5/, INTERP. FROM STORAGE CONTENT TABLE
7/ LOWER OF ELEV. FROM 6/ OR BASE ECC (INTIAL), NOT LESS THAN LOWER LIMIT, BUT NOT MORE THAN FLOOD CONTROL.
8/ HIGHER OF THE ARC OR CRC1 IN DOP

# Table 3:  2008 Variable Refill Curve for Arrow Reservoir

| | | INITIAL | JAN 1 Total | FEB 1 Total | MAR 1 Total | APR 1 Total | MAY 1 Total | JUN 1 Total |
|---|---|---|---|---|---|---|---|---|
| PROBABLE DATE-31JULY INFLOW, KAF | | | 21169.1 | 20581.0 | 19942.5 | 18953.9 | 18170.8 | 13668.3 |
| & IN KSFD | ** | | 10672.6 | 10376.1 | 10054.2 | 9555.8 | 9161.0 | 6891.0 |
| 95% FORECAST ERROR FOR DATE, IN KSFD | | | 1482.1 | 1095.5 | 953.7 | 810.2 | 722.5 | 678.6 |
| 95% CONF.DATE-31JULY INFLOW, KSFD | 1/ | | 9190.5 | 9280.6 | 9100.5 | 8745.6 | 8438.5 | 6212.4 |
| | | | | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, % OF VOL. | | | 100.0 | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, KSFD | 2/ | | 9190.5 | | | | | |
| MIN FEB1-JUL31 OUTFLOW, KSFD | 3/ | | 3650.0 | | | | | |
| UPSTREAM DISCHARGE, KSFD | 4/ | | 1860.3 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, KSFD | 5/ | | 8.7 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, FEET | 6/ | | 1383.9 | | | | | |
| JAN31 ORC, FT | 7/ | | 1383.9 | | | | | |
| BASE ECC, FT | 8/ | 1417.4 | | | | | | |
| LOWER LIMIT, FT | | 1383.9 | | | | | | |
| | | | | | | | | |
| ASSUMED MAR1-JUL31 INFLOW, % OF VOL. | | | 97.7 | 97.7 | | | | |
| ASSUMED MAR1-JUL31 INFLOW, KSFD | 2/ | | 8979.2 | 9067.1 | | | | |
| MIN MAR1-JUL31 OUTFLOW, KSFD | 3/ | | 3510.0 | 3510.0 | | | | |
| UPSTREAM DISCHARGE, KSFD | 4/ | | 1871.8 | 1871.8 | | | | |
| VRC FEB28 RESERVOIR CONTENT, KSFD | 5/ | | 0.1 | 0.1 | | | | |
| VRC  FEB28 RESERVOIR CONTENT, FEET | 6/ | | 1378.4 | 1378.4 | | | | |
| FEB28 ORC, FT | 7/ | | 1378.4 | 1378.4 | | | | |
| BASE ECC, FT | 8/ | 1418.0 | | | | | | |
| LOWER LIMIT, FT | | 1378.4 | | | | | | |
| | | | | | | | | |
| ASSUMED APR1-JUL31 INFLOW, % OF VOL. | | | 94.8 | 94.8 | 97.1 | | | |
| ASSUMED APR1-JUL31 INFLOW, KSFD | 2/ | | 8712.6 | 8798.0 | 8836.6 | | | |
| MIN APR1-JUL31 OUTFLOW, KSFD | 3/ | | 3355.0 | 3355.0 | 3355.0 | | | |
| UPSTREAM DISCHARGE, KSFD | 4/ | | 2057.0 | 2057.0 | 2057.0 | | | |
| VRC MAR31 RESERVOIR CONTENT, KSFD | 5/ | | 279.0 | 193.6 | 155.0 | | | |
| VRC MAR31 RESERVOIR CONTENT, FEET | 6/ | | 1384.6 | 1382.6 | 1381.7 | | | |
| MAR31 ORC, FT | 7/ | | 1384.6 | 1382.6 | 1381.7 | | | |
| BASE ECC, FT | 8/ | 1419.5 | | | | | | |
| | | | | | | | | |
| ASSUMED MAY1-JUL31 INFLOW, % OF VOL. | | | 87.9 | 87.9 | 90.1 | 92.8 | | |
| ASSUMED MAY1-JUL31 INFLOW, KSFD | 2/ | | 8078.5 | 8157.6 | 8199.5 | 8115.9 | | |
| MIN MAY1-JUL31 OUTFLOW, KSFD | 3/ | | 3205.0 | 3205.0 | 3205.0 | 3205.0 | | |
| UPSTREAM DISCHARGE, KSFD | 4/ | | 2057.0 | 2057.0 | 2057.0 | 2057.0 | | |
| VRC APR30 RESERVOIR CONTENT, KSFD | 5/ | | 763.1 | 684.0 | 642.1 | 725.7 | | |
| VRC APR30 RESERVOIR CONTENT, FEET | 6/ | | 1395.0 | 1393.3 | 1392.5 | 1394.2 | | |
| APR30 ORC, FT | 7/ | | 1395.0 | 1393.3 | 1392.5 | 1394.2 | | |
| BASE ECC, FT | 8/ | 1411.6 | | | | | | |
| | | | | | | | | |
| ASSUMED JUN1-JUL31 INFLOW, % OF VOL | | | 65.3 | 65.3 | 66.9 | 68.9 | 74.3 | |
| ASSUMED JUN1-JUL31 INFLOW, KSFD | 2/ | | 6001.4 | 6060.2 | 6088.2 | 6025.7 | 6269.8 | |
| MIN JUN1-JUL31 OUTFLOW, KSFD | 3/ | | 3050.0 | 3050.0 | 3050.0 | 3050.0 | 3050.0 | |
| UPSTREAM DISCHARGE, KSFD | 4/ | | 1357.7 | 1357.7 | 1357.7 | 1357.7 | 1357.7 | |
| VRC MAY31 RESERVOIR CONTENT, KSFD | 5/ | | 1985.9 | 1927.1 | 1899.1 | 1961.6 | 1717.5 | |
| VRC MAY31 RESERVOIR CONTENT, FEET | 6/ | | 1428.0 | 1410.6 | 1415.9 | 1406.1 | 1407.8 | |
| MAY31 ORC, FT | 7/ | | 1418.1 | 1417.0 | 1416.5 | 1417.6 | 1413.3 | |
| BASE ECC, FT | 8/ | 1431.0 | | | | | | |
| | | | | | | | | |
| ASSUMED JUL1-JUL31 INFLOW, % OF VOL. | | | 30.5 | 30.5 | 31.3 | 32.3 | 34.8 | 46.8 |
| ASSUMED JUL1-JUL31 INFLOW, KSFD | 2/ | | 2803.1 | 2830.6 | 2848.5 | 2816.1 | 2936.8 | 2907.4 |
| MIN JUL1-JUL31 OUTFLOW, KSFD | 3/ | | 1550.0 | 1550.0 | 1550.0 | 1550.0 | 1550.0 | 1550.0 |
| UPSTREAM DISCHARGE, KSFD | 4/ | | 317.0 | 357.9 | 365.5 | 339.9 | 374.9 | 377.2 |
| VRC JUN30 RESERVOIR CONTENT, KSFD | 5/ | | 2837.0 | 2820.3 | 2820.3 | 2853.6 | 2915.2 | 2900.2 |
| VRC JUN30 RESERVOIR CONTENT, FEET | 6/ | | 1432.4 | 1432.1 | 1432.1 | 1432.6 | 1433.6 | 1433.4 |
| JUN30 ORC, FT | 7/ | | 1432.4 | 1432.1 | 1432.1 | 1432.6 | 1433.6 | 1433.4 |
| BASE ECC, FT | 8/ | 1435.6 | | | | | | |
| | | | | | | | | |
| JUL 31 ECC, FT | | | 1444.0 | 1444.0 | 1444.0 | 1444.0 | 1444.0 | 1444.0 |

** FORECAST START DATE IS 1FEB OR LATER. OBSERVED INFLOW  FROM 1JAN-DATE IS SUBTRACTED.
1/ PROBABLE INFLOW MINUS  (95% ERROR & JAN1-DATE INFLOW).
2/ PRECEEDING LINE TIMES 1/.
3/ CUMMULATIVE MINIMUM OUTFLOW FROM DATE TO JULY, USING POWER DISCHARGE REQUIREMENTS
4/ UPSTREAM DISCHARGE REQUIREMENT.
5/ MAXIMUM(FULL CONTENT (3579.6 KSFD ) MINUS 2/ PLUS 3/ MINUS /4 OR LOWER LIMIT)
6/ ELEV. FROM 5/, INTERP. FROM STORAGE CONTENT TABLE
7/ LOWER OF ELEV. FROM 6/ OR BASE ECC (INTIAL), NOT LESS THAN LOWER LIMIT, BUT NOT MORE THAN FLOOD CONTROL.
8/ HIGHER OF THE ARC OR CRC1 IN DOP

# Table 4M (metric): 2008 Variable Refill Curve for Duncan Reservoir

| | | INITIAL | JAN 1 | FEB 1 | MAR 1 | APR 1 | MAY 1 | JUN 1 |
|---|---|---|---|---|---|---|---|---|
| PROBABLE DATE-31JULY INFLOW, km3 | | | 2.3 | 2.2 | 2.2 | 2.1 | 1.9 | 1.5 |
| & IN hm3 | ** | | 2321.8 | 2217.4 | 2166.5 | 2087.4 | 1935.3 | 1464.8 |
| 95% FORECAST ERROR FOR DATE, IN hm3 | | | 309.7 | 256.1 | 256.1 | 231.3 | 210.6 | 190.0 |
| 95% CONF.DATE-31JULY INFLOW, hm3 | 1/ | | 2012.1 | 1961.3 | 1910.4 | 1856.2 | 1724.6 | 1274.8 |
| | | | | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, % OF VOL. | | | 100.0 | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, hm3 | 2/ | | 2012.1 | | | | | |
| FEB MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 2.8 | | | | | |
| MIN FEB1-JUL31 OUTFLOW, hm3 | 4/ | | 517.5 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, hm3 | 5/ | | 232.2 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, METERS | 6/ | | 552.5 | | | | | |
| JAN31 ORC, m | 7/ | | 553.2 | | | | | |
| BASE ECC, m | 8/ | 566.2 | | | | | | |
| LOWER LIMIT, m | | 553.2 | | | | | | |
| | | | | | | | | |
| ASSUMED MAR1-JUL31 INFLOW, % OF VOL. | | | 98.1 | 98.1 | | | | |
| ASSUMED MAR1-JUL31 INFLOW, hm3 | 2/ | | 1973.9 | 1924.0 | | | | |
| MAR MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 2.8 | 2.8 | | | | |
| MIN MAR1-JUL31 OUTFLOW, hm3 | 4/ | | 510.6 | 510.6 | | | | |
| VRC FEB28 RESERVOIR CONTENT, hm3 | 5/ | | 263.5 | 313.4 | | | | |
| VRC FEB28 RESERVOIR CONTENT, METERS | 6/ | | 553.2 | 554.2 | | | | |
| FEB28 ORC, m | 7/ | | 551.0 | 551.0 | | | | |
| BASE ECC, m | 8/ | 563.3 | | | | | | |
| LOWER LIMIT, m | | 549.7 | | | | | | |
| | | | | | | | | |
| ASSUMED APR1-JUL31 INFLOW, % OF VOL. | | | 95.7 | 95.7 | 97.6 | | | |
| ASSUMED APR1-JUL31 INFLOW, hm3 | 2/ | | 1925.5 | 1877.0 | 1864.6 | | | |
| APR MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 2.8 | 2.8 | 2.8 | | | |
| MIN APR1-JUL31 OUTFLOW, hm3 | 4/ | | 503.0 | 503.0 | 503.0 | | | |
| VRC MAR31 RESERVOIR CONTENT, hm3 | 5/ | | 304.4 | 352.8 | 365.3 | | | |
| VRC MAR31 RESERVOIR CONTENT, METERS | 6/ | | 554.0 | 554.9 | 555.2 | | | |
| MAR31 ORC, m | 7/ | | 551.0 | 551.0 | 551.0 | | | |
| BASE ECC, m | 8/ | 558.4 | | | | | | |
| LOWER LIMIT, m | | 547.1 | | | | | | |
| | | | | | | | | |
| ASSUMED MAY1-JUL31 INFLOW, % OF VOL. | | | 89.7 | 89.7 | 91.6 | 93.8 | | |
| ASSUMED MAY1-JUL31 INFLOW, hm3 | 2/ | | 1804.9 | 1759.4 | 1750.1 | 1741.0 | | |
| MAY MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 51.0 | 51.0 | 51.0 | 51.0 | | |
| MIN MAY1-JUL31 OUTFLOW, hm3 | 4/ | | 495.7 | 495.7 | 495.7 | 495.7 | | |
| VRC APR30 RESERVOIR CONTENT, hm3 | 5/ | | 417.6 | 463.1 | 472.4 | 481.5 | | |
| VRC APR30 RESERVOIR CONTENT, METERS | 6/ | | 556.2 | 557.0 | 557.2 | 557.3 | | |
| APR30 ORC, m | 7/ | | 551.0 | 551.0 | 551.0 | 551.0 | | |
| BASE ECC, m | 8/ | 559.6 | | | | | | |
| | | | | | | | | |
| ASSUMED JUN1-JUL31 INFLOW, % OF VOL. | | | 67.5 | 67.5 | 69.0 | 70.6 | 75.3 | |
| ASSUMED JUN1-JUL31 INFLOW, hm3 | 2/ | | 1358.1 | 1323.9 | 1318.2 | 1310.4 | 1298.7 | |
| JUN MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 56.6 | 56.6 | 56.6 | 56.6 | 56.6 | |
| MIN JUN1-JUL31 OUTFLOW, hm3 | 4/ | | 359.2 | 359.2 | 359.2 | 359.2 | 359.2 | |
| VRC MAY31 RESERVOIR CONTENT, hm3 | 5/ | | 727.9 | 762.1 | 767.7 | 775.6 | 787.3 | |
| VRC MAY31 RESERVOIR CONTENT, METERS | 6/ | | 561.6 | 562.2 | 562.3 | 562.4 | 562.6 | |
| MAY31 ORC, m | 7/ | | 561.6 | 562.2 | 562.3 | 562.4 | 562.6 | |
| BASE ECC, m | 8/ | 565.9 | | | | | | |
| | | | | | | | | |
| ASSUMED JUL1-JUL31 INFLOW, % OF VOL. | | | 32.5 | 32.5 | 33.3 | 34.0 | 36.3 | 48.2 |
| ASSUMED JUL1-JUL31 INFLOW, hm3 | 2/ | | 654.0 | 637.3 | 636.1 | 631.0 | 626.1 | 614.3 |
| JUL MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 79.3 | 79.3 | 79.3 | 79.3 | 79.3 | 79.3 |
| MIN JUL1-JUL31 OUTFLOW, hm3 | 4/ | | 212.4 | 212.4 | 212.4 | 212.4 | 212.4 | 212.4 |
| VRC JUN30 RESERVOIR CONTENT, hm3 | 5/ | | 1285.2 | 1301.8 | 1303.1 | 1308.2 | 1313.1 | 1324.8 |
| VRC JUN30 RESERVOIR CONTENT, METERS | 6/ | | 570.3 | 570.6 | 570.6 | 570.7 | 570.7 | 570.9 |
| JUN30 ORC, m | 7/ | | 570.3 | 570.6 | 570.6 | 570.7 | 570.7 | 570.9 |
| BASE ECC, m | 8/ | 571.4 | | | | | | |
| | | | | | | | | |
| JUL 31 ECC, m | | | 576.7 | 576.7 | 576.7 | 576.7 | 576.7 | 576.7 |

** FORECAST START DATE IS 1FEB OR LATER. OBSERVED INFLOW FROM 1JAN-DATE IS SUBTRACTED.
1/ PROBABLE INFLOW MINUS (95% ERROR & JAN1-DATE INFLOW).
2/ PRECEEDING LINE TIMES 1/.
3/ POWER DISCHARGE REQUIREMENTS.
4/ CUMULATIVE MINIMUM OUTFLOW FROM 3/,DATE TO JULY.
5/ FULL CONTENT (1726.81 hm3) PLUS 4/ MINUS /2.
6/ ELEV FROM 5/, INTERP FROM STORAGE CONTENT TABLE.
7/ LOWER OF ELEV. FROM 6/ OR BASE ECC (INTIAL), NOT LESS THAN LOWER LIMIT, BUT NOT MORE THAN FLOOD CONTROL.
8/ HIGHER OF ARC OR CRC1 IN DOP

# Table 4:  2008 Variable Refill Curve for Duncan Reservoir

| | | INITIAL | JAN 1 | FEB 1 | MAR 1 | APR 1 | MAY 1 | JUN 1 |
|---|---|---|---|---|---|---|---|---|
| PROBABLE DATE-31JULY INFLOW, KAF | | | 1882.3 | 1797.6 | 1756.4 | 1692.3 | 1568.9 | 1187.5 |
| & IN KSFD | ** | | 949.0 | 906.3 | 885.5 | 853.2 | 791.0 | 598.7 |
| 95% FORECAST ERROR FOR DATE, IN KSFD | | | 126.6 | 104.7 | 104.7 | 94.5 | 86.1 | 77.6 |
| 95% CONF.DATE-31JULY INFLOW, KSFD | 1/ | | 822.4 | 801.6 | 780.8 | 758.7 | 704.9 | 521.1 |
| ASSUMED FEB1-JUL31 INFLOW, % OF VOL. | | | 100.0 | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, KSFD | 2/ | | 822.4 | | | | | |
| FEB MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 100.0 | | | | | |
| MIN FEB1-JUL31 OUTFLOW, KSFD | 4/ | | 211.5 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, KSFD | 5/ | | 94.9 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, FEET | 6/ | | 1812.8 | | | | | |
| JAN31 ORC, FT | 7/ | | 1814.8 | | | | | |
| BASE ECC, FT | 8/ | 1857.5 | | | | | | |
| LOWER LIMIT, FT | | 1814.9 | | | | | | |
| ASSUMED MAR1-JUL31 INFLOW, % OF VOL. | | | 98.1 | 98.1 | | | | |
| ASSUMED MAR1-JUL31 INFLOW, KSFD | 2/ | | 806.8 | 786.4 | | | | |
| MAR MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 100.0 | 100.0 | | | | |
| MIN MAR1-JUL31 OUTFLOW, KSFD | 4/ | | 208.7 | 208.7 | | | | |
| VRC FEB28 RESERVOIR CONTENT, KSFD | 5/ | | 107.7 | 128.1 | | | | |
| VRC FEB28 RESERVOIR CONTENT, FEET | 6/ | | 1814.9 | 1818.2 | | | | |
| FEB28 ORC, FT | 7/ | | 1807.8 | 1807.8 | | | | |
| BASE ECC, FT | 8/ | 1848.0 | | | | | | |
| LOWER LIMIT, FT | | 1803.4 | | | | | | |
| ASSUMED APR1-JUL31 INFLOW, % OF VOL. | | | 95.7 | 95.7 | 97.6 | | | |
| ASSUMED APR1-JUL31 INFLOW, KSFD | 2/ | | 787.0 | 767.2 | 762.1 | | | |
| APR MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 100.0 | 100.0 | 100.0 | | | |
| MIN APR1-JUL31 OUTFLOW, KSFD | 4/ | | 205.6 | 205.6 | 205.6 | | | |
| VRC MAR31 RESERVOIR CONTENT, KSFD | 5/ | | 124.4 | 144.2 | 149.3 | | | |
| VRC MAR31 RESERVOIR CONTENT, FEET | 6/ | | 1817.6 | 1820.7 | 1821.5 | | | |
| MAR31 ORC, FT | 7/ | | 1807.8 | 1807.8 | 1807.8 | | | |
| BASE ECC, FT | 8/ | 1832.1 | | | | | | |
| LOWER LIMIT, FT | | 1795.1 | | | | | | |
| ASSUMED MAY1-JUL31 INFLOW, % OF VOL. | | | 89.7 | 89.7 | 91.6 | 93.8 | | |
| ASSUMED MAY1-JUL31 INFLOW, KSFD | 2/ | | 737.7 | 719.1 | 715.3 | 711.6 | | |
| MAY MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 1800.0 | 1800.0 | 1800.0 | 1800.0 | | |
| MIN MAY1-JUL31 OUTFLOW, KSFD | 4/ | | 202.6 | 202.6 | 202.6 | 202.6 | | |
| VRC APR30 RESERVOIR CONTENT, KSFD | 5/ | | 170.7 | 189.3 | 193.1 | 196.8 | | |
| VRC APR30 RESERVOIR CONTENT, FEET | 6/ | | 1824.7 | 1827.5 | 1828.0 | 1828.5 | | |
| APR30 ORC, FT | 7/ | | 1807.8 | 1807.8 | 1807.8 | 1807.8 | | |
| BASE ECC, FT | 8/ | 1835.8 | | | | | | |
| ASSUMED JUN1-JUL31 INFLOW, % OF VOL. | | | 67.5 | 67.5 | 69.0 | 70.6 | 75.3 | |
| ASSUMED JUN1-JUL31 INFLOW, KSFD | 2/ | | 555.1 | 541.1 | 538.8 | 535.6 | 530.8 | |
| JUN MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 2000.0 | 2000.0 | 2000.0 | 2000.0 | 2000.0 | |
| MIN JUN1-JUL31 OUTFLOW, KSFD | 4/ | | 146.8 | 146.8 | 146.8 | 146.8 | 146.8 | |
| VRC MAY31 RESERVOIR CONTENT, KSFD | 5/ | | 297.5 | 311.5 | 313.8 | 317.0 | 321.8 | |
| VRC MAY31 RESERVOIR CONTENT, FEET | 6/ | | 1842.5 | 1844.4 | 1844.7 | 1845.1 | 1845.8 | |
| MAY31 ORC, FT | 7/ | | 1842.5 | 1844.4 | 1844.7 | 1845.1 | 1845.8 | |
| BASE ECC, FT | 8/ | 1856.5 | | | | | | |
| ASSUMED JUL1-JUL31 INFLOW, % OF VOL. | | | 32.5 | 32.5 | 33.3 | 34.0 | 36.3 | 48.2 |
| ASSUMED JUL1-JUL31 INFLOW, KSFD | 2/ | | 267.3 | 260.5 | 260.0 | 257.9 | 255.9 | 251.1 |
| JUL MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 2800.0 | 2800.0 | 2800.0 | 2800.0 | 2800.0 | 2800.0 |
| MIN JUL1-JUL31 OUTFLOW, KSFD | 4/ | | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 |
| VRC JUN30 RESERVOIR CONTENT, KSFD | 5/ | | 525.3 | 532.1 | 532.6 | 534.7 | 536.7 | 541.5 |
| VRC JUN30 RESERVOIR CONTENT, FEET | 6/ | | 1871.1 | 1872.0 | 1872.0 | 1872.3 | 1872.5 | 1873.1 |
| JUN30 ORC, FT | 7/ | | 1871.1 | 1872.0 | 1872.0 | 1872.3 | 1872.5 | 1873.1 |
| BASE ECC, FT | 8/ | 1874.7 | | | | | | |
| JUL 31 ECC, FT | | | 1892.0 | 1892.0 | 1892.0 | 1892.0 | 1892.0 | 1892.0 |

** FORECAST START DATE IS 1FEB OR LATER. OBSERVED INFLOW FROM 1JAN-DATE IS SUBTRACTED.
1/ PROBABLE INFLOW MINUS (95% ERROR & JAN1-DATE INFLOW).
2/ PRECEEDING LINE TIMES 1/.
3/ POWER DISCHARGE REQUIREMENTS.
4/ CUMULATIVE MINIMUM OUTFLOW FROM 3/,DATE TO JULY.
5/ FULL CONTENT (705.8 KSFD) PLUS 4/ MINUS /2.
6/ ELEV FROM 5/, INTERP FROM STORAGE CONTENT TABLE.
7/ LOWER OF ELEV. FROM 6/ OR BASE ECC (INTIAL), NOT LESS THAN LOWER LIMIT, BUT NOT MORE THAN FLOOD CONTROL.
8/ HIGHER OF ARC OR CRC1 IN DOP

# Table 5M (metric) - 2008 Variable Refill Curve for Libby Reservoir

| | | INITIAL | JAN 1 | FEB 1 | MAR 1 | APR 1 | MAY 1 | JUN 1 |
|---|---|---|---|---|---|---|---|---|
| PROBABLE JAN.-31JULY INFLOW, km3 | | | 7.8 | 8.0 | 7.8 | 7.7 | 7.4 | 7.9 |
| PROBABLE JAN.-31JULY INFLOW, hm3 | | | 7784.6 | 7969.6 | 7809.3 | 7740.1 | 7436.7 | 7907.9 |
| 95% FORECAST ERROR FOR DATE, hm3 | | | 1593.7 | 1195.2 | 1118.8 | 1084.3 | 980.6 | 941.2 |
| OBSERVED JAN1-DATE INFLOW, IN hm3 | | | 0.0 | 189.9 | 368.7 | 566.1 | 839.9 | 3012.3 |
| 95% CONF.DATE-31JULY INFLOW, hm3 | 1/ | | 6190.9 | 6584.3 | 6321.8 | 6089.8 | 5616.2 | 3954.7 |
| | | | | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, % OF VOL. | | | 96.9 | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, hm3 | 2/ | | 5999.1 | | | | | |
| FEB MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 113.3 | | | | | |
| MIN FEB1-JUL31 OUTFLOW, hm3 | 4/ | | 2666.8 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, hm3 | 5/ | | 2809.9 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, METERS | 6/ | | 728.4 | | | | | |
| JAN31 ORC, m | 7/ | | 728.4 | | | | | |
| BASE ECC, m | 9/ | 735.8 | | | | | | |
| LOWER LIMIT, m | | 722.7 | | | | | | |
| | | | | | | | | |
| ASSUMED MAR1-JUL31 INFLOW, % OF VOL. | | | 94.1 | 97.1 | | | | |
| ASSUMED MAR1-JUL31 INFLOW, hm3 | 2/ | | 5825.6 | 6393.5 | | | | |
| MAR MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 113.3 | 113.3 | | | | |
| MIN MAR1-JUL31 OUTFLOW, hm3 | 4/ | | 2392.8 | 2392.8 | | | | |
| VRC FEB28 RESERVOIR CONTENT, hm3 | 5/ | | 2709.4 | 2141.5 | | | | |
| VRC FEB28 RESERVOIR CONTENT, METERS | 6/ | | 727.5 | 722.5 | | | | |
| FEB28 ORC, m | 7/ | | 727.5 | 722.5 | | | | |
| BASE ECC, m | 9/ | 734.9 | | | | | | |
| LOWER LIMIT, m | | 707.4 | | | | | | |
| | | | | | | | | |
| ASSUMED APR1-JUL31 INFLOW, % OF VOL. | | | 90.6 | 93.5 | 96.3 | | | |
| ASSUMED APR1-JUL31 INFLOW, hm3 | 2/ | | 5609.1 | 6156.4 | 6087.9 | | | |
| APR MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 113.3 | 113.3 | 113.3 | | | |
| MIN APR1-JUL31 OUTFLOW, hm3 | 4/ | | 2089.4 | 2089.4 | 2089.4 | | | |
| VRC MAR31 RESERVOIR CONTENT, hm3 | 5/ | | 2622.5 | 2075.2 | 2143.7 | | | |
| VRC MAR31 RESERVOIR CONTENT, METERS | 6/ | | 726.8 | 721.9 | 722.6 | | | |
| MAR31 ORC, m | 7/ | | 726.8 | 721.9 | 722.6 | | | |
| BASE ECC, m | 9/ | 734.0 | | | | | | |
| LOWER LIMIT, m | | 697.5 | | | | | | |
| | | | | | | | | |
| ASSUMED MAY1-JUL31 INFLOW, % OF VOL. | | | 82.4 | 85.0 | 87.6 | 93.8 | | |
| ASSUMED MAY1-JUL31 INFLOW, hm3 | 2/ | | 5101.4 | 5596.8 | 5537.9 | 5712.1 | | |
| MAY MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 113.3 | 113.3 | 113.3 | 113.3 | | |
| MIN MAY1-JUL31 OUTFLOW, hm3 | 4/ | | 1795.8 | 1795.8 | 1795.8 | 1795.8 | | |
| VRC APR30 RESERVOIR CONTENT, hm3 | 5/ | | 2836.6 | 2341.2 | 2400.1 | 2225.7 | | |
| VRC APR30 RESERVOIR CONTENT, METERS | 6/ | | 728.6 | 724.3 | 724.9 | 723.3 | | |
| APR30 ORC, m | 7/ | | 728.6 | 724.3 | 724.9 | 723.3 | | |
| BASE ECC, m | 9/ | 731.4 | | | | | | |
| | | | | | | | | |
| ASSUMED JUN1-JUL31 INFLOW, % OF VOL. | | | 55.2 | 57.0 | 58.7 | 62.9 | 67.0 | |
| ASSUMED JUN1-JUL31 INFLOW, hm3 | 2/ | | 3417.4 | 3753.1 | 3710.8 | 3830.4 | 3762.9 | |
| JUN MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 283.2 | 283.2 | 283.2 | 283.2 | 283.2 | |
| MIN JUN1-JUL31 OUTFLOW, hm3 | 4/ | | 1492.4 | 1492.4 | 1492.4 | 1492.4 | 1492.4 | |
| VRC MAY31 RESERVOIR CONTENT, hm3 | 5/ | | 4217.2 | 3881.5 | 3923.9 | 3804.2 | 3871.7 | |
| VRC MAY31 RESERVOIR CONTENT, METERS | 6/ | | 738.4 | 736.2 | 736.5 | 735.7 | 736.2 | |
| MAY31 ORC, m | 7/ | | 738.4 | 736.2 | 736.5 | 735.7 | 736.2 | |
| BASE ECC, m | 9/ | 738.9 | | | | | | |
| | | | | | | | | |
| ASSUMED JUL1-JUL31 INFLOW, % OF VOL. | | | 19.7 | 20.4 | 21.0 | 22.5 | 24.0 | 35.8 |
| ASSUMED JUL1-JUL31 INFLOW, hm3 | 2/ | | 1219.6 | 1343.2 | 1327.5 | 1370.1 | 1347.8 | 1415.8 |
| JUL MINIMUM FLOW REQUIREMENT, m3/s | 3/ | | 283.2 | 283.2 | 283.2 | 283.2 | 283.2 | 283.2 |
| MIN JUL1-JUL31 OUTFLOW, hm3 | 4/ | | 758.4 | 758.4 | 758.4 | 758.4 | 758.4 | 758.4 |
| VRC JUN30 RESERVOIR CONTENT, hm3 | 5/ | | 5681.0 | 5557.5 | 5573.1 | 5530.5 | 5552.8 | 5484.8 |
| VRC JUN30 RESERVOIR CONTENT, METERS | 6/ | | 747.0 | 746.3 | 746.4 | 746.2 | 746.3 | 745.9 |
| JUN30 ORC, m | 7/ | | 747.0 | 746.3 | 746.4 | 746.2 | 746.3 | 745.9 |
| BASE ECC, m | 9/ | 749.5 | | | | | | |
| | | | | | | | | |
| JUL 31 ORC, m | | | 749.5 | 749.5 | 749.5 | 749.5 | 749.5 | 749.5 |
| JAN1-JUL31 FORECAST,-EARLYBIRD, km3 | 8/ | | 125.8 | 127.0 | 127.0 | 124.6 | 124.6 | 120.0 |

1/ PROBABLE JAN. TO JULY INFLOW MINUS 95% FORECAST ERROR AND OBSERVED JAN1-DATE INFLOW.
2/ PRECEEDING LINE TIMES 1/.
3/ POWER DISCHARGE REQUIREMENTS.
4/ CUMULATIVE MINIMUM OUTFLOW FROM 3/,DATE TO JULY.
5/ FULL CONTENT (2510.5 KSFD) PLUS 4/ MINUS /2.
6/ ELEV FROM 5/, INTERP FROM STORAGE CONTENT TABLE.A143
7/ LOWER OF ELEV. FROM 6/ OR BASE VRC DETERMINED PRIOR TO YEAR (INTIAL),BUT NOT LESS THAN LOWER LIMIT
8/ MEASURED AT THE DALLES USED TO CALCULATE THE POWER DISCHARGE REQUIREMENTS FOR 3/.
9/ HIGHER OF ARC OR CRC1 IN DOP

# Table 5 - 2008 Variable Refill Curve for Libby Reservoir

| | | INITIAL | JAN 1 | FEB 1 | MAR 1 | APR 1 | MAY 1 | JUN 1 |
|---|---|---|---|---|---|---|---|---|
| PROBABLE JAN.-31JULY INFLOW, KAF | | | 6311.0 | 6461.0 | 6331.0 | 6275.0 | 6029.0 | 6411.0 |
| PROBABLE JAN.-31JULY INFLOW, KSFD | | | 3181.8 | 3257.4 | 3191.9 | 3163.6 | 3039.6 | 3232.2 |
| 95% FORECAST ERROR FOR DATE, KSFD | | | 651.4 | 488.5 | 457.3 | 443.2 | 400.8 | 384.7 |
| OBSERVED JAN1-DATE INFLOW, IN KSFD | | | 0.0 | 77.6 | 150.7 | 231.4 | 343.3 | 1231.2 |
| 95% CONF.DATE-31JULY INFLOW, KSFD | 1/ | | 2530.4 | 2691.2 | 2583.9 | 2489.1 | 2295.5 | 1616.4 |
| | | | | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, % OF VOL. | | | 96.9 | | | | | |
| ASSUMED FEB1-JUL31 INFLOW, KSFD | 2/ | | 2452.0 | | | | | |
| FEB MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 4000.0 | | | | | |
| MIN FEB1-JUL31 OUTFLOW, KSFD | 4/ | | 1090.0 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, KSFD | 5/ | | 1148.5 | | | | | |
| VRC JAN31 RESERVOIR CONTENT, FEET | 6/ | | 2389.7 | | | | | |
| JAN31 ORC, FT | 7/ | | 2389.7 | | | | | |
| BASE ECC, FT | 9/ | 2413.9 | | | | | | |
| LOWER LIMIT, FT | | 2371.2 | | | | | | |
| | | | | | | | | |
| ASSUMED MAR1-JUL31 INFLOW, % OF VOL. | | | 94.1 | 97.1 | | | | |
| ASSUMED MAR1-JUL31 INFLOW, KSFD | 2/ | | 2381.1 | 2613.2 | | | | |
| MAR MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 4000.0 | 4000.0 | | | | |
| MIN MAR1-JUL31 OUTFLOW, KSFD | 4/ | | 978.0 | 978.0 | | | | |
| VRC FEB28 RESERVOIR CONTENT, KSFD | 5/ | | 1107.4 | 875.3 | | | | |
| VRC FEB28 RESERVOIR CONTENT, FEET | 6/ | | 2386.9 | 2370.5 | | | | |
| FEB28 ORC, FT | 7/ | | 2386.9 | 2370.5 | | | | |
| BASE ECC, FT | 9/ | 2411.1 | | | | | | |
| LOWER LIMIT, FT | | 2320.8 | | | | | | |
| | | | | | | | | |
| ASSUMED APR1-JUL31 INFLOW, % OF VOL. | | | 90.6 | 93.5 | 96.3 | | | |
| ASSUMED APR1-JUL31 INFLOW, KSFD | 2/ | | 2292.6 | 2516.3 | 2488.3 | | | |
| APR MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 4000.0 | 4000.0 | 4000.0 | | | |
| MIN APR1-JUL31 OUTFLOW, KSFD | 4/ | | 854.0 | 854.0 | 854.0 | | | |
| VRC MAR31 RESERVOIR CONTENT, KSFD | 5/ | | 1071.9 | 848.2 | 876.2 | | | |
| VRC MAR31 RESERVOIR CONTENT, FEET | 6/ | | 2384.5 | 2368.5 | 2370.6 | | | |
| MAR31 ORC, FT | 7/ | | 2384.5 | 2368.5 | 2370.6 | | | |
| BASE ECC, FT | 9/ | 2408.2 | | | | | | |
| LOWER LIMIT, FT | | 2288.5 | | | | | | |
| | | | | | | | | |
| ASSUMED MAY1-JUL31 INFLOW, % OF VOL. | | | 82.4 | 85.0 | 87.6 | 93.8 | | |
| ASSUMED MAY1-JUL31 INFLOW, KSFD | 2/ | | 2085.1 | 2287.6 | 2263.5 | 2334.7 | | |
| MAY MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 4000.0 | 4000.0 | 4000.0 | 4000.0 | | |
| MIN MAY1-JUL31 OUTFLOW, KSFD | 4/ | | 734.0 | 734.0 | 734.0 | 734.0 | | |
| VRC APR30 RESERVOIR CONTENT, KSFD | 5/ | | 1159.4 | 956.9 | 981.0 | 909.7 | | |
| VRC APR30 RESERVOIR CONTENT, FEET | 6/ | | 2390.4 | 2376.4 | 2378.2 | 2373.0 | | |
| APR30 ORC, FT | 7/ | | 2390.4 | 2376.4 | 2378.2 | 2373.0 | | |
| BASE ECC, FT | 9/ | 2399.5 | | | | | | |
| | | | | | | | | |
| ASSUMED JUN1-JUL31 INFLOW, % OF VOL. | | | 55.2 | 57.0 | 58.7 | 62.9 | 67.0 | |
| ASSUMED JUN1-JUL31 INFLOW, KSFD | 2/ | | 1396.8 | 1534.0 | 1516.7 | 1565.6 | 1538.0 | |
| JUN MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 10000.0 | 10000.0 | 10000.0 | 10000.0 | 10000.0 | |
| MIN JUN1-JUL31 OUTFLOW, KSFD | 4/ | | 610.0 | 610.0 | 610.0 | 610.0 | 610.0 | |
| VRC MAY31 RESERVOIR CONTENT, KSFD | 5/ | | 1723.7 | 1586.5 | 1603.8 | 1554.9 | 1582.5 | |
| VRC MAY31 RESERVOIR CONTENT, FEET | 6/ | | 2422.6 | 2415.5 | 2416.4 | 2413.8 | 2415.2 | |
| MAY31 ORC, FT | 7/ | | 2422.6 | 2415.5 | 2416.4 | 2413.8 | 2415.2 | |
| BASE ECC, FT | 9/ | 2424.2 | | | | | | |
| | | | | | | | | |
| ASSUMED JUL1-JUL31 INFLOW, % OF VOL. | | | 19.7 | 20.4 | 21.0 | 22.5 | 24.0 | 35.8 |
| ASSUMED JUL1-JUL31 INFLOW, KSFD | 2/ | | 498.5 | 549.0 | 542.6 | 560.0 | 550.9 | 578.7 |
| JUL MINIMUM FLOW REQUIREMENT, CFS | 3/ | | 10000.0 | 10000.0 | 10000.0 | 10000.0 | 10000.0 | 10000.0 |
| MIN JUL1-JUL31 OUTFLOW, KSFD | 4/ | | 310.0 | 310.0 | 310.0 | 310.0 | 310.0 | 310.0 |
| VRC JUN30 RESERVOIR CONTENT, KSFD | 5/ | | 2322.0 | 2271.5 | 2277.9 | 2260.5 | 2269.6 | 2241.8 |
| VRC JUN30 RESERVOIR CONTENT, FEET | 6/ | | 2450.8 | 2448.6 | 2448.8 | 2448.1 | 2448.5 | 2447.2 |
| JUN30 ORC, FT | 7/ | | 2450.8 | 2448.6 | 2448.8 | 2448.1 | 2448.5 | 2447.2 |
| BASE ECC, FT | 9/ | 2459.0 | | | | | | |
| | | | | | | | | |
| JUL 31 ORC, FT | | | 2459 | 2459 | 2459 | 2459 | 2459 | 2459 |
| JAN1-JUL31 FORECAST,-EARLYBIRD,MAF | 8/ | | 102.0 | 103.0 | 103.0 | 101.0 | 101.0 | 97.3 |

1/ PROBABLE JAN. TO JULY INFLOW MINUS 95% FORECAST ERROR AND OBSERVED JAN1-DATE INFLOW.
2/ PRECEEDING LINE TIMES 1/.
3/ POWER DISCHARGE REQUIREMENTS.
4/ CUMULATIVE MINIMUM OUTFLOW FROM 3/,DATE TO JULY.
5/ FULL CONTENT (2510.5 KSFD) PLUS 4/ MINUS /2.
6/ ELEV FROM 5/, INTERP FROM STORAGE CONTENT TABLE.A143
7/ LOWER OF ELEV. FROM 6/ OR BASE VRC DETERMINED PRIOR TO YEAR (INTIAL),BUT NOT LESS THAN LOWER LIMIT
8/ MEASURED AT THE DALLES USED TO CALCULATE THE POWER DISCHARGE REQUIREMENTS FOR 3/.
9/ HIGHER OF ARC OR CRC1 IN DOP

## Table 6: Computation of Initial Controlled Flow

## Columbia River at The Dalles, OR

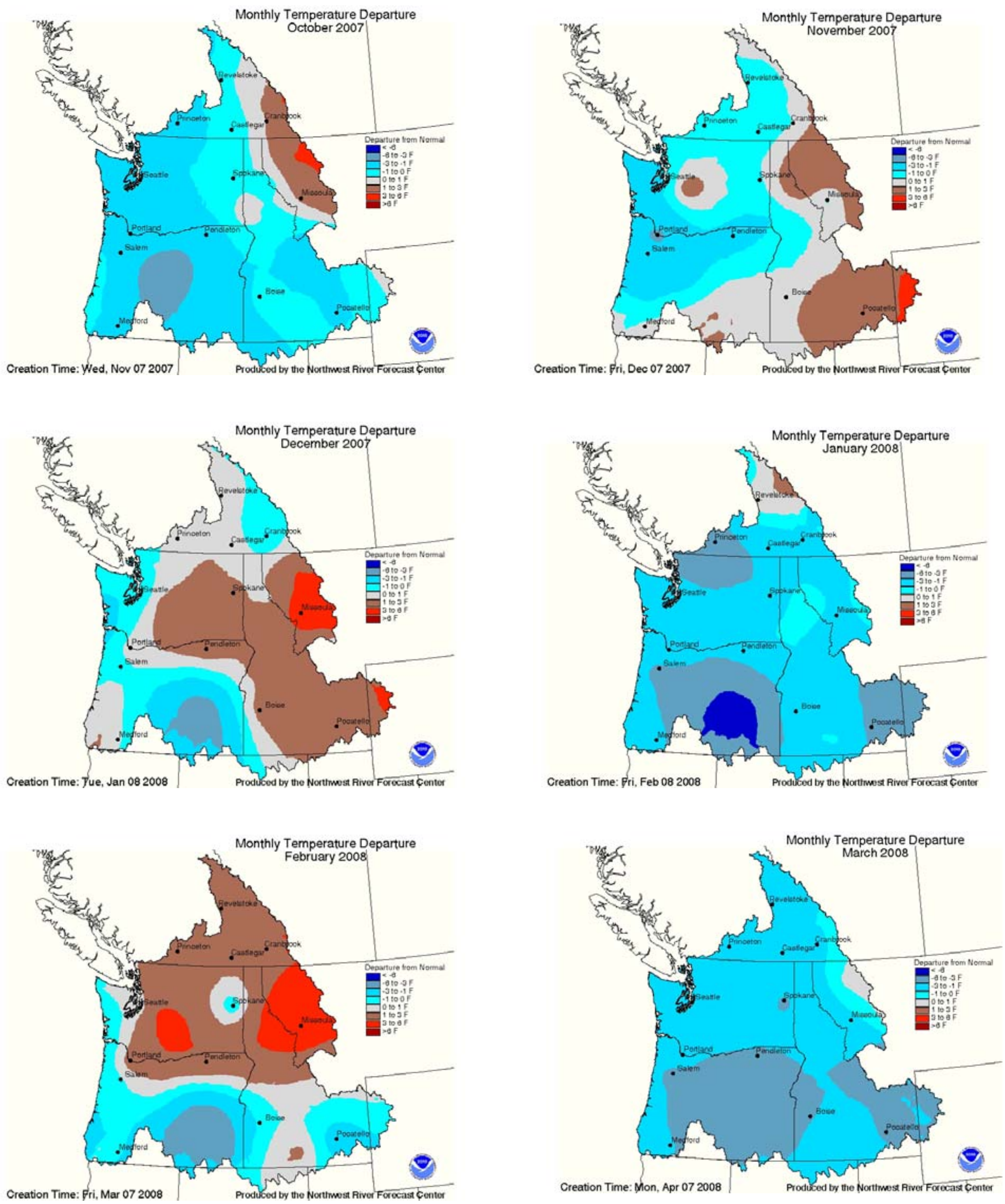
## Metric and English Units, 1 May 2008

| **Upstream Storage Corrections in $km^3$ and Maf** | Metric ($km^3$) | | English (Maf) | |
|---|---|---|---|---|
| Mica | 8.609 | | 6.979 | |
| Arrow | 4.441 | | 3.600 | |
| Duncan | 1.717 | | 1.392 | |
| Libby | 3.107 | | 2.519 | |
| Hungry Horse | 1.597 | | 1.295 | |
| Flathead Lake | 0.617 | | 0.500 | |
| Noxon Rapids | 0.000 | | 0.000 | |
| Pend Oreille Lake | 0.617 | | 0.500 | |
| Grand Coulee | 5.042 | | 4.088 | |
| Brownlee | 0.713 | | 0.578 | |
| Dworshak | 2.128 | | 1.725 | |
| John Day | 0.195 | | 0.158 | |
| Total Upstream Storage Corrections | 28.783 | | 23.335 | |
| 1-May Forecast of May – August Unregulated Runoff Volume | | 95.050 | | 77.058 |
| Less Estimated Depletions | | - 2.061 | | - 1.671 |
| Less Total Upstream Storage Corrections | | - 28.783 | | - 23.335 |
| Forecast of Adjusted Residual Runoff Volume | | 64.206 | | 52.052 |
| Computed Initial Controlled Flow from Chart 1 of the Flood Control Operating Plan, $km^3/s$ and kcfs | | 99.963 | | 328 |

# VIII - CHARTS

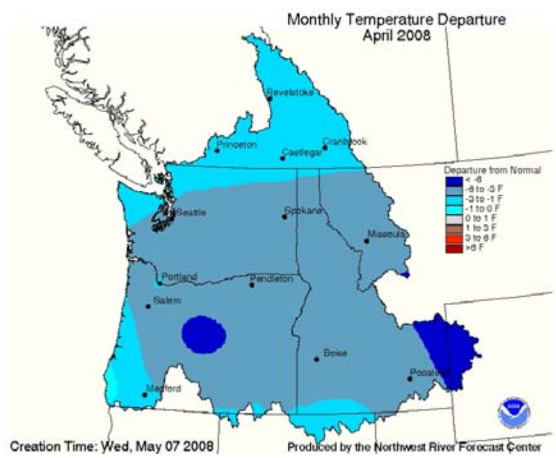
## Chart 1: Pacific Northwest Monthly Temperature Departures

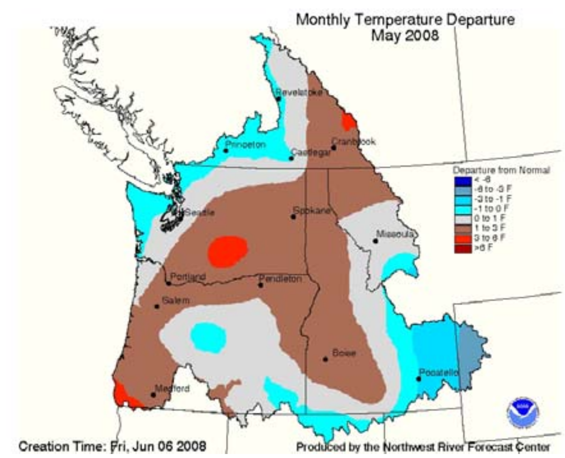
**October - March**

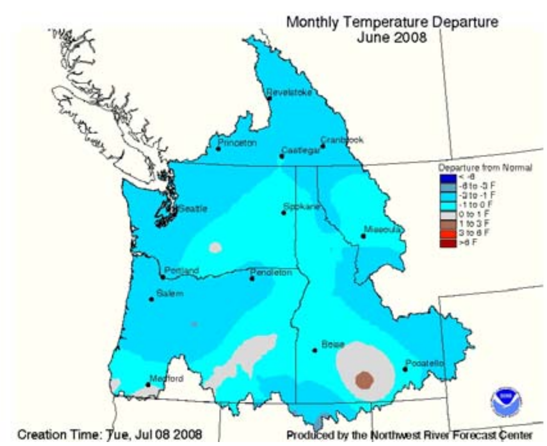


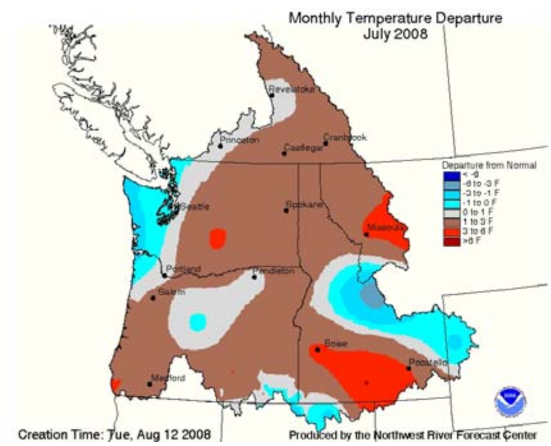
# Chart 1: Pacific Northwest Monthly Temperature Departures (continued)

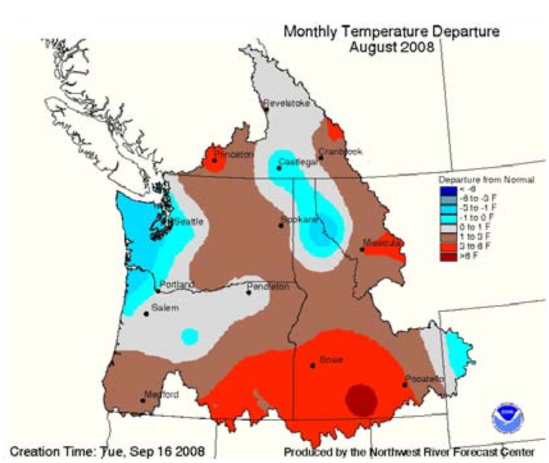
## April – September



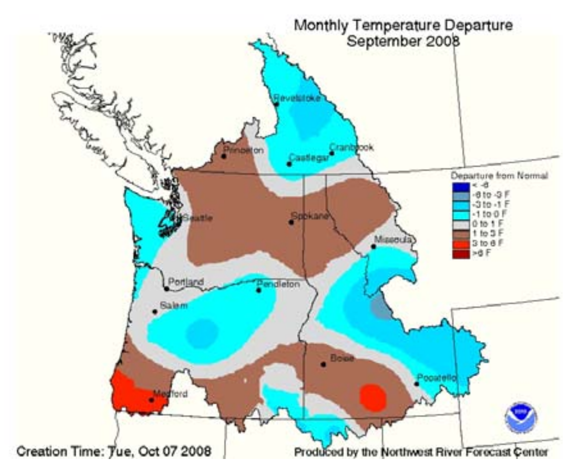
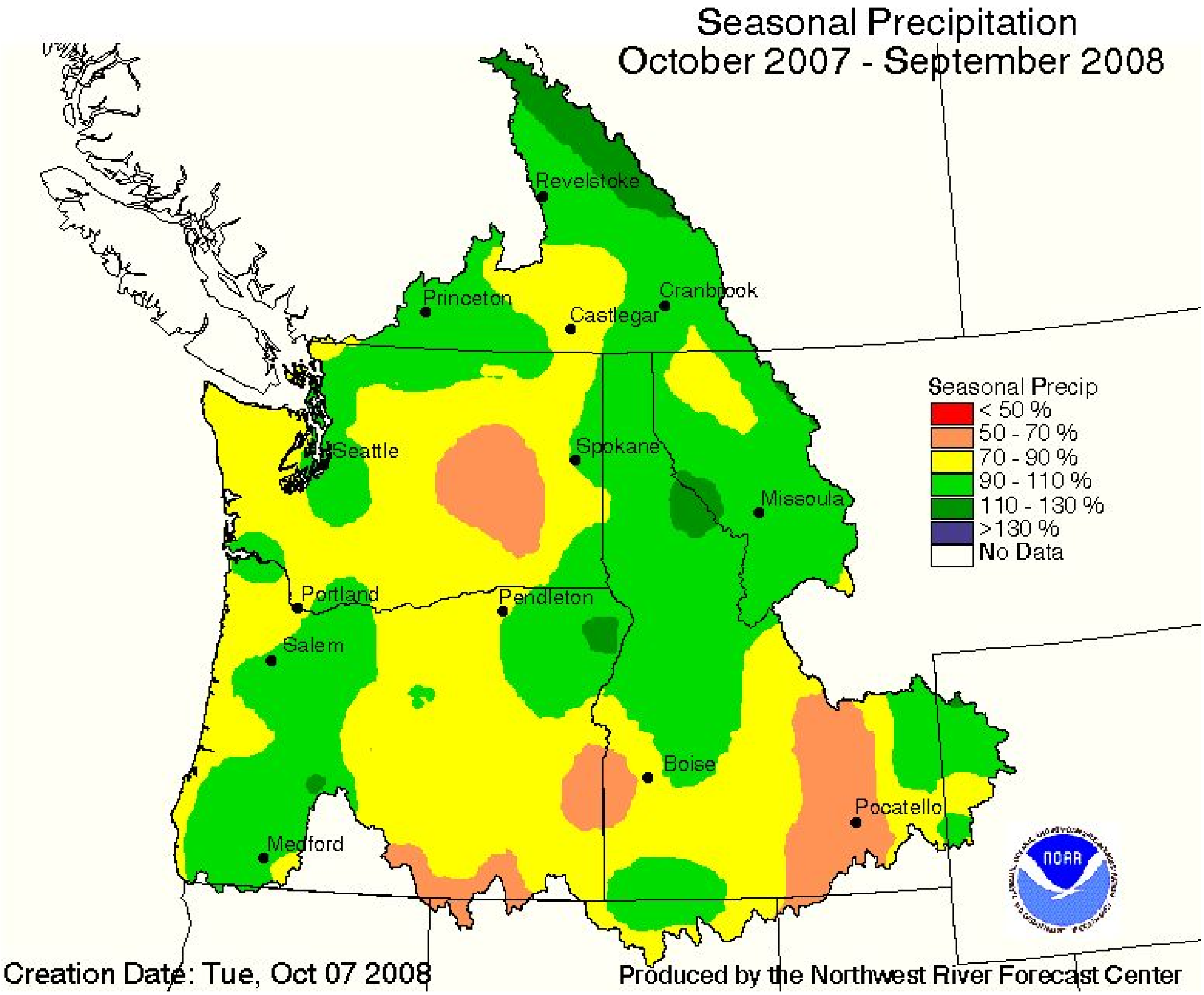



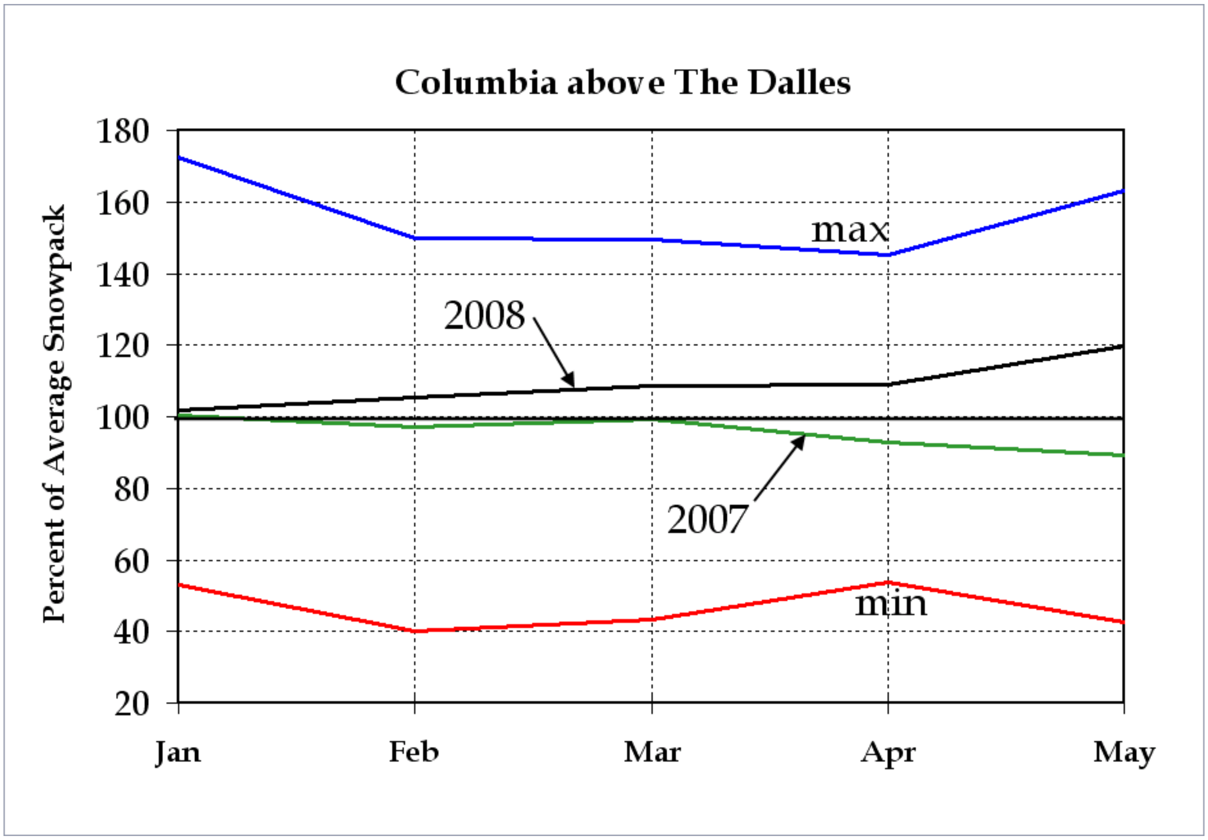
**Chart 2: Seasonal Precipitation**

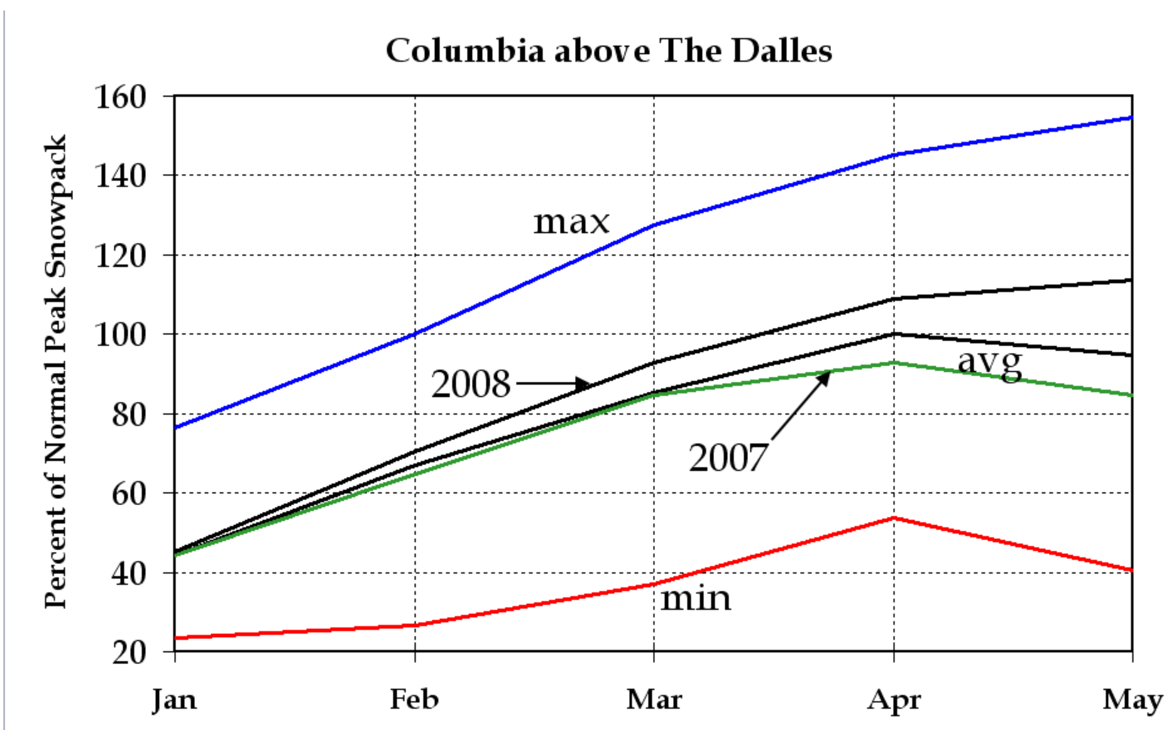
**Columbia River Basin**

**October 2007 – September 2008**



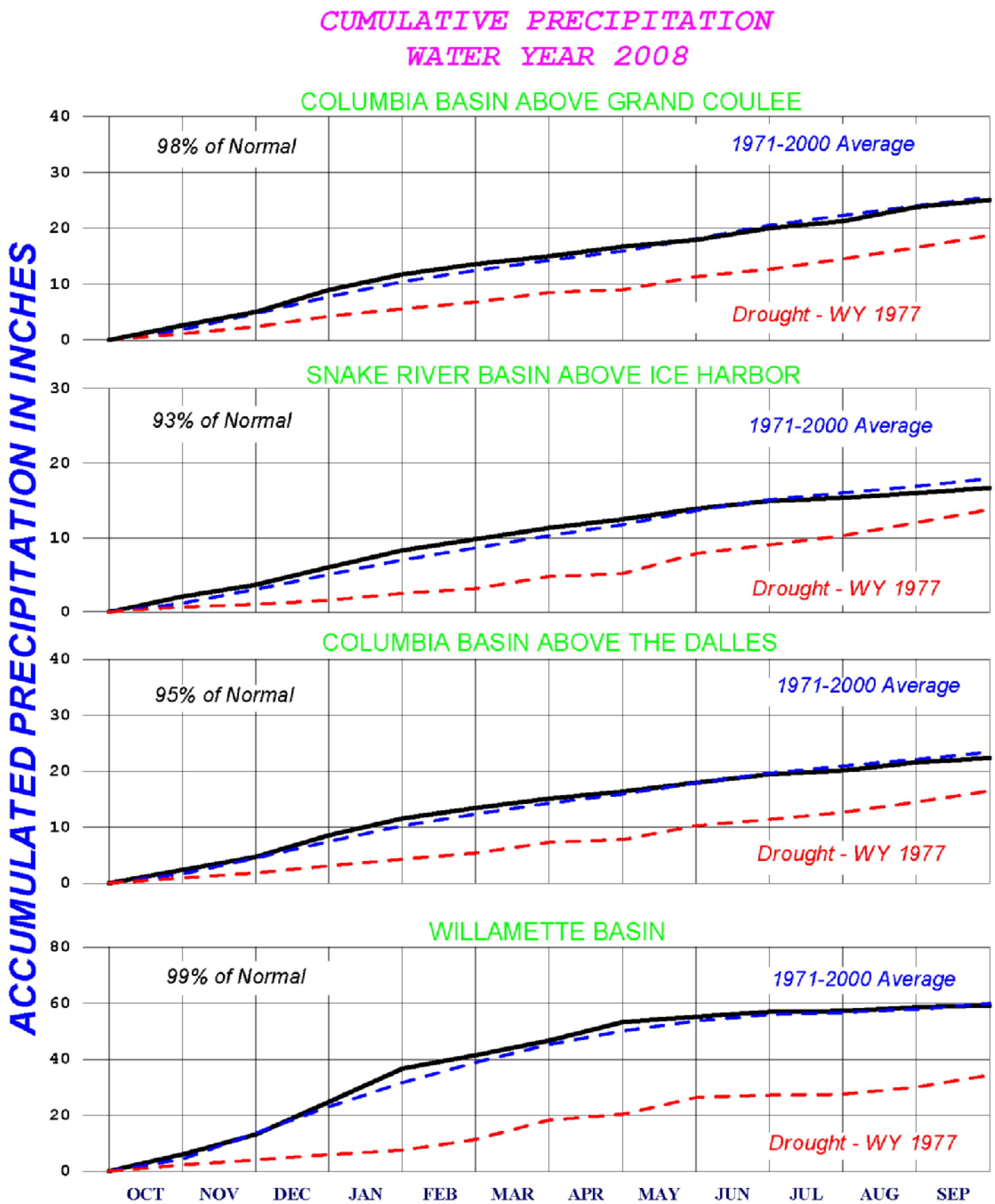
## Chart 3: Columbia Basin Snowpack



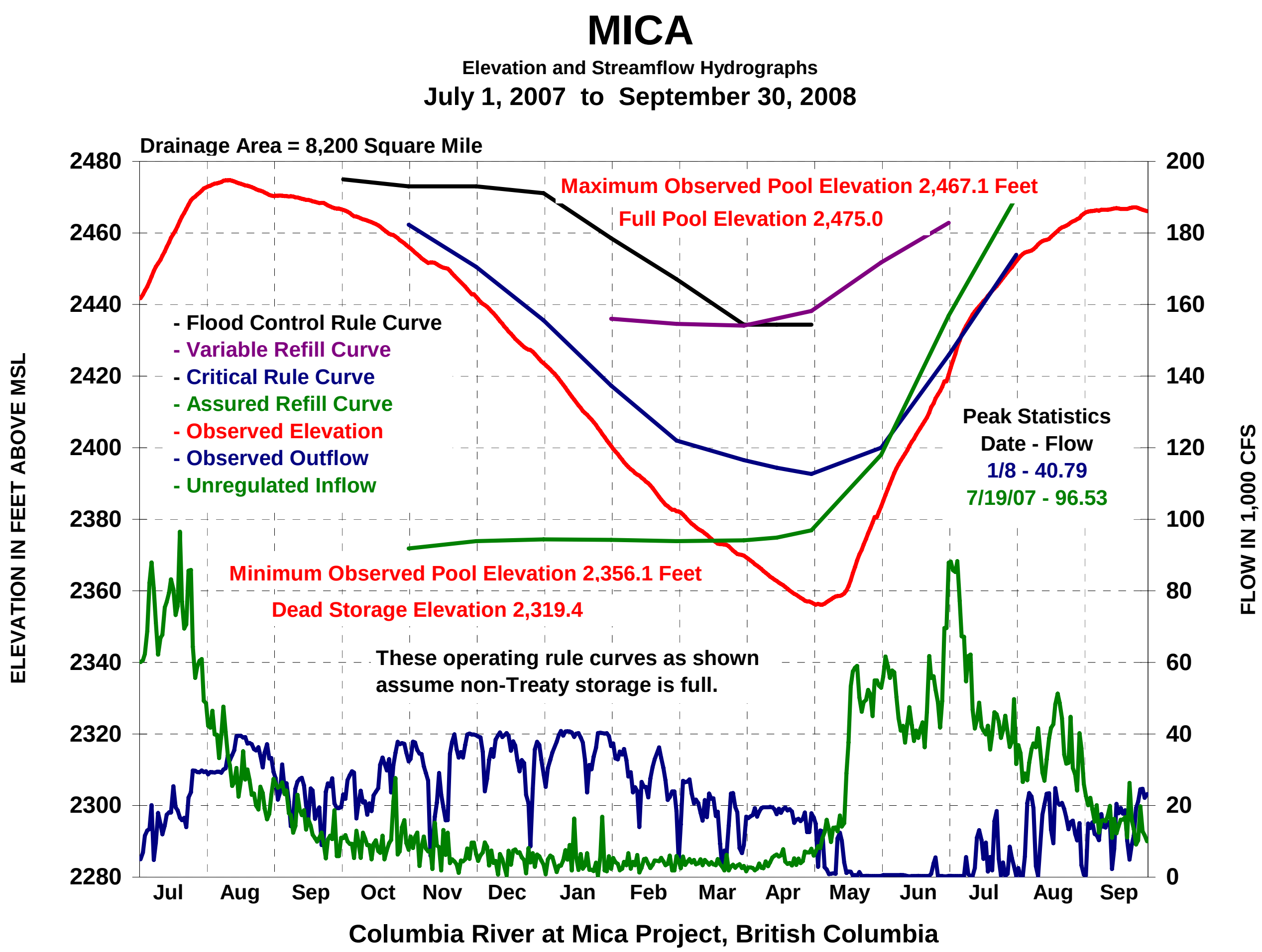
## Chart 4: Accumulated Precipitation for WY 2008

## At Primary Columbia River Basins



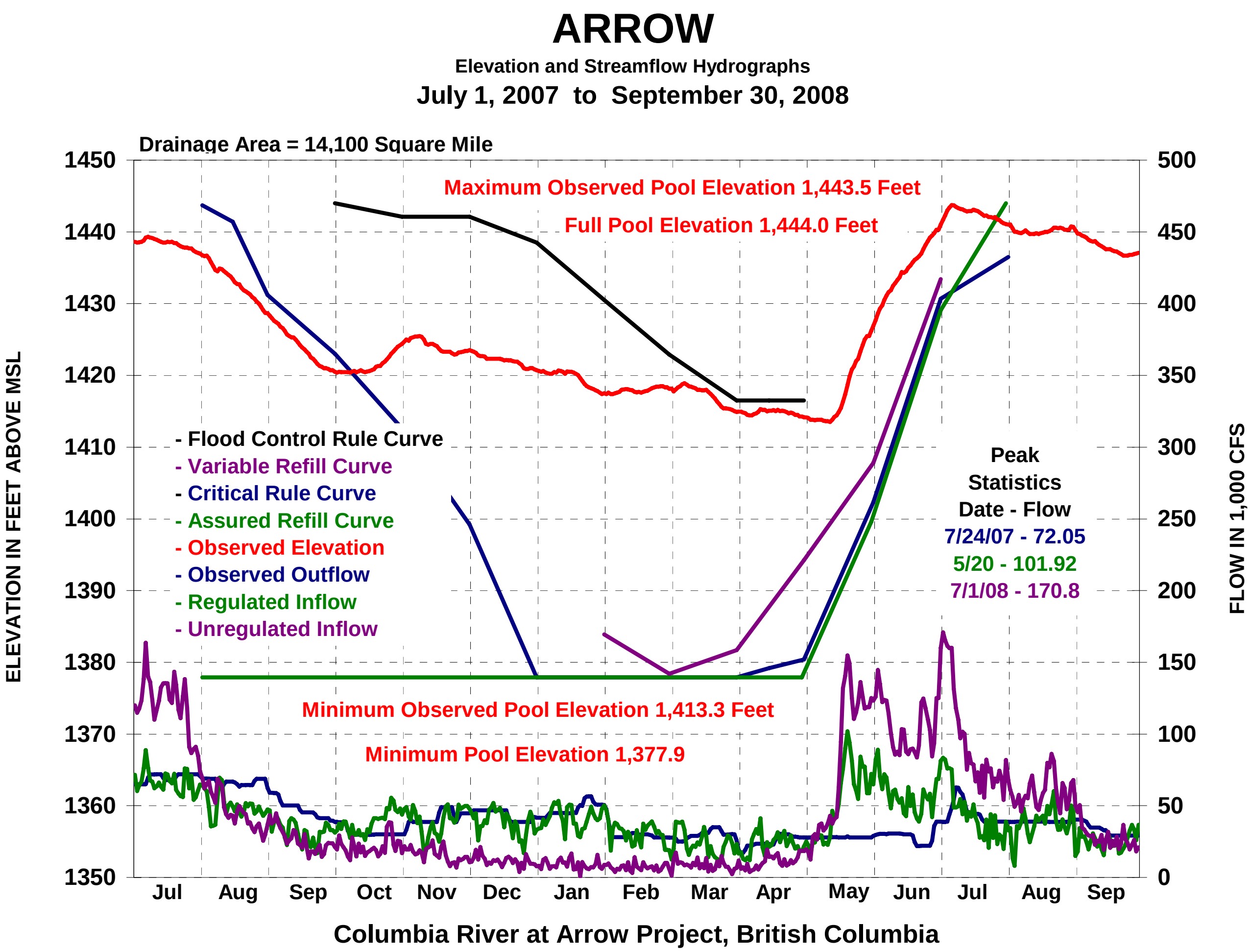
# Chart 5: Regulation of Mica

# 1 August 2007 – September 2008



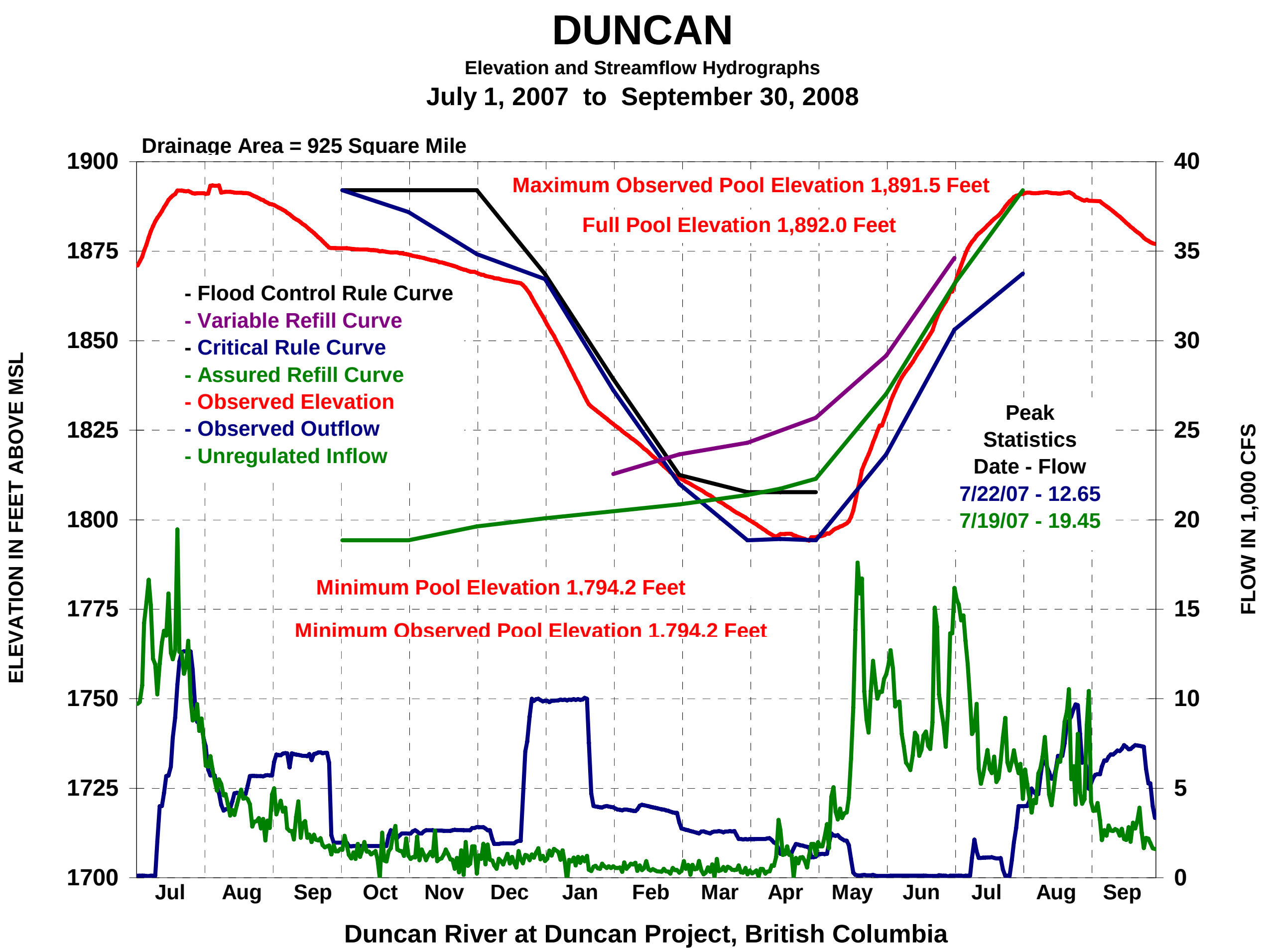
# Chart 6: Regulation of Arrow

# 1 August 2007 – September 2008



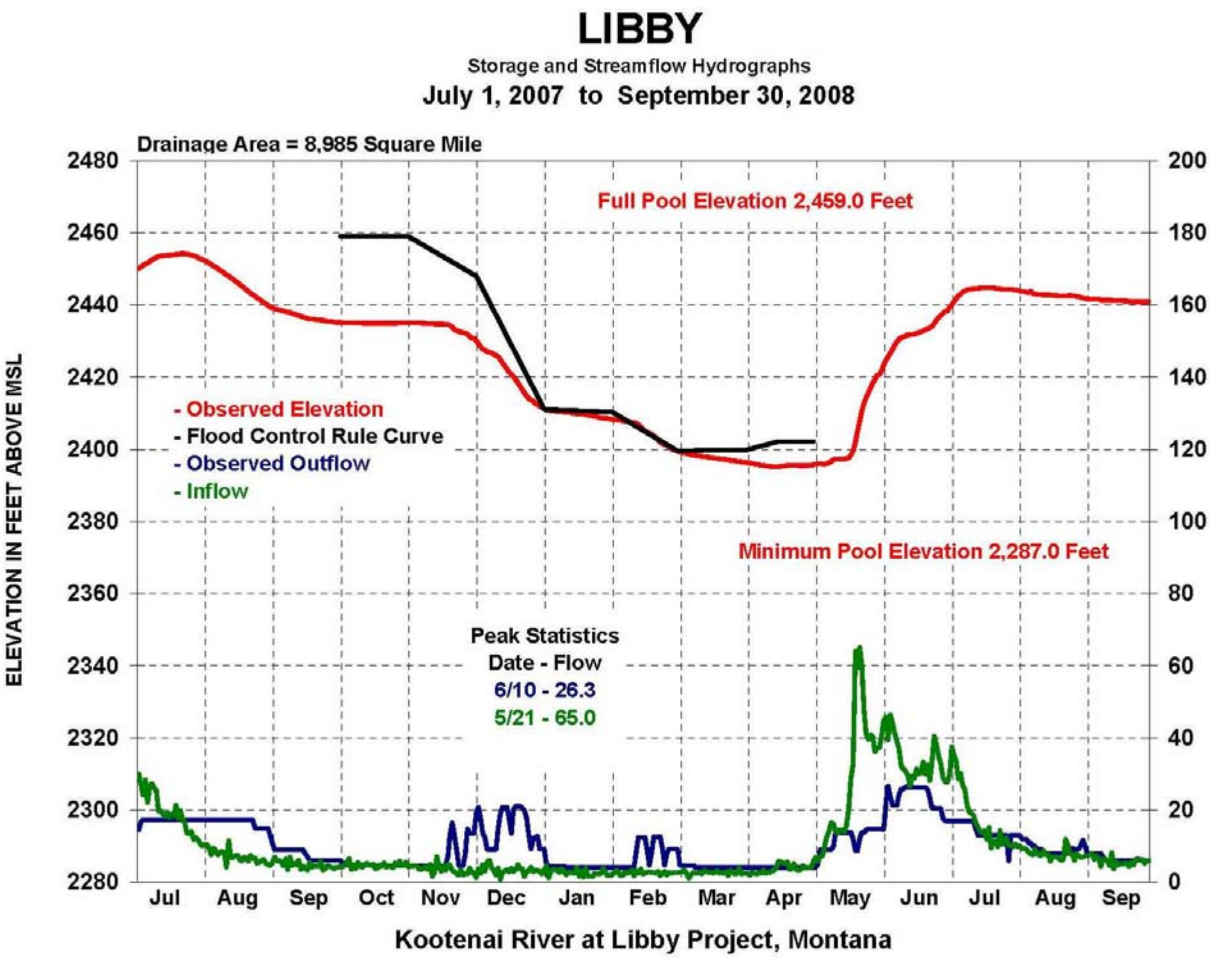
## Chart 7: Regulation of Duncan

## 1 August 2007 – September 2008



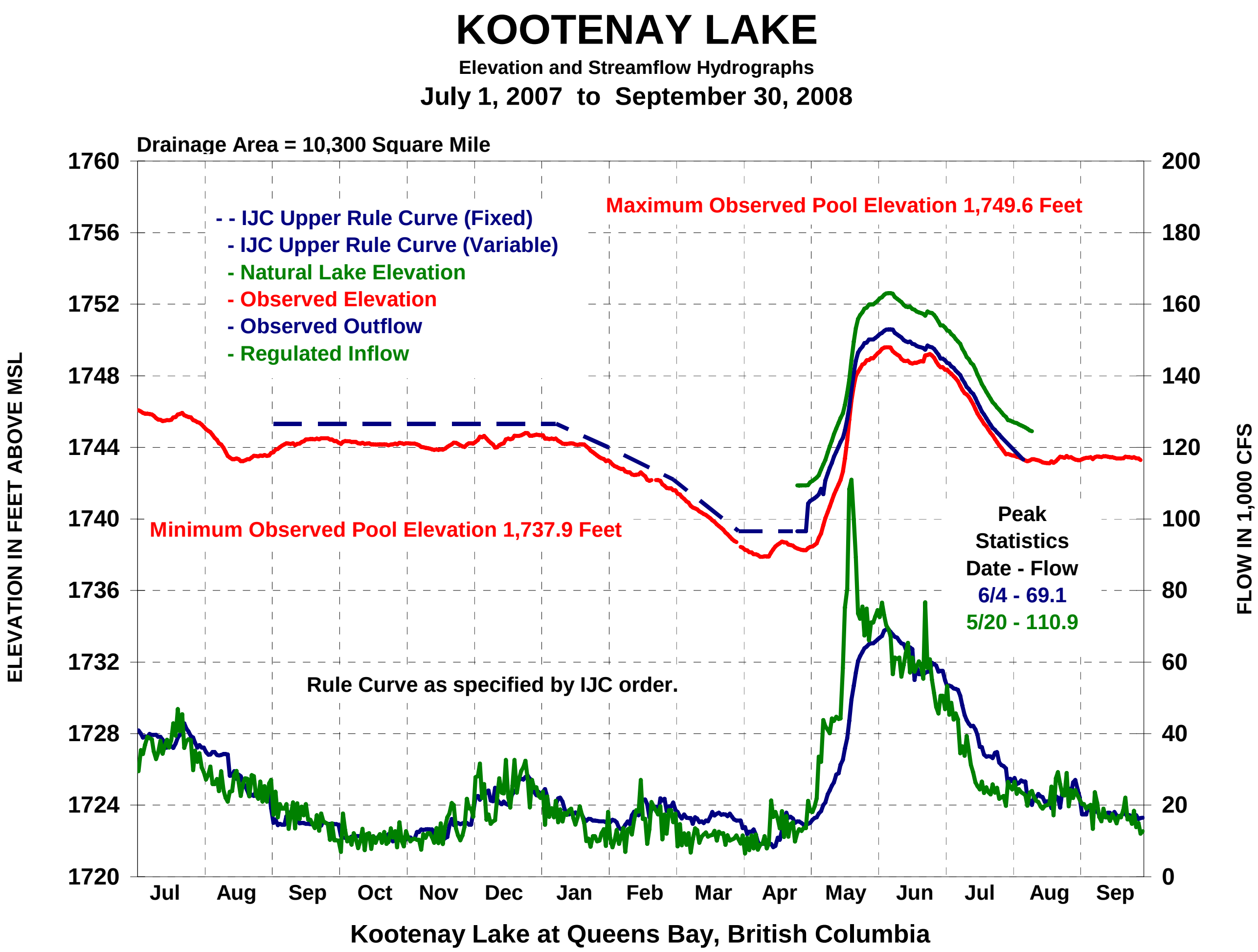
# Chart 8: Regulation of Libby

# 1 August 2007 – September 2008

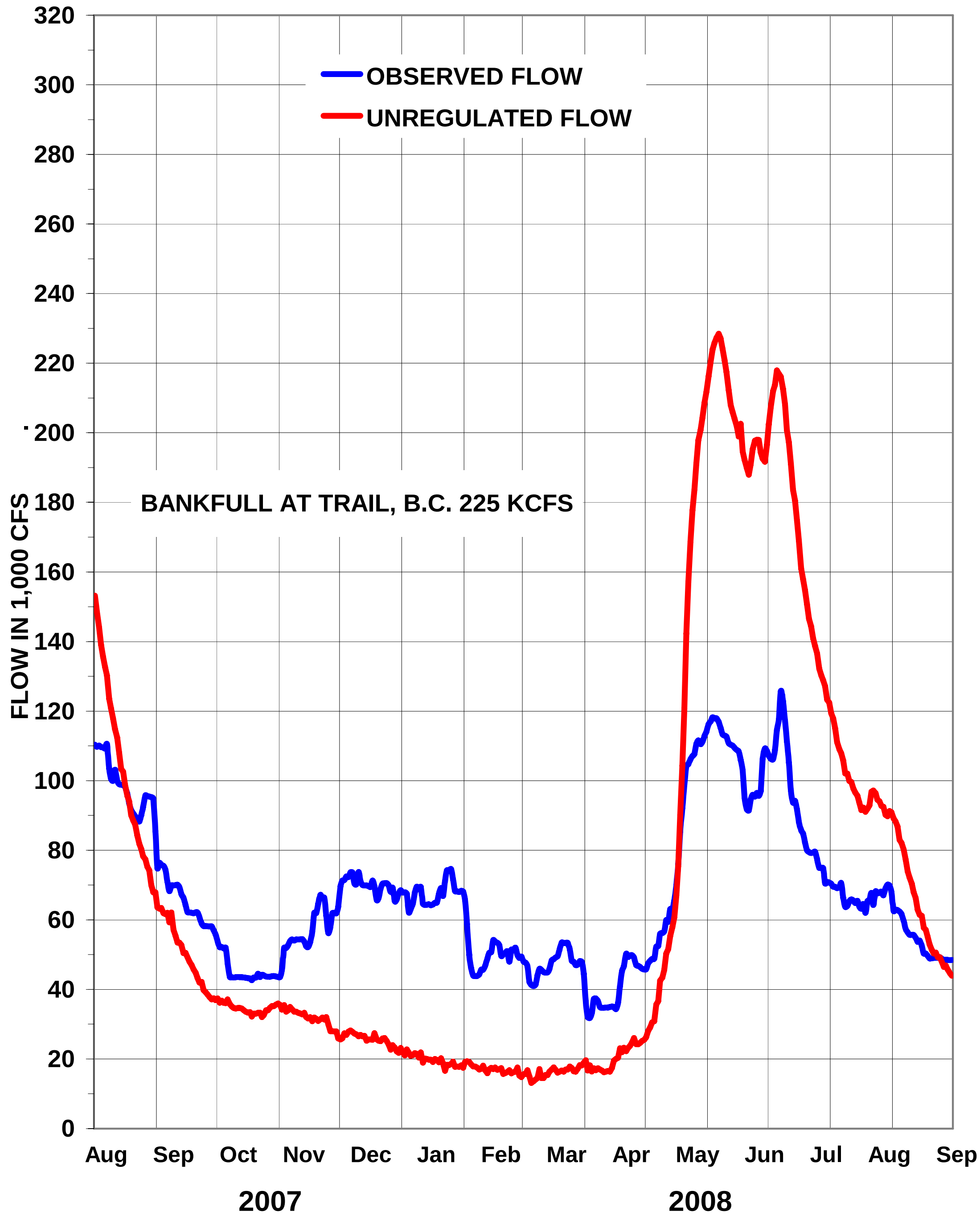


# Chart 9: Regulation of Kootenay Lake

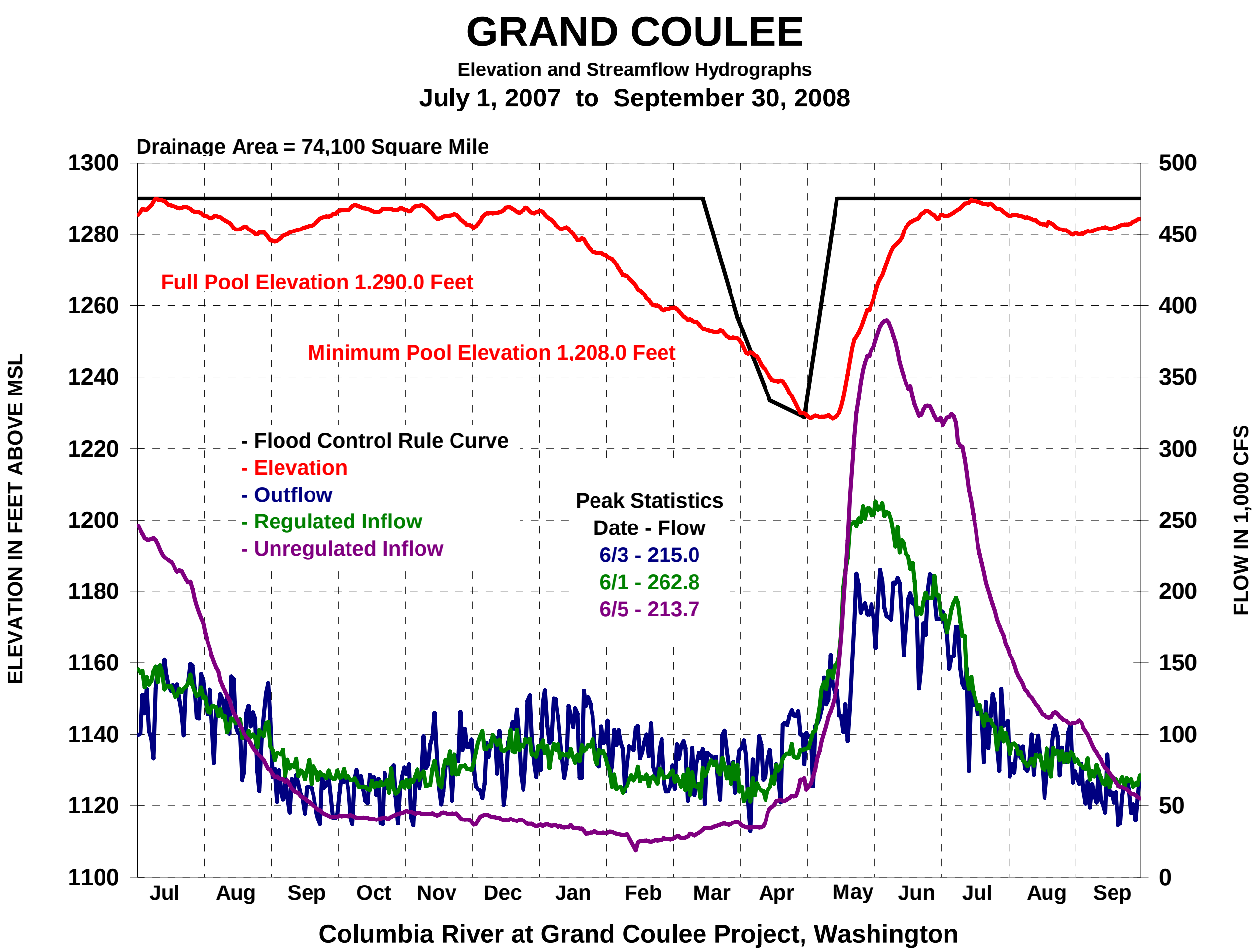
## 1 August 2007 – September 2008



## Chart 10: Columbia River at Birchbank
## 1 August 2007 – 31 August 2008



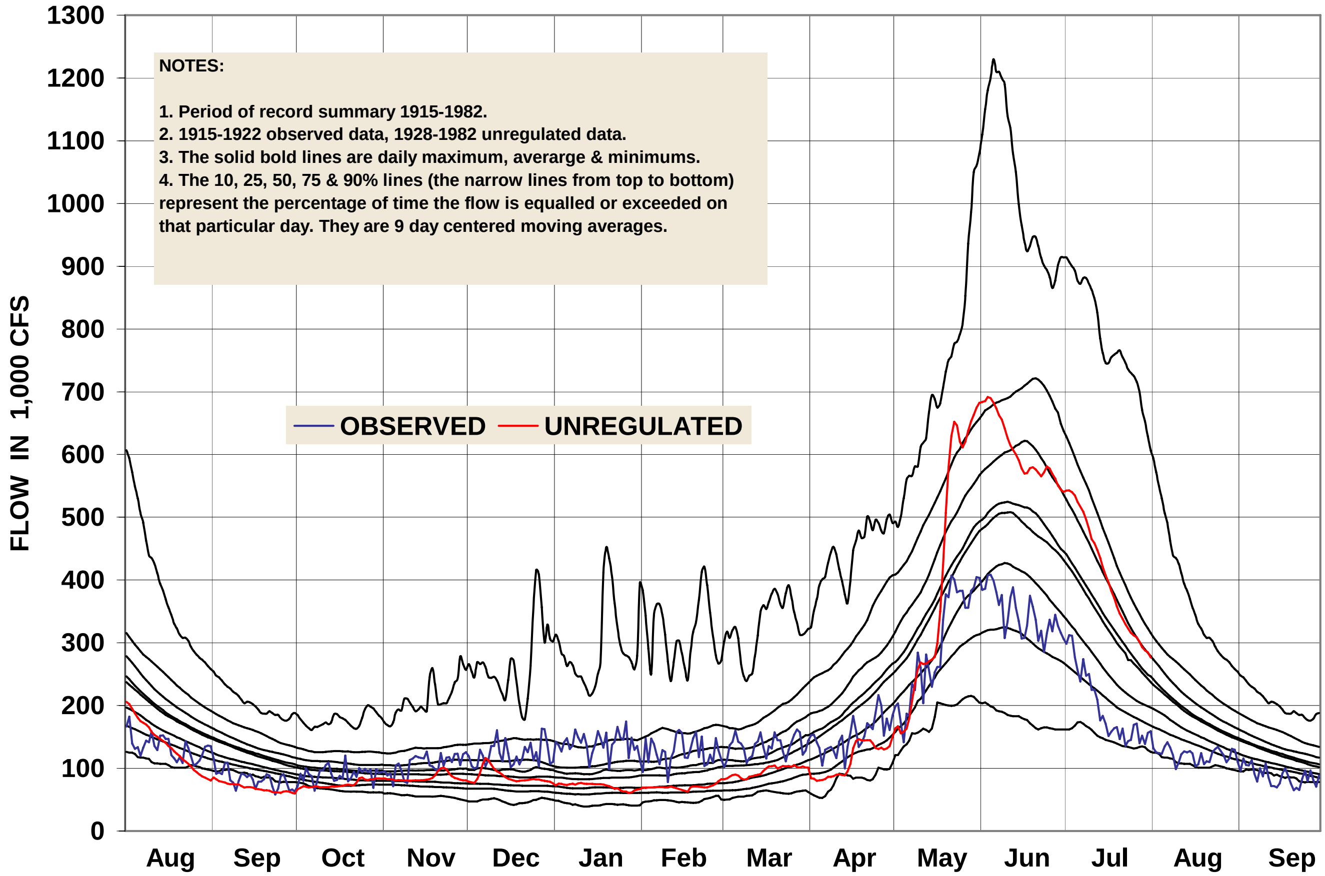
# Chart 11: Regulation of Grand Coulee
# 1 August 2007 – 30 September 2008



# Chart 12: Columbia River at The Dalles

# (Summary Hydrograph)

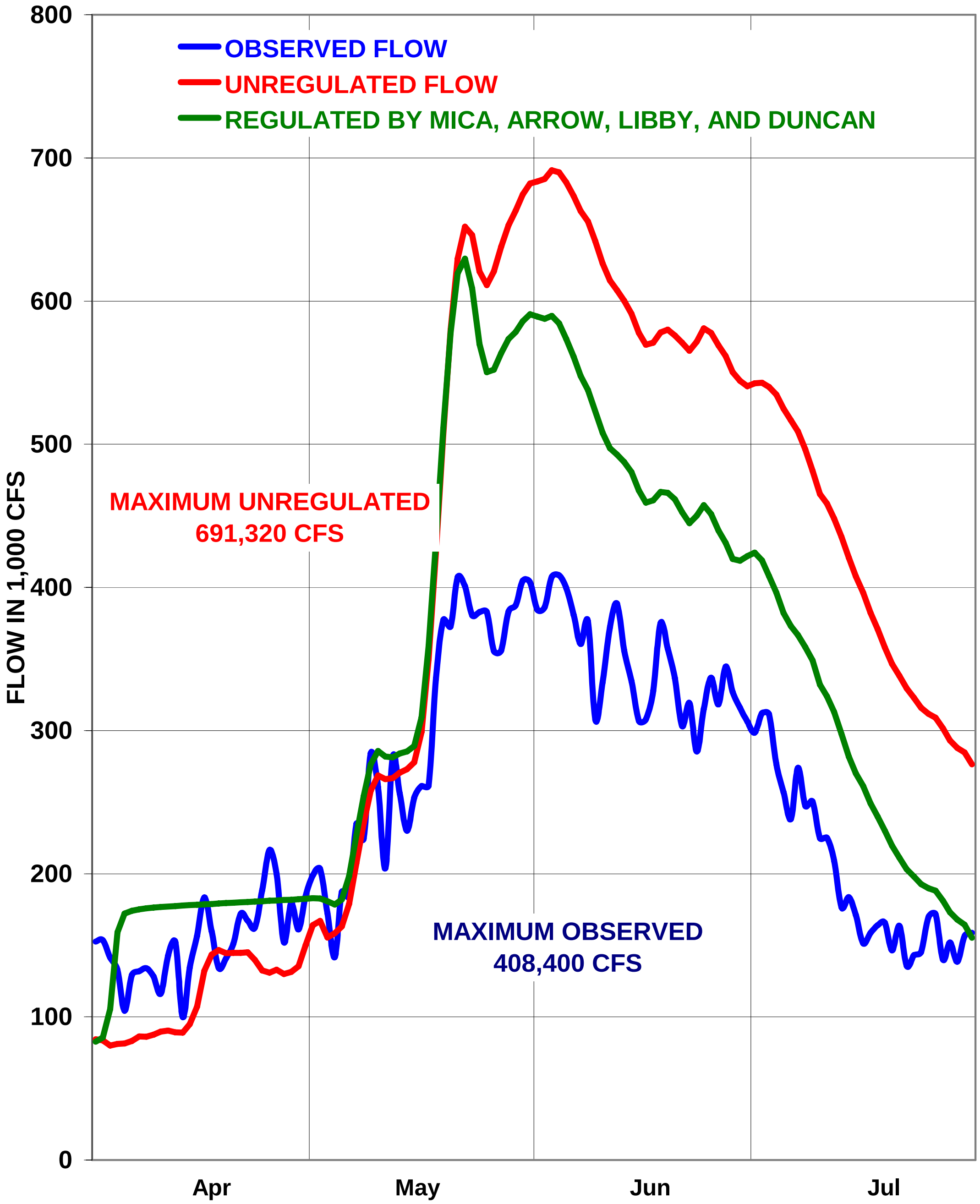
# 1 August 2007 – 30 September 2008



## Chart 13: Columbia River at The Dalles

## Re-Regulation Plot

## 1 April 2008 – 31 July 2008



# Chart 14:  2008 Relative Filling

# Arrow and Grand Coulee