

**ANNUAL REPORT  
to the  
GOVERNMENTS  
of  
THE UNITED STATES and CANADA**

**COLUMBIA RIVER TREATY  
PERMANENT ENGINEERING BOARD**

Washington, D.C.

Ottawa, Ontario

30 September 2001



# 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

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## UNITED STATES SECTION

S.L. STOCKTON, Chairman  
R.H. Wilkerson, Member

28 February 2002

The Honorable Colin Powell  
Secretary of State  
Washington, DC

The Honourable Herb Dhaliwal  
Minister of Natural Resources  
Ottawa, Ontario

Dear Secretary Powell and Minister Dhaliwal:

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, DC, on 17 January 1961.

In accordance with the provisions of Article XV paragraph 2(e), we are submitting the thirty-seventh Annual Report of the Permanent Engineering Board, dated 30 September 2001. The report documents the results achieved under the Treaty for the period from 1 October 2000 to 30 September 2001.

The Board is pleased to report that at the present time, the requirements of the Treaty have been satisfied.

Respectfully submitted

For the United States

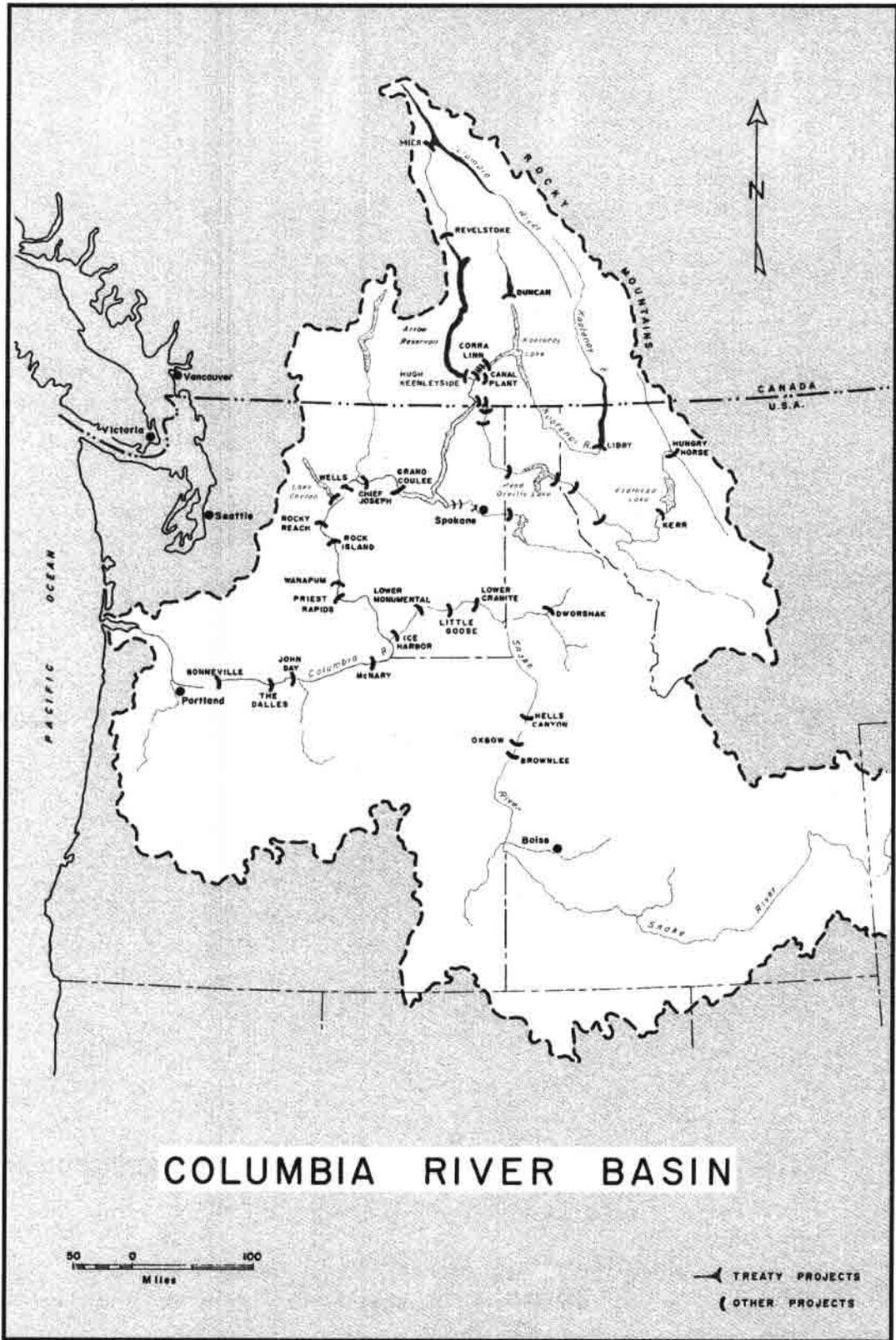
For Canada

Steven Stockton, Chair

Dan Whelan, Chair

Ronald Wilkerson

Jack Ebbels



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## SUMMARY

The thirty-seventh Annual Report of the Permanent Engineering Board is submitted to the governments of the United States and Canada in compliance with Article XV of the Columbia River Treaty of 17 January 1961. This report describes the status of projects, progress of Entity studies, operation of the Duncan, Arrow, Mica and Libby reservoirs, and the resulting benefits.

As reported in this document, the requirements of the Treaty have been satisfied. The Assured Operating Plans (AOPs) and Determination of Downstream Power Benefits (DDPBs) through 2005–2006 have been received.

During the operating year, 1 August 2000 through 31 July 2001, the entitlement to the downstream power benefits accruing to each country from the Treaty storage was determined, according to the procedures set out in the Treaty and Protocol, to be 508.4 average megawatts of energy and 1447.3 MW of capacity.

From 1 August 2000 through 31 July 2001, the U.S. Entity delivery of the Canadian Entitlement to downstream power benefits was 277.4 average megawatts of energy at rates up to 793.7 MW of capacity. No entitlement power was disposed of in the United States during that period.

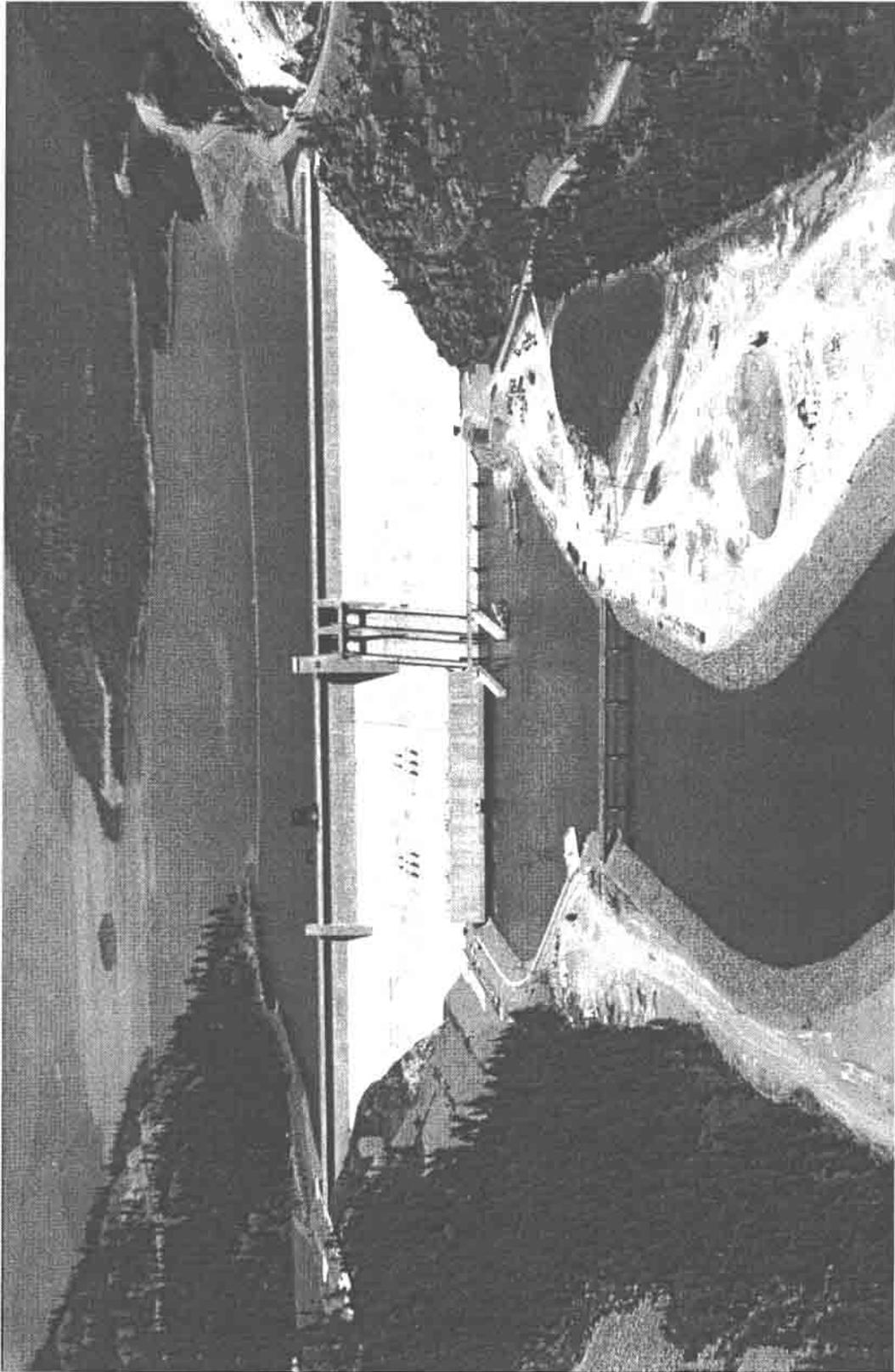
The Duncan, Arrow and Mica projects were operated in conformity with the Treaty during the 2000–2001 operating year. The operation reflected detailed operating plans developed by the Entities, the flood control operating plan for Treaty reservoirs and other agreements between the Entities. The reporting year was characterized by the extremely low run-off in the Columbia River Basin. The Treaty projects were not operated for flood control during this reporting year.

The Entities continued to operate the hydrometeorological network as required by the Treaty. The Permanent Engineering Board reviewed a proposal by the Entities to streamline the process of documenting the hydrometeorological system for the Columbia River Basin and concluded that the proposed process was consistent with the Treaty. The Hydrometeorological Committee will publish future listings of gage network according to this new procedure.

## **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 the 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 1 October 2000 through 30 September 2001, describes activities of the Board, progress being achieved by both countries under the terms of the Treaty, operation of the Treaty projects and the resulting benefits. Summaries of the essential features of the Treaty and of the responsibilities of the Board and of the Entities are included. The report refers to items currently under review by the Entities, provides discussion regarding the operations of the Treaty reservoirs and of the resulting power and flood control benefits and presents the conclusions of the Board.



Libby Dam and Lake Koocanusa – Kootenai River, Montana  
The dam and reservoir, Lake Koocanusa, with the powerhouse at the left of the spillway

## **THE COLUMBIA RIVER TREATY**

### **General**

The Columbia River Treaty was signed in 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 in a formal agreement by an exchange of notes on 22 January 1964 to a Protocol to the Treaty and to an Attachment Relating to Terms of Sale. The Parliament of Canada approved the Treaty and related documents in June 1964.

The Canadian Entitlement Purchase Agreement 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 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 governments. 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 15.5 million acre-feet 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 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 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 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 uses and, in addition, after September 1984 Canada has the option of making for power purposes specific diversions of the Kootenay River into the headwaters of the Columbia River.
- (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 Canadian Entitlement Purchase Agreement 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.

## **PERMANENT ENGINEERING BOARD**

### **General**

Article XV of the Columbia River Treaty established a Permanent Engineering Board consisting of two members to be appointed by Canada and two members 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 were also stipulated in the Treaty and related documents.

### **Establishment of the Board**

Pursuant to Executive Order No. 11177 dated 16 September 1964, the Secretary of the Army and the Secretary of the Interior, on 7 December 1964, 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.

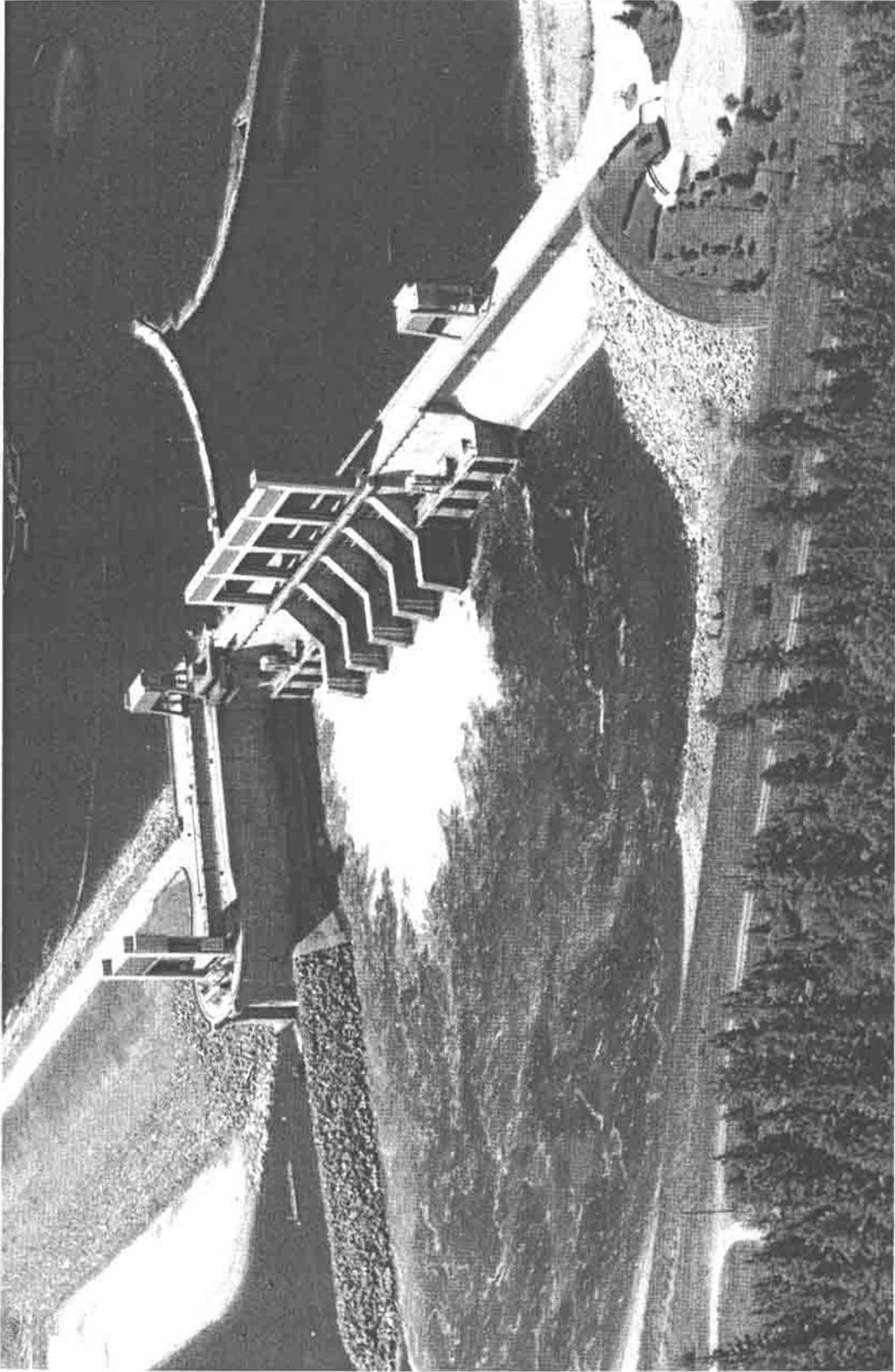
The names of Board members, alternate members and secretaries are shown in Appendix A. The names of the current members of the Board's Engineering Committee are also shown in Appendix A.

### **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 boundary;
- (b) reporting to Canada and the United States 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 and with a view to ensuring that the objectives of the Treaty are being met;
- (e) making reports to Canada and the United States 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; and
- (g) consulting with the Entities in 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 lock and earth dam

## ENTITIES

### General

Article XIV(1) of the 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, the Department of the Interior and the Division Engineer, North Pacific Division, Corps of Engineers, Department of the Army, as the U.S. Entity, with the Administrator to serve as Chair. Pursuant to the *Department of Energy Organization Act* of 4 August 1977, the Bonneville Power Administration 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 (known more familiarly as 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 for standby transmission services;
- (d) consultation on requests for variations made pursuant to articles XII(5) and XIII(6);
- (e) the establishment and operation of a hydrometeorological system as required by Annex A;

- (f) assistance to and cooperation with the Permanent Engineering Board in the discharge of its functions;
- (g) periodic calculation of accounts;
- (h) preparation of the hydroelectric operating plans and the 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 68th meeting on 21 February 2001 in Vancouver, British Columbia. In conjunction with this meeting, the Board also held its 49th joint meeting with the Entities.

At this meeting, topics included the status of Assured Operating Plans (AOPs) and Determination of Downstream Power Benefits (DDPBs); transmission issues and return of the Canadian Entitlement; the impacts of U.S. resource agencies' Biological Opinions on Treaty operations; the implications of power deregulation on the Treaty; and a proposal by the Hydrometeorological Committee on streamlining their reports.

### Reports Received

Throughout the report year, the Entities maintained contact with the Board and its Engineering Committee. Information pertinent to the operation of Treaty storage projects was made available to the Board.

The following documents involving the operation of Columbia River Treaty Storage have been received by the Board from the Entities since the last Annual Report:

- *Agreement on Implementation of the Arrow Local Method for Canadian Treaty Storage for Operating Year 2000–2001, among the Columbia River Treaty Operating Committee, the Bonneville Power Administration and the British Columbia Hydro and Power Authority, signed 23 August 2000.*

This agreement defines arrangements for sharing the downstream U.S. power benefits that arise from implementing the Arrow Local Method of computing the Variable Energy Content Curve (VECC) for Arrow in the 2000–2001 *Detailed Operating Plan (DOP)* rather than the Arrow Total Method. The benefits depend on actual streamflow conditions and market prices and were computed to be about 7 average megawatts annual energy for operating year 2001. The Arrow Local VECC Method has never been included in the AOP, but had been the only method used in the DOP from the late 1970s through the 1995–1996 operating year. The Canadian Entity had requested compensation for its continued use in the DOP because of the increased power benefits that typically result from the use of this method. These increased power benefits result from the additional draft of Arrow that typically occurs with the Arrow Local Method during the January–March period and a corresponding return to normal levels during the April–July period. This occurs because the Arrow Local Method uses the Mica Target Discharge plus local inflow to compute Arrow's VECC, and the Mica Target Discharge is usually greater and more accurate than the conventional VECC (Arrow Total) method of basing the net inflow on unregulated inflow minus an

upstream refill requirement determined from Mica's VECC. This agreement supplements the 2000–2001 DOP.

- *Columbia River Treaty Operating Committee Agreement on the Operation of Treaty Storage for Non-Power Uses from 1 January through 31 July 2001*, signed 30 November 2000.

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 United States of providing spring and summer flow augmentation for salmon and steelhead by storing 1 000 000 acre-feet of water in Arrow by late April, (3) enhancing Arrow lake 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. This agreement supplements the 2000–2001 Detailed Operating Plan.

- *Columbia River Treaty Operating Committee Agreement for Optimal Balancing of Storage Between Arrow and Libby Reservoirs for the Period 13 February 2001 Through 3 April 2001, Among the Columbia River Treaty Operating Committee, the Bonneville Power Administration and the British Columbia Hydro and Power Authority*, signed 8 May 2001.

The Canadian Entity made a request to the U.S. Entity under this agreement for a change to the weekly operation of Libby. The U.S. Entity stored water requested by the Canadian Entity in Lake Koocanusa. The storage period was from 13 February 2001 through 24 February 2001. The Canadian Entity released from the Arrow reservoir at rates equal to and concurrent with storage into Lake Koocanusa. The water stored in Lake Koocanusa was recorded by the Entities in the "Water in Libby Account." The U. S. Entity released all water from that account by 3 April 2001. The Canadian Entity accompanied releases of water from that account with equal reductions in releases from the Arrow reservoir. Concurrent with the storage of additional water in Lake Koocanusa, the British Columbia Hydro and Power Authority provided to the Bonneville Power Administration (BPA) in-lieu energy, and BPA returned the energy in accordance with agreed-upon daily schedules. No storage fees were charged to any party for transactions under this agreement. This agreement supplements the 2000–2001 Detailed Operating Plan.

- *Columbia River Treaty Operating Committee Agreement on Operation of Summer Treaty Storage for 1 August 2001 through 31 March 2002*, signed 18 July 2001.

This agreement covers the operation of Treaty storage for the period 1 August 2001 through 31 March 2002. The objective of this agreement is to enhance

fisheries and summer reservoir levels at Canadian Treaty projects and the storage of water for U. S. Pacific Northwest reliability requirements during the fall and winter of 2001–2002. It is also intended that the resulting Treaty reservoir operation will reduce the level of risk for Canadian mountain whitefish that are spawning during this period. This agreement supplements the *2001–2002 Detailed Operating Plan*.

- *Assured Operating Plan and Determination of Downstream Power Benefits for Operating Year 2005–06*, signed 16 August 2001.

This document is the Assured Operating Plan and Determination of Downstream Power Benefits for the operating year 1 August 2005 through 31 July 2006.

- *Columbia River Treaty Entity Agreement on the Detailed Operating Plan for Columbia River Storage for 1 August 2001 through 31 July 2002*, signed July 2001.

This agreement implements the DOP for Columbia River Storage for 1 August 2001 through 31 July 2002.

- *Detailed Operating Plan for Columbia River Storage for 1 August 2001 through 31 July 2002*, dated July 2001.

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 August 2001 through July 2002.

- *Annual Report of the Columbia River Treaty, Canadian and United States Entities, for the period 1 October 2000 through 30 September 2001*, dated October 2001.

This report summarizes the operation of Treaty projects and other activities of the Entities for the period 1 October 2000 through 30 September 2001. Further details on the Entity Annual Report are provided later in this report.

- *Hydrometeorological Committee's Proposed Strategy for Future Updates of Committee Documents*, dated February 2001.

The proposal summarizes a process to eliminate the practice of categorizing each data station as either Treaty or Support. Instead, it focuses on the Committee's efforts to ensure there is adequate hydrometeorological data available for Treaty purposes. This strategy was proposed due to the proliferation of hydrometeorological stations used for Treaty operations, and to avoid the need to duplicate catalogues maintained by other agencies. The format of future Hydrometeorological Committee documents would be revised to include only changes to the network, as opposed to a complete listing of all stations. Permanent Engineering Board Engineering Committee (PEBCOM) reviewed the proposal and concluded that it will not adversely impact the Entities' ability to carry out the

operating arrangements needed to implement the Treaty, or affect the results being achieved under the Treaty. The proposal includes provisions to track changes, make updates and review modeling and forecasting methodologies to ensure implementation of the Treaty.

The Board received no documents involving the operation of Columbia River Non-Treaty Storage during this operating year.

### **Report to the Governments**

The thirty-sixth Annual Report of the Board was submitted to the governments of Canada and the United States on 28 February 2001.



Duncan Dam – Duncan River, British Columbia  
The earth dam with discharge tunnels (*left*) and spillway (*right*)

## **PROGRESS**

### **General**

The results achieved under the terms of the Treaty include construction of the Treaty projects, development of the hydrometeorological network, annual preparation of power and flood control operating plans and the annual calculation of downstream power benefits. The three Treaty storage projects in British Columbia – the Duncan, Arrow and Mica projects – produce power and flood control benefits in Canada and the United States. The Libby storage project also provides power and flood control benefits in both countries. In the United States, 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 generators at Mica Dam in 1976–1977 and completion of the Revelstoke project in 1984 have increased power benefits substantially. This amounts to some 4000 MW of generation capacity in Canada that may not have been installed without the Treaty. In addition, adjacent to the Hugh Keenleyside Dam, the installation of two units for a total generating capacity of 185 MW is nearing completion. Additional generating units at Revelstoke and Mica Dams in Canada are also being considered.

The Treaty provides Canada with an option, which commenced in 1984, of diverting the Kootenay River at Canal Flats into the headwaters of the Columbia River. The British Columbia Hydro and Power Authority undertook certain engineering feasibility and environmental studies of the potential diversion. No further activities have occurred since that time.

The locations of the above projects are shown in Appendix D, Plate No. 1.

### **Status of the Treaty Projects**

#### **Duncan Project**

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

The earthfill dam is about 130 ft high and extends 2600 ft across the Duncan River valley, approximately six miles north of Kootenay Lake. The reservoir behind the dam extends for about 27 miles and provides 1 400 000 acre-feet of usable storage, which is committed under the Treaty. No power facilities are included in this project.

The project is shown in the picture on page 14, and project data are provided in Appendix D, Table 1.

## Arrow Project

The Hugh Keenleyside Dam, at the outlet of the Arrow Lake, was the second Treaty project to be completed. It became operational on 10 October 1968, well ahead of the date of 1 April 1969 scheduled by the Sales Agreement.

The dam consists of two main components: a concrete gravity structure that extends 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 170 ft above the river bed and extends 1650 ft from the navigation lock to the south bank of the river. The reservoir, about 145 miles long, includes both the Upper and Lower Arrow lakes and provides 7 100 000 acre-feet of Treaty storage.

The original project had no associated power facilities. However, installation of two generating units, totalling about 185 MW of generating capacity, is nearing completion. The new power plant is located on the north abutment (left bank); an intake approach channel of about 4900 ft long around the north end of the concrete dam diverts waters of the Arrow reservoir through a powerhouse located in a rock outcrop 1300 ft downstream. The generating facility contains two Kaplan turbines, 92.5 MW each. The facility is connected by a new 230-kV transmission line to the Selkirk substation, for integration into the British Columbia Hydro and Power Authority's existing power grid. The expected completion date is the spring of 2002, and the power production at the new generating facilities will be incidental to releases made for Treaty purposes. Environmental benefits are also associated with reduced entrained gases, which are known to be harmful to fish.

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

## Mica Project

The Sales Agreement scheduled Mica Dam, the largest of the Treaty projects, for initial operation on 1 April 1973. The project was declared operational and commenced storing on 29 March 1973.

Mica Dam is located on the Columbia River about 85 miles north of Revelstoke, British Columbia. The earthfill dam rises more than 800 ft above its foundation and extends 2600 ft across the Columbia River valley. It creates a reservoir 135 miles long, Kinbasket Lake, with a total storage capacity of 20 000 000 acre-feet. The project utilizes 12 000 000 acre-feet of live storage, of which 7 000 000 acre-feet are committed under the Treaty.

Although not required by the Treaty, the British Columbia Hydro and Power Authority added a powerhouse to the project. The underground powerhouse has space for a total of six generators. Four generators have been installed and currently produce a maximum capacity of 1805 MW.

The project is shown in the picture on page 22, and project data are provided in Appendix D, Table 3.

### **Libby Project in the United States**

Libby Dam is located on the Kootenai River, 17 miles northeast of the town of Libby, Montana. Construction began in the spring of 1966; 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 3055 ft long, rises 370 ft above the riverbed and creates Lake Koocanusa, which is 90 miles long and extends 42 miles into Canada. Lake Koocanusa has a gross storage of 5 869 000 acre-feet, of which 4 980 000 acre-feet are usable for flood control and power purposes. The Libby powerhouse, when completed in 1976, 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 525 MW. Recent U.S. legislation (Public Law 104-303, 12 October 1996) authorizes the Corps of Engineers to complete generating units 6 through 8. No action to do so has been taken during this report period.

The Libby project is shown in the picture 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 42-mile portion of Lake Koocanusa in Canada. The British Columbia Hydro and Power Authority is now responsible for reservoir debris clean up.

## **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 detailed programming of flood control and power operation. This system includes snow courses, meteorological stations and streamflow gauges. The Columbia River Treaty Hydrometeorological Committee, formed by the Entities, makes recommendations on further development of the Treaty Hydrometeorological System.

In developing the hydrometeorological network, the Entities, with the concurrence of the Board, adopted a document in 1976 that defined the Columbia River Treaty Hydrometeorological System, which also outlined a method of classifying facilities into those required as part of the Treaty System and those of value as Supporting Facilities. During the

1976–1977 report year, the Entities, with the concurrence of the Board, adopted a plan for exchanging operational hydrometeorological data. That plan is still in force.

The document describing the Treaty Hydrometeorological System has been updated on a number of occasions since 1976; most recently, in 1992. The initial reason for not updating the 1992 document was that there had not been any appreciable changes in the hydrometeorological network for several years following publication in 1992. During recent years, as a result of the emergence and adoption of more sophisticated streamflow forecasting procedures, the number of stations used in the Treaty studies increased from 866 in 1992 to about 1500 in 2000. Considerable effort is required to classify and prepare documentation of network stations on a regular basis.

The Entities began an effort in the fall of 1999 to reconsider the definition of hydrometeorological facilities required as part of the Treaty System and of those with value as Supporting Facilities. The Entities briefed the Board in February 2001 and followed up by sending a letter dated June 20, 2001, describing their proposal for future updates of the document. The Entities proposed to eliminate the practice of categorizing each data station as either “Treaty” or “Support.” Instead, a new classification called Treaty/Support would be used if a station is used directly or indirectly to monitor, plan and operate Treaty projects. The Entities would communicate with data collection agencies on a regular basis to remain informed of the status of the network and would take steps to ensure that the monitoring, planning and operation of Treaty facilities are not adversely affected by any changes to the hydrometeorological network. The format of future Hydrometeorological Committee documents would be revised to include only changes to the network as opposed to the complete listings of all stations.

The Board studied the proposal and concluded that the Entities would be able to ensure having an appropriate mix of data, forecasting and modeling methodologies to effectively implement the requirements of the Treaty. The changes will take effect October 1, 2001.

## **Power Operating Plans and Calculation of Downstream Benefits**

The Treaty and related documents require the Entities to agree annually on operating plans and on the resulting downstream power benefits for the sixth succeeding year of operation. These operating plans, prepared five years in advance, are called Assured Operating Plans (AOPs). They represent the basic commitment of the Canadian Entity to operate the Treaty storage in Canada (Duncan, Arrow and Mica) and provide the Entities with a basis for system planning. Canada’s commitment to operate under an AOP is tied directly to the benefits produced by that plan.

At the beginning of each operating year, a detailed operating plan, which includes the three Treaty storage projects in Canada and the Treaty project in the United States (Libby),

is prepared on the basis of current resources and loads. The detailed operating plan (DOP) aims to obtain results that may be more advantageous to both countries than those which would be obtained by operating in accordance with the AOP.

The AOP for the 2000–2001 operating year provides criteria for Treaty operations. The Determination of Downstream Power Benefits (DDPBs), which was also prepared in advance along with the AOP, defines the power benefits under the Treaty, based on the same Treaty operation criteria contained in the AOP. During the report year, actual operations of the Treaty storage in Canada were regulated under the rule curves set out in the Entities' report *Detailed Operating Plan (DOP) for Columbia River Treaty Storage, 1 August 2000 through 31 July 2001*, agreed to in July 2000 and also in accordance with additional Entities' agreements signed in the course of the year. The DOP for Canadian storage was based on the operating criteria and hydro regulation studies contained in the 2000–2001 AOP, together with any changes thereto agreed to by the Entities.

Beginning with this year's DOP, Libby operating limits and the expected operation of the Libby project are no longer included in the DOP. Information for Libby operation was presented separately in the Libby Operating Plan prepared by the U.S. Entity. The actual Pacific Northwest Coordination Agreement operations in the U.S. system are based on the U.S. Fish and Wildlife Service and the National Marine Fishery Service Biological Opinions and associated non-power requirements. One of the main measures defined in the Biological Opinions includes changing the customary seasonal release rates from Libby Dam such that spring and summer flows would be higher, and fall and winter flows lower, than in the past.

The Canadian Entity believes that these fishery operations are not consistent with the Treaty. However, as reported in the 2000 Board Annual Report, the Libby Coordination Agreement (LCA) signed on 16 February 2000 addressed the issues concerning the operations of the Libby project. It also allowed the Entities to coordinate reservoir operations and agree to AOPs and DD PBs without needing to alter their respective positions regarding the validity of the Libby fisheries operation under the Treaty. The LCA essentially freezes the dispute, potentially until 2024, unless either Entity chooses to terminate early, on 30 days' notice. Details of the LCA are presented in the Operation section of this report.

It was reported in the 1996, 1997 and 1998 Board annual reports that 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* resolved a lengthy dispute regarding the calculation of the downstream power benefits. If this issue is raised in the future, the Board will re-examine the matter by using its earlier recommendations as guidelines on the appropriate Treaty interpretation and 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*, which was 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 referred to above, the terms and conditions for the disposal of portions of the Canadian Entitlement within the United States is based on the agreement entitled *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 a diplomatic exchange of notes between the United States and Canada.

## **Flood Control Operating Plans**

The Treaty provides that the Canadian Entity will operate Canadian storage reservoirs 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, and the revised plan, dated October 1999, defined the flood control operation of the Duncan, Arrow, Mica and Libby reservoirs during the period covered in this report. The 1972 plan was received from the Entities and reviewed by the Board in the 1972–1973 report year, and was in effect until October 1999. This 1972 plan has been replaced by the new plan completed in October 1999.

## **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–United States boundary. Flows for this report 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**

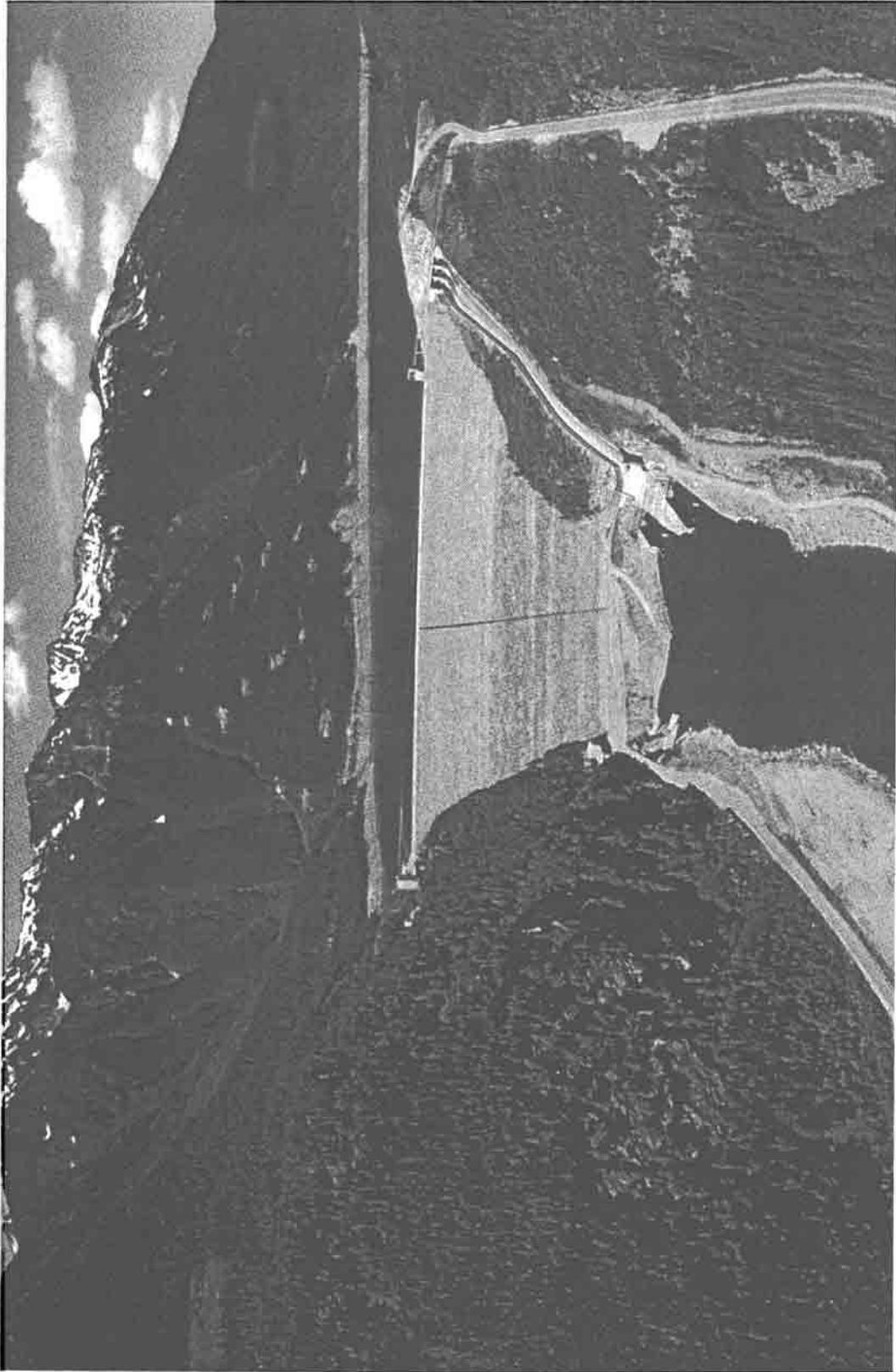
Since 1984, agreements have also been reached between the British Columbia Hydro and Power Authority and the Bonneville Power Administration (BPA) concerning the use of non-Treaty storage. These agreements do not interfere with operations under the Treaty.

Rather, they extend the concepts of the Treaty and benefit both the British Columbia Hydro and Power Authority and BPA.

### **Operations for Fish**

Many U.S. reservoirs are presently operated in accordance with Biological Opinions issued by the U.S. Fish and Wildlife and the National Marine Fishery Service under the *Endangered Species Act*.

Treaty reservoirs in Canada are operated in accordance with the requirements of Fishery and Oceans Canada. These efforts continue to evolve. In this regard, the Board notes that the AOPs and the DDPBs are to be based on optimal operation for power and flood control in accordance with the requirements of the Treaty. The Board continues to maintain its long-standing position that the Entities may develop DOPs to address fishery needs providing those actions do not conflict with Treaty requirements.



Mica Dam and Lake Kinbasket – Columbia River, British Columbia  
The earth dam showing the spillway (*right*), with the underground powerhouse (*left*)

## OPERATION

### General

The Columbia River Treaty Operating Committee was established by the Entities to develop operating plans for the Treaty storage and to direct operation of this storage in accordance with the terms of the Treaty and subsequent Entity agreements.

During the report year, the Canadian Entity operated the Treaty storage in accordance with the following documents:

- *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 principles for changes in the preparation of the Assured Operating Plans (AOPs) and the Determination of Downstream Power Benefits (DDPBs). These changes involve revisions of information to be used in studies, such as the definition of the power loads and generating resources in the Pacific Northwest area, the streamflows to be used and the 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 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 on the initial filling of Revelstoke Reservoir, the coordinated use of some of the Columbia River non-Treaty storage and the actions taken to enhance the refill of the reservoirs impounded by Mica and Arrow Dams.

- *Columbia River Treaty Principles and Procedures for Preparation and Use of Hydroelectric Operating Plans*, dated December 1991.

This document serves as a guide for the preparation and use of hydroelectric operating plans, such as the AOPs and Detailed Operating Plans (DOPs) used to plan the operation of Columbia River Treaty Storage.

- *Assured Operating Plan for Columbia River Treaty Storage, 1 August 2000 through 31 July 2001*, dated January 2000.

This document provides information on the operation plan for Columbia River Treaty storage and resulting downstream power benefits for the period 1 August 2000 through 31 July 2001.

- *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, the method of accounting for transmission losses and the guidelines for scheduling. The Agreement became effective on 31 March 1999 through a diplomatic exchange of 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 April 1, 1998 through September 15, 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 April 1, 1998 through September 15, 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 Canadian Entitlement shall be disposed of in the United States by British Columbia.

- *Columbia River Treaty Flood Control Operating Plan*, dated October 1999.

This plan prescribes the criteria and procedures by which the Canadian Entity will operate Mica, Duncan and Arrow Reservoirs to achieve desired flood control objectives in the United States and Canada. (Criteria for 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. This 1999 plan updates information, incorporates new storage reservation diagrams and clarifies procedures.

- *Agreement on Implementation of the Arrow Local Method for Treaty Storage for Operating Year 2000–2001, among the Columbia Treaty Operating Committee, the Bonneville Power Administration, and the British Columbia Hydro and Power Authority, signed 29 December 2000.*

This agreement defines arrangements for sharing approximately 7 MW of annual average downstream U.S. power benefits that arise from implementing the Arrow Local Method of computing the Variable Energy Content Curve (VECC) for Arrow in the 2000–2001 DOP, rather than the Arrow Total Method. The Arrow Local VECC Method had been the only method used in the DOP from the late 1970s through the 1995–1996 operating year, and the Canadian Entity had requested compensation for its continued use because of the increased power benefits that typically result from using this method. These increased power benefits result from the additional draft of Arrow that typically occurs with the Arrow Local Method during the January-March period and a corresponding reduction in the draft during the April-July period. This occurs because the Arrow Local Method does not adjust Arrow to compensate for Mica being re-operated to its Project Operating Criteria as in the DOP. In the Arrow Total Method, however, the operation of Arrow is adjusted in response to the re-operation of Mica.

- *Columbia River Treaty Operating Committee Agreement on Operation of Treaty Storage for Non-Power Uses for 1 January through 31 July 2001, signed 30 November 2000.*

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 United States of providing spring and summer flow augmentation for salmon and steelhead by storing 1 000 000 acre-feet of water in Arrow by late April, (3) enhancing the lake levels at Arrow and (4) improving the U.S. capability to meet flow objectives for salmon at Vernita Bar below Priest Rapids Dam.

- *Columbia River Treaty Entity Agreement Coordinating the Operation of the Libby Project with the Operation of Hydroelectric Plants on the Kootenay River and Elsewhere in Canada, signed 16 February 2000, (Libby Coordination Agreement [LCA]).*

This agreement sets forth the implementing procedures of the Entities for cooperating, on a continuing basis, the operation of the Libby project with the operation of hydroelectric plants on the Kootenay River and elsewhere in Canada. To accomplish this, it (1) establishes the Arrow provisional draft provisions related to the operation of Libby for updated non-power requirements, (2) sets forth procedures for storage exchanges between Libby and Canadian storage,

(3) specifies Libby non-power requirements in the AOP studies, (4) states that DOP studies apply only to Canadian storage and (5) addresses alleged past and any future power losses and differences regarding the operation of the Libby project and impacts upon the hydroelectric plants on the Kootenay River and elsewhere in Canada. The Agreement is effective 16 February 2000 and will remain in effect until 15 September 2024 unless either Entity elects to terminate the Agreement.

- *Columbia River Treaty Entity Agreement on the Detailed Operating Plan for Columbia River Storage for 1 August 2001 through 31 July 2002*, signed 13 July 2001.

This agreement implements the DOP for Columbia River Storage for 1 August 2001 through 31 July 2002.

- *Detailed Operating Plan for Columbia River Storage for 1 August 2001 through 31 July 2002*, dated July 2001.

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 and the Libby Project in the United States for the operating year from August 2001 through July 2002.

- *Annual Report of the Columbia River Treaty Canadian and United States Entities, for the period 1 October 2000 through 30 September 2001*, dated November 2000.

This report summarizes the operation of Treaty projects for the period 1 October 2000 through 30 September 2001. Further details on the Entities' annual report are provided later in this report.

## **Power Operation**

The most significant event to be documented for this year's operation is the extremely low runoff that occurred in the Columbia River Basin. Precipitation during the typically wettest part of the year (November through March) was only half of normal. On 1 January 2001, the water supply that was forecast for the Columbia River at The Dalles (January–July) was 80.4 million acre-feet (Maf), or 76 percent of the 1961–1990 average. Precipitation spiked in April, sagged in May and rose to near normal amounts in June and July. Because of the extended dry weather pattern from January through March, the water supply that was forecast dropped from 80.4 Maf on 1 January to 56.1 Maf on 1 April 2001. The actual runoff for the January through July 2001 period was 58.2 Maf, or 55 percent of average. Of note is that the actual unregulated runoff during the August 2000 through July 2001 operating year at The Dalles was the lowest in the 1878–2001 historic record – at 82.6 Maf. For the 2000–2001 water year, the runoff at The Dalles was second lowest

on record at 79.3 Maf. The unregulated flow at The Dalles peaked at 326 800 cubic feet per second (cfs) on 30 May 2001.

The summer of 2000, preceding the beginning of the report year, saw the coordinated Columbia River reservoir system filled to 97.07 percent of capacity. This storage condition triggered the use of the first-year firm load carrying capability for the 2000–2001 operating year. Due to the near-record low unregulated streamflows during most of the year, the hydro system operated to draft, proportionally well below the Operating Rule Curve from 16 August 2000 through July 2001. By 31 July 2001, the coordinated system storage dropped to only 67.07 percent full.

The Columbia River in the United States was operated to meet the needs of listed chum salmon below Bonneville Dam and the power demands from November 2000 through 16 March 2001. During this time, the federal, state and tribal agencies in the United States were active in setting operating priorities and criteria. By April the operating strategy shifted to refilling reservoir storage as much as possible.

The Canadian Treaty projects – Duncan, Mica and Arrow – were operated throughout the year in accordance with the 2000–2001 DOP, the October 1999 Flood Control Operating Plan and several supplemental operating agreements noted in the Operation section of this report.

### **Mica Project**

The Treaty storage account at Mica was 6.6 Maf on 31 July 2000 and with continued refill reached 7.0 Maf, or 100 percent full storage, on 15 August 2000. The actual reservoir elevation reached a maximum of 2457.9 ft (17.1 ft below full) on 14 August 2000. By 31 December 2000, Treaty storage was drafted to 4.3 Maf, and the reservoir level had dropped to elevation 2405.6 ft. The reservoir reached its lowest level for the 2000–2001 water year on 26 April 2001 at elevation 2345.0 ft. Treaty storage reached its lowest level for the year on 11 May 2001 at 0.02 Maf below empty. From then on, the Treaty storage at Mica refilled to 4.7 Maf on 24 August 2001. The maximum Mica reservoir level for water year 2001 was elevation 2434.8 ft (40.2 ft below full) on 3 September 2001.

### **Arrow Project**

Arrow reservoir began the report year on 1 October 2000 at elevation 1430.0 ft – 14.0 ft below full – after a summer in which the reservoir filled to near capacity at elevation 1443.9 ft (just 0.1 ft below full) on 26 July 2000. Reservoir releases decreased over the fall months from an average of 58 200 cfs in September to 32 600 cfs in October and 37 800 cfs in November. The discharge increased to an average of 58 600 cfs in December. Arrow reservoir drafted to elevation 1418.2 ft by 31 December 2000.

The Arrow fisheries operations were conducted under the terms of two Operating Committee agreements, "Operation of Treaty Storage for Enhancement of Mountain Whitefish Spawning for the Period of 1 September 2000 through 30 April 2001" and "Operation of Treaty Storage for Nonpower Uses for January through 31 July 2001." These agreements enabled the Arrow project flows to be adjusted to enhance whitefish and rainbow trout spawning and emergence downstream of the Arrow project in Canada.

For the period 24 December 2000 to 22 January 2001, Arrow outflows were held near 38 000 cfs. This flow level was established because it was one that could be sustained or exceeded through the period of fish emergence in February and March. Unlike the previous operating year, where the Arrow Treaty Storage Regulation (TSR) flow for January was higher than the preferred whitefish flows, the Arrow TSR flow for January 2001 was closer to the preferred whitefish flow level. As a result, the British Columbia Hydro and Power Authority did not need to exercise an available option to store up to 400 thousand second foot days under the agreement to enhance Mountain Whitefish. Arrow outflow through the period of whitefish emergence from 23 January to 23 March averaged 49 000 cfs – well above the 38 000 cfs established for spawning. On 24 March, the outflow from Arrow was reduced from 45 000 cfs to 30 000 cfs to meet objectives for rainbow trout spawning under the Nonpower Uses Agreement. Between 10 April and 29 May, Arrow outflow increased to 35 000 cfs, under the same agreement, to permit the United States to meet the Vernita Bar salmon flow requirements.

The Columbia River Treaty Operating Committee agreed to use an alternate method this year for determining the Arrow Variable Refill Curve (VRC) between January and February 2001. The alternate method, known as the Arrow Local Method, uses Mica outflow when computing Arrow's VRC. This method on average results in lower VRC levels at Arrow during January through April than the normal method, while Arrow reservoir is still targeted to be full on 31 July. The Agreement to use the alternate Arrow Local Method was signed in December 2000, with the expectation that power benefits realized in excess of those expected by the Total Method would be shared equally between the Bonneville Power Administration (BPA) and the British Columbia Hydro and Power Authority. The Operating Committee agreed that operations under the 2001 Arrow Local Agreement resulted in a net generation gain in the U.S. system valued at US\$6.48 million. The Agreement provided for delivery of the British Columbia Hydro and Power Authority share of this generation gain over the period October to December 2001.

During this report year, the United States did not store water in Arrow under the Nonpower Uses Agreement for the purpose of salmon flow augmentation. This was because inflow to Arrow was below average during the January through March storage period, and Arrow outflow needed to be kept at levels for whitefish spawning and for power generation uses in the United States. The Operating Committee did agree to the Summer Treaty Storage (STS) Agreement with mutually agreeable storage opportunities,

for enhancing summer reservoir levels at Treaty projects and storing additional water for U.S. Pacific Northwest power system reliability requirements during the fall and winter of 2001–2002. This agreement was signed in July 2001. In anticipation of this agreement, water was stored in the Canadian Treaty reservoirs during June and July under the Nonpower Uses Agreement and later transferred to the STS agreement account.

The Treaty storage account at Arrow was 7.0 Maf, or 99 percent full, on 31 July 2000. The reservoir elevation reached a maximum of 1443.9 ft on 26 July 2000. The reservoir was drafted to elevation 1418.2 ft by 31 December 2000, with Treaty storage of 3.9 Maf, or 55 percent full. Arrow reservoir reached its lowest level of the year at elevation 1385.1 ft on 22 May 2001. The Treaty storage at Arrow reached its lowest level on 10 May 2001 at 0.81 Maf, or 11 percent full. During the period 24 December 2000 to 22 January 2001, Arrow outflows were held at 38 000 cfs to maintain lower river levels during the whitefish spawning period. During April and May 2001, outflows were held between 30 000 cfs and 35 000 cfs to insure successful rainbow trout spawning immediately below Arrow, at water levels that could be maintained until hatch. The reservoir reached its highest level on 3 August 2001 at elevation 1412.1 ft, with the Treaty storage reaching its highest level on 19 August 2001 at 5.3 Maf, or 74 percent full.

The Arrow Lakes Power Company project at Hugh Keenleyside Dam began full construction of a powerhouse on 15 March 1999. The powerhouse will contain two generating units, each capable of generating 85 MW of capacity. Construction of the powerhouse may be completed as early as November 2001.

### **Duncan Project**

Duncan reservoir reached full pool at elevation 1892.0 ft on 31 July 2000. For the period September through December, Duncan outflow averaged 7200 cfs while the reservoir was drafted to support Kootenay Lake elevations. On 31 December, the reservoir reached elevation 1795.6 ft, 1.4 ft above empty. For the period January through April 2001, the Duncan project passed inflow, keeping the reservoir near empty.

For the period January 2001 through July 2001, inflow to Duncan was 74 percent of normal. Outflow for the period averaged 600 cfs. The reservoir reached the maximum elevation for the 2000–2001 year of 1875.7 ft on 30 July 2001, 16.3 ft below full and 81.5 ft above empty.

During August, Duncan outflow was increased to an average of 6200 cfs to maintain Kootenay Lake levels close to the maximum summer elevations permitted under an International Joint Commission (IJC) order. This operation at Duncan drafted the reservoir to elevation 1870.7 ft by 31 August. During September, outflow was further increased to 10 000 cfs to raise the Kootenay Lake up to the IJC limit of 1745.32 ft for the period 1 September to 7 January.

## Libby Project

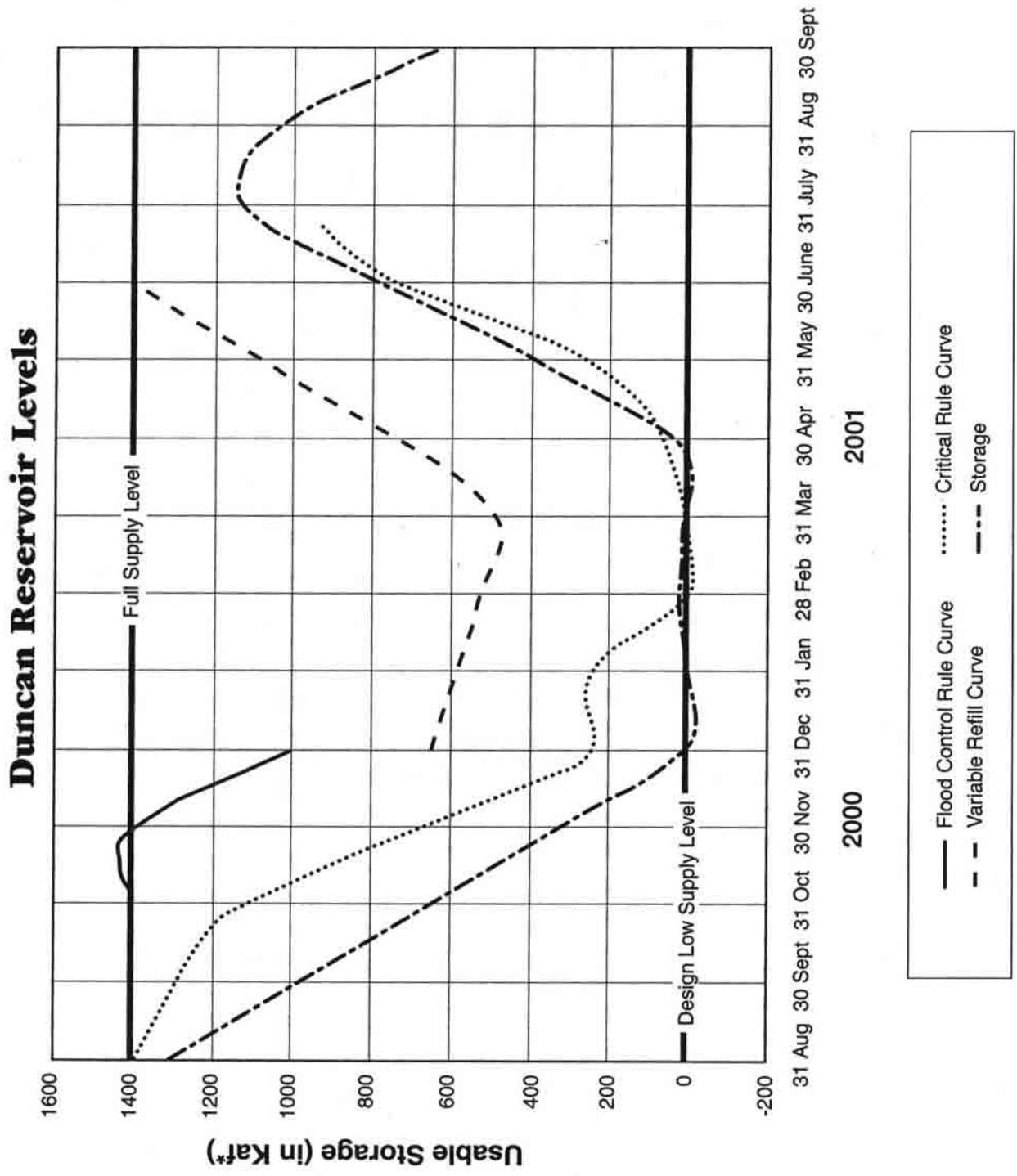
Lake Koocanusa (Libby reservoir) started the water year on 1 October 2000 at elevation 2432.3 ft, 26.7 ft below full. Throughout the year, Libby was operated in accordance with the 1999 Flood Control Operating Plan and the Libby Coordination Agreement (LCA). Libby was also operated in response to a regionally declared power emergency.

In December 2000, a Regional Emergency Warning was declared by the Western Systems Coordinating Council's Northwest Security Coordinator. The warning was issued at the recommendation of the Regional Response team, which includes Northwest utilities, federal hydro operation agencies and states. On 8 December, a level 2 warning was issued. This warning is tied to an emergency alert status (NERC Alert 2) prescribed by the North American Electric Reliability Council (NERC). It is called when the regional forecast indicates that firm load can be met only after including extraordinary actions by the hydroelectric projects. In response to this warning, Libby flow was increased to full load for a short time on 11 and 12 December. Outflow was brought up to 10 000 cfs for the power emergency on 22 January. Outflow was maintained at 10 000 cfs until 7 February, at which time outflow was ramped up to 15 000 cfs to provide additional generation for the power emergency. Additional increases were planned for 13 February, but the Canadian Entity made a request in accordance with the LCA to limit outflow from Libby.

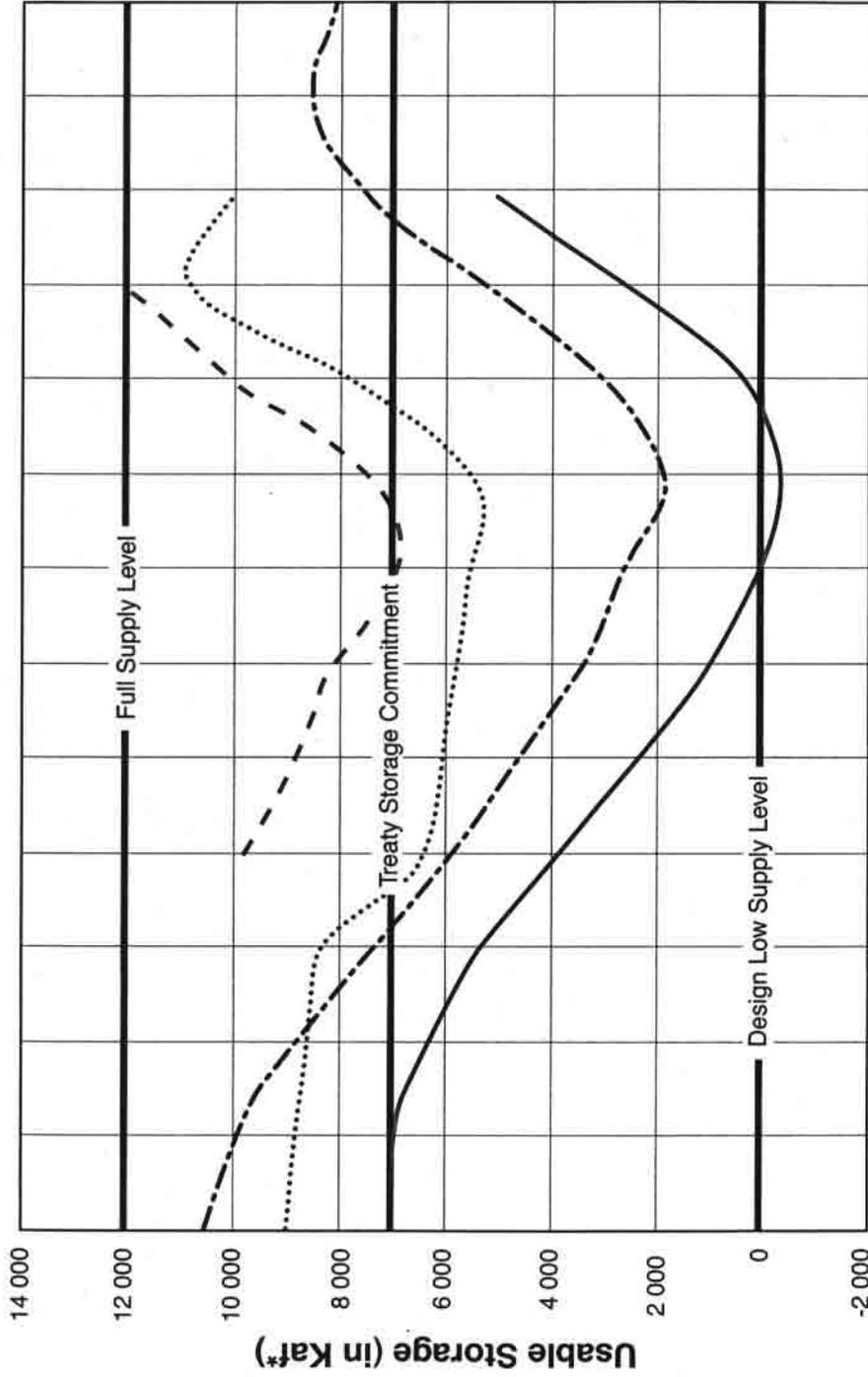
While the LCA was negotiated to allow flexibility in Libby operations to protect endangered fish species, it was also useful this year as a mechanism to accommodate emergency power operations. The Entities signed a storage exchange agreement, and flow remained at 15 000 cfs through the designated storage period of 13–19 February. In exchange for the reduced outflow from Libby, Canada provided additional discharge from Arrow, and megawatts to the U.S. flow were reduced to 6000 MW by 23 February and remained there until 4 March. The March release averaged 4400 cfs. Minimum flow of 4000 cfs was released from 7 to 26 March, when flow was increased to 4500 cfs from 27 March to 3 April to return the remaining water owed to Canada as per the February storage exchange agreement. Due to the extremely low runoff conditions, Libby remained at minimum discharge from 4 April to 1 July in an attempt to save water for multipurpose needs later. The project did not perform a sturgeon pulse operation in 2001. Libby reached a maximum elevation of 2436.6 ft on 31 July, 22.4 ft from full, and ended the water year at elevation 2431 ft, 28 ft from full, on 30 September 2001.

## **Flood Control Operation**

The Columbia River Basin reservoir system, including the Columbia River Treaty projects, was not operated for flood control during the 2000–2001 winter period, since the weekly operations agreed upon were adequate to accomplish spring flood evacuation goals. There was never any real potential for flooding in the Basin due to a near record low runoff. The regulated peak flow at The Dalles, Oregon, was 4796.87 m<sup>3</sup>/s (169 400 cfs), and the unregulated flow was estimated at 9253.94 m<sup>3</sup>/s (326 800 cfs). The peak stage observed at Vancouver, Washington, was 1.68 m (5.5 ft), and the estimated unregulated stage was 3.20 m (10.5 ft).



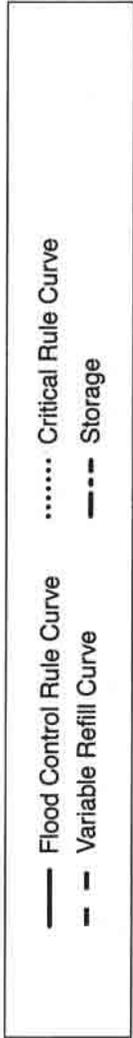
# Mica Reservoir Levels



31 Aug 30 Sept 31 Oct 30 Nov 31 Dec 31 Jan 28 Feb 31 Mar 30 Apr 31 May 30 June 31 July 31 Aug 30 Sept

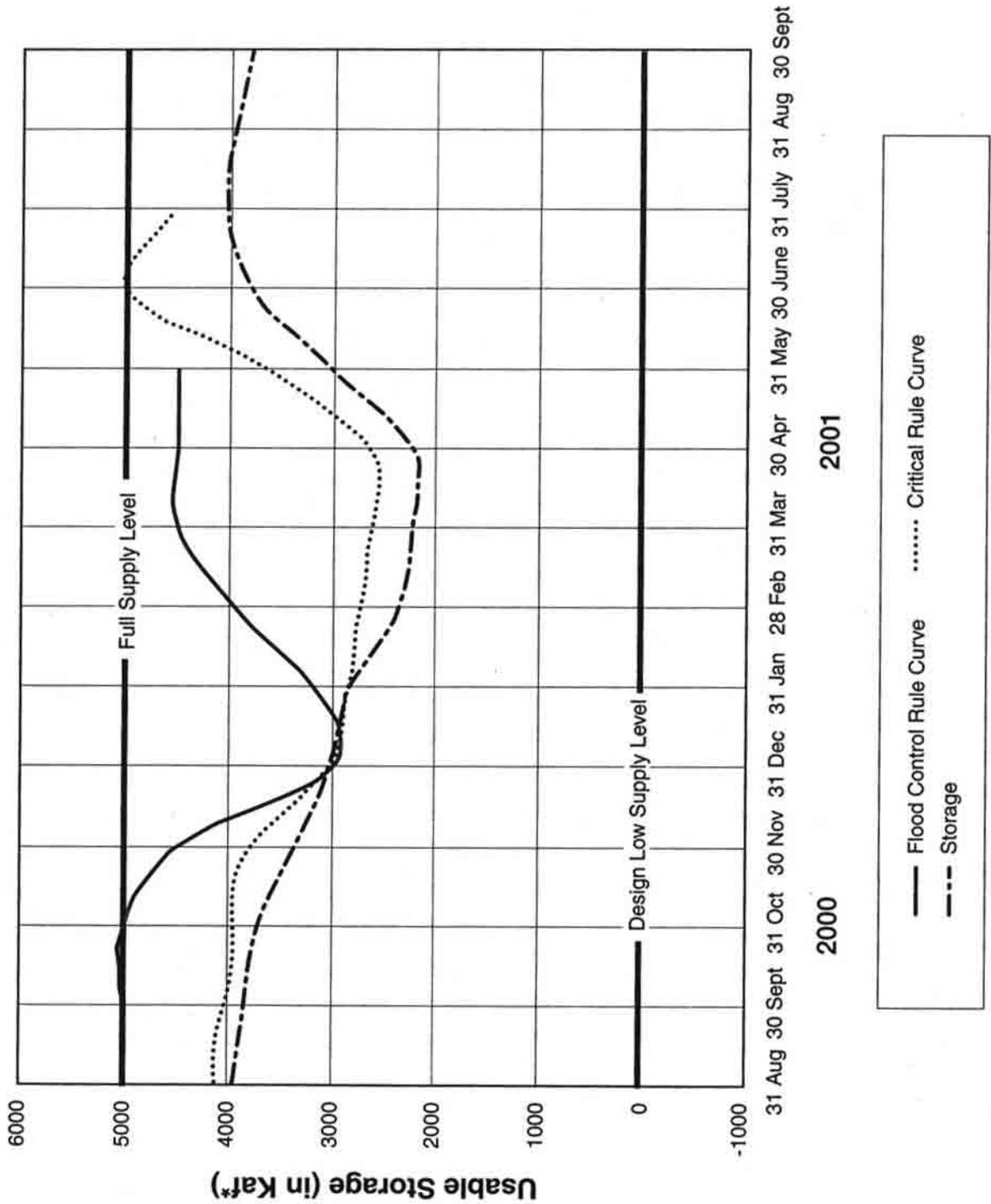
2001

2000



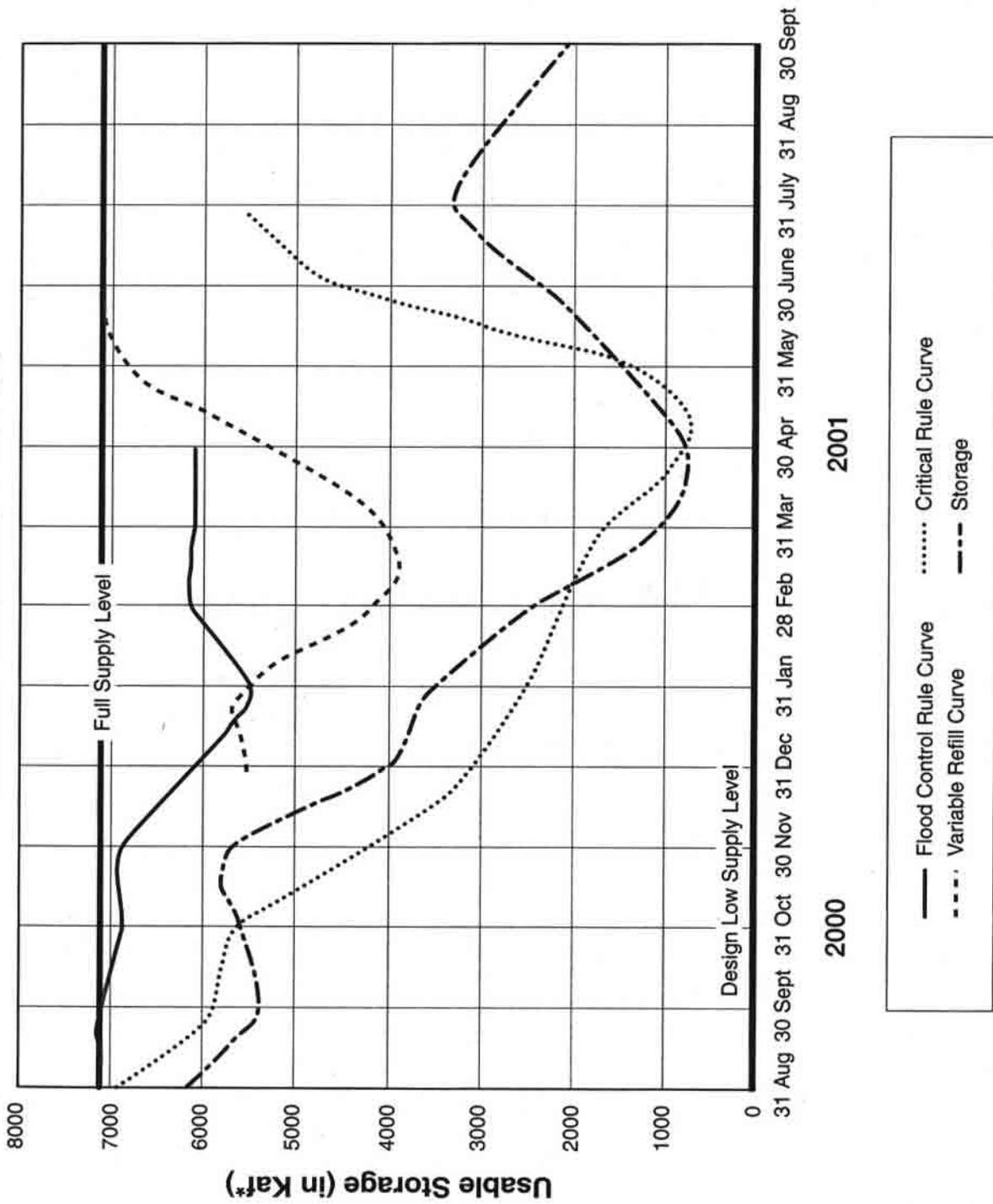
\* Kaf = thousand acre-feet

### Libby Reservoir Levels



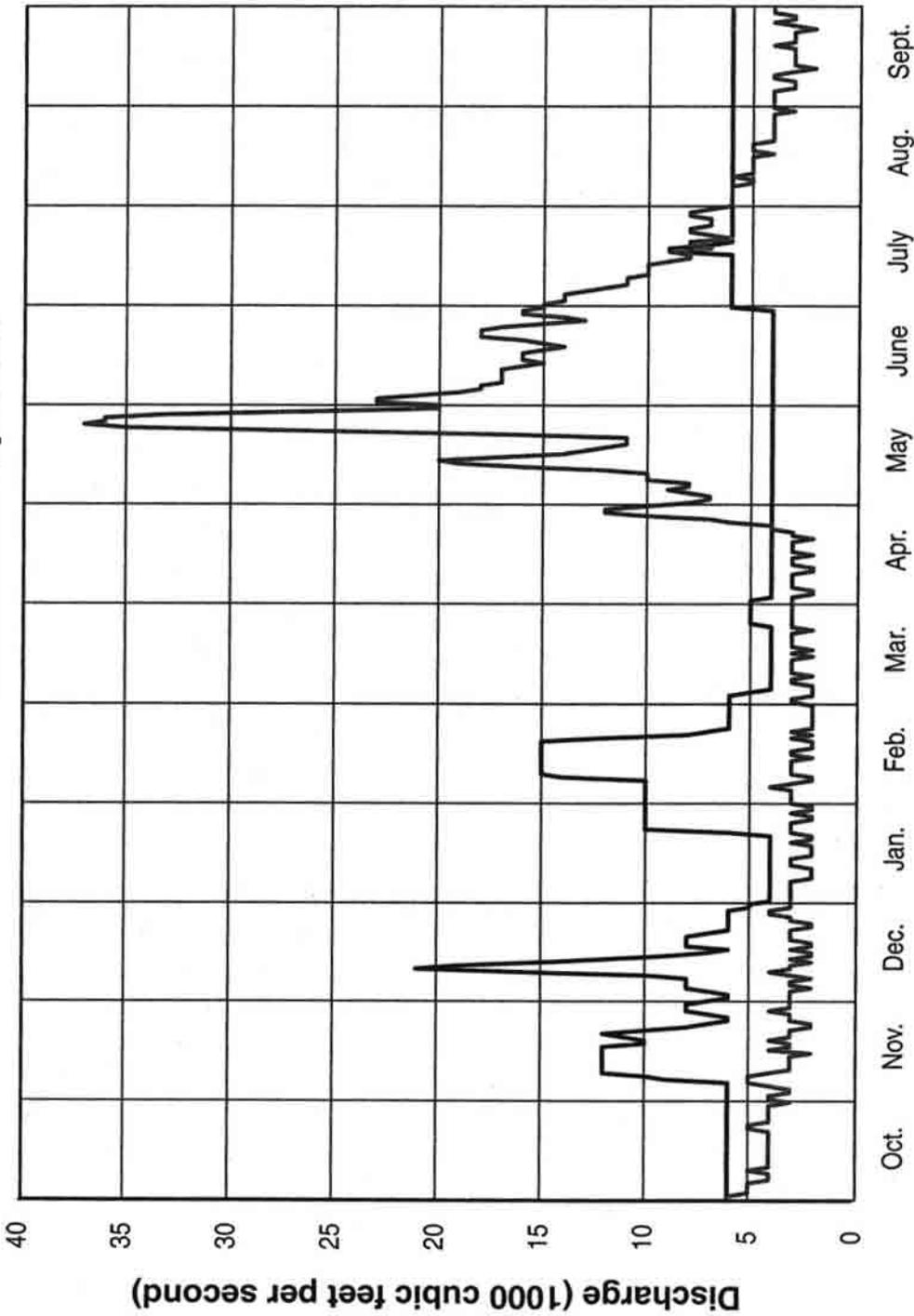
\* Kaf = thousand acre-feet

# Arrow Reservoir Levels



\* Kaf = thousand acre-feet

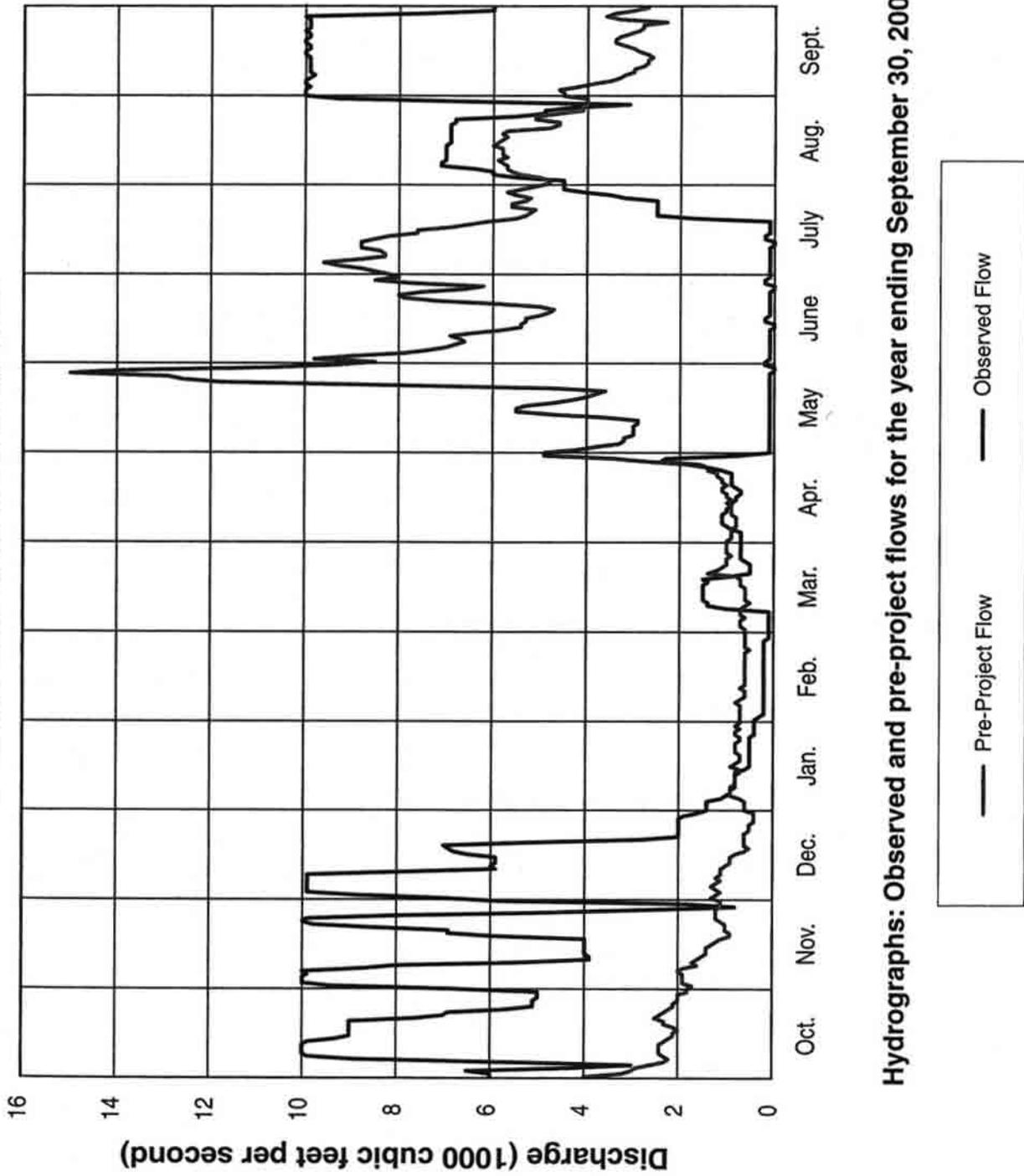
### Kootenai River at Libby Dam



Hydrographs: Observed and pre-project flows for the year ending September 30, 2001

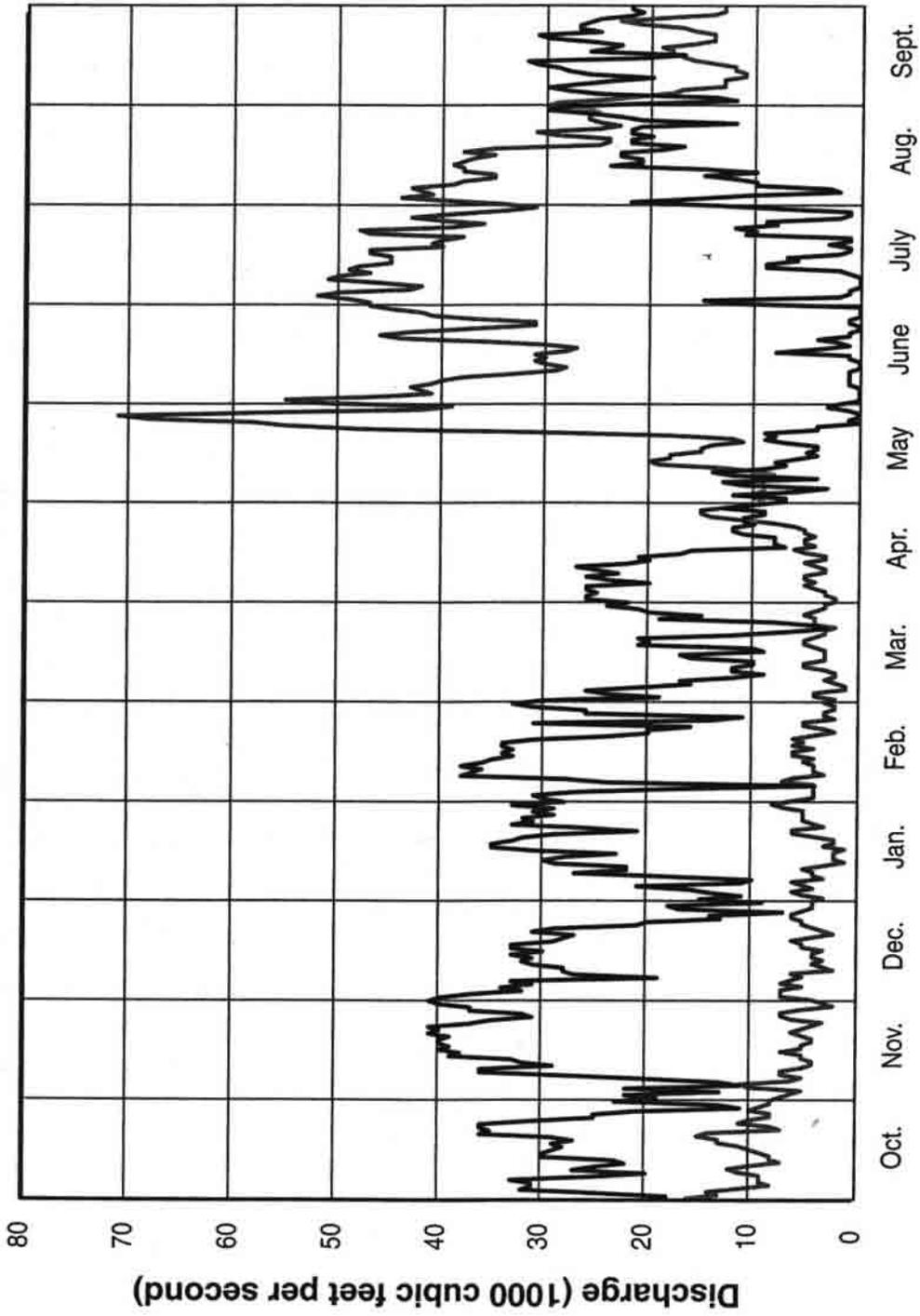


### Duncan River at Duncan Dam



Hydrographs: Observed and pre-project flows for the year ending September 30, 2001

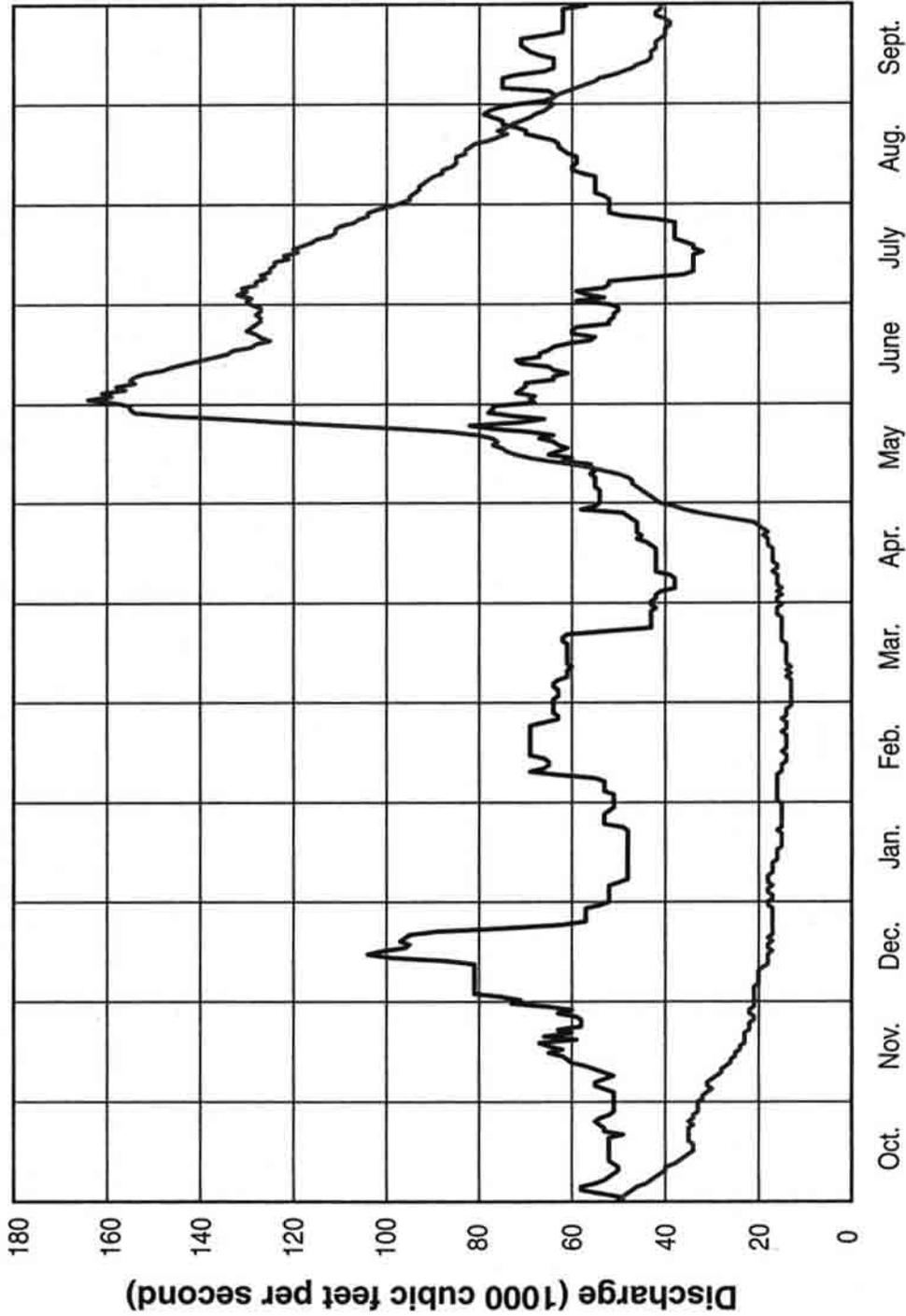
### Columbia River at Mica Dam



Hydrographs: Observed and pre-project flows for the year ending September 30, 2001



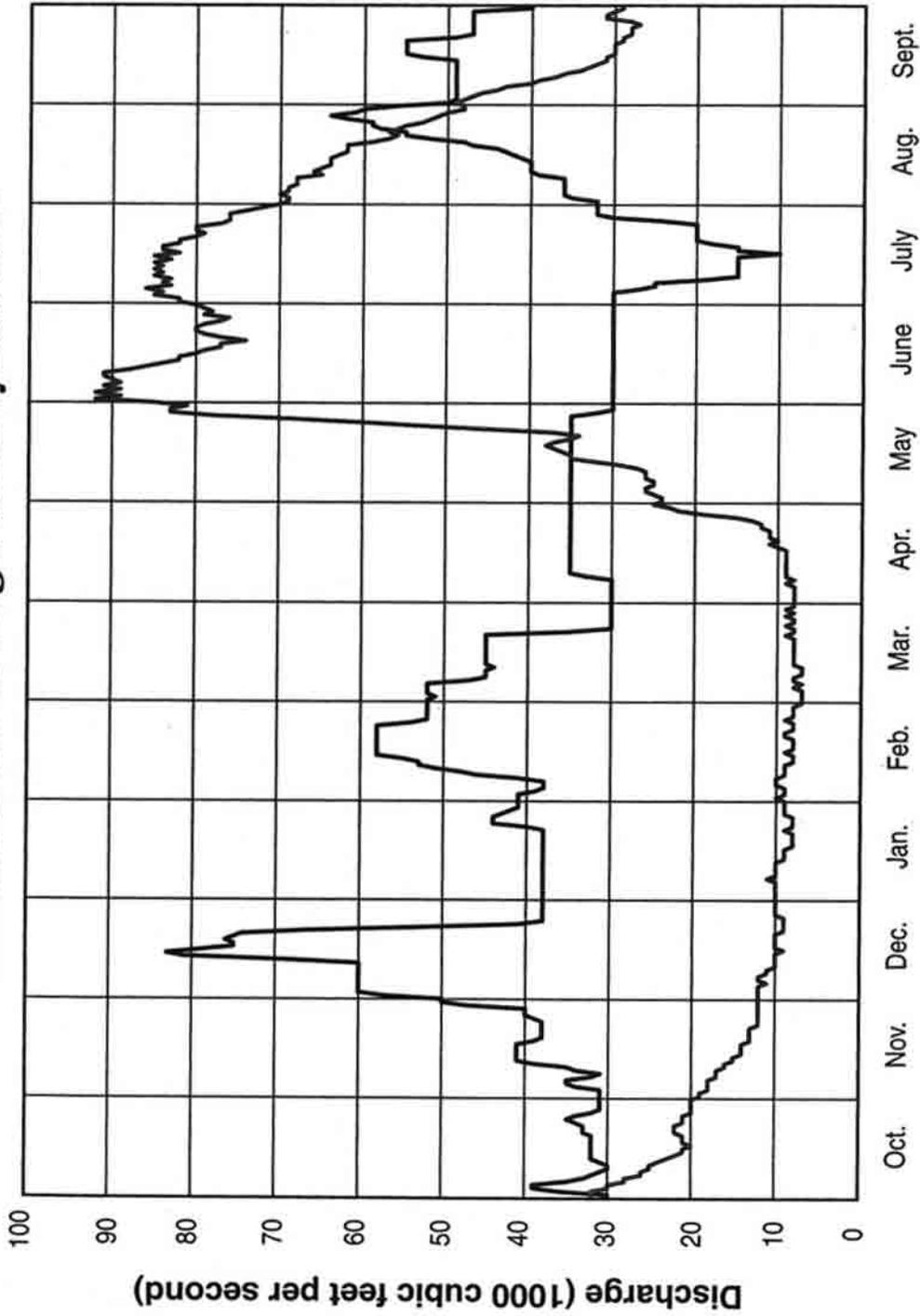
**Columbia River at Birchbank**



**Hydrographs: Observed and pre-project flows for the year ending September 30, 2001**



### Columbia River at Hugh Keenleyside Dam



Hydrographs: Observed and pre-project flows for the year ending September 30, 2001



## BENEFITS

### Flood Control Benefits

There was no Columbia River flooding during the 2000–2001 operating year. Operations for flood control were not a factor due to the near-record low runoff. The peak regulated flow and river stages are shown in the tables following.

#### Columbia River Streamflow at The Dalles, Oregon

Date	Peak Regulated Flow (cfs)	Date	Peak Unregulated Flow (cfs)
17 May 2001	169 400	30 May 2001	326 800

#### Columbia River Stage at Vancouver, Washington (flood stage = 16.0 ft)

Date	Peak Regulated Stage (ft)	Date	Peak Unregulated Stage (ft)
01 June 2001	5.5	31 May 2001	10.5

It is estimated that the Duncan and Libby projects reduced the peak stage on Kootenay Lake by about 3 ft. The Duncan, Arrow, Mica and Libby projects reduced the peak stage of the Columbia River at Trail, British Columbia, during June 2001 freshet flows by about 7.9 ft. It should be noted that both the regulated and unregulated peak stages at Kootenay Lake and Trail, British Columbia, were well below flood stages. The effect of storage in the Duncan, Arrow, Mica and Libby reservoirs on flows at the sites, and on flows of the Columbia River at Birchbank, is illustrated by the hydrographs on pages 36 to 40. These show the actual discharges and the flows that would have occurred if the dams had not been built. The hydrograph showing pre-project conditions for Birchbank has been computed on the assumption that the effects of Duncan, Arrow, Mica and Libby regulation, and of the regulation provided by the Corra Linn development on Kootenay Lake, have been removed.

### Power Benefits

Downstream power benefits in the United States, which arise from operation of the Canadian Treaty storage, were pre-determined for the first 30 years of operation of each project, and the Canadian share was sold in the United States under the terms of the Canadian Entitlement Purchase Agreement. The U.S. Entity delivers capacity and energy

to Columbia Storage Power Exchange participants, the purchasers of the Canadian entitlement. Canada retains the benefits of additional generation made possible on the Kootenay River in Canada as a result of regulation provided by Libby, as well as generation at the Mica and Revelstoke projects. The benefits from Libby regulation, which occur downstream in the United States, are not shared under the Treaty.

The Canadian Entitlement Purchase Agreement expires in stages over the period 1998 to 2003. The portion of Canada's share of downstream power benefits attributable to each of the Treaty projects is the ratio of each project's storage to the whole of Canadian Treaty storage. The table below summarizes Canada's share of the downstream power benefits from each project:

Treaty Storage	Date Returnable	Share of Canadian Entitlement (%)
Duncan	1 April 1998	9.0
Arrow	1 April 1999	45.8
Mica	1 April 2003	45.2

After 1 April 2003, Canada's share of downstream benefits is fully returnable.

During the operating year, 1 August 2000 through 31 July 2001, the entitlement to the downstream power benefits accruing to each country from the Treaty storage was determined, according to the procedures set out in the Treaty and Protocol, to be 508.4 average megawatts of energy and 1447.3 MW of capacity.

From 1 August 2000 through 31 July 2001, the U.S. Entity delivery of the Canadian Entitlement to downstream power benefits was 277.4 average megawatts of energy at rates up to 793.7 MW of capacity. The delivery from 1 August 2001 to 30 September 2001 was 292.1 average megawatts of energy at rates up to 783.0 MW of capacity.

The Agreement between the Entities, signed on 20 November 1996, sets out the details of delivery points and the reliability of delivery for the downstream power benefits returnable to Canada beginning 1 April 1998 and will be completed on 1 April 2003. Further, on 31 March 1999, a diplomatic exchange of notes adopted an agreement permitting disposal of the Canadian Entitlement directly in the United States. The exchange also designated the Province of British Columbia as a Canadian Entity.

In accordance with the Entity Agreements on the Determination of Downstream Power Benefits (DDPBs) for operating years 1999–2000 and 2000–2001, the Canadian Entity delivered to the U.S. Entity 0.4 average megawatts of annual energy and no dependable capacity during the period 1 August 1999 through 31 March 2000, and no energy nor capacity afterward.

### **Other Benefits**

By agreement between the Entities, streamflows are regulated for non-power purposes, such as accommodating construction in river channels and providing water to meet fish needs in both countries. These arrangements are implemented under the Detailed Operating Plan (DOP) and other agreements to provide mutual benefits.

## CONCLUSIONS

1. The Duncan, Arrow and Mica projects were operated in conformity with the Treaty during the 2000–2001 operating year. The operation reflected Detailed Operating Plans developed by the Entities, the flood control operating plan for Treaty reservoirs and other agreements between the Entities.
2. The reporting year was characterized by the extremely low runoff that occurred in the Columbia River Basin. Precipitation during the typically wettest part of the year (November through March) was only half of normal. The actual unregulated runoff during the August 2000 through July 2001 operating year at The Dalles was the lowest in the 1878–2001 historic record at 82.6 million acre-feet (Maf). For the 2000–2001 water year, the runoff at The Dalles, Oregon, was second lowest on record, at 79.3 Maf.
3. During the operating year, 1 August 2000 through 31 July 2001, the entitlement to the downstream power benefits accruing to each country from the Treaty storage were determined, according to the procedures set out in the Treaty and Protocol, to be 508.4 average megawatts of energy and 1447.3 MW of capacity.
4. From 1 August 2000 through 31 July 2001 the U.S. Entity delivery of the Canadian Entitlement to downstream power benefits was 277.4 average megawatts of energy at rates up to 793.7 MW of capacity.
5. The Columbia River Treaty Projects were not operated for flood control during this reporting year.
6. The Entities continued to operate the hydrometeorological network as required by the Treaty. The Permanent Engineering Board reviewed a proposal by the Entities to streamline the process of documenting the hydrometeorological system for the Columbia River Basin, and concluded that the proposed process was consistent with the Treaty. The Hydrometeorological Committee will publish future listings of the gage network according to this new procedure.
7. The 2005/2006 Assured Operating Plan/Determination of Downstream Power Benefits was signed in August 2001.
8. As reported in this document, the requirements of the Treaty have been satisfied.

**APPENDIX A**

**COLUMBIA RIVER TREATY  
PERMANENT ENGINEERING BOARD**

**COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD**

**United States**

Mr. Steven Stockton, Chair  
Director of Programs Management  
South Pacific Division  
U.S. Army Corps of Engineers  
San Francisco, California

Mr. Ronald Wilkerson  
Missoula, Montana

Mr. Earl Eiker (Nominee)  
Ellicott City, Maryland

Mr. George Bell  
Lake Oswego, Oregon

Mr. Robert Bank, P.E.  
Engineering and Construction Division  
HQ, U.S. Army Corps of Engineers  
Washington, D.C.

**Canada**

**Members**

Mr. Daniel Whelan, Chair  
Director General  
Energy Resources Branch  
Natural Resources Canada  
Ottawa, Ontario

Mr. Jack Ebbels  
Deputy Minister  
Ministry of Energy and Mines  
Victoria, British Columbia

**Alternates**

Mr. David Burpee  
Director, Renewable and Electrical Energy  
Division  
Energy Resources Branch  
Natural Resources Canada  
Ottawa, Ontario

Mr. James Mattison  
Director, Water Planning and Allocation  
Branch  
Ministry of Sustainable Resource  
Management  
Victoria, British Columbia

**Secretaries**

Mr. David Burpee  
Director, Renewable and Electrical Energy  
Division  
Energy Resources Branch  
Natural Resources Canada  
Ottawa, Ontario

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**COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD**
**Record of Membership****United States****Canada****Members**

Mr. Wendell Johnson <sup>1</sup>	1964–1970	Mr. Gordon McNabb <sup>1</sup>	1964–1991
Mr. Morgan Dubrow	1964–1970	Mr. Arthur Paget	1964–1973
Mr. John Neuberger	1970–1973	Mr. Valter Raudsepp	1973–1974
Mr. Joseph Caldwell <sup>1</sup>	1971–1973	Mr. Ben Marr	1974–1987
Mr. Homer Willis <sup>1</sup>	1973–1979	Mr. Tom Johnson	1987–1988
Mr. King Mallory	1973–1975	Mr. Douglas Horswill	1989–1991
Mr. Raymond Peck, Jr.	1976–1977	Mr. John Allan	1991–1999
Mr. Emerson Harper	1978–1988	Mr. David Oulton <sup>1</sup>	1991–1996
Mr. Lloyd Duscha <sup>1</sup>	1979–1990	Mr. Daniel Whelan <sup>1</sup>	1996–
Mr. Ronald Wilkerson	1988–	Mr. Charles Kang	1999–2001
Mr. Herbert Kennon <sup>1</sup>	1990–1994		
Mr. John Elmore <sup>1</sup>	1994–1996		
Mr. Steven Stockton <sup>1</sup>	1996–		

**Alternates**

Mr. Fred Thrall	1964–1974	Mr. Mac Clark	1964–1992
Mr. Emerson Harper	1964–1978	Mr. Jim Rothwell	1964–1965
Mr. Alex Shwaiko	1974–1987	Mr. Hugh Hunt	1966–1988
Mr. Herbert Kennon	1987–1990	Dr. Donald Kasianchuk	1988–1996
Mr. Thomas Weaver	1979–1997	Mr. Vic Niemela	1992–1994
Mr. John Elmore	1990–1994	Mr. David Burpee	1994–
Mr. Paul Barber	1994–1995	Mr. Jack Farrell	1996–1997
Mr. Daniel Burns	1995–1997	Mr. Prad Kharé	1997–1999
Mr. George Bell	1997–	Mr. James Mattison	1999–

**Secretaries**

Mr. John Roche	1965–1969	Mr. Mac Clark	1964–1992
Mr. Verle Farrow	1969–1972	Mr. David Burpee	1992–
Mr. Walter Duncan	1972–1978		
Mr. Shapur Zanganeh	1978–1995		
Mr. Richard DiBuono	1995–2000		
Mr. Robert Bank	2000–		

<sup>1</sup> Chair

**COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD  
ENGINEERING COMMITTEE**

**Current Membership**

**United States**

Mr. Robert Bank, P.E., Chair  
Engineering and Construction Division  
HQ, U.S. Army Corps of Engineers  
Washington, D.C.

Mr. Kamau Sadiki  
Water Management Division  
U.S. Army Corps of Engineers  
Northwestern Division  
Portland, Oregon

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

Mr. James Fodrea, P.E.  
U.S. Bureau of Reclamation  
Pacific Northwest Region  
Boise, Idaho

**Canada**

Mr. Roger McLaughlin, P.Eng., Chair  
Electricity Development Branch  
Ministry of Energy and Mines  
Victoria, British Columbia

Ms. Donna Clarke, P.Eng.  
Renewable and Electrical Energy Division  
Natural Resources Canada  
Ottawa, Ontario

Dr. Bala Balachandran, P.Eng.  
Water Management Branch  
Land and Water B.C., Inc.  
Victoria, British Columbia

## **APPENDIX B**

### **COLUMBIA RIVER TREATY ENTITIES**

## COLUMBIA RIVER TREATY ENTITIES

### United States

### Canada

#### Members

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

Mr. Larry Bell, Chair  
British Columbia Hydro and Power  
Authority  
Vancouver, British Columbia

BG David Fastabend  
Division Engineer  
U.S. Army Engineer Division,  
North Pacific  
Portland, Oregon

**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 2001

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	7.5	7.0	8.6	5.7	10.3	6.8	5.4	11.5	9.9	6.0	6.8	6.2
2	7.4	7.1	7.8	5.2	10.3	6.8	5.5	10.6	9.6	5.8	6.9	6.5
3	7.4	6.9	7.0	5.3	10.3	6.9	5.6	9.7	9.4	7.1	6.7	6.5
4	7.2	6.8	7.0	5.2	10.4	6.9	5.5	9.3	9.0	7.3	6.9	6.6
5	7.2	7.0	8.2	5.3	10.4	6.8	5.1	9.7	8.7	7.2	6.8	6.6
6	7.2	7.1	8.5	5.2	10.5	6.3	4.9	10.1	8.3	7.3	6.7	6.6
7	7.0	7.0	8.5	5.2	10.4	5.5	4.9	9.9	8.3	7.2	6.6	7.0
8	7.0	7.9	8.6	5.1	10.4	5.0	5.0	10.0	7.9	7.1	6.9	6.5
9	7.0	10.3	8.8	5.1	13.8	4.8	5.0	10.8	7.8	7.2	6.8	6.8
10	7.0	11.8	10.8	5.2	14.7	4.8	5.0	11.6	7.8	7.0	6.7	6.8
11	7.0	11.7	16.6	5.3	14.8	4.8	5.2	11.9	7.5	7.1	6.7	6.8
12	7.0	11.8	19.7	5.2	14.8	4.8	5.0	12.4	7.9	6.9	6.7	6.7
13	7.0	11.9	18.3	5.2	14.9	4.6	4.8	14.3	8.2	6.9	6.7	6.6
14	7.0	12.0	14.5	5.2	14.9	4.9	4.9	16.2	8.0	7.2	6.7	6.6
15	7.0	11.9	11.5	5.3	14.8	4.9	4.9	16.5	8.2	6.9	6.7	6.5
16	7.0	12.0	9.3	5.1	14.8	4.9	5.0	16.0	7.7	7.0	6.6	6.5
17	7.0	12.1	8.0	5.1	14.9	4.7	4.9	14.6	7.7	7.0	6.5	6.4
18	7.0	11.7	7.3	5.0	14.8	4.7	5.0	13.2	7.3	7.0	6.5	6.7
19	7.0	10.4	8.5	5.1	14.8	4.9	5.3	12.4	7.1	7.0	6.5	6.4
20	7.0	10.3	8.7	5.1	14.8	5.1	5.4	12.0	7.2	9.1	6.5	6.5
21	7.2	11.9	8.6	5.0	11.8	5.0	5.4	11.5	6.8	9.0	6.4	6.6
22	7.3	11.8	8.6	5.1	9.0	5.0	5.5	11.9	6.5	8.1	6.4	6.5
23	7.2	10.0	7.8	7.2	7.8	5.1	5.4	13.5	6.4	7.3	6.5	6.4
24	7.1	8.5	7.2	9.7	6.7	5.0	5.5	15.5	6.4	6.9	6.4	6.4
25	7.1	7.8	7.2	10.1	7.0	5.1	6.3	16.7	6.6	7.1	6.5	6.6
26	7.1	7.1	7.2	10.2	6.8	5.1	7.3	16.1	6.5	7.0	6.5	6.3
27	7.1	7.2	7.1	10.2	6.8	5.3	8.5	14.8	6.4	6.9	6.5	6.4
28	7.1	8.5	7.1	10.2	6.8	5.5	11.7	13.7	6.1	6.7	6.5	6.5
29	7.1	8.8	7.1	10.3	-	5.5	13.7	12.3	6.3	6.9	6.6	6.5
30	7.1	8.7	6.7	10.3	-	5.5	12.3	11.2	6.2	6.9	6.5	6.5
31	7.0	-	6.2	10.2	-	5.5	-	10.1	-	6.9	6.4	-
<b>Mean</b>	<b>7.1</b>	<b>9.5</b>	<b>9.2</b>	<b>6.5</b>	<b>11.5</b>	<b>5.4</b>	<b>6.1</b>	<b>12.6</b>	<b>7.6</b>	<b>7.1</b>	<b>6.6</b>	<b>6.5</b>

## Columbia River at Birchbank, British Columbia

Daily discharges (in thousands of cubic feet per second) for the year ending 30 September 2001

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	50.1	51.2	71.3	52.3	50.5	63.6	42.7	54.7	77.0	50.1	51.6	71.7
2	50.1	51.2	74.5	52.3	50.9	63.9	42.7	54.4	67.8	51.9	51.6	65.7
3	54.0	51.2	80.5	51.9	52.6	63.6	42.0	54.4	68.9	58.6	51.6	63.9
4	57.9	52.6	80.9	51.9	53.0	62.9	41.7	54.4	67.8	53.3	53.3	63.9
5	57.9	54.7	80.5	51.9	53.0	62.9	40.6	54.4	72.0	56.5	55.4	65.0
6	55.4	54.7	80.5	49.8	53.0	63.2	38.5	54.0	71.3	59.0	55.4	74.9
7	52.6	53.3	80.5	47.7	55.4	63.6	38.5	54.7	69.9	53.3	55.4	75.2
8	52.3	51.2	80.5	47.7	62.9	63.6	38.1	55.4	70.3	51.6	55.4	75.2
9	51.2	52.6	80.5	48.4	68.9	62.5	38.1	55.4	63.9	51.9	55.1	75.2
10	50.1	54.7	80.5	48.4	66.4	61.1	39.2	55.4	64.3	44.1	55.4	71.7
11	50.1	57.2	80.5	48.4	65.0	61.1	41.7	56.2	61.1	35.7	57.6	66.0
12	50.9	60.0	81.2	48.4	65.0	61.1	41.7	55.4	63.9	33.9	59.7	63.9
13	51.9	60.7	86.9	48.4	66.0	60.4	42.0	56.2	65.0	33.8	59.7	63.9
14	51.9	61.8	99.2	48.4	68.9	60.7	42.0	56.2	70.6	33.7	59.3	63.9
15	51.9	65.0	104.2	48.4	68.5	60.7	42.0	61.8	72.4	33.7	58.6	63.9
16	51.9	61.8	101.0	48.0	68.5	61.1	42.0	59.7	67.5	33.7	59.3	66.7
17	51.9	65.3	95.7	48.0	68.9	61.1	42.0	65.0	66.7	33.6	60.7	69.2
18	51.9	67.1	95.0	48.0	68.5	60.7	42.4	62.9	65.3	31.6	61.8	70.3
19	51.9	59.0	97.1	48.0	69.2	61.1	43.4	61.4	63.9	33.7	62.9	71.0
20	51.9	65.7	96.1	48.0	68.9	61.1	44.5	63.2	61.1	33.7	62.9	71.0
21	49.1	60.4	94.6	48.0	68.9	61.8	45.6	63.6	56.2	36.0	63.9	71.0
22	52.6	62.5	88.6	48.0	68.5	62.2	45.2	67.1	55.4	38.5	66.7	66.0
23	53.0	57.9	74.2	49.1	68.9	61.1	45.9	63.9	59.7	38.5	70.3	61.8
24	53.7	57.6	61.8	53.0	65.7	51.9	45.9	68.5	59.7	38.5	70.3	61.8
25	54.7	58.3	56.9	53.0	62.5	43.1	46.3	76.6	58.6	38.5	72.4	61.8
26	54.0	59.3	56.9	53.0	63.2	43.1	46.3	82.3	52.3	38.5	74.5	62.2
27	51.9	62.9	56.9	52.6	64.3	43.1	46.6	70.6	51.6	38.5	74.9	62.2
28	51.2	59.7	56.9	51.6	63.9	43.1	48.0	66.0	50.5	42.4	77.3	62.2
29	51.2	64.6	56.9	50.9	-	43.4	49.4	73.5	50.5	48.7	79.5	62.2
30	51.2	73.5	54.0	50.9	-	43.1	57.9	78.4	50.1	51.6	77.7	61.8
31	51.2	-	51.9	50.9	-	42.4	-	76.6	-	51.6	75.6	-
Mean	52.3	58.9	78.6	49.8	63.2	57.4	43.4	62.3	63.2	42.9	62.8	66.8

## APPENDIX D

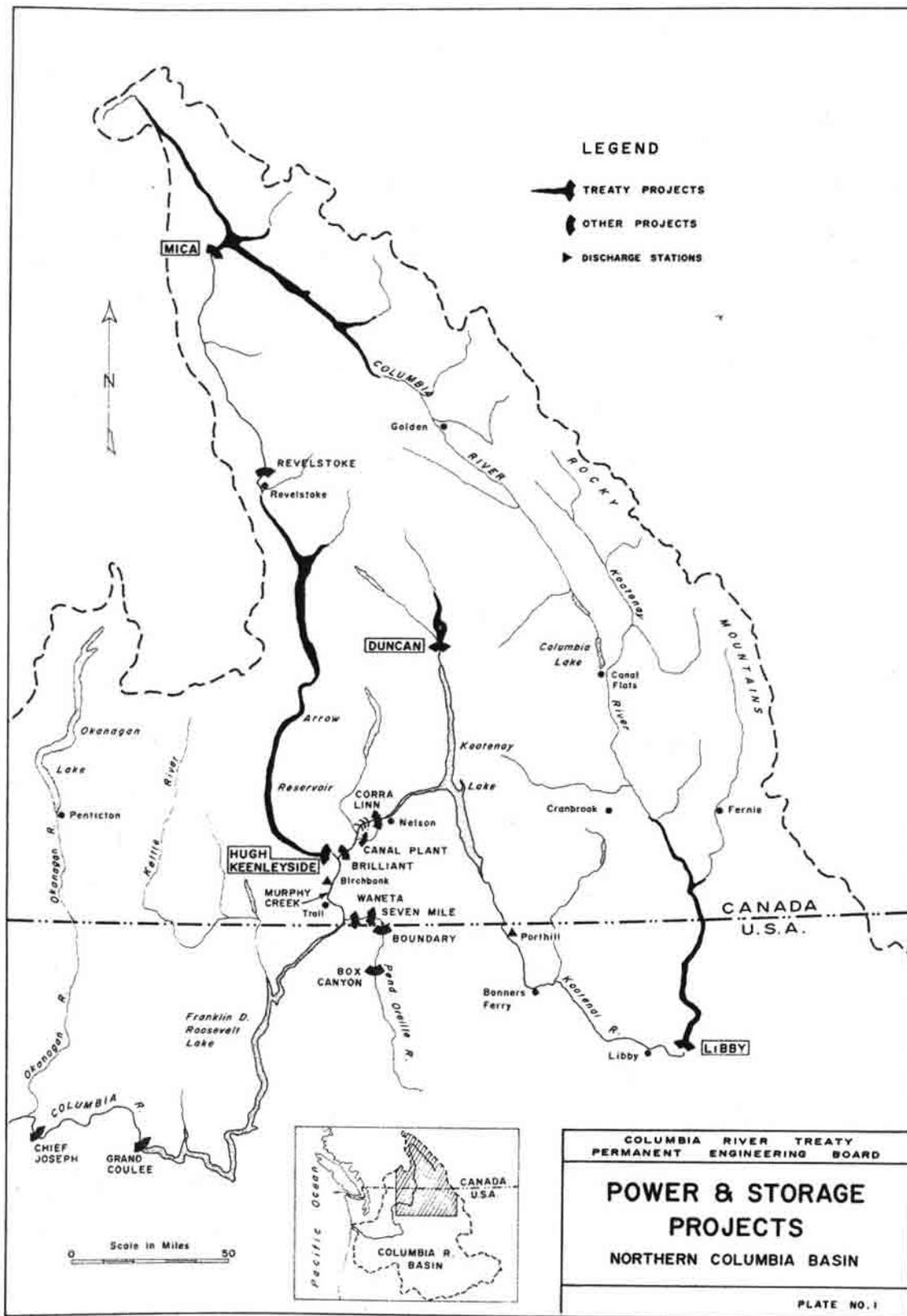
### PROJECT INFORMATION

Power and Storage Projects, Northern Columbia Basin

Plate No. 1

Project Data:

Duncan Project	Table 1
Arrow Project	Table 2
Mica Project	Table 3
Libby Project	Table 4



# POWER AND STORAGE PROJECTS

## Northern Columbia Basin

### 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	1892.0 ft
Normal minimum pool elevation	1794.2 ft
Surface area at full pool	18 000 acres
Total storage capacity	1 432 400 acre-feet
Usable storage capacity	1 400 000 acre-feet
Treaty storage commitment	1 400 000 acre-feet

#### Dam, Earthfill

Crest elevation	1907 ft
Length	2600 ft
Approximate height above riverbed	130 ft
Spillway – Maximum capacity	47 700 cfs
Discharge tunnels – Maximum capacity	20 000 cfs

#### 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	1444.0 ft
Normal minimum pool elevation	1377.9 ft
Surface area at full pool	130 000 acres
Total storage capacity	8 337 000 acre-feet
Usable storage capacity	7 100 000 acre-feet
Treaty storage commitment	7 100 000 acre-feet

**Dam, Concrete Gravity and Earthfill**

Crest elevation	1459 ft
Length	2850 ft
Approximate height above riverbed	170 ft
Spillway – Maximum capacity	240 000 cfs
Low-level outlets – Maximum capacity	132 000 cfs

**Power Facilities**

None

**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	2475 ft
Normal minimum pool elevation	2320 ft
Surface area at full pool	106 000 acres
Total storage capacity	20 000 000 acre-feet
Usable storage capacity	12 000 000 acre-feet
Treaty storage commitment	7 000 000 acre-feet

**Dam, Earthfill**

Crest Elevation	2500 ft
Length	2600 ft
Approximate height above foundation	800 ft
Spillway – Maximum capacity	150 000 cfs
Outlet works – Maximum capacity	37 400 cfs

**Power Facilities**

Designed ultimate installation – 6 units at 434 MW	2604 MW
Power commercially available	December 1976
Currently installed – 4 units at 434 MW	1736 MW
Head at full pool	600 ft
Maximum turbine discharge of 4 units at full pool	38 140 cfs

**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	2459 ft
Normal minimum pool elevation	2287 ft
Surface area at full pool	46 500 acres
Total storage capacity	5 869 000 acre-feet
Usable storage capacity	4 980 000 acre-feet

**Dam, Concrete Gravity**

Deck elevation	2472 ft
Length	3055 ft
Approximate height above riverbed	370 ft
Spillway – Maximum capacity	145 000 cfs
Low-level outlets – Maximum capacity	61 000 cfs

**Power Facilities**

Designed ultimate installation – 8 units at 105 MW	840 MW
Power commercially available	24 August 1975
Currently installed – 5 units at 105 MW	525 MW
Head at full pool	352 ft
Maximum turbine discharge – of 5 units at full pool	26 500 cfs