ANNUAL REPORT

to the

GOVERNMENTS

of

THE UNITED STATES and CANADA

COLUMBIA RIVER TREATY

PERMANENT ENGINEERING BOARD

Washington, D.C. **Ottawa, Ontario**

30 September 2012

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COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD

C A N A D A • U N I T E D S T A T E S

CANADIAN SECTION
J. WILL, Chair
T. Newton, Member

UNITED STATES SECTION
S.L. STOCKTON, Chair
E. Sienkiewicz, Member

6 February 2013

The Honorable John Kerry
Secretary of State
Washington, D.C.

The Honourable Joe Oliver
Minister of Natural Resources
Ottawa, Ontario

Dear Secretary Kerry and Minister Oliver:

We refer you to the Treaty between the United States of America and Canada relating to cooperative development of the water resources of the Columbia River Basin, signed at Washington, D.C., on 17 January 1961.

In accordance with the provisions of Article XV, paragraph 2(e), we are submitting the forty-eighth Annual Report of the Permanent Engineering Board, dated 30 September 2012. The report documents the results achieved under the Treaty for the period from 1 October 2011 to 30 September 2012.

The Board is pleased to report that, for this reporting period, the objectives of the Treaty were met.

Respectfully submitted:

For the United States

Steven Stockton, Chair

Ed Sienkiewicz

For Canada

Jonathan Will, Chair

Tim Newton

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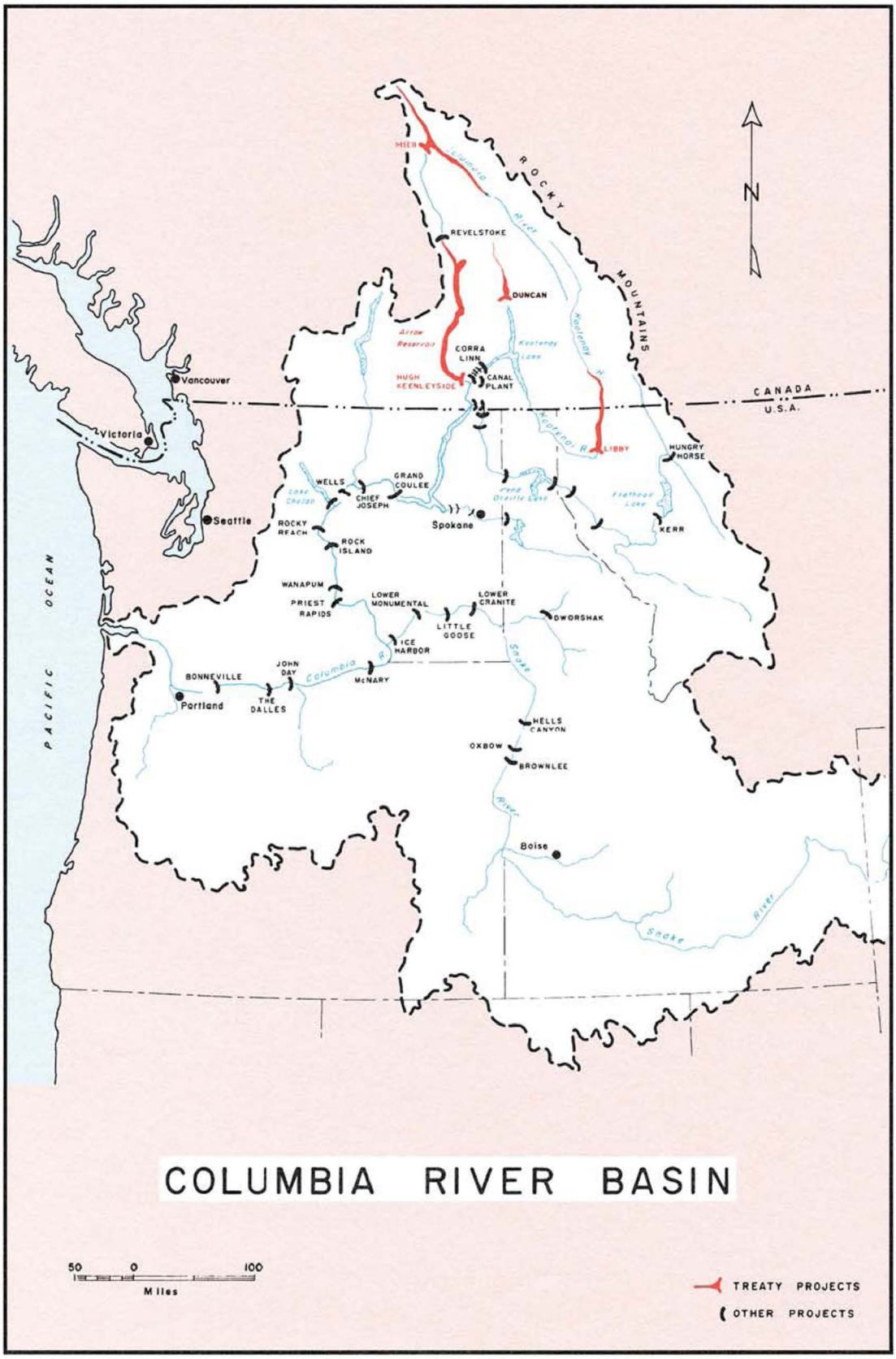
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MOUNTAINS
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DUNCAN
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COLUMBIA RIVER TREATY

PERMANENT ENGINEERING BOARD

Washington, D.C. Ottawa, Ontario

30 September 2012

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EXECUTIVE SUMMARY

The forty-eighth Annual Report of the Permanent Engineering Board is submitted to the governments of Canada and the United States in compliance with Article XV of the Columbia River Treaty of 17 January 1961. This report describes Treaty projects, storage operations, and the resulting benefits achieved by each country for the period from 1 October 2011 to 30 September 2012.

During the reporting period, the Canadian Treaty projects – Mica, Duncan, and Arrow – were operated according to the 2011-2012 and 2012-2013 Detailed Operating Plans (DOPs), the 2003 Flood Control Operating Plan (FCOP), and several supplemental operating agreements. Treaty storage in the United States at the Libby project was operated by the U.S. Entity according to the Libby Coordination Agreement (LCA) including the Libby Operating Plan (LOP), United States (U.S.) requirements for power and guidelines set forth in the U.S. Fish and Wildlife Service (USFWS) 2006 Biological Opinion, as clarified, and the NOAA Fisheries' 2010 Biological Opinion (BiOp) for operation and maintenance of the Federal Columbia River Power System. Modifications in actual operations were required during the May-June period due to higher than normal late season precipitation in the Upper Columbia Basin.

The Canadian Entitlement to the downstream power benefits for the reporting period was determined according to the procedures set out in the Treaty and Protocol. From 1 August 2011 through 31 July 2012, the U.S. Entity delivery of the Canadian Entitlement to downstream power benefits, before deducting transmission losses, was 525.9 megawatts of average energy at rates up to 1,314 megawatts. From 1 August 2012 to 30 September 2012, the U.S. Entity delivery of the Canadian Entitlement to downstream power benefits before deducting transmission losses was 504.5 megawatts of average energy at rates up to 1,321 megawatts. The Canadian Entitlement obligation was determined by the 2011-2012 and 2012-2013 Assured Operating Plan and Determination of Downstream Power Benefits.

During the course of the 2011-2012 Operating Year, there were four curtailment events for Canadian Entitlement deliveries within a span of two months, primarily due to a combination of planned maintenance and unexpected weather/load-resource conditions that included system constraints from wind power production. All of the curtailed power was delivered later within the same month of curtailment, as per agreements between the Entities.

Canadian Treaty storage began the Operating Year on 1 August 2011 at 99.2 percent full, and ended the year on 31 July 2012 at 100.0 percent full. The actual runoff for the overall Columbia Basin (U.S. and Canada combined) measured at The Dalles for January through July 2012 was 121% of normal. Water Year (WY) 2012 was an exceptional year in that after a relatively uneventful winter, record spring precipitation and cold temperatures resulted in very high runoff and a very active late flood control season, especially in the Upper Columbia and Kootenai Rivers.

The Columbia River Treaty Hydrometeorological Committee (CRTHMC) continues to work on evaluating the sufficiency and adequacy of the existing hydrometeorological network capabilities to support Treaty operations. Reports on the status of hydrometeorological stations in Canada for 2005-2010 and a report recommending five additional snow pillow stations in the British Columbia portion of Columbia Basin were completed during this reporting period. In August the National Weather Service announced a change to their water supply forecasting procedures. The CRTHMC met with the Northwest River Forecast Center to develop a recommendation to the CRTOC on how to incorporate this new forecast procedure. Studies by Canadian and U.S. Entities addressing climate change projections in the Columbia River Basin were completed.

BPA and B.C. Hydro executed a new Long Term Non-Treaty Storage Agreement on 10 April 2012. The agreement provides for coordinated use of up to 6.2 km^3 (5 Maf) of Non-Treaty Storage (NTS) in Canada for the period 10 April 2012 through 15 September 2024. The Entities reviewed the Agreement and are satisfied that mutual benefits can be achieved without adversely affecting the operation of Treaty space.

The Federal Columbia River Power System (FCRPS) reservoirs were operated in 2012 under the terms in the National Marine Fisheries Service's 2008/2010 Biological Opinion (BiOp). Although the BiOp was challenged in court in 2011 and found lacking in some respects, it was determined to be adequate with respect to most flow related matters. Corps of Engineers continues to conduct spring and summer spill operations in a manner consistent with the court's annual spill orders. The court ordered that a new biological opinion be issued by January 1, 2014.

During the period of this Annual Report, the U.S. Entity continued interaction with state, federal and Tribal representatives with regard to potential future Treaty actions. The U.S. Entity engaged the Sovereign Review Team and Sovereign Technical Team to advance development of flood risk management, hydropower and ecosystem based alternatives for consideration in making recommendations to the U.S. State Department regarding future Treaty actions. Consultation between the U.S. Entity and the U.S. State Department continued and State Department representatives began attending outreach and stakeholder sessions as observers.

In Canada, the CRT Review is being led by the B.C. provincial government. While the Canadian Entity had no authorization or funds from the Province of British Columbia to continue joint Treaty analysis and work during the period, it is pursuing independent analysis on post-2024 operations and continues to coordinate with Canadian stakeholders on future Treaty options. In addition, Canadian representatives from B.C. Hydro provided feedback as requested on U.S. studies related to proposed post-2024 procedures and potential future Canadian power operations. The provincial CRT Review team completed work on the first iteration of analyses of the reference conditions Treaty operating scenarios and presented preliminary results to the Sovereign teams and stakeholders. Based on those results the CRT Review team is continuing to refine the evaluation tools and moving toward the completion of their evaluation and development of recommendations to the provincial Cabinet, expected in Fall 2013.

TABLE OF CONTENTS

Letter of Transmittal

EXECUTIVE SUMMARY iii

ABBREVIATIONS AND ACRONYMS viii

INTRODUCTION 1

THE COLUMBIA RIVER TREATY 3
General 3
Features of the Treaty and Related Documents 3
Termination Provisions 4

PERMANENT ENGINEERING BOARD 5
General 5
Establishment of the Board 5
Duties and Responsibilities 5

ENTITIES 8
General 8
Establishment of the Entities 8
Powers and Duties of the Entities 8

ACTIVITIES OF THE BOARD 10
Meetings 10
Reports Received 10
Report to the Governments 11

TREATY IMPLEMENTATION 13
General 13
Treaty Projects 13
Duncan Project 13
Arrow Project 14
Mica Project 14
Libby Project in the United States 15
Libby Project in Canada 15
Hydrometeorological Network 15
Power Operating Plans and Calculation of Downstream Power Benefits 16
Transmission Developments 17
Flood Control Operating Plan 18
Flow Records 18

Non-Treaty Storage 19
Fisheries Operations 19
Biological Opinion on the Federal Columbia River Power System 19

OPERATIONS UNDER THE TREATY 21
General 21
System Storage 24
Mica Reservoir 26
Arrow Reservoir 27
Duncan Reservoir 27
Libby Reservoir 28
Flood Control Operations 29
Duncan Reservoir Levels 30
Mica Reservoir Levels 31
Libby Reservoir Levels 32
Arrow Reservoir Level 33
Kootenai River at Libby Dam 34
Duncan River at Duncan Dam 35
Columbia River at Mica Dam 36
Columbia River at Hugh Keenleyside Dam 37
Columbia River at Birchbank 38

TREATY BENEFITS 39
Flood Control Benefits 39
Power Benefits 40
Other Benefits 41

CONCLUSIONS 43

LIST OF PHOTOGRAPHS

Libby Dam 2
Hugh Keenleyside Dam 7
Duncan Dam 12
Mica Dam 20
Columbia River, Revelstoke Dam and Cora Linn Dam 42
Treaty Tower, Mica Spillway and 2010 Treaty Inspection Tour 45

Photographs supplied by the British Columbia Hydro and Power Authority and the U.S. Army Corps of Engineers.

LIST OF HYDROGRAPHS

Duncan Reservoir Levels 30
Mica Reservoir Levels 31
Libby Reservoir Levels 32
Arrow Reservoir Levels 33
Kootenai River at Libby Dam 34
Duncan River at Duncan Dam 35
Columbia River at Mica Dam 36
Columbia River at Hugh Keenleyside Dam 37
Columbia River at Birchbank 38

APPENDICES

A: Columbia River Treaty Permanent Engineering Board 46
B: Columbia River Treaty Entities 51
C: Record of Flows at the International Boundary 55
D: Project Information 58

ABBREVIATIONS AND ACRONYMS

AER ……Actual Energy Regulation
aMW ……Average Megawatts
AOP ……Assured Operating Plan (from 1 August to 31 July)
BC Hydro ……British Columbia Hydro and Power Authority
BiOp ……Biological Opinion
BPA ……Bonneville Power Administration
CEPA ……Canadian Entitlement Purchase Agreement
CRTHMC ……Columbia River Treaty Hydrometeorological Committee
cfs ……Cubic feet per second
DDPB ……Determination of Downstream Power Benefits
DOP ……Detailed Operating Plan (from 1 August to 31 July)
FCOP ……Flood Control Operating Plan
FCRPS ……Federal Columbia River Power System
ft ……Feet
hm^3 ……Cubic hectometres
IJC ……International Joint Commission
kaf ……Thousand acre-feet
kcfs ……Thousand cubic feet per second
km ……Kilometres
km^3 ……Cubic kilometres
kV ……Kilovolts
LCA ……Libby Coordination Agreement
m ……Meters
m^3/s ……Cubic meters per second
Maf ……Million acre-feet
mi ……Miles
MW ……Megawatts
MWh ……Megawatt hour
NMFS ……National Marine Fisheries Service
NOAA ……National Oceanic and Atmospheric Administration
NTSA ……Non-Treaty Storage Agreement
PEBCOM ……Permanent Engineering Board Engineering Committee
PNCA ……Pacific Northwest Coordination Agreement
PSANI ……Puget Sound Area / Northern Intertie
TSR ……Treaty Storage Regulation
USACE ……U.S. Army Corps of Engineers
USFWS ……U.S. Fish and Wildlife Service
VarQ ……Variable discharge flood control

INTRODUCTION

The Columbia River Treaty provides for the cooperative development of the water resources of the Columbia River Basin. Article XV of the Treaty established a Permanent Engineering Board and specified that one of its duties is to "make reports to Canada and the United States of America at least once a year of the results being achieved under the Treaty."

This annual report, which covers the period from 1 October 2011 through 30 September 2012, describes the activities of the Board, Treaty projects, storage operations, and the resulting benefits achieved by each country. It also presents summaries of the essential features of the Treaty and of the responsibilities of the Board and the Entities.

The report refers to items currently under review by the Entities; provides details on calculating flood control and power benefits and on operation of Treaty reservoirs and flow discharges at the border; and presents the conclusions of the Board.

Libby Dam – Kootenai River, Montana

THE COLUMBIA RIVER TREATY

General

The Columbia River Treaty was signed at Washington, D.C., on 17 January 1961, and was ratified by the United States Senate in March of that year. In Canada, ratification was delayed. Further negotiations between the two countries resulted, on 22 January 1964, in a formal agreement by an exchange of notes to a Protocol to the Treaty, and to an Attachment Relating to Terms of Sale. The Treaty and related documents were approved by the Canadian Parliament in June 1964.

The Canadian Entitlement Purchase Agreement (CEPA) was signed on 13 August 1964. Under the terms of this agreement, Canada's share of downstream power benefits resulting from the first 30 years of scheduled operation of each of the Canadian storage projects was sold to a group of electric utilities in the United States known as the Columbia Storage Power Exchange.

On 16 September 1964, the Treaty and Protocol were formally ratified by an exchange of notes between the two countries. The sum of US$253.9 million was delivered to the Canadian representatives as payment in advance for the Canadian entitlement to downstream power benefits during the period of the Purchase Agreement. On the same date, at a ceremony at the Peace Arch Park on the International Boundary, the Treaty and its Protocol were proclaimed by President Johnson of the United States, Prime Minister Pearson of Canada, and Premier Bennett of British Columbia.

Features of the Treaty and Related Documents

The essential undertakings of the Treaty are as follows:

(a) Canada will provide 19.1 km^3 (15.5 Maf) of usable storage by constructing dams near Mica Creek, the outlet of Arrow Lakes, and Duncan Lake in British Columbia.

(b) The United States will maintain and operate the hydroelectric power facilities included in the base system and any new main-stem projects to make the most effective use of improved streamflow resulting from operation of the Canadian storage. Canada will operate the storage in accordance with the procedures and operating plans specified in the Treaty.

(c) The United States and Canada will share equally the additional power benefit available in the United States as a result of river regulation by upstream storage in Canada.

(d) On commencement of the respective storage operations, the United States will make payments to Canada totalling US$64.4 million for flood control provided by Canada.

(e) The United States has the option of constructing a dam on the Kootenai River near Libby, Montana. The Libby Reservoir would extend some 67.6 km (42 miles) into Canada, and Canada would make the necessary Canadian land available for flooding.

(f) Both Canada and the United States have the right to make diversions of water for consumptive use and, in addition, after September 1984, Canada has the option of making specific diversions of the Kootenay River into the headwaters of the Columbia River for power purposes.

(g) Differences arising under the Treaty that cannot be resolved by the two countries may be referred by either country to the International Joint Commission or to arbitration by an appropriate tribunal as specified by the Treaty.

(h) The Treaty shall remain in force for at least 60 years from its date of ratification, 16 September 1964. The Protocol of January 1964 amplified and clarified certain terms of the Columbia River Treaty. The Attachment Relating to Terms of Sale signed on the same date established agreement that, under certain terms, Canada would sell in the United States its entitlement to downstream power benefits for a 30-year period. The Exchange of Notes and Attachment Relating to Terms of Sale of January 1964 and the CEPA of 13 August 1964 (the Sales Agreement) provided that the Treaty storage would be operative for power purposes on the following dates: Duncan storage on 1 April 1968; Arrow storage on 1 April 1969; and Mica storage on 1 April 1973. All sales under the Sales Agreement have now expired.

Termination Provisions

Article XIX describes the period of the Treaty and provisions for its termination. While the Treaty has no official termination date, Canada or the United States may issue notice to terminate most of the provisions of the Treaty 60 years (at the earliest) from its date of ratification (that is, on September 16, 2024), provided they have given at least ten years' written notice. Certain provisions of Treaty change automatically in 2024, while others continue for the useful life of the Treaty facilities.

The Entities are currently engaged in technical studies aimed at establishing baseline conditions for power and flood control operations post-2024 with and without the Treaty. These studies, together with other work and public consultation, will help inform decision makers on matters affecting the future of the Treaty.

PERMANENT ENGINEERING BOARD

General

Article XV of the Columbia River Treaty establishes a Permanent Engineering Board consisting of two members to be appointed by Canada and two members to be appointed by the United States. Appointments to the Board were to be made within three months of the date of ratification. The duties and responsibilities of the Board are also stipulated in the Treaty and related documents.

Establishment of the Board

On 7 December 1964, pursuant to Executive Order No. 11177 dated 16 September 1964, the Secretary of the Army and the Secretary of the Interior each appointed a member and an alternate member to form the United States Section of the Permanent Engineering Board. Pursuant to the Department of Energy Organization Act of 4 August 1977, the appointments to the United States Section of the Board are now made by the Secretary of the Army and the Secretary of Energy. The members of the Canadian Section of the Board were appointed by Order in Council P.C. 1964-1671 dated 29 October 1964. Each Canadian member was authorized to appoint an alternate member. On 11 December 1964, the two governments announced the composition of the Board.

The names of Board members, alternate members, and secretaries are shown in Appendix A, as are the names of the current members of the Board's Engineering Committee (PEBCOM).

Duties and Responsibilities

The general duties and responsibilities of the Board to the governments, as set forth in Article XV(2) of the Treaty and related documents, include:

(a) assembling records of the flows of the Columbia River and the Kootenay River at the Canada–United States of America boundary;

(b) reporting to Canada and the United States of America whenever there is substantial deviation from the hydroelectric and flood control operating plans and, if appropriate, including in the report recommendations for remedial action and compensatory adjustments;

(c) assisting in reconciling differences concerning technical or operational matters that may arise between the Entities;

(d) making periodic inspections and requiring reports as necessary from the Entities, with a view to ensuring that the objectives of the Treaty are being met;

(e) making reports to Canada and the United States of America at least once a year of the results being achieved under the Treaty and making special reports concerning any matter that it considers should be brought to their attention;

(f) investigating and reporting with respect to any other matter coming within the scope of the Treaty at the request of either Canada or the United States of America; and

(g) consulting with the Entities on the establishment and operation of a hydrometeorological system as required by Annex A of the Treaty.

Hugh Keenleyside Dam (Arrow Lakes) – Columbia River, British Columbia
Concrete spillway and discharge works with navigation locks and earthfill dam.
The new 185-MW power plant is on the north abutment (right-hand side).

ENTITIES

General

Article XIV(1) of the Columbia River Treaty provides that Canada and the United States of America shall each designate one or more Entities to formulate and execute the operating arrangements necessary to implement the Treaty. The powers and duties of the Entities are specified in the Treaty and its related documents.

Establishment of the Entities

Executive Order No. 11177, previously referred to, designated the Administrator of the Bonneville Power Administration (BPA), the Department of the Interior (moved by a later Executive Order to the Department of Energy), and the Division Engineer, North Pacific (now Northwestern) Division, Corps of Engineers, Department of the Army, as the United States Entity, with the Administrator to serve as Chair. Pursuant to the Department of Energy Organization Act of 4 August 1977, the BPA was transferred to the Department of Energy. Order in Council P.C. 1964-1407, dated 4 September 1964, designated the British Columbia Hydro and Power Authority (BC Hydro) as the Canadian Entity.

The names of the members of the Entities are shown in Appendix B.

Powers and Duties of the Entities

In addition to the powers and duties specified elsewhere in the Treaty and related documents, Article XIV(2) of the Treaty requires that the Entities be responsible for the following:

(a) coordination of plans and exchange of information relating to facilities to be used in producing and obtaining the benefits contemplated by the Treaty;

(b) calculation of and arrangements for delivery of hydroelectric power to which Canada is entitled for providing flood control;

(c) calculation of the amounts payable to the United States of America for standby transmission services;

(d) consultation on requests for variations made pursuant to articles XII(5) and XIII(6);

(e) establishment and operation of a hydrometeorological system as required by Annex A;

(f) assisting and cooperating with the Permanent Engineering Board in the discharge of its functions;

(g) periodic calculation of accounts;

(h) preparation of the hydroelectric operating plans and flood control operating plans for the Canadian storage together with determination of the downstream power benefits to which Canada is entitled;

(i) preparation of proposals to implement Article VIII, and carrying out of any disposal authorized or exchange provided for therein;

(j) making appropriate arrangements for delivery to Canada of the downstream power benefits to which Canada is entitled, including such matters as load factors for delivery, times and points of delivery, and calculation of transmission loss; and

(k) preparation and implementation of detailed operating plans that may produce results more advantageous to both countries than those that would arise from operation under the plans referred to in annexes A and B. Article XIV(4) of the Treaty provides that the two governments may, by an exchange of notes, empower or charge the Entities with any other matter coming within the scope of the Treaty.

ACTIVITIES OF THE BOARD

Meetings

The Board held its 79th meeting on 8 February 2012 in Portland, OR. In conjunction with this meeting, the Board also held its 60th joint meeting with the Entities.

The following topics were discussed at the meeting: the 2011 and 2012 DOP and supplemental operating agreements; Libby VarQ and 2011 Operations; Canadian entitlement delivery; production of the 2016-2017 Assured Operating Plan and Determination of Downstream Power Benefits (AOP/DDPB) and development of future plans for AOP18 and AOP19; status of progress on developing a long-term non-treaty storage agreement; Kootenay Lake IJC Board of Control activities; update on Hydrometeorological Committee activities; update on litigation activities associated with the 2010 Supplemental FCRPS BiOp ; status of Treaty websites; and status of 2014/2024 planning studies.

Reports Received

Throughout the reporting year, the Entities maintained contact with the Board and the Board's Engineering Committee (PEBCOM). Information pertinent to the operation of Treaty storage projects was made available to the Board.

Since the last Annual Report, the Board has received the following documents involving the operation of Columbia River Treaty storage:

- Columbia River Treaty Operating Committee Agreement on Operation of Treaty Storage for Non-power Uses from 10 December 2011 through 31 July 2012, signed 30 November 2011

  This agreement is similar to previous agreements implemented to utilize Treaty storage for non-power uses. These uses include the following: (1) providing flows for Canadian trout spawning for the April through June period; (2) enhancing the capability in the U.S. of providing spring and summer flow augmentation for salmon and steelhead by storing 1 Maf of water in Arrow by late April; (3) enhancing Arrow Lakes levels by ensuring progressive refill; (4) providing a minimum discharge objective at Arrow during January through March 2012 for the purpose of protecting eggs deposited on the streambed by Mountain Whitefish during December 2011 through January 2012; (5) improving the U.S. capability to meet flow objectives for salmon at Vernita Bar below Priest Rapids Dam during the period of December 2011 through early May 2012. This agreement supplements the 2011–2012 Detailed Operating Plan (DOP).

- Columbia River Treaty Assured Operating Plan and Determination of Downstream Power Benefits for Operating Year 2016-2017, dated January 2012

  This document provides information on the operating plan for Columbia River Treaty storage and the resulting downstream power benefits for the period 1 August 2016 through 31 July 2017.

- Columbia River Treaty Entity Agreement on the Assured Operating Plan and Determination of Downstream Power Benefits for the 2016-2017 Operating Year, signed 5 January 2012.

  This document is the agreement to implement the AOP and DDPB that provide information on the operating plan for Columbia River Treaty storage and the resulting downstream power benefits for the period 1 August 2016 through 31 July 2017.

- Detailed Operating Plan for Columbia River Storage for 1 August 2012 through 31 July 2013, dated June 2012

  This document provides the general guidelines, operating criteria, and reservoir rule curves for the operation of the three Treaty reservoirs (Mica, Arrow, and Duncan) in Canada for the operating year from 1 August 2012 through 31 July 2013.

- Columbia River Treaty Entity Agreement on the Detailed Operating Plan for Columbia River Storage for 1 August 2012 through 31 July 2013, signed 8 June 2012

  This document is the agreement between the Entities to implement the DOP for Columbia River storage during the period 1 August 2012 through 31 July 2013.

- Annual Report of the Columbia River Treaty, Canadian and United States Entities, for the period 1 October 201 through 30 September 2012.

  This report summarizes the operation of Treaty projects and other activities of the Entities for the period 1 October 2011 through 30 September 2012.

Report to the Governments

The forty-seventh Annual Report of the Board, dated 30 September 2011, was submitted to the governments of Canada and the United States.

Duncan Dam – Duncan River, British Columbia
The earthfill dam with discharge tunnels to the left and spillway to the right.

TREATY IMPLEMENTATION

General

Implementation of the Treaty resulted in the construction of the Treaty projects, development of the hydrometeorological network, preparation of flood control operating plan, and annual preparation of operating plans for power and calculation of downstream power benefits. The three Treaty storage projects in British Columbia (Duncan, Arrow, and Mica) and the Libby storage project in the United States have been operated accordingly to produce flood control and power benefits in both Canada and the United States. The locations of the Treaty projects are shown in Plate No. 1 in Appendix D.

In the United States, the increased flow regulation provided by Treaty projects facilitated the installation of additional generating capacity at existing plants on the Columbia River.

In Canada, completion of the Canal Plant on the Kootenay River in 1976, installation of four turbines at Mica Dam by 1977, and completion of the Revelstoke dam in 1984 (and a fifth turbine in December 2010), and installation of two turbines adjacent to the Keenleyside Dam in Arrow Lakes in 2002, have resulted in 5053 MW of generation capacity in British Columbia that might not have been installed without the Treaty. Two additional turbines with a capacity of 520 MW each are being installed in the Mica Dam. The first one is targeted for completion by 2015 and the other by 2016. An additional generation unit at Revelstoke is also being planned.

The Treaty provides Canada with an option to divert the Kootenay River at Canal Flats into the headwater of the Columbia River starting 1984. BC Hydro undertook engineering feasibility and environmental studies but no further work has been done recently.

Further to the expiration of the Sales Agreements in 1998, 1999 and 2003, the Board has monitored issues relating to the transmission and return of the Canadian entitlement, and the restructuring of electricity markets. It has also reviewed the impacts of U.S. resource agencies' biological opinions (BiOps) on Treaty operations.

Treaty Projects

Duncan Project

Duncan Dam, the smallest Treaty project, was scheduled to begin operation by 1 April 1968. It was the first of the Treaty projects to be completed and became fully operational on 31 July 1967, well in advance of Treaty requirement. The Sales Agreement for Duncan expired 31 March 1998.

The earthfill dam is situated 9.7 km (6 mi) north of Kootenay Lake. The reservoir behind the dam extends for as much as 43.5 km (27 mi) and provides 1.73 km^3 (1.4 Maf) of usable storage, which is all committed under the Treaty. No power generation facilities have been installed.

The project is shown on page 12, and project data are provided in Appendix D, Table 1.

Arrow Project

Hugh Keenleyside Dam, at the outlet of the Arrow Lakes, was the second Treaty project to be completed. It became operational on 10 October 1968, well ahead of the starting date of 1 April 1969 for the 30-year Sales Agreement.

The dam consists of two main components: a concrete gravity structure that extends 366 m (1200 ft) from the north bank of the river and includes the spillway, low-level outlets, and navigation lock; and an earthfill section that rises 52 m (170 ft) above the riverbed and extends 503 m (1650 ft) from the navigation lock to the south bank of the river. The reservoir, up to 233 km (145 mi) long when full, includes both the Upper and Lower Arrow lakes and provides 8.8 km^3 (7.1 Maf) of Treaty storage.

The new 185-MW power plant at the Arrow Project, completed in 2002 and licensed to Arrow Lakes Power Corporation (owned by Columbia Basin Trust and Columbia Power Corporation, which are Crown Corporations in British Columbia), is located on the north abutment (left bank). A 1493 m (4900 ft) intake approach channel runs along the north end of the concrete dam and diverts the water of the Arrow Lakes through a powerhouse located in a rock outcrop 396 m (1300 ft) downstream. The generating facility contains two 92.5 MW Kaplan turbines. The facility is connected by a new 230 kV transmission line to the Selkirk substation integrated into BC Hydro's existing power grid. The power production at the new generating facility is incidental to releases for Treaty purposes. This new power plant reduces spill at Keenleyside Dam and provides environmental benefits by reducing the total gas pressure in the releases, which could be harmful to fish.

The project is shown on page 7, and project data are provided in Appendix D, Table 2.

Mica Project

Mica Dam, the largest of the Treaty projects, was scheduled under the 30-year Sales Agreement to begin operation on 1 April 1973. The project was declared operational and commenced to store water on 29 March 1973. The dam is located on the Columbia River 137 km (85 mi) north of the town of Revelstoke in British Columbia. The earthfill dam rises more than 244 m (800 ft) above its foundation and extends 793 m (2600 ft) across the Columbia River valley. It is one of the tallest dams in North America. It creates a reservoir, the Kinbasket Lake, that is up to 217 km (135 mi) long with a storage capacity of 24.7 km^3 (20 Maf). The project is operated within 14.8 km^3 (12 Maf) of live storage, of which 8.6 km^3 (7 Maf) are committed under the Treaty.

Although not required by the Treaty, BC Hydro added a powerhouse to the project. The underground powerhouse was designed for six generating units. Four generators have been installed with a total capacity of 1805 MW. Installations of the two remaining generating units, each with a capacity of 520 MW, are scheduled for completion by 2016.

The project is shown on page 19, and project data are provided in Appendix D, Table 3.

Libby Project in the United States

Libby Dam is located on the Kootenai River, 27.4 km (17 mi) northeast of the town of Libby, Montana. Construction began in the spring of 1966, and storage has been fully operational since 17 April 1973. Commercial generation of power began on 24 August 1975, which coincided with the formal dedication of the project. The concrete gravity dam is 931 m (3055 ft) long, rises 113 m (370 ft) above the riverbed, and creates Lake Koocanusa, which is up to 145 km (90 mi) long and extends 67.6 km (42 mi) into Canada. Lake Koocanusa has a gross storage of 7.2 km^3 (5. 9 Maf), of which 6.1 km^3 (5.0 Maf) is usable for flood control and power purposes. When completed in 1976, the Libby powerhouse had four units with a total installed capacity of 420 MW.

Construction of four additional generating units was initiated during fiscal year 1978, but Congressional restrictions imposed in the 1982 *Appropriations Act* provided for completion of only one of these units. That unit became available for service late in 1987. The total installed capacity for the five units is 600 MW. Recent U.S. legislation (*Public Law 104-303*, 12 Oct. 1996) authorizes the U.S. Army Corps of Engineers (USACE) to complete generating units six through eight. No action was taken in this regard during this reporting period.

The Libby project is shown on page 2, and project data are provided in Appendix D, Table 4.

Libby Project in Canada

Canada has fulfilled its obligation to prepare the land required for the 68 km (42 mi) portion of Lake Koocanusa in Canada. British Columbia is responsible for reservoir debris clean-up on the Canadian side of the border.

Hydrometeorological Network

One of the responsibilities assigned to the Entities by the Treaty is the establishment and operation, in consultation with the Permanent Engineering Board, of a hydrometeorological system to obtain data for the planning of flood control and power operation. This system includes snow courses, meteorological stations, and reservoir level and streamflow gauges. The Columbia River Treaty Hydrometeorological Committee (CRTHMC), formed by the Entities in 1968, makes recommendations on further development of the Treaty Hydrometeorological System. The Committee's 2011 Annual Report was completed in January 2012 and its 2012 Annual Report is scheduled for completion in early 2013.

The Committee continued its review of the adequacy of the monitoring stations network. As a first step, the stations were categorized in a hierarchy of importance. At the same time, the lack of real time and late season snowpack data was identified as a deficiency of the network, and BPA and BC Hydro are working to install additional snow pillows.

Data management improvements completed during the reporting period include a new improved data transfer system at BC Hydro and a new data control system and secure FTP system at USACE. The Committee decided to avoid a costly fix to Treaty accounting caused by changes from daylight savings time, and agreed to minimize changes in project operation over the affected period and to make adjustments manually where necessary.

The Committee has reviewed the new Ensemble Streamflow Prediction forecast procedure of the Northwest River Forecast Center and recommended its use in Treaty operations and planning. The Committee continued to review a new Dworshak seasonal volume forecast procedure.

Power Operating Plans and Calculation of Downstream Power Benefits

The Treaty and related documents require the Entities to develop and agree on an Assured Operating Plan (AOP) annually for the sixth succeeding year from the current year. This AOP, prepared five years in advance, represents the commitment of the Canadian Entity to operate the Treaty storage in Canada (Duncan, Arrow, and Mica) and provides the Entities with a basis for system planning. The calculation of downstream power benefits accrued to each country under the Treaty is also prepared five years in advance based on the Treaty operation criteria in the AOP. At the beginning of each Operating Year, a Detailed Operating Plan (DOP) for the three Treaty projects in Canada is prepared. This plan accounts for projected resources and demands to determine operations that are more advantageous to both countries than those in accordance with the AOP. To supplement the DOP, the Entities may enter into agreements throughout the year regarding the operation of Treaty storage that provide mutual benefits to both Entities. Details on Libby operations are discussed further below.

During the reporting year, operation of Treaty storage in Canada was regulated under the rule curves set out in the Entities' *Detailed Operating Plan for Columbia River Treaty Storage, 1 August 2011 through 31 July 2012*, signed on 21 June 2011, and the *Detailed Operating Plan for Columbia River Treaty Storage, 1 August 2012 through 31 July 2013*, signed on June 8, 2012, as well as in accordance with additional agreements between the Entities signed during the year. These documents were based on the operating criteria and hydro-regulation studies contained in the corresponding AOPs, together with any changes agreed to by the Entities.

The Libby operating criteria and expected operation of the Libby project are no longer included in the annual DOP beginning in the 2000-2001 Operating Year. Information on Libby operations is provided separately in the Libby Operating Plan prepared by the U.S. Entity. Operation at Libby takes non-power considerations into account as required in the BiOps of the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic & Atmospheric Administration (NOAA) Fisheries Service. Compared to operations prior to 2000–2001, the BiOps require higher releases from Libby Dam in the spring and summer and lower releases in the fall and winter. In January 2003, USACE adopted, on an interim basis, a new approach to determine operations at Libby. This approach, referred to as VarQ, applies only when dry-to-moderate hydrologic runoff conditions are forecasted. It uses (encroaches) flood control storage space to store water to increase flows for fisheries during the spring period. In June 2008, USACE issued a Record of Decision for Libby Dam Flood Control and Fish Operations and incorporated the VarQ Flood Control Procedures into the Libby Dam Water Control Manual. USACE will continue to coordinate with Canada on the operation of Libby Dam pursuant to the provisions of the Columbia River Treaty.

The Libby Coordination Agreement (LCA), signed on 16 February 2000, addressed some of the issues concerning salmon and white sturgeon fisheries operations of the Libby Project, and allowed the Entities to coordinate reservoir releases and agree to AOPs and DDPBs without having to fully resolve outstanding issues of disagreement. The LCA could be terminated by either Entity on 30 days' notice. Details of the LCA are presented later in this report under "Operations under the Treaty." The Entities have successfully implemented the LCA since signing.

A lengthy dispute between the Entities during the early 1990s regarding the calculation of downstream power benefits was resolved by signing the *Entity Agreement on Resolving the Dispute on Critical Period Determination, the Capacity Entitlement for the 1998–1999, 1999–2000, and 2000–2001 AOP/DDPBs, and Operating Procedures for the 2001–2002 and Future AOPs*. If circumstances so require in the future, the Board will re-examine the matter by using its earlier recommendations as guidelines for the appropriate Treaty interpretation, and for the application of the critical streamflow period definition and the established operating procedures. A more detailed discussion of this issue is contained in the 1996 and 1997 annual reports of the Board.

The arrangements for returning the Canadian entitlement to British Columbia across existing transmission lines are based on the *Columbia River Treaty Entity Agreement on Aspects of the Delivery of the Canadian Entitlement for April 1, 1998 through September 15, 2024*, signed 29 March 1999. This agreement provides arrangements for the delivery of the Canadian entitlement, including the point of delivery, method of accounting for transmission losses, and guidelines for scheduling.

In addition to the delivery agreement referenced above, the terms and conditions for the disposal of portions of the Canadian entitlement within the United States are based on the *Agreement on Disposals of the Canadian Entitlement within the United States for April 1, 1998 through September 15, 2024 between Bonneville Power Administration, Acting on Behalf of the U.S. Entity, and the Province of British Columbia*, signed 29 March 1999. Both the delivery agreement and the disposal agreement became effective on 31 March 1999 through an exchange of diplomatic notes between Canada and the United States.

Transmission Developments

During the reporting period the Canadian Entitlement was delivered as scheduled 99.94 percent of the time. Four curtailments occurred in March and April 2012 totaling 5 hours and 625 MWh.

BPA Transmission Services owns and operates more than 15,000 circuit miles of high-voltage transmission lines in the Pacific Northwest. To ensure continued transmission system reliability and to respond to growing requests for transmission service, BPA is expanding and reinforcing the aging transmission system. This past year BPA built a 79-mile 500-kilovolt high-voltage transmission line in the Washington and Oregon area known as "McNary-John Day". When combined with other BPA projects currently being planned or built, this project will enable up to 3,880 MW of total transmission service requests.

BPA is also moving ahead with shorter term transmission initiatives to manage congestion on the transmission system that include installation of several new flowgates throughout the BPA network. Currently, BPA manages congestion in the Puget Sound Area and the Northern Intertie at the Northern Intertie. However, the Northern Intertie does not fully protect for limiting elements in the Puget Sound Area. Therefore, two flowgates are planned to be added by February 2013 for the Puget Sound Area: North of Echo Lake (S>N) and South of Custer (N>S). These flowgates will be added and used for Available Flowgate Capacity (AFC) calculations and operations. Curtailments on these network flowgates will continue to be managed according to the Columbia River Treaty.

The 357 km (214 mile) privately-owned 230-kV Alberta –Montana Ltd ("MATL") line between Lethbridge, Alberta and Great Falls, Montana began construction in September of 2010. Work on the line continues, commissioning is expected in 2013. Involvement of the U.S. government is primarily through the Western Area Power Administration (WAPA), which committed $161 million in stimulus loan funds to encourage the project.

Legislation was proposed in the U.S. in 2008, and reintroduced in 2010, to amend the Federal Power Act to give the Federal Energy Regulatory Commission the authority to address known cybersecurity threats to the reliability of the bulk power system, and to provide emergency authority to address future cybersecurity threats. The legislation is still being debated. In September 2012 the Commission announced the creation of a new Office of Energy Infrastructure Security that will help it to focus on potential cyber and physical security risks to energy facilities under its jurisdiction. Canadian governments have continued in discussion with the U.S. regarding cybersecurity threats to reliability.

The Board will continue to keep governments informed of transmission developments that may impact Treaty implementation.

Flood Control Operating Plan

The Treaty provides that Canadian storage reservoirs will be operated by the Canadian Entity in accordance with operating plans designed to minimize flood damage in the United States and Canada. The Columbia River Treaty Flood Control Operating Plan, dated October 1972, was received from the Entities and reviewed by the Board in the 1973 reporting year, and was in effect until October 1999. The revised plan, dated October 1999 and updated in May 2003, defines the flood control operations of the Duncan, Arrow, Mica, and Libby reservoirs during the period covered in this report.

Flow Records

Article XV(2)(a) of the Treaty specifies that the Permanent Engineering Board shall assemble records of flows of the Columbia and Kootenai Rivers at the Canada-U.S. boundary. Flows for this reporting year are tabulated in Appendix C for the Kootenai River at Porthill, Idaho, and for the Columbia River at Birchbank, British Columbia.

Non-Treaty Storage

Since 1984, agreements have also been reached between B.C. Hydro and the BPA concerning the use of non-Treaty storage. These agreements do not interfere with operations under the Treaty. They do extend the concepts of the Treaty and benefit both B.C. Hydro and the BPA.

BPA and B.C. Hydro executed a new Long Term Non-Treaty Storage Agreement on 10 April 2012. The agreement provides for coordinated use of up to 6.2 km^3 (5 Maf) of Non-Treaty Storage (NTS) in Canada for the period 10 April 2012 through 15 September 2024. The Entities reviewed the Agreement and are satisfied that mutual benefits can be achieved without adversely affecting the operation of Treaty space.

Fisheries Operations

Many U.S. reservoirs are presently operated in accordance with BiOps issued by the USFWS and the NMFS under the Endangered Species Act. Treaty reservoirs in Canada are operated in accordance with the requirements of Fisheries and Oceans Canada. These efforts continue to evolve. In this regard, the Board notes that the AOP and DDPB are to be based on optimal operations for power and flood control in accordance with the requirements of the Treaty. The Board continues to maintain its long-standing position that the Treaty permits the Entities to develop DOPs to address fisheries' needs, to the extent that these actions do not conflict with Treaty objectives.

Biological Opinion on the Federal Columbia River Power System

NOAA's National Marine Fisheries Service concluded in their 2008/2010 Biological Opinion (BiOp) that the operation of the Federal Columbia River Power System (FCRPS) is not likely to jeopardize the continued existence of salmon and steelhead in the Columbia River Basin. In October 2010, several environmental groups, the State of Oregon, and the Nez Perce Tribe challenged the 2008/2010 FCRPS BiOp. In August 2011, Judge Redden sent the 2008/2010 BiOp back to NOAA Fisheries after concluding that the BiOp needed further work on the non-specific mitigation actions (mostly related to fish habitat). He further concluded that the existing 2008/2010 FCRPS BiOp was adequate under the Endangered Species Act and directed that the BiOp remain in place through 2013. The Judge also ordered that the government continue to fund and implement all of the mitigation measures in the BiOp through December 31, 2013. The court ordered a new biological opinion be issued by January 1, 2014. Annual progress reports are filed with the Court. Finally, the Corps of Engineers continues to conduct spring and summer spill operations in a manner consistent with the court's annual spill orders, and provides monthly implementation reports.

On November 22, 2011, Judge Redden stepped down from this case. On November 28th, Judge Michael H. Simon was announced as his replacement.

Mica Dam and Lake Kinbasket – Columbia River, British Columbia
The spillway is on the right of the earthfill dam, and the underground powerhouse on the left.

OPERATIONS UNDER THE TREATY

General

The Columbia River Treaty Operating Committee was established by the Entities to develop operating plans for the Treaty storage, and to direct the operation of this storage in accordance with the terms of the Treaty and subsequent Entity agreements. These plans follow the Operating Year from August to July of the following year. Although the Permanent Engineering Board reporting period is 1 October 2011 to 30 September 2012, Treaty operations thereunder are based on the Treaty Operating Year of 1 August 2011 to 31 July 2012. Additional information for 1 August 2012 to 30 September 2012 is based on the Treaty Operating Year 1 August 2012 to 31 July 2013.

Treaty storage in Canada was operated by the Canadian Entity in accordance with the documents listed below. The Libby project was operated by the U.S. Entity according to the 2003 FCOP, the 2000 LCA, including the 13 January 2010 and 12 October 2010 updates to the Libby Operating Plan (LOP), U.S. requirements for power, guidelines set forth in the U.S. Fish and Wildlife Service (USFWS) 2008 Biological Opinion, and the U.S. National Marine Fisheries Service (NMFS) Biological Opinions and Action Agency Plans, as approved by Court order, and strict application of the eight-step VarQ operating procedures.

- *Columbia River Treaty Entity Agreement on Principles for Preparation of the Assured Operating Plan and Determination of Downstream Power Benefits*, dated July 1988

  This agreement states the principles for changes to the preparation of the AOP and DDPB. These changes involve revisions to the information to be used in studies, such as the definition of the power loads and generating resources in the Pacific Northwest area, stream flows to be used, estimates of irrigation withdrawals and return flows, and other related information.

- *Columbia River Treaty Entity Agreement on Changes to Procedures for the Preparation of the Assured Operating Plan and Determination of Downstream Power Benefit Studies*, dated August 1988

  This agreement states the specific procedures to be used in implementing the previous agreement on Principles for Preparation of the Assured Operating Plan and Determination of Downstream Power Benefits.

- *Agreement executed by the United States of America Department of Energy, acting by and through the Bonneville Power Administration, and the British Columbia Hydro and Power Authority relating to: (a) Use of Columbia River Non-Treaty Storage, (b) Mica and Arrow Refill Enhancement, and (c) Initial Filling of non-Treaty Reservoirs*, signed 9 July 1990

  This agreement provides information relating to the initial filling of Revelstoke Reservoir, the coordinated use of some of the Columbia River non-Treaty storage, and actions taken to enhance the refill of the reservoirs impounded by the Mica and Arrow dams.

- *Columbia River Treaty Entity Agreement on Aspects of the Delivery of the Canadian Entitlement for 1 April 1998 through 15 September 2024*, signed 29 March 1999

  This agreement provides arrangements for the delivery of the Canadian entitlement, including the point of delivery, method of accounting for transmission losses, and guidelines for scheduling. The Agreement became effective on 31 March 1999 through an exchange of diplomatic notes between the United States and Canada. Execution of this agreement supersedes and terminates the Columbia River Treaty Entity Agreement on Aspects of the Delivery of the Canadian Entitlement for 1 April 1998 through 15 September 2024 between the Canadian Entity and the United States Entity, dated 20 November 1996, and the Entity Agreement of the same name, dated 26 March 1998, which never reached its effective date.

- *Agreement on Disposals of the Canadian Entitlement Within the United States for 1 April 1998 through 15 September 2024 between the Bonneville Power Administration, Acting on Behalf of the U.S. Entity, and the Province of British Columbia*, signed 29 March 1999

  This agreement describes the arrangements by which the Province of British Columbia may dispose of the Canadian entitlement in the United States.

- *Columbia River Treaty Entity Agreement Coordinating the Operation of the Libby Project with the Operation of Hydroelectric Plans on the Kootenay River and Elsewhere in Canada*, signed 16 February 2000

  The LCA addresses issues concerning the operation of the Libby project and allows the Entities to coordinate reservoir operations and agree to AOPs and DDPBs without having to alter their respective positions on the validity of the Libby fisheries operations under the Treaty.

- *Columbia River Treaty Flood Control Operating Plan*, updated May 2003

  This plan prescribes the criteria and procedures by which the Canadian Entity will operate the Mica, Duncan, and Arrow reservoirs to achieve desired flood control objectives in the United States and Canada. Criteria for the Libby Reservoir were included in the plan to meet the Treaty requirement to coordinate its operation for flood control protection in Canada. The plan was originally prepared in October 1972. The 1999 plan provides current information, incorporates new storage reservation diagrams, and clarifies procedures. The plan was updated in May 2003.

- *U.S. Entity Approval Relating to Amendatory Agreement No. 1 to the 1997 Pacific Northwest Coordination Agreement*, signed 13 June 2003

  This agreement amends the 1997 Pacific Northwest Coordination Agreement to include definitions; adds text related to previously received interchange energy; and replaces text related to interchange pricing, accounting, and review of charges.

- *Columbia River Treaty Principles and Procedures for Preparation and Use of Hydroelectric Operating Plans for Operation of Canadian Treaty Storage*, dated 16 December 2003

  This document serves as a guide for the preparation and use of hydroelectric operating plans, such as the AOP and DOP, for operation of the Columbia River Treaty storage.

- *Columbia River Treaty Assured Operating Plan and Determination of Downstream Power Benefits for Operating Year 2011–2012*, dated March 2007

  This document provides information on the operating plan for Columbia River Treaty storage and the resulting downstream power benefits for the period 1 August 2011 through 31 July 2012.

- *Columbia River Treaty Operating Committee Agreement on Changes to Attachment B to the Columbia River Treaty Entity Agreement on Aspects of the Delivery of the Canadian Entitlement for 1 April 1998 through 15 September 2024 between the Canadian Entity and the United States Entity, dated 29 March 1999*, signed 19 December 2007

  This agreement amends the scheduling guidelines for delivery of the Canadian Entitlement contained in Attachment B in the Aspects of Delivery Agreement.

- *Columbia River Treaty Assured Operating Plan and Determination of Downstream Power Benefits for Operating Year 2012–2013*, dated January 2008

  This document provides information on the operating plan for Columbia River Treaty storage and the resulting downstream power benefits for the period 1 August 2012 through 31 July 2013.

- *Detailed Operating Plan for Columbia River Storage for 1 August 2011 through 31 July 2012*, dated June 2011

  This document provides the general guidelines, operating criteria, and reservoir rule curves for the operation of the three Treaty reservoirs (Mica, Arrow, and Duncan) in Canada for the operating year from 1 August 2011 through 31 July 2012.

- *Columbia River Treaty Operating Committee Agreement on Operation of Treaty Storage for Non-power Uses from 11 December 2011 through 31 July 2012*, signed 30 November 2011

  This agreement is similar to previous agreements implemented to utilize Treaty storage for non-power uses. These uses include: (1) providing flows for Canadian trout spawning for the April through June period; (2) enhancing the capability in the U.S. of providing spring and summer flow augmentation for salmon and steelhead by storing 1 Maf of water in Arrow by late April; (3) enhancing Arrow Lakes levels by ensuring progressive refill; and, (4) improving the U.S. capability to meet flow objectives for salmon at Vernita Bar below Priest Rapids Dam.

- *Detailed Operating Plan for Columbia River Storage for 1 August 2012 through 31 July 2013,* dated May 2012

  This document provides the general guidelines, operating criteria, and reservoir rule curves for the operation of the three Treaty reservoirs (Mica, Arrow, and Duncan) in Canada for the operating year from 1 August 2012 through 31 July 2013.

System Storage

Water Year (WY) 2012 was an exceptional year in that after a relatively uneventful winter, record spring precipitation and cold temperatures resulted in very high runoff and a very active late flood control season, especially in the Upper Columbia and Kootenai Rivers. Reservoirs in the upper part of the basin, Mica, Keenleyside, Duncan and Libby exceeded historical maximum pool elevations in operating to minimize flood damages. Notable factors contributing to this unique year were the high late spring precipitation and the very low ratio of peak discharge to runoff volume. Basin-wide precipitation in June was 164 percent of average while the April through August runoff at The Dalles was 128 percent of average, the unregulated peak flow was estimated at 16,617 m^3/s (cubic meters per second) (586.8 kcfs (thousand cubic feet per second)).

For the 1 August 2011through 30 September 2012 reporting period the Canadian Treaty Projects were operated according to the 2011-2012 and the 2012-2013 Detailed Operating Plans (DOPs), the 2003 Flood Control Operating Plan (FCOP), and several supplemental operating agreements described below. The Libby project was operated consistently with the Libby Coordination Agreement (LCA) including the Libby Operating Plan, United States (U.S.) requirements for power, and U.S. Fish and Wildlife Service's 2006 Biological Opinion (BiOp), as clarified, and NOAA Fisheries' 2010 Biological Opinion (BiOp) for operation and maintenance of the Federal Columbia River Power System. Modifications in actual operations were required during the May-June period due to higher than normal late season precipitation in the Upper Columbia Basin. Since 1960, 2012 ranks highest in total April-August runoff in the Upper Columbia and the Kootenai River Basins. Due to these high precipitation levels, the Canadian projects (Mica, Arrow, and Duncan reservoirs) along with the Libby project exceeded normal elevations as specified in their operating agreements. The Libby operation to exceed the Treaty maximum pool elevation of 749.5 m (2459.0 ft) was a coordinated Treaty operation to help reduce flood damages in the Kootenai River system in both countries. In addition, British Columbia Hydro (B.C. Hydro) and Power Authority sought and received approvals from the B.C. Comptroller of Water Rights (CWR) to temporarily surcharge Mica, Arrow, and Duncan for downstream flood control purposes, and utilized this space for flood risk management during the summer of 2012.

The 2011–2012 operating year began on 1 August 2011 with the Canadian Treaty storage at 18.9 km^3 (15.3 Maf) or 99.2 percent full. Canadian Treaty storage drafted to a minimum of 3.6 km^3 (2.9 Maf) on 19 April 2012 and refilled to 19.1 km^3 (15.5 Maf) or 100 percent full on 31 July 2012. Throughout the operating year, composite Canadian Treaty storage (Canadian Storage) was operated close to the Treaty Storage Regulation (TSR) study composite storage, plus any operations implemented under the Supplemental Operating Agreements (SOAs) or the LCA, except for some amounts of inadvertent draft or storage in all periods. Inadvertent draft or storage occurs routinely due to updated forecasts or differences between forecast and actual inflows.

Canadian Storage began the operating year 1 August 2011 slightly below the DOP levels as determined in the TSR study. Canadian Storage was drafted below TSR levels through 15 August primarily due to differences in forecast and actual inflows, but also due to the operation of the non-power agreement to smooth Arrow Treaty flows through August. Canadian Storage remained near the target TSR levels from the end of August through December. The Canadian Entity exercised their option to provisionally draft Arrow for two cycles under the LCA this year. The first cycle drafted Arrow by 68.5 cubic hectometer (hm^3 (55.5 kaf)). This was implemented and returned (stored back) in September 2011. During December 2011, the Canadian Entity exercised the second option to provisionally draft Arrow. This 137 hm^3 (111 kaf) provisional draft was returned in early January and the remainder by late March. For January until the end of June 2012, Canadian Storage remained above the TSR-specified levels. This was due to operation under the Non-Power Uses Agreement that was implemented to achieve mutual fish benefits for the U.S. and Canada. Under provisions of this agreement, the U.S. Entity stored 1 233 hm^3 (1 Maf) of flow augmentation water. At the time this water was stored, the water supply forecast was less than average at 112.7 km^3 (91.4 Maf). This operation helped to modify and manage flows downstream of Hugh Keenleyside Dam for Canadian whitefish operation in January through March, and for Canadian trout spawning protection in April through June 2012. The flow augmentation water was subsequently released during July 2012 to avoid exceeding the flood control maximum levels in May through June, to meet U.S. salmon flow objectives in July.

The spring water supply forecasts at The Dalles increased as the water year developed, from 121.9 km^3 (98.8 Maf) (January-July) in March to 158.4 km^3 (128.4 Maf) in July. During the spring freshet, B.C. Hydro sought and received approvals from the B.C. CWR to surcharge by up to 3 feet at Mica, 3 feet at Arrow, and 2 feet at Duncan reservoirs for downstream flood control purposes. Additionally, B.C. Hydro and BPA exercised storage operation under the Long Term Non-Treaty Storage agreement from May through mid-July by utilizing the maximum available Non-Treaty Storage (NTS). This Non-Treaty Storage was made available due to earlier releases under the Bridge Agreement. A total of approximately 2.3 Maf (2.83 km^3) was released by early March. Refer to Section III Long Term Non-Treaty Storage for more information on Non-Treaty operations. Even with this operation, the Columbia River flows at Birchbank (downstream of the Kootenai and Columbia confluence) peaked at 6090 m^3/s (215 kcfs) on 21 July 2012, the highest flow recorded since the Treaty dams began operation. Flows at Birchbank returned to non-flood levels when they receded to 4670 m^3/s (165 kcfs) on 1 August 2012. For the August through September 2012 period, Canadian Storage was slightly below TSR levels due to differences in forecast and actual inflows.

The 1 January 2012 water supply forecast for the Columbia River above The Dalles for January through July was 106.1 km^3 (86.0 Maf), or 80.1 percent of the 1971–2000 average. The spring water supply forecasts at the Dalles increased as the water year developed. By the 1 June 2012 forecast, the runoff prediction increased to 145.3 km^3 (117.8 Maf), and with record June precipitation, the actual January through July runoff for the Columbia River above The Dalles rose to 159.7 km^3 (129.4 Maf), or 120.6 percent of the 1971-2000 average.

Operations of the three Canadian reservoirs — Mica, Arrow, and Duncan — and the Libby Reservoir in the United States, are illustrated on pages 30 to 33 for the 13-month period from 31 August 2011 to 30 September 2012. The hydrographs show actual reservoir levels (Storage Curve) and key rule curves that govern the operations of the Treaty storage. The Flood Control Rule Curve specifies maximum month-end reservoir levels which will permit evacuation of the reservoir to control precipitation and snowmelt events. The Critical Rule Curve shows minimum month-end reservoir levels, which should be maintained to enable the anticipated power demands to be met under the most adverse water supply conditions. The Variable Refill Curve shows the reservoir elevations necessary to ensure refilling of the reservoir by the end of July with a reasonable degree of confidence.

Mica (KinbasketReservoir)

Kinbasket Reservoir reached its 2011 maximum elevation of 754.17 m (2474.3 ft) on 3 October 2011 due to a number of rainfall events in late September through early October contributing to high basin inflows. The reservoir was drawn down during the fall and winter to meet electrical demands and to prepare for above normal spring runoff and extensive planned generating unit outages in the spring/summer 2012. The project ran harder than normal due to the flexibility of moving additional water from Mica and Arrow in the fall/winter under the Bridge Agreement between BPA and B.C. Hydro. Kinbasket Reservoir reached a minimum level this year of 722.0 m (2368.7 ft) on 21 April 2012; about 3 m (10 ft) lower than the 2011 minimum level. Mica generation was limited to 2 units during an extended outage from March through August 2012. Mica power-plant output was gradually reduced in May but remained above normal in the latter half of May due to unusually cool weather and higher load demands. From mid-June to mid-July, generation was reduced to near minimum.

The basin runoff forecast increased from month to month starting from near normal in January to 120 percent of normal in the 1 June forecast. The situation was compounded by extraordinary amounts of rain throughout June and into July throughout the province. The actual February-July inflows at Mica were about 135 percent of normal, the highest recorded runoff in the 40-year period. In July, due to high freshet flows, B.C. Hydro received permission from the B.C. CWR, to surcharge all of its major reservoirs in the Columbia/Kootenai system (Kinbasket, Revelstoke, Arrow, and Duncan). For Kinbasket Reservoir, the project was permitted to surcharge the first 0.3 m (1 ft) for power purposes and an additional 0.6 m (2 ft) for downstream flood control. To manage the refill of Kinbasket Reservoir, Mica releases were increased through a combination of spill and generation on 15 July. Generation was increased to maximum possible with 2 unit operation and the project spilled until the end of August when the power-plant was returned to service. The Kinbasket Reservoir reached a maximum level of 754.7 m (2476.0 ft), or 0.3 m (1.0 ft) above full pool on 28 August 2012. The 2012 spill at Mica was the first spill at the facility since 1997.

Keenleyside (Arrow Lakes Reservoir)

The Arrow Lakes Reservoir reached a maximum level of 439.6 m (1442.1 ft), or 0.6 m (1.9 ft) below full pool on 28 July 2011, just prior to the start of the 2011-2012 Operating Year. Due to above normal runoff in the Columbia system, Canadian treaty storage did not operate in proportional draft mode at any time during the 2011-2012 Operating Year. In anticipation of extended outages at Mica and high freshet runoff, B.C. Hydro and BPA developed a Bridge agreement to allow additional releases from Mica and Arrow reservoirs using NTS space prior to the spring freshet. The minimum level for Arrow Lakes Reservoir during 2012 was 427.5 m (1402.6 ft) on 1 April, 2012. This was 3m (10 ft) lower than the previous year's minimum level. The Arrow local runoff forecast also increased from month to month starting from slightly below normal in January to 112 percent of normal in the 1 June forecast.

The Canadian Lower Columbia region received exceptionally high amounts of rain throughout June, recording 2 to 3 times the normal amount of rain at Castlegar, B.C. Actual local February to July inflows were about 126 percent of normal and were the 3rd highest recorded in the 42-year period. Due to high freshet flows, B.C. Hydro received permission from the B.C. CWR to surcharge Arrow Reservoir by up to 0.9 m (3 ft) for downstream flood control. As basin inflows increased during May through July, the reservoir filled rapidly exceeding its normal full pool on 4 July 2012 and reaching a maximum level of 440.5 m (1445.3 ft), or 0.4 m (1.3 ft) above full pool on 22 July 2012, this was the highest Arrow Reservoir level since 1990. Downstream of Arrow, Columbia River flows at Birchbank exceeded 4670 m^3/s (165 kcfs), the threshold flow for minor flooding impacts, on 24 June 2012. Under the Long Term NTSA, 2.8 Maf of empty reservoir was completely refilled during June and July 2012 to assist downstream flood management. During this period of unusual runoff conditions on the Columbia system, these agreements provided significant power and flood control benefits for communities in the region. Flows in the Columbia River at Birchbank peaked at 6090 m^3/s (215 kcfs) on 21 July 2012. While this was the highest recorded flow since the four Treaty dams began operation, efforts to maintain flows below the more damaging threshold of 6370 m3/s (225 kcfs) were successful. Columbia River flows at Birchbank returned to non-flood levels (below 4672 m^3/s or 165 kcfs on 1 August 2012. The Arrow Reservoir level returned to normal full pool, 440.13 m (1444 ft) on 30 July 2012 and then continued to draft across the remaining summer months, reaching, 433.9 m (1423.7 ft) on 30 September 2012.

Duncan (Duncan Reservoir)

Duncan Reservoir filled to 576.71 m (1892.2 ft) or 0.03 m (0.2 ft) above full on 1 August 2011. From September 2011 through April 2012, Duncan Reservoir was operated to supplement inflow into Kootenay Lake to provide spawning and incubation flows for fish and to meet Treaty flood control requirements. Duncan Reservoir was drafted to 547.0 m (1794.7 ft) on 14 April 2012 or near its licensed minimum level. The reservoir normally reaches its annual minimum level between mid-April and early May. The reservoir discharge was reduced to a minimum of 3 m^3/s (0.1 kcfs) beginning 7 June 2012 to initiate reservoir refill and to reduce flood levels on Kootenay Lake.

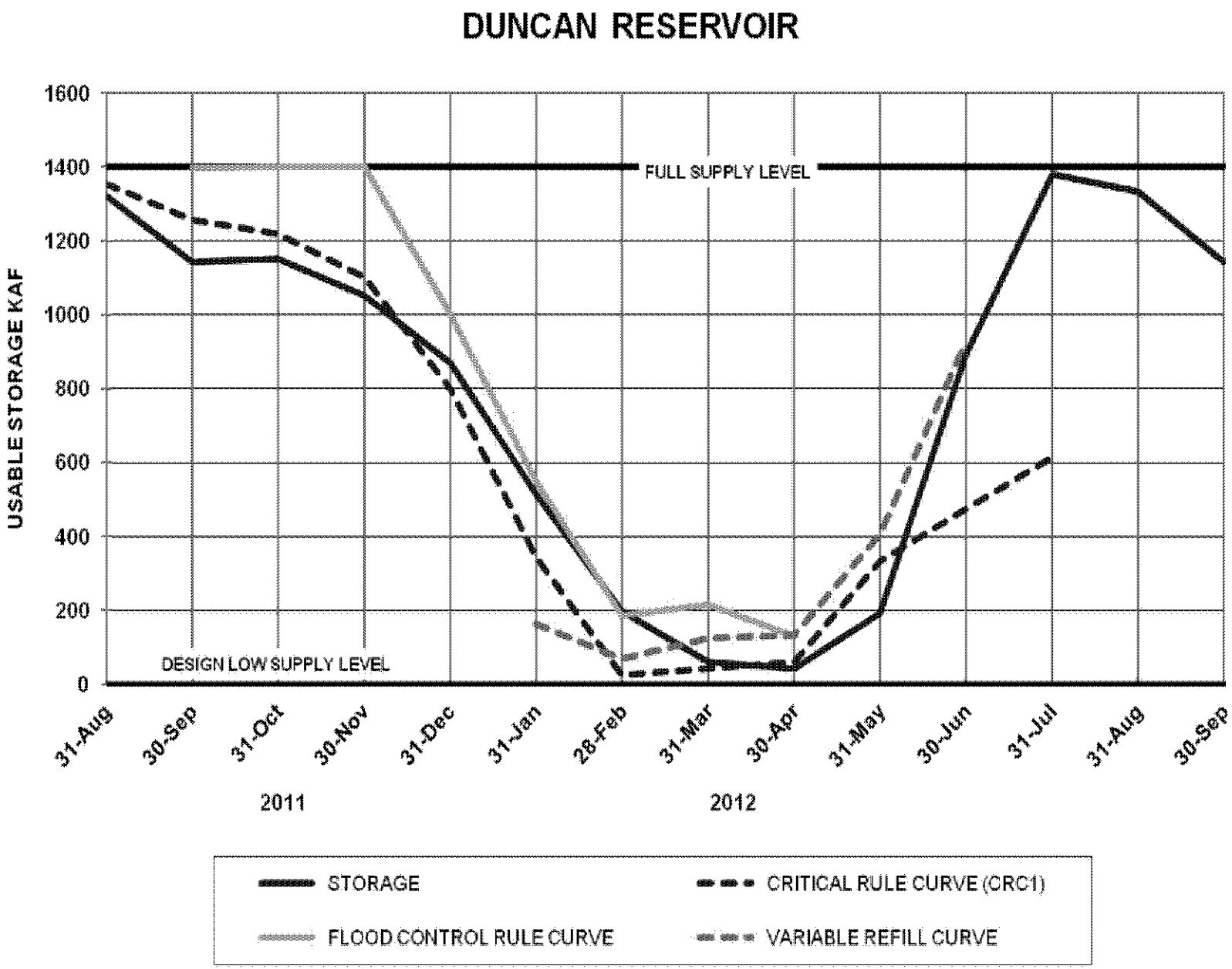
In response to significant rainstorms in June and July, Duncan Reservoir inflows increased dramatically, and B.C. Hydro received permission from the B.C. CWR to store 0.6 m (2 ft) above the normal full pool level. Releases from Duncan Reservoir were held at minimum until early July to help manage the high levels of Kootenay Lake. After the Kootenay Lake level began to recede; Duncan Reservoir discharges were increased to manage (slow) the rate of refill for Duncan Reservoir. By 20 July 2012, Duncan Reservoir reached full pool, and then surcharged by 0.3 m (1 ft) over its full pool level to 577.0 m (1893.0 ft) on 23 July, reaching its highest level recorded since the dam began operation in 1967. With Duncan Reservoir passing inflow and high concurrent discharges in the unregulated Lardeau River, the flows in the Duncan River downstream of the Lardeau (DRL) peaked at 575 m^3/s (20.3 kcfs) on 21 July 2012. While this peak flow was well above the normal annual peak flow, the reservoir filling and surcharge operation did reduce discharges and flood damages immediately downstream, with little impact around the Duncan Reservoir shoreline. As inflows subsided, Duncan Reservoir discharges were adjusted across August and early September to target a reservoir elevation of ~575.2 +/- 0.3 m (~1,887 +/- 1 ft) on Labor Day (3 September). For the balance of September, project flows were increased to draft the reservoir to reach an elevation of 571.5 m (1875.0 ft) on 30 September 2012.

Libby (Koocanusa Reservoir)

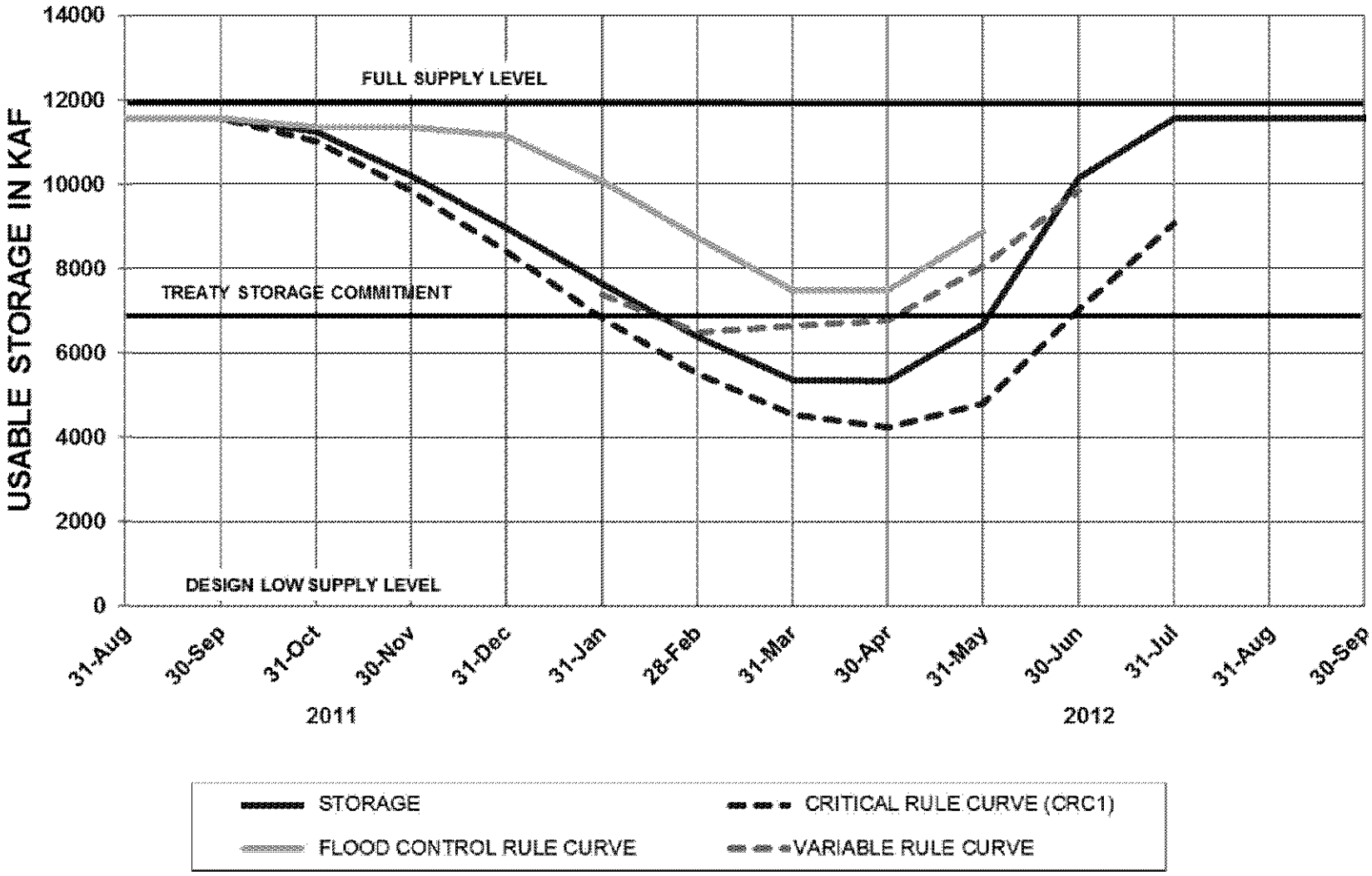
The Koocanusa Reservoir filled to a maximum elevation of 747.8 m (2453.4 ft) on 4 August 2011, 1.7 m (5.6 ft) from full pool and drafted to elevation 746.1 m (2447.7 ft) by 31 August 2011, and to elevation 745.8 m (2446.8 ft) by 30 September 2011. Drafting continued through the fall and winter period. By 31 December 2011, the reservoir was at elevation 735.3 m (2412.4 ft) and operated during the winter to the Variable Discharge Flood Control (VARQ) storage reservation diagram. The late winter and spring period was characterized by above average snow build-up followed by heavy rains in June and a rising water supply forecast. Lake Koocanusa was drafted to elevation 728.5 m (2390.2 ft) at the end of April. The reservoir drafted to its lowest elevation of 725.7 m (2380.9 ft) on 23 April 2012. Outflow was adjusted pursuant to VARQ rules as well as system flood risk management refill guidance. In 2012 Libby Dam provided 1.46 km^3 (1.18 Maf) of storage for sturgeon releases. An exceptionally wet June required a balancing act between controlling the forebay levels while minimizing impacts downstream. For the first time ever, the Treaty Operating Committee coordinated a surcharge of Lake Koocanusa for the purpose of reducing downstream flood damage in both countries. The reservoir filled to a project record elevation of 749.8 m (2459.96 ft) on 14 July 2012 and then again on 16 July 2012, 0.3 m (0.88 ft) above full pool and drafted to elevation 747.31 m (2451.7 ft) by 31 August 2012 and to elevation 746.3 m (2448.34 ft) by 30 September 2012. The final April through August inflow volume to the project was 9.2 Maf or 147 percent of normal (1971 – 2000, 30 year normal).

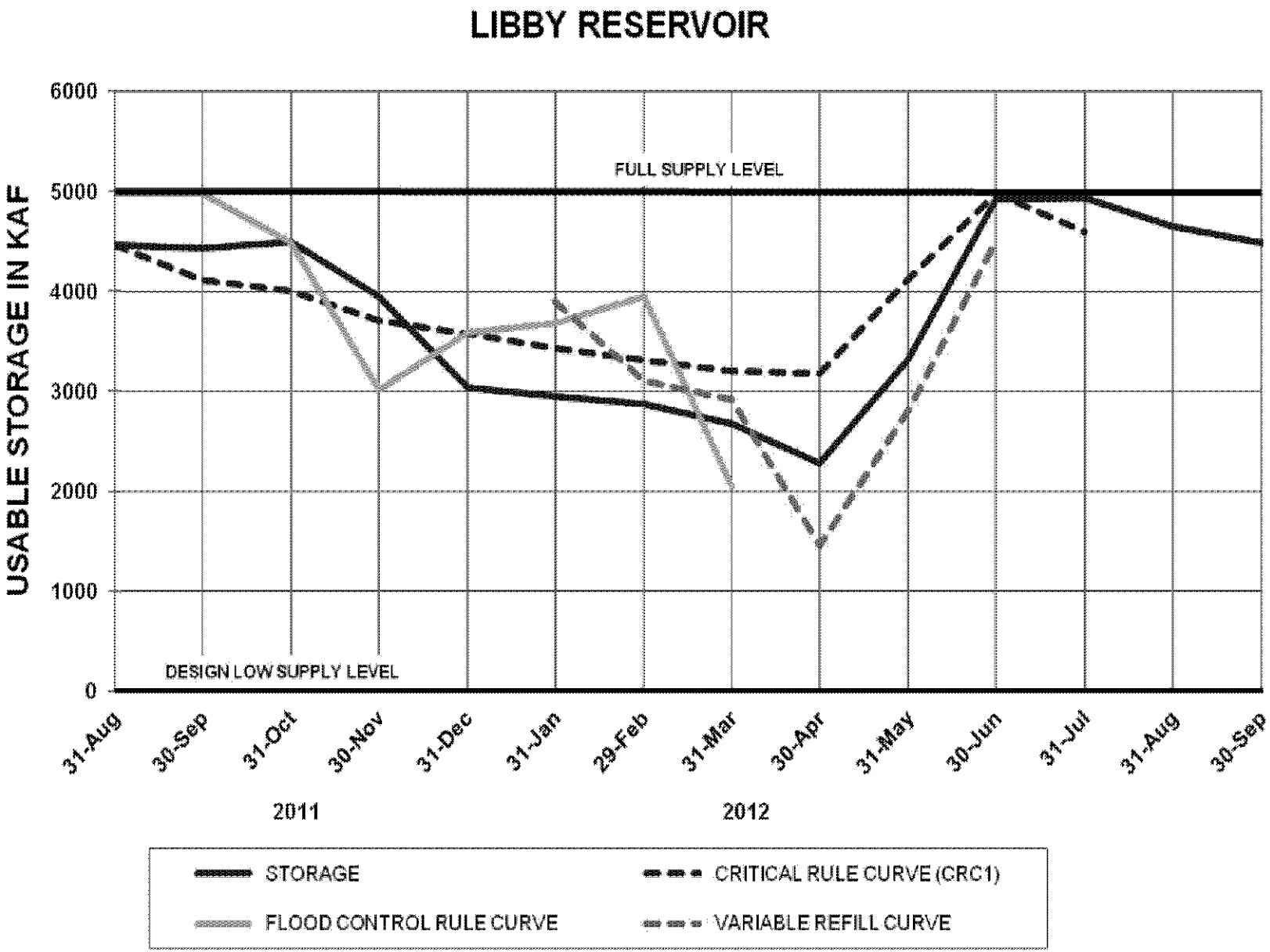
Flood Control Operations

Columbia River Basin projects were operated according to the May 2003 Flood Control Operating Plans. The regulated peak flow at The Dalles, Oregon, was 11 737 m^3/s (414.5 kcfs) on 27 June 2012, and the unregulated flow was estimated at 16 617 m^3/s (586.8 kcfs) on 26 June 2012. The peak stage observed at Vancouver, Washington, was 4.78 m (15.7 ft.) on 2 April 2012, just under the NWRFC's flood stage for Vancouver at elevation 16 feet. The peak observed stage occurred so early in the season due to high flows from the Willamette River during that period. The estimated unregulated stage at Vancouver, Washington was 6.23 m (20.4 ft.) on 27 June 2012.

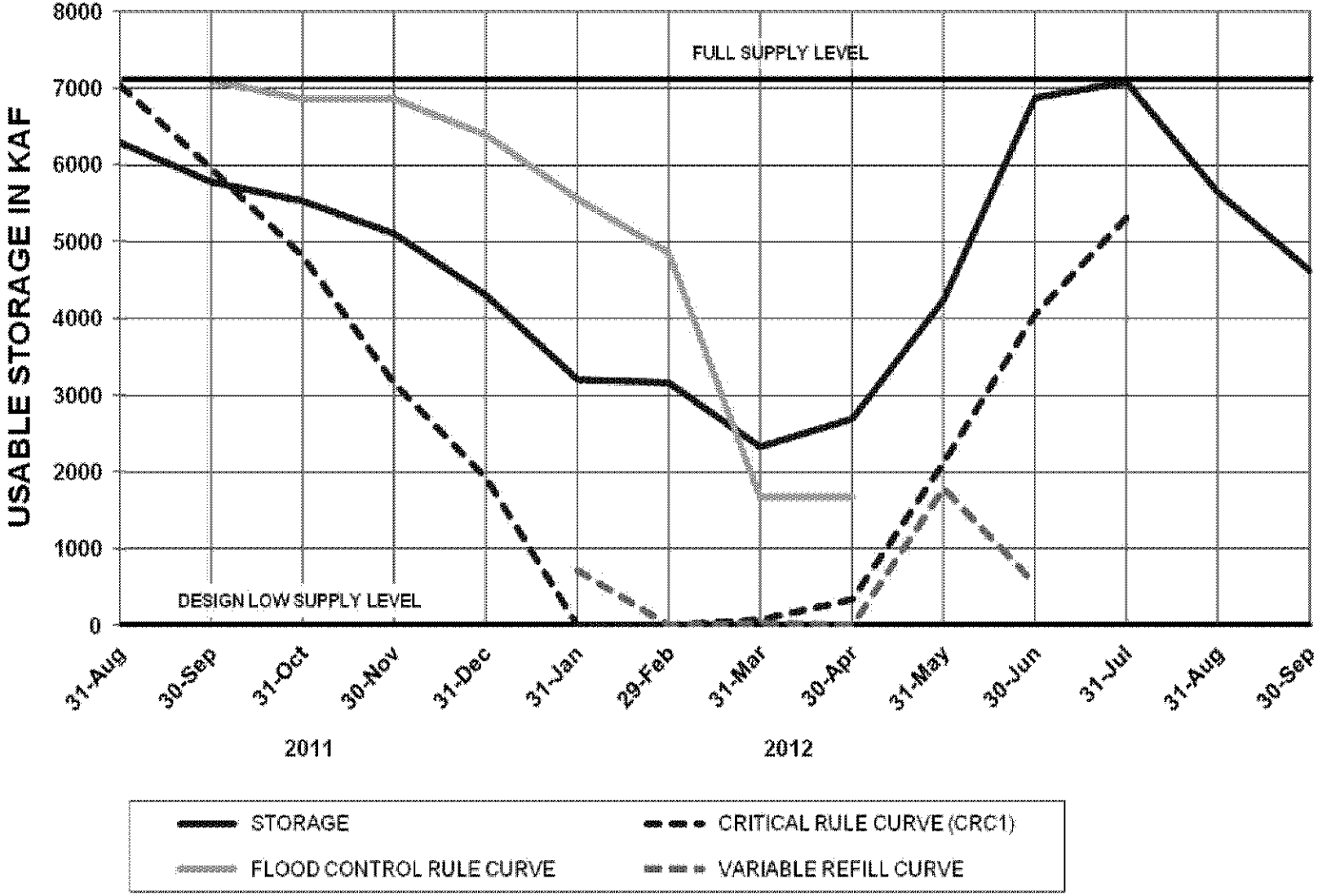

DUNCAN RESERVOIR
USABLE STORAGE KAF
1600
1400
1200
1000
800
600
400
200
0
FULL SUPPLY LEVEL
DESIGN LOW SUPPLY LEVEL
31-Aug
30-Sep
31-Oct
30-Nov
31-Dec
31-Jan
28-Feb
31-Mar
30-Apr
31-May
30-Jun
31-Jul
31-Aug
30-Sep
2011
2012
STORAGE
CRITICAL RULE CURVE (CRC1)
FLOOD CONTROL RULE CURVE
VARIABLE REFILL CURVE

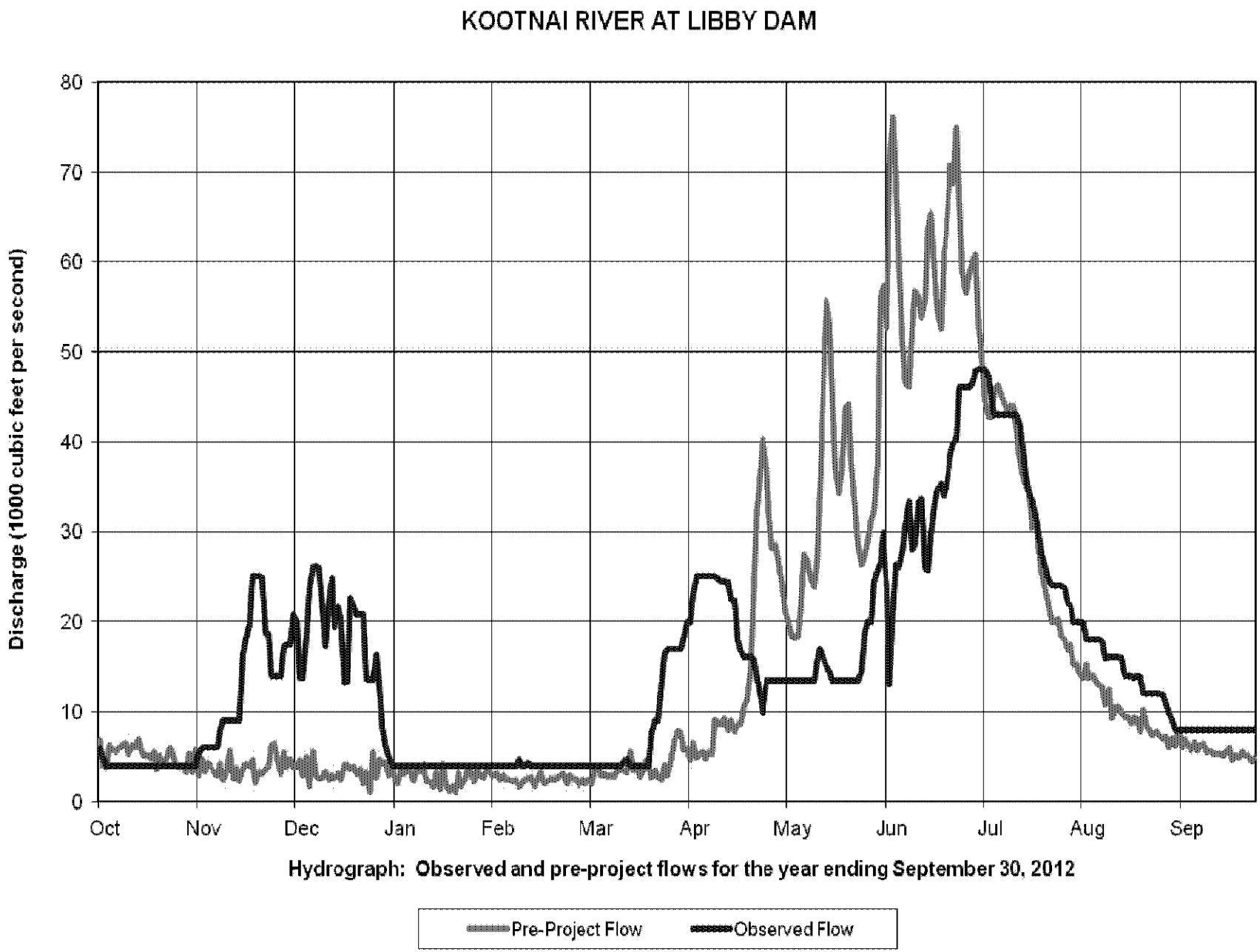
MICA RESERVOIR

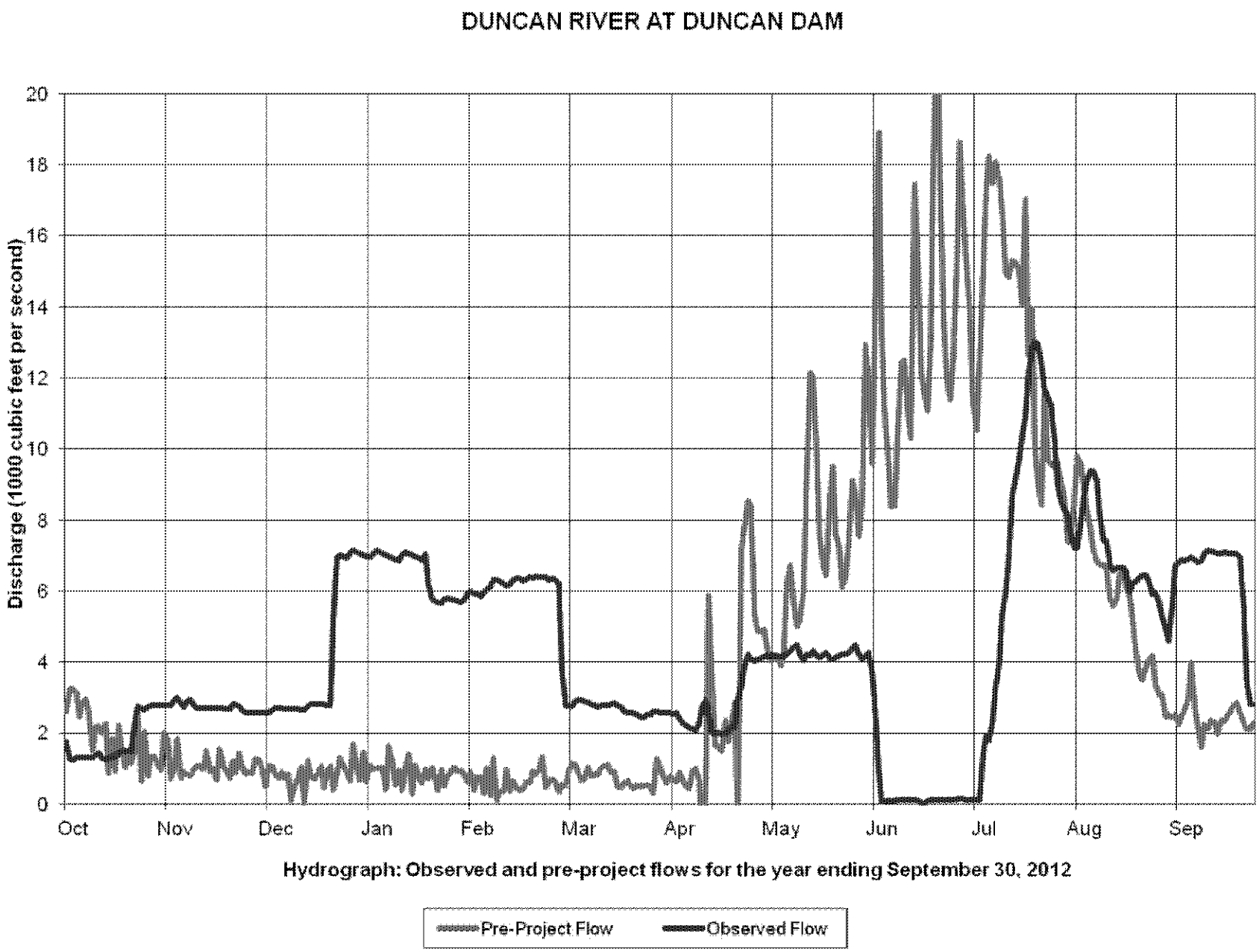


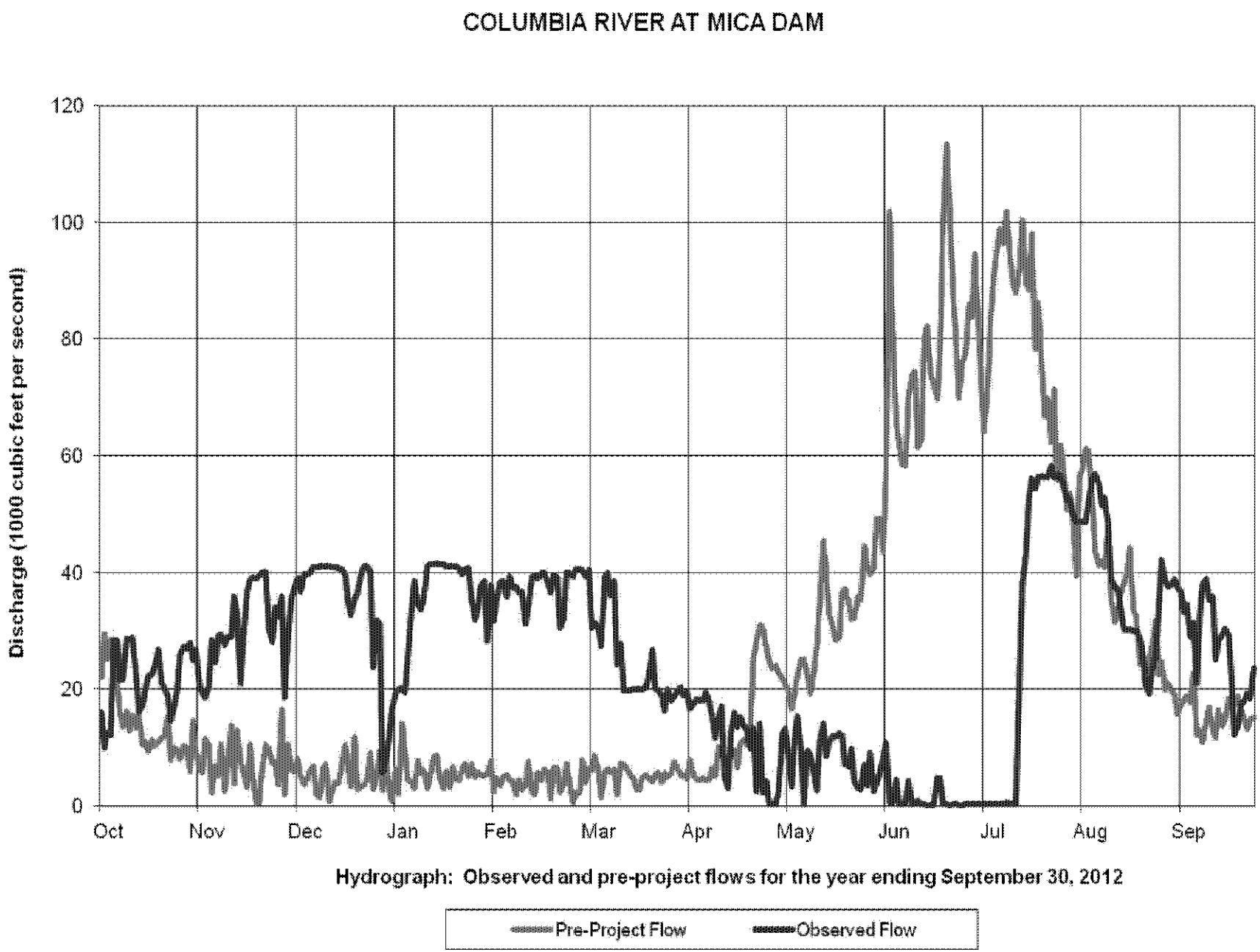

LIBBY RESERVOIR
USABLE STORAGE IN KAF
6000
5000
4000
3000
2000
1000
0
FULL SUPPLY LEVEL
DESIGN LOW SUPPLY LEVEL
31-Aug
30-Sep
31-Oct
30-Nov
31-Dec
31-Jan
29-Feb
31-Mar
30-Apr
31-May
30-Jun
31-Jul
31-Aug
30-Sep
2011
2012
STORAGE
CRITICAL RULE CURVE (CRC1)
FLOOD CONTROL RULE CURVE
VARIABLE REFILL CURVE

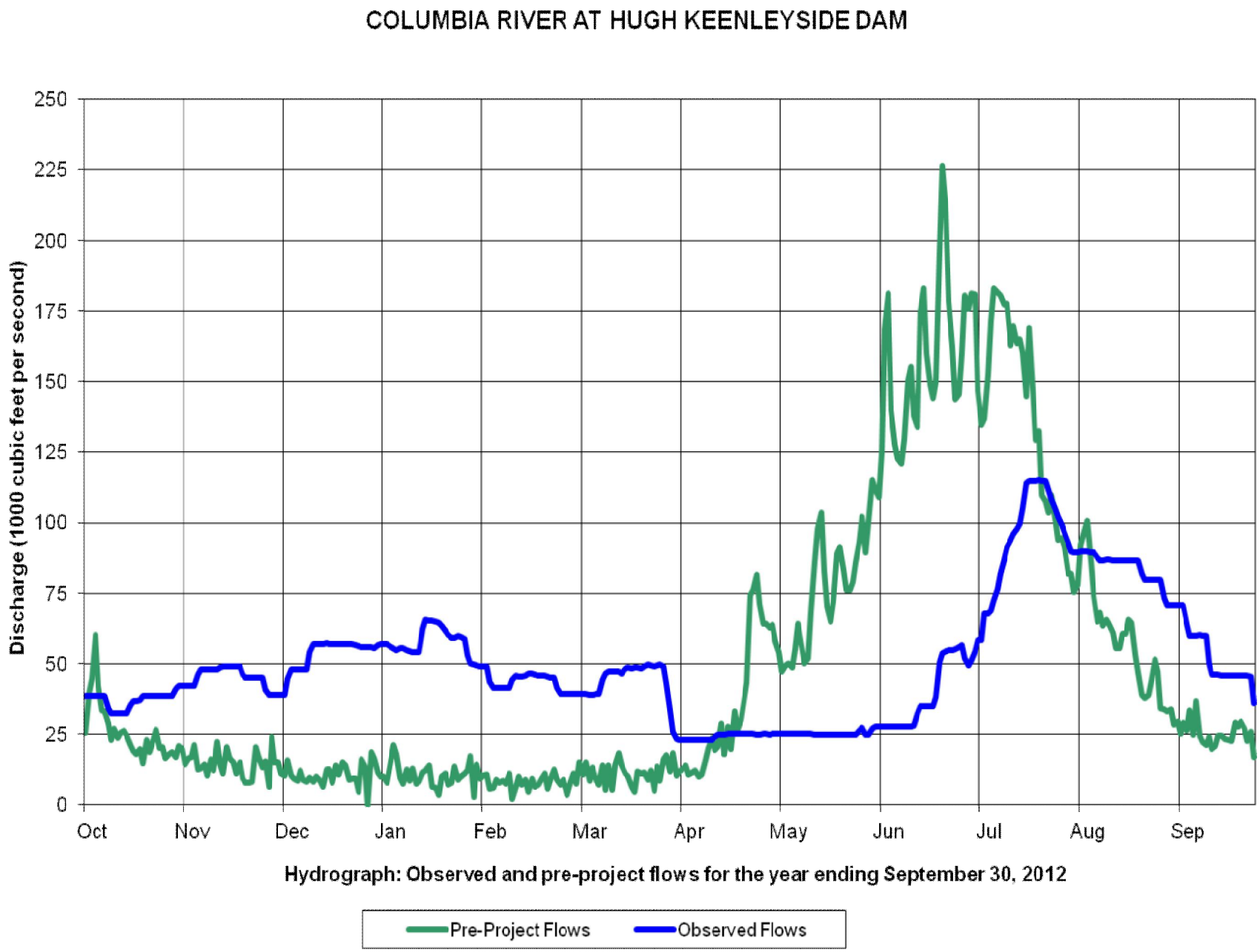
ARROW RESERVOIR

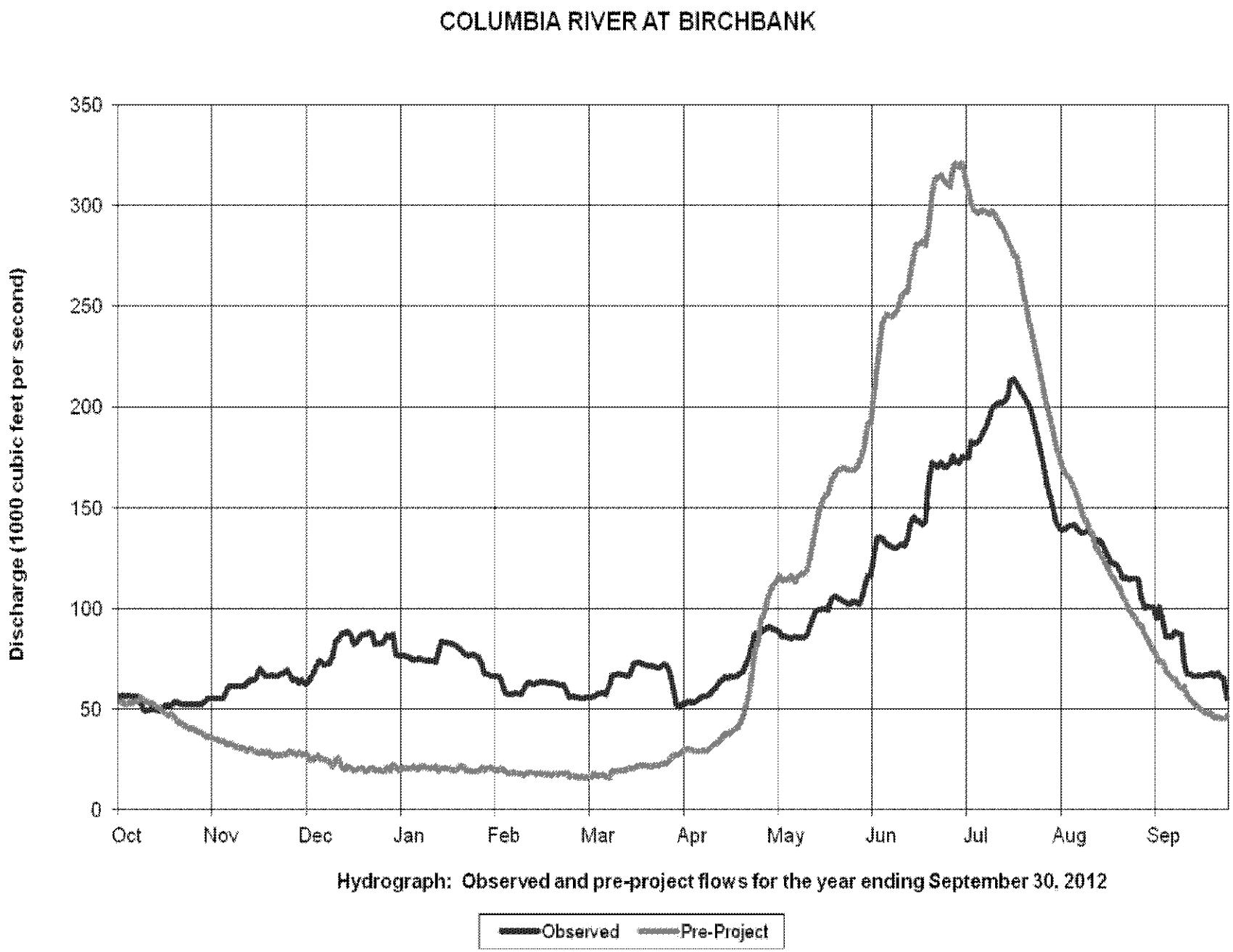



KOOTNAI RIVER AT LIBBY DAM
Discharge (1000 cubic feet per second)
80
70
60
50
40
30
20
10
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Hydrograph: Observed and pre-project flows for the year ending September 30, 2012
Pre-Project Flow
Observed Flow


DUNCAN RIVER AT DUNCAN DAM
Discharge (1000 cubic feet per second)
20
18
16
14
12
10
8
6
4
2
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Hydrograph: Observed and pre-project flows for the year ending September 30, 2012
Pre-Project Flow
Observed Flow


COLUMBIA RIVER AT MICA DAM
Discharge (1000 cubic feet per second)
120
100
80
60
40
20
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Hydrograph: Observed and pre-project flows for the year ending September 30, 2012
Pre-Project Flow
Observed Flow


COLUMBIA RIVER AT HUGH KEENLEYSIDE DAM
Discharge (1000 cubic feet per second)
250
225
200
175
150
125
100
75
50
25
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Hydrograph: Observed and pre-project flows for the year ending September 30, 2012
Pre-Project Flows
Observed Flows


COLUMBIA RIVER AT BIRCHBANK
Discharge (1000 cubic feet per second)
350
300
250
200
150
100
50
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Hydrograph: Observed and pre-project flows for the year ending September 30, 2012
Observed
Pre-Project

TREATY BENEFITS

Flood Control Benefits

Water Year 2012 featured a very active flood season in the Columbia River Basin. Reservoirs in the upper part of the basin, Mica, Keenleyside, Duncan and Libby exceeded historical maximum pool elevations in operating to minimize flood damages. The Libby operation to exceed elevation 2459.0 feet was coordinated through the Treaty to help reduce flood damages in the Kootenai River system in both countries. In addition, B.C. Hydro sought and received approvals from the B.C. Comptroller of Water Rights (CWR) to temporarily surcharge Mica, Arrow, and Duncan for downstream flood control purposes, and utilized this space for flood risk management during the summer of 2012.

The actual runoff for the overall Columbia Basin (U.S. and Canada combined) measured at The Dalles for January through July 2012 was 121 percent of normal. The peak regulated and unregulated flows, and river stages are shown in the following tables:

Columbia River Steam flow at The Dalles, Oregon

Date	**Peak Unregulated Flow** m^3/s (cfs)	**Date**	**Peak Regulated Flow** m^3/s (cfs)
26 June 2012	16,617 (586,800)	27 June 2012	11,737 (414,500)

Columbia River Stage at Vancouver, Washington
Flood Stage is 4.9 meters (16.0 feet)

Date	**Peak Unregulated Stage** meters (feet)	**Date**	**Peak Regulated Stage** meters (feet)
27 June 2012	6.23 (20.4)	2 April 2012	4.78 (15.7)

Duncan and Libby projects limited the peak elevation of Kootenay Lake to elevation 534.6 meters (1753.8 feet) on 3 July 2012, the highest level since 1974. Without regulation from those Treaty dams, the peak would have been about 2 meters (7 feet) higher. For reference, flood stage at Kootenay Lake is 534.92 meters (1755.0 feet). The coordinated surcharge at Libby reduced the maximum Kootenay Lake elevation by an estimated 0.3 feet and reduced flood damages in Canada and upstream into the U.S. (e.g. Bonners Ferry). Duncan, Arrow, Mica and Libby projects limited the peak flow of the Columbia River at Trail, just upstream of Birchbank, British Columbia, to 6,090 m3/s (215,000 cfs) on 21 July 2012, the highest flow recorded since the Treaty dams began operation. Absent the dams, the flow would have been approximately 10,340 m3/s (365,000 cfs). For reference, the bankfull flow at Birchbank is estimated to be 6,370 m3/s (225,000 cfs) and the non-flood level is 4672 m3/s (165,000 cfs).

Power Benefits

A Determination of Downstream Power Benefits (DDPB) is computed in conjunction with the AOP. This computation represents the optimized generation from downstream U.S. projects that could have been produced by an optimized Canadian/U.S. system. The DDPB is prepared in accordance with the Treaty, the Protocol, and other Entity Agreements. The Canadian Entitlement represents one-half of the DDPB. For the period 1 August 2011 through 31 July 2012, the Canadian Entitlement amount, before deducting transmission losses, was 525.9 aMW of energy, scheduled at rates up to 1314 MW capacity. From 1 August 2012 through 30 September 2012, the amount, before deducting transmission losses, was 504.5 aMW of energy, scheduled at rates up to 1321 MW capacity.

During the course of the Operating Year, there were four curtailment events within a span of two months to Canadian Entitlement deliveries, primarily due to a combination of planned maintenance and unexpected weather/load-resource conditions that included system constraints from wind power production. These included a 557 MWh reduction on 1 March 2012, and a 22 MWh reduction the following day. Subsequent reductions included a small 3 MWh reduction on 14 March 2012 and a 43 MWh reduction on 24 April 2012. A further 43 MWh curtailment was realized on 9 September 2012 due to forest fires near transmission lines. All of the curtailed power was delivered later within the same month of curtailment, as per agreements between the Entities.

Actual U.S. power benefits from the operation of Canadian storage are unknown and can only be roughly estimated. Canadian 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. A rough estimate for the average monthly impact on downstream U.S. power generation during the 2011-2012 operating year, with and without the regulation of Canadian storage, is 1245 aMW. This is the estimated increase in average annual U.S. power generation due to the operation of Canadian storage and based on the PNCA AER that includes minimum flow and spill requirements for fishery objectives. 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 was done.

Other Benefits

The CRTOC completed one supplemental operating agreement for non-power benefits both in Canada and the U.S. in 2012. Non-power benefits include changes to stream flows below Arrow Dam that enhanced trout and mountain whitefish spawning in Canada and the downstream migration of salmon in the U.S.

Columbia River, British Columbia

Revelstoke Dam, Columbia River, BC

Cora Linn Dam (FortisBC) at the outflow of Kootenay Lake, British Columbia

CONCLUSIONS

1. The Duncan, Arrow, and Mica projects were operated in compliance with the Treaty during the period covered by this report. Operations reflected the 2011-2012 and 2012-2013 Detailed Operating Plans (DOPs), the 2003 Flood Control Operating Plan (FCOP), and several supplemental operating agreements. Treaty storage in the United States at the Libby project was operated by the U.S. Entity according to the Libby Coordination Agreement (LCA) including the Libby Operating Plan (LOP), United States (U.S.) requirements for power and guidelines set forth in the U.S. Fish and Wildlife Service (USFWS) 2006 Biological Opinion, as clarified, and the NOAA Fisheries' 2010 Biological Opinion (BiOp) for operation and maintenance of the Federal Columbia River Power System.

2. The Canadian entitlement to the downstream power benefits for the reporting period was determined, according to the procedures set out in the Treaty and Protocol. For the period 1 August 2011 through 31 July 2012, the Canadian Entitlement amount, before deducting transmission losses, was 525.9 aMW of energy, scheduled at rates up to 1314 MW capacity. From 1 August 2012 through 30 September 2012, the amount, before deducting transmission losses, was 504.5 aMW of energy, scheduled at rates up to 1321 MW capacity. The Canadian Entitlement obligation was determined by the 2011-2012 and 2012-2013 Assured Operating Plan and Determination of Downstream Power Benefits.

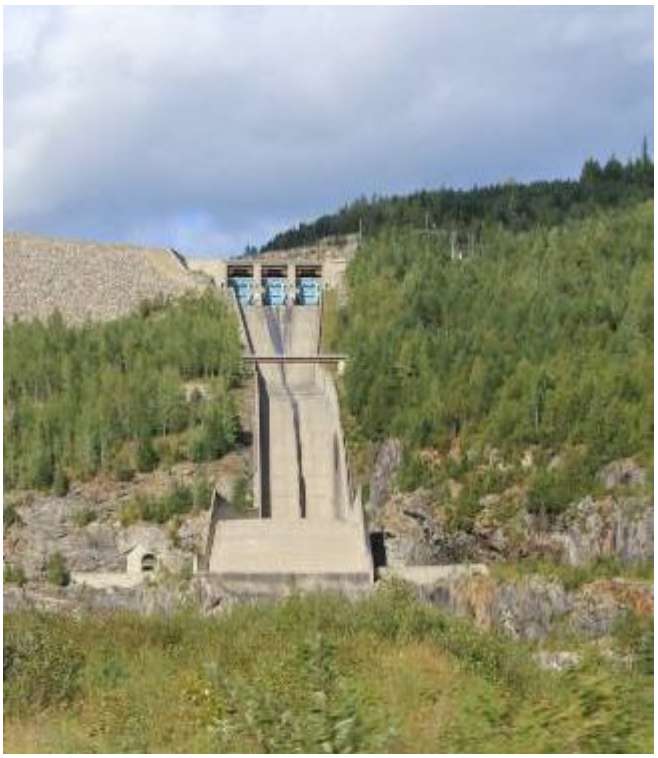
3. The 2011–2012 Operating Year began on 1 August 2011 with the Canadian Treaty storage at 18.9 km^3 (15.3 Maf) or 99.2 percent full. Canadian Treaty storage drafted to a minimum of 3.6 km^3 (2.9 Maf) on 19 April 2012 and refilled to 19.1 km^3 (15.5 Maf) or 100 percent full on 31 July 2012. Basin-wide precipitation in June was 164 percent of average while the April through August runoff at The Dalles was 128 percent of average. Since 1960, 2012 ranks highest in total April-August runoff in the Upper Columbia and the Kootenai River Basins. Due to these high precipitation levels, the Canadian projects (Mica, Arrow, and Duncan reservoirs) along with the Libby project filled to above the maximum pools specified in their operating agreements and in the case of Libby Reservoir, even exceeded the maximum elevation as specified in the Columbia River Treaty. The actual January through July runoff for the Columbia River above The Dalles rose to 159.7 km^3 (129.4 Maf), or 120.6 percent of the 1971-2000 average.

4. In August 2011, the presiding court sent the 2008/2010 BiOp back to NOAA Fisheries after concluding that the BiOp needed further work on the non-specific mitigation actions (mostly related to fish habitat). The Court further concluded that the existing 2008/2010 FCRPS BiOp was adequate under the Endangered Species Act and directed that the BiOp remain in place through 2013. The Court also ordered that the government continue to fund and implement all of the mitigation measures in the BiOp through December 31, 2013. The Court ordered a new biological opinion be issued by January 1, 2014. Annual progress reports are filed with the Court. USACE continues to conduct spring and summer spill operations in a manner consistent with the Court's annual spill orders, and provides monthly implementation reports.

5. The Columbia River Treaty Hydrometeorological Committee (CRTHMC) continues to work on evaluating the adequacy of the existing hydro-met network capabilities to support Treaty operations. The CRTHC is working with the National Weather Service River Forecast Center (NWRFC) to update forecast procedures for use in Treaty operations planning and the committee is coordinating proposed improvements to the snow monitoring network.

6. The Board concludes that the objectives of the Treaty have been met for the reporting period.

Treaty Tower, Libby Dam, Libby Montana



Spillway, Mica Dam, Columbia River, BC

2010 Treaty Inspection Tour, Revelstoke Airport, BC (Mount Revelstoke is in the background)

APPENDIX A

COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD

COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD

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Civil Works
U.S. Army Corps of Engineers
Washington, DC

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Consultant
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Institute for Water Resources
U.S. Army Corps of Engineers
Alexandria, Virginia

Mr. George Bell
Consultant
Lake Oswego, Oregon

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Principal Hydrologic & Hydraulic Engineer
Engineering & Construction CoP
Directorate of Civil Works
U.S. Army Corps of Engineers
Washington, DC

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Director General
Electricity Resources Branch
Natural Resources Canada
Ottawa, Ontario

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Consultant
Vancouver, British Columbia

Mr. Glen Davidson, P.Eng.
Comptroller of Water Rights
Water Management Division
B.C. Ministry of Natural Resource Operations
Victoria, British Columbia

Mr. Ivan Harvie, P.Eng.
Senior Engineer
Renewable and Electrical Energy Division
Electricity Resources Branch
Natural Resources Canada
Calgary, Alberta

Mr. Darcy Blais
Senior Policy Advisor
Renewable and Electrical Energy Division
Electricity Resources Branch
Natural Resources Canada
Ottawa, Ontario

COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD

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Mr. John Neuberger 1970–1973
Mr. Joseph Caldwell* 1971–1973
Mr. Homer Willis* 1973–1979
Mr. King Mallory 1973–1975
Mr. Raymond Peck, Jr. 1976–1977
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Mr. John Elmore* 1994–1996
Mr. Steven Stockton* 1996–
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Mr. John Elmore 1990–1994
Mr. Paul Barber 1994–1995
Mr. Daniel Burns 1995–1997
Mr. George Bell 1997–
Mr. Earl Eiker 2000–2004
Mr. Robert Pietrowsky 2004–

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Mr. Shapur Zanganeh 1978–1995
Mr. Richard DiBuono 1995–2000
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Mr. Charles Kang 1999–2001
Mr. Jack Ebbels 2001–2003
Mr. Tim Newton 2003–
Mr. Tom Wallace* 2004–2012
Mr. Jonathan Will* 2012–

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Mr. Jim Rothwell 1964–1965
Mr. Hugh Hunt 1966–1988
Dr. Donald Kasianchuk 1988–1996
Mr. Vic Niemela 1992–1994
Mr. David Burpee 1994–2007
Mr. Jack Farrell 1996–1997
Mr. Prad Kharé 1997–1999
Mr. James Mattison 1999–2009
Mr. Ivan Harvie 2007–
Mr. Glen Davidson 2009–

Mr. Mac Clark 1964–1992
Mr. David Burpee 1992–2003
Ms. Eve Jasmin 2003–2007
Mr. Darcy Blais 2007–

*Chair

COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD
ENGINEERING COMMITTEE

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Engineering & Construction CoP
Directorate of Civil Works
U.S. Army Corps of Engineers
Washington, DC

Mr. Kamau Sadiki
Manager
National Hydropower Program Business Line
Operations Community of Practice
U.S. Army Corps of Engineers
Washington, DC

Mr. Michael Cowan, P.E.
Technical Services Manager
Corporate Services Office
Western Area Power Administration
Lakewood, Colorado

Mr. Patrick McGrane, P.E.
Manager
River and Reservoir Operations Group
Pacific Northwest Regional Office
Bureau of Reclamation
Boise, Idaho

Canada

Mr. Ivan Harvie, P.Eng., Chair
Senior Engineer
Renewable and Electrical Energy Division
Electricity Resources Branch
Natural Resources Canada
Calgary, Alberta

Mr. Darcy Blais
Senior Policy Advisor
Renewable and Electrical Energy Division
Electricity Resources Branch
Natural Resources Canada
Ottawa, Ontario

Mr. KT Shum
Head, Licensing & Allocation
Water Management Division
B.C. Ministry of Natural Resource Operations
Victoria, British Columbia

COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD
ENGINEERING COMMITTEE

RECORD OF MEMBERSHIP

United States

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Mr. Shapur Zanganeh* 1990-1995
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Mr. Earl Eiker 1990-2000
Mr. Steve Wright 1990-1996
Mr. Larry Eilts 1991-1995
Mr. Richard Mittelstadt 1991-1996
Mr. Richard DiBuono* 1995-2000
Mr. James Barton 1996-2001
Mr. Robert Johnson 1996-1998
Mr. James Fodrea 1997-2009
Mr. Michael Cowan 1998-
Mr. Robert Bank* 2000-2004
Mr. Kamau Sadiki 2001-
Mr. Jerry Webb* 2003-
Mr. Patrick McGrane 2009-

Canada

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Mr. Dave McCauley 1990-1992
Mr. B. Stipdonk 1990-1991
Mr. Roger McLaughlin* 1991-2009
Mr. Robin Round 1991-1993
Mr. David Burpee* 1992-2000
Dr. Bala Balachandran 1993-2008
Mr. Bruno Gobeil 1995-1997
Mr. Larry Adamache 1996-2001
Ms. Myriam Boudreault 1997-2001
Ms. Donna Clarke 2001-2003
Mr. Ivan Harvie* 2002-
Ms. Eve Jasmin 2003-2007
Mr. Darcy Blais 2007-
Mr. KT Shum 2008-

*Chair

APPENDIX B

COLUMBIA RIVER TREATY ENTITIES

COLUMBIA RIVER TREATY ENTITIES

United States

Members

Mr. Steven J. Wright, Chair
Administrator and Chief Executive Officer
Bonneville Power Administration
Department of Energy
Portland, Oregon

BG John R. McMahon, Member
Division Engineer
U.S. Army Engineer Division
Northwestern
Portland, Oregon

Coordinators

Mr. Stephen R. Oliver, BPA Coordinator
Vice President
Generation Supply
Bonneville Power Administration
Department of Energy
Portland, Oregon

Mr. David Ponganis, USACE Coordinator
Regional Director of Programs
Programs Directorate
U.S. Army Engineer Division
Northwestern
Portland, Oregon

Secretaries

Mr. Scott R. Simms, Secretary
Policy Strategist
Regional Coordination
Bonneville Power Administration
Department of Energy
Portland, Oregon

Canada

Mr. Christopher K. O'Riley, Deputy Chair
Executive Vice President
Engineering, Aboriginal Relations and Generation
British Columbia Hydro and Power Authority
Vancouver, British Columbia

Ms. Renata Kurschner, Coordinator
Director
Generation Resource Management
British Columbia Hydro and Power Authority
Burnaby, British Columbia

Mr. Douglas A. Robinson, Secretary
Specialist Engineer
Generation Resource Management
British Columbia Hydro and Power Authority
Burnaby, British Columbia

COLUMBIA RIVER TREATY ENTITIES OPERATING COMMITTEE

CURRENT MEMBERSHIP

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Manager
Power and Operations Planning
Bonneville Power Administration
Department of Energy
Portland, Oregon

Ms. Pamela A. Kingsbury, Member
Treaty Team Coordinator
Regional Coordination
Bonneville Power Administration
Department of Energy
Portland, Oregon

Mr. James D. Barton, Alternating Chair
Chief
Columbia Basin Water Management Division
U.S. Army Engineer Division
Northwestern
Portland, Oregon

Mr. William Proctor, Member
Hydraulic Engineer
U.S. Army Engineer Division
Northwestern
Portland, Oregon

Canada

Mr. Kelvin J. Ketchum, Chair
Manager
System Optimization
Generation Resource Management
British Columbia Hydro and Power Authority
Burnaby, British Columbia

Mr. Alaa Abdalla, Member
Manager
Reliability and Planning
Generation Resource Management
British Columbia Hydro and Power Authority
Burnaby, British Columbia

Ms. Gillian Kong, Member
Specialist Engineer
Generation Resource Management
British Columbia Hydro and Power Authority
Burnaby, British Columbia

Mr. Herbert Louie, Member
Specialist Engineer
Generation Resource Management
British Columbia Hydro and Power Authority
Burnaby, British Columbia

COLUMBIA RIVER TREATY ENTITIES HYDROMETEOROLOGICAL COMMITTEE

CURRENT MEMBERSHIP

United States

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APPENDIX C

RECORD OF FLOWS AT THE INTERNATIONAL BOUNDARY

KOOTENAI RIVER AT PORTHILL, IDAHO

Daily discharges in thousands of cubic feet per second for the year ending 30 September 2012

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	7.54	5.96	20.10	7.54	5.95	5.82	34.50	37.00	36.60	57.80	26.00	13.50
2	7.27	7.30	21.70	6.64	5.84	5.86	32.70	36.20	43.10	58.30	24.40	12.40
3	6.36	7.54	21.00	6.45	5.83	5.83	31.40	33.10	50.30	58.20	24.00	11.60
4	5.65	7.48	16.30	6.42	5.81	5.88	31.10	31.60	48.40	58.80	22.90	10.90
5	5.54	7.53	15.70	6.05	5.78	6.29	30.10	30.40	55.20	57.20	22.60	10.10
6	5.99	7.45	20.00	6.40	5.73	6.85	32.20	29.20	49.80	55.60	22.60	10.20
7	5.82	7.32	25.10	6.40	5.71	6.95	33.10	27.90	41.20	55.10	21.80	10.00
8	5.98	7.39	26.50	6.22	5.60	6.83	32.40	27.70	45.00	53.70	20.60	9.97
9	5.58	9.55	27.10	6.15	5.60	6.69	32.10	28.50	47.30	50.80	20.30	10.00
10	5.54	10.30	26.20	6.17	5.78	6.81	32.00	30.50	46.40	48.90	20.20	9.87
11	6.04	10.30	22.40	6.39	6.12	7.12	32.70	30.60	46.30	48.60	20.20	9.95
12	6.38	10.50	19.40	6.07	5.50	7.38	34.80	29.30	48.70	47.80	20.20	9.85
13	6.15	10.40	24.20	5.90	5.53	7.65	37.80	28.60	51.00	46.90	19.70	9.78
14	5.95	10.30	25.60	5.68	6.01	8.60	38.10	29.70	48.20	47.30	18.30	9.60
15	5.95	10.80	22.10	5.93	5.66	8.96	36.80	35.00	47.70	49.00	18.60	9.54
16	5.95	17.20	22.40	5.89	5.50	11.90	36.50	41.20	50.00	48.30	18.40	9.66
17	5.77	19.10	21.30	5.71	5.58	13.80	35.10	43.40	49.70	47.40	18.30	9.69
18	5.70	22.00	15.90	5.84	5.64	12.20	33.80	41.00	48.20	45.40	18.40	9.80
19	5.57	25.30	16.20	5.68	5.52	11.30	32.70	36.90	47.20	42.60	17.80	9.70
20	5.58	25.80	23.50	5.46	5.50	10.20	29.50	33.00	47.40	39.30	16.50	9.75
21	5.62	25.80	22.80	5.63	5.38	9.81	31.00	31.70	48.00	38.70	16.20	9.67
22	5.72	25.00	22.30	5.66	5.42	9.50	32.80	36.20	49.00	36.60	16.00	9.56
23	5.93	22.30	22.20	5.80	5.93	9.35	35.00	39.30	48.10	34.30	15.80	9.49
24	6.17	22.40	21.30	5.81	5.91	12.20	42.40	36.20	47.30	31.70	15.80	9.48
25	5.81	18.30	16.20	5.61	5.94	13.60	53.40	32.90	48.00	30.20	15.60	9.53
26	5.60	17.30	15.40	5.64	5.76	14.00	54.40	30.60	51.60	28.90	14.00	9.53
27	5.72	16.80	15.50	5.91	5.87	18.50	52.20	29.20	59.70	27.20	14.10	9.57
28	5.60	16.80	17.80	5.66	5.65	21.70	45.20	28.40	58.60	27.00	13.90	9.64
29	5.65	19.20	15.40	5.63	5.65	23.10	39.40	29.70	60.30	26.80	14.00	9.62
30	5.38	19.40	11.80	5.88		25.50	35.70	34.20	58.80	26.60	14.10	9.51
31	5.64		8.96	6.04		32.50		35.40		26.70	13.80	
Mean	**5.91**	**14.76**	**20.08**	**6.01**	**5.71**	**11.38**	**36.36**	**33.05**	**49.24**	**43.60**	**18.55**	**10.05**

COLUMBIA RIVER AT BIRCHBANK, BRITISH COLUMBIA

Daily discharges in thousands of cubic feet per second for the year ending 30 September 2012

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	56.4	55.5	62.4	76.3	66.2	55.3	52.4	90.6	104.5	175.8	161.0	105.2
2	56.6	55.3	63.3	76.4	66.1	55.6	50.7	90.4	110.0	172.6	154.5	100.3
3	56.5	55.5	65.6	76.5	65.9	55.5	52.6	89.5	116.3	172.3	149.2	100.6
4	56.6	55.4	68.8	75.9	61.6	55.6	53.0	88.8	116.5	175.4	142.6	100.7
5	56.4	58.3	72.2	75.0	57.5	56.3	53.7	88.3	125.1	174.7	139.6	100.2
6	56.5	61.3	73.8	74.3	57.4	57.4	53.4	86.2	134.8	175.0	138.8	95.1
7	56.5	61.3	71.9	74.9	57.5	57.7	53.2	86.0	135.6	182.9	139.3	100.5
8	52.7	61.3	72.4	75.2	57.5	57.6	54.3	85.7	134.3	181.7	141.2	92.9
9	49.3	61.3	72.2	74.6	57.6	57.5	55.5	85.1	131.9	182.2	140.9	86.1
10	49.3	61.3	76.5	73.9	57.5	61.6	56.2	86.1	131.6	184.4	141.3	85.9
11	49.5	61.3	83.3	73.7	59.6	66.8	56.3	85.3	130.5	187.5	138.9	85.8
12	49.6	62.8	84.4	73.7	62.8	67.0	57.3	85.3	129.8	190.8	137.7	88.3
13	49.5	64.4	87.5	73.6	62.7	67.3	59.3	85.3	130.5	194.8	137.6	87.3
14	49.4	64.2	87.7	79.1	62.5	67.1	60.3	86.4	132.1	199.8	138.4	87.3
15	50.4	65.4	88.5	83.7	62.8	66.9	63.1	90.5	131.1	201.2	137.8	73.4
16	51.5	69.7	86.6	83.1	63.4	66.4	64.3	95.4	134.1	201.9	135.9	67.2
17	51.6	68.3	81.8	83.1	63.5	67.2	65.7	98.7	141.5	202.1	132.2	67.1
18	51.5	66.3	82.8	82.4	63.4	72.6	65.5	99.0	145.4	203.0	134.1	66.2
19	53.0	66.1	86.2	81.9	63.0	72.7	66.3	99.5	143.6	205.5	132.5	66.6
20	53.5	66.7	87.2	81.2	62.8	72.9	66.0	99.5	143.0	213.2	129.3	66.8
21	52.7	66.5	87.0	80.0	62.8	72.3	66.4	99.3	141.4	213.4	125.7	66.6
22	52.3	66.3	88.2	77.9	62.5	71.8	67.7	104.7	143.5	211.6	122.7	66.9
23	52.1	67.3	87.6	77.0	61.9	71.5	68.6	105.6	161.3	208.6	122.3	66.9
24	52.2	67.9	82.0	76.4	61.9	71.5	72.0	105.5	172.3	206.0	121.6	67.9
25	52.3	69.1	82.6	76.7	58.8	71.1	76.3	104.2	171.4	203.4	118.3	66.4
26	52.3	66.6	82.7	76.4	55.9	70.5	81.5	103.6	170.5	201.0	114.7	67.8
27	52.4	64.6	83.5	76.2	56.0	71.0	87.5	102.6	172.5	195.5	115.0	65.9
28	52.2	65.0	86.5	72.2	55.9	72.3	86.8	102.2	170.4	189.8	114.2	65.2
29	53.9	62.7	85.7	67.4	55.6	71.4	88.7	103.2	170.4	184.4	114.8	55.4
30	55.4	64.2	86.9	67.2		68.0	88.8	103.0	172.2	175.9	114.8	46.7
31	55.5		76.9	66.6		59.6		102.3		169.4	114.3	
Mean	**52.9**	**63.4**	**80.2**	**76.2**	**60.8**	**65.4**	**64.8**	**94.8**	**141.6**	**191.5**	**132.3**	**78.6**

APPENDIX D

PROJECT INFORMATION

Power and Storage Projects

Northern Columbia Basin	Plate No. 1

Project Data

Duncan Project	Table No. 1
Arrow Project	Table No. 2
Mica Project	Table No. 3
Libby Project	Table No. 4

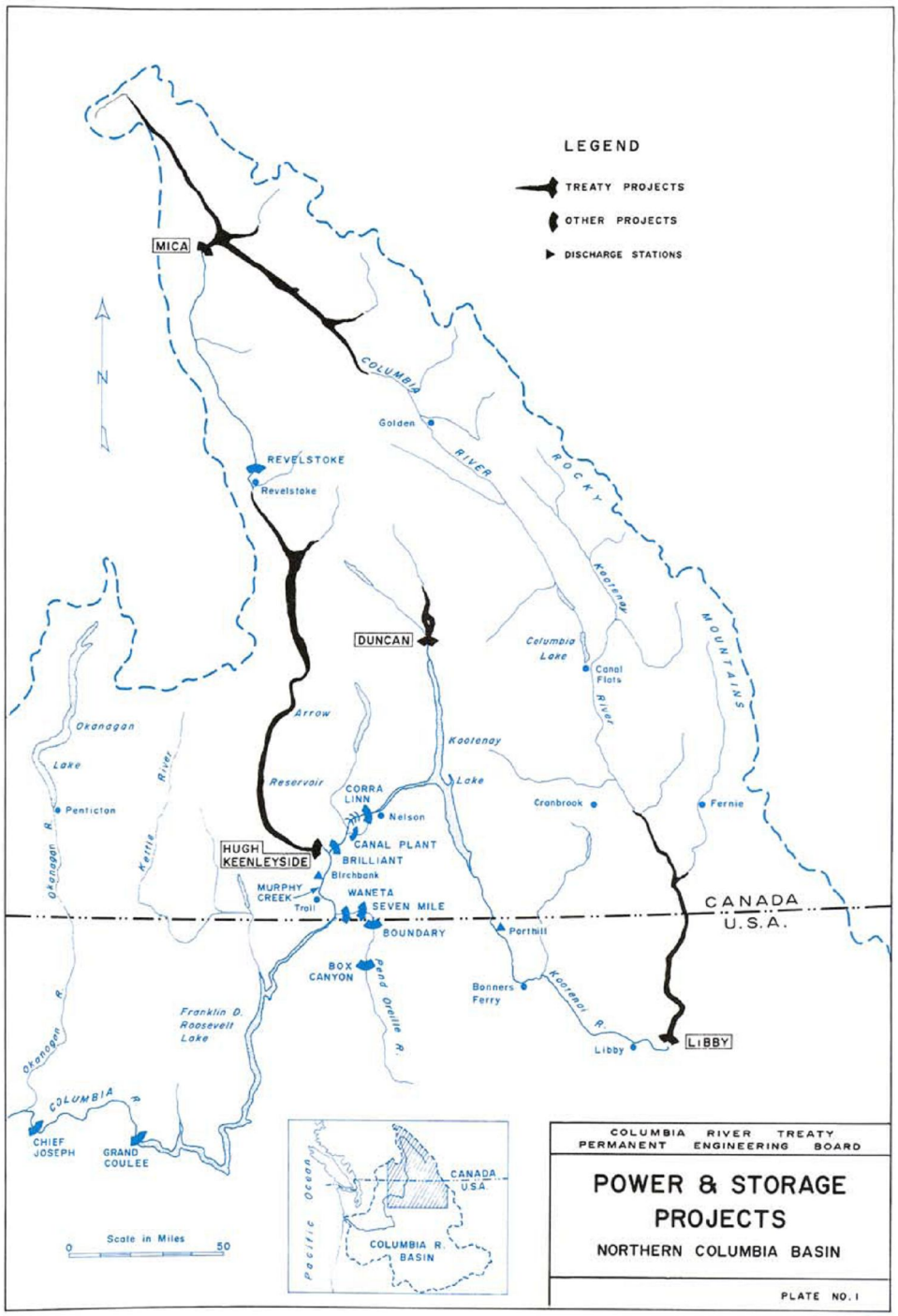
LEGEND
TREATY PROJECTS
OTHER PROJECTS
DISCHARGE STATIONS
MICA
N
COLUMBIA
RIVER
ROCKY
MOUNTAINS
Golden
REVELSTOKE
Revelstoke
DUNCAN
Columbia Lake
Canal Flats
Kootenay
River
Arrow
Reservoir
Okanagan
Lake
Penticton
Okanagan R.
Kettle
River
Kootenay
Lake
CORRA LINN
Nelson
Cranbrook
Fernie
HUGH KEENLEYSIDE
CANAL PLANT
BRILLIANT
Birchbank
MURPHY CREEK
Trail
WANETA
SEVEN MILE
BOUNDARY
CANADA
U.S.A.
Porthill
BOX CANYON
Pend Oreille R.
Bonners Ferry
Kootenai R.
Franklin D. Roosevelt Lake
Libby
LIBBY
COLUMBIA R.
CHIEF JOSEPH
GRAND COULEE
Scale in Miles
0
50
Pacific Ocean
CANADA
USA
COLUMBIA R. BASIN
COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD
POWER & STORAGE PROJECTS
NORTHERN COLUMBIA BASIN
PLATE NO. 1

TABLE 1

DUNCAN PROJECT

Duncan Dam and Duncan Lake

Storage Project

Construction began	17 September 1964
Storage became fully operational	31 July 1967

Reservoir

Normal full pool elevation	577 m (1892 ft)
Normal minimum pool elevation	547 m (1794 ft)
Surface area at full pool	7290 hectares (18,000 acres)
Total storage capacity	1.77 km^3 (1.43 Maf)
Usable storage capacity	1.73 km^3 (1.40 Maf)
Treaty storage commitment	1.73 km^3 (1.40 Maf)

Dam, Earthfill

Crest elevation	581 m (1907 ft)
Length	792 m (2600 ft)
Approximate height above riverbed	39.6 m (130 ft)
Spillway – Maximum capacity	1350 m^3/sec (47.7 kcfs)
Discharge tunnels – Maximum capacity	570 m^3/sec (20.0 kcfs)

Power Facilities

None

TABLE 2

ARROW PROJECT

Hugh Keenleyside Dam and Arrow Lakes

Storage Project

Construction began	March 1965
Storage became fully operational	10 October 1968

Reservoir

Normal full pool elevation	440 m (1444 ft)
Normal minimum pool elevation	420 m (1378 ft)
Surface area at full pool	52,610 hectares (130,000 acres)
Total storage capacity	10.3 km^3 (8.34 Maf)
Usable storage capacity	8.8 km^3 (7.10 Maf)
Treaty storage commitment	8.8 km^3 (7.10 Maf)

Dam, Concrete Gravity and Earthfill

Crest elevation	445 m (1459 ft)
Length	869 m (2850 ft)
Approximate height above riverbed	52 m (170 ft)
Spillway – Maximum capacity	6800 m^3/sec (240 kcfs)
Low-level outlets – Maximum capacity	3740 m^3/sec (132 kcfs)

Power Facilities

Currently installed:

2 units at 92.5 MW	185 MW
Power commercially available	2002
Head at full pool (Gross maximum head)	23.5 m (77 ft)
Maximum turbine discharge	1200 m^3/sec (42.4 kcfs)

TABLE 3

MICA PROJECT

Mica Dam and Kinbasket Lake

Storage Project

Construction began	September 1965
Storage became fully operational	29 March 1973

Reservoir

Normal full pool elevation	754.4 m (2475 ft)
Normal minimum pool elevation	707.1 m (2320 ft)
Surface area at full pool	42,900 hectares (106,000 acres)
Total storage capacity	24.7 km^3 (20 Maf)
Usable storage capacity	14.8 km^3 (12 Maf)
Treaty storage commitment	8.6 km^3 (7 Maf)

Dam, Earthfill

Crest elevation	762.0 m (2500 ft)
Length	792.5 m (2600 ft)
Approximate height above foundation	244 m (800 ft)
Spillway – Maximum capacity	4250 m^3/sec (150 kcfs)
Outlet works – Maximum capacity	1060 m^3/sec (37.4 kcfs)

Power Facilities

Designed ultimate installation:

6 units at 450 MW	2700 MW

Currently installed:

4 units at 451 MW	1805 MW
Power commercially available	1976
Head at full pool	183 m (600 ft)
Maximum turbine discharge of 4 units at full pool	1080 m^3/sec (38.2 kcfs)

Currently under-construction (expected completion by 2016):

2 units at 520 MW	1040 MW

TABLE 4

LIBBY PROJECT

Libby Dam and Lake Koocanusa

Storage Project

Construction began	June 1966
Storage became fully operational	17 April 1973

Reservoir

Normal full pool elevation	749.5 m (2459 ft)
Normal minimum pool elevation	697.1 m (2287 ft)
Surface area at full pool	18,820 hectares (46,500 acres)
Total storage capacity	7.2 km^3 (5.87 Maf)
Usable storage capacity	6.1 km^3 (4.98 Maf)

Dam, Concrete Gravity

Deck elevation	753.5 m (2472 ft)
Length	931.2 m (3055 ft)
Approximate height above riverbed	112.8 m (370 ft.)
Spillway – Maximum capacity	4110 m^3/sec (145 kcfs)
Low-level outlets – Maximum capacity	1730 m^3/sec (61 kcfs)

Power Facilities

Designed ultimate installation:

8 units at 105 MW	840 MW

Currently installed:

5 units at 120 MW	600 MW
Power commercially available	1975
Head at full pool	107 m (352 ft)
Maximum turbine discharge of 5 units at full pool	750 m^3/sec (26.5 kcfs)