CANADA

THE COLUMBIA RIVER TREATY
PROTOCOL
AND
RELATED DOCUMENTS

ISSUED BY THE DEPARTMENTS OF
EXTERNAL AFFAIRS
AND
NORTHERN AFFAIRS AND NATIONAL RESOURCES

FEBRUARY 1964

48-205-174

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Price subject to change without notice

ROGER DUHAMEL, F.R.S.C.
Queen's Printer and Controller of Stationery
Ottawa, Canada
1964

PREFACE

The documents published herein relate to the co-operative development of the water resources of the Columbia River Basin pursuant to the Columbia River Treaty which was signed at Washington on 17 January 1961, and to the Protocol and Attachment Relating to Terms of Sale which were agreed to by Canada and the United States on 22 January 1964.

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TREATY BETWEEN THE UNITED STATES AND GREAT BRITAIN RELATING TO BOUNDARY WATERS, AND QUESTIONS ARISING BETWEEN THE UNITED STATES AND CANADA

The United States of America and His Majesty the King of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the Seas, Emperor of India, being equally desirous to prevent disputes regarding the use of boundary waters and to settle all questions which are now pending between the United States and the Dominion of Canada involving the rights, obligations, or interests of either in relation to the other or to the inhabitants of the other, along their common frontier, and to make provision for the adjustment and settlement of all such questions as may hereafter arise, have resolved to conclude a treaty in furtherance of these ends, and for that purpose have appointed as their respective plenipotentiaries:

The President of the United States of America, Elihu Root, Secretary of State of the United States; and

His Britannic Majesty, the Right Honourable James Bryce, O.M., his Ambassador Extraordinary and Plenipotentiary at Washington;

Who, after having communicated to one another their full powers, found in good and due form, have agreed upon the following articles:

PRELIMINARY ARTICLE

For the purposes of this treaty boundary waters are defined as the waters from main shore to main shore of the lakes and rivers and connecting waterways, or the portions thereof, along which the international boundary between the United States and the Dominion of Canada passes, including all bays, arms, and inlets thereof, but not including tributary waters which in their natural channels would flow into such lakes, rivers, and waterways, or waters flowing from such lakes, rivers, and waterways, or the waters of rivers flowing across the boundary.

ARTICLE I

The High Contracting Parties agree that the navigation of all navigable boundary waters shall forever continue free and open for the purposes of commerce to the inhabitants and to the ships, vessels, and boats of both countries equally, subject, however, to any laws and regulations of either country, within its own territory, not inconsistent with such privilege of free navigation and applying equally and without discrimination to the inhabitants, ships, vessels, and boats of both countries.

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It is further agreed that so long as this treaty shall remain in force, this same right of navigation shall extend to the waters of Lake Michigan and to all canals connecting boundary waters, and now existing or which may hereafter be constructed on either side of the line. Either of the High Contracting Parties may adopt rules and regulations governing the use of such canals within its own territory and may charge tolls for the use thereof, but all such rules and regulations and all tolls charged shall apply alike to the subjects or citizens of the High Contracting Parties and the ships, vessels, and boats of both of the High Contracting Parties, and they shall be placed on terms of equality in the use thereof.

ARTICLE II

Each of the High Contracting Parties reserves to itself or to the several State Governments on the one side and the Dominion or Provincial Governments on the other as the case may be, subject to any treaty provisions now existing with respect thereto, the exclusive jurisdiction and control over the use and diversion, whether temporary or permanent, of all waters on its own side of the line which in their natural channels would flow across the boundary or into boundary waters; but it is agreed that any interference with or diversion from their natural channel of such waters on either side of the boundary, resulting in any injury on the other side of the boundary, shall give rise to the same rights and entitle the injured parties to the same legal remedies as if such injury took place in the country where such diversion or interference occurs; but this provision shall not apply to cases already existing or to cases expressly covered by special agreement between the parties hereto.

It is understood, however, that neither of the High Contracting Parties intends by the foregoing provision to surrender any right, which it may have, to object to any interference with or diversions of waters on the other side of the boundary the effect of which would be productive of material injury to the navigation interests on its own side of the boundary.

ARTICLE III

It is agreed that, in addition to the uses, obstructions, and diversions heretofore permitted or hereafter provided for by special agreement between the Parties hereto, no further or other uses or obstructions or diversions, whether temporary or permanent, of boundary waters on either side of the line, affecting the natural level or flow of boundary waters on the other side of the line, shall be made except by authority of the United States or the Dominion of Canada within their respective jurisdictions and with the approval, as hereinafter provided, of a joint commission, to be known as the International Joint Commission.

The foregoing provisions are not intended to limit or interfere with the existing rights of the Government of the United States on the one

side and the Government of the Dominion of Canada on the other, to undertake and carry on governmental works in boundary waters for the deepening of channels, the construction of breakwaters, the improvement of harbours, and other governmental works for the benefit of commerce and navigation, provided that such works are wholly on its own side of the line and do not materially affect the level or flow of the boundary waters on the other, nor are such provisions intended to interfere with the ordinary use of such waters for domestic and sanitary purposes.

ARTICLE IV

The High Contracting Parties agree that, except in cases provided for by special agreement between them, they will not permit the construction or maintenance on their respective sides of the boundary of any remedial or protective works or any dams or other obstructions in waters flowing from boundary waters or in waters at a lower level than the boundary in rivers flowing across the boundary, the effect of which is to raise the natural level of waters on the other side of the boundary unless the construction or maintenance thereof is approved by the aforesaid International Joint Commission.

It is further agreed that the waters herein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other.

ARTICLE V

The High Contracting Parties agree that it is expedient to limit the diversion of waters from the Niagara River so that the level of Lake Erie and the flow of the stream shall not be appreciably affected. It is the desire of both Parties to accomplish this object with the least possible injury to investments which have already been made in the construction of power plants on the United States side of the river under grants of authority from the State of New York, and on the Canadian side of the river under licences authorized by the Dominion of Canada and the Province of Ontario.

So long as this treaty shall remain in force, no diversion of the waters of the Niagara River above the Falls from the natural course and stream thereof shall be permitted except for the purposes and to the extent hereinafter provided.

ARTICLE VI

The High Contracting Parties agree that the St. Mary and Milk Rivers and their tributaries (in the State of Montana and the Provinces of Alberta and Saskatchewan) are to be treated as one stream for the purposes of irrigation and power, and the waters thereof shall be

apportioned equally between the two countries, but in making such equal apportionment more than half may be taken from one river and less than half from the other by either country so as to afford a more beneficial use to each. It is further agreed that in the division of such waters during the irrigation season, between the 1st of April and 31st of October, inclusive, annually, the United States is entitled to a prior appropriation of 500 cubic feet per second of the waters of the Milk River, or so much of such amount as constitutes three-fourths of its natural flow, and that Canada is entitled to a prior appropriation of 500 cubic feet per second of the flow of St. Mary River, or so much of such amount as constitutes three-fourths of its natural flow.

The channel of the Milk River in Canada may be used at the convenience of the United States for the conveyance, while passing through Canadian territory, of waters diverted from the St. Mary River. The provisions of Article II of this treaty shall apply to any injury resulting to property in Canada from the conveyance of such waters through the Milk River.

The measurement and apportionment of the water to be used by each country shall from time to time be made jointly by the properly constituted reclamation officers of the United States and the properly constituted irrigation officers of His Majesty under the direction of the International Joint Commission.

ARTICLE VII

The High Contracting Parties agree to establish and maintain an International Joint Commission of the United States and Canada composed of six commissioners, three on the part of the United States appointed by the President thereof, and three on the part of the United Kingdom appointed by His Majesty on the recommendation of the Governor in Council of the Dominion of Canada.

ARTICLE VIII

This International Joint Commission shall have jurisdiction over and shall pass upon all cases involving the use or obstruction or diversion of the waters with respect to which under Articles III and IV of this Treaty the approval of this Commission is required, and in passing upon such cases the Commission shall be governed by the following rules or principles which are adopted by the High Contracting Parties for this purpose:

The High Contracting Parties shall have, each on its own side of the boundary, equal and similar rights in the use of the waters herein-before defined as boundary waters.

The following order of precedence shall be observed among the

various uses enumerated hereinafter for these waters, and no use shall be permitted which tends materially to conflict with or restrain any other use which is given preference over it in this order of precedence:

(1) Uses for domestic and sanitary purposes;

(2) Uses for navigation, including the service of canals for the purposes of navigation;

(3) Uses for power and for irrigation purposes.

The foregoing provisions shall not apply to or disturb any existing uses of boundary waters on either side of the boundary.

The requirement for an equal division may in the discretion of the Commission be suspended in cases of temporary diversions along boundary waters at points where such equal division can not be made advantageously on account of local conditions, and where such diversion does not diminish elsewhere the amount available for use on the other side.

The Commission in its discretion may make its approval in any case conditional upon the construction of remedial or protective works to compensate so far as possible for the particular use or diversion proposed, and in such cases may require that suitable and adequate provision, approved by the Commission, be made for the protection and indemnity against injury of any interests on either side of the boundary.

In cases involving the elevation of the natural level of waters on either side of the line as a result of the construction or maintenance on the other side of remedial or protective works or dams or other obstructions in boundary waters or in waters flowing therefrom or in waters below the boundary in rivers flowing across the boundary, the Commission shall require, as a condition of its approval thereof, that suitable and adequate provision, approved by it, be made for the protection and indemnity of all interests on the other side of the line which may be injured thereby.

The majority of the Commissioners shall have power to render a decision. In case the Commission is evenly divided upon any question or matter presented to it for decision, separate reports shall be made by the Commissioners on each side to their own Government. The High Contracting Parties shall thereupon endeavour to agree upon an adjustment of the question or matter of difference, and if an agreement is reached between them, it shall be reduced to writing in the form of a protocol, and shall be communicated to the Commissioners, who shall take such further proceedings as may be necessary to carry out such agreement.

ARTICLE IX

The High Contracting Parties further agree that any other questions or matters of difference arising between them involving the rights, obligations, or interests of either in relation to the other or to the inhabitants of the other, along the common frontier between the United States and the Dominion of Canada, shall be referred from time to time to the International Joint Commission for examination and report, whenever either the Government of the United States or the Government of the Dominion of Canada shall request that such questions or matters of difference be so referred.

The International Joint Commission is authorized in each case so referred to examine into and report upon the facts and circumstances of the particular questions and matters referred, together with such conclusions and recommendations as may be appropriate, subject, however, to any restrictions or exceptions which may be imposed with respect thereto by the terms of the reference.

Such reports of the Commission shall not be regarded as decisions of the questions or matters so submitted either on the facts or the law, and shall in no way have the character of an arbitral award.

The Commission shall make a joint report to both Governments in all cases in which all or a majority of the Commissioners agree, and in case of disagreement the minority may make a joint report to both Governments, or separate reports to their respective Governments.

In case the Commission is evenly divided upon any question or matter referred to it for report, separate reports shall be made by the Commissioners on each side to their own Government.

ARTICLE X

Any questions or matters of difference arising between the High Contracting Parties involving the rights, obligations, or interests of the United States or of the Dominion of Canada either in relation to each other or to their respective inhabitants, may be referred for decision to the International Joint Commission by the consent of the two Parties, it being understood that on the part of the United States any such action will be by and with the advice and consent of the Senate, and on the part of His Majesty's Government with the consent of the Governor General in Council. In each case so referred, the said Commission is authorized to examine into and report upon the facts and circumstances of the particular questions and matters referred, together with such conclusions and recommendations as may be appropriate, subject, however, to any restrictions or exceptions which may be imposed with respect thereto by the terms of the reference.

A majority of the said Commission shall have power to render a decision or finding upon any of the questions or matters so referred.

If the said Commission is equally divided or otherwise unable to render a decision or finding as to any questions or matters so referred, it shall be the duty of the Commissioners to make a joint report to both Governments, or separate reports to their respective Governments, showing the different conclusions arrived at with regard to the matters or questions so referred, which questions or matters shall thereupon be referred for decision by the High Contracting Parties to an umpire chosen in accordance with the procedure prescribed in the fourth, fifth, and sixth paragraphs of Article XLV of the Hague Convention for the pacific settlement of international disputes, dated October 18, 1907. Such umpire shall have power to render a final decision with respect to those matters and questions so referred on which the Commission failed to agree.

ARTICLE XI

A duplicate original of all decisions rendered and joint reports made by the Commission shall be transmitted to and filed with the Secretary of State of the United States and the Governor General of the Dominion of Canada, and to them shall be addressed all communications of the Commission.

ARTICLE XII

The International Joint Commission shall meet and organize at Washington promptly after the members thereof are appointed, and when organized the Commission may fix such times and places for its meetings as may be necessary, subject at all times to special call or direction by the two Governments. Each Commissioner upon the first joint meeting of the Commission after his appointment, shall, before proceeding with the work of the Commission, make and subscribe a solemn declaration in writing that he will faithfully and impartially perform the duties imposed upon him under this treaty, and such declaration shall be entered on the records of the proceedings of the Commission.

The United States and Canadian sections of the Commission may each appoint a secretary, and these shall act as joint secretaries of the Commission at its joint sessions, and the Commission may employ engineers and clerical assistants from time to time as it may deem advisable. The salaries and personal expenses of the Commission and of the secretaries shall be paid by their respective Governments, and all reasonable and necessary joint expenses of the Commission, incurred by it, shall be paid in equal moieties by the High Contracting Parties.

The Commission shall have power to administer oaths to witnesses, and to take evidence on oath whenever deemed necessary in

any proceeding, or inquiry, or matter within its jurisdiction under this treaty, and all parties interested therein shall be given convenient opportunity to be heard, and the High Contracting Parties agree to adopt such legislation as may be appropriate and necessary to give the Commission the powers above mentioned on each side of the boundary, and to provide for the issue of subpœnas and for compelling the attendance of witnesses in proceedings before the Commission. The Commission may adopt such rules of procedure as shall be in accordance with justice and equity, and may make such examination in person and through agents or employees as may be deemed advisable.

ARTICLE XIII

In all cases where special agreements between the High Contracting Parties hereto are referred to in the foregoing articles, such agreements are understood and intended to include not only direct agreements between the High Contracting Parties, but also any mutual arrangement between the United States and the Dominion of Canada expressed by concurrent or reciprocal legislation on the part of Congress and the Parliament of the Dominion.

ARTICLE XIV

The present treaty shall be ratified by the President of the United States of America, by and with the advice and consent of the Senate thereof, and by His Britannic Majesty. The ratifications shall be exchanged at Washington as soon as possible and the treaty shall take effect on the date of the exchange of its ratifications. It shall remain in force for five years, dating from the day of exchange of ratifications, and thereafter until terminated by twelve months' written notice given by either High Contracting Party to the other.

In faith whereof the respective plenipotentiaries have signed this treaty in duplicate and have hereunto affixed their seals.

Done at Washington the 11th day of January, in the year of our Lord one thousand nine hundred and nine.

(Signed) Elihu Root (SEAL)

(Signed) James Bryce (SEAL)

PROTOCOL OF EXCHANGE

On proceeding to the exchange of the ratifications of the treaty signed at Washington on January 11, 1909, between the United States and Great Britain, relating to boundary waters and questions arising along the boundary between the United States and the Dominion of Canada, the undersigned plenipotentiaries, duly authorized thereto by their respective Governments, hereby declare that nothing in this treaty shall be construed as affecting, or changing, any existing territorial, or riparian rights in the water, or rights of the owners of lands under water, on either side of the international boundary at the rapids of the St. Mary's River at Sault Ste. Marie, in the use of the waters flowing over such lands, subject to the requirements of navigation in boundary waters and of navigation canals, and without prejudice to the existing right of the United States and Canada, each to use the waters of the St. Mary's River, within its own territory; and further, that nothing in this treaty shall be construed to interfere with the drainage of wet, swamp, and overflowed lands into streams flowing into boundary waters, and also that this declaration shall be deemed to have equal force and effect as the treaty itself and to form an integral part thereto.

The exchange of ratifications then took place in the usual form.

In witness whereof, they have signed the present Protocol of Exchange and have affixed their seals thereto.

Done at Washington this 5th day of May, one thousand nine hundred and ten.

Philander C Knox (SEAL)

James Bryce (SEAL)

PROCLAMATION AT WASHINGTON, D.C.

AND WHEREAS the Senate of the United States by their resolution of March 3, 1909, (two-thirds of the Senators present concurring therein) did advise and consent to the ratification of the said Treaty with the following understanding, to wit:

"Resolved further, as a part of this ratification, That the United States approves this treaty with the understanding that nothing in this treaty shall be construed as affecting, or changing, any existing territorial or riparian rights in the water, or rights of the owners of lands under water, on either side of the international boundary at the rapids of the St. Mary's river at Sault Ste. Marie, in the use of the waters flowing over such lands, subject to the requirements of navigation in boundary waters and of navigation canals, and without prejudice to the existing right of the United States and Canada, each to use the waters of the St. Mary's river, within its own territory, and further, that nothing in this

treaty shall be construed to interfere with the drainage of wet, swamp and overflowed lands into streams flowing into boundary waters, and that this interpretation will be mentioned in the ratification of this treaty as conveying the true meaning of the treaty, and will, in effect, form part of the treaty;"

AND WHEREAS the said understanding has been accepted by the Government of Great Britain, and the ratifications of the two Governments of the said treaty were exchanged in the City of Washington, on the 5th day of May, one thousand nine hundred and ten;

Now, THEREFORE, be it known that I, William Howard Taft, President of the United States of America, have caused the said treaty and the said understanding, as forming a part thereof, to be made public, to the end that the same and every article and clause thereof may be observed and fulfilled with good faith by the United States and the citizens thereof.

In testimony whereof, I have hereunto set my hand and caused the seal of the United States to be affixed.

Done at the City of Washington this thirteenth day of May in the year of our Lord one thousand nine hundred and ten,
(SEAL) and of the Independence of the United States of America the one hundred and thirty-fourth.

Wm H Taft

By the President:

P C Knox
Secretary of State.

REFERENCE FROM THE CANADIAN AND UNITED STATES GOVERNMENTS TO THE INTERNATIONAL JOINT COMMISSION
(Canadian Note)

Ottawa, 9 March 1944.

Sir:

I have the honour to inform you that in order to determine whether a greater use than is now being made of the waters of the Columbia River System would be feasible and advantageous, the Governments of the United States and Canada have agreed to refer the matter to the International Joint Commission for investigation and report pursuant to Article IX of the Convention concerning Boundary Waters between the United States and Canada, signed 11 January 1909.

2. It is desired that the Commission shall determine whether in its judgment further development of the water resources of the river basin would be practicable and in the public interest from the points of view of the two Governments, having in mind (A) domestic water supply and sanitation, (B) navigation, (C) efficient development of water power, (D) the control of floods, (E) the needs of irrigation, (F) reclamation of wet lands, (G) conservation of fish and wildlife, and (H) other beneficial public purposes.

3. In the event that the Commission should find that further works or projects would be feasible and desirable for one or more of the purposes indicated above, it should indicate how the interests on either side of the boundary would be benefited or adversely affected thereby, and should estimate the costs of such works or projects, including indemnification for damage to public and private property and the costs of any remedial works that may be found to be necessary, and should indicate how the costs of any projects and the amounts of any resulting damage be apportioned between the two Governments.

4. The Commission should also investigate and report on existing dams, hydro-electric plants, navigation works, and other works or projects located within the Columbia River system in so far as such investigation and report may be germane to the subject under consideration.

5. In the conduct of its investigation and otherwise in the performance of its duties under this reference, the Commission may utilize the services of engineers and other specially qualified personnel of the technical agencies of Canada and the United States and will so far as possible make use of information and technical data heretofore acquired by such technical agencies or which may become available during the course of the investigation, thus avoiding duplication of effort and unnecessary expense.

I have the honour to be,
Sir,
Your obedient servant,

(Sgd) W.L. Mackenzie King
Secretary of State for
External Affairs

The Secretary,
The International Joint Commission,
Ottawa.

Abstract of Report to the International Joint Commission
on
WATER RESOURCES of the COLUMBIA RIVER BASIN[1]

This Abstract provides, in summary form, the more important facts presented in the Report, together with the text of the conclusions reached by the Engineering Board.

PURPOSE AND SCOPE OF REPORT

Under the terms of the Columbia River Reference of 9 March 1944, the International Joint Commission was directed to investigate and report on the possibilities of cooperative development by Canada and the United States of the water resources of the Columbia Basin. The reference is as follows:

> "1. In order to determine whether a greater use than is now being made of the waters of the Columbia River system would be feasible and advantageous, the Governments of the United States and Canada have agreed to refer the matter to the International Joint Commission for investigation and report pursuant to Article IX of the Convention concerning boundary waters between the United States and Canada, signed 11 January 1909.
>
> "2. It is desired that the Commission shall determine whether in its judgment further development of the water resources of the river basin would be practicable and in the public interest from the points of view of the two Governments, having in mind (A) domestic water supply and sanitation, (B) navigation, (C) efficient development of water power, (D) the control of floods, (E) the needs of irrigation, (F) reclamation of wet lands, (G) conservation of fish and wildlife, and (H) other beneficial public purposes.
>
> "3. In the event that the Commission should find that further works or projects would be feasible and desirable for one or more of the purposes indicated above, it should indicate how the interests on either side of the boundary would be benefited or adversely affected thereby, and should estimate the costs of such works or projects, including indemnification for damage to public and private property and the costs of any remedial works that may be found to be necessary, and should indicate how the costs of any projects and the amounts of any resulting damage be apportioned between the two Governments.

1. Prepared by International Columbia River Engineering Board, 1959.

"4. The Commission should also investigate and report on existing dams, hydro-electric plants, navigation works, and other works or projects located within the Columbia River system insofar as such investigation and report may be germane to the subject under consideration.

"5. In the conduct of its investigation and otherwise in the performance of its duties under this reference, the Commission may utilize the services of engineers and other specially qualified personnel of the technical agencies of Canada and the United States and will so far as possible make use of information and technical data heretofore acquired by such technical agencies or which may become available during the course of the investigation, thus avoiding duplication of effort and unnecessary expense."

The Report, "Water Resources of the Columbia River Basin" submitted to the Commission in March 1959 by the International Columbia River Engineering Board, presents alternative plans of water resource development for the information of the Commission.

These plans were designed with the primary objective of producing the maximum feasible hydro-electric development of the Basin and therefore the individual projects were studied as integral parts of a unified power system. The Report shows that other types of water resource development, particularly for flood control, could also be served by the same system of projects with minor modification where required.

The submission of the Report in March 1959 completed the preliminary stage of the Columbia River Investigation. The Report is an engineering appraisal of the possibilities of full cooperative development; it is not in any sense a proposal or a specific recommendation.

Although the scope of the Report is basin-wide, it treats principally the larger developments of international significance on the main stem and major tributaries. Elements of the plans are covered in some detail with physical description, cost estimates and discussion of beneficial and adverse effects. These elements, together with others which were considered but found less desirable for inclusion in a plan of development, receive full coverage in the appendices of the Report.

Investigations supporting the Report are comprehensive in nature. Cost estimates in most cases are preliminary, but they are adequate for comparative project or system justification. In accordance with instructions from the International Joint Commission, no attempt is made to apportion costs and benefits or indemnification for damages for specific projects between the two countries. However, facts and conclusions are presented which may serve as bases for recommendations to the two Governments.

DESCRIPTION OF THE BASIN

The portion of the basin considered in detail consists of the main stem of the Columbia River and the major international tributaries. The Columbia River and its tributaries drain an area of 259,000 square miles, mostly between the Rocky Mountains and Cascade Range. The basin extends 270 miles north into Canada and 550 miles south into the United States. The maximum width is about 730 miles.

The Canadian portion of the basin, 39,500 square miles, is in the southeasterly part of British Columbia; the United States portion, 219,500 square miles, includes most of Idaho, Oregon and Washington, all of Montana west of the Continental Divide, and small areas of Nevada, Utah and Wyoming.

The Columbia River rises in Columbia Lake in the Rocky Mountain Trench and flows a distance of 480 miles in British Columbia before crossing the international boundary into the northeast corner of the State of Washington. In the United States the river flows southerly through the central part of Washington to its junction with the Snake River, then turns and flows westerly and northwesterly to the Pacific Ocean, a total distance of 1,225 miles from its source in Columbia Lake. The total fall of the river from its source to the ocean is 2,655 feet.

The Kootenay River rises southeast of Golden, British Columbia, and flows southerly, passing within a mile of Columbia Lake at Canal Flats, British Columbia. About 45 miles south of the international boundary the river turns in a wide semicircle, re-enters Canada, and flows northerly into Kootenay Lake. From the outlet of the lake, the river flows westerly to join the Columbia about 29 miles north of the boundary. The total length of the Kootenay River is 464 miles.

The Clark Fork has its source near Butte, Montana, and flows northwesterly 490 miles to its junction with the Columbia just upstream from the international boundary. It is joined by the Flathead River, its principal tributary, at mile 245, and enters Pend Oreille Lake at mile 139. From Pend Oreille Lake to the Columbia, the stream name is Pend Oreille River. The river crosses the international boundary into Canada 16 miles upstream from its mouth.

The Okanagan River has its source in Okanagan Lake and flows south for 32 miles, passing through Skaha and Vaseaux Lakes to enter Osoyoos Lake, which straddles the international boundary. It then flows southerly 73 miles to its confluence with the Columbia near Brewster, Washington. The Similkameen River, which is larger than the Okanagan River and tributary to it at Oroville, Washington, rises in Canada and crosses the international boundary near Nighthawk, Washington.

ECONOMIC DEVELOPMENT

Economic development has taken place at different rates in the Canadian and United States parts of the Columbia River basin. A concentration of primary activities has resulted in the Canadian part of the basin, contrasted with a much more diversified economic structure in the United States portion, where secondary activities are of much greater importance. The economic activities of the two parts of the basin are in no way integrated or complementary. Rather, they are competitive—both in domestic and foreign markets.

WATER RESOURCES OF THE BASIN

The Columbia River is one of the great rivers of the continent, with length and average volume of runoff exceeded only by the Mississippi, MacKenzie, and St. Lawrence Rivers. Collection of basic hydrologic data has been carried on for many years in the basin, and the streamflow patterns have been fairly well defined for the main stem and principal tributaries. For the smaller tributaries data are sparse, and runoff patterns are not well defined.

The drainage basin of the Columbia River embraces many climatic conditions, which results in a wide variation of runoff from the different parts of the basin. In parts of the Columbia Plateau runoff occurs only during those years of heavy precipitation; it is nonexistent during an average or below-average year. On the other hand, annual runoff may exceed 50 to 60 inches in many of the mountainous parts of the basin. This is especially true of those streams draining the upper slopes of the Cascade, Bitterroot, Selkirk, and Rocky Mountains. These large streams are of primary importance, and in general are the ones studied in detail for this report. The distribution of runoff from the major sub-basins is shown in the table on the following page.

Three notable features concerning the runoff of the basin follow: 30.0 per cent of the runoff comes from the area tributary to the Columbia River upstream from Trail, representing 13.0 per cent of the drainage area; 46.7 per cent comes from the area between Trail and the Cascade Range, representing 79.7 per cent of the drainage area; and 23.3 per cent comes from the area west of the Cascades, comprising only 7.3 per cent of the drainage area.

The runoff in the western part of the basin, particularly west of the Cascade Mountains, has a pattern which includes high runoff during the winter months of November through February, caused primarily by rain. A gradual recession follows until the snow starts melting in April and May, which produces a runoff volume somewhat smaller than that which occurs during the winter period. After late June, the streamflow generally recedes to a minimum in the early fall, after which it again increases as a result of fall rains. The streams east of the Cascades

Distribution of Runoff

Basin	Drainage Area, Square Miles	Average Annual Runoff		
		Million Acre-Feet[1]	Per cent of Total	Inches
Main Stem above Pend Oreille River excluding the Kootenay River	14,500	33	18.3	42.8
Kootenay River basin	19,200	21	11.7	20.4
Clark Fork-Pend Oreille basin	26,000	19	10.6	13.7
Main stem and tributaries from international boundary to Snake River	43,300	19	10.6	8.2
Snake River basin	109,000	37	20.5	6.4
Main stem and tributaries between Snake River and Cascade Range (Bonneville Dam)	28,000	9	5.0	6.0
Main stem and tributaries west of Cascade Range	19,000	42	23.3	41.4
Basin Total	259,000	180	100.0	13.0

1. Based upon estimated 50-year averages by Corps of Engineers.

have a different seasonal runoff pattern. The high-water period occurs in the spring and early summer as a result of melting of snow that accumulates during the winter period. From 70 to 90 per cent of the total annual runoff takes place during the five-month period of April through August. Peak flows occur normally during May or June, followed by an almost unbroken recession until February or March of the following year. Minor variations due to fall rains occur frequently but, in general, this does not have a pronounced effect on the shape of the annual hydrograph.

The annual spring runoff of streams east of the Cascades may be wide-spread and accumulate as a damaging flood on the lower reaches of the Columbia River. The volume and peak of this spring runoff is dependent upon local weather conditions during the spring months as well as upon the amounts and distribution of accumulated snow and ice on the various watersheds. Streams draining the southerly sections of the basin normally start rising earlier in the spring than do those tributaries from the higher, more northerly sections. Therefore, there is usually a difference of about two weeks between the time of peak stages on the

Snake River, and those on the Kootenay River and on the Columbia River in Canada. The spring flood on the main stem has a broad crest often with minor peaks due to local weather conditions. Exceptions to the typical runoff pattern are found on such tributaries as the Yakima and Spokane Rivers. In these basins, winter rainstorms together with unseasonably high temperatures create floods in the winter or early spring months. These floods are localized and have little effect on the main stem of the Columbia River.

The largest known flood of general occurrence in the Columbia River basin was that of June 1894. It was severe on most of the streams upstream from the Dalles, Oregon, with the exception of those tributaries draining the eastern slopes of the Cascades. The flood resulted from rapid melting of an above-normal snow pack that had accumulated during the preceding winter. Maximum discharge of the Columbia River was estimated at 680,000 cubic feet per second at the international boundary and 1,240,000 cubic feet per second at The Dalles. The peak stage at The Dalles was 34 feet above extreme low water and 26.6 feet above the stage at mean annual flow.

PRESENT AND PROSPECTIVE USES OF WATER RESOURCES

Use and development of the water resources of the basin have been a significant influence on its economic development. Large and complex projects have been constructed to utilize the vast water resources of the basin. The rapidly expanding population and industrial growth currently taking place in the Pacific Northwest is creating a need for large blocks of electrical power, more protection of life and property from floods, additional irrigated lands, improved water transportation and the development of other water uses. These are compelling reasons why additional developments in the Columbia River basin should be planned and designed for the optimum use of the water resources.

Optimum use of the water resources requires facilities to store excess runoff during the spring and early summer for flood control and for release during the remainder of the year for irrigation and power production. The release of stored water for power increases minimum channel depths for navigation, improves industrial and municipal water supplies, aids in pollution abatement, and adds fishery and recreation benefits.

In the United States, utilization of the water resources of the Columbia River is extensive, whereas this is true of only a few areas in Canada. Current uses of the water resources are mainly those related to the development of hydro-electric power, irrigation, navigation, and the control of floods.

Power

During the period July 1956 through June 1957, hydro-electric

power plants within the Columbia River basin produced approximately 43 billion kilowatt hours of electric energy. This was composed of 40.3 billion kilowatt hours produced in the United States portion of the basin and 2.7 billion kilowatt hours in the Canadian portion of the basin and did not include some of the minor resources which were used specifically for a local need, such as irrigation pumping. Approximately two-thirds of the total power of the principal Northwest utilities was generated by facilities of the United States Columbia River basin power system.

Many of the early power developments were small plants on tributary streams which were frequently run-of-river plants with little or no storage capacity. Most of the recent developments have been on the main stem and major tributaries in the Columbia River basin. Large blocks of upstream storage are required for maximum utility for this type of development. So far, only 13.3 million acre-feet of storage capacity is available for the use of power plants on the main stem. Potential reservoir sites are being considered which could increase this storage capacity to about 50 million acre-feet.

The present program of construction of power projects is notable for the absence of any major storage project. Despite favorable engineering and economic factors at several proposed storage sites in the United States part of the basin, construction has been either held up or postponed due to conflicts of interest. There are a number of favorable sites in British Columbia which could provide much of the storage required for optimum utilization of the water of the basin. Many of these sites could be developed with only minor conflicts. They would produce large benefits to both the United States and Canada. Development of these Canadian storage sites would enhance the value of both present and future developments in the United States. The flow regulation by storage projects, whether in Canada or the United States, would permit a much greater power output than is possible at the present time. This flow regulation is essential to the full development of the power potential of the basin.

Irrigation

In the area upstream from the Methow River, irrigation is an important development. The combined areas in Canada and the United States for different levels of development are tabulated below:

	Estimated irrigated area 1,000 acres		
	1928	1960	2010
Canada	139.4	139.4	538.5
United States above Methow River	349.6	813.0	1,947.2
Total	489.0	952.4	2,485.7

The amounts of additional streamflow depletions that will be required for irrigation are relatively small in proportion to the average flow in the Columbia River. Thus, although large blocks of land may be developed for irrigation in the area above the Methow River, the effect of this development will not be a limiting factor for other water resource developments. In many areas return flow actually increases the water available during the fall and winter months, with diversions having been made during times of high flow.

Flood Control

The early basin-wide floods caused comparatively little damage because the economic development was small at the time of occurrence. However, as economic development in the basin has advanced and large areas of flood plain have become occupied, potential damages which would result from basin-wide floods have increased correspondingly. Floods of the magnitude of those of 1876 and 1894 would cause enormous damage at the present time.

The area of greatest flood damage in the Columbia River basin is along the Columbia River below The Dalles, Oregon. Most damage occurs immediately above and below the metropolitan and port facilities of Portland, Oregon; Vancouver, Washington; and some of the associated smaller towns and villages. In this area, 308 miles of levees have been constructed, partially protecting about 100,000 acres of suburban and agricultural lands. This levee system is effective in controlling medium-sized floods; however, in order to control major floods, upstream storage is a basic requirement.

In the upper portion of the Columbia River basin the following areas are subject to major flood threats: the Kootenay Valley between Bonners Ferry and Kootenay Lake; the Okanagan Valley from Okanagan Lake to the mouth of the Okanagan River; the Columbia River between Athalmer and Donald and at Revelstoke and Trail, British Columbia.

It has been estimated by the Corps of Engineers that between 18 and 21 million acre-feet of usable storage capacity, depending upon location and including existing storage of about 8,000,000 acre-feet, would be required to control a flood of 1894 proportions to 800,000 cubic feet per second at The Dalles, Oregon, and eliminate all major damage in the lower river.

Navigation

In the United States at the present time the main stem of the Columbia River and the lower portions of the Snake River are the only areas in which navigation is a major consideration.

In Canada, navigation on Arrow, Kootenay, Slocan, and Okanagan Lakes is important locally. The main traffic consists of log booms and ore shipments on Arrow Lakes, ore shipments on Kootenay and

Slocan Lakes, and fruit transfer by car barge on Okanagan Lake. In addition, ferries are an integral part of the highway system.

COMPREHENSIVE DEVELOPMENT

The water resources of the Columbia River basin can be developed for a variety of purposes. Maximum utilization of these resources can be achieved only by implementation of a comprehensive plan of development covering all parts of the basin. Such a plan should reconcile - as far as possible - competing and alternative uses. A key requirement would be the provision of the maximum practical amount of upstream storage. With resulting relatively complete flow regulation, increased power output and flood control would be provided and water supplies for most of the other uses would be assured. The plans presented in the report have been formulated mainly on physical and economic factors related to hydro-electric power development.

PLANS OF DEVELOPMENT

The original purpose of this report was to present from an international viewpoint the best over-all plan of development, with possible alternatives, for maximum practicable utilization of the water resources of the Columbia River basin. However, the studies which have been carried out indicate that each of three plans achieves about the same degree of water resource development, particularly with respect to hydro-electric power. The various plans studied and set forth herein are based principally on engineering and economic considerations; they take no cognizance of the international boundary. Studies of each plan assume the existence of the complete system, and the conclusions as to the performance of each plan do not necessarily apply to partial or incomplete development. Timing of construction of the elements of the plans is not considered, but its importance is acknowledged. The criterion of adopting the lowest-cost potential developments has been followed wherever possible; however, in a few cases non-technical considerations (such as conflict with other resource uses) have resulted in elimination of the lowest-cost projects and have caused substitution of alternative projects to fill out a given plan.

The largest and most valuable tangible use of the water resources of the basin, either existing or in the foreseeable future, is for hydro-electric power production. Therefore, the full development of the hydro-electric power potential has been a primary goal. Such development would require a series of dams utilizing as much of the potential head as possible on the main stem and major tributaries. Where topography is favorable, some of these dams would provide reservoirs for storing water during the high-flow period that could not be used by the downstream installations and would otherwise be wasted. This stored water would be available for release at times when it could be utilized. Moreover, because the season of high flows in the main part of the Columbia

Basin is generally limited to the months of May, June, and July, storage space for flood control could be made available in most reservoirs during those months without any significant conflict with use for power. In addition, these reservoirs could provide storage, if needed, for water supply, navigation, irrigation, pollution abatement, and other conservation purposes.

From the foregoing, it is evident that if the goal of maximum hydro-electric power development can be attained, flood control will be assured, and it should be possible to develop all other water uses. Therefore, attainment of this goal was the basis for the selection of the plans of development.

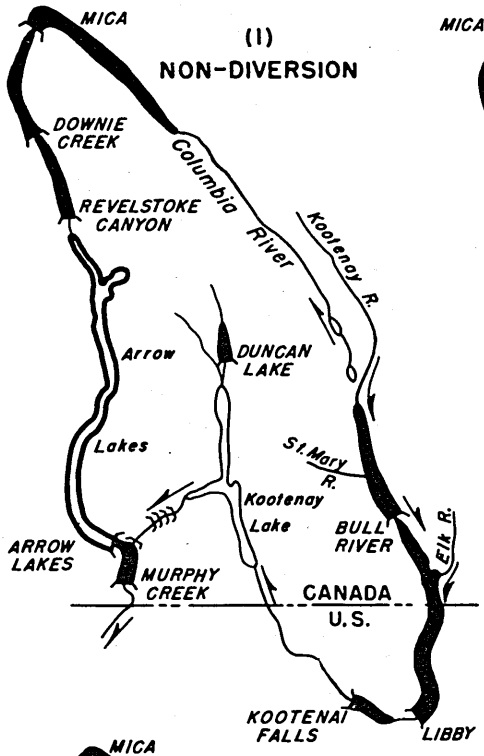
The following sketch map shows the location of the elements and direction of water movement for the portion of each plan where they differ. Table 20 (taken from the report) shows the elements selected for each of the three plans. One of these includes no diversion, while the other two include diversion of the Kootenay River to the Columbia River, one at Copper Creek about 12 miles south of Columbia Lake, and the other at Dorr about 10 miles north of the international boundary. These plans are designated: (1) Non-Diversion, (2) Copper Creek Diversion, and (3) Dorr Diversion. The Copper Creek and Dorr Diversion plans would divert an annual average of about 3,600 and 8,000 cubic feet per second (2.6 and 5.8 million acre-feet), respectively, into the Columbia River from the Kootenay River.

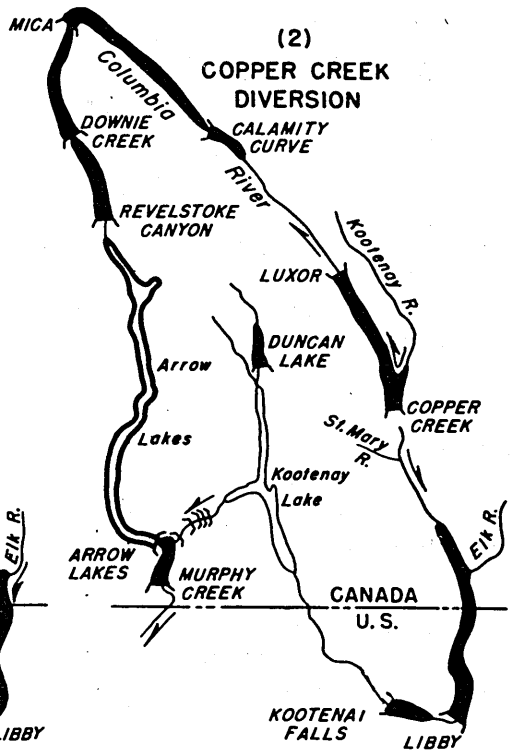
Monthly power studies were carried out for the 20-year period July 1928 through June 1948 to meet estimated 1985 power loads with a minimum of thermal generating capacity. The 1985 load forecasted for the Pacific Northwest in the United States, averaging 22,750,000 kilowatts, was increased by an average load of 5,000,000 kilowatts for the Canadian portion of the basin to obtain the estimated international load used in the studies – 27,750,000 kilowatts.

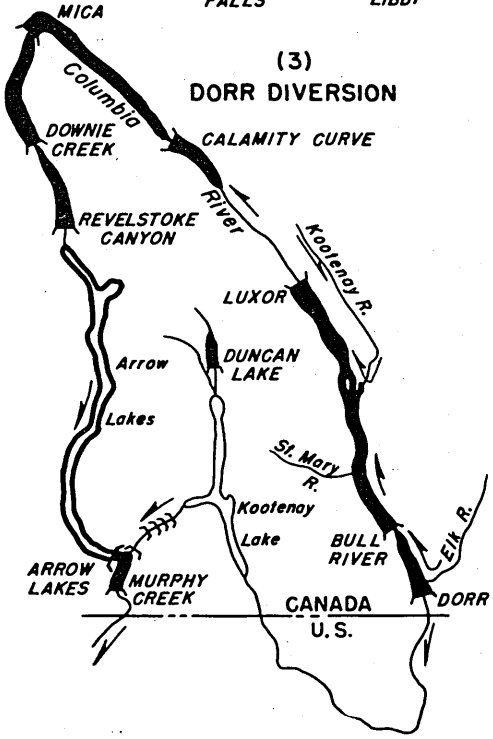
The systems of reservoirs and hydro-electric installations in the plans of development, which are designed for coordinated operation, would make as full utilization of available water resources as can now be envisioned. The output from the hydro-electric power installations under such operations would meet about 60 per cent of the net power requirement for 1985. The storage projects would provide flood control on the main stem of the Columbia River and on those tributaries on which storage projects are located. Other incidental purposes such as irrigation, water supply, pollution abatement, and navigation would be served also. To complement the main stem and major tributaries for comprehensive development, sub-basin plans will be needed for the tributaries (such as the Willamette River). These sub-basin plans would have but minor effect on the major over-all plans.

Although elements of the plans of development have been selected, it must be recognized that future studies may indicate that new sites or alternative methods of developing stretches of the main stem and major

PLANS OF DEVELOPMENT







Notes:

The plans downstream from Murphy Creek are identical.

In alternative plans Arrow Lakes project is eliminated.

tributaries are advantageous. For example, since completion of the power studies for the report, the Corps of Engineers has considered the development of the Knowles project in lieu of Buffalo Rapids No. 4 and Smoky Range projects on the Flathead River. Similarly, alternative developments for Hells Canyon, Pleasant Valley, and Mountain Sheep projects on the Snake River are under consideration. Such substitutions would have no significant effect on the power outputs of the plans of development.

The following tables (Tables 22 and 23 of the report) show the at-site average critical period (August 1928 through March 1932) and twenty-year power outputs for each element in the plans. Projects with no at-site power, such as Duncan Lake and Arrow Lakes, are not shown.

Investment and annual costs of elements in the international plans of development are shown in Tables 24 and 25 (taken from the report) for "High Arrow" and "Low Arrow" developments, respectively. Annual costs are made up of interest and amortization of the investment cost at 3 per cent interest for 50 years, plus operation and maintenance cost, plus an allowance for interim replacement of those items having a life of less than 50 years. Individual element costs are given for all projects excepting those on the Snake River and Pend Oreille Rivers and on the Columbia River below Murphy Creek. Costs for these latter elements, including those for additional installations at existing developments, are combined under "all other projects" in these tables.

Table 20

Elements of Selected Plans of Development

Non-Diversion	Copper Creek Diversion	Dorr Diversion
Bull River	--	DORR (POWER)
LIBBY	LIBBY	--
KOOTENAI FALLS	KOOTENAI FALLS	--
LONG MEADOWS	LONG MEADOWS	LONG MEADOWS
DUNCAN LAKE	DUNCAN LAKE	DUNCAN LAKE
Kootenay River Plants	Kootenay River Plants	Kootenay River Plants
--	--	DORR (PUMPING)
--	COPPER CREEK-LUXOR	BULL RIVER-LUXOR
--	CALAMITY CURVE	CALAMITY CURVE
MICA	MICA	MICA
DOWNIE CREEK	DOWNIE CREEK	DOWNIE CREEK
REVELSTOKE CANYON	REVELSTOKE CANYON	REVELSTOKE CANYON
ARROW LAKES[1]	ARROW LAKES[1]	ARROW LAKES[1]
MURPHY CREEK[1]	MURPHY CREEK[1]	MURPHY CREEK[1]
SPRUCE PARK	SPRUCE PARK	SPRUCE PARK
Hungry Horse	- - Same as for Non-Diversion Plan - -	- - Same as for Non-Diversion Plan - -
SMOKY RANGE[2]		
Kerr		
BUFFALO RAPIDS No. 4[2]		
NINEMILE PRAIRIE		
QUARTZ CREEK		
Thompson Falls		
Noxon Rapids		
Cabinet Gorge		
Albeni Falls		
Box Canyon		
BOUNDARY		
SEVEN MILE		
Waneta		
ENAVILLE		
Coeur d'Alene Lake		
Grand Coulee		
Chief Joseph		
WELLS		
Chelan		
Rocky Reach		
Rock Island		
WANAPUM		
Priest Rapids		
Brownlee		
Oxbow		
HELLS CANYON[2]		
PLEASANT VALLEY[2]		
MOUNTAIN SHEEP[2]		
CHINA GARDENS		
WENAHA		
ASOTIN		
PENNY CLIFFS		
BRUCES EDDY		
LOWER GRANITE		
LITTLE GOOSE		
LOWER MONUMENTAL		
Ice Harbor		
McNary		
John Day		
The Dalles		
Bonneville		

1. Alternative combinations of Arrow Lakes and Murphy Creek projects are provided for each plan. The 'Low Arrow' storage of 3,100,000 acre-feet is provided by a dam at Murphy Creek and channel improvement between Upper and Lower Arrow Lakes. The 'High Arrow' storage of nearly 8,000,000 acre-feet would be provided by two dams, one at Murphy Creek and one at the outlet of Lower Arrow Lake.
2. Alternative projects are under investigation by United States agencies.

Note: Existing developments in lower case and potential projects in capitals.

Table 22

Plans of Development - Average Critical Period Power Outputs

Project or Development	Average Output in Megawatts for 44-Month Critical Period			
	Non-Diversion 'High Arrow'	Copper Cr. Div. 'High Arrow'	Dorr Diversion	
			'High Arrow'	'Low Arrow'
SPRUCE PARK	33.3	33.2	33.2	33.2
Hungry Horse	109.8	111.5	111.5	109.3
SMOKY RANGE	53.1	52.0	52.0	51.1
Kerr	129.5	129.4	129.5	129.6
BUFFALO RAPIDS No. 4	111.6	114.2	114.2	114.2
NINEMILE PRAIRIE	18.9	18.9	18.9	18.9
QUARTZ CREEK	33.9	34.1	34.1	34.1
Thompson Falls	39.8	39.7	39.7	39.7
Noxon Rapids	177.5	179.1	179.4	179.8
Cabinet Gorge	129.7	129.7	129.7	129.7
Albeni Falls	30.1	32.1	32.4	32.5
Box Canyon and BOUNDARY	409.1	409.3	409.1	409.1
SEVEN MILE and Waneta	581.8	582.6	581.8	582.2
Sub-total - Pend Oreille	1,858.1	1,865.8	1,865.5	1,863.4
BULL RIVER	63.1	-	-	-
DORR (PUMPING)	-	-	(-38.5)	(-38.5)
DORR (POWER)	-	-	8.0	8.0
LIBBY	233.8	146.6	-	-
KOOTENAI FALLS	121.2	82.2	-	-
LONG MEADOWS	5.4	5.2	5.2	5.2
Kootenay River Plants	479.0	430.3	265.5	265.5
BULL RIVER-LUXOR	-	-	30.0	28.4
COPPER CREEK-LUXOR	-	19.8	-	-
CALAMITY CURVE	-	69.6	107.1	107.0
MICA	746.4	882.6	1,092.9	1,081.7
DOWNIE CREEK	481.3	541.0	630.8	630.5
REVELSTOKE CANYON	338.8	377.5	434.7	434.6
Sub-total - Kootenay - Columbia	2,469.0	2,554.8	2,535.7	2,522.4
Brownlee	197.9	197.2	199.2	194.6
Oxbow and HELLS CANYON	279.9	279.8	279.8	279.8
PLEASANT VALLEY	334.7	332.7	332.7	332.7
MOUNTAIN SHEEP	148.5	148.3	148.3	148.3
CHINA GARDENS	128.2	128.5	128.5	128.6
WENAHA	75.7	77.6	77.5	73.7
ASOTIN	158.3	158.7	158.8	158.7
PENNY CLIFFS	174.4	173.0	172.9	169.2
BRUCES EDDY	129.5	129.7	129.7	128.3
LOWER GRANITE	219.5	219.4	219.4	219.3
LITTLE GOOSE	235.5	235.7	235.6	235.6
LOWER MONUMENTAL	216.5	216.5	216.5	216.5
Ice Harbor	223.5	223.4	223.4	223.4
Sub-total - Snake	2,522.1	2,520.5	2,522.3	2,508.7
MURPHY CREEK	204.6	227.4	223.3	208.7
ENAVILLE	20.2	20.3	20.3	20.3
Grand Coulee	2,148.4	2,140.9	2,131.4	2,085.4
Chief Joseph	1,119.7	1,118.4	1,113.1	1,091.0
WELLS	404.7	404.0	402.4	395.8
Chelan	38.2	39.7	39.7	39.8
Rocky Reach	616.6	615.6	613.0	601.6
Rock Island	230.2	231.4	231.5	230.2
WANAPUM	509.0	508.6	506.3	497.6
Priest Rapids	535.3	535.0	532.6	523.2
McNary	710.8	709.8	707.5	697.3
John Day	982.0	980.8	977.1	963.5
The Dalles	846.4	845.2	842.0	831.0
Bonneville	578.1	577.5	575.7	568.9
Sub-total - Columbia	8,944.2	8,954.6	8,915.9	8,754.3
Downstream effect Duncan Lake additional 400,000 acre-feet	+13.1	+13.1	-	-
TOTAL	15,806.5	15,908.8	15,839.4	15,648.8
Storage Used in Acre-feet	51,244,000	50,725,000	49,282,000	44,383,000

Note: Existing developments in lower case and potential projects in capitals.

Table 23

Plans of Development - Average Twenty-Year Power Outputs

Project or Development	Average Output in Megawatts for 239-Month Period			
	Non-Diversion 'High Arrow'	Copper Cr. Div. 'High Arrow'	Dorr Diversion	
			'High Arrow'	'Low Arrow'
SPRUCE PARK	33.5	33.5	33.5	33.4
Hungry Horse	117.1	114.8	116.2	113.6
SMOKY RANGE	55.1	53.7	54.8	54.5
Kerr	126.5	125.9	127.1	128.5
BUFFALO RAPIDS No. 4	115.4	116.0	116.6	117.0
NINEMILE PRAIRIE	19.1	18.8	19.2	19.1
QUARTZ CREEK	38.7	38.9	38.7	38.7
Thompson Falls	38.7	39.4	39.2	39.5
Noxon Rapids	178.3	180.3	181.5	183.0
Cabinet Gorge	138.4	139.1	139.6	140.4
Albeni Falls	30.1	30.9	31.3	31.8
Box Canyon and BOUNDARY	452.7	454.1	451.7	454.1
SEVEN MILE and Waneta	592.1	596.3	590.4	597.5
Sub-total - Pend Oreille	1,935.7	1,941.7	1,939.8	1,951.1
BULL RIVER	67.0	-	-	-
DORR (PUMPING)	-	-	(-43.1)	(-43.1)
DORR (POWER)	-	-	8.1	8.1
LIBBY	229.9	147.9	-	-
KOOTENAI FALLS	121.8	89.5	-	-
LONG MEADOWS	6.3	6.1	6.3	6.3
Kootenay River Plants	481.1	450.2	273.3	272.9
BULL RIVER-LUXOR	-	-	31.4	31.1
COPPER CREEK-LUXOR	-	22.0	-	-
CALAMITY CURVE	-	72.3	111.7	111.6
MICA	731.0	852.4	1,049.3	1,048.2
DOWNIE CREEK	460.6	514.4	602.0	606.5
REVELSTOKE CANYON	328.0	363.2	418.9	422.3
Sub-total - Kootenay - Columbia	2,425.7	2,518.0	2,457.9	2,463.9
Brownlee	236.1	239.4	240.7	235.1
Oxbow and HELLS CANYON	314.3	314.3	314.7	315.6
PLEASANT VALLEY	377.0	377.7	376.7	377.9
MOUNTAIN SHEEP	168.1	167.8	168.3	168.7
CHINA GARDENS	148.5	148.2	149.0	149.7
WENAHA	90.7	91.6	90.6	89.7
ASOTIN	179.8	180.0	181.2	181.9
PENNY CLIFFS	193.9	190.3	191.1	189.6
BRUCES EDDY	152.8	153.3	153.1	152.3
LOWER GRANITE	248.7	249.3	251.4	251.3
LITTLE GOOSE	265.0	265.8	268.0	268.0
LOWER MONUMENTAL	253.1	253.1	255.1	255.1
Ice Harbor	259.5	259.4	261.7	261.5
Sub-total - Snake	2,887.5	2,890.2	2,901.6	2,896.4
MURPHY CREEK	218.1	248.8	247.0	233.7
ENAVILLE	24.6	24.8	25.0	25.0
Grand Coulee	2,292.8	2,288.5	2,276.3	2,218.5
Chief Joseph	1,146.8	1,146.6	1,140.6	1,111.7
WELLS	420.2	419.9	418.3	409.3
Chelan	42.2	42.8	42.2	42.5
Rocky Reach	630.6	630.1	627.1	611.6
Rock Island	225.2	226.0	225.5	223.3
WANAPUM	519.4	518.7	516.1	503.8
Priest Rapids	547.7	547.0	544.3	531.6
McNary	785.3	783.8	782.6	769.7
John Day	1,062.0	1,061.7	1,060.5	1,041.4
The Dalles	927.5	927.4	926.6	911.3
Bonneville	622.5	622.1	621.9	612.0
Sub-total - Columbia	9,464.9	9,488.2	9,454.0	9,245.4
Downstream effect Duncan Lake additional 400,000 acre-feet	+19.0	+25.0	-	-
TOTAL	16,732.8	16,863.1	16,753.3	16,556.8
Storage Used in Acre-feet	51,244,000	50,725,000	49,282,000	44,383,000

Note: Existing developments in lower case and potential projects in capitals.

Table 24

Project Costs, High Arrow

Project or Development	Investment Cost $1,000[1]			Annual Cost $1,000[2]		
	Non-Diversion Plan	Copper Cr. Diversion Plan	Dorr Diversion Plan	Non-Diversion Plan	Copper Cr. Diversion Plan	Dorr Diversion Plan
Bull River	83,600	-	-	3,740	-	-
Dorr[3]	-	-	35,900	-	-	2,030
Libby	324,800	312,800	-	13,740	13,170	-
Kootenai Falls	98,000	92,500	-	4,450	4,150	-
Long Meadows	26,900	26,900	26,900	1,340	1,340	1,340
Duncan Lake	24,800	24,800	24,800	1,100	1,100	1,100
Kootenay River Plants	40,800	40,800	2,400	2,140	2,140	180
Bull River-Luxor	-	-	110,000	-	-	4,830
Copper Creek-Luxor	-	54,400	-	-	2,490	-
Calamity Curve	-	33,000	38,200	-	1,650	1,960
Mica	302,400	314,800	327,200	13,400	14,070	14,740
Downie Creek	123,500	138,900	146,600	6,070	6,860	7,260
Revelstoke Canyon	104,400	116,900	123,200	5,280	5,960	6,300
Arrow Lakes	66,400	66,400	66,400	3,010	3,010	3,010
Murphy Creek	94,900	94,900	94,900	4,990	4,990	4,990
Sub-total	1,290,500	1,317,100	996,500	59,260	60,930	47,740
All other projects[4]	2,563,300	2,563,300	2,563,300	117,450	117,450	117,450
TOTAL	3,853,800	3,880,400	3,559,800	176,710	178,380	165,190

Table 25

Project Costs, Low Arrow

Bull River	83,600	-	-	3,740	-	-
Dorr[3]	-	-	35,900	-	-	2,030
Libby	324,800	312,800	-	13,740	13,170	-
Kootenai Falls	98,000	92,500	-	4,450	4,150	-
Long Meadows	26,900	26,900	26,900	1,340	1,340	1,340
Duncan Lake	24,800	24,800	24,800	1,100	1,100	1,100
Kootenay River Plants	40,800	40,800	2,400	2,140	2,140	180
Bull River-Luxor	-	-	110,000	-	-	4,830
Copper Creek-Luxor	-	54,400	-	-	2,490	-
Calamity Curve	-	33,000	38,200	-	1,650	1,960
Mica	302,400	314,800	327,200	13,400	14,070	14,740
Downie Creek	123,500	138,900	146,600	6,070	6,860	7,260
Revelstoke Canyon	104,400	116,900	123,200	5,280	5,960	6,300
Arrow Lakes	-	-	-	-	-	-
Murphy Creek	103,500	103,500	103,500	5,350	5,350	5,350
Sub-total	1,232,700	1,259,300	938,700	56,610	58,280	45,090
All other projects[4]	2,563,300	2,563,300	2,563,300	117,450	117,450	117,450
TOTAL	3,796,000	3,822,600	3,502,000	174,060	175,730	162,540

1. Investment cost includes all construction costs plus interest at 3 per cent for one-half the construction period.
2. Annual cost includes interim replacement, operation and maintenance costs and interest at 3 per cent during 50-year amortization period.
3. Includes cost of pumping.
4. Includes cost of additional installations at existing developments. See Table 20 for complete list of elements.

Power Outputs from the Plans

The total estimated power outputs that would be produced by each of the plans of development, including existing developments, are shown in the following tabulation:

Plan	Storage Used (1,000 acre-feet)	Average Output - Megawatts	
		Critical Period	20-year Period
"High Arrow"[1]			
Non-Diversion	51,244	15,807	16,733
Copper Creek Diversion	50,725	15,909	16,863
Dorr Diversion	49,282	15,839	16,753
"Low Arrow"[2]			
Non-Diversion	46,345	15,616	16,536
Copper Creek Diversion	45,826	15,718	16,667
Dorr Diversion	44,383	15,649	16,557

1. "High Arrow" - Usable storage of 7,999,000 acre-feet developed by two dams, one at Murphy Creek and one at the outlet of Lower Arrow Lake.
2. "Low Arrow" - Usable storage of 3,100,000 acre-feet developed by a dam at Murphy Creek and channel improvement between the Arrow Lakes.

The Copper Creek Diversion plan shows the greatest over-all power potential; its average annual estimated output is about 130 megawatts greater than that of the Non-Diversion plan and about 110 megawatts greater than that of the Dorr Diversion plan.

The Copper Creek Diversion plan would provide the greatest total increase over present hydro-power output of any of the plans. The Non-Diversion plan would have the greatest increase in the United States and the least in Canada. The Dorr Diversion plan would have the least increase in the United States and the greatest in Canada. The differences in average output between the plans and the differences in increases in one country or the other depend upon the extent of diversion of Kootenay River water to the Columbia River in the several plans. The Copper Creek Diversion plan allows the fullest resource development of all, because in this plan the Calamity Curve project becomes justified economically, yet the Libby and Kootenai Falls projects remain feasible.

The location of storage projects is particularly important not only on engineering grounds but because there are two national jurisdictions in the basin. Although the amount of storage in Arrow Lakes does not

affect the economic justification of any project, it is important because virtually all of the benefits resulting from the storage occur in the United States.

Flood Control

The greatest need for flood control in the basin is along the main stem of the Columbia River downstream from The Dalles, Oregon. Any of the plans could control the equivalent of the 1894 flood to a discharge of less than 600,000 second-feet at The Dalles, and could practically eliminate flood damages along the lower river. All plans are considered to solve equally the major flood problems of the basin.

Each of four projects in the plans would provide more than 4,000,000 acre-feet of storage usable for controlling a major flood at The Dalles. These are the Mica, Libby, "High Arrow", and the Dorr-Bull River-Luxor projects. Libby and the Dorr-Bull River-Luxor projects are alternatives. Mica would provide the most storage usable for flood control at The Dalles, about 7,700,000 acre-feet; Libby would provide up to 5,000,000 acre-feet, depending upon the amount of upstream storage; and either "High Arrow" or Dorr-Bull River-Luxor would provide about 4,900,000 acre-feet. Of storage in the four projects, an acre-foot in "High Arrow" would be the most effective in controlling floods at The Dalles, because there is the least natural storage between these two locations. Storage projects on the Kootenay River would be particularly valuable, because they would provide large local, as well as downstream, flood-control benefits, and might allow additional economic reclamation of lands in the Kootenay Valley in both the United States and Canada.

Other Water Uses

The three plans contain about equal amounts of storage, and would provide relatively complete regulation of the main stem and principal tributaries for power and flood-control purposes. No regulation was provided specifically for any other water use; however it is likely that water for nearly all other uses could be supplied by projects in any of the plans with a minimum of modification. As irrigation is the major consumptive use, adjusted river flows allowing for estimated irrigation development in 1985 were used in the power studies to ensure that the selected power installation and output would be appropriate. Benefits and costs of other water-use developments associated with projects common to the plans would probably be the same for all plans, though the inclusion or exclusion of individual projects according to the several plans might influence local water-use developments. For the purposes of this report, it was unnecessary to consider the development of water uses other than for power and flood control, and for water requirements for irrigation. Detailed study of any plan would require investigation of potential benefits and associated costs for irrigation and other uses.

Costs

For comparative purposes the investment and annual costs (July 1957 price levels) of the additional development (exclusive of transmission cost) for each of the plans are shown in the following tabulation:

	Costs	
	Investment	Annual
"High Arrow"		
Non-Diversion	$3,853,800,000	$176,710,000
Copper Creek Diversion	3,880,400,000	178,380,000
Dorr Diversion	3,559,800,000	165,190,000
"Low Arrow"		
Non-Diversion	3,796,000,000	174,060,000
Copper Creek Diversion	3,822,600,000	175,730,000
Dorr Diversion	3,502,000,000	162,540,000

Investment costs of the Copper Creek Diversion and the Non-Diversion plans are, respectively, about 9 and 8 per cent greater than the cost of the Dorr Diversion plan; and the respective corresponding annual costs are 8 and 7 per cent greater. Although the Copper Creek Diversion plan has the greatest cost, the cost of adding the Copper Creek-Luxor and Calamity Curve projects and additional installation at plants downstream on the Columbia River in Canada to the Non-Diversion plan is nearly balanced by the elimination of the Bull River project and the reduction of installed capacity at the Libby project. The estimated cost of the Dorr Diversion plan is lower than that of the other plans primarily because elimination of the relatively high cost Libby and Kootenai Falls projects far outweighs the cost of the Dorr-Bull River-Luxor diversion project and related costs at downstream plants on the Columbia River in Canada. The inclusion of "High Arrow" in any of the plans increases the total investment costs by about 1.5 per cent, or $57,800,000.

CONCLUSIONS

The Report concludes that:

(a) Further development of the water resources of the Columbia River basin is practicable and in the public interest from the points of view of the two Governments.

(b) In the three important fields of water power, flood control, and irrigation, greater use of the waters of the Columbia River system can be made possible by cooperative development of certain water resources in each country.

(c) In irrigation, cooperative development would be feasible and advantageous in the Okanogan-Similkameen Sub-basin. The two plans for

cooperative development in this area would provide for flood control and power production as well as for irrigation.

(d) At present there is no urgent need for cooperative development in reclamation of wet lands and no reason for cooperative development in the fields of domestic water supply and sanitation, navigation, or conservation of fish and wildlife.

(e) The largest and most valuable benefit to be obtained from water resources developments in the Columbia River basin is the production of hydro-electric power. Further, power benefits in both countries can be materially increased by cooperative development and operation of storage and power projects to conform to a plan of basin development.

(f) It is physically and economically feasible to develop a system of power plants that will produce an average of more than 16 million kilowatts utilizing about 50,000,000 acre-feet of storage.

(g) A system of projects constructed and operated in accordance with a plan of basin development could provide substantial flood control for the lower Columbia River without significant loss of power generation.

(h) In the United States, continuing economic development in the Columbia River basin and in the general region requires further development of the Columbia River and major tributaries for power and flood control purposes. These objectives would be furthered by construction of storage projects on the upper Columbia and Kootenay Rivers operated under international agreement.

(i) In Canada the only immediate market for large blocks of additional Columbia Basin power is located on the West Coast, involving expensive transmission facilities if this power is to be generated at Canadian projects in the Columbia Basin. Moreover there are no major flood problems in the Columbia Basin in Canada.

(j) Substantial blocks of power generated downstream in the United States from storage in Canada resulting from cooperative developments by the two countries could be readily absorbed by the growing power load in the Vancouver area of British Columbia.

(k) Three possible methods of developing the Kootenay and upper Columbia Rivers produce potential benefits nearly equal in terms of total effect in the basin. The results of the power studies indicated that, on the basis of system power production and under the given assumptions, the Copper Creek diversion plan would provide the highest level of development of the water resources of the basin. However, the apparent superiority of this plan takes into account only physical and economic factors, and the margin on which this superiority rests is small. In view of these factors, and having regard to the practical limits of accuracy of the studies, no one plan of development can be selected as representing the optimum use of sites and water resources.

(l) The method of cooperative development of the Kootenay and upper Columbia Rivers will be determined by considerations beyond the scope of this report, but the information provided herein on the alternative plans will provide a reasonable basis for discussion between the two countries.

(m) The projects considered and described in this report include among them the salient features of any major plan of cooperative development which might be contemplated by responsible entities in the United States and Canada.

(n) In the case of alternative projects, their respective dates of completion may be the deciding factor and hence the choice of projects may depend upon consideration of the time factor. In this report, however, all projects were considered as constructed simultaneously.

(o) Certain projects common to all three plans could be recommended by the Commission for early development without waiting for or prejudicing the final selection of a single plan of international system development.

(p) For any further progress towards cooperative development, some measure of general agreement between the two countries should be reached with respect to principles for sharing benefits and costs. Project justification requires the use of such principles to determine the benefits and costs to be ascribed to individual components of an agreed plan of development.

(q) There are no serious physical obstacles to the cooperative developments studied by the Board, nor are there many problems of conflicting interests of the two countries.

(r) Orderly development of the water resources of a basin normally requires that the most economically attractive projects be constructed first; this process cannot be followed completely in the case of the Columbia River basin unless cooperative development is made possible by international agreement.

REPORT OF THE INTERNATIONAL JOINT COMMISSION ON PRINCIPLES FOR DETERMINING AND APPORTIONING BENEFITS FROM COOPERATIVE USE OF STORAGE OF WATERS AND ELECTRICAL INTERCONNECTION WITHIN THE COLUMBIA RIVER SYSTEM

29 December 1959

In identical letters to the United States and Canadian Sections of the International Joint Commission, dated 28 January 1959 and 29 January 1959, respectively, the Secretary of State for the United States and the Secretary of State for External Affairs for Canada referred to the general objectives of the Columbia River Reference of 9 March 1944 and requested a special report as follows:

"The Governments of the United States and Canada, as a part of their continuing discussions, have agreed to request the International Joint Commission to report specially to the Governments at an early date its recommendations concerning the principles to be applied in determining:

(a) the benefits which will result from the cooperative use of storage of waters and electrical interconnection with the Columbia River System; and

(b) the apportionment between the two countries of such benefits more particularly in regard to electrical generation and flood control."

In the preparation of this special report, the Commission utilized as background data all the information available to it on the water resources development needs and possibilities in the Columbia River area. This included the reports of the International Columbia River Engineering Board under the Columbia River Reference, as well as studies of other agencies in both the United States and Canada. A special work group was established to prepare summaries of the available data that would provide a background and orientation and thus facilitate mutual understanding of the situation and conditions under which principles for benefit determination and apportionment would be applied. Also, the Commission approached the problem of formulating principles within the context and intent of the Boundary Waters Treaty of 1909.

The studies of the International Columbia River Engineering Board, as well as other available information, indicate clearly that there are possibilities for cooperative development in the Columbia Basin that could be of mutual advantage to the two countries. Accordingly, the

Commission was able to approach the problem of formulating principles for benefit determination and apportionment with information on specific projects for cooperative development which would offer advantages to both countries. The Commission was guided by the basic concept that the principles recommended herein should result in an equitable sharing of the benefits attributable to their cooperative undertakings and that these should result in an advantage to each country as compared with alternatives available to that country. The Commission gave consideration to the practical problems that will be encountered in applying the principles to cooperative arrangements between the two countries on specific projects in the Columbia River Basin. This was done to ensure that the principles would be workable but no attempt was made to spell out in the principles the detailed procedures that will necessarily be delineated when cooperative arrangements are entered into. The Commission recognizes that several administrative and legislative actions in each country may be necessary before these details can be worked out.

The principal benefits in the downstream country from cooperative use of storage of waters within the Columbia River System are improvements in hydro-electric power production and prevention of flood damage. Although other benefits would also be realized from such cooperative use, the outlook at this time is that their value would be so small in comparison to the power and flood control values that formulation of principles for their determination and apportionment would not be warranted. This is not intended to preclude consideration by the two Governments of any benefits, tangible or intangible, which may prove to be significant in the selection of projects or formulation of agreements thereon.

The prospective downstream power benefits are transportable and within reasonable transmission distances of the boundary. With adequate electrical interconnection, it would therefore be feasible to share these benefits in kind, that is, share the power itself rather than its value in money. The flood control benefits, however, accrue in specific localities and are not transportable. Cooperative use of storage designed to produce such benefits therefore requires recompense in money or by other means. In addition to providing a means for the return to the upstream country of its share of downstream power benefits, electrical interconnection between the power systems in the upstream and downstream countries opens the possibility of significant economies and advantages in the operation of the interconnected systems in both countries through the cooperative use of generation and transmission facilities.

In view of the foregoing, the Commission's recommendations on principles for benefit determination and apportionment are presented herein in three sections, namely, general principles, power principles and flood control principles.

GENERAL PRINCIPLES

Selection of Projects

A necessary step in the development of cooperative arrangements involving sharing of downstream benefits is the selection of the projects to which such arrangements would apply.

In selecting individual projects from among the available alternatives in both countries for comprehensive development of the Columbia River Basin, it would be consistent with customary practice to give first consideration to those projects that are most attractive economically as reflected in the ratio of benefits to costs. It is suggested that this widely accepted principle be followed in international cooperative development of the Columbia River Basin to the extent that it may prove practicable and feasible to do so. If projects are developed successively to meet the growing needs for power production and to provide flood protection, the most efficient projects for those purposes should generally be developed first in order to maximize the net benefits to each country. It is recognized, however, that the results to be obtained from possible cooperative projects in the Columbia River Basin will constitute only a part of the total requirements for water resource development and use in the affected regions in both countries. Therefore application of the principle will necessarily be subject to the sovereign responsibilities in each country with respect to many vital and important national interests which must be taken into account in utilizing the water resources in each country. The Commission therefore recommends the following general principles:

General Principle No. 1

> Cooperative development of the water resources of the Columbia River Basin, designed to provide optimum benefits to each country, requires that the storage facilities and downstream power production facilities proposed by the respective countries will, to the extent it is practicable and feasible to do so, be added in the order of the most favorable benefit-cost ratio, with due consideration of factors not reflected in the ratio.

Discussion of General Principle No. 1

It is intended in the application of this principle that benefits and costs of the projects given consideration in either country would be determined on the basis of the same or comparable evaluation standards, including such factors as the nature and extent of the benefits to be considered, the evaluation of such benefits, the determination of the initial investment and the computation of the annual costs.

The phrase "to the extent that it is practicable and feasible to do so" is included in recognition of the fact that it will not always be possible to

adopt a project wholly on the basis of its benefit-cost ratio as compared to other projects in the river basin. There may be important non-monetary factors, not reflected in the benefit-cost ratio, which may require consideration and which may be of compelling influence in choosing projects for construction. Such factors include the disruption of community and regional economies, scenic, historic or aesthetic considerations, the preservation of fish and wildlife, and similar considerations, which cannot be adequately evaluated in monetary terms. Other practical considerations that might preclude the theoretically desirable order of construction of projects would include the following:

(a) the availability of funds, whether from public or private sources, may be an important consideration in the scheduling of projects within each country in an extensive basin-wide plan. This factor alone may require selection of a small project providing urgently needed benefits even though the small project may have a lower benefit-cost ratio than a larger project requiring more funds than are available. On the other hand, it is important to recognize that a small project undertaken for such an immediate consideration might jeopardize an eventual development of far-reaching beneficial consequences.

(b) an urgent need to provide for such purposes as local or regional flood control, navigation, irrigation, or exceptional increases in power requirements may determine the order of project construction rather than the ratio of benefits to costs.

(c) the attitude of affected interests on the flooding of lands and improvements or to the effect of a project on other uses of the water resource may require postponement or abandonment of construction of projects that are the most attractive when viewed solely from the standpoint of their benefit-cost ratio.

General Principle No. 2

> Cooperative development of the water resources of the Columbia River basin should result in advantages in power supply, flood control, or other benefits, or savings in costs to each country as compared with alternatives available to that country.

Discussion of General Principle No. 2

This principle was used as a basic concept by the Commission in the preparation of the more specific principles recommended herein, and is recorded for future guidance in the application of those principles.

Trans-Boundary Projects

Projects which could produce downstream benefits to be shared between the two countries may be located entirely in the upstream country, or may be trans-boundary projects in which the benefit-producing potentials of storage and head are partly in each country. Such projects

affect the level of water above the boundary and in consequence are subject to Article IV of the Boundary Waters Treaty of 1909. The principles presented elsewhere in this report are applicable directly to storage projects situated entirely in the upstream country and relate to the effects produced in the other. To apply these principles to a trans-boundary project, it is first necessary to assign to each country an "entitlement" to the storage. This entitlement or share of the benefit-producing potential of the storage would then form the basis for determination and apportionment of downstream benefits between the two countries in accordance with the principles recommended herein. In addition, an entitlement to at-site power generation should be determined based on the benefit-producing potential of the head and flow involved. Also, the respective entitlements to share in any other benefit-producing potentials should be determined if significant.

As a basis for determining the "entitlement" of each country to the benefit-producing potentials of storage and head at trans-boundary projects, the Commission recommends the following general principle:

General Principle No. 3

> With respect to trans-boundary projects in the Columbia Basin, which are subject to the provisions of Article IV of the Boundary Waters Treaty of 1909, the entitlement of each country to participate in the development and to share in the downstream benefits resulting from storage, and in power generated at site, should be determined by crediting to each country such portion of the storage capacity and head potential of the project as may be mutually agreed.

Discussion of General Principle No. 3

The "entitlements" determined in accordance with this principle provide a basis for establishing benefit credits. The principle is designed to provide flexibility in the arrangements between the two countries for cooperation on trans-boundary projects. The entitlement of a country computed in accordance with this principle would be the basis for determining the share of downstream benefits due that country in accordance with the other principles presented in this report for projects wholly in one country.

POWER PRINCIPLES

The setting in which principles for determining and sharing power benefits from the cooperative use of upstream storage in the Columbia River system would be applied is one in which significant changes are likely to occur within the life of projects that might be considered for development at this time. At present the power loads in the United States portion of the Columbia Basin and adjacent areas of the Pacific Northwest are supplied almost entirely from hydro-electric plants.

The downstream generating plants in the United States are now in a position to benefit materially from storage regulation upstream primarily through improvement of the dependable capacity and usable energy of the downstream plants. As the more economically attractive hydro plants are developed progressively, it will become necessary and advantageous to add thermal plants to the system until ultimately the Pacific Northwest power system in the United States will become predominantly thermal.

In the course of this change, the character of the benefits to downstream hydro-electric plants in the United States from storage will change to benefits in the form of peaking capacity and thermal replacement energy and may change in value.

In Canada, the hydro-electric power potential has not yet been developed to a comparable extent. For this reason, the type of change envisioned in the United States is unlikely to occur in the Canadian portion of the Columbia River Basin and adjoining areas until a considerable period of time has elapsed.

In the light of the foregoing, the Commission has found it necessary in its formulation of principles for determination and sharing of power benefits to allow for changing conditions during the specified period that a cooperative development agreement or any extension thereof would be effective. The principles recommended below for the determination and apportionment of power benefits are believed to be sufficiently flexible to provide for equitable arrangements to permit taking into due account the changing conditions expected.

Application of the power principles to conditions in the Columbia basin would require electrical interconnection between the power systems of the two countries to make possible delivery of the upstream country's share of the power produced in the downstream country from the use of stored waters. Although such delivery could be accomplished initially with a somewhat limited degree of interconnection, the Commission is of the opinion that provision should be made for the eventual development of a broader, long-range plan for cooperative operation of the interconnected power systems of the two countries. Accordingly, the power principles include in addition to those governing cooperative use of stored waters, a principle providing for interconnection and coordination of the major power systems in the Columbia basin and adjoining areas in both countries so as to permit the power utilities of the two countries to gain the advantages of cooperative arrangements in power system operations.

Power Principle No. 1

Downstream power benefits in one country should be determined on the basis of an assured plan of operation of the storage in the other country.

Discussion of Power Principle No. 1

This principle is basic to a determination of the dependable capacity and usable energy that can properly be credited to operation of upstream storage for the benefit of hydro-electric power generation downstream. Emphasis is placed particularly on the concept of an assured plan of operation of the storage with the expectation that the downstream system will be developed and operated so as to make optimum use of the stream flow regulation provided.

It is a generally accepted engineering principle in the electric power field that any power supply which is classified as "firm" or "dependable" must be deliverable on such a schedule or plan as to assure availability of the power at the times when it is needed to serve the load, particularly during peak load periods. It is, therefore, highly important that river-flow regulation be provided under an agreed operating plan or rule curve that will assure the dispatch of water by the owner of storage facilities to the owners of downstream hydro plants in such a manner as to meet the needs of the latter for delivery of firm power to their customers. Such a plan of operation will provide the maximum downstream power benefit consistent with the degree of co-ordination agreed upon.

It is expected that a general plan of operation of the upstream storage project will be estimated for the entire period of the agreement with the understanding that mutually satisfactory adjustments in the long-range plan of operation can be made from time to time as necessary. This general provision for adjustment is additional to the flexibility for changes by either country which may be specifically provided for in the agreement. Factors that may bring about the need for adjustments in the operating plan are covered in the discussion of Power Principle No. 2.

Power Principle No. 2

> The power benefits attributable to an upstream storage project should be estimated in advance to the extent possible to the mutual satisfaction of the upstream and downstream countries. These estimates of power benefits should be subject to review in accordance with the agreed principles every five years, or more often as may be agreed, to take into account in subsequent estimates any change in previously assumed conditions and to insure optimum utilization of the storage and accurate determination of future benefits.

Discussion of Power Principle No. 2

This principle is intended to provide in advance of construction of upstream storage reservoirs a long-range estimate of the expected benefits of the international cooperative undertaking. The estimate of benefits, expressed in power, or in monetary terms if necessary, would be determined on the basis of the current assured plan of operation as

described under Power Principle No. 1 and in accordance with Power Principle No. 3.

It is contemplated that the appropriate agencies in each country will collaborate in the preparation of the estimate and that it will cover the entire period of the international agreement. Any extension of the agreement would also require similar estimates. It should be based on the relevant conditions of load and power supply expected to prevail during the period of the agreement. The assumed power supply should include the projects, both hydro-electric and steam-electric, considered most likely to be constructed to meet the long-range needs of the power systems concerned.

In estimating the long range power benefits attributable to upstream storage and in the periodic reviews provided for in this principle, due recognition should be given to the adjustments in storage operation that are likely to be required to meet power loads and other water use needs in either country. Factors in either country which could change and thus alter the role of storage include: the magnitude and characteristics of the power loads to be served, installed generating capacity available in the hydro-electric plants on the affected systems, the amount of thermal generating capacity available and the requirements of other water uses. The time and effect of such changes should be anticipated by the appropriate Canadian and United States agencies as far in advance as possible and taken into account either by provision in the assured plan of operation or by agreement on mutually satisfactory adjustment as a result of the periodic review of the plan of operation and long-range estimate as provided for in this principle.

In addition to the primary purpose of furnishing a long-range estimate of the benefits of the international cooperative undertaking the advance estimate and periodic reviews are expected to serve several other purposes. The agencies affected will be afforded a basis for anticipating the probable long-range use or role of the storage in the respective countries so that other developments on the affected power systems can be planned well in advance and timely provision made for their construction as required by each country. Assurance as to use of the storage would facilitate advance planning of the transmission systems required to coordinate the storage operation with generating plants on the interconnected power systems. Information provided from the estimates would also aid the two countries in determining the timing and value of other projects of international scope in which they may be jointly interested.

Power Principle No. 3

The amount of power benefits considered to result in the downstream country from regulation of flow by storage in the upstream country should be determined in advance by computing the difference between the amount of power that would be produced at the downstream plants with the storage regulation and the amount

that would be produced without such regulation. This determination would be made on the assumption that upstream storage is added at an agreed-upon level or condition of storage and power supply. The storage credit position of the upstream storage thus established should be preserved throughout the period of the agreement.

Discussion of Power Principle No. 3

Application of the with and without principle involves several significant determinations and procedures to insure that the upstream storage receives proper credit for its contribution toward meeting the load. Because of the fact that successive units of storage capacity added to a system of projects result in decreasing amounts of regulatory effect per unit, the time at which a project is considered as added to the system in relation to the time at which other storages are added affects the amount of regulatory effect and accompanying firm power benefit with which a particular storage project may be credited. Thus the conditions under which a project is considered as added determines its "credit position".

Under this principle, it is intended that the storage credit position of an upstream storage reservoir be determined on the assumption that it is added at an agreed-upon level or condition of storage and power supply. This "level" or "condition" might be defined by relating it to a "base system". The "base system" would be comprised of all developments existing at the time of negotiation of an agreement together with developments actually under construction at that time.

Since many estimates and computations have already been made on the basis of data available during the Commission's consideration of these principles, it is suggested that negotiations undertaken in the near future utilize as a base system the developments existing and under construction on 29 January 1959, the date of the two Governments' request for this report. The pertinent storage developments in the current base system are:

Project	Usable storage
Kootenay Lake	673,000 acre-feet
Hungry Horse	2,982,000
Flathead Lake	1,217,000
Albeni Falls	1,153,000
Coeur d'Alene Lake	225,000
Grand Coulee	5,072,000
Chelan	676,000
Brownlee	1,034,000
	13,032,000 acre-feet

If negotiations are undertaken or continued at a time when major changes have occurred, a revised base system should be agreed upon.

Conditions of International Joint Commission Orders of Approval affecting any of these developments would continue to be applicable.

It is contemplated that the representatives of the two governments who negotiate arrangements under these principles would agree on the order in which the storages they have under consideration would be considered as added to the base system so that a credit position for each such storage could be established. It is intended under this principle to provide that the credit positions of the storages thus established will not be adversely affected by the addition of subsequent storage and that the storage credit of such agreed upon storages may increase or decrease only as the role of storage generally in the system changes.

Power Principle No. 4

> The amount of power benefits determined to result in the downstream country from regulation of flow by storage in the upstream country would normally be expressed as the increase in dependable hydro-electric capacity in kilowatts under an agreed-upon critical stream flow condition, and the increase in average annual usable hydro-electric energy output in kilowatt-hours on the basis of an agreed-upon period of stream flow record. Since this procedure requires relating the increased power production to the loads to be met in the downstream country and adjustment of the upstream country's entitlement to conform more nearly to its load requirements, consideration might be given in the negotiations to the adoption of arrangements that would be less dependent upon consideration of the load patterns in each country.

Discussion of Power Principle No. 4

In determining the increase in dependable hydro capacity and in usable energy output at downstream plants resulting from upstream regulation, the estimates should be based on the ability of those plants, enlarged as necessary, to serve the coordinated system loads in the downstream country expected to be realized during the periods under consideration.

The critical flow period used to determine hydro plant outputs available for supporting dependable capacity on the downstream load would be that corresponding with the agreed-upon level or condition of storage and power supply as contemplated in Power Principle No. 3.

Estimates of increase in average annual usable energy output at the affected downstream plants should be based on an agreed-upon period of stream flow record which is expected to give results representative of long-term conditions.

It is expected that both dependable capacity and energy benefits will result during the early and intermediate stages of the storage operation, but during the later stages the power benefit may consist only

of increased usable energy.

Whether the objectives are to produce the maximum firm power, peaking capacity or thermal replacement energy, the power usable on the downstream load is the basis for determining the monetary value of the power resulting from the cooperative arrangements. Such value as defined later in Power Principle No. 5 would serve as the basis for adjusting the upstream country's entitlement as between capacity and energy, to amounts of equivalent total value, which conform more nearly to the requirements of the upstream country's load.

Power Principle No. 5

> Whenever it is necessary to place a monetary value on downstream power benefits arising in one country from storage operation in the other country, the value should be the estimated cost to the downstream country of obtaining equivalent power from the most economical alternative source available except where the appropriate Canadian and United States agencies specifically agree on some other basis of evaluation.

Discussion of Power Principle No. 5

This principle is intended to provide a basis for the evaluation, in monetary terms, of downstream capacity and energy benefits attributable to upstream storages for whatever purposes such monetary evaluation may be required; but is intended to have application only in those cases where appropriate monetary values for specific purposes are not otherwise agreed upon by the appropriate United States and Canadian agencies. It is further intended that where such monetary values are agreed upon by the agencies, for any period during the life of the covering agreement, the value so agreed upon shall over-ride the provisions of this principle.

The alternative source used as a basis for the evaluation should be the most likely source available to furnish an amount of power equivalent to the power being evaluated and might be hydro-electric, thermal or some combination thereof.

Power Principle No. 6

> The power benefits determined to result in the downstream country from regulation of flow by storage in the upstream country should be shared on a basis such that the benefit, in power, to each country will be substantially equal, provided that such sharing would result in an advantage to each country as compared with alternatives available to that country, as contemplated in General Principle No. 2. Each country should assume responsibility for providing that part of the facilities needed for the cooperative development that is located within its own territory. Where such sharing would not result in an

advantage to each country as contemplated in General Principle No. 2, there should be negotiated and agreed upon such other division of benefits or other adjustments as would be equitable to both countries and would make the cooperative development feasible.

Discussion of Power Principle No. 6

It is assumed that each country would bear all capital and operating costs for facilities it would provide in its own territory to carry out the cooperative development. The upstream country's share of the power would be transmitted to the boundary by the downstream country at such points as may be most economical to the downstream country. Other points could be selected upon request of the upstream country provided that any excess costs to the downstream country are paid by the upstream country. Losses in transmission of the power to the international boundary from the points of generation would be borne by the upstream country. The voltage at which power would be delivered to the upstream country would be mutually agreed upon but such voltage should be a level that is in common use on the downstream power system through which the transfers of power are to be made.

The load factor at which the upstream country's share of power is delivered should also be agreed upon in advance. Basically, the downstream country should not be required to provide more facilities for generation and transmission to furnish the upstream country its entitlement of power than would be required if the power were to be used in the downstream country at the load factor generally applicable to its affected hydro plants.

Power Principle No. 7

In addition to benefits from cooperative use of stored water, interconnection and coordination of the electric power systems to the extent that they are practicable and desirable, would also provide many mutual benefits which should be shared. Coordination being a continuing function would require specific arrangements on the part of the operating agencies as the need arises.

Discussion of Power Principle No. 7

The first six power principles recommended in this report are directed to determination and apportionment of benefits which would result from international cooperation in the use of stored waters. These are basically hydraulic benefits which can be realized by storing flood flows during the spring and summer months and releasing the stored waters during the fall and winter months when they can be put to use for the production of firm power at the storage site and downstream. Electrical interconnection between the power systems of the two countries would be required to make possible delivery of the upstream country's share of the power produced in the downstream country from the use of

stored waters, but the interconnection capacity provided for this purpose would be only that needed to accomplish such delivery. This limited degree of interconnection would not, however, make possible the greater benefits that would accrue to the two countries from a comprehensive plan of interconnection and coordination.

Such coordination should be recognized in the development of the agreed-upon plan of upstream storage operation and in the computation of system power benefits. Separate arrangements may be required for sharing coordination benefits because the electrical coordination envisaged could extend geographically beyond the service areas of the generating plants or power systems directly benefited by the release of stored waters from storage projects constructed by the upstream country. It is recognized that the power systems in British Columbia are not now developed to the same extent as in the United States portion of the Columbia River basin, but it is the intention of this principle to provide for long-range international cooperation between the systems of the two countries as they continue to develop in the future.

Under arrangements for coordination, it would be expected that all participating power systems would retain their local autonomy but would necessarily operate their generation and transmission facilities under the terms of appropriate agreements with a view to maximizing mutual benefits. The arrangements should set forth the broad operating principles to be observed and should be written in sufficient detail to describe the specific purposes and objectives.

FLOOD CONTROL PRINCIPLES

Among the sections in the United States to which principles for flood control benefit determination and sharing would be applicable are the Kootenai River downstream from Bonners Ferry, Idaho, and the lower main stem of the Columbia River. These areas now have partial protection against flooding and there are plans for utilization of storage in the United States to be developed primarily for power purposes in such a way that ultimately a high degree of protection against major floods would be obtained. As successive blocks of storage for flood control purposes are added to the system, the amount of flood damage that can be prevented per unit of flood control storage decreases. Accordingly, the value that can be assigned to upstream storage for flood control purposes is greater for projects to be constructed in the near future than for those to be built later. Also, in the Columbia Basin the hydrologic and hydraulic characteristics are such that storage can be operated in the interests of flood control to a considerable extent with little, if any, interference with the operation of the same storage project in the interests of power generation.

These factors, as well as other information available to the Commission, have been taken into account in formulating the following principles for determination and sharing of flood control benefits which

may result from cooperative development of storage in the Columbia River Basin.

Flood Control Principle No. 1

> Flood control benefits should be determined on the basis of an assured plan of operation and flood control regulations agreed to in advance.

Discussion of Flood Control Principle No. 1

The assured plan of operation for flood control would not be a separate plan of operation but rather a joint or composite plan of operation of a given storage project in the interests of flood control as well as for other purposes, principally power. The plan of operation for any reservoir included in the flood control plan, therefore, should be worked out initially so as to obtain the best combination of benefits for all purposes. In the Pacific Northwest meteorological and hydrological conditions and the requirements for storage operations in the interests of power and flood control are such that little, if any, loss of ability to maximize power benefits is required to accommodate flood control. In any event, the plan of operation worked out in accordance with these principles would be the basis for determination of the flood control and power benefits to be shared.

Once the plan of operation is agreed to, normal operations for both power and flood control would be in accordance with that plan. It is to be expected that both the upstream storage interests and the downstream power and flood control interests may wish from time to time to request or suggest deviations from the plan. If such deviations would involve an adverse effect on the other party at interest it would be expected that a basis for compensating for the adverse effect would also be proposed. Such deviations would then be made possible if the deviations and any required compensation were mutually acceptable to both parties. If the upstream country wished to have the option of using alternative storage to provide equivalent downstream flood control effects as contemplated in the plan of operation, such option should be provided for in the agreement.

It is assumed that acts of God, emergencies, and other events over which neither party has control, would be interpreted and handled in the manner usually contemplated in a "force majeure" clause in an agreement.

Flood Control Principle No. 2

> The downstream flood control benefit of the upstream storage to be operated in accordance with an agreed-upon flood control plan should be estimated in advance on the basis of the effectiveness of such storage in meeting the flood control objectives applicable in the downstream country at the time the upstream storage is provided.

Discussion of Flood Control Principle No. 2

This principle places prospective Canadian storage to be operated in accordance with an agreed-upon flood control plan in exactly the same position that any concurrently prospective United States storage for flood control purposes would have. The effectiveness of all flood control storage is measured in terms of the flood control objectives applicable at the time the storage is to be provided and the effectiveness determined at that time is applicable for the entire life of the project in question or for the period of agreement in the case of Canadian storage.

In the United States the current primary flood control objective is to obtain storage sufficient to control a flood of the magnitude of that of 1894 at The Dalles to 800,000 cfs. All additional storage in the United States or Canada necessary to achieve this objective (approximately 7 1/2 million acre-feet of storage usable for flood control) would, if included in the flood control plan, be given equal credit on the basis of the effectiveness of each acre-foot of such storage in controlling floods at The Dalles. Storage either in the United States or Canada added after the necessary amount has been reached to control the 1894 flood to 800,000 cfs would, if included in the flood control plan, be evaluated at a lesser rate based on the average value of all additional storage needed to control the 1894 flood at The Dalles to 600,000 cfs.

Local flood control objectives have also been identified in other parts of the basin especially on the Kootenai River downstream from Bonners Ferry where control of the 1894 flood to a maximum of 60,000 cfs is desirable. Storage either in the United States or Canada should be entitled to credit on the basis of satisfying such local objectives.

Flood Control Principle No. 3

> The monetary value of the flood control benefit to be assigned to the upstream storage should be the estimated average annual value of the flood damage prevented by such storage.

Discussion of Flood Control Principle No. 3

The average annual value of flood damage prevented by upstream storage can be computed by conventional methods using stage-frequency and damage-frequency relationships. The methods are described and their application illustrated in the most recent report of the Corps of Engineers on the Columbia River Basin recently submitted by the Division Engineer, US Army Engineer Division, North Pacific, to the Chief of Engineers under the title "Water Resources Development, Columbia River Basin" dated June 1958.

Flood Control Principle No. 4

> The upstream country should be paid one-half of the benefits as measured in Flood Control Principle No. 3, i.e., one-half of the value of the damages prevented.

Discussion of Flood Control Principle No. 4

In the event that application of this principle should indicate a payment to the upstream country greater than the estimated cost of alternative means of obtaining equivalent flood control in the United States the requirement of General Principle No. 2 that there should be an advantage as compared with available alternatives would not be satisfied and consideration should be given to this circumstance in the negotiations.

Flood Control Principle No. 5

> The amount due to the upstream country under the foregoing principles should be determined in advance of construction of each storage project. Payments to cover the entire period that the arrangements are to be effective should be made in cash as a lump sum or as periodic amounts as may be agreed upon to the mutual satisfaction of the upstream and downstream countries.

Discussion of Flood Control Principle No. 5

The payment of a lump sum or periodic amount as may be agreed upon would, of course, be subject to the authorization of such payment by the Congress of the United States. Request for such authorization could be presented to the Congress for consideration as soon as a definite arrangement between the two countries became available as a basis for the request.

Flood Control Principle No. 6

> In the event of the downstream country requesting special operation for flood control of storage included in the assured plan of operation, beyond the type of operation provided for in such assured plan, the upstream country should be compensated for any loss of power which may result therefrom. In the event of the downstream country requesting the operation, for flood control, of storage not included in the assured plan, the upstream country should similarly be compensated for any loss of power which may be sustained by the upstream country and in addition should be paid on the basis of half the damages prevented by the operation of the storage in question.

Discussion of Flood Control Principle No. 6

This principle is included to provide for emergency operations to meet unusual flood producing conditions not covered in the assured plan of operation discussed under Principle No. 1. As long as operations for flood control remain in conformity with the assured plan of operation, there would be no compensation beyond that provided for in the other power and flood control principles.

If, however, unusual flood producing conditions should occur and,

at the request of the downstream country, the upstream country should draw down its storages included in the assured plan to a greater extent or at a different time or in any manner not provided for in the assured plan of operation, the downstream country should compensate the upstream country for the loss of power sustained in providing the additional flood protection. That is, if such action caused a loss of power as compared with the results that would have been possible by adhering to the assured plan of operation, then the upstream country would be reimbursed for the loss of power at its plants and for the decrease in its share of power in the downstream country's plants. The reimbursement could be either in cash or in power as might be mutually agreed upon. In any event, the downstream country should give assurances that it would furnish sufficient power to meet minimum load requirements of the upstream country if the loss of power were so great as to adversely affect the upstream country's ability to meet the loads from its own resources.

The foregoing arrangements will apply also to upstream storage not in the flood control plan but which is operated in response to the request of the downstream country to give emergency relief. In this case, however, the downstream country should, in addition to the compensation to the upstream country for power loss, make a payment to the upstream country on the basis of half the damages prevented.

Signed at Washington this twenty-ninth day of December 1959.

(Signed) Eugene W. Weber

(Signed) A. G. L. McNaughton

(Signed) Francis L. Adams

(Signed) J. Lucien Dansereau

(Signed) D. M. Stephens

PRESS RELEASE FROM THE OFFICE OF THE PRIME MINISTER
ANNOUNCING RECEIPT OF THE REPORT OF THE
INTERNATIONAL JOINT COMMISSION

Ottawa, 30 December 1959.

The Prime Minister, the Right Honourable John G. Diefenbaker, announced today that the International Joint Commission has submitted to the Governments of Canada and the United States its report on "Principles for Determining and Apportioning Benefits from Cooperative Use of Storage of Waters and Electrical Interconnection Within the Columbia River System."

In January, 1959, the two Governments requested the Commission to make a special report on the determination and allocation of benefits which might result from the cooperative development of the Columbia River System, with particular regard to electrical generation and flood control. "This report," the Prime Minister said, "has now been submitted by the Commission to the appropriate authorities in Canada and the United States."

Mr. Diefenbaker recalled that on December 16, the Commission announced that this report would be forthcoming shortly and that, in welcoming the news, he had expressed the hope that it would soon be possible to move forward in negotiations with the United States towards a solution of the Columbia River problem.

The Prime Minister expressed pleasure at receiving the report and paid tribute to the five Canadian and United States members of the International Joint Commission who signed the report for the dedicated manner in which they had discharged their responsibility. The Chairman of the Canadian Section is General McNaughton and the Acting Chairman of the United States Section is Mr. E.W. Weber. The other Canadian Commissioners are Dr. D.M. Stephens of Winnipeg and Mr. Lucien Dansereau of Montreal, and the other United States Commissioner is Mr. Francis Adams. In particular, the Prime Minister referred to the comprehensive and constructive approach made to the task by the late Governor MacKay as Chairman of the United States Section of the Commission.

"I am sure," Mr. Diefenbaker continued, "that the recommendations which have been approved unanimously by the Canadian and United States Commissioners, will be of great value to the governments concerned in the negotiations which lie ahead."

The Prime Minister announced that the Secretary of State for External Affairs, the Honourable Howard Green, had informed him this morning prior to departure for Vancouver that arrangements for a meeting of representatives of Canada and the United States have already been discussed and it is hoped that negotiation of a treaty will begin early in the New Year.

STATEMENT OF THE PRIME MINISTER
IN THE HOUSE OF COMMONS ANNOUNCING START OF
NEGOTIATIONS BETWEEN CANADA AND THE UNITED STATES

Monday, 25 January 1960.

Right Honourable John G. Diefenbaker (Prime Minister): Mr. Speaker, I wish to inform the House that negotiations between Canada and the United States for the co-operative development of the water resources of the Columbia River system are to commence in Ottawa on Thursday, 11 February.

The Minister of Justice (Mr. Fulton) will be the chairman of the Canadian delegation, other members being Mr. Robertson, deputy minister of the Department of Northern Affairs and National Resources; Mr. A. E. Ritchie, assistant under-secretary, Department of External Affairs and Mr. E. W. Bassett, deputy minister of Lands and Forests of the Province of British Columbia.

The United States delegation will have as its chairman Mr. E. F. Bennett, under-secretary, Department of Interior, other members being Mr. I. B. White, assistant secretary, Department of State, and Lieutenant General E. C. Itschner, chief, United States Army Corps of Engineers.

An announcement similar to the one given by me will be made simultaneously in the United States.

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TREATY BETWEEN CANADA AND THE UNITED STATES OF AMERICA RELATING TO COOPERATIVE DEVELOPMENT OF THE WATER RESOURCES OF THE COLUMBIA RIVER BASIN

Signed at Washington 17 January 1961

The Governments of Canada and the United States of America:

Recognizing that their peoples have, for many generations, lived together and cooperated with one another in many aspects of their national enterprises for the greater wealth and happiness of their respective nations, and

Recognizing that the Columbia River basin, as a part of the territory of both countries, contains water resources that are capable of contributing greatly to the economic growth and strength and to the general welfare of the two nations, and

Being desirous of achieving the development of those resources in a manner that will make the largest contribution to the economic progress of both countries and to the welfare of their peoples of which those resources are capable, and

Recognizing that the greatest benefit to each country can be secured by cooperative measures for hydroelectric power generation and flood control, which will make possible other benefits as well,

Have agreed as follows:

ARTICLE I

Interpretation

(1) In the Treaty, the expression

(a) "average critical period load factor" means the average of the monthly load factors during the critical stream flow period;

(b) "base system" means the plants, works and facilities listed in the table in Annex B as enlarged from time to time by the installation of additional generating facilities, together with any other plants, works or facilities which may be constructed on the main stem of the Columbia River in the United States of America;

(c) "Canadian storage" means the storage provided by Canada under Article II;

(d) "critical stream flow period" means the period, beginning with the initial release of stored water from full reservoir conditions and ending with the reservoirs empty, when the water available from reservoir releases plus the natural stream flow is capable of producing the least amount of hydroelectric power in meeting system load requirements;

(e) "consumptive use" means use of water for domestic, municipal, stock-water, irrigation, mining or industrial purposes but does not include use for the generation of hydroelectric power;

(f) "dam" means a structure to impound water, including facilities for controlling the release of the impounded water;

(g) "entity" means an entity designated by either Canada or the United States of America under Article XIV and includes its lawful successor;

(h) "International Joint Commission" means the Commission established under Article VII of the Boundary Waters Treaty, 1909, or any body designated by Canada and the United States of America to succeed to the functions of the Commission under this Treaty;

(i) "maintenance curtailment" means an interruption or curtailment which the entity responsible therefor considers necessary for purposes of repairs, replacements, installations of equipment, performance of other maintenance work, investigations and inspections;

(j) "monthly load factor" means the ratio of the average load for a month to the integrated maximum load over one hour during that month;

(k) "normal full pool elevation" means the elevation to which water is stored in a reservoir by deliberate impoundment every year, subject to the availability of sufficient flow.

(l) "ratification date" means the day on which the instruments of ratification of the Treaty are exchanged;

(m) "storage" means the space in a reservoir which is usable for impounding water for flood control or for regulating stream flows for hydroelectric power generation;

(n) "Treaty" means this Treaty and its Annexes A and B;

(o) "useful life" means the time between the date of commencement of operation of a dam or facility and the date of its permanent retirement from service by reason of obsolescence or wear and tear which occurs notwithstanding good maintenance practices.

(2) The exercise of any power, or the performance of any duty, under the Treaty does not preclude a subsequent exercise of performance of the power or duty.

ARTICLE II

Development by Canada

(1) Canada shall provide in the Columbia River basin in Canada 15,500,000 acre-feet of storage usable for improving the flow of the Columbia River.

(2) In order to provide this storage, which in the Treaty is referred to as the Canadian storage, Canada shall construct dams:

(a) on the Columbia River near Mica Creek, British Columbia, with approximately 7,000,000 acre-feet of storage;

(b) near the outlet of Arrow Lakes, British Columbia, with approximately 7,100,000 acre-feet of storage; and

(c) on one or more tributaries of the Kootenay River in British Columbia downstream from the Canada-United States of America boundary with storage equivalent in effect to approximately 1,400,000 acre-feet of storage near Duncan Lake, British Columbia.

(3) Canada shall commence construction of the dams as soon as possible after the ratification date.

ARTICLE III

Development by the United States of America Respecting Power

(1) The United States of America shall maintain and operate the hydroelectric facilities included in the base system and any additional hydroelectric facilities constructed on the main stem of the Columbia River in the United States of America in a manner that makes the most effective use of the improvement in stream flow resulting from operation of the Canadian storage for hydroelectric power generation in the United States of America power system.

(2) The obligation in paragraph (1) is discharged by reflecting in the determination of downstream power benefits to which Canada is entitled the assumption that the facilities referred to in paragraph (1) were maintained and operated in accordance therewith.

ARTICLE IV

Operation by Canada

(1) For the purpose of increasing hydroelectric power generation in Canada and the United States of America, Canada shall operate the Canadian storage in accordance with Annex A and pursuant to hydroelectric operating plans made thereunder. For the purposes of this obligation an operating plan if it is either the first operating plan or if in the view of either Canada or the United States of America it departs substantially from the immediately preceding operating plan must, in order to be effective, be confirmed by an exchange of notes between Canada and the United States of America.

(2) For the purpose of flood control until the expiration of sixty years from the ratification date, Canada shall

(a) operate in accordance with Annex A and pursuant to flood control operating plans made thereunder

(i) 80,000 acre-feet of the Canadian storage described in Article II (2)(a),

(ii) 7,100,000 acre-feet of the Canadian storage described in Article II (2)(b),

(iii) 1,270,000 acre-feet of the Canadian storage described in Article II (2)(c),

provided that the Canadian entity may exchange flood control storage under subparagraph (ii) for flood control storage additional to that under subparagraph (i), at the location described in Article II (2)(a), if the entities agree that the exchange would provide the same effectiveness for control of floods on the Columbia River at the Dalles, Oregon;

(b) operate any additional storage in the Columbia River basin in Canada, when called upon by an entity designated by the United States of America for that purpose, within the limits of existing facilities and as the entity requires to meet flood control needs for the duration of the flood period for which the call is made.

(3) For the purpose of flood control after the expiration of sixty years from the ratification date, and for so long as the flows in the Columbia River in Canada continue to contribute to potential flood hazard in the United States of America, Canada shall, when called upon by an entity designated by the United States of America for that purpose, operate within the limits of existing facilities any storage in the Columbia River basin in Canada as the entity requires to meet flood control needs for the duration of the flood period for which the call is made.

(4) The return to Canada for hydroelectric operation and the compensation to Canada for flood control operation shall be as set out in Articles V and VI.

(5) Any water resource development, in addition to the Canadian storage, constructed in Canada after the ratification date shall not be operated in a way that adversely affects the stream flow control in the Columbia River within Canada so as to reduce the flood control and hydroelectric power benefits which the operation of the Canadian storage in accordance with the operating plans in force from time to time would otherwise produce.

(6) As soon as any Canadian storage becomes operable Canada shall commence operation thereof in accordance with this Article and in any event shall commence full operation of the Canadian storage described in Article II (2)(b) and Article II (2)(c) within five years of the ratification date and shall commence full operation of the balance of the Canadian storage within nine years of the ratification date.

ARTICLE V

Entitlement to Downstream Power Benefits

(1) Canada is entitled to one half the downstream power benefits determined under Article VII.

(2) The United States of America shall deliver to Canada at a point on the Canada-United States of America boundary near Oliver, British Columbia, or at such other place as the entities may agree upon, the downstream power benefits to which Canada is entitled, less

(a) transmission loss,

(b) the portion of the entitlement disposed of under Article VIII (1), and,

(c) the energy component described in Article VIII (4).

(3) The entitlement of Canada to downstream power benefits begins for any portion of Canadian storage upon commencement of its operation in accordance with Annex A and pursuant to a hydroelectric operating plan made thereunder.

ARTICLE VI

Payment for Flood Control

(1) For the flood control provided by Canada under Article IV(2)(a) the United States of America shall pay Canada in United States funds:

(a) 1,200,000 dollars upon the commencement of operation of the

storage referred to in subparagraph (a)(i) thereof,

(b) 52,100,000 dollars upon the commencement of operation of the storage referred to in subparagraph (a)(ii) thereof, and

(c) 11,100,000 dollars upon the commencement of operation of the storage referred to in subparagraph (a)(iii) thereof.

(2) If full operation of any storage is not commenced within the time specified in Article IV, the amount set forth in paragraph (1) of this Article with respect to that storage shall be reduced as follows:

(a) under paragraph (1)(a), 4,500 dollars for each month beyond the required time,

(b) under paragraph (1)(b), 192,100 dollars for each month beyond the required time, and

(c) under paragraph (1)(c), 40,800 dollars for each month beyond the required time.

(3) For the flood control provided by Canada under Article IV (2)(b) the United States of America shall pay Canada in United States funds in respect only of each of the first four flood periods for which a call is made 1,875,000 dollars and shall deliver to Canada in respect of each and every call made, electric power equal to the hydroelectric power lost by Canada as a result of operating the storage to meet the flood control need for which the call was made, delivery to be made when the loss of hydroelectric power occurs.

(4) For each flood period for which flood control is provided by Canada under Article IV (3) the United States of America shall pay Canada in United States funds:

(a) the operating cost incurred by Canada in providing the flood control, and

(b) compensation for the economic loss to Canada arising directly from Canada foregoing alternative uses of the storage used to provide the flood control.

(5) Canada may elect to receive in electric power, the whole or any portion of the compensation under paragraph (4) (b) representing loss of hydroelectric power to Canada.

ARTICLE VII

Determination of Downstream Power Benefits

(1) The downstream power benefits shall be the difference in the hydroelectric power capable of being generated in the United States of America with and without the use of Canadian storage, determined in

advance, and is referred to in the Treaty as the downstream power benefits.

(2) For the purpose of determining the downstream power benefits:

(a) the principles and procedures set out in Annex B shall be used and followed;

(b) the Canadian storage shall be considered as next added to 13,000,000 acre-feet of the usable storage listed in Column 4 of the table in Annex B;

(c) the hydroelectric facilities included in the base system shall be considered as being operated to make the most effective use for hydroelectric power generation of the improvement in stream flow resulting from operation of the Canadian storage.

(3) The downstream power benefits to which Canada is entitled shall be delivered as follows:

(a) dependable hydroelectric capacity as scheduled by the Canadian entity, and

(b) average annual usable hydroelectric energy in equal amounts each month, or in accordance with a modification agreed upon under paragraph (4).

(4) Modification of the obligation in paragraph (3) (b) may be agreed upon by the entities.

ARTICLE VIII

Disposal of Entitlement to Downstream Power Benefits

(1) With the authorization of Canada and the United States of America evidenced by exchange of notes, portions of the downstream power benefits to which Canada is entitled may be disposed of within the United States of America. The respective general conditions and limits within which the entities may arrange initial disposals shall be set out in an exchange of notes to be made as soon as possible after the ratification date.

(2) The entities may arrange and carry out exchanges of dependable hydroelectric capacity and average annual usable hydroelectric energy to which Canada is entitled for average annual usable hydroelectric energy and dependable hydroelectric capacity respectively.

(3) Energy to which Canada is entitled may not be used in the United States of America except in accordance with paragraphs (1) and (2).

(4) The bypassing at dams on the main stem of the Columbia River in the United States of America of an amount of water which could produce

usable energy equal to the energy component of the downstream power benefits to which Canada is entitled but not delivered to Canada under Article V or disposed of in accordance with paragraphs (1) and (2) at the time the energy component was not so delivered or disposed of, is conclusive evidence that such energy component was not used in the United States of America and that the entitlement of Canada to such energy component is satisfied.

ARTICLE IX

Variation of Entitlement to Downstream Power Benefits

(1) If the United States of America considers with respect to any hydroelectric power project planned on the main stem of the Columbia River between Priest Rapids Dam and McNary Dam that the increase in entitlement of Canada to downstream power benefits resulting from the operation of the project would produce a result which would not justify the United States of America in incurring the costs of construction and operation of the project, Canada and the United States of America at the request of the United States of America shall consider modification of the increase in entitlement.

(2) An agreement reached for the purposes of this Article shall be evidenced by an exchange of notes.

ARTICLE X

East-West Standby Transmission

(1) The United States of America shall provide in accordance with good engineering practice east-west standby transmission service adequate to safeguard the transmission from Oliver, British Columbia, to Vancouver, British Columbia, of the downstream power benefits to which Canada is entitled and to improve system stability of the east-west circuits in British Columbia.

(2) In consideration of the standby transmission service, Canada shall pay the United States of America in Canadian funds the equivalent of 1.50 United States dollars a year for each kilowatt of dependable hydroelectric capacity included in the downstream power benefits to which Canada is entitled.

(3) When a mutually satisfactory electrical coordination arrangement is entered into between the entities and confirmed by exchange of notes between Canada and the United States of America the obligation of Canada in paragraph (2) ceases.

ARTICLE XI

Use of Improved Stream Flow

(1) Improvement in stream flow in one country brought about by operation of storage constructed under the Treaty in the other country shall not be used directly or indirectly for hydroelectric power purposes except:

(a) in the case of use within the United States of America with the prior approval of the United States entity, and

(b) in the case of use within Canada with the prior approval of the authority in Canada having jurisdiction.

(2) The approval required by this Article shall not be given except upon such conditions, consistent with the Treaty, as the entity or authority considers appropriate.

ARTICLE XII

Kootenai River Development

(1) The United States of America for a period of five years from the ratification date, has the option to commence construction of a dam on the Kootenai River near Libby, Montana, to provide storage to meet flood control and other purposes in the United States of America. The storage reservoir of the dam shall not raise the level of the Kootenai River at the Canada-United States of America boundary above an elevation consistent with a normal full pool elevation at the dam of 2,459 feet, United States Coast and Geodetic Survey datum, 1929 General Adjustment, 1947 International Supplemental Adjustment.

(2) All benefits which occur in either country from the construction and operation of the storage accrue to the country in which the benefits occur.

(3) The United States of America shall exercise its option by written notice to Canada and shall submit with the notice a schedule of construction which shall include provision for commencement of construction, whether by way of railroad relocation work or otherwise, within five years of the ratification date.

(4) If the United States of America exercises its option, Canada in consideration of the benefits accruing to it under paragraph (2) shall prepare and make available for flooding the land in Canada necessary for the storage reservoir of the dam within a period consistent with the construction schedule.

(5) If a variation in the operation of the storage is considered by Canada to be of advantage to it the United States of America shall, upon request,

consult with Canada. If the United States of America determines that the variation would not be to its disadvantage it shall vary the operation accordingly.

(6) The operation of the storage by the United States of America shall be consistent with any order of approval which may be in force from time to time relating to the levels of Kootenay Lake made by the International Joint Commission under the Boundary Waters Treaty, 1909.

(7) Any obligation of Canada under this Article ceases if the United States of America, having exercised the option, does not commence construction of the dam in accordance with the construction schedule.

(8) If the United States of America exercises the option it shall commence full operation of the storage within seven years of the date fixed in the construction schedule for commencement of construction.

(9) If Canada considers that any portion of the land referred to in paragraph (4) is no longer needed for the purpose of this Article Canada and the United States of America, at the request of Canada, shall consider modification of the obligation of Canada in paragraph (4).

(10) If the Treaty is terminated before the end of the useful life of the dam Canada shall for the remainder of the useful life of the dam continue to make available for the storage reservoir of the dam any portion of the land made available under paragraph (4) that is not required by Canada for purposes of diversion of the Kootenay River under Article XIII.

ARTICLE XIII

Diversions

(1) Except as provided in this Article neither Canada nor the United States of America shall, without the consent of the other evidenced by an exchange of notes, divert for any use, other than a consumptive use, any water from its natural channel in a way that alters the flow of any water as it crosses the Canada-United States of America boundary within the Columbia River basin.

(2) Canada has the right, after the expiration of twenty years from the ratification date, to divert not more than 1,500,000 acre-feet of water a year from the Kootenay River in the vicinity of Canal Flats, British Columbia, to the headwaters of the Columbia River, provided that the diversion does not reduce the flow of the Kootenay River immediately downstream from the point of diversion below the lesser of 200 cubic feet per second or the natural flow.

(3) Canada has the right, exercisable at any time during the period commencing sixty years after the ratification date and expiring one

hundred years after the ratification date, to divert to the headwaters of the Columbia River any water which, in its natural channel, would flow in the Kootenay River across the Canada-United States of America boundary, provided that the diversion does not reduce the flow of the Kootenay River at the Canada-United States of America boundary near Newgate, British Columbia, below the lesser of 2,500 cubic feet per second or the natural flow.

(4) During the last twenty years of the period within which Canada may exercise the right to divert described in paragraph (3) the limitation on diversion is the lesser of 1,000 cubic feet per second or the natural flow.

(5) Canada has the right:

(a) if the United States of America does not exercise the option in Article XII (1), or

(b) if it is determined that the United States of America, having exercised the option, did not commence construction of the dam referred to in Article XII in accordance therewith or that the United States of America is in breach of the obligation in that Article to commence full operation of the storage,

to divert to the headwaters of the Columbia River any water which, in its natural channel, would flow in the Kootenay River across the Canada-United States of America boundary, provided that the diversion does not reduce the flow of the Kootenay River at the Canada-United States of America boundary near Newgate, British Columbia, below the lesser of 1,000 cubic feet per second or the natural flow.

(6) If a variation in the use of the water diverted under paragraph (2) is considered by the United States of America to be of advantage to it Canada shall, upon request, consult with the United States of America. If Canada determines that the variation would not be to its disadvantage it shall vary the use accordingly.

ARTICLE XIV

Arrangements for Implementation

(1) Canada and the United States of America shall each, as soon as possible after the ratification date, designate entities and when so designated the entities are empowered and charged with the duty to formulate and carry out the operating arrangements necessary to implement the Treaty. Either Canada or the United States of America may designate one or more entities. If more than one is designated the powers and duties conferred upon the entities by the Treaty shall be allocated among them in the designation.

(2) In addition to the powers and duties dealt with specifically elsewhere in the Treaty the powers and duties of the entities include:

(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) the 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 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 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,

(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.

(3) The entities are authorized to make maintenance curtailments. Except in case of emergency, the entity responsible for a maintenance curtailment shall give notice to the corresponding Canadian or United States entity of the curtailment, including the reason therefor and the probable duration thereof and shall both schedule the curtailment with a view to minimizing its impact and exercise due diligence to resume full operation.

(4) Canada and the United States of America may by an exchange of notes empower or charge the entities with any other matter coming within the scope of the Treaty.

ARTICLE XV

Permanent Engineering Board

(1) A Permanent Engineering Board is established consisting of four members, two to be appointed by Canada and two by the United States of America. The initial appointments shall be made within three months of the ratification date.

(2) The Permanent Engineering Board shall:

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

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

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

(d) make periodic inspections and require reports as necessary from the entities with a view to ensuring that the objectives of the Treaty are being met;

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

(f) investigate and report 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.

(3) Reports of the Permanent Engineering Board made in the course of the performance of its functions under this Article shall be prima facie evidence of the facts therein contained and shall be accepted unless rebutted by other evidence.

(4) The Permanent Engineering Board shall comply with directions, relating to its administration and procedures, agreed upon by Canada and the United States of America as evidenced by an exchange of notes.

ARTICLE XVI

Settlement of Differences

(1) Differences arising under the Treaty which Canada and the United States of America cannot resolve may be referred by either to the

International Joint Commission for decision.

(2) If the International Joint Commission does not render a decision within three months of the referral or within such other period as may be agreed upon by Canada and the United States of America, either may then submit the difference to arbitration by written notice to the other.

(3) Arbitration shall be by a tribunal composed of a member appointed by Canada, a member appointed by the United States of America and a member appointed jointly by Canada and the United States of America who shall be Chairman. If within six weeks of the delivery of a notice under paragraph (2) either Canada or the United States of America has failed to appoint its member, or they are unable to agree upon the member who is to be Chairman, either Canada or the United States of America may request the President of the International Court of Justice to appoint the member or members. The decision of a majority of the members of an arbitration tribunal shall be the decision of the tribunal.

(4) Canada and the United States of America shall accept as definitive and binding and shall carry out any decision of the International Joint Commission or an arbitration tribunal.

(5) Provision for the administrative support of a tribunal and for remuneration and expenses of its members shall be as agreed in an exchange of notes between Canada and the United States of America.

(6) Canada and the United States of America may agree by an exchange of notes on alternative procedures for settling differences arising under the Treaty, including reference of any difference to the International Court of Justice for decision.

ARTICLE XVII

Restoration of Pre-Treaty Legal Status

(1) Nothing in this Treaty and no action taken or foregone pursuant to its provisions shall be deemed, after its termination or expiration, to have abrogated or modified any of the rights or obligations of Canada or the United States of America under then existing international law, with respect to the uses of the water resources of the Columbia River basin.

(2) Upon termination of this Treaty, the Boundary Waters Treaty, 1909, shall, if it has not been terminated, apply to the Columbia River basin, except insofar as the provisions of that Treaty may be inconsistent with any provision of this Treaty which continues in effect.

(3) Upon termination of this Treaty, if the Boundary Waters Treaty, 1909, has been terminated in accordance with Article XIV of that Treaty, the provisions of Article II of that Treaty shall continue to apply to the waters of the Columbia River basin.

(4) If upon the termination of this Treaty Article II of the Boundary Waters Treaty, 1909, continues in force by virtue of paragraph (3) of this Article the effect of Article II of that Treaty with respect to the Columbia River basin may be terminated by either Canada or the United States of America delivering to the other one year's written notice to that effect; provided however that the notice may be given only after the termination of this Treaty.

(5) If, prior to the termination of this Treaty, Canada undertakes works usable for and relating to a diversion of water from the Columbia River basin, other than works authorized by or undertaken for the purpose of exercising a right under Article XIII or any other provision of this Treaty, paragraph (3) of this Article shall cease to apply one year after delivery by either Canada or the United States of America to the other of written notice to that effect.

ARTICLE XVIII

Liability for Damage

(1) Canada and the United States of America shall be liable to the other and shall make appropriate compensation to the other in respect of any act, failure to act, omission or delay amounting to a breach of the Treaty or of any of its provisions other than an act, failure to act, omission or delay occurring by reason of war, strike, major calamity, act of God, uncontrollable force or maintenance curtailment.

(2) Except as provided in paragraph (1) neither Canada nor the United States of America shall be liable to the other or to any person in respect of any injury, damage or loss occurring in the territory of the other caused by any act, failure to act, omission or delay under the Treaty whether the injury, damage or loss results from negligence or otherwise.

(3) Canada and the United States of America, each to the extent possible within its territory, shall exercise due diligence to remove the cause of and to mitigate the effect of any injury, damage or loss occurring in the territory of the other as a result of any act, failure to act, omission or delay under the Treaty.

(4) Failure to commence operation as required under Articles IV and XII is not a breach of the Treaty and does not result in the loss of rights under the Treaty if the failure results from a delay that is not wilful or reasonably avoidable.

(5) The compensation payable under paragraph (1):

(a) in respect of a breach by Canada of the obligation to commence full operation of a storage, shall be forfeiture of entitlement to downstream power benefits resulting from the operation of that storage, after operation commences, for a period equal to the period between the day of commencement of operation and the day

when commencement should have occurred;

(b) in respect of any other breach by either Canada or the United States of America, causing loss of power benefits, shall not exceed the actual loss in revenue from the sale of hydroelectric power.

ARTICLE XIX

Period of Treaty

(1) The Treaty shall come into force on the ratification date.

(2) Either Canada or the United States of America may terminate the Treaty other than Article XIII (except paragraph (1) thereof), Article XVII and this Article at any time after the Treaty has been in force for sixty years if it has delivered at least ten years written notice to the other of its intention to terminate the Treaty.

(3) If the Treaty is terminated before the end of the useful life of a dam built under Article XII then, notwithstanding termination, Article XII remains in force until the end of the useful life of the dam.

(4) If the Treaty is terminated before the end of the useful life of the facilities providing the storage described in Article IV (3) and if the conditions described therein exist then, notwithstanding termination, Articles IV (3) and VI (4) and (5) remain in force until either the end of the useful life of those facilities or until those conditions cease to exist, whichever is the first to occur.

ARTICLE XX

Ratification

The instruments of ratification of the Treaty shall be exchanged by Canada and the United States of America at Ottawa, Canada.

ARTICLE XXI

Registration with the United Nations

In conformity with Article 102 of the Charter of the United Nations, the Treaty shall be registered by Canada with the Secretariat of the United Nations.

This Treaty has been done in duplicate copies in the English language.

IN WITNESS WHEREOF the undersigned, duly authorized by their respective Governments, have signed this Treaty at Washington, District of Columbia, United States of America, this 17th day of January, 1961.

FOR CANADA:

(Signed) John G. Diefenbaker
Prime Minister of Canada

(Signed) E. D. Fulton
Minister of Justice

(Signed) A. D. P. Heeney
Ambassador Extraordinary and
Plenipotentiary of Canada to the
United States of America.

FOR THE UNITED STATES OF AMERICA:

(Signed) Dwight D. Eisenhower
President of the United States
of America

(Signed) Christian L. Herter
Secretary of State

(Signed) Elmer F. Bennett
Under-Secretary of the Interior

ANNEX A

PRINCIPLES OF OPERATION

General

1. The Canadian storage provided under Article II will be operated in accordance with the procedures described herein.

2. A hydrometeorological system, including snow courses, precipitation stations and stream flow gauges will be established and operated, as mutually agreed by the entities and in consultation with the Permanent Engineering Board, for use in establishing data for detailed programming of flood control and power operations. Hydrometeorological information will be made available to the entities in both countries for immediate and continuing use in flood control and power operations.

3. Sufficient discharge capacity at each dam to afford the desired regulation for power and flood control will be provided through outlet works and turbine installations as mutually agreed by the entities. The discharge capacity provided for flood control operations will be large enough to pass inflow plus sufficient storage releases during the evacuation period to provide the storage space required. The discharge capacity will be evaluated on the basis of full use of any conduits provided for that purpose plus one half the hydraulic capacity of the turbine installation at the time of commencement of the operation of storage under the Treaty.

4. The outflows will be in accordance with storage reservation diagrams and associated criteria established for flood control purposes and with reservoir-balance relationships established for power operations. Unless otherwise agreed by the entities the average weekly outflows shall not be less than 3,000 cubic feet per second at the dam described in Article II (2)(a), not less than 5,000 cubic feet per second at the dam described in Article II (2) (b) and not less than 1,000 cubic feet per second at the dam described in Article II (2) (c). These minimum average weekly releases may be scheduled by the Canadian entity as required for power or other purposes.

Flood Control

5. For flood control operation, the United States entity will submit flood control operating plans which may consist of or include flood control storage reservation diagrams and associated criteria for each of the dams. The Canadian entity will operate in accordance with these diagrams or any variation which the entities agree will not derogate from the desired aim of the flood control plan. The use of these diagrams will be based on data obtained in accordance with paragraph 2.

The diagrams will consist of relationships specifying the flood control storage reservations required at indicated times of the year for volumes of forecast runoff. After consultation with the Canadian entity the United States entity may from time to time as conditions warrant adjust these storage reservation diagrams within the general limitations of flood control operation. Evacuation of the storages listed hereunder will be guided by the flood control storage reservation diagrams and refill will be as requested by the United States entity after the consultation with the Canadian entity. The general limitations of flood control operation are as follows:

(a) The Dam described in Article II (2) (a) - The reservoir will be evacuated to provide up to 80,000 acre-feet of storage, if required, for flood control use by May 1 of each year.

(b) The Dam described in Article II (2) (b) - The reservoir will be evacuated to provide up to 7,100,000 acre-feet of storage, if required, for flood control use by May 1 of each year.

(c) The Dam described in Article II (2) (c) - The reservoir will be evacuated to provide up to 700,000 acre-feet of storage, if required, for flood control use by April 1 of each year and up to 1,270,000 acre-feet of storage, if required, for flood control use by May 1 of each year.

(d) The Canadian entity may exchange flood control storage provided in the reservoir referred to in subparagraph (b) for additional storage provided in the reservoir referred to in subparagraph (a) if the entities agree that the exchange would provide the same effectiveness for control of floods on the Columbia River at The Dalles, Oregon.

Power

6. For power generating purposes the 15,500,000 acre-feet of Canadian storage will be operated in accordance with operating plans designed to achieve optimum power generation downstream in the United States of America until such time as power generating facilities are installed at the site referred to in paragraph 5(a) or at sites in Canada downstream therefrom.

7. After at-site power is developed at the site referred to in paragraph 5(a) or power generating facilities are placed in operation in Canada downstream from that site, the storage operation will be changed so as to be operated in accordance with operating plans designed to achieve optimum power generation at-site in Canada and downstream in Canada and the United States of America, including consideration of any agreed electrical coordination between the two countries. Any reduction in the downstream power benefits in the United States of America resulting from that change in operation of the Canadian storage shall not exceed in any one year the reduction in downstream power benefits in the

United States of America which would result from reducing by 500,000 acre-feet the Canadian storage operated to achieve optimum power generation in the United States of America and shall not exceed at any time during the period of the Treaty the reduction in downstream power benefits in the United States of America which would result from similarly reducing the Canadian storage by 3,000,000 acre-feet.

8. After at-site power is developed at the site referred to in paragraph 5(a) or power generating facilities are placed in operation in Canada downstream from that site, storage may be operated to achieve optimum generation of power in the United States of America alone if mutually agreed by the entities in which event the United States of America shall supply power to Canada to offset any reduction in Canadian generation which would be created as a result of such operation as compared to operation to achieve optimum power generation at-site in Canada and downstream in Canada and the United States of America. Similarly, the storage may be operated to achieve optimum generation of power in Canada alone if mutually agreed by the entities in which event Canada shall supply power to the United States of America to offset any reduction in United States generation which would be created as a result of such operation as compared to operation to achieve optimum power generation at-site in Canada and downstream in Canada and the United States of America.

9. Before the first storage becomes operative, the entities will agree on operating plans and the resulting downstream power benefits for each year until the total of 15,500,000 acre-feet of storage in Canada becomes operative. In addition, commencing five years before the total of 15,500,000 acre-feet of storage is expected to become operative, the entities will agree annually on operating plans and the resulting downstream power benefits for the sixth succeeding year of operation thereafter. This procedure will continue during the life of the Treaty, providing to both the entities, in advance, an assured plan of operation of the Canadian storage and a determination of the resulting downstream power benefits for the next succeeding five years.

ANNEX B

DETERMINATION OF DOWNSTREAM POWER BENEFITS

1. The downstream power benefits in the United States of America attributable to operation in accordance with Annex A of the storage provided by Canada under Article II will be determined in advance and will be the estimated increase in dependable hydroelectric capacity in kilowatts for agreed critical stream flow periods and the increase in average annual usable hydroelectric energy output in kilowatt hours on the basis of an agreed period of stream flow record.

2. The dependable hydroelectric capacity to be credited to Canadian storage will be the difference between the average rates of generation in kilowatts during the appropriate critical stream flow periods for the United States of America base system, consisting of the projects listed in the table, with and without the addition of the Canadian storage, divided by the estimated average critical period load factor. The capacity credit shall not exceed the difference between the capability of the base system without Canadian storage and the maximum feasible capability of the base system with Canadian storage, to supply firm load during the critical stream flow periods.

3. The increase in the average annual usable hydroelectric energy will be determined by first computing the difference between the available hydroelectric energy at the United States base system with and without Canadian storage. The entities will then agree upon the part of available energy which is usable with and without Canadian storage, and the difference thus agreed will be the increase in average annual usable hydroelectric energy. Determination of the part of the energy which is usable will include consideration of existing and scheduled transmission facilities and the existence of markets capable of using the energy on a contractual basis similar to the then existing contracts. The part of the available energy which is considered usable shall be the sum of:

(a) the firm energy,

(b) the energy which can be used for thermal power displacement in the Pacific Northwest Area as defined in Paragraph 7, and

(c) the amount of the remaining portion of the available energy which is agreed by the entities to be usable and which shall not exceed in any event 40 per cent of that remainder.

4. An initial determination of the estimated downstream power benefits in the United States of America from Canadian storage added to the United States base system will be made before any of the Canadian storage becomes operative. This determination will include estimates of the downstream power benefits for each year until the total of 15,500,000 acre-feet of Canadian storage becomes operative.

5. Commencing five years before the total of 15,500,000 acre-feet of storage is expected to become operative, estimates of downstream power benefits will be calculated annually for the sixth succeeding year on the basis of the assured plan of operation for that year.

6. The critical stream flow period and the details of the assured plan of operation will be agreed upon by the entities at each determination. Unless otherwise agreed upon by the entities, the determination of the downstream power benefits shall be based upon stream flows for the twenty year period beginning with July 1928 as contained in the report entitled Modified Flows at Selected Power Sites - Columbia River Basin, dated June 1957. No retroactive adjustment in downstream power benefits will be made at any time during the period of the Treaty. No reduction in the downstream power benefits credited to Canadian storage will be made as a result of the load estimate in the United States of America, for the year for which the determination is made, being less than the load estimate for the preceding year.

7. In computing the increase in dependable hydroelectric capacity and the increase in average annual hydroelectric energy, the procedure shall be in accordance with the three steps described below and shall encompass the loads of the Pacific Northwest Area. The Pacific Northwest Area for purposes of these determinations shall be Oregon, Washington, Idaho and Montana west of the Continental Divide but shall exclude areas served on the ratification date by the California Oregon Power Company and Utah Power and Light Company.

Step I

The system for the period covered by the estimate will consist of the Canadian storage, the United States base system, any thermal installation operated in coordination with the base system, and additional hydroelectric projects which will provide storage releases usable by the base system or which will use storage releases that are usable by the base system. The installations included in this system will be those required, with allowance for adequate reserves, to meet the forecast power load to be served by this system in the United States of America, including the estimated flow of power at points of inter-connection with adjacent areas, subject to paragraph 3, plus the portion of the entitlement of Canada that is expected to be used in Canada. The capability of this system to supply this load will be determined on the basis that the system will be operated in accordance with the established operating procedures of each of the projects involved.

Step II

A determination of the energy capability will be made using the same thermal installation as in Step I, the United States base system with the same installed capacity as in Step I and Canadian storage.

Step III

A similar determination of the energy capability will be made using the same thermal installation as in Step I and the United States base system with the same installed capacity as in Step I.

8. The downstream power benefits to be credited to Canadian storage will be the differences between the determinations in Step II and Step III in dependable hydroelectric capacity and in average annual usable hydroelectric energy, made in accordance with paragraphs 2 and 3.

Annex B – Base System

Project	Stream	Stream Miles Above Mouth	Usable Storage Acre-feet	Normal Elevation		Gross Head Feet	Initial Installation		Ultimate Installation (Estimated)	
				Pool Feet	Tailwater Feet		No. of Units	Plant Kilowatts (Nameplate)	No. of Units	Plant Kilowatts (Nameplate)
Hungry Horse	S. Fk. Flathead	5	3,161,000[4]	3,560	3,083	477	4	285,000	4	285,000
Kerr	Flathead	73	1,219,000	2,893	2,706	187	3	168,000	3	168,000
Thompson Falls	Clark Fork	209	Pondage	2,396	2,336	60	6	30,000	8	65,000
Noxon Rapids	Clark Fork	170	Pondage	2,331	2,179	152	4	336,000	5	420,000
Cabinet Gorge	Clark Fork	150	Pondage	2,175	2,078	97	4	200,000	6	300,000
Albeni Falls	Pend Oreille	90	1,155,000	2,062	2,034	28	3	42,600	3	42,600
Box Canyon	Pend Oreille	34	Pondage	2,031	1,989	42	4	60,000	4	60,000
Grand Coulee	Columbia	597	5,232,000[4]	1,290[3,4]	947	343	18	1,944,000	34	3,672,000
Chief Joseph	Columbia	546	Pondage	946	775	171	16	1,024,000	27	1,728,000
Wells[1]	Columbia	516	Pondage	775	707	68	6	400,000	10	666,700
Rocky Reach	Columbia	474	Pondage	707	614	93	7	711,550	11	1,118,150
Rock Island	Columbia	453	Pondage	608[3]	570	38	10	212,100	10	212,100
Wanapum	Columbia	415	Pondage	570	486	84	10	831,250	16	1,330,000
Priest Rapids	Columbia	397	Pondage	486	406	80	10	788,500	16	1,261,600
Brownlee	Snake	285	974,000	2,077	1,805	272	4	360,400	6	540,600
Oxbow	Snake	273	Pondage	1,805	1,683	122	4	190,000	5	237,500
Ice Harbor	Snake	10	Pondage	440	343	97	3	270,000	6	540,000
McNary	Columbia	292	Pondage	340	265	75	14	980,000	20	1,400,000
John Day	Columbia	216	Pondage	265	161	104	8	1,080,000	20	2,700,000
The Dalles	Columbia	192	Pondage	160	74	86	16[2]	1,119,000	24[2]	1,743,000
Bonneville	Columbia	145	Pondage	74	15	59	10	518,400	16	890,400
Kootenay Lake	Kootenay	16	673,000	1,745	-	-	-	-	-	-
Chelan	Chelan	0	676,000	1,100	707	393	2	48,000	4	96,000
Coeur d'Alene L.	Coeur D'Alene	102	223,000	2,128	-	-	-	-	-	-
TOTAL 24 PROJECTS			13,313,000[4]			3,128	166	11,598,800	258	19,476,650

1. The Wells project is not presently under construction; when this project or any other project on the main stem of the Columbia River is completed, they will be integral components of the base system.
2. Includes two 13,500 kilowatt units for fish attraction water.
3. With flashboards.
4. In determining the base system capabilities with and without Canadian storage the Hungry Horse reservoir storage will be limited to 3,008,000 acre-feet (normal full pool elevation of 3,560 feet) and the Grand Coulee project will not include the effect of adding flashboards, limiting the storage to 5,072,000 acre-feet (normal full pool elevation of 1,288 feet). The total usable storage of the base system as so adjusted will be 13,000,000 acre-feet.

74441—6½

PRESS RELEASE BY THE PRIME MINISTER
FOLLOWING THE SIGNING OF THE COLUMBIA RIVER TREATY
Washington, D. C., 17 January 1961

The Right Honourable John Diefenbaker, Prime Minister of Canada, made the following statement today in Washington D.C. immediately after the signature of the Columbia River Treaty.

It is with great pleasure that I am able to announce that the treaty for the cooperative development of the Columbia River Basin has been signed in Washington today. This marks the successful outcome of nearly three years of intensive work on a project that will, in years to come, bring very great benefits to both Canada and the United States.

Knowing the great importance that a suitable arrangement for development of the Columbia Basin could have for Canada, the present government began work on it almost immediately after it assumed office. The project had been under consideration for many years and engineering studies, under a reference to the International Joint Commission, had been pursued since 1944. The problem was to get the matter actively advanced and to put negotiations with the United States on a profitable and fruitful basis. Essential to the whole plan, so far as Canada was concerned, was the need to secure recognition by the United States - which there had never been before - of the principle that a downstream country should share the benefits it might get from storage works in a neighbouring upstream country. I regard it as a great achievement that, not only were we able to get negotiations under way with purpose and action, but we were also successful in securing agreement on that principle of such basic and far-reaching importance to this country.

It will be recalled that at the end of January, 1959, the governments of Canada and the United States requested the International Joint Commission to report to them on:

"(a) the benefits which will result from the cooperative use of storage of waters and electrical interconnection within the Columbia River System; and

(b) the apportionment between the two countries of such benefits more particularly in regard to electrical generation and flood control."

The Commission reported and submitted the principles on which it had been able to achieve agreement on 29 December 1959. Less than a month later, on 25 January 1960, the two governments announced the appointment of delegations to represent them in negotiations looking toward the formulation of a definite agreement for development of the Columbia Basin. Eight months after that, on 28 September, the two negotiating teams were able to submit a Progress Report that set forth the basic provisions that they recommended for inclusion in a treaty. That Progress Report was accepted by the two governments in an

exchange of notes on 19 October last.

Since October the negotiations for a treaty have proceeded with meetings in Washington and Ottawa. On 8 January of this year the negotiating teams signed a report to the two governments submitting a draft of the treaty that they recommended for signature and ratification. That draft treaty has now been considered, not only by the national governments in Ottawa and Washington but also by the Government of British Columbia in Victoria. It has been approved by all governments and has been signed today on behalf of Canada by the Right Honourable the Prime Minister and Honourable E. D. Fulton, Minister of Justice and Chairman of the Canadian negotiating group, and by the Canadian Ambassador in Washington.

The Treaty does not depart in any fundamental respect from the program that was recommended in the Progress Report of 28 September, although a number of improvements have been made.

So far as Canada is concerned, the most important single feature of the Treaty is the one I have already referred to - the recognition of the principle of division of downstream benefits. From that principle all the great advantages that are possible for Canada as a result of cooperative development of the Columbia Basin flow. Without that principle the entire arrangement would be fruitless for this country. Our predecessors in office had failed to achieve recognition of this basic point. We have succeeded. The Treaty embodies the principle that downstream benefits are to be divided equally. That alone is a success of the most outstanding character.

We have been able to achieve this in a way which will fully respect the sovereignty of each country. By avoiding any complicated cost-sharing and by making the arrangement as self-enforcing as possible we have ensured that there will be no unnecessary intrusion into each others affairs across the international boundary.

The Columbia River Treaty calls for construction of three major dams for the storage of water on the Columbia River system in Canada. The largest of these will be located near Mica Creek on the main stem of the Columbia River and is estimated to cost some $247 million. The second dam will be near the outlet of the Arrow Lakes at an estimated cost of nearly $72 million. The third dam will be on the Kootenay system tributary to the Columbia River, probably near Duncan Lake, at an estimated cost of nearly $26 million. The total expenditure involved in the Canadian storages is thus estimated to be approximately $345 million. Table 1 attached sets forth these figures in greater detail.

The dams in Canada will store very large quantities of water for regulated release to increase the production of power downstream. Initially that increase in power production will be entirely in the United States since Canada does not now have any generators installed on the Columbia River in this country. In return for the very valuable

regulation of the flow of water, the treaty provides that Canada will receive 50 per cent of the increase in usable power in the United States. This increase in power downstream is the gain that is commonly referred to as the "downstream benefits". It is these benefits that the United States has agreed to share with us.

The magnitude of the increase in power production as a result of the Canadian storages is very great indeed. This results in part from the fact that the Columbia River has an extreme variation in flow in its natural state. The flow at the border can vary as much as 40:1 because of seasonal fluctuation. The increase in power output is also great because of the enormous investment that the United States has made in the installation of power producing facilities downstream. The control of the widely variable natural flow of water in order to cause the passage of regulated quantities at a planned rate through the very large United States facilities is what produces the valuable downstream benefits. It has been agreed in the treaty that the Canadian storages will be put in the most favourable position in the attribution of benefits to storage. In the terms of engineering science, this is described by giving the Canadian storages "next added" position in the credit that is to be given to our 15.5 million acre-feet in regulation for downstream benefits. By agreeing that our storages have that position, the United States has agreed, in effect, that their benefits shall be of the largest order that this storage can achieve. This is a point of very great importance in ensuring the maximum share of power for Canada.

To give some idea of the magnitude of the power benefits I am advised that the Canadian share attributable to the storages and delivered to load centres in British Columbia will amount to 6.856 billion kilowatt hours per year and to a firm electrical capacity of 1,118,000 kilowatts. Table 2 attached gives a detailed example of the power benefits to be received in a sample year.

There has been some confusion concerning the sharing of the downstream benefits because figures released in Portland, Oregon, on 19 October 1960, dealt with the question in a somewhat different way than figures released here have done. I want to make it quite clear that I am not suggesting that those figures were inaccurate. I am advised that, so far as Canadian information goes, they are entirely accurate. Moreover, on the extent of the downstream power and its division between the two countries they are entirely consistent with the figures released here. The problem is to analyze them without a knowledge of electrical engineering. In order to help clarify what has been a point of uncertainty Table 3 has been prepared and is attached hereto.

The power that Canada secures from the Treaty projects will not only be great in quantity, but it will also be low in cost. The treaty provides that the United States will deliver the Canadian share of the power free of charge at a point on the Canada-United States boundary near Oliver, British Columbia. They will also provide standby transmission facilities at a cost of $1.50 per year for each kilowatt of

Canadian capacity. These standby facilities will make it unnecessary for British Columbia to incur substantial costs that would otherwise be necessary to build an additional line to ensure the regular delivery of the power to Vancouver. As a result of all these factors it is estimated, on what I am advised is a conservative basis, that the Canadian share of power can be delivered at load centres in the Lower Mainland and Interior at less than 4 mills per kilowatt hour.

The United States will, of course, secure an equal amount of the increase in power brought about there by the control of the Canadian storages. In considering the cost of this power to the United States, it is important to bear in mind that, although they do not now have to make new expenditures equal to those in Canada to secure this power, this is only because the United States has already expended upwards of two billion dollars at 1957 prices on plants and developments on the Columbia River in their country. As I have said, it is only because this investment has been made that the increase in downstream power from Canadian storage is possible.

The securing of downstream benefits from the Canadian storages is only the initial stage of the results that will flow from the Columbia River development. It will be possible later on to install generators at the dam near Mica Creek and also, as the power requirements of British Columbia justify it, to construct additional plants downstream in Canada to make use of our regulated flow of water.

The treaty makes provision for flexibility in the plans under which our storages will be regulated. As power generation facilities are installed on the Columbia River in Canada it will be possible to devote steadily greater proportions of the stored water to increasing power generation in Canada and the United States jointly instead of in the United States alone. There will thus be a shift of emphasis in the future from shared downstream benefits to Canadian power production. While the nature and timing of Canadian power plans cannot be definite at this stage, I am advised that it seems reasonable to estimate that the Columbia River development will ultimately produce 20.2 billion kilowatt hours of power each year in Canada over and above the 6.856 billion kilowatt hours that is our initial share of downstream benefits. It is estimated that the average cost of this entire block of power delivered at British Columbia load centres will still be approximately the 4 mill figure that I have mentioned.

While these later developments cannot, as I have said, be scheduled at this time the character of the projects and the magnitude of the power they would produce can be calculated. Table 4 lists these possibilities.

In order that the full magnitude of the investment in the initial phase of the program may be understood, I should mention (as the tables will disclose) that, in addition to the $345 million for the storages that I have already referred to, there will be investment in new

transmission in British Columbia to an estimated cost of some $114 million. The total investment in the first phase will thus amount to about $458 million. The ultimate investment to provide for a full development of the kind I have referred to could be in the vicinity of $1.5 billion.

I have dealt thus far with only one aspect - although the largest aspect - of the advantages that will flow from the Columbia River development. I have spoken entirely of power. The regulation of the flow of water in Canada will provide other benefits through the reduction of the danger of serious floods in the United States. Under the treaty Canada will receive a substantial return for this service.

I mentioned that the three Canadian storages will impound a very large quantity of water of which 15.5 million acre-feet will be operated under agreed plans for the optimum production of power in the Columbia River basin. Of these 15.5 million acre-feet, 8,450,000 acre-feet will be handled from time to time under agreed flood control plans. These will be designed to control the flows of water downstream in the United States so that they will, at the flood periods, not exceed 800,000 cubic feet per second at The Dalles, Oregon. This plan of operation for flood control will continue for 60 years. In return for this service the United States will make payments to Canada upon the commencement of operation of each storage dam. These payments will be calculated on the basis that Canada is entitled to a return equivalent to 50 per cent of the estimated damage that is prevented to downstream developments as they would stand in 1985. The calculations are complicated and involve a number of assumptions, but they have been established to the satisfaction not only of the engineers but of the financial experts on both sides. As the payments for the full amount of the service over the entire 60 years will be made to Canada in lump sum on the completion of the various storages, they will help substantially in the financing of the dams. The treaty calls for the dams on the Arrow Lakes and near Duncan Lake to be completed in five years from the ratification date. The dam at Mica Creek is larger and its completion is not called for until nine years from the ratification date. The total of the flood control payments to be made at the five and nine year completion dates is $64.4 million in United States funds. In order to enable the completion schedule to be maintained the treaty calls for the construction of all three dams to begin as soon as possible after the ratification date.

While I need not enlarge on the obvious advantage of the very substantial lump sum flood payment in helping with initial financing, I think I might point out that this is not the whole story. If the payment is invested in the projects, it is not an obligation to repay and it bears no interest. The saving from that fact is very great. It can be demonstrated by assuming that the money invested in the projects earns money at a low borrowing rate over the amortization period. The end result is a value to Canada over a fifty-year period of $190,200,000. There is attached a table on this matter (Table 5).

During the 60 years that the agreed flood control plan is to

operate, Canada will also stand ready to provide additional flood control on an "on call" basis if it is required. For this service Canada will be paid $1,875,000 on each of the first four calls - up to a total of $7.5 million. This amount is related to a plan that was originally contemplated in the Progress Report on 28 September 1960, but which has now been varied in order to provide greater freedom for Canada to use the stored water for power production. In addition to the cash payments that I have referred to, Canada will also receive compensation - in cash or in power at our option - for any loss in power that may be suffered through the control of water to avoid flooding beyond the primary flood control objective. This is a compensation that was not originally provided for in the Progress Report and is an improvement from the Canadian point of view.

The dams that are contemplated will have a life and usefulness well beyond the 60 years of the flood control plan. After that time Canada has agreed, so far as existing facilities may then permit, to provide flood control for the United States to the extent that the flows of water down the Columbia from Canada continue to constitute a flood hazard. If any call is made for such flood control after the 60-year period the United States is committed to pay Canadian operating costs, together with compensation for any economic loss to Canada that results. Any losses in Canadian power may be taken by Canada in power, rather than in cash.

I have dealt with the three storage dams planned in Canada. There is a fourth major storage contemplated under the treaty which would involve construction in the United States and some flooding into Canada. This is the storage on the Kootenai River in Montana that has been referred to as the "Libby Dam". Under the treaty the United States will have five years from the ratification date to decide whether it wishes to build this dam at its own expense. If it exercises this option, the treaty requires Canada to make available the land in Canada that is needed for the reservoir. This land would cost, it is estimated, from $7 million to $12 million. In return for that, Canada would secure all the increase in power capacity that results on the lower Kootenay River after it has re-entered Canada below the Libby Dam as well as valuable flood protection. It is estimated that the gain in power in Canada will amount to between 250,000 and 300,000 kilowatts. The United States, which meets the entire cost of the dam, will secure the benefits that accrue on their side of the boundary. For purposes of convenience, the tables that I have submitted give an indication of the results for Canada if the "Libby option" is exercised.

The treaty makes provision for a number of diversions of water that may be made by Canada from the Kootenay River in its natural course in different circumstances and at different times. It will be possible, even if the United States exercises its option to build the Libby Dam, to divert 1.5 million acre-feet of water per year from the Kootenay River in Canada into the head waters of the Columbia River to increase power production in Canada. It will not be advantageous to do this until generators have been installed on our part of the Columbia, which will not

be for some years. This right is exercisable by Canada at any time after 20 years from the ratification date. If the United States does not exercise its option to build Libby Dam, the treaty provides that Canada has the immediate right to make a major diversion from the Kootenay River into the Columbia River that would send approximately 90 per cent of the flow down that course. There are also provisions for major diversions at the end of 60 and 80 years even if the United States has built the Libby Dam. The permanent rights of Canada to the free use of the waters of the Kootenay River are thus protected.

I might emphasize at this point that the position of the Boundary Waters Treaty of 1909 has been kept very much in mind in recent negotiations. The applicability of that Treaty to the Columbia has been preserved to the fullest extent consistent with the great and beneficial developments envisaged in this new Treaty and our rights under the Boundary Waters Treaty have been completely protected against the time when the new Treaty may approach an end. The application of the Boundary Waters Treaty to other waters along the international boundary will, of course, be unaffected by the Columbia River Treaty.

The outline I have given of the main features of the construction projects and returns to Canada under the Columbia River Treaty has, of necessity, been brief and general. A study of its terms and of the tables I have submitted will fill in much of the detail. There is one further matter, however, on which it might be useful for me to provide some information that will help in an evaluation of the proposed development.

I mentioned that the principle of sharing downstream benefits is basic to the treaty. I also mentioned that while, in the initial phase, the main power advantage to Canada will be in downstream benefits returned by the United States, there will be a steady shift in later years to power produced in Canada. Of the three Canadian storages, those in the Arrow Lakes and near Duncan Lake will provide the major returns in the early years, because their value is largely for downstream benefits. The great dam near Mica Creek will produce its largest advantages in the later phase because it makes possible very great power production in Canada. The costs of the Arrow Lakes and Duncan Lake storages are so low in relation to the power return they secure that they can, in effect, go a great distance toward easing the burden of the Mica costs in the early years before its full benefits come in. Similarly our returns from the Libby Dam, if it is built, will come at a very small cost. I have a table (Table 6) that shows the large accumulations of revenue that can be made in the early years from the sales of power deriving from the Arrow Lakes and Duncan Lake storages and downstream from Libby in Canada. These figures are all on the basis that the power is sold at the 4 mill figure I have referred to. The other assumptions are shown and all are, I believe, conservative.

This table shows that, on the basis I have mentioned, the dams at Arrow Lakes and Duncan Lake as well as the new transmission to return

the downstream power, together with the new facilities on the lower Kootenay, can be fully paid for in accumulated revenues by about 1983. The interest on the earned revenues of these projects can more than offset their total annual costs by 1991. The table is based on a decline in downstream power benefits at that time which may or may not occur to the extent assumed. In no event, however, can the projects after that point be net losers. They will, moreover, have served their purpose in securing great amounts of low cost power in the early years and in assisting to make the Mica Dam possible and thus ensuring its enormous benefits in later years.

Implementation of the program under the treaty will require the designation of responsible operating entities in both Canada and the United States. In the case of Canada it is expected that the operating entity will be the British Columbia Power Commission. There will also be a Permanent Engineering Board, consisting of 2 members appointed by Canada and 2 by the United States, to make periodic inspections, to require reports from the operating entities and generally to watch the operation of the plans provided for by the treaty. The Board will report to the governments of Canada and the United States whenever there is a substantial deviation from the hydro-electric and flood control operating plans. The Board will also have additional functions including that of assisting in the reconciliation of any differences on technical or operating matters.

If the entities cannot reconcile any differences that arise between them with the help of the Permanent Engineering Board, or if there are other unresolved differences, the treaty provides that either party to the treaty - that is, either Canada or the United States - may refer the matter to the International Joint Commission. If the Commission does not render a decision within stipulated times, either party may submit the difference to an arbitration tribunal. There is also provision for alternative procedures, if they are agreed on, including reference to the International Court of Justice.

The treaty, if ratified, will remain in force for a minimum of 60 years, terminable on 10 years' notice by either party. There are, however, as I have mentioned, special provisions that extend beyond the minimum 60-year period in relation to flood control and certain diversions of water from the Kootenay River.

I have dealt only with the highlights of this extensive and complex agreement. The government will, of course, submit the entire treaty for consideration by the Parliament of Canada and for its approval before ratification takes place. The timing of ratification will depend so far as Canada is concerned, partly on action by British Columbia. So far as the government of Canada itself is concerned, we would be prepared to initiate action for Parliamentary approval and subsequent ratification at once. The significance of this treaty, and the program contemplated by it, for the economic development of Canada is such that any undue delay would be most unfortunate.

The Government of Canada has made it clear to the Government of British Columbia that it is prepared to join on an equal basis in the financing of the construction costs of the storage dams I have referred to. It has been made clear that we are prepared to do this on a basis that will call for repayment, not on a fixed schedule, but as returns are earned through the sale of power. That offer is still open. My colleague, the Minister of Finance, has made it clear that he stands ready to meet the Premier of British Columbia in order to discuss the offer at any time that may be mutually convenient.

In conclusion, the treaty that is being signed today is without precedent in the relations between nations. It represents a new level of cooperation for mutual advantage. Without the proposed agreement neither country could secure benefits for its people equal to those that can be realized through the action that the treaty contemplates. The treaty is, I believe, fair and equitable to both parties. Its implementation will be a splendid example of cooperation between neighbours. It will also through the great investment involved and by reason of the low-cost power it provides serve as a most important stimulus to the Canadian economy.

Table 1

APPROXIMATE PROJECT AND TRANSMISSION INVESTMENT COSTS

Project	At-Site Investment Cost	Transmission Investment Cost	Total
High Arrow Lakes	$ 71,800,000	$ 81,400,000	$153,200,000
Duncan Lake	$ 25,600,000	$ 2,300,000	$ 27,900,000
Mica Storage	$247,200,000	$ 30,100,000	$277,300,000
Total Cost of Treaty Projects	$344,600,000	$113,800,000	$458,400,000
Estimated Cost of Libby Flowage in Canada	$ 10,000,000	0	$ 10,000,000
Extensions to West Kootenay Area Power Developments	$ 46,000,000	$ 25,400,000	$ 71,400,000
Totals	$400,600,000	$139,200,000	$539,800,000

Table 2

ESTIMATED CANADIAN SHARE OF DOWNSTREAM POWER BENEFITS FOR THE YEAR 1970

Project	Benefits at the Generators		Benefits Adjusted to a 70 per cent Load Factor and Delivered to Loads (1)	
	Capacity in Kilowatts	Energy in Billions of Kilowatt Hours	Capacity in Kilowatts	Energy in Billions of Kilowatt Hours
High Arrow Lakes	771,000	4.240	684,000	4.194
Duncan Lake	145,000	0.657	118,000	0.724
Mica Storage	394,000	1.761	316,000	1.938
Total for Treaty Projects	1,310,000	6.658	1,118,000	6.856
Estimated Downstream Benefits in the West Kootenay Area in Canada from Duncan and Libby Regulation			359,000	2.201
Total Benefits at Loads			1,477,000	9.057

(1) 6 per cent transmission loss assumed for all power delivered to Vancouver and Kamloops areas. No losses assumed for power utilized in the Trail area. In the adjustment to a 70 per cent load factor it is assumed that some Canadian capacity will be exchanged for additional energy.

Table 3

ESTIMATED POWER BENEFITS - 1970 - UNITED STATES AND CANADA[1]

	Project	Share of Increase in Average Annual Usable Energy in Kilowatt Years	Secondary Energy Previously Existing which is "Firmed Up" - Kilowatt Years[2]	Total Increase in Prime Energy in Kilowatt Years	Share of Increase in Dependable Capacity in Kilowatts
Canada	High Arrow	484,000	0	484,000	771,000
	Duncan	75,000	0	75,000	145,000
	Mica Storage	204,000	0	204,000	394,000
	Total	763,000	0	763,000	1,310,000
United States	High Arrow	484,000	161,000	645,000	771,000
	Duncan	75,000	63,000	138,000	145,000
	Mica Storage	204,000	155,000	359,000	394,000
	Total	763,000	379,000	1,142,000	1,310,000

Other power benefits are realized by the United States at the Libby project and downstream in the United States from Libby, and by Canada at the West Kootenay reach in Canada downstream from the Libby and Duncan Lake reservoirs.

1. This table is an expansion of a table appearing in the "Analysis and Progress Report " issued by the United States Columbia River Negotiators on 19 October 1960.
2. There is no additional energy in this column for the United States as a result of the construction of the Canadian Storage. What happens is that energy presently available but not sure at worst possible flow conditions becomes sure at all times, i.e. "firmed up".

Table 4

Estimated Benefits and Costs of One Possible Plan of Development for the Columbia River in Canada [1]

Project [2]	Project Investment Cost - $Millions	Transmission Investment Cost - $Millions	Total Investment Cost - $Millions	Annual Power Benefits at Loads - Billions of KWH (70% load factor)	United States Flood Control Payments $Millions
Canal Flats Diversion and Calamity Curve Project	38.8	10.5	49.3	1.007 [4]	0
Mica Generation	85.0	205.5	290.5	6.938	0
Mica D/S Benefits from the United States	247.2	30.1	277.3	1.938 [5]	1.2
Downie Creek	148.2	118.8	267.0	3.653	0
Revelstoke Canyon	122.1	52.9	175.0	2.488	0
Arrow Lakes D/S Benefits from the United States	71.8	81.4	153.2	4.194 [5]	52.1
Duncan Lake D/S Benefits from the United States	25.6	2.3	27.9	0.724 [5]	11.1
Extensions to West Kootenay and Pend Oreille Area Generation	115.0 [3]	50.4	165.4	4.374	0
Murphy Creek	93.8	11.6	105.4	1.770	0
TOTALS	947.5	563.5	1511.0	27.086	64.4 [6]

1. All projects listed benefit either directly or indirectly from the Columbia River Treaty.
2. Listed in downstream order.
3. Includes estimated cost of Libby flowage in Canada.
4. Includes estimated benefits of Canal Flats diversion realized at downstream plants on the Columbia River in Canada.
5. Estimates of downstream benefits for the year 1970.
6. This total does not include "on call" payments, the total of which is expected to be $7.5 million.

Table 5

FLOOD CONTROL PAYMENTS BY THE UNITED STATES[1]

Project	Payment Made at Commencement of Operation	Value of Payment when Invested in Columbia River Projects (5 1/2 per cent Interest and 50-Yr. Amortization Period)
High Arrow Lakes	$52,100,000	$153,800,000
Duncan Lake	$11,100,000	$ 32,800,000
Mica Storage	$ 1,200,000	$ 3,600,000
Totals	$64,400,000	$190,200,000

1. Payment for primary flood control only, no payment included for secondary flood control requirements.

Table 6

The assumptions used in the calculations for this table (which in most respects are less favourable to Canada than is likely in fact to be the case, especially in relation to numbers 2, 6 and 8) are as follows:

(1) High Arrow Lakes completed or partially completed by 1965; Duncan Lake completed by 1966; Libby completed by 1967; extensions to the Consolidated Mining and Smelting generation facilities in the West Kootenay Area completed in 1969 and further facilities (the Canal Plant) completed in 1970.

(2) No market in the United States for surplus Canadian downstream benefits.

(3) Power sales in Canada made at 4.0 mills per kilowatt hour.

(4) An 8 per cent annual load growth in British Columbia. This is based on load forecasts excluding special industrial loads such as Kitimat.

(5) An interest rate of 5 1/2 per cent applied to both construction costs and accumulated operating benefits or deficits.

(6) No co-ordination agreement with the United States and thus a continuing annual charge of $1.50 per kilowatt for downstream capacity benefit stand-by transmission.

(7) Capacity benefits traded for energy benefits at the rate of 1.65 kilowatts of capacity for 1.00 kilowatt years of energy, giving an end result at a 70 per cent load factor.

(8) An average reduction in downstream benefits of 100 million kilowatt hours annually in the 1970 to 1985 period and a reduction of 169 million kilowatt hours annually in the 1986 to 2010 period.

Table 6 (Continued)

Financial Analysis of Canadian Benefits from Arrow Lakes, Duncan Lake and the Kootenay Extensions Below Libby [1]

Year	Projects Completed	Incremental Power Sales In British Columbia KWH x 10^9	Incremental Power Revenues At 4.0 Mills Per KWH $Million	Flood Control Revenues $Million	Total Revenues $Million	Project Annual Cost (5 1/2% Int.) $Million	Transmission Annual Cost [3] (5 1/2% Int.) $Million	Total Annual Costs (5 1/2% Int.) $Million	Net Annual Revenue $Million	Accumulated Net Revenue to Date $Million	Annual Profit On Net Revenue (5 1/2% Int.) $Million
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1965	Arrow Lakes	0.288	1.152	52.100	53.252	4.670	6.592	11.262	41.990	41.990	2.309
66	Duncan Lake [2]	1.361	5.444	11.100	16.544	6.892	6.888	13.780	2.764	47.063	2.588
67		2.434	9.736	0	9.736	6.892	7.183	14.075	- 4.339	45.312	2.492
68		3.691	14.764	0	14.764	6.892	7.710	14.602	0.162	47.966	2.638
69	Extensions in West Kootenay	5.041	20.164	0	20.164	7.463	8.159	15.622	4.542	55.146	3.033
1970	Canal Project	6.543	26.172	0	26.172	10.239	9.950	20.189	5.983	64.162	3.529
71		6.995	27.980	0	27.980	10.239	9.924	20.163	7.817	75.508	4.153
72		6.895	27.580	0	27.580	10.239	9.898	20.137	7.443	87.104	4.791
73		6.795	27.180	0	27.180	10.239	9.872	20.111	7.069	98.964	5.443
74		6.695	26.780	0	26.780	10.239	9.846	20.085	6.695	111.102	6.111
75		6.595	26.380	0	26.380	10.239	9.820	20.059	6.321	123.534	6.794
76		6.495	25.980	0	25.980	10.239	9.794	20.033	5.947	136.275	7.495
77		6.395	25.580	0	25.580	10.239	9.768	20.007	5.573	149.343	8.214
78		6.295	25.180	0	25.180	10.239	9.742	19.981	5.199	162.756	8.952
79		6.195	24.780	0	24.780	10.239	9.716	19.955	4.825	176.533	9.709
1980		6.095	24.380	0	24.380	10.239	9.690	19.929	4.451	190.693	10.488
81		5.995	23.980	0	23.980	10.239	9.664	19.903	4.077	205.258	11.289
82		5.895	23.580	0	23.580	10.239	9.638	19.877	3.703	220.250	12.114
83		5.795	23.180	0	23.180	10.239	9.612	19.851	3.329	235.693	12.963
84		5.695	22.780	0	22.780	10.239	9.586	19.825	2.955	251.611	13.839
85		5.632	22.528	0	22.528	10.239	9.560	19.799	2.729	268.179	14.750
86		5.463	21.852	0	21.852	10.239	9.516	19.755	2.097	285.026	15.676
87		5.294	21.176	0	21.176	10.239	9.472	19.711	1.465	302.167	16.619
88		5.125	20.500	0	20.500	10.239	9.428	19.667	.833	319.619	17.579
89		4.956	19.824	0	19.824	10.239	9.384	19.623	.201	337.399	18.557
1990		4.787	19.148	0	19.148	10.239	9.340	19.579	- .431	355.525	19.554
1991	[4]	4.618	18.472	0	18.472	10.239	9.296	19.535	-1.063	374.016	20.571 [4]

Notes: 1. This analysis does not include Mica which, in addition to its substantial downstream benefit advantage under the Treaty will made possible very large power production in Canada.

2. Cost of Libby flowage in Canada added in 1966.

3. Annual transmission costs include the $1.50 per kw. paid to U.S. for standby downstream benefit transmission.

4. Interest on accumulated benefits has exceeded annual costs at this point. Interest will continue to increase and costs will continue to decline from here on. The profitability of the projects is thus assured. Substantial power benefits will continue to be derived.

STATEMENT OF THE
PRIME MINISTER IN THE HOUSE OF COMMONS TABLING
THE TREATY AND PRESS RELEASE

Wednesday, 18 January 1961.

Right Honourable John G. Diefenbaker (Prime Minister): Mr. Speaker, as the House knows the Columbia River treaty was signed in Washington yesterday. The President and Secretary of State and the Under-Secretary of the Interior signed for the United States of America. The treaty was signed for Canada by myself together with the Minister of Justice and the Canadian ambassador at Washington.

I indicated the other day that I would table at the earliest possible date copies of the treaty and also the statement I made outlining some of the features and particulars of that treaty. In view of the wide-spread interest in these documents I propose that with the consent of the House they be printed as an appendix to Hansard.

May I say that in the signing of this tremendous treaty the course followed was one that gave emphasis to the importance of the occasion. The fact is that it was the last major official discharge of responsibility on the part of the President of the United States. That fact gives it emphasis. During the course of our stay there the Minister of Justice, myself and several representatives from the two countries were entertained at luncheon at the White House, the last function of the kind that will take place during the presidency of Dwight D. Eisenhower.

I agree with the remarks that were made at the conclusion of this treaty, that it represents a major advance in co-operation by the two nations without the sacrifice of the rights, the sovereignty or otherwise of either country, and is indeed a landmark in responsible joint action by nations for their economic betterment.

With the leave of the House, as I indicated earlier, I therefore wish to table the treaty in both English and French, and the summary in both languages.

EXCERPT FROM JOINT COMMUNIQUE ISSUED 11 MAY 1963
BY THE OFFICE OF THE PRIME MINISTER
AND THE OFFICE OF THE WHITE HOUSE PRESS SECRETARY
FOLLOWING MEETINGS BETWEEN
PRESIDENT JOHN F. KENNEDY
AND PRIME MINISTER LESTER B. PEARSON
AT HYANNIS PORT, MASSACHUSETTS, 10-11 MAY 1963

9. While it is essential that there should be respect for the common border which symbolizes the independence and national identity of two countries, it is also important that this border should not be a barrier to cooperation which could benefit both of them. Wise cooperation across the border can enhance rather than diminish the sovereignty of each country by making it stronger and more prosperous than before.

10. In this connection the President and the Prime Minister noted especially the desirability of early progress on the cooperative development of the Columbia River. The Prime Minister indicated that if certain clarifications and adjustments in arrangements proposed earlier could be agreed on, to be included in a protocol to the treaty, the Canadian Government would consult at once with the provincial Government of British Columbia, the province in which the Canadian portion of the river is located, with a view to proceeding promptly with the further detailed negotiations required with the United States and with the necessary action for approval within Canada. The President agreed that both Governments should immediately undertake discussions on this subject looking to an early agreement.

CANADA - BRITISH COLUMBIA AGREEMENT

THIS AGREEMENT made this 8th day of July, 1963

BETWEEN THE GOVERNMENT OF CANADA, herein referred to as "Canada",

AND THE GOVERNMENT OF BRITISH COLUMBIA, herein referred to as "British Columbia",

WHEREAS a Treaty between Canada and the United States of America relating to Cooperative Development of the water resources of the Columbia River Basin has been signed on the 17th day of January 1961; and

WHEREAS it is desirable that an Agreement be made between Canada and British Columbia concerning implementation of the Treaty and disposal of benefits arising thereunder:

NOW THEREFORE THIS AGREEMENT WITNESSETH:

1. In this Agreement

"Treaty" means "The Treaty between Canada and the United States of America relating to cooperative development of the Water Resources of the Columbia River Basin" signed at Washington, District of Columbia, United States of America on the 17th day of January, 1961, together with any protocol or exchange of notes relating thereto.

2. All proprietary rights, title and interests arising under the Treaty and particularly those with respect to

(a) downstream power benefits accruing to Canada,

(b) proceeds from the sale of downstream power benefits in the United States of America,

(c) monies payable and electric power accruing to Canada in return for flood control,

(d) The stand-by transmission services rendered by transmission grids in the United States of America,

(e) benefits arising in Canada from any dam constructed pursuant to the Treaty,

(f) rights of water diversion granted to Canada by Article XIII of the Treaty, and

(g) monies paid to Canada by the United States of America in settlement of any claim made by Canada under the Treaty which relates in any way to the obligations of British Columbia under this Agreement

belong to British Columbia absolutely for its own use,

3. British Columbia shall at its own expense;

(a) construct or arrange for the construction of all the dams and operate or arrange for the operation of all of the storages as required by Articles II and IV of the Treaty;

(b) not operate and prevent the operation of any storage in British Columbia in the manner prohibited by Article IV(5) of the Treaty;

(c) prepare and make available for flooding the land in Canada required for the purposes of any dam constructed by the United States of America under Article XII of the Treaty;

(d) not make and prevent the making of any diversion of water prohibited by Article XIII of the Treaty;

(e) carry out or arrange for the carrying out of any variation in operation of any Kootenay River diversion agreed upon pursuant to Article XIII(6) of the Treaty;

(f) abide by and carry out or arrange for the carrying out of any decisions made pursuant to Article XVI of the Treaty which relate in any way to the obligations of British Columbia under this Agreement;

(g) pay to Canada, upon demand therefor, all costs incurred by Canada in connection with proceedings under Article XVI of the Treaty which relate in any way to the obligations of British Columbia under this Agreement;

(h) carry out or arrange for the carrying out of anything required to be done by Canada under Article XVIII(3) of the Treaty;

(i) carry out and give full force and effect to all conditions, provisions, orders and decisions imposed or made by the Permanent Engineering Board established by the Treaty; and

(j) generally do all those things which constitutionally it is capable of doing to ensure that Canada is not in default under the Treaty and not do and so far as it is constitutionally capable prevent any person from doing anything which Canada has under the Treaty undertaken to refrain from doing.

4. (1) It is acknowledged and agreed that Canada has the right and obligation to do all things which the Treaty requires Canada to do that British Columbia has not undertaken to do by this Agreement.

(2) Notwithstanding subsection (1) of this section Canada shall obtain the concurrence of British Columbia before;

(a) confirming by exchange of notes any operating plan pursuant to Article IV of the Treaty;

(b) making any election pursuant to Article VI(5) of the Treaty relating to payment for flood control;

(c) agreeing to any variation of entitlement to downstream power benefits pursuant to Article IX of the Treaty;

(d) confirming any electrical coordination arrangement made pursuant to the Treaty;

(e) agreeing to any diversion of water by the United States of America pursuant to Article XIII of the Treaty;

(f) agreeing, as provided for in Article XIII(6) of the Treaty, to any variation in the use of water diverted by British Columbia pursuant to that Article;

(g) charging the entities designated pursuant to Article XIV of the Treaty with any new power or duty; and

(h) terminating the Treaty.

5. Canada shall, if requested by British Columbia, endeavour to obtain the agreement of the United States of America with respect to;

(a) any variation of the operation of any dam constructed under Article XII of the Treaty;

(b) any modification of the area of land in Canada required for the purposes of any dam constructed under Article XII of the Treaty;

(c) any diversions of water not provided for by the Treaty;

(d) any new power or duty which British Columbia wishes to impose upon the entities designated under Article XIV of the Treaty;

(e) any direction which British Columbia with the concurrence of Canada wishes given to the Permanent Engineering Board established by the Treaty; and

(f) any proposal relating to the Treaty which Canada and British Columbia agree is in the public interest.

6. (1) Canada shall designate the British Columbia Hydro and Power Authority as the Canadian entity for the purposes of Article XIV of the Treaty and British Columbia shall ensure that the British Columbia Hydro and Power Authority fulfills the obligations imposed on the Canadian entity by the Treaty.

(2) British Columbia may nominate one of the two persons to be appointed to the Permanent Engineering Board established by the Treaty and Canada shall upon such nomination appoint the nominee to that Board.

7. (1) Canada shall do whatever is reasonably possible to ensure compliance with the Treaty by the United States of America and shall not waive any default or breach by the United States of America without having consulted British Columbia.

(2) Canada shall, at the request of British Columbia, present any claim deemed reasonable by Canada arising under the Treaty which British Columbia wishes made against the United States of America.

(3) Canada shall establish any arbitration tribunal necessary to settle differences under the Treaty and shall, after consultation with British Columbia, defend or prosecute, as the case may be, all differences submitted to such tribunal or to the International Joint Commission under the Treaty.

8. (1) British Columbia shall indemnify and save harmless Canada from and in respect to any liability of Canada to the United States of America arising under the Treaty.

(2) British Columbia shall not be required to indemnify Canada pursuant to subsection (1) of this section in respect of any liability to the United States of America directly attributable to any action or failure to take action by Canada.

(3) Canada shall not discharge any liability in respect of which it is indemnified pursuant to subsection (1) of this section without having consulted with British Columbia.

9. British Columbia shall maintain or arrange for the maintenance of complete accounts and records relating to;

(a) the discharge of the obligations of British Columbia under this Agreement;

(b) the receipt and ultimate disposal of all monies derived from the sale in the United States of America of any downstream power benefits arising under the Treaty;

(c) the receipt and ultimate disposal of all monies and other compensation derived from the provision of flood control under the Treaty; and

shall comply with or arrange for compliance with any reasonable request for disclosure of any such account or record made by Canada or the Permanent Engineering Board established by the Treaty.

10. (1) Canada shall transfer to British Columbia the administration and control of any unimproved lands in Canada belonging to Canada which are required for the construction and operation of the dams and storages which British Columbia is obligated by this Agreement to construct or operate.

(2) For the purposes of subsection (1) of this section the expression "lands" does not include lands forming part of an Indian Reserve.

11. (1) As soon as may be convenient after execution of this Agreement, Canada shall undertake negotiations with the United States of America with a view to entering into a protocol to the Treaty embodying certain matters agreed to by Canada and British Columbia and Canada shall thereafter with due diligence proceed toward ratification of the Treaty.

(2) Any protocol entered into pursuant to subsection (1) of this section shall be attached to this Agreement as Schedule A and shall form part of this Agreement.

12. (1) Canada agrees that the downstream power benefits arising in the United States of America under the Treaty may be sold in the United States of America subject to terms that are acceptable to both Canada and British Columbia and that will ensure that the proceeds of the sale will contribute to savings in the cost of electric power in the Province of British Columbia.

(2) Any agreement concluded under subsection (1) of this section with respect to the sale of downstream power benefits shall be attached to this Agreement as Schedule B and shall form part of the Agreement.

(3) British Columbia will finance the Treaty projects by use of the funds derived from the sale of the downstream power benefits arising in the United States of America, from the flood control benefits and from other sources as required, so that Canada shall have no obligation for the financing of these Treaty projects.

13. (1) The construction of the dams and operation of the storages required by the Treaty shall be carried out in accordance with all laws in force from time to time whether those of Canada or British Columbia.

(2) British Columbia shall take whatever steps are necessary to amend or repeal any law, permit or regulation and shall not enact any new law or regulation or issue any permit which may operate to frustrate, hamper or interfere with the carrying out of any undertaking in the territory of Canada provided for by the Treaty.

(3) Canada shall do everything possible to expedite the issue of all licences and permits required under the laws of Parliament by either British Columbia or the British Columbia Hydro and Power Authority in order for them to carry out and perform their obligations under this agreement, including Schedules A and B.

14. Canadian labour and material shall be used in all construction or operation of the dams and storages constructed or operated pursuant to this Agreement to the full extent to which they are procurable, consistent with proper economy and the expeditious carrying out of the construction and operation and no person shall be discriminated against in the course of the construction and operation by reason of his race, colour, religion or political affiliation.

15. (1) Canada and British Columbia will consult as required on technical and other matters of mutual interest with a view to facilitating the implementation of the Treaty, avoiding disputes and carrying out this Agreement.

(2) In particular a Liaison Committee shall be established consisting of senior representatives of Canada and British Columbia.

(3) If differences or questions arise or allegations are made as to loss arising out of any action or failure to take action by either Canada or British Columbia which cannot be resolved through consultation they shall be submitted to the Exchequer Court of Canada for decision and that Court has jurisdiction to determine the rights and liabilities of either party under this Agreement.

(4) British Columbia shall, in respect of itself, procure the enactment of whatever legislation is necessary to implement subsection (3) of this section.

16. (1) British Columbia agrees that generators will be installed in the dam at Mica Creek as soon as economically feasible.

(2) Subject to the requirements of British Columbia, British Columbia will make available to other provinces of Canada, through a national grid or otherwise, on a first call basis, electric power from the Columbia River and other power developments in the Province of British Columbia at prices not higher than those obtainable by British Columbia from time to time from the United States of America for any comparable British Columbia entity electric power exported thereto.

17. This Agreement binds Canada and British Columbia from the date of the Agreement and thereafter so long as any obligation or right of either the United States of America or Canada exists under the Treaty or any part thereof.

IN WITNESS WHEREOF THE UNDERSIGNED, DULY AUTHORIZED BY THEIR RESPECTIVE GOVERNMENTS HAVE SIGNED AND DELIVERED THIS AGREEMENT,

For the Government of Canada on the 8th day of July, 1963

(Signed)	L.B. Pearson	Prime Minister
(Signed)	Paul Martin	Secretary of State for External Affairs

For the Government of British Columbia on the 8th day of July, 1963

(Signed)	W.A.C. Bennett	Premier and President of the Executive Council
(Signed)	R.G. Williston	Minister of Lands, Forests and Water Resources

CANADA - BRITISH COLUMBIA AGREEMENT

THIS AGREEMENT made this 13th day of January, 1964

BETWEEN THE GOVERNMENT OF CANADA, herein referred to as "Canada",

AND THE GOVERNMENT OF BRITISH COLUMBIA, herein referred to as "British Columbia",

WHEREAS Canada and British Columbia entered into an agreement on the 8th day of July, 1963, herein referred to as the "Main Agreement";

AND WHEREAS as contemplated by the Main Agreement negotiations with the United States of America have been completed concerning a Protocol to the Treaty and the Terms of Sale of Canada's downstream power benefits, each of which is attached hereto and herein referred to as the "Protocol" and the "Terms of Sale" respectively;

AND WHEREAS the Protocol and Terms of Sale are satisfactory to both Canada and British Columbia:

NOW THEREFORE THIS AGREEMENT FURTHER WITNESSETH:

1. Canada shall as soon as it receives the purchase price referred to in the Terms of Sale or other monies under The Treaty pay the full equivalent thereof, in Canadian dollars, to British Columbia and British Columbia shall assume the remaining obligation of Canada under Section A.3 of the Terms of Sale.

2. Notwithstanding section 3(a) of the Main Agreement British Columbia shall observe the time schedule relating to the Treaty Storages set out in the Terms of Sale.

3. British Columbia shall at all times hereafter keep Canada indemnified against all liability to

(a) the United States of America,

(b) the entity designated by the United States of America for the purposes of Article XIV of the Treaty, or

(c) the private Purchaser contemplated by the Terms of Sale,

arising under

(d) the Protocol,

(e) the Terms of Sale, or

(f) any Exchange of Notes hereafter made by Canada pursuant to the Treaty and in accordance with the Main Agreement

and from and in respect of all actions, proceedings, claims, damages, costs and expenses whatsoever in relation thereto other than any liability, action, proceeding, claim, damages, costs and expenses incurred by Canada which is directly attributable to any action or failure to take action by Canada.

4. (1) Where any payment ordered by the Exchequer Court to be paid by British Columbia to Canada remains unpaid for 60 days Canada may at any time thereafter recover the amount of the payment by deduction from monies owing to British Columbia by Canada on any account.

(2) The rights given in this section are in addition to all other rights and remedies which Canada has.

5. British Columbia shall, at reasonable intervals, provide current reports to Canada on the progress of construction of the Treaty Storages.

6. This agreement is supplemental to the Main Agreement and except as specifically provided in this agreement the Main Agreement remains in full force and effect and operates according to the meaning and intent thereof.

7. This agreement binds Canada and British Columbia from the date hereof and thereafter so long as any obligation or right of either the United States of America or Canada exists under the Treaty, the Protocol or any Notes exchanged thereunder.

IN WITNESS WHEREOF THE UNDERSIGNED, DULY AUTHORIZED BY THEIR RESPECTIVE GOVERNMENTS, HAVE SIGNED AND DELIVERED THIS AGREEMENT,

For the Government of Canada on the 13th day of January, 1964

(Signed)	L.B. Pearson	Prime Minister
(Signed)	Paul Martin	Secretary of State for External Affairs

For the Government of British Columbia on the 12th day of January, 1964

(Signed)	W.A.C. Bennett	Premier and President of the Executive Council
(Signed)	Ray G. Williston	Minister of Lands, Forests and Water Resources

Ottawa, 22 January 1964

Sir,

I have the honour to refer to discussions which have been held between representatives of the Government of Canada and of the Government of the United States of America regarding the Treaty between Canada and the United States of America relating to cooperative development of the water resources of the Columbia River Basin signed at Washington on 17 January 1961. On the basis of these discussions, the Government of Canada understands that the two Governments have agreed to the terms of the attached Protocol.

I should like to propose that, if agreeable to your Government, this Note together with the Protocol attached thereto and your reply, shall constitute an agreement between our two Governments relating to the carrying out of the provisions of the Treaty with effect from the date of the exchange of instruments of ratification of the Treaty.

Accept, Sir, the renewed assurances of my highest consideration.

Secretary of State for
External Affairs

The Honourable
Dean Rusk,
Secretary of State of the
United States of America,
Washington.

ANNEX TO EXCHANGE OF NOTES DATED 22 JANUARY 1964 BETWEEN THE GOVERNMENTS OF CANADA AND THE UNITED STATES REGARDING THE COLUMBIA RIVER TREATY

PROTOCOL

1. If the United States entity should call upon Canada to operate storage in the Columbia River Basin to meet flood control needs of the United States of America pursuant to Article IV(2) (b) or Article IV(3) of the Treaty, such call shall be made only to the extent necessary to meet forecast flood control needs in the territory of the United States of America that cannot adequately be met by flood control facilities in the United States of America in accordance with the following conditions:

(1) Unless otherwise agreed by the Permanent Engineering Board, the need to use Canadian flood control facilities under Article IV(2) (b) of the Treaty shall be considered to have arisen only in the case of potential floods which could result in a peak discharge in excess of 600,000 cubic feet per second at The Dalles, Oregon, assuming the use of all related storage in the United States of America existing and under construction in January 1961, storage provided by any dam constructed pursuant to Article XII of the Treaty and the Canadian storage described in Article IV(2) (a) of the Treaty.

(2) The United States entity will call upon Canada to operate storage under Article IV(3) of the Treaty only to control potential floods in the United States of America that could not be adequately controlled by all the related storage facilities in the United States of America existing at the expiration of 60 years from the ratification date but in no event shall Canada be required to provide any greater degree of flood control under Article IV(3) of the Treaty than that provided for under Article IV(2) of the Treaty.

(3) A call shall be made only if the Canadian entity has been consulted whether the need for flood control is, or is likely to be, such that it cannot be met by the use of flood control facilities in the United States of America in accordance with subparagraphs (1) or (2) of this paragraph. Within ten days of receipt of a call, the Canadian entity will communicate its acceptance, or its rejection or proposals for modification of the call, together with supporting considerations. When the communication indicates rejection or modification of the call the United States entity will review the situation in the light

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of the communication and subsequent developments and will then withdraw or modify the call if practicable. In the absence of agreement on the call or its terms the United States entity will submit the matter to the Permanent Engineering Board provided for under Article XV of the Treaty for assistance as contemplated in Article XV(2) (c) of the Treaty. The entities will be guided by any instructions issued by the Permanent Engineering Board. If the Permanent Engineering Board does not issue instructions within ten days of receipt of a submission the United States entity may renew the call for any part or all of the storage covered in the original call and the Canadian entity shall forthwith honor the request.

2. In preparing the flood control operating plans in accordance with paragraph 5 of Annex A of the Treaty, and in making calls to operate for flood control pursuant to Articles IV(2) (b) and IV(3) of the Treaty, every effort will be made to minimize flood damage both in Canada and the United States of America.

3. The exchange of Notes provided for in Article VIII(1) of the Treaty shall take place contemporaneously with the exchange of the Instruments of Ratification of the Treaty provided for in Article XX of the Treaty.

4. (1) During the period and to the extent that the sale of Canada's entitlement to downstream power benefits within the United States of America as a result of an exchange of Notes pursuant to Article VIII(1) of the Treaty relieves the United States of America of its obligation to provide east-west standby transmission service as called for by Article X(1) of the Treaty, Canada is not required to make payment for the east-west standby transmission service with regard to Canada's entitlement to downstream power benefits sold in the United States of America.

(2) The United States of America is not entitled to any payments of the character set out in subparagraph (1) of this paragraph in respect of that portion of Canada's entitlement to downstream power benefits delivered by the United States of America to Canada at any point on the Canada-United States of America boundary other than at a point near Oliver, British Columbia, and the United States of America is not required to provide the east-west standby transmission service referred to in subparagraph (1) of this paragraph in respect of the portion of Canada's entitlement to downstream power benefits which is so delivered.

5. Inasmuch as control of historic streamflows of the Kootenay River by the dam provided for in Article XII(1) of the Treaty would result in

more than 200,000 kilowatt years per annum of energy benefit downstream in Canada, as well as important flood control protection to Canada, and the operation of that dam is therefore of concern to Canada, the entities shall, pursuant to Article XIV(2) (a) of the Treaty, cooperate on a continuing basis to coordinate the operation of that dam with the operation of hydro-electric plants on the Kootenay River and elsewhere in Canada in accordance with the provisions of Article XII(5) and Article XII(6) of the Treaty.

6. (1) Canada and the United States of America are in agreement that Article XIII(1) of the Treaty provides to each of them a right to divert water for a consumptive use.

(2) Any diversion of water from the Kootenay River when once instituted under the provisions of Article XIII of the Treaty is not subject to any limitation as to time.

7. As contemplated by Article IV(1) of the Treaty, Canada shall operate the Canadian storage in accordance with Annex A and hydro-electric operating plans made thereunder. Also, as contemplated by Annexes A and B of the Treaty and Article XIV (2) (k) of the Treaty, these operating plans before they are agreed to by the entities will be conditioned as follows:

(1) As the downstream power benefits credited to Canadian storage decrease with time, the storage required to be operated by Canada pursuant to paragraphs 6 and 9 of Annex A of the Treaty, will be that required to produce those benefits.

(2) The hydro-electric operating plans, which will be based on Step I of the studies referred to in paragraph 7 of Annex B of the Treaty, will provide a reservoir-balance relationship for each month for the whole of the Canadian storage committed rather than a separate relationship for each of the three Canadian storages. Subject to compliance with any detailed operating plan agreed to by the entities as permitted by Article XIV(2) (k) of the Treaty, the manner of operation which will achieve the specific storage or release of storage called for in a hydro-electric operating plan consistent with optimum storage use will be at the discretion of the Canadian entity.

(3) Optimum power generation at-site in Canada and downstream in Canada and the United States of America referred to in paragraph 7 of Annex A of the Treaty will include power generation at-site and downstream in Canada of the Canadian storages referred to in Article II(2) of the Treaty, power generation in Canada which is coordinated therewith, downstream power benefits from the Canadian storage which are produced in the United States of America and measured

under the terms of Annex B of the Treaty, power generation in the Pacific Northwest Area of the United States of America and power generation coordinated therewith.

8. The determination of downstream power benefits pursuant to Annex B of the Treaty, in respect of each year until the expiration of thirty years from the commencement of full operation in accordance with Article IV of the Treaty of that portion of the Canadian storage described in Article II of the Treaty which is last placed in full operation, and thereafter until otherwise agreed upon by the entities, shall be based upon stream flows for the thirty-year period beginning July 1928 as contained in the report entitled "Extension of Modified Flows Through 1958 - Columbia River Basin" and dated June 1960, as amended and supplemented to 29 June 1961, by the Water Management Subcommittee of the Columbia Basin Inter-Agency Committee.

9. (1) Each load used in making the determinations required by Steps II and III of paragraph 7 of Annex B of the Treaty shall have the same shape as the load of the Pacific Northwest area as that area is defined in that paragraph.

(2) The capacity credit of Canadian storage shall not exceed the difference between the firm load carrying capabilities of the projects and installations included in Step II of paragraph 7 of Annex B of the Treaty and the projects and installations included in Step III of paragraph 7 of Annex B of the Treaty.

10. In making all determinations required by Annex B of the Treaty the loads used shall include the power required for pumping water for consumptive use into the Banks Equalizing Reservoir of the Columbia Basin Federal Reclamation Project but mention of this particular load is not intended in any way to exclude from those loads any use of power that would normally be part of such loads.

11. In the event operation of any of the Canadian storages is commenced at a time which would result in the United States of America receiving flood protection for periods longer than those on which the amounts of flood control payments to Canada set forth in Article VI(1) of the Treaty are based, the United States of America and Canada shall consult as to the adjustments, if any, in the flood control payments that may be equitable in the light of all relevant factors. Any adjustment would be calculated over the longer period or periods on the same basis and in the same manner as the calculation of the amounts set forth in Article VI(1) of the Treaty. The consultations shall begin promptly upon the determination of definite dates for the commencement of operation of the Canadian storages.

12. Canada and the United States of America are in agreement that the Treaty does not establish any general principle or precedent applicable to waters other than those of the Columbia River Basin and does not detract from the application of the Boundary Waters Treaty, 1909, to other waters.

Washington, 22 January 1964

Sir,

I have the honor to refer to your Note dated 22 January 1964, together with the Annex thereto regarding the Treaty between Canada and the United States of America relating to cooperative development of the water resources of the Columbia River Basin signed at Washington on 17 January 1961.

I wish to advise you that the Government of the United States of America agrees that your Note with the Annex thereto, together with this reply, shall constitute an agreement between our two Governments relating to the carrying out of the provisions of the Treaty with effect from the date of the exchange of instruments of ratification of the Treaty.

Accept, Sir, the renewed assurances of my highest consideration.

Secretary of State

The Honorable
Paul Martin, P.C., Q.C.,
Secretary of State for External Affairs,
Ottawa.

UNITED STATES NOTE

Washington, 22 January 1964.

Sir,

I have the honor to refer to the discussions which have been held between representatives of the Government of Canada and of the Government of the United States of America regarding a sale of Canada's entitlement to downstream power benefits under the Treaty between Canada and the United States of America relating to Cooperative Development of the Water Resources of the Columbia River Basin, signed on 17 January 1961.

On the basis of these discussions my Government understands that the two Governments recognize that it would be in the public interest of both countries if Canada's entitlement to downstream power benefits could be disposed of, as contemplated by Article VIII of the Treaty, in accordance with general conditions and limits similar to those set out in detail in the attachment hereto, and further, that before such a disposition can be concluded and confirmed by the two Governments, additional steps must be taken in each country. Therefore, in furtherance of this aim, it is understood the two Governments are agreed that:

(a) the Government of the United States will use its best efforts to arrange for disposition of Canada's entitlement to downstream power benefits within the United States of America in accordance with the general conditions and limits set forth in the attachment, and

(b) the Government of Canada will use its best efforts to accomplish all those things which are considered necessary and preliminary to ratification of the Treaty as quickly as possible, including any arrangements for implementation and acceptance of the general conditions and limits set forth in the attachment.

I should like to propose that if agreeable to your Government this Note together with the attachment and your reply shall constitute an agreement by our Governments relating to the Treaty.

Accept, Sir, the renewed assurances of my highest consideration.

Secretary of State

The Honorable
Paul Martin, P.C., Q.C.,
Secretary of State for External Affairs,
Ottawa.

ATTACHMENT RELATING TO TERMS OF SALE

A. The disposition shall consist of the downstream power benefits to which Canada is entitled under the Treaty, other than Canada's entitlement to downstream power benefits resulting from the construction or operation of a project described in Article IX of the Treaty, and shall be by way of a contract of sale authorized in accordance with Article VIII of the Treaty between the British Columbia Hydro and Power Authority and a single Purchaser containing provisions mutually satisfactory to the parties to the contract but shall be subject to and be operative in accordance with the following general conditions and limits:

1. (a) The storages described in Article II of the Treaty shall be fully operative for power purposes in accordance with the following schedule:

Storage described in Article II (2) (c) - approximately 1,400,000 acre-feet on 1 April 1968,

Storage described in Article II (2) (b) - approximately 7,100,000 acre-feet on 1 April 1969,

Storage described in Article II (2) (a) - approximately 7,000,000 acre-feet on 1 April 1973.

(b) The period of sale of the entitlement allocated to each of the storages shall terminate and expire thirty years from the date on which that storage is required to be fully operative for power purposes in accordance with the schedule in subparagraph (a) of this paragraph.

(c) In the event any storage is not fully operative in accordance with the schedule in subparagraph (a) of this paragraph or if, during the period of sale, the storage is not operated as required by the hydro-electric operating plans agreed upon in accordance with the Treaty, as modified by any detailed operating plan agreed upon in accordance with Article XIV (2) (k) of the Treaty, and the Canadian entitlement is thereby reduced, the British Columbia Hydro and Power Authority shall pay the Purchaser an amount equal to the cost it would have to incur to replace that part of the reduction in the Canadian entitlement which the vendees of the Purchaser could have used other than costs that could have been avoided had every reasonable effort to mitigate losses been made by the Purchaser, the United States entity and the owners of non-federal dams on the Columbia River

in the United States of America. Alternatively, the British Columbia Hydro and Power Authority may, at its option, supply power to the Purchaser in an amount which assures that the Purchaser receives the capacity and energy which would have constituted that part of the reduction in the Canadian entitlement that the vendees of the Purchaser could have used if there had been no default, together with appropriate adjustments to reflect transmission costs in the United States of America, delivery to be made when the loss of power would otherwise have occurred.

If the assurance described in paragraph B. 5. of this Attachment is given to the Purchaser, the United States entity may succeed to all the rights of the Purchaser and its vendees to receive the entire Canadian entitlement, or that part that could be used by the vendees, and to be compensated by British Columbia Hydro and Power Authority in the event of non-receipt thereof. The United States entity agrees that before it purchases more costly power from any third party for the purpose of supplying the necessary amount of the Canadian entitlement to the Purchaser, it will first cause to be delivered to the Purchaser, or for its account, any available surplus capacity or energy from the United States Federal Columbia River System and compensation to the United States entity because of such deliveries shall be computed by applying the then applicable rate schedules of the Bonneville Power Administration to the deliveries.

In the event of disagreement, determination of compensation in money or power due under this paragraph shall be resolved by arbitration and shall be confined to the actual loss incurred in accordance with the principles in this paragraph. "

(d) For the purpose of allocating downstream power benefits among the Treaty storages from 1 April 1998 to 1 April 2003, the percentage of downstream power benefits allocated to each Treaty storage shall be the percentage of the total of the Treaty storages provided by that storage.

2. For the period of the sale the British Columbia Hydro and Power Authority shall operate and maintain the Treaty storages in accordance with the provisions of the Treaty.

3. (a) The purchase price of the entitlement shall be $254,400,000 in United States funds as of 1 October 1964, subject to adjustment, in the event of an earlier payment of all or part thereof, to the then present worth, at a discount rate of 4 1/2 per cent per annum.

(b) The purchase price shall be paid to Canada contemporaneously with the exchange of ratifications of the Treaty and shall be applied towards the cost of constructing the Treaty projects through a transfer of the purchase price by Canada to the Government of British Columbia, pursuant to arrangements deemed satisfactory to Canada, to be entered into between Canada and the Government of British Columbia.

4. If, during the period of the sale, there is any reduction in Canada's entitlement to downstream power benefits which results from action taken by the Canadian entity pursuant to paragraph 7 of Annex A of the Treaty, the British Columbia Hydro and Power Authority shall, by supplying power to the Purchaser, or otherwise as may be agreed, offset that reduction in a manner so that the Purchaser will be compensated therefor.

5. The Purchaser shall have and may exercise the rights of the British Columbia Hydro and Power Authority relating to the negotiation and conclusion with the United States entity, of proposals relating to the exchanges authorized by Article VIII (2) of the Treaty with respect to any portion of Canada's entitlement to downstream power benefits sold to the Purchaser.

B. The Notes to be exchanged pursuant to Article VIII (1) of the Treaty shall contain, inter alia, provisions incorporating the following requirements:

1. As soon as practicable after start of construction of each Treaty project the Canadian and United States entities shall agree upon a program for filling the storage provided by the project. The filling program shall have the objective of having the storage described in Article II (2) (c) and Article II (2) (b) of the Treaty full by 1 September following the date when the storages become fully operative and the storage provided by the dam mentioned in Article II (2) (a) of the Treaty full to 15 million acre-feet by 1 September 1975. This objective shall be reflected in the hydro-electric operating plans and shall take into account generating requirements at-site and downstream in Canada and the United States of America to meet loads.

2. In the event the United States of America becomes entitled to compensation in respect of a breach of the obligation under Article IV (6) of the Treaty to commence full operation of a storage, compensation payable to the United States of America under Article XVIII (5) (a) of the Treaty shall be made in an amount equal to 2.70 mills per kilowatt-hour, and 46 cents per kilowatt of dependable capacity for each month or fraction thereof, in United States funds, for and in lieu of the power which would have been forfeited under Article XVIII (5) (a) of the Treaty if

Canada's entitlement to downstream power benefits had not been sold in the United States of America. Alternatively, Canada may, at its option, supply capacity and energy to the United States entity in an amount equal to that which would have been forfeited, together with appropriate adjustments to reflect transmission costs in the United States of America, delivery to be made when the loss would otherwise have occurred.

3. A diminution of Canada's entitlement to downstream power benefits sold in the United States of America which is directly attributable to a failure to comply with paragraph A. 1 (a) or paragraph A. 2 of this Attachment, in the absence of compensation therefor by the British Columbia Hydro and Power Authority, constitutes a breach of the Treaty by Canada and Article XVIII (5) of the Treaty and the exculpatory provisions in Article XVIII of the Treaty do not apply to such breach. Compensation or replacement of power as specified in paragraph A. 1 (c) of this Attachment shall be made by Canada and shall be accepted by the United States of America as complete satisfaction of Canada's liability under this paragraph.

4. For any year in which Canada's entitlement to downstream power benefits is sold in the United States of America, the United States entity may decide the amount of the downstream power benefits for purposes connected with the disposition thereof in the United States of America. This authorization, however, shall not affect the rights or relieve the obligations of the Canadian and United States entities relating to joint activities under the provisions of Article XIV and Annexes A and B of the Treaty; nor shall it apply to determination of Compensation provided for in paragraph A. 1 (c) and paragraph B. 2 of this Attachment.

5. If necessary to accomplish the sale of Canada's entitlement to downstream power benefits in accordance with this Attachment, the United States entity shall assure unconditionally the delivery to or for the account of the Purchaser, by appropriate exchange contracts, of an amount of power agreed between the United States entity and the Purchaser to be the equivalent of the entitlement during the period of the sale.

C. Canada shall designate the British Columbia Hydro and Power Authority as the Canadian entity for the purposes of Article XIV (1) of the Treaty.

Ottawa, 22 January 1964

Sir,

I have the honour to refer to your Note dated 22 January 1964, together with the attachment thereto regarding the Treaty between Canada and the United States of America relating to cooperative development of the water resources of the Columbia River Basin signed at Washington on 17 January 1961.

I wish to advise you that the Government of Canada agrees that your Note with the attachment thereto, together with this reply, shall constitute an agreement between our two Governments relating to the Treaty.

Accept, Sir, the renewed assurances of my highest consideration.

Secretary of State for
External Affairs

The Honourable
Dean Rusk,
Secretary of State of the
United States of America,
Washington.

74441—9½

JOINT STATEMENT
BY PRIME MINISTER PEARSON AND PRESIDENT JOHNSON
REGARDING THE COLUMBIA RIVER DEVELOPMENT
22 January 1964

1. President Johnson and Prime Minister Pearson presided today at the White House at the signing of further important agreements between the two Governments regarding the cooperative development of the water resources of the Columbia River Basin. Mr. Rusk, Secretary of State, signed for the United States, and Mr. Martin, Secretary of State for External Affairs, signed for Canada.

2. The arrangements which are now being made will be of great benefit to both countries, particularly to the province of British Columbia in Canada and to the states of Washington, Idaho, Montana and Oregon in the United States. Today's signing took place in the presence of representatives of the area on both sides of the border.

3. The Treaty of 17 January 1961, provides for effective regulation of the flow from the Canadian portion of the Columbia River for flood control and increased power production in the United States as well as for benefits in Canada. The downstream power benefits resulting from increased generation in the United States are to be shared by the two countries, and the United States is to compensate Canada for the flood protection which it receives. Effective storage amounting to 15,500,000 acre-feet will be provided in Canada from two dams on the main stem of the Columbia at Mica Creek and Arrow Lakes, and from one dam near Duncan Lake, all in British Columbia. The additional storage approximately doubles that presently available for regulation of the flows of the Columbia River.

4. Under the terms of the Treaty, the United States has the option to commence construction of the Libby project on the Kootenai River in northern Montana with 5,000,000 acre-feet of usable storage. Canada and the United States each will retain all of the benefits from the Libby project which accrue in their respective countries.

5. At the Hyannis Port meeting in May 1963 President Kennedy and Prime Minister Pearson

> ". . . noted especially the desirability of early progress on the cooperative development of the Columbia River. The Prime Minister indicated that if certain clarifications and adjustments in arrangements proposed earlier could be agreed on, to be included in a protocol to the treaty, the Canadian Government would consult at once with the provincial government of British Columbia, the province in which the Canadian portion of the river

is located, with a view to proceeding promptly with the further detailed negotiations required with the United States and with the necessary action for approval within Canada. The President agreed that both Governments should immediately undertake discussions on this subject looking to an early agreement."

6. These things have now been done. The way has been cleared for the completion of the necessary financial and related arrangements in the United States and the ratification of the Treaty by Canada.

7. The primary purpose of the first set of documents signed today was to agree now on the clarifications and adjustments that would eliminate possible sources of controversy between the two countries in later years. These documents contain important, if rather technical, provisions regarding such varied matters as conditions governing flood control; the intention to complete arrangements for the initial sale of Canada's share of the downstream benefits at the time when ratifications of the Treaty are exchanged; the avoidance by Canada of stand-by transmission charges in the event of sales of downstream benefits in the United States; provision for cooperation in connection with the operation of the Libby dam in the light of the Canadian benefits from it; clarification regarding water diversions; the procedures relating to hydro-electric operating plans; the adoption of a longer streamflow period as a basis for calculating downstream power benefits; various matters relating to power load calculations; adjustments to be considered in the event of the provision of flood control by Canada ahead of schedule; the avoidance of any precedent regarding waters other than those of the Columbia River Basin; and clarification regarding the position of the Boundary Waters Treaty, 1909.

8. The other set of documents relates to the arrangements to be made for the sale of the Canadian entitlement to downstream power benefits for a period limited to 30 years. The arrangements which the two Governments have agreed upon will be beneficial to the United States in facilitating the coming into force of the Treaty and thereby removing uncertainty about the availability of power and flood control protection for the Northwestern part of the United States for a considerable period of time. Equally, they will benefit Canada by removing uncertainty about the return to be received by Canada from the Columbia River development during the first 30 years after the completion of each dam.

9. The Treaty, together with the arrangements now being made, represent an important step in achieving optimum development of the water resources of the Columbia River Basin as a whole, from which the United States and Canada will each receive benefits materially larger than either could obtain independently.

10. These arrangements fully respect the sovereignty and the interests of the two countries. As was said in the Hyannis Port communique "close cooperation across the border can enhance rather than diminish the sovereignty of each country by making it stronger and more prosperous than before".

DEPARTMENT OF EXTERNAL AFFAIRS

PRESS RELEASE

22 January 1964.

COLUMBIA RIVER TREATY

1. Great benefits to Canada and the United States from the development of the Columbia River will result from the agreement announced today by the governments of British Columbia, Canada and the United States.

2. The United States will pay to Canada:

(a) For downstream benefits: $274.8 million for the Canadian entitlement to its half share of the increased power generation in the United States, which is being sold for 30 years. This payment is to be made on 1 October 1964, the expected date of the exchange of ratifications.

(b) For flood control: $12 million on completion of the Duncan project in 1968; $56.3 million on completion of the Arrow project in 1969; and $1.3 million on completion of Mica in 1973. These payments total $69.6 million.

3. The United States payments correspond to 5.3 mills per kilowatt hour at the time the power is produced. These payments would have a total value to Canada of $501 million by 1973, when the three dams are completed. On a similar basis the total construction costs of the dams, including full compensation for all persons affected, will total $448 million in 1973. Surplus revenues of $53 million will therefore be available for application against the cost of the Mica generators.

As a result, the payments will:

(a) Pay all the capital costs of the three Treaty dams to be built in British Columbia; and

(b) Pay about half the capital cost of the generators for Canadian use at the Mica dam, the largest of the three projects.

Note: Unless otherwise noted all figures in Canadian dollars.

As a consequence, these payments will enable a 1,800,000 kilowatt installation at Mica to produce 6.6 billion kilowatt hours of energy annually for less than 1.5 mills per kilowatt hour. The corresponding cost under development without the Treaty would be approximately 4 mills per kilowatt hour. The savings at Mica at full production will therefore be about $16 million a year up to and including the year 2003. The cost of Mica energy without the Treaty development might well rule out any development either at that site or downstream in Canada. (The installation at Mica will be twice that of Canadian generators at the St. Lawrence River Barnhart plant).

4. In return for the payments which produce these benefits British Columbia will construct the three large storage dams at Duncan Lake, Arrow Lakes and Mica Creek. These will provide increased power generation and flood control in the Columbia River basin in Canada and the United States.

5. The arrangements ensure that the storage projects in Canada will be fully paid for as soon as they are constructed instead of in 50 to 100 years, the normal amortization period for such projects.

6. Construction of the Treaty projects on this basis, with all costs paid for, will make possible very great economic advantages to Canada and British Columbia which without the Treaty could only be attained at much higher cost, if at all. These advantages make possible:

(a) The installation of over 4 million kilowatts at points in the Columbia River basin in Canada capable of producing annually about 20 billion kilowatt hours of energy for Canada at an at-site cost of approximately 2 mills per kilowatt hour. (This installed capacity is nearly 1 1/2 times the total present hydro-electric installation in British Columbia and about 1/5th of the total for all of Canada).

(b) The prevention of floods in settled areas on the Kootenay and Columbia rivers.

(c) The continued production, at the end of the 30-year sales contract, of downstream benefits in the United States with a potential value to British Columbia of $5 to $10 million per year for the life of the Treaty and possibly thereafter.

(d) Additional payments of up to $8 million by the United States for extra flood control if it is required during the Treaty period (as well as special flood control compensation for any emergency requirements of the United States during and after the life of the Treaty).

7. The construction of the Libby Reservoir by the United States will make possible the annual additional generation of more than 200,000 kilowatt years of low cost energy in Canada essential for the continued development of the Kootenays. These benefits do not have to be shared.

The Libby dam will also provide additional flood control in the industrial and farming areas of the West Kootenays.

8. Among improvements through the Protocol to the Treaty are:

(a) New procedures for Canadian participation in determining the need for any flood control requested by the United States that is additional to the flood control covered by the initial payments.

(b) Reaffirmation in positive terms of Canada's right to make any diversions of Columbia basin water required for consumptive needs such as irrigation and municipal uses.

(c) Clarification of Canada's right to continue in perpetuity any diversions of Kootenay River water undertaken in accordance with the Treaty.

(d) Confirmation of Canadian control over the detailed operation of the Canadian Treaty storage for power purposes.

(e) An increase in Canada's downstream energy benefits by 14 to 18 per cent by using a longer period of streamflow in benefit calculations.

(f) A clear statement that the Treaty does not establish any principle or precedent that applies to any waters other than those of the Columbia River basin, and does not modify the application of the Boundary Waters Treaty to such other waters.

(g) Elimination of the Treaty standby transmission charges for the 30-year period of the sale and thereafter if the service is not required.

The total effect of the improvements through the Protocol is to establish a better balance between essentially Canadian interests and the interests of the Columbia River basin as a whole.

9. A peak labour force of about 3,000 men and an average of some 1,350 will be employed on the dams alone during the nine-year construction period of the Treaty storage projects. Expenditures by this labour force, and by industries across Canada on the production of materials and equipment for the dams, will create a great many more jobs. Following the construction of Duncan, Arrow and Mica there will be a continuing building program for a further 10 to 15 years for other large dams on the Columbia River.

10. Canada will benefit from the increase in foreign exchange resources derived directly from the payment by the United States of $319 million in U.S. funds, of which $254 million will be paid in 1964.

11. The United States will also obtain major benefits from the Treaty. It will secure substantial flood protection and a very large increase in the power produced at plants on the Columbia River in the United States. One-half of this increased power is the United States' own entitlement under the Treaty and the other half is the Canadian share now to be bought by the United States for 30 years.

12. The accord between the Government of Canada and the Government of British Columbia, prerequisite to and implicit in the achievement of today's agreements, is an example of cooperative federalism effectively at work. It is founded on the two governments' common determination to secure maximum benefit to the national and provincial interests. This objective has now been met.

13. The agreements between Canada and the United States are based on the discussions between the late President John F. Kennedy and Prime Minister L.B. Pearson in Hyannis Port in May, 1963, and reflect the spirit of that meeting. That meeting recognized the duty of both nations to bargain hard for their own national interests, while accepting the interdependence of two countries sharing a common continent.

14. The Canadian and United States governments hope to exchange Treaty ratifications by 1 October 1964. To that end, the Canadian government will bring the Treaty before the Second Session of the 26th Parliament, opening 18 February, where opportunity for full examination will be afforded.

BACKGROUND PAPER ON THE COLUMBIA RIVER TREATY
22 January 1964

Background

In January 1961 the governments of Canada and the United States signed the Columbia River Treaty which envisaged co-operative development of the river on both sides of the border. The Treaty was ratified shortly afterward by the United States Congress. In Canada, however, ratification has not yet taken place.

Following the Hyannis Port meeting in the spring of 1963 negotiations were begun which led to:

(a) an agreement with British Columbia setting out the responsibilities of the two governments respectively;

(b) an agreement with the United States on a Protocol to the Treaty to adjust and clarify certain provisions of the original document;

(c) an agreement for the sale of downstream power benefits to the United States for part of the Treaty period.

As a result of continuous negotiations, an arrangement has now been reached satisfactory to all governments concerned. The following sections of this background paper briefly review the Protocol to the Treaty, the Attachment relating to terms of sale, and the advantages to Canada of the development of the Columbia River under these agreements.

Protocol to the Treaty

The British Columbia - Canada agreement signed on 8 July 1963, which is analyzed along with the supplementary agreement of 13 January 1964 in an attachment to this paper, cleared the way for negotiations with the United States on a Protocol to the Treaty. The Protocol gives Canada a number of advantages which were either lacking or were not clearly defined in the Treaty. They are the following:

1. Flood Control Operation

Under the Treaty, Canada is to receive $64.4 million in United States funds for the operation of 8.5 million acre-feet of storage at the three Treaty dams - Mica, Arrow Lakes and Duncan Lake - during the 60-year life of the Treaty. In addition to this flood control protection Canada has agreed to operate further storage for flood control during the period of the Treaty and all existing storage facilities thereafter if called upon by the

United States. Although the Treaty stipulates that Canada will be reimbursed for any economic or hydro-electric loss which might be incurred as a result of providing the additional flood control, the federal government was concerned that Canada had no voice in determining whether a need for additional flood control actually existed. It was also concerned that with the development of the potential flood areas in the United States the calls on Canadian flood control storage might become so frequent that they would interfere with the effective operation of the storage for Canada's own needs.

The Protocol requires that the United States entity requesting the additional flood control must submit its requests to the Canadian operating entity. The latter can accept, reject or suggest modifications to these requests. If agreement between the entities cannot be reached, the request is then submitted to the Permanent Engineering Board, a joint Canadian - United States body. The Board's decision will be binding on both entities. If, however, the Board fails to agree as to the need for the flood control, the request must be honoured so that the possibility of loss of life and damage to property will be minimized. The provision under the Treaty by which Canada is reimbursed for loss incurred through such flood control operation remains in effect.

The Protocol is quite specific as to when the United States can call for additional flood control. During the Treaty period, calls for additional storage can only be made if the flood peak expected at The Dalles, Oregon, would exceed 600,000 cubic feet per second* after the use of all storage facilities which existed or were under construction in the United States portion of the basin in January 1961, as well as storage at the Libby Dam and the 8.5 million acre-feet of basic flood control storage provided by Canada. Thus only a flood of major proportions would require the use of the additional Canadian storage during the Treaty period.

After the Treaty period, calls for any Canadian flood control storage can be made only if the flood peak at The Dalles would exceed 600,000 cubic feet per second after the use of all storage facilities existing in the basin in the United States at the termination of the Treaty. Once again, Canada will be effectively protected against an undue number of calls on its storage.

Thus the Protocol improves on the Treaty by providing an objective test of need and ensuring that Canada will have a voice in determining whether or not flood control is actually needed.

* The presently desired level of flood control in the United States.

2. Aim of Flood Control Operating Plans

The Protocol also requires that any operating plans for flood control to be carried out under the Treaty and Protocol be prepared in a manner which will minimize flood damage in both the United States and Canada. While substantial flood control protection to Canada is automatic when the Treaty projects are in operation, the specific inclusion of Canadian needs in the determination of flood control plans was not provided for in the Treaty and is an important clarification of that document.

3. The Exchange of Notes Concerning Downstream Benefit Sales

The Protocol modifies the Treaty on a point which is vital to the sales agreement with the United States. Article VIII(1) of the Treaty, which refers to a possible disposal of downstream power benefits in the United States, requires that such disposals be covered by an exchange of notes between the two countries "as soon as possible after the ratification date". The sale of Canada's entire entitlement to downstream benefits for 30 years as is now planned and the absence of immediate markets for those power benefits in Canada make it essential that assurance of purchase by the United States is made either before, or contemporaneously with, ratification by Canada. The Protocol requires a simultaneous exchange of the ratifications and completion of the initial sales agreement and therefore insures a market for Canada's downstream benefits.

4. Elimination of Standby Charge

The Protocol eliminates the standby transmission charge on Canada's downstream benefits which are either sold to the United States or delivered to Canada at points other than Oliver, British Columbia. This charge, provided for under the Treaty, could have amounted to as much as $2 million per year. Under the terms of the Protocol the charge is for all practical purposes eliminated completely.

5. Co-ordination of Libby for Canadian Benefit

The Protocol acknowledges that Canada will benefit from the operation of Libby and makes more specific the willingness of the United States to co-ordinate the operation of that dam with the operation of Canadian Kootenay River plants, unless such co-ordination is to the disadvantage of the United States or would result in a violation of the International Joint Commission Order relating to the levels of Kootenay Lake.

6. Diversions by Canada

Article XIII of the Treaty gives Canada the right to divert

the waters of the Kootenay River to the Columbia River for power purposes within specified times in the future. These diversions, if deemed economic by Canada, would in time permit the maximum diversions which have been advocated by certain critics of the Treaty. Although it was intended that any diversions under the Treaty could continue in perpetuity there was room for doubt as to whether the wording of the Treaty made this clear. The Protocol specifies that diversions of Kootenay waters undertaken by Canada during the period stipulated by the Treaty may continue indefinitely.

Doubt has also been expressed as to whether Article XIII(1) of the Treaty gives Canada the right to make diversions of Columbia system waters for consumptive purposes such as irrigation, domestic, and municipal needs. The Protocol clears up any misunderstanding on this point by affirming Canada's rights to make such diversions under the Treaty. This right would apply for example to any diversion that might become desirable to the Prairie Provinces for irrigation. It should be noted that provisions for diversions under the Treaty generally continue for at least 60 years while diversion rights under the Boundary Waters Treaty can be terminated on one year's notice.

7. Control of Canadian Storage for Power

It has been claimed that the Treaty gives the United States control over Canadian storage operation for power, and therefore limits the benefits which Canada might otherwise obtain from regulation of the Columbia. It is difficult to see where the Treaty supports this view, as it refers to plans of operation which must not only be agreed to jointly, but which will take into account the benefits which are possible within Canada. However, there are instances in the Annexes of the Treaty which leave doubt as to the exact procedure to be followed in formulating and carrying out the operating plans. The Protocol removes any uncertainty in this regard by placing the following conditions on the plans of operation:

(a) The plans will only commit the amount of Canadian Treaty storage necessary to produce the downstream benefits credited to that storage;

(b) They will be based on the same series of studies from which the benefits are calculated five years in advance;

(c) Canada is given full discretion to decide from which projects storage releases will be made;

(d) Canada is given full discretion also as to the detailed operation which will give the monthly storage quantities required by the agreed operating plan drawn up five years in advance.

8. Calculation of Downstream Benefits

The Columbia River Treaty stipulates that, unless otherwise agreed, a 20-year period of streamflow record be used to calculate downstream power benefits. Under the Protocol, the two governments have agreed to use a 30-year period of record. Use of the longer period has the effect of increasing the average flows under study, thereby increasing the need for control by Canadian storage. The resulting average increase in Canada's downstream energy benefits is approximately 500 million kilowatt hours annually, or an increase of 14 to 18 per cent of the total energy benefit.

Canadian capacity benefits have also been increased significantly (5 per cent to 7 per cent) through the clarification of how the irrigation pumps at the Grand Coulee project should be considered in the studies of downstream benefit credits. The Protocol also clarifies the general calculation of energy and capacity credits under the Treaty by stating the annual load shape to be used in the calculations and defining more explicitly the Treaty limitation on the capacity credit to Canadian storage.

9. Added Flood Control Payments for Early Completion of Storage

The Protocol allows for the upwards adjustment of the payments to Canada for flood control protection in the event of an earlier completion of the Treaty storages than is called for by the Treaty. This adjustment will be calculated on the same basis as the Treaty payments.

10. No Precedent for Other Developments

It has been suggested that the Treaty would establish a precedent for the development of international rivers which would restrict Canada's freedom to develop rivers such as the Yukon in a manner most advantageous to this country in the particular circumstances of each case. The Protocol states clearly that the Treaty does not establish any such principle or precedent and effects no change in the application of the Boundary Waters Treaty to other international rivers.

Attachment Relating to Terms of Sale

This agreement provides that Canada will sell to the United States its full entitlement to the downstream power benefits from the three Treaty projects for 30 years after each project goes into operation. In return, the United States will make a payment to Canada which, together with the Treaty flood control payments will have a value to Canada of $501 million (Canadian) by 1973 when all three dams will have been completed.

The derivation of the $501 million value is indicated on Table 1 which also gives the derivation of the equivalent value of the construction costs of the projects by 1973. The indicated surplus of revenues over costs of $53.4 million is approximately half the cost of installing 10 generating units at Mica with a total capacity of 1.8 million kilowatts.

Rather than paying for the power year by year, the annual values of the power sold have been discounted at 4-1/2 per cent to a lump sum payment in October 1964. Investment at higher interest rates of that part of both power and flood control payments not immediately needed for construction will substantially enhance their value to Canada. The calculations presented in this document assume that reinvestment within Canada is possible at 5 per cent interest.

The value of the payments to Canada can be illustrated in a number of ways. Table 1 compares the value and the corresponding Treaty construction costs at the point in time when all three Treaty dams are completed. The surplus of revenues then existing is compared to the capital cost of installing the very large generating installation at Mica.

A second approach to the value of the payments is to apply them year by year to the cost of constructing and maintaining the Treaty storage over the full construction and sales period (1964 to 2003). Under this approach we find that all construction costs are paid as they occur and all operating and maintenance costs, of the storage, are fully covered. In addition, a revenue surplus of $40 million remains at the end of the period. Over the full period of construction and sale, the value to Canada of the initial payments plus interest earned on the unused portions of those payments, totals $488 million.

No matter which approach is used, the end result is the full coverage of all Treaty costs and with surplus revenues to be applied against Mica generation so that the average cost of the 6.6 billion kilowatt hours of energy produced annually at that site will be less than 1.5 mills per kilowatt hour.

Advantages to Canada of Treaty, Protocol and Sales Agreement

The agreements which have been reached with the governments of the United States and British Columbia make the full development of the Columbia River system in Canada an economically viable undertaking. There is no evidence available that development of the river in Canada without the Treaty could produce power at competitive rates and in that case development might not take place at all.

Under the proposed arrangement by which the storages will be more than paid for by the flood control payments plus the sale of downstream benefits for 30 years, the advantages of the storages will be available to Canada at no cost. The benefits to Canada, in addition to the revenues referred to above, will be as follows:

(a) Mica Generation in Canada

The installed capacity of 1.8 million kilowatts at Mica will produce 6.6 billion kilowatt hours of energy annually at a cost of less than 1.5 mills per kilowatt hour and at a very low load factor. If there were no Treaty the cost of Mica generation would be approximately 4 mills per kilowatt hour. The annual savings to Canada after full production is achieved at Mica will be about $16 million a year up to the year 2003 and $13 million a year for a further period of at least 20 years. These multi-million dollar savings to Canada are the direct result of the Treaty and sales agreement.

(b) Generation Downstream from Mica in Canada

The regulation of the river provided by the Mica dam will also make economically feasible generating plants downstream on the river in Canada at Downie Creek, Revelstoke Canyon and Murphy Creek with a combined installed capacity of 1.9 million kilowatts. These projects are dependent on the river regulation provided by the Mica dam and therefore would probably not be constructed if Mica proved uneconomic without the Treaty.

(c) Kootenay River Benefits

Construction of the Libby dam in the United States and the Duncan Lake dam in Canada will increase the generating potential of the Kootenay River in Canada by approximately 250,000 kilowatt years of energy annually. Of this increase approximately 200,000 kilowatt years will be contributed by the construction of the Libby dam by the United States. These downstream benefits do not have to be shared with the United States and thereby provide Canada with a major energy resource costing less than 2 mills per kilowatt hour including consideration of both generating costs and the cost of that portion of the Libby reservoir which is in Canada. The power benefits which will be realized on the Kootenay River in Canada will ensure the future economic growth of an area largely dependent on sources of low-cost power.

(d) Total Power Benefits to Canada

The total power potential of the Columbia River basin within Canada with development under the Treaty will amount to over 4 million kilowatts of installed capacity producing energy at an average cost of approximately 2 mills per kilowatt hour. These benefits will be increased even further through co-ordination with other resources within Canada. For comparison, the total hydro-electric generating capacity in Canada at the end of 1963 was 20 million kilowatts.

The additional hydro-electric capacity available on the Columbia River therefore represents 1/5th of today's total for Canada.

(e) Flood Control Benefits in Canada

Canada will benefit from flood control protection provided by the three Canadian dams and the Libby dam. Canada is not required to pay the United States for the flood protection given by Libby.

(f) Downstream Benefits after the Period of Sale

When the period of sale to the United States ends, a substantial quantity of downstream power benefits will still be available to Canada. Even under the most adverse conditions these benefits will continue at approximately 1.7 billion kilowatt hours annually, and, with the Treaty projects already paid for, will be available to Canada at the cost of operating those projects and delivering the power to load centres. The value to Canada of these continuing benefits will be from $5 to $10 million annually.

(g) Balance of Payments Situation

Canada's foreign exchange resources will benefit directly from the payment by the United States of $319 million in U.S. funds, of which $254 million will be paid in 1964.

(h) Employment

During the nine-year construction period of the Treaty storage projects an average of some 1,350 men will be employed at the dams, in the peak years of construction about 3,000 men. Expenditures by this labour force and by industries across Canada on the production of materials and equipment for the dams will create a great many more jobs. Following the construction of Duncan, Arrow and Mica there will be a continuing building program for a further 10 to 15 years for other large dams on the Columbia River.

ATTACHMENT TO BACKGROUND PAPER

British Columbia - Canada Agreements

The Government of Canada (referred to as "Canada") and the Government of British Columbia entered into a main agreement dated 8 July 1963, and a supplemental one dated 13 January 1964, under which

the rights and obligations of British Columbia under the Treaty and related arrangements are defined and provision is made for effective implementation of all the arrangements that are contemplated.

The need for the agreements lies in the fact that, while "Canada" is the contracting party in the Treaty, the Protocol and the exchange of notes, in relation to the United States, it is British Columbia that is the owner, in Canada, of the water resource involved and which is to do the things required for its development under the Treaty. There must, therefore, be very clear agreement as to just how British Columbia is going to discharge the obligations that Canada has undertaken in relation to the United States, both immediately and during the entire life of the Treaty. Equally, there must be clear understanding as to how Canada is going to pass on to British Columbia the payments and other benefits the United States is to provide and how, during the life of the Treaty, Canada will handle the claims, benefits and other questions that will arise. These all constitute a very complex set of relationships between three different governments stretching over sixty years at least. The two agreements have been worked out to cover them and are as important as the Treaty itself. They are, indeed, essential to its successful operation.

As the owner of the water resource, British Columbia gets the downstream power benefits or the proceeds of their sale, all compensation payable by the United States in return for flood control, the Kootenay River benefits in Canada resulting from Libby Dam, the water diversion rights in Article XIII of the Treaty and any future payments to settle claims, compensate for extra flood control requests or cover any other arrangements that may be agreed on.

In return, British Columbia agrees to carry out the construction and operation of the three Treaty dams through its agency the British Columbia Hydro and Power Authority and to do everything which constitutionally it is capable of doing to carry out the terms of the Treaty. British Columbia has to comply with the construction schedule and must install generation at the Mica Dam as soon as "economically feasible".

In order to protect Canada in respect of obligations under the Treaty arrangements, British Columbia undertakes a complete indemnification of Canada in respect of all liability to the United States not due directly to some fault of Canada itself. In particular, British Columbia will reimburse Canada for any costs or expenses Canada incurs in doing anything which British Columbia should have done.

British Columbia agrees to use the money received under the Treaty to finance the construction of the Treaty dams and it is expressly stated that Canada will have no obligation to assist in the financing.

The agreements also provide:

(a) that British Columbia will make progress reports during the

construction phase to Canada and will maintain complete records and accounts;

(b) the respective responsibilities of Canada and British Columbia relating to the Permanent Engineering Board and any arbitration proceedings under the Treaty;

(c) that Canadian labour and materials are intended to be used in the construction of the Treaty dams and that all discrimination is prohibited.

Disputes under the agreements are to be submitted to the Exchequer Court of Canada for decision. Any amounts which British Columbia owes Canada under the agreements, and which remain unpaid for 60 days after an Exchequer Court order, may be deducted by Canada from amounts which Canada owes British Columbia on any other account including such accounts as the tax agreements.

Table 1

COMPARISON OF REVENUES AND COSTS

COLUMBIA RIVER TREATY PROJECTS

A. Payments to be made by United States of America

Payment for	Amount of Payment $Millions (Can.)	at date of	Value on 1 April 1973 $Millions (Can.)
Power Benefits	274.8	1 Oct. 1964	416.1
Flood Control			
Duncan	12.0	1 April 1968	15.3
Arrow	56.3	1 April 1969	68.4
Mica	1.3	1 April 1973	1.3
		Total	501.1

B. Capital Costs of Projects

Project	Capital Cost $Millions (Can.)*	at in-service date of	Cost on 1 April 1973 $Millions (Can.)
Duncan Storage	33.3	1 April 1968	42.5
Arrow Storage	129.5	1 April 1969	157.4
Mica Storage	245.2	1 April 1973	245.2
General Costs	2.6	1 April 1973	2.6
		Total	447.7

C. Surplus

Total payments less total capital cost, i.e. A - B $53.4 million

This surplus represents approximately one-half the cost of Mica at-site generation.

Note: (1) Interest rate assumed at 5 per cent both on costs and investment of payments.
(2) Exchange rate assumed to be $1.00 (U.S.) - $1.08 (Canadian)

* Includes interest during construction at 5% per annum.

Table 2

COLUMBIA RIVER -
GENERAL & PHYSICAL CHARACTERISTICS

GENERAL DATA	Canada	U.S.A.
Source of Columbia River	Columbia Lake	
Mouth of Columbia River		Astoria, Oregon
Length in Miles	480	740
Drainage Area in Square Miles	39,500	219,500
Total Fall of River in Feet	1,360	1,290
Average Yearly Runoff in Millions of Acre-feet	73	107

TREATY PROJECTS

Project	Arrow Lakes	Duncan Lake	Mica Creek
Location	5 miles upstream from Castlegar	Outlet of Duncan Lake	90 miles upstream of Revelstoke
Consultants	CBA Engineering Co. Ltd.	Montreal Engineering Co. Ltd.	Caseco Consultants Ltd.
Drainage Area	14,100 sq. miles	925 sq. miles	8,220 sq. miles
Average Flow	39,800 cfs	3,600 cfs	20,700 cfs
Max. Recorded Flow	220,000 cfs	21,400 cfs	112,000 cfs
Min. Recorded Flow	4,800cfs	268 cfs	2,140 cfs
Dam Type	Earthfill	Earthfill	Earth and Rockfill
Dam Height	190 feet	120 feet	645 feet ±
Dam Crest Length	2,850 feet	2,600 feet	2,500 feet ±
Dam Volume	8,500,000 cu.yds.	6,400,000 cu.yds.	37,000,000 cu.yds.
Live Storage Capacity	7,100,000 ac.ft.	1,400,000 ac.ft.	Stage 1 - Storage only 7,000,000 ac.ft. Stage 2 - with at-site gen. 12,000,000 ac.ft.
Length of Reservoir	145 miles	28 miles	85 miles
Completion period after ratification	5 years	5 years	9 years
Flood Control Payment in U.S. Dollars	$52,100,000	$11,100,000	$1,200,000

Table 3

PROPOSED HYDRO-ELECTRIC PROJECTS
IN THE COLUMBIA RIVER BASIN IN CANADA

SUMMARY OF DATA

Name of Project	Live Storage Ac.Ft.	Normal Full Pool Elevation	Maximum Gross Head Feet	Number of Units	Installed Capacity KW
Mica Creek	12,000,000	2,475	570	10	1,820,000
Downie	480,000	1,905	255	10	1,000,000(a)
Revelstoke	220,000	1,650	196	9	630,000
Arrow Lakes	7,100,000	1,444	42	-	-
Murphy Creek	Pondage	1,402	62	6	300,000
Duncan Lake	1,400,000	1,892	110	-	-
Lower Bonnington (Additions only)	Pondage	1,620	70	1	13,700
Brilliant (Additions only)	Pondage	1,470	70(b)	2	54,600
Kootenay Canal Plant	817,000	1,745	272	3	270,000
Seven Mile	Pondage	1,714	198	4	350,000
Total					4,438,300

(a) Output is reduced to 930,000 kw when tailwater is at normal full pool elevation of Revelstoke Project.

(b) Following completion of Murphy Project which reduces head by 26 feet.

APPENDIX

CALCULATION OF TREATY PAYMENTS TO CANADA FOR FLOOD CONTROL

A. Amount of Storage Required

The basic flood control objective of the United States is the control of the design flood of 1894 to a maximum flow of 800,000 cfs at The Dalles, Oregon. The total storage required for this purpose, apart from the effect of estimated irrigation depletions, is the equivalent of 15,100,000 acre-feet effective at The Dalles. When this effective storage requirement is distributed throughout the basin the remoteness of the storages from the flood damage area increases the total requirement to about 17,300,000 acre-feet. Of this amount, 10,800,000 acre-feet are available from projects existing or under construction in the United States. This leaves a requirement of 6,500,000 acre-feet of additional storage in the basin.

With the addition of the Treaty projects there is considerably more storage space available in the upper basin of the Columbia River than is required to meet the primary flood control objective. Therefore, the storage space required for this purpose must be allocated among the various projects. The amount which can be allocated to any one project is limited by:

(a) the relative or percentage contribution of flood flow from that part of the basin,

(b) the desirable limits of storage capacity available at the project for flood control purposes, and

(c) the effectiveness of this amount of storage in reducing the flood flow at The Dalles.

Under limitation (a), and with limitation (b) in mind, storages in the upper basin were allocated in accordance with the method called the "Rational Distribution" of flood control storage. The results of this allocation are shown in Table 1. The relative contribution to the flood flow at The Dalles is about 18 per cent from the Columbia River above the Kootenay, and about 17 per cent from the Kootenay River.

It was agreed during the Treaty negotiations that without Canadian flood control storage, United States storage would need to be over-developed by 22 per cent above the foregoing national limits in order to provide equivalent flood control. Therefore a 22 per cent allowance was credited to Canadian storage by increasing the rational distribution figures to those shown in column (1) of Table 2.

Referring again to Table 2, the total in column (1), 7,700,000 acre-feet, is more than the 6,500,000 acre-feet required for flood protection to 800,000 cfs. As a result of Treaty negotiation Canada was able to obtain a "first added" credit for its storages; therefore, the surplus storage was deducted entirely from Libby storage and the final quantities used for allocating benefits were as shown in column (2) of Table 2. The small

amount allocated to Mica for primary flood control purposes ensures that operation for flood control will not interfere with the desired operation for at-site generation of power at Mica.

The effectiveness of storage distributed throughout the basin varies with such factors as the remoteness of the storage from the flood damage area and the amount of storage used for flood control in relation to the total usable storage at the project. Effectiveness factors were determined by means of flood routing studies for control of the 1894 flood. They are listed for each of the upstream storages, in column (2) of Table 3, and are used in the calculation of flood control payments as shown in Table 3.

Table 1

Project	Usable storage for protection to 800,000 cfs at The Dalles (acre-feet)	
High Arrow	3,135,000	(in addition to natural storage)
Mica	65,000	
Columbia above the Kootenay	=3,200,000	= 18% of 17,300,000 acre-foot requirement of the basin
Duncan Lake	1,270,000	
Libby	1,830,000	
Kootenay River	=3,100,000	= 17% of 17,300,000 acre-foot requirement of the basin.

Table 2

Project	(1) Rational Distribution Plus 22% (acre-feet)	(2) Usable Storage Limited by Total Requirement (acre-feet)
High Arrow	3,820,000	3,820,000
Mica	80,000	80,000
Sub-Total: Columbia above the Kootenay	3,900,000	3,900,000
Duncan Lake	1,270,000	1,270,000
Libby	2,530,000	1,330,000
Sub-Total: Kootenay	3,800,000	2,600,000
Total	7,700,000	6,500,000

Table 3

Project	(1) Usable Storage acre-feet		(2) Effectiveness Factor per cent		(3) Unit Value per acre-foot		(4) Annual Value
High Arrow	3,820,000	x	87.5	x	$1.38[1]	=	$4,610,000
Duncan Lake	1,270,000	x	56.0	x	1.38[1]	=	980,000
Mica	80,000	x	100.0	x	1.38[1]	=	110,000
Total annual benefit from Canadian storage =							$5,600,000
Canada's share =							2,850,000
Libby	1,330,000	x	90.0	x	1.38[1]	=	1,650,000

1. Computed by dividing total benefits attributable to storage and irrigation depletions effective in reducing the 1894 flood to 800,000 cfs at The Dalles, $23,750,000, by 17,300,000 acre-feet, which is the sum of 15,100,000 acre-feet of storage required at The Dalles plus 2,200,000 acre-feet of irrigation depletions.

B. Value of the Storage Added

The monetary value of flood control benefits is the average annual value of flood damage prevented, as evaluated by the Corps of Engineers, U.S. Army, in a study of its Major Water Plan system. The average annual damage was computed by conventional methods using stage-frequency and stage-damage relationships as described in the Corps of Engineers' report on the Columbia River Basin, dated June 1958. The benefits are based upon 1957 prices and an estimated 1985 level of economic development in the basin.

As indicated by the footnote to Table 3, the total flood control benefit attributable to storage and irrigation depletions was evaluated at an average annual amount of $23,750,000 for control to 800,000 cfs at The Dalles. The corresponding storage and estimated irrigation depletions required to produce this saving totalled 17,300,000 acre-feet (effective at The Dalles) so that the unit value of effective storage is $\frac{23,750,000}{17,300,000}$ = $1.38 per acre-foot per year.

Additional flood control benefits in the Lower Columbia River, resulting from a further reduction of the 1894 flood from 800,000 cfs to 600,000 cfs at The Dalles, were similarly evaluated at an average annual amount of $1,650,000. The required additional effective storage for this further reduction of peak flow is 14,540,000 acre-feet and the corresponding annual value is

$$\frac{1,650,000}{14,540,000} = \$0.114 \text{ per acre-foot.}$$

The application of this unit value is described in the section of this appendix entitled "Secondary Flood Control Benefits".

For the basic flood control objective, i.e. control to 800,000 cfs at The Dalles, the unit value, $1.38, was multiplied by the effective storage at each of the upstream storages, as listed in Table 3, and the corresponding monetary value of these benefits for each project was determined. This value represents the average annual value of the damage averted by the projects.

The two unit values, $1.38 per acre-foot for control to 800,000 cfs and $0.114 per acre-foot for supplementary control to 600,000 cfs illustrate dramatically the basic truth that, in the provision of storage for flood control, each additional acre-foot of flood control storage added to the system results in a smaller saving than the acre-foot added previously. However, under the Treaty, Canadian storage receives identical credit with storages now existing or under construction in the United States.

C. Capitalization of Canada's Primary Flood Control Benefits

I.J.C. Flood Control Principle No. 5 suggests that payment to Canada for flood control protection could be made as a lump sum. The Treaty adopted this suggestion and the following calculations show how the annual values are capitalized to the lump sum values given in Article VI of the Treaty.

(a) Annual Benefits

Arrow Lakes:
3,820,000 acre-feet x effectiveness factor of .875 x $1.38 per acre-foot = $4,610,000 per annum

Duncan Lake:
1,270,000 acre-feet x effectiveness factor of .560 x $1.38 per acre-foot = $980,000 per annum

Mica:
80,000 acre-feet x effectiveness factor of 1.0 x $1.38 per acre-foot = $110,000 per annum

(b) Capitalized Benefits

Arrow Lakes: Effective period in the Treaty is 55 years
Value of 55 annual payments of $4,610,000 capitalized to the beginning of the 55-year period at 3-7/8 per cent interest
= $4,610,000 x 22.61768 = $104,267,505
Canada's 1/2 share = $ 52,134,000
Treaty sum = $ 52,100,000

Duncan Lake: Capitalized value of 55 annual payments
= $980,000 x 22.61768 = $22,165,326
Canada's 1/2 share = $11,083,000
Treaty sum = $11,100,000

Mica: Effective period in the Treaty is 51 years
Value of 51 annual payments of $110,000 capitalized to the beginning of the 51-year period at 3-7/8 per cent interest
= $110,000 x 22.09394 = $2,430,333
Canada's 1/2 share = $1,215,000
Treaty sum = $1,200,000

Total calculated sum = $64,432,000 U.S. Funds

Total Treaty sum = $64,400,000 U.S. Funds
or $69,600,000 in Canadian Funds at an exchange rate of 7-1/2 per cent.

D. Comparison of Treaty Payment to a Payment in Perpetuity

Under the terms of the Treaty, payment to Canada for primary flood control protection is the sum of a number of annual payments capitalized to a present worth value using an interest rate of 3-7/8 per cent. The amount paid under the Treaty is thereby limited by the number of years during the 60-year period of the Treaty that the projects will be operative.

It is of interest to consider what payment Canada could have expected from the United States if the Treaty payment had been considered as the present worth value of a payment in perpetuity. It is also of interest to see what effect the interest rate has on such a payment; for instance what would be the value to Canada of a payment in perpetuity if a Canadian interest rate of 5-1/2 per cent were used rather than the Treaty rate of 3-7/8 per cent. The following table compares all these possibilities.

Present Worth of a Flood Control Payment in Perpetuity

Interest Rate Used	Present Worth Payment to Canada	Treaty Payment as a Per cent of Payment in Perpetuity
%	$ million U.S.	%
3-7/8	73.6	88
4	71.2	90
4-1/2	63.3	102
5	57.0	113
5-1/2	51.8	124
6	47.5	136

E. Secondary Flood Control Benefits

In Annex B of the 28 September 1960 "Progress Report" to the two governments by the negotiators, it was indicated that annual payments would be made to Canada for secondary flood control benefits resulting from the control of flows between 800,000 and 600,000 cubic feet per second at The Dalles. If this provision had been retained in the final Treaty, Canada would have been required to provide this secondary flood control on an annual basis, and to accept any at-site power losses which might result. In return for this operation, the capitalized payments to Canada would have been as follows:

Arrow Lakes:
1/2 of 280,000 acre-feet x effectiveness factor of .875 x $0.114 per acre-foot x 22.61768 (capitalized over 55 years) = $315,800

Duncan Lake:
1/2 of 130,000 acre-feet x effectiveness factor of .900 x $0.114 per acre-foot x 22.61768 (capitalized over 55 years) = $150,800

Mica:
1/2 of 2,920,000 acre-feet x effectiveness factor of .900 x $0.114 per acre-foot x 22.09394 (capitalized over 51 years) = $3,309,600

Total secondary flood control payments to Canada = $3,770,000

When capitalized at 3-7/8 per cent to a present value at the beginning of the Treaty the value of all annual payments would have been $2,737,000.

Under the terms of the Treaty, Canada will receive $1,875,000 for each of the first four calls made by the United States for secondary flood control protection. If these calls are spaced uniformly throughout the Treaty period at 12, 24, 36 and 48 years, the value of the four payments capitalized to the beginning of the Treaty amounts to $2,738,000 (see attached plate).

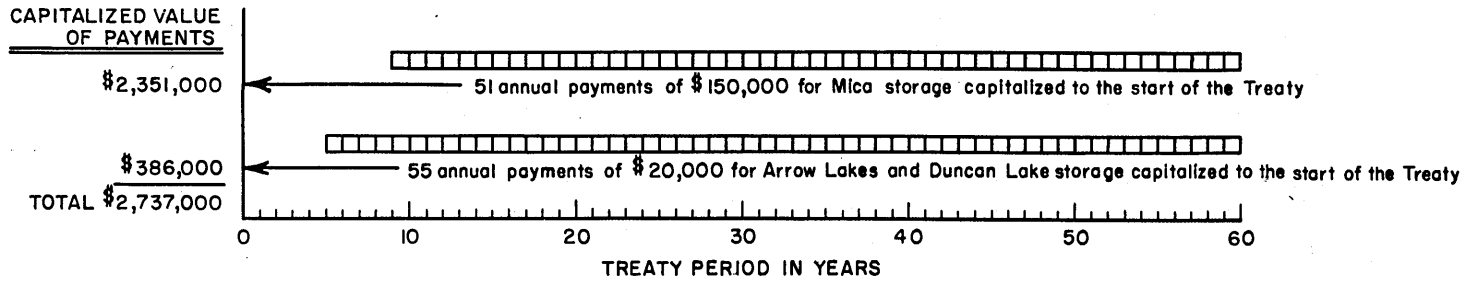
If the four calls should come later in the Treaty period, their capitalized value will be less, and similarly if they should come earlier, their capitalized value will be greater.

In addition to these four payments required from the United States, Canada will be reimbursed in power for any power lost when providing secondary flood control protection. This payment of power is not limited to the first four calls for flood control operation.

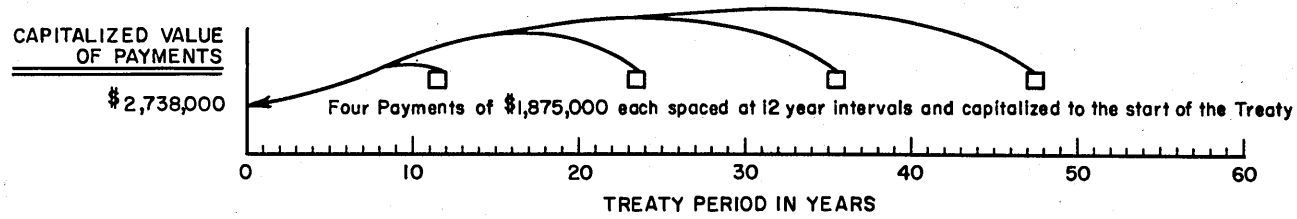
Therefore, the treatment of secondary flood control under the terms of the Treaty ensures flexibility of storage operation for Canada, provides for payments by the United States if and when secondary flood control is required, and guarantees that Canada will not lose any power through operation for secondary flood control protection.

COLUMBIA RIVER SECONDARY FLOOD CONTROL BENEFITS

TREATMENT OF SECONDARY FLOOD CONTROL PAYMENTS UNDER THE PROGRESS REPORT



CALCULATION OF POSSIBLE SECONDARY FLOOD CONTROL PAYMENTS UNDER THE TREATY



NOTE :- Interest rate of $3\frac{7}{8}\%$ and U.S. funds used in all calculations

SUMMARY OF ENGINEERING REPORTS
ON THE
DEVELOPMENT OF THE COLUMBIA RIVER
IN CANADA

Report and Date

International Columbia River Engineering Board, 1 March 1959.

Crippen Wright Engineering Ltd., 12 January 1959.

Montreal Engineering Co. Ltd., November 1957.

U.S. Army Engineer Division, North Pacific, June 1958.

Montreal Engineering Co. Ltd., May 1961.

Sir Alexander Gibb and Partners, and Merz and McLellan,
Consulting Engineers, July 1961 with Supplement in August 1961.

B.C. Engineering Co. Ltd., 1956.

Report By: The International Columbia River Engineering Board.

Report For: The International Joint Commission.

Title & Date: Water Resources of the Columbia River Basin – 1 March 1959.

Scope: Ultimate development of the Columbia River for maximum international benefit.

Recommended Schemes of Development:

Six alternative plans are presented.[1] The major differences in these plans are as follows:

Plan #1: High Arrow Project, no Kootenay River Diversion
Plan #4: Low Arrow Project, no Kootenay River Diversion

Plan #2: High Arrow, Copper Creek Diversion
Plan #5: Low Arrow, Copper Creek Diversion

Plan #3: High Arrow, Dorr Diversion
Plan #6: Low Arrow, Dorr Diversion

The Canadian projects involved in these plans are:

(a) Plan 1: Mica 2435, Downie Creek 1869, Revelstoke Canyon 1612, Arrow Lakes 1446, Bull River 2660, Duncan Lake 1892, Kootenay Lake 1748.3, West Kootenay Plants, Murphy Creek 1402, Seven Mile 1720 and Waneta.

Live Storage in acre-feet (including all Libby storage):
Canada 24,906,000 U.S. 26,338,000 Total 51,244,000

(b) Plan 2: Delete Bull River from Plan 1 and add Copper Creek-Luxor Diversion 2711 and Calamity Curve 2551

Live Storage in acre-feet (including all Libby storage):
Canada 24,387,000 U.S. 26,338,000 Total 50,725,000

(c) Plan 3: Delete Bull River from Plan 1 and add Dorr 2513, Dorr Pumping, Bull River-Luxor Diversion 2703 and Calamity Curve 2551.

Live Storage in acre-feet:
Canada 26,989,000 U.S. 22,293,000 Total 49,282,000

1. The "Trans-Boundary" project Libby is included in all plans except 3 and 6.

(d) (e) and (f) Plans 4, 5 and 6 are similar to 1, 2 and 3 respectively with Arrow site deleted and Murphy Creek storage slightly increased. Canadian and total storage figures are decreased by 4.9 million acre-feet.

Benefits: (a) Power:

Plan	1	2	3	4	5	6
Increase in Critical Period output in megawatts						
Can.	2549	2785	2989	2522	2758	2962
U.S.	6569	6435	6161	6405	6271	5998
Total	9118	9220	9150	8927	9029	8960
Increase in 20-year average output in megawatts						
Can.	2441	2682	2852	2441	2682	2852
U.S.	5597	5486	5206	5400	5290	5010
Total	8038	8168	8058	7841	7972	7862

(b) Flood Control: All schemes solve equally well the major flood problems of the basin. A monetary flood control value is given to each storage project, assuming that each project would be one element of the primary group of projects credited with major flood control benefit.

Suggested Division of Downstream Benefits:

No suggestion is made for international division of downstream benefits. Downstream benefits are credited to the upstream storage project only for the purpose of project justification. The benefits credited are in the form of average annual energy gain and are calculated as follows:

Each storage project is allocated the theoretical downstream gain in energy from its average monthly storage release over the 20 years studied. This downstream energy gain is then modified so that the total gain credited to all storage plants is equal to the energy difference in operating the complete system with and without storage releases.

A generating plant is credited with all at-site energy produced with no storage releases and a share of the critical peaking capacity of the system based upon its average critical period capacity contribution. These benefits are given a monetary value based upon the cost of alternative power.

Costs: (a) Total investment in millions of dollars (exclusive of transmission)

Plan	1	2	3	4	5	6
Can.	914.6	958.7	1043.4	856.8	900.9	985.6
U.S.	2939.2	2921.7	2516.4	2939.2	2921.7	2516.4
Total	3853.8	3880.4	3559.8	3796.0	3822.6	3502.0

(b) Annual Costs [1]

(1) in thousands of dollars

Plan	1	2	3	4	5	6
Can.	43,048	45,594	49,719	40,398	42,944	47,069
U.S.	133,662	132,786	115,471	133,662	132,786	115,471
Total	176,710	178,380	165,190	174,060	175,730	162,540

(2) as a per cent of total investment

Plan	1	2	3	4	5	6
Can.	4.71	4.76	4.77	4.71	4.77	4.78
U.S.	4.55	4.54	4.59	4.55	4.54	4.59

(c) Cost of incremental "At Site" power: [2]

(1) Primary energy in mills/kwh

Plan	1	2	3	4	5	6
Can.	1.93	1.87	1.90	1.83	1.78	1.81
U.S.	2.32	2.36	2.14	2.38	2.42	2.20

(2) Average energy in mills/kwh

Plan	1	2	3	4	5	6
Can.	2.01	1.94	1.99	1.89	1.83	1.88
U.S.	2.73	2.76	2.53	2.83	2.86	2.63

(d) Cost of Alternative Energy:

Thermal power at $14.45 per kw of peaking capability and 3.30 mills per kwh of energy at load centre. (Using 3 per cent interest, no taxes and July 1957 prices). At hydro power sites these costs are altered to $13.80 per kw of peaking capability and 3.19 mills per kwh of energy.

(e) Transmission Costs:

For the U.S. Pacific Northwest area using 2.5 per cent interest, the average transmission cost is $3.48 per kw of overload capacity.

1. Interest rate of 3 per cent and July 1957 prices assumed.
2. No downstream benefit return or flood control value used.

Report By: Crippen Wright Engineering Ltd., Vancouver

Report For: The Comptroller of Water Rights, Department of Lands and Forests, Government of British Columbia.

Title & Date: Hydro-Electric Development of the Columbia River Basin in Canada - 12 January 1959.

Scope: National and international benefits from the development of the Columbia River in Canada. Co-ordinated development of the Clearwater River also included.

Recommended Schemes of Development:

(a) No downstream benefit agreement:

Kootenay River Diversion at Canal Flats, Findlay Creek Diversion, Calamity Curve 2670, Kinbasket 2550, Mica 2215, Downie Creek 1905, Revelstoke Canyon 1650, Arrowhead 1450, Murphy Creek 1402, Duncan 1895, West Kootenay Plants, Seven Mile and Waneta. Also Hobson, Azure, Hemp Creek, Project X, and Clearwater projects on the Clearwater River. Live storage capacity = 19.7 million acre-feet.

(b) With downstream benefit agreement:

Kinbasket 2600, Mica 2215, Downie Creek 1905, Revelstoke Canyon 1650, Arrow Lakes 1450, Murphy Creek 1402, (Libby 2460), Duncan 1895, West Kootenay Plants, Seven Mile and Waneta. Also Hobson, Azure, Hemp Creek, Project X, and Clearwater project on the Clearwater River. Live storage capacity (excluding Libby) = 24.6 million acre-feet.

Benefits:

(a) Power:

Scheme (a) (No downstream benefit return) -
Canada 26.79×10^9 kwh with increase in firm "at site".

U.S.A. 8.4×10^9 kwh increase in firm "at site".

Scheme (b) (50 per cent return of downstream benefits) -
Canada 25.24×10^9 kwh increase in firm "at site"
and 7.78×10^9 kwh return from U.S.
Canadian Total = 33.02×10^9 kwh increase in firm.

U.S.A. 7.78×10^9 kwh increase in firm "at site".

(b) Flood control: No value quoted.

Suggested Division of Downstream Benefits:

A return to Canada (at no charge) of 50 per cent of the downstream benefit measured by the increase in firm power in the U.S. due to Canadian

storage upstream of Arrow Lakes. Also a 50 per cent return of the benefit of electrical integration. It is assumed for the sake of simplicity that downstream benefits that accrue to each country from the Libby project and the Pend d'Oreille developments in effect are equal and cancel out. It is suggested that the return of downstream benefits from Arrow Lakes storage should be greater than 50 per cent (60 per cent - 70 per cent).

Costs:

(a) Investment Costs:

Scheme (a) $1,167,700,000 (exclusive of transmission)

Scheme (b) $1,129,300,000 (exclusive of transmission)

(b) Annual Costs: Range from 5.75 per cent to 6.25 per cent for 5 representative schemes of development. (Interest and amortization = 4.65 per cent).

(c) Cost of Power Delivered to Vancouver:

Scheme (a) 25.0×10^9 kwh at 3.58 mills/kwh with no downstream benefit return.

Scheme (b) 31.2×10^9 kwh at 2.86 mills/kwh with 50 per cent downstream benefit return. (Firming Power)

(d) Cost of Alternative Energy: Not determined.

(e) Transmission Costs to Vancouver: Range from 3.49 mills/kwh to 0.81 mills/kwh depending upon stage of development.

Report By: Montreal Engineering Co. Ltd.

Report For: Department of Northern Affairs and National Resources.

Title & Date: The Development of Canada's Water Power Resources in the Columbia River Basin - November 1957.

Scope: National and international benefits from the development of the Columbia River in Canada.

Recommended Schemes of Development:

(a) Assuming no integration with U.S.:

Canal Flats Diversion, Surprise Rapids 2560, Mica 2285, Downie Creek 1868, Revelstoke Canyon 1612, Murphy Creek 1402. (Alternative scheme given). Live storage = 7.35 million acre-feet.

(b) Assuming integration with U.S.:

Canal Flats Diversion, Mica 2435, Downie Creek 1868, Revelstoke Canyon 1612, Arrow Lakes 1446, Murphy Creek 1402. (Alternative scheme given). Live storage = 20.9 million acre-feet.

Benefits:

(a) Power:

Non-integrated system -
Canada 13.3×10^9 kwh/year additional primary energy at site.

U.S.A. 13.2×10^9 kwh/year additional primary energy at site.

Integrated system -
Canada 14.0×10^9 kwh/year additional primary energy at site.

U.S.A. 27.7×10^9 kwh/year additional primary energy at site.

(b) Flood control: Benefits not set out in terms of monetary saving.

Suggested Division of Downstream Benefits:

Return of a percentage of downstream benefits in the U.S.A. up to a maximum where the benefits remaining in the U.S. could be produced from other sources at a competitive rate. This division would result in a maximum return of 50 per cent when using the cost of thermal power at U.S. load centres as the alternative source of power.

Costs:

(a) Total Investment Cost: Non-integrated system = $551.5 million, integrated system = $709.5 million (Exclusive of transmission)

(b) Annual Costs: (1) Fixed Costs = 10 per cent of capital investment.
(2) Operating Costs = $2.50/kw of installation.

(c) Cost of Power Delivered to Vancouver: (ultimate development)
(1) Non-integrated system = 7.1 mills/kwh primary energy.
(2) Integrated system = 4.6 mills/kwh primary energy assuming 50 per cent return of downstream benefits.

(d) Cost of Alternative Energy: Thermal Power - 7.3 mills/kwh (coal), 6.4 mills/kwh (gas) at 65 per cent load factor at Vancouver.

(e) Transmission Costs to Vancouver: (including losses) 2.5 mills/kwh ultimate development.

Report By: Division Engineer, U.S. Army Engineer Division, North Pacific.

Report For: Chief of Engineers, United States Army.

Title & Date: Water Resources Development of the Columbia River Basin June 1958.

Scope: A major water plan for the Columbia River basin in United States. Canadian projects mentioned but not included in proposed system. "Trans-Boundary" project (Libby) is a major project in proposed system. (See last paragraph under "Power", Chapter IX and paragraph on Future Elements, Chapter IX).

Recommended Scheme of Development:

Proposed additions to the existing system of projects are Libby, Long Meadows, Ninemile Prairie, Flathead Lake Improvements, Knowles, Enaville, Garden Valley Diversion, High Mountain Sheep, Lower Canyon, Wenaha, Asotin, Penny Cliffs and Bruces Eddy. Total additional live storage would be 22.5 million acre-feet. Four new projects are also recommended for the Willamette River basin but the effects of these projects are not considered in the Benefit and Cost paragraphs below.

Benefits:

(a) Power (1958 Operation):

Increase in installed capacity = 3,178,000 kw

Increase in prime power credits (at site and downstream) = 4,100,000 kw

Increase in average annual energy = 28×10^9 kwh

(b) Flood Control:

With the addition of proposed projects the total usable flood control storage would be 32.4 million acre-feet.

Annual flood control benefit of proposed projects = $11,012,000

Annual flood control benefit of complete system (Exclusive of levees) = $27,758,000

(c) Navigation: New hydro projects and extensions to navigation improvements would have an annual benefit of $5,426,000.

(d) Recreation: Annual benefits attributed to new projects = $600,000.

(e) Fish and Wildlife: Annual benefits at Long Meadows and Ninemile total $535,000

(f) Other Benefits: Domestic water supply, pollution abatement, fish and wildlife, irrigation.

Suggested Division of Downstream Benefits:

Two Methods Used:

(1) The "Justification Ratio" is used for evaluating relative economic merit of all projects investigated and allocates all downstream benefits to storage projects.

(2) The "Benefit Cost Ratio" method allocates the benefits of storage between upstream and downstream projects so that the net benefit remaining after meeting costs is shared equally by both storage and head plant.

Costs:

(a) Total Investment: $1,832,170,000.

(b) Annual Costs: Average 4.35 per cent excluding taxes.

(c) Cost of Alternative Energy: Thermal power from coal, $15.46 per kw of dependable capacity and 3.32 mills/kwh of usable energy assuming Federal financing.

(d) Cost of Transmission: $3.48/kw of plant peaking capability.

Report By: Montreal Engineering Co. Ltd.

Report For: Department of Northern Affairs and National Resources.

Title & Date: Factors Affecting the Cost of Columbia River Power in Canada, May 1961.

Objective: To provide an independent estimate of power costs in Canada for the development of the Columbia River, taking the Columbia River Treaty into account; such estimate to provide comparison with corresponding cost figures used by the Canadian negotiators of the Treaty.

Scope: Determination of Columbia River power costs in Canada under three alternative rates of load growth in British Columbia (6, 8 and 10 per cent) assuming a 65 per cent load factor and taking into account Canadian downstream benefits in the United States which are based upon the

maximum forecast load growth in the United States Pacific Northwest. Transmission losses are taken at 6 per cent for generation in Canada and 12 per cent for Canadian downstream benefits generated in the United States. (Note: Estimates of the Water Resources Branch employed a load growth in British Columbia at 8 per cent and a load factor of 70 per cent).

Scheme of Development:

Characteristics of Proposed Plant*

Plant	No. of Units	Rated Generator Capacity (kw)	Firm Plant Capacity (kw)	Est. Annual Output	
				Dry Year	Average Year
				(billions of kwh)	
Mica Generation	12	116,000	1,020,000	6.49	6.49
Downie Creek	12	84,000	1,000,000	3.90	4.10
Revelstoke Canyon	12	58,000	700,000	2.63	2.76
Murphy Creek	8	42,000	336,000 [a]	2.10 [b]	2.20 [b]
Calamity Curve	3	40,000	120,000		
Canal Flats Diversion	-	-	-	1.22 [c]	1.28 [c]
Canal Plant	3	71,000	213,000	1.73	1.82
Brilliant #4 & #5	2	27,000	54,000 [d]	.44 [d]	.44 [d]
Waneta #3 & #4	2	92,000	184,000	.93	1.02
Seven Mile	4	87,500	350,000	2.30	2.39
				21.74	22.50
Less reduction at Brilliant				0.24	0.08
Total at-site generation				21.50	22.42

Arrow Storage
Duncan Storage
Mica Storage

Estimated Canadian downstream benefits from United States:

Capacity - 1,312,000 kw in 1970, declining to zero by year 2010.

Energy - 6.7 billion kwh in 1970, declining to 2.5 billion kwh by year 2010.

* Source: Department of Northern Affairs and National Resources.

a Gross : Brilliant plant (5 units) reduced 36,000 kw by construction of Murphy Creek.

b Gross : Brilliant plant (5 units) reduced 0.24 billion kwh in dry year and 0.08 billion kwh in average year.

c Net : Allowance made for loss of power at Canal plant and Brilliant extension resulting from the Canal Flats diversion.

d Gross : See a and b above.

Table A

Cost Estimates of Columbia River Projects

Project	Estimates Used in Treaty Negotiations			Estimates by the Montreal Engineering Company		
Treaty Projects						
Arrow Lakes:						
Direct Construction and Relocation Costs	57,596,000			57,101,000		
Engineering, Contingencies and Other Indirect Costs	14,194,000			24,099,000		
Total Cost		$ 71,790,000			$ 81,200,000	
Duncan Lake:						
Direct Construction and Relocation Costs	19,866,000			20,079,000		
Engineering, Contingencies and Other Indirect Costs	5,750,000			8,621,000		
Total Cost		$ 25,6.0,000			$ 28,700,000	
Mica Storage:						
Direct Construction and Relocation Costs	187,463,000			186,435,000		
Engineering, Contingencies and Other Indirect Costs	59,730,000			101,665,000		
Total Cost		$247,193,000			$288,100,000	
Total Treaty Project Costs			$344,599,000			$398,000,000
Total Associated Transmission Costs		$113,800,000			$129,300,000	
Total Treaty Costs			$458,399,000			$527,300,000
West Kootenay Extensions						
Total Project and Transmission Costs and Libby Flowage in Canada		$ 81,400,000			$ 54,800,000	
Total Treaty plus West Kootenay Costs			$539,799,000			$582,100,000
Balance of Columbia River Development in Canada						
Total Project and Transmission Costs		$971,200,000			$866,500,000	
COST OF COMPLETE COLUMBIA RIVER DEVELOPMENT			$1,511,000,000			$1,448,600,000

Table B

Comparison of Unit Cost in Mills per Kilowatt Hour

System	Montreal Engineering Co. Estimates			Water Resources Branch Estimates (8 per cent Load Growth) Excludes Surplus Sale in All Cases			
	Load Growth	Excluding Sale of Surplus Energy for Fuel Displacement	Including Sale of Surplus Energy for Fuel Displacement	Maximum U.S. Load Forecast		Minimum U.S. Load Forecast	
				Standby Charge Continued	Standby Charge Removed	Standby Charge Continued	Standby Charge Removed
Complete Development Including Downstream Benefits (1)	6% 8% 10%	4.9 4.5 4.4	4.6 4.3 4.2	4.39	4.34	4.23	4.16
	Downstream Benefits as a Per Cent of Those Calculated Using Maximum U.S. Load Forecast (3)						
	80%	90%	100%	110%	125%		
Downstream Benefits Only (2)	4.4	3.9	3.6	3.3	3.0	3.04 (4)	2.88 (4)	2.79 (4)	2.60 (4)

(1) Montreal Engineering Co. Cost of 4.5 mills and Water Resources Branch Cost of 4.39 mills are comparable.
(2) Montreal Engineering Co. Cost of 3.6 mills and Water Resources Branch Cost of 3.04 mills are comparable.
(3) Assumes a 3-year wait before machining Mica.
(4) Assumes a 2 to 2 1/4-year wait before machining Mica.

Benefits: (see also benefits listed under "Scheme of Development")

(a) Power: Additional energy available from Columbia System (at point of generation):

	Millions of kwh for, Low Year	Average Year
At 6 per cent load growth (complete development in 1985)	24,800	25,700
At 8 and 10 per cent load growth (complete development in 1982)	25,400	26,300

(b) Flood Control: United States capital payment of $64.4 million for flood control credited towards Columbia River power costs.

Costs:

(a) Annual Costs:

(1) Fixed Costs: 5.91 per cent per annum on invested capital, including cost of money at 5.5 per cent and a 0.41 per cent annual charge for amortization.

(2) Operating Costs - Formulae from the I.C.R.E.B. report to the I.J.C. used to cover overall annual cost of plant operation, maintenance, interim replacements and administration. Corresponding annual operating costs for transmission lines taken as 2.1 per cent of capital costs.

(b) Investment Cost: Total investment costs estimated by the Montreal Engineering Co. are listed under Table A, together with the corresponding estimates used during the Treaty negotiations.

(c) Cost of Energy: Table B compares Montreal Engineering Co. and Water Resources Branch estimates of unit costs of energy.

Report By: Sir Alexander Gibb & Partners, and Merz and McLellan, Consulting Engineers.

Report For: British Columbia Energy Board.

Title & Date: Columbia and Peace River Power Projects, Report On Power Costs, and Appendices - July 1961; Columbia and Peace River Power Projects, Supplement to Consultants' Report on Power Costs - August 1961.

Scope: Comparison of National benefits up to the year 1985, from the development of the Columbia River as provided for under the Treaty and the development of the Peace River, both under alternative rates of load growth. The following items refer to benefits from the development of the Columbia River only. Columns (A) and (C) refer to the July 1961 Report; Column (B) refers to the August 1961 Supplement.

Recommended Schemes of Development (In Canada):

(A) Basic Load Growth (excludes West Kootenay Generation and Loads and New Industrial Loads)		(B) Basic Load Growth + New Industrial Loads (excludes West Kootenay Generation and Loads)		(C) Basic Load Growth + West Kootenay Generation and Loads + New Industrial Loads	
Project	Elevation	Project	Elevation	Project	Elevation
Calamity Curve	2,551	Mica	2,435	Mica	2,435
Mica	2,435	Downie Creek	1,869	Downie Creek	1,869
Downie Creek	1,869	Revelstoke Canyon	1,612	Revelstoke Canyon	1,612
Revelstoke Canyon	1,612	Arrow Lakes	1,446	Arrow Lakes	1,446
Arrow Lakes	1,446	Murphy Creek	1,402	Murphy Creek	1,402
Murphy Creek	1,402	Duncan Lake	1,892	Duncan Lake	1,892
Duncan Lake	1,892			Seven Mile	1,720
				Waneta No. 4	1,510
				Kootenay Canal	1,745
				Brilliant No. 4	1,483
(Including Canal Flats Diversion)		(Excluding Canal Flats Diversion)		(Excluding Canal Flats Diversion)	
Usable storage = 21.1 million acre-feet		Usable storage = 21.1 million acre-feet		Usable storage = 21.1 million acre-feet	

Benefits:

(a) Power

Firm energy at load centres in Canada, including estimated downstream power benefits under the Treaty (1985):

20,600 million kwh (excludes up to 2.5 billion kwh annual benefits at West Kootenay plants resulting from Duncan and Libby storage and over 2.5 billion kwh of potential benefits on the Pend d'Oreille River)	20,200 million kwh (excludes up to 2.5 billion kwh annual benefits at West Kootenay plants resulting from Duncan and Libby storage and over 2.5 billion kwh of potential benefits on the Pend d'Oreille River)	25,700 million kwh

Recommended Schemes of Development (Continued):

(A)	(B)	(C)
Basic Load Growth (excludes West Kootenay Generation and Loads and New Industrial Loads)	Basic Load Growth + New Industrial Loads (excludes West Kootenay Generation and Loads)	Basic Load Growth + West Kootenay Generation and Loads + New Industrial Loads

(b) Flood Control - Flood control benefits assumed as provided for under the Treaty, but capital payment of $64.4 million is not credited towards Columbia River power costs.

Costs:

(a) Overall capital investment, including transmission to Canadian load centres:

$1,284 million (spread over 22 years)	$1,202 million (spread over 17 years)	$1,325 million (spread over 18 years)

(b) Annual costs: For each load condition approximately 7.0 per cent of capital investment by 1985, assuming 5 1/2 per cent interest on investment.

(c) Energy Costs: (Average up to 1985, excluding flood control benefit of $64.4 million)

(i) with no sale of downstream benefits:

4.40 mills/kwh [1]	4.03 mills/kwh [2]	3.61 mills/kwh [3]

(ii) with surplus downstream benefits sold at 2.00 mills/kwh:

4.29 mills/kwh		3.54 mills/kwh [4]

(iii) with surplus downstream benefits sold at 4.00 mills/kwh:

4.18 mills/kwh		3.47 mills/kwh [5]

1. If flood control benefit is included, figure quoted in August 1961 Supplement to the Consultants' Report = 4.04 mills/kwh.
2. This figure obtained from Table J of the Supplement to the Consultants' report. If flood control benefit is included,
   - figure calculated by Water Resources Branch using Consultants' estimates of benefits and costs = 3.75 mills/kwh.
3. If flood control benefit is included,
   - figure calculated by Water Resources Branch using Consultants' estimates of benefits and costs = 3.40 mills/kwh.
4. If flood control benefit is included,
   - figure calculated by Water Resources Branch using Consultants' estimates of benefits and costs = 3.33 mills/kwh.
5. If flood control benefit is included,
   - figure calculated by Water Resources Branch using Consultants' estimates of benefits and costs = 3.26 mills/kwh.

Report By: B.C. Engineering Company Ltd.

Report For: Department of Northern Affairs and National Resources.

Title and Date: Report on An Investigation of Columbia to Fraser River Diversion Project, 1956.

Specifications and Criteria for the Study

The Department of Northern Affairs and National Resources commissioned the B. C. Engineering Company Ltd. on 14 June 1955 to undertake a study of possible diversions of water from the Columbia River to the Fraser River basin. The contract specifications for the study stated in part as follows:

> "To carry out an engineering investigation concerning the diversion of 10,000,000 acre-feet of water from the Columbia River system by way of what is known as the Eagle Pass diversion route which is the subject of a reconnaissance report by Water Resources Division dated May 16, 1955, and to further investigate and determine how and to what extent the Fraser River System could be economically developed with the addition of the diverted water in conformity with the recommendations made and the conclusions arrived at in the reconnaissance reports of B. C. Engineering Company dated March and April 1955.
>
> To provide a complete engineering report thereon".

During initial talks between representatives of the B. C. Electric Company, the B. C. Engineering Company, the Canadian Section of the International Joint Commission, the Department of Fisheries and the Department of Northern Affairs and National Resources it was agreed that the height of the dams to be considered in the study would be limited to a maximum of 100 feet in order not to create excessive barriers to fish migration. This restriction made it possible to avoid costly relocation of extensive reaches of the two trans-continental railways, and to some extent, of the Trans-Canada Highway, all of which follow the valleys of the Thompson and Fraser Rivers. Fish ladders and other fish facilities were incorporated in the various structures in accordance with requirements specified by the Department of Fisheries. The estimated construction cost of these facilities is $308,000,000 and water equivalent to 85,000 kw. of power would be required to service them during the migrating season.

It was also agreed at these initial talks to undertake the study on the basis of an annual diversion of 10,000,000 acre-feet from the Columbia River with the understanding that this assumed rate of diversion could be adjusted later if necessary. Regulation studies carried out in 1956 indicated that with full diversion of the Kootenay River at Canal Flats

an average of 9,400,000 acre-feet of water could be diverted from the Columbia to the Fraser River without reducing the then existing level of generation on the Columbia River in the United States. During critical water years on the Columbia only 6,200,000 acre-feet would be available for diversion.

The Plan

Plates 1 and 2 herewith present, respectively, a map of the Columbia and Fraser River basins and a profile of the diversion route from the Columbia River through the Eagle, Thompson and Fraser Rivers on which the locations of the proposed power developments and storage reservoirs are shown. Along this 400 mile route from above the proposed Revelstoke Canyon (Little Dalles) dam on the Columbia River to the mouth of the Fraser River there is a total fall of 1,610 feet, of which the study indicates it is feasible to utilize 1,205 feet in 11 power plants - two on the Eagle River, five on the Thompson River, and four on the lower Fraser River with heads and installations as follows:-

Proposed Power Installations

Plant	Max. Gross Head-Ft.	Proposed Installation Hp.	Kw.
Fraser River			
Yale	70	635,000	475,000
Spuzzum	100	930,000	695,000
Boston Bar	100	930,000	695,000
Cisco	100	930,000	695,000
Sub total	370	3,425,000	2,560,000
Thompson River			
Gladwin	95	475,000	355,000
Seddell	95	475,000	355,000
Martel	100	500,000	375,000
Basque	100	500,000	375,000
McAbee	95	475,000	355,000
Sub total	485	2,425,000	1,815,000
Eagle River			
Malakwa	130	400,000	300,000
Kay Falls-Taft	220	720,000	535,000
Sub total	350	1,120,000	835,000
Total	1,205	6,970,000	5,210,000

From available records it was determined that the maximum and minimum flows of the Thompson River at Spences Bridge were 146,000 second feet and 4,100 second feet with a long term mean flow of 26,100 second feet. The comparable figures for the Fraser River at Hope were found to be 536,000 second feet, 12,000 second feet, and 92,300 second feet, respectively.

The report found that with no regulation of the stream flow the theoretical firm potential of the Thompson River from Kamloops to Lytton, and of the Fraser River from Lytton to Hope would be less than 1,000,000 horse power, and that physical conditions are such as to make it uneconomic to develop this power. However, by means of storage independent of the Columbia diversion it was found practical to increase the firm capacity to the point where the four sites on the Fraser below Lytton and the Gladwin site on the Thompson totalling 2,433,000 horse power would approach economic feasibility. By means of the diversion of 10,000,000 acre-feet of water annually from the Columbia, four additional sites on the Thompson achieve economic feasibility and head can be developed on the Eagle River. Under this condition the gross installed capacity along the route could approach 7,000,000 horse power.

Total development was planned over a 20-year period. Capital cost of the various structures and equipment was estimated at $2,234,700,000. However, this does not include the cost of the Mica Creek and Revelstoke Canyon dams essential to the project. It was assumed that the annual cost of power production would be 9.5 per cent of the capital cost.

Conclusions

The report presents the following summary of data and the conclusion derived from the study:-

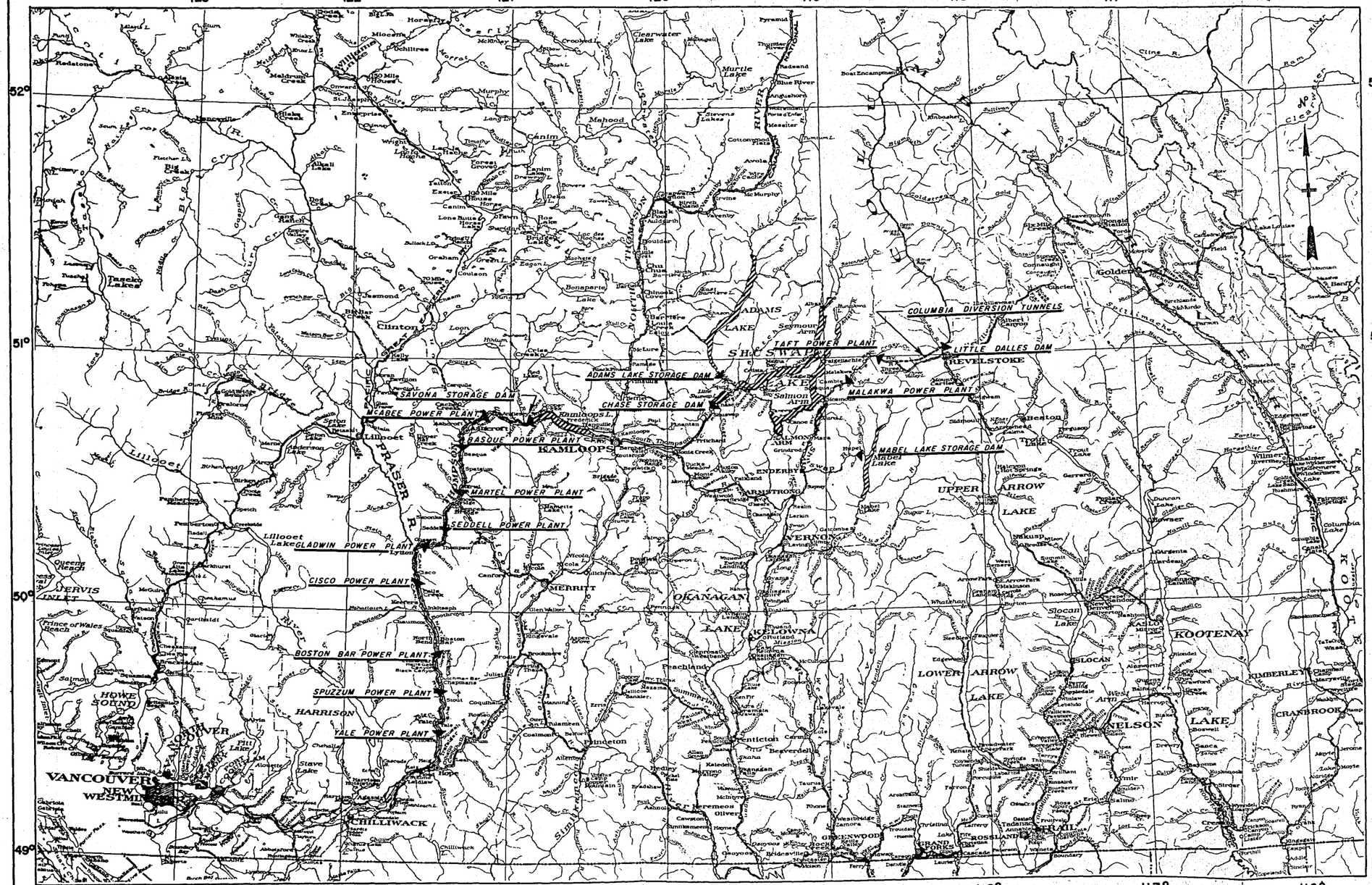
SUMMARY

Details of the results of this investigation are reported in succeeding chapters. The essence of these results is represented by the following figures:

Item	Without Columbia Diversion	With Columbia Diversion
Installation - KW	1,816,000	5,210,000
Capital Cost - Millions of Dollars	938.2	2,234.7
Capital Cost - per Unit KW in Dollars	516.0	429.0

Item		Without Columbia Diversion	With Columbia Diversion
Generation	- Billions of KWH/Year		
	Firm	9.2	26.5
	Secondary	4.0	4.0
Production Cost	- Mills/KWH		
	Firm	9.70	8.00
	Firm plus Secondary	6.75	6.95

Exclusive of the necessary dams on the Columbia River, the Columbia diversion would therefore represent 3,394,000 kilowatts of installation at $382 per kilowatt and total production of 17.3 billion kilowatt-hours annually at 7.10 mills per kilowatt-hour. All of the above figures are for energy delivered at Vancouver, B. C.



Prepared in connection with the Columbia River Reference to the International Joint Commission.

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES
WATER RESOURCES DIVISION

INVESTIGATION OF
COLUMBIA TO FRASER RIVER DIVERSION PROJECT

PROJECT AREA

B.C. ENGINEERING COMPANY LIMITED

DRAWN		CHK'D	RECOMMENDED
DESIGN		SUBM'TED	APPROVED

216	VANCOUVER, B.C. DATE 1956	101 - 1

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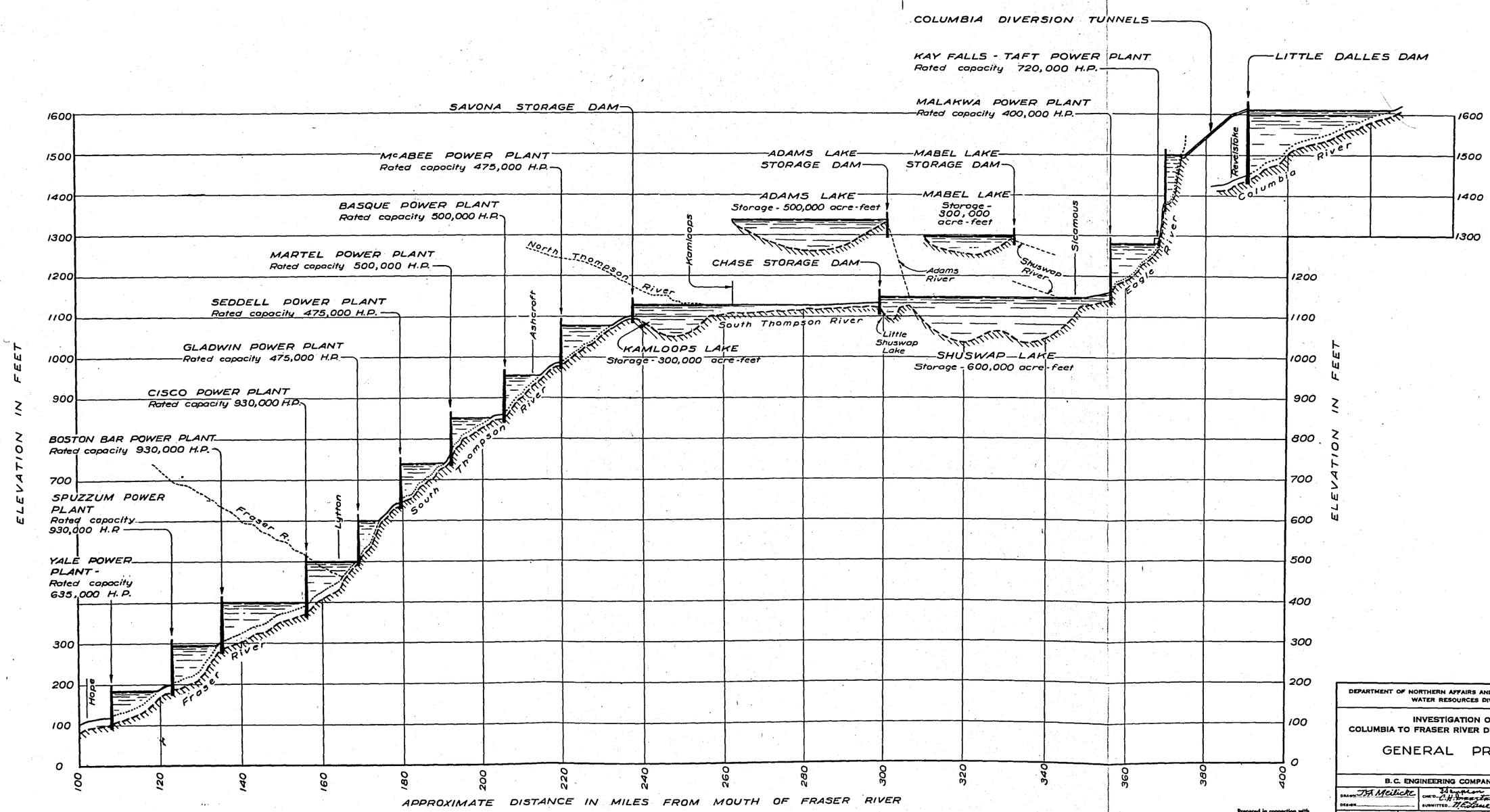

Prepared in connection with the Columbia River Reference to the International Joint Commission.

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES
WATER RESOURCES DIVISION

INVESTIGATION OF
COLUMBIA TO FRASER RIVER DIVERSION PROJECT

GENERAL PROFILE

B.C. ENGINEERING COMPANY LIMITED

DRAWN: J.A. Meilicke	CHK'D: C.H. Swanston	RECOMMENDED: [illegible]
DESIGN:	SUBMITTED: [illegible]	APPROVED: [illegible]

216	VANCOUVER, B.C. DATE May 1, 1956	101 - 2

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PAYMENTS AND PRICES UNDER COLUMBIA RIVER ARRANGEMENTS

The payments to be made by the United States to Canada for power and flood control benefits, as set out in the Treaty and in related documents, can be expressed or evaluated in a number of ways. Thus, a cash payment made, say, in 1964, can be evaluated in terms of its equivalent value at some specific future date. Or a series of payments for power and flood control benefits can be translated into a price per kilowatt hour of power sold, and so on. The Governments of Canada and the United States, each concerned with evaluations and explanations for purposes of domestic comparison, have found it useful to present calculations of this kind. Since the bases used in such calculations were sometimes different in the two countries, the statistical results were different. It the same way, different figures have been used in Canada to express the monetary value of the payments receivable from the United States by Canada. The purpose of this note is to set out the various factors involved in evaluating the payments to be made under Columbia River arrangements, and to show how certain apparently conflicting evaluations can be reconciled.

Among the factors or assumptions involved in appraising the value of the payments are;

(a) The currency involved: United States or Canadian dollars;

(b) Present worth and the time factor;

(c) The appropriate interest rate to be used in making calculations under (b);

(d) The appropriate load factor to be used in calculations concerning power;

(e) The inclusion or exclusion of flood control payments in evaluating certain benefits.

The assumptions used in evaluating the payments to be received by Canada can be explained and illustrated as follows:

(a) <u>The currency involved</u>

Payments quoted in the Treaty documents in United States funds are converted for Canadian purposes into Canadian dollars at the rate $1.00 (United States) being equal to $1.08 (Canadian).

(b) Present Worth and the Time Factor

The sale arrangement will provide for the United States buyer to receive amounts of power as it is produced downstream over a period of 30 years. Such a sales contract could involve a series of annual cash payments for the power sold each year. Instead, British Columbia preferred to receive a single lump sum in advance equivalent in value to such future payments. This arrangement has been agreed to. To determine the appropriate value to be placed upon such a lump sum, each of the future annual payments was discounted at 4 1/2 per cent (the appropriate rate of interest applicable to the purchaser in the United States) over the appropriate number of years. This means, for example, that if a single payment of, say, $10 million happened to be owing on 1st October 1974, a payment of $6,439,000 on 1st October 1964, would be equally satisfactory, since this amount invested at 4 1/2 per cent and compounded, would be equal to a payment of $10 million in ten years. And similarly for the other annual payments. In this way the Canadian entitlement to downstream power benefits over a 30-year period has been calculated as having the same value as a payment of $254.4 million (United States funds) paid in the form of a lump sum on 1st October 1964. By the same token, if one wishes to calculate the value of this and other lump-sum payments (flood control benefits) to British Columbia expressed in terms of a single future date, the payment amounts must be "invested" at an appropriate rate of interest (compound) for the appropriate number of years.

(c) The appropriate interest rate

In reducing future payments to their "present worth" or in raising a figure of present worth to its value at a future date, a rate of interest which is appropriate to the circumstances must be selected. In determining the "present worth" of a series of annual revenues which the United States expected to earn from the disposal of Canada's power entitlement the United States used a rate of 4 1/2 per cent. This was deemed to be the approximate rate at which the agencies concerned in the United States could borrow or invest funds over a long term. The lower the interest rate chosen, the larger will be the "present worth".

If we wish to evaluate the future worth (say in 1973) to British Columbia of lump-sum payments to be received in 1964, 1968, 1969 and 1973, as is done below, it is appropriate to use a rate of, say, 5 per cent, this being a conservative estimate of what it might cost British Columbia to borrow funds, or what might be earned by investing any surplus funds. The larger the rate of interest used, the larger will be the future value.

(d) The question of load factor

In power sales there are two different measures of quantity that have to be considered: "capacity", which is the rate at which the electrical energy can be drawn at any one time and which is measured in "kilowatts", and the "energy" itself, which is the amount of work that can be done over a period of time and which is normally measured in "kilowatt hours" or "kilowatt years". The electrical requirements in a system are highly variable at different times of the day and different seasons of the year, depending on the "work" the system has to do in homes, factories and all places using power. If the "energy" has to be taken at a constant rate, with little or no flexibility, it is not as useful and valuable as if the rate of use can be varied. The ratio between the average rate of use and the maximum rate at which the supplier contracts to provide it is the "load factor". If the energy can be drawn only at a constant rate, the average rate and the maximum rate are the same; the ratio is 1:1 and the load factor is 100 per cent. There is no flexibility at all in such a situation. If the average rate of use is at a level of 60 kilowatts, but the power can be taken at times up to the rate of 100 kilowatts, the ratio is 60:100 and the load factor is 60 per cent.

Under the Treaty Canada's downstream benefits are calculated in both "capacity" (kilowatts) and "energy" (kilowatt hours). The "load factor" at which our entitlement is produced over the period of sale is approximately 48 per cent, averaged over the 30-year period of sale.

(e) The inclusion of the flood control payments

In the United States one agency (the United States Government) pays the flood control payments to which Canada is entitled and another (the association of utilities being formed to buy our downstream power) pays for the power. From the United States point of view it is therefore reasonable to consider the payment for power quite apart from the payment for flood control. In Canada, a single agency in British Columbia will receive the entire amounts paid in return for its service of operating the Treaty storages in Canada. From the Canadian point of view it is thus reasonable to consider the payment as a whole.

The above factors explain the differences in a number of figures that have been given out concerning payments under the Treaty arrangements. One example is the apparent disparity between statements in the United States that the Canadian power entitlement was bought at a price of "3.75 mills" and statements in Canada that the yield to Canada is "5.3 mills". The reconciliation of these two figures is as follows:-

United States statement: 3.75 mills per kilowatt hour (The relevant details are that this figure is in United States currency, for power at 60 per cent load factor and leaves out of consideration the payments for the flood control service).

Change 3.75 mills (United States) to Canadian funds = 3.75 x 1.08 = 4.05 mills per kwh (Can.).

Load Factor Adjustment: While the United States have quoted their price at a 60 per cent load factor, the actual benefits sold to the United States do not occur at this load factor but at an average load factor of about 48 per cent. More capacity is involved at that load factor for which United States payment is required. To arrive at the payment to be made the values that have been established for "capacity" and "energy" respectively have to be taken into account.

The figures underlying the United States calculation are $5.50 per kilowatt per year for capacity and 2.7 mills per kilowatt hour ($23.65 per kilowatt year) for energy. These values are in United States funds and are equal to $5.94 (Can.) per kilowatt per year for capacity alone, and 2.92 mills (Can.) per kilowatt hour ($25.58 per kilowatt year) for energy alone. The following examples indicate how the figures apply in relation to 48 per cent load factor power as compared to 60 per cent load factor:

60 per cent load factor

1 kilowatt year of energy at	$25.58 per kilowatt year
requires $\frac{1}{.6}$ = 1.67 kilowatts of capacity at $5.94 per kilowatt =	9.92
Total value of power =	$35.50 per year for

1 kilowatt year of energy with the amount of capacity required to enable it to be drawn on a 60 per cent load factor basis.

On the basis of 8760 hours in a year, the above value in kilowatt hour terms is, therefore, $35.50 ÷ 8760 = 4.05 mills for every kilowatt hour of energy at 60 per cent load factor.

48 per cent load factor

1 kilowatt year of energy at	$25.58 per kilowatt year
requires $\frac{1}{.48}$ = 2.08 kilowatts of capacity at $5.94 per kilowatt =	12.36
Total value of power =	$37.94 per year

for 1 kilowatt year of energy with capacity required on a 48 per cent load factor basis.

Reducing this figure to a value per kilowatt hour, as in the previous example, the result is 4.33 mills per kilowatt hour.

Returning to the United States figure of 4.05 mills (Can.) or 3.75 mills (U.S.) for 60 per cent load factor power, it is clear that this calculation does not take into account the additional capacity that is required to permit the energy belonging to Canada under the Treaty to be drawn on the 48 per cent load factor basis to which we are entitled on the average over the term of the sale. To cover that extra amount of capacity, as the above calculations show, the United States purchaser has agreed to make a payment that is the equivalent, not of $35.50 (4.05 mills per kilowatt hour) but $37.94 or 4.33 mills per kilowatt hour (in Canadian funds).

While the examples have been worked out at 48 per cent load factor, the actual value of power sold year by year under the sales agreement comes to 4.36 mills per kilowatt hour, the difference being due to the "rounding" required in the specific examples employed.

In brief, .31 mills per kilowatt hour (4.36 minus 4.05) has to be added to adjust for the load factor difference.

Add Flood Control Payments: The payments Canada will receive for flood control operation, when included with the payments for power, increase the evaluation of the price for power by about 0.91 mills per kilowatt hour.

The total value to Canada can therefore be expressed as 5.3 mills (Can.) per kilowatt hour. (4.05 mills + .31 + .91 = 5.27 mills)

Values and Costs at Points of Time

To look at a different aspect of the complex problem of stating figures in a meaningful way, the "time factor" is relevant in arriving at the "present worth" of energy sold at 5.3 mills (Can.) per kwh over 30 years at the rates at which it is estimated that it will be produced, year by year, during that period. As has been indicated above, the discount rate that is reasonable for the "customer" in the United States to apply is 4 1/2 per cent (the long-term interest rate that is reasonably available). If the downstream benefit energy which is sold year by year to the United States is evaluated at 5.3 mills per kwh and these annual values are then discounted at 4 1/2 per cent to a single value on 1 October 1964, the single value is equal to the sum of:

(1) the $274.8 million (Can.) payment which will be made for power on that date, plus

(2) the discounted value of the $69.6 million (Can.) payment for flood control that is to be made in three parts as storages are

completed in 1968, 1969 and 1973. Those three amounts, discounted from the actual payment date to 1 October 1964 in each case, would come to $56.2 million (Can.) if made on that day.

The total of $274.8 million + $56.2 million = $331.0 million (Can.) is a correct expression of the discounted value on one day -- 1 October 1964 -- of the values at 5.3 mills per kwh (Can.) being paid over 30 years of sale.

When the Canadian dollars that are the equivalent of the payments by the United States are in the hands of the Canadian vendor (the British Columbia Hydro and Power Authority), the time factor has a second application at a new interest rate: the rate of return that can reasonably be expected when the funds are invested in Canada. As mentioned previously, a fair long-term rate here is currently over 5 per cent.

The payments to be made by the United States in 1964, 1968, 1969 and 1973 will be well in advance of expenditures on construction. There will thus be surpluses to be invested for varying periods until construction is completed (and thereafter as well). To arrive at a single "time point" for evaluation of the arrangement in relation to Canadian costs the date of completion of the last Treaty storage project was taken -- 1 April 1973. Calculation was made on the basis that the entire payments should be regarded as earning interest, since they will either earn interest in fact (the funds available ahead of construction needs) or will "earn" it in the sense that they avoid the need to pay interest on funds that would otherwise have to be borrowed to cover the actual construction costs. Applying a minimum rate of 5 per cent the payments are worth $501 million (Can.) on 1 April 1973. The calculations are:

Payment for	Amount of Payment $Million (Can.)	at date of	Value on 1 April 1973 $Million (Can.)
Power Benefits	274.8	1 Oct. 1964	416.1
Flood Control			
Duncan	12.0	1 Apr. 1968	15.3
Arrow	56.3	1 Apr. 1969	68.4
Mica	1.3	1 Apr. 1973	1.3
		Total	501.1

To obtain a comparison with the costs of constructing the storage dams, the actual costs to be incurred can similarly have interest added to them for the time from the date of construction to 1 April 1973.

The figures are:

Project	Actual Capital Cost $Million (Can.) (*)	at in-service date of	Cost and interest to 1 April 1973 $ Million (Can.)
Duncan Storage	33.3	1 Apr. 1968	42.5
Arrow Storage	129.5	1 Apr. 1969	157.4
Mica Storage	245.2	1 Apr. 1973	245.2
General Costs	2.6	1 Apr. 1973	2.6
		Total	447.7

As the figures show, there is a surplus of $53.4 million (Can.) as of 1 April 1973. This will cover approximately 50 per cent of the cost of installing generators in the Mica dam in Canada with a capacity of 1.8 million kilowatts and capable of producing 6.6 billion kilowatt hours of energy annually.

From the above it will be apparent how the figures that have been officially issued in Canada and the United States are to be reconciled. It will also be apparent that, on the basis of true comparability as of a single suitable point of time, with interest added in respect both of revenues and costs, there is a surplus of revenues over all storage costs to Canada under the Treaty.

* These figures include interest on all costs during the construction period, and thus are complete costs at the date of finishing each storage project.

STATEMENT BY MR. CHARLES LUCE,
ADMINISTRATOR OF THE BONNEVILLE POWER ADMINISTRATION
AND DR. HUGH L. KEENLEYSIDE,
CHAIRMAN OF BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

Mr. Charles Luce, Administrator of the Bonneville Power Administration and Dr. Hugh L. Keenleyside, Chairman of British Columbia Hydro and Power Authority joined in the release of the following statement:

"The Agreement that has now been reached is not based, primarily, on the sale by Canada of a certain number of kilowatt hours to the United States. The essence of the Agreement is the sale by Canada and the purchase by the United States Government and public utilities in the United States of a service -- the controlled flow of Columbia River water across the boundary in accordance with an agreed plan of operation.

Nevertheless the question has been and will be raised as to the price, in terms of mills per kilowatt hour, for this service.

There are two answers to this question.

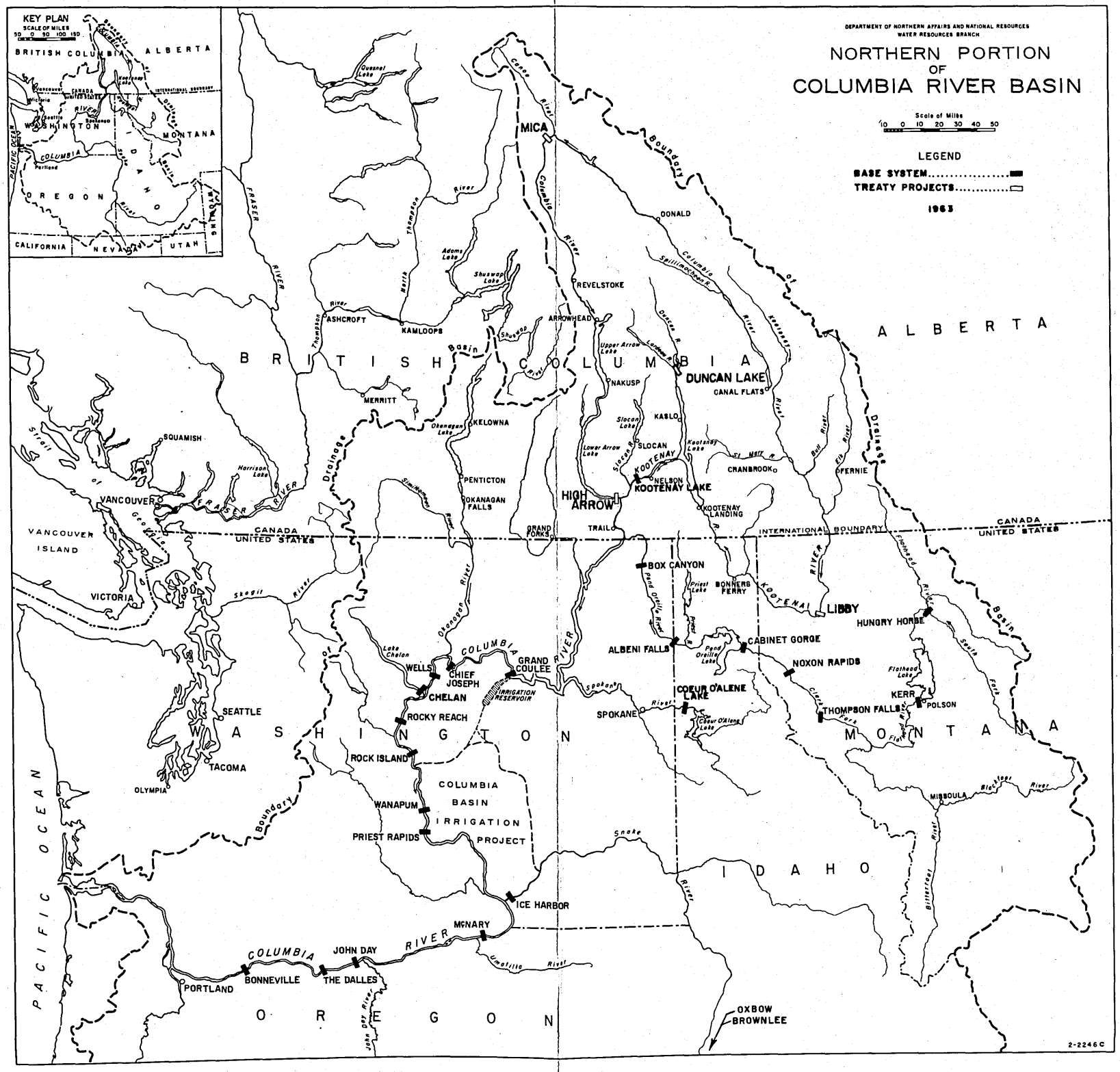
From the standpoint of the United States the purchase of the downstream power and flood control benefits to which Canada is entitled in recompense for the service to be provided, is divided into two parts. The United States is paying $64.4 million (U.S.) for the part of the service that is defined as flood control and public utilities in the United States are paying $254.4 million (U.S.) for the part of the service that is credited against the generation of electricity.

Canada, on the other hand, considers the service as a single transaction for which it will receive a lump sum payment of $274.8 million (Can.), on 1 October 1964, and the remaining $69.6 million (Can.) at the time when the projects come into operation, that is 1968, 1969 and 1973.

In order to define a figure in mills/KWH Canada will divide the total proceeds thus received together with interest at 4 1/2% by the number of kilowatt hours estimated to be in the Canadian entitlement over the 30-year period of sale.

There are different views as to the amounts of power in the Canadian entitlement to downstream benefits. As there is no way of working out in advance the exact amounts of power, the two sides have both agreed to accept for computation purposes a compromise figure. On this basis the value received by Canada for the downstream energy will be equivalent to 5.3 mills/KWH in Canadian currency.

On the same basis of computation but, as indicated, omitting the flood control payments and without the exchange differential, the U.S. cost of electrical energy at 60% load factor, delivered at the generators, will be equivalent to 3.75 mills/KWH in United States currency."


DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES
WATER RESOURCES BRANCH
NORTHERN PORTION
OF
COLUMBIA RIVER BASIN
Scale of Miles
10 0 10 20 30 40 50
LEGEND
BASE SYSTEM.....
TREATY PROJECTS.....
1963
KEY PLAN
SCALE OF MILES
50 0 50 100 150
BRITISH COLUMBIA
ALBERTA
WASHINGTON
MONTANA
OREGON
IDAHO
CALIFORNIA
NEVADA
UTAH
PACIFIC OCEAN
COLUMBIA RIVER
SNAKE RIVER
MICA
REVELSTOKE
ARROWHEAD
OONALD
ASHCROFT
KAMLOOPS
MERRITT
KELOWNA
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OKANAGAN FALLS
SQUAMISH
VANCOUVER
VANCOUVER ISLAND
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