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PROBLEMS ASSOCIATED WITH THE NECHAKO-KEMANO DIVERSION AND HYDRO-ELECTRIC DEVELOPMENT IN BRITISH COLUMBIA

Fisheries Service, Pacific Region

Water Planning and Operations Branch, Pacific Region

Department of Fisheries and Forestry

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INTRODUCTION

At a director's meeting in Ottawa it was agreed that the Pacific Regional offices of the Fisheries Service and of the Engineering Division of the Water Sector would prepare a brief preliminary report to discuss the problems associated with the Nechako-Kemano diversion, to determine whether these problems should be considered by the Fraser River Joint Advisory Board, and to outline steps required to assess hydro power problems in British Columbia. This agreement was stated in Mr. K.C. Lucas' memorandum dated October 30, 1970 to the Honourable Jack Davis, Minister of Fisheries and Forestry.

This report presents a brief assessment of problems associated with the further diversion of the Nechako River and with diversion of the Nanika River into the Nechako Reservoir, and relates these diversions to the work of the Fraser River Joint Advisory Board. It also lists other potential hydro-electric developments and associated problems and outlines further steps necessary to make a continuing assessment of these problems in British Columbia.

NECHAKO-KEMANO DIVERSION

The British Columbia Government is now actively promoting early completion of the Nechako diversion in accordance with the existing water licence. The present plan is to duplicate the existing diversion tunnel

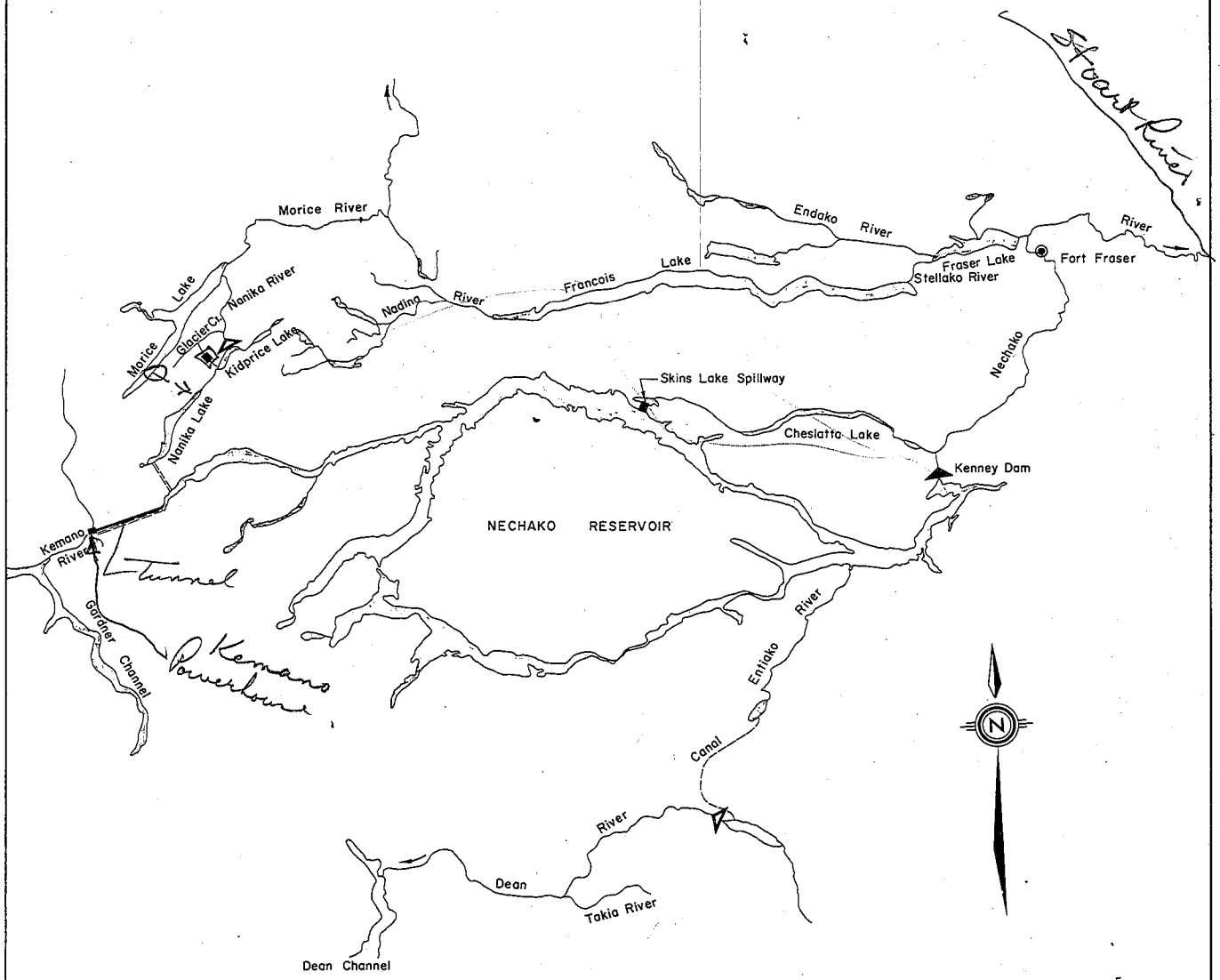
and generating facilities and to leave the reservoir and spillway unchanged. Operation of the reservoir will, however, be modified. The whole diversion scheme is shown on Plan 1.

Since 1958 the average inflow to the reservoir has been 7,800 cfs with about 40% of this now being diverted through the powerplant. The remaining inflow is released from the Skins Lake spillway through Cheslatta Lake into the Nechako River. Ultimate development will mean that most or all of this flow, supplemented by diversions from the Nanika River and perhaps from the Dean River, will be diverted from the Nechako River into the Kemano River. The residual flow in the Nechako River will then consist of the runoff from its watershed area below Kenney Dam including the Cheslatta-Murray Lake systems and sporadic releases from the Skins Lake spillway as necessary to control the reservoir.

The fisheries problems associated with the Nechako-Kemano development were outlined in reports prepared jointly by the Department of Fisheries and the International Pacific Salmon Fisheries Commission between 1950 and 1953. It was concluded that the fisheries would require a maximum annual release of 70,000 acre-feet of cold water from the main reservoir into the Nechako River to maintain the salmon stocks after the project was fully developed. This recommendation was not accepted by Alcan or the Water Comptroller and the problems with respect to ultimate development have never been resolved.

PLAN I

NECHAKO DEVELOPMENT



Existing dam
Proposed dam
Spillway
PROPOSED SPILLWAY
Existing tunnel
Proposed tunnel

10 0 10 20 30
SCALE IN MILES

use heavier lines and increase lettering size. (double for important features - dams rivers etc.

The major salmon runs affected by the diversion are the sockeye runs which pass through Fraser Lake enroute to the Nadina, Stellako and Endako Rivers; the chinook runs into the Nechako River above Fort Fraser; and the chinook and sockeye runs into the Stuart River system. Escapements into these systems during recent cycle years have been in the order of 150,000, 1000 and 350,000 respectively. The Nadina sockeye run is expected to return to historic levels after completion of the spawning channels presently being constructed by the Salmon Commission.

The problems associated with the diversion can be summarized as follows:

1) insufficient transportation water in the Nechako River above its confluence with the Stuart River.
2) spawning and incubation water for chinook salmon in the Nechako River above Fort Fraser.
3) maintenance of acceptable migration and spawning temperatures for each of the three major runs.

The Nechako Reservoir was filled between October 1952 and August 1957. During this time no water entered the river below Kenney Dam except for controlled flows in the range of 150 to 600 cfs from the reservoir which was temporarily provided for fisheries purposes on Cheslatta and Murray Lakes. Flows in the Nechako River downstream from the dam during this period are therefore indicative of those expected after ultimate development if the dam at Murray Lake is replaced and flow regulation is provided. A significant amount of biological and engineering data collected during this time is now being analyzed for inclusion in a report later this year.

Diversion into the Kemano River commenced with powerplant operation in May 1957. This river contains excellent runs of all salmon species except sockeye and there has been no indication of a decline in any of these as a result of the diversion. Very little data is available on this river and bio-engineering studies will be required before the effects of increased discharges which will result with ultimate development can be determined. The possibility of constructing spawning channels in the area to augment natural production is being considered.

The review of upstream storage for flood control within the Fraser River basin being carried out under the Fraser River Joint Advisory Board includes the Nechako Reservoir. Operation with both the present and increased diversions is being studied for maximum flood control and other environmental effects. Results of these studies will be available in about three years and should be considered in evaluation of the project.

NANIKA RIVER DIVERSION

The final stage of the Nechako-Kemano development could be the diversion of the Nanika and Dean Rivers to augment the natural supply to the reservoir. This section describes the diversion of the Nanika River from the Skeena River drainage into the Nechako Reservoir.

Alcan plan to construct a dam at the outlet of Kidprice Lake, a tunnel from Nanika Lake to the Nechako Reservoir and a spillway draining into Glacier Creek which enters the Nanika River about two miles below the

dam site. This diversion would supply an additional 990 cfs to the Nechako Reservoir and would increase the regulated firm flow available for generating power by about 13%.

The annual sockeye escapement to the Nanika River prior to 1954 ranged from 50,000 to 100,000. However, there was a drastic decline in the run in 1954 and the escapement since has been below 10,000. This was attributed to the combined effects of native food fisheries and obstructions to migration at Moricetown Falls and Hagwilget Canyon on the Bulkley River. Although the runs were improved considerably after 1960 by removing the obstruction at Hagwilget, constructing a fishway at Moricetown and operating a hatchery on the Nanika River, a complete recovery to pre-1954 levels has not been realized to date. The Nanika River has, however, an excellent potential for substantial sockeye runs and there is no reason to believe that the stock will not be naturally rehabilitated if suitable environmental conditions are maintained.

The Nanika spawning grounds lie entirely upstream from the mouth of Glacier Creek and will be completely dewatered if an outlet is not provided in the proposed dam. In past negotiations Alcan would not agree to the provision of such an outlet. They contended that its operation would present a potential danger to the dam. However, in view of the technical advances since 1950 it is now reasonable to expect serious consideration of this request.

Loss of the Nanika River flows may also affect salmon runs in the Morice and Bulkley River systems. This is discussed in detail in the 1951 report on the Fisheries Problems Created by the Development of Power

in the Nechako-Kemano-Nanika River systems which concluded that between 10% and 30% of the Morice River chinook and cohoe runs would be lost. The problem is further complicated by the recent proposal to construct a pulp mill and sawmill at Houston and consideration must be given to the flow requirements for dilution of effluent.

The overall effects of the Nanika River diversion are now being studied in detail by the Fisheries Service in conjunction with the study of the Nechako-Kemano diversion referred to in the previous section.

The diversion of the Nanika River should be studied by the Fraser River Joint Advisory Board as this diversion would affect operation of the Nechako Reservoir. The effect of this diversion in the Skeena River basin is considered to be outside the terms of reference of the Fraser River basin studies.

UPPER DEAN RIVER DIVERSION

Alcan has recently reported on the feasibility of diverting water from the Upper Dean River to supplement flows into the Nechako Reservoir. Preliminary plans call for the construction of a storage-diversion dam on the river near the eastern boundary of Tweedsmuir Park, approximately 70 miles from the mouth of the river. Water would be diverted through a canal to the headwaters of the Entiako River and thence to the Nechako Reservoir.

Discharges in the Dean River near the proposed dam site have averaged 690 cfs according to estimates made by Alcan for the 1950-1970 period. Diversion of this water into the Nechako Reservoir would add about 530 cfs to the regulated firm flow available to the Kemano powerhouse.

The Dean River is utilized by all species of salmon with a total estimated annual escapement in the order of 30,000. The river also supports large runs of steelhead trout. All runs are confined to the lower 33 miles of the river below Salmon House Falls, which is located approximately two miles above the confluence of the Takia River.

Flow records obtained at the mouth of the Dean River from 1923 to 1932 show an average annual discharge between 3,370 and 6,940 cfs. Based on these figures, the quantity of water diverted into the Nechako Reservoir would represent from 8% to 16% of the total flow. However, without knowing the contribution of the various tributaries below Salmon House Falls, it is difficult to know what effects the diversion will have on the fisheries. Bio-engineering studies will be required to identify and assess any potential problems related to the diversion.

POTENTIAL HYDRO-ELECTRIC PROJECTS

In order to carry out its responsibilities in the water resource field and to assist provincial agencies, the federal government must be involved in planning potential hydro-electric developments. Such developments in British Columbia are the responsibility of the provincial government which must ensure that projects are developed to meet the demand for electric power. As the current plan for the sequence of development of projects is not known this section summarizes data presently available from both official and unofficial sources. Locations of these projects are shown on Plan 2.

Major hydro-electric developments under active consideration at this time are:

1) the addition of five more 227 mw generators to the existing five in the Gordon M. Shrum powerhouse at W.A.C. Bennett Dam on the Peace River to complete the planned installation. Downstream effects of the operation of this reservoir are under study by Canada, Alberta and British Columbia.

2) powerhouse and generators at Mica dam on the Columbia River with an installed capacity of up to 2,000 mw. The dam will be completed in 1973 and operation of the reservoir to provide flood control and storage releases will change the regime of the river in Canada. The addition of generating facilities will produce only relatively small changes in the pattern of releases.

3) the Canal Plant which would be built on the Kootenay River at the outlet of Kootenay Lake would have an installed capacity of about 300 mw and would make use of flows which have been regulated by Libby Reservoir. This project would only cause minor changes to the regime of Kootenay Lake.

4) the Nechako-Kemano diversion increase and the Nanika and Dean River diversions are discussed in the previous sections. A second power plant would be built at Kemano and would roughly double the present installation of 812 mw.

5) Site 1 on the Peace River is a run-of-river project downstream from the W.A.C. Bennett Dam and is a logical development to make further use of storage in Williston Reservoir. The powerhouse could have an installed capacity of about 800 mw. As this project would not provide regulation it would have little effect on flows in the river.

6) The McGregor River diversion into the Peace River drainage would augment the water supply for the Gordon M. Shrum powerplant to increase the production of firm power as well as provide part of the desired flood control for the Lower Fraser Valley. A small powerplant at the site would have an installed capacity of about 40 mw. Since the diversion would provide a link between the Peace River and Fraser River basins, it would be necessary to prevent the passage of fish from the Peace to the Fraser system. The development would also eliminate a portion of the McGregor River salmon runs. Study of the effects of this diversion in the Fraser River basin is included in the review of upstream storages described in item 10.

7) Revelstoke Canyon and Downie Creek are two run-of-the-river projects downstream from Mica dam on the Columbia River which could have a combined capacity of about 1,500 mw. Neither project would materially affect stream flows or fisheries.

Other potential hydro-electric projects which are being or might be considered for future development are:

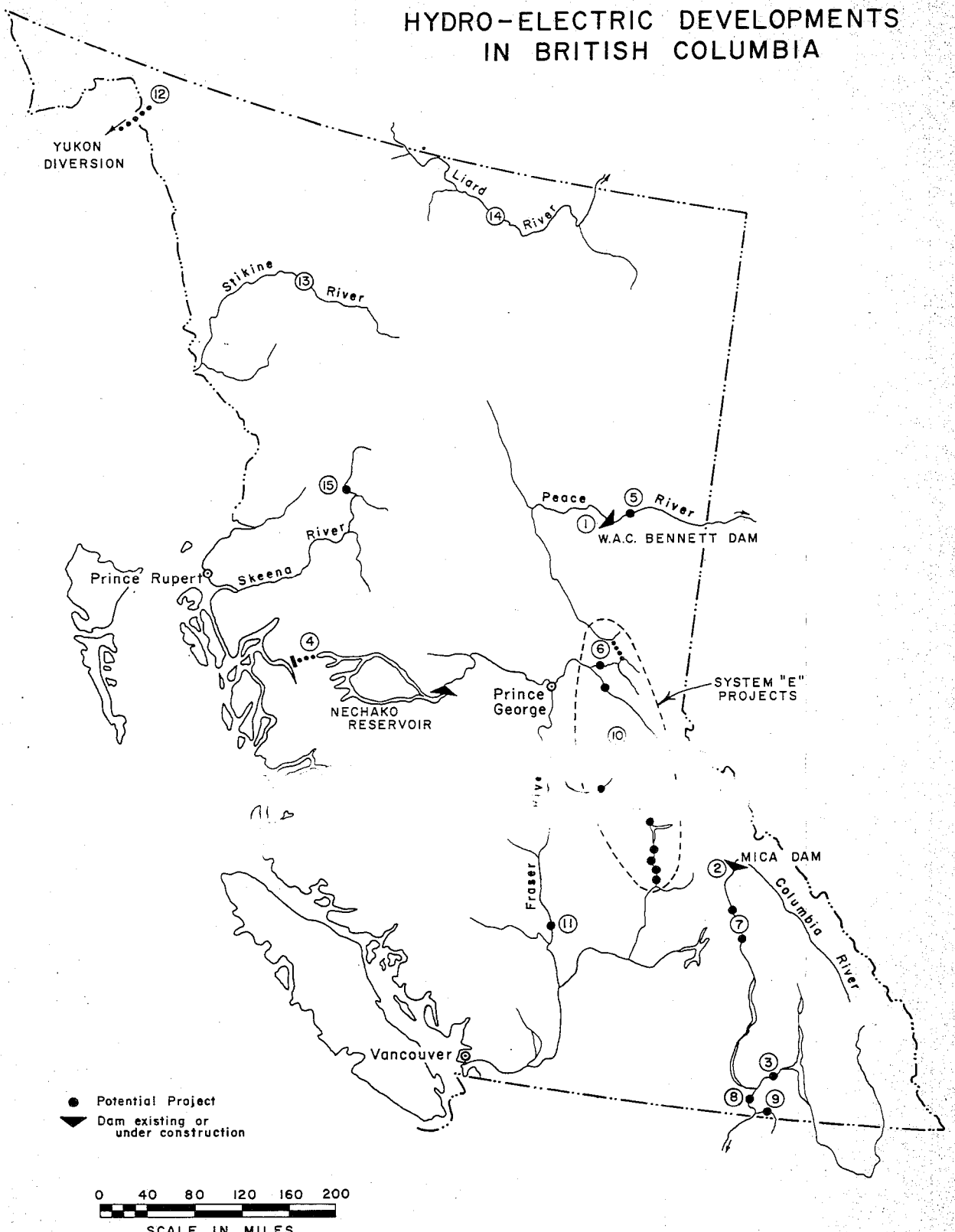
8) Murphy Creek at a site on the Columbia River between Castlegar and Trail would have an installed capacity of about 250 mw.

9) Seven-Mile on the Pend d'Oreille River upstream from Waneta. The proposed powerhouse would have an installed capacity of about 500 mw.

10) System E project listed in the Fraser River Board 1963 report which are currently being reviewed under the Fraser River Joint Advisory Board for combined flood control and hydro-electric development.

PLAN 2

POTENTIAL HYDRO-ELECTRIC DEVELOPMENTS IN BRITISH COLUMBIA



This review includes a comprehensive assessment of effects on the environment. The projects include one of three possibilities on the Fraser River upstream from Prince George, one project on the Cariboo River, five projects on the Clearwater River system some of which are in the Wells Gray Park, and the McGregor River diversion. Installed capacity, excluding the McGregor site could total more than 1,000 mw. All these projects would affect salmon runs to some extent.

11) Moran Canyon dam on the Fraser River above Lillooet which has been in the news recently. Although generators with an installed capacity of 3,600 mw could produce a large block of power and the project would provide effective flood control for the Lower Fraser Valley it would be detrimental to a significant percentage of the Fraser River salmon runs.

12) Upper Yukon River diversion to near tidewater. A recently completed market study indicates that this 4,000 mw project merits further study. However, in comparison with other projects it may not be economically attractive at this time. This is a salmon producing stream and any diversion would adversely affect runs in the area.

13) Stikine River Basin - several projects could be developed to realize a total potential of over 1,300 mw. Salmon utilize most tributaries in the headwaters of the Stikine River and would undoubtedly be affected by hydro-electric development of the river. However, the river empties into U.S. coastal waters and most of these salmon are taken by American fishermen.

14) Upper Liard River Basin - three sites could be developed with generator installations totalling some 3,700 mw and alternative arrangements are under study.

15) Upper Skeena River - preliminary information shows that a site above the Babine River could be developed with an installed capacity of 750 mw. Major runs of chinook, cohoe and steelhead would be affected.

Of this latter group the projects shown under 8, 9 and 10 are the most probable in the near future. The distance from existing transmission facilities would be a major factor in considering economic feasibility of projects 12, 13 and 14. There are many other potential projects in British Columbia but only major ones that have received serious study are listed here.

The sequence of development or estimated dates for construction are needed to establish priorities for collecting data and studying problems associated with hydro-electric development. Presently available information indicates that:

1) The installation of additional generators at W.A.C. Bennett Dam is proceeding and is scheduled to be completed by 1974 except that the tenth unit may be delayed until the McGregor River diversion is accomplished.

2) Installation of generators at Mica dam will probably proceed soon. If it does the first units may come on line in 1976 and the full capacity should be developed within the following two or three years.

3) The Canal Plant at the outlet of Kootenay Lake could be constructed fairly soon after Libby comes into service and would probably be completed by about 1976.

4) Completion of the Nechako-Kemano diversion scheme is a real possibility in the near future provided that agreement is reached between B.C. Hydro and Power Authority and the Aluminum Company of Canada. The Nanika and Dean River diversions would probably be added within a few years.

5) Site 1 on the Peace River can be expected to be developed by 1978 or 1980.

6) The McGregor diversion is desirable for power as soon as possible but a decision will likely be deferred until the Fraser River upstream storage review is completed and flood control effects have been evaluated.

7) Revelstoke Canyon and Downie Creek projects would follow full utilization of the Mica site but are not expected to be in service before 1980.

The items in this list constitute one sequence of development that would serve the forecast electrical loads in British Columbia for the next 10 or 12 years. The findings of the present B.C. Energy Board will provide more information about the relative desirability of these projects and will permit a better forecast. B.C. Hydro and Power Authority is expected to decide within this calendar year which of these projects, 2 to 6 in the above list, will be constructed first.

The B.C. Energy Board was authorized in June 1970 to examine power resources in the province and to plan their utilization to meet forecast power requirements through 1985. The work is scheduled for completion in 1971 and the final report is currently scheduled for completion in February 1972. The Department is represented on the two Advisory Committees, Fisheries and Flood Control, by representatives of the Fisheries Service and Water Planning and Operations Branch and is therefore involved in this phase of planning the use of water resources in the province. The Board will be reviewing all major potential hydro-electric projects in British Columbia including the Moran site on the Fraser River.

PROBLEMS ASSOCIATED WITH HYDRO-ELECTRIC DEVELOPMENTS

The provincial government now has a firm policy to develop hydro power ahead of other forms of electric energy. All these developments will affect the environment to some extent in the reservoir, at the site and in the river basin downstream. To identify and evaluate these effects before commitments to build have been made requires studies and probably the collection of basic data. Because resources are limited priorities must be established to permit directing studies and data collection for the most useful results.

The federal interest in water resource development has in the past been chiefly with the problems created with respect to fisheries and navigation and inter-provincial or international downstream effects of streamflow regulation. In more recent years it has included flood control

in co-operation with the provinces. Under the Canada Water Act the federal government is now concerned with management of the water resource and therefore may require an assessment of effects of hydro-electric development on water quality, recreation, wildlife, and sedimentation or erosion, as well as on fisheries, navigation and flood control benefits and costs.

Study and data collection priorities can only be established when potential problems associated with a particular project have been identified and possible dates for construction have been estimated. The provincial agencies are responsible for meeting the electric load growth and therefore must carry out planning for the sequence of project development on a continuous basis to meet changing loads and conditions. It is not feasible for federal agencies to do similar planning nor to plan their own programs or assist the provincial agencies without provincial co-operation.

STEPS REQUIRED TO ASSESS PROBLEMS

The provincial government has provided little information about its plans to develop hydro-electric projects to meet the growth of electrical load in British Columbia in the near future. This may not be due to reluctance to convey the information as there have recently been official indications that no firm decision has been made on the next project to be built nor on the probable sequence of development thereafter. It is understood that the prime function of the present B.C. Energy Board is to provide

a basis for planning hydro-electric development up to 1985. As this type of information becomes available the province should be encouraged to discuss it with federal agencies and invite participation in the planning so that matters of federal concern can be included and programs for study and data collection established.

It is recommended that Canada and British Columbia, possibly through the Consultative Committee, establish a permanent line of communication which will enable federal engineers to discuss hydro-electric planning with their provincial counterparts and to obtain data on decisions and tentative plans as they are made. The exchange of information should be between government agencies involved in hydro-electric activities rather than through a committee and should include the projects under present and future consideration and their probable sequence of construction. This information can then be made available to other interested federal services for their own planning and appropriate action. It would have to be recognized, however, that provincial agencies are reluctant for power plans to be released and that such information would have to be used with discretion.

Studies and data collection programs required will vary with the type of problem encountered and the magnitude of its effect. Assessment of effects on fisheries require bio-engineering studies for any project involving streams which support populations of salmon and resident sport fish. Problems include effects on spawning grounds, adult and juvenile migration, temperature regime, discharge patterns, chemical water quality and many other factors.

Investigations may include evaluations of artificial spawning channels and rearing facilities to offset losses. Streamflow studies using computer models may be needed to assess effects at downstream points. Since investigations may require several years it is important that studies be initiated in time for results to be included in total project evaluations leading to decisions to build and for development of solutions to problems as part of project design.

FRASER RIVER JOINT ADVISORY BOARD

In 1968 the governments of Canada and British Columbia set up the Fraser River Joint Advisory Board to implement construction of flood control works in the Lower Fraser Valley and to review the possibility of using upstream storage for flood control. The review would evaluate hydro-power, flood control, fisheries and other affected interests in the Fraser Basin for both diversions and for the System E projects. Results will be reported by 1974.

As described in the preceding sections, the Nechako-Kemano diversion and the effects of the Nanika River diversion in the Fraser basin should be studied by the Board as part of its review of potential storage projects. However, since the Board will terminate in 1978, and since its terms of reference cover only the Fraser River basin, it does not appear to be the appropriate body to undertake continuing study of hydro-power problems on a province-wide basis.