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B.C. Hydro

Liard River Hydroelectric Studies

Information Bulletin No. 4

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Community Relations Department
970 Burrard Street
Vancouver, B.C. V6Z 1Y3

LIARD RIVER HYDROELECTRIC STUDIES
INFORMATION BULLETIN NO. 4

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1.0 INTRODUCTION

This is the fourth information bulletin on B.C. Hydro's investigations of the hydroelectric power potential of the Liard River.

The earlier information bulletins were issued in February 1979, September 1979, and March 1981. Copies are available upon request.

Hydro is in its fifth year of studies of the engineering and environmental feasibility of developing the hydroelectric potential of the Liard River. This bulletin outlines the nature of these investigations, and describes some preliminary findings.

For further information, please contact:

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2.0 STATUS OF LIARD DEVELOPMENT

The Liard River studies program was cut back in 1982 as a result of reductions in the electrical load forecast for British Columbia and financial restraints implemented during the year by B.C. Hydro. Major segments of the program planned for 1982 were deferred. However, some of the field studies in progress at the time of the cutback were continued. At the present time it appears that the restraints on the Liard study program will continue through 1983 and possibly longer.

Studies completed to date show that the Liard River development would provide more power, at lower unit cost, than any other river basin currently under investigation in British Columbia. However, recent long-range projections of B.C. Hydro system requirements indicate that power from the Liard would not be needed until the year 2000 or later, a deferral of at least two years from previous estimates.

No decision has been made by B.C. Hydro whether or not to apply for regulatory approval for any of the Liard River projects, and such a decision will not likely be made for some time. On the basis of an assumed year 2000 in-service date, B.C. Hydro would need to apply by 1988 to allow sufficient time for regulatory reviews and, if the development were approved, construction of the first project and associated transmission facilities.

As a result of the slowdown in the Liard program, work in 1983 will consist mainly of office studies. Engineering site explorations and environmental field studies previously planned for 1983 have been deferred. However, a limited program of hydrological and environmental data collection will continue, to provide additional information for the environmental impact assessment studies when they resume.

3.0 PLANNING AND LICENSING

(a) The Planning Process

It takes 10 to 20 years to plan, design, license and build a major hydroelectric project. For this reason, Hydro must look years ahead in examining potential sites. When the need arises for more electricity, projects must be operating to meet that need. Therefore, Hydro's plans must be flexible enough to accommodate events such as a change in electrical demand or the loss of a project (due

to high cost, environmental or other factors, or rejection at the licensing stage).

Hydro selects a sequence of projects to meet projected electricity needs. This sequence is reviewed annually, and adjusted if necessary, in the light of new information about projects and electrical demand. Lower-cost energy sources, assuming they could be built in time to meet expected electrical demand, are generally scheduled first. Such scheduling is in keeping with Hydro's objective of supplying electricity at the lowest long-term cost to British Columbia customers.

(b) Public Consultation

During the planning of potential new projects, B.C. Hydro carries out a public consultation program to discuss its studies and preliminary plans with interested parties. The public consultation program for the Liard River hydroelectric development provides for participation by government representatives, local interest groups and the general public. The program's objectives are:

1. to ensure that interested members of the public are informed about the proposed development;

2. to provide opportunities for the public to consult with Hydro representatives about the implications of the proposal;

3. to enable Hydro to work with representatives of the public in dealing with issues pertaining to the proposal, and

4. to assist Hydro in obtaining the information necessary to make informed, responsive decisions.

(c) The Project Certification Procedure

(i) Regulatory Approvals

For Hydro to proceed with construction of a major hydro-electric generation or transmission project, it must obtain various approvals, certificates, permits and licences.

Depending upon the location, nature and scope of the hydro-electric generation project, provincial statutes which may apply include the Utilities Commission Act, the Water Act, the Agricultural Land Commission Act, the Heritage Conservation Act, the Park Act, the Environment and Land Use Act, the Highway Act, the Environment Management Act and the Forest Act.

Federal statutes which may apply include the Navigable Waters Protection Act, the Fisheries Act, the Indian Act, the Northern Inland Waters Act and the Canada Water Act.

For certain projects only some of these statutes would be applicable while for others, such as the Liard project, it is anticipated that most or all of the approvals required by the above statutes might be involved.

(ii) The Provincial Energy Review Process

The Utilities Commission Act established a comprehensive mechanism for decision-making on major energy projects. Major hydroelectric generation projects and 500 kilovolt (kV = 1000 volts) transmission lines are subject to review by and decisions of the Minister of Energy, Mines and Petroleum Resources, the B.C. Utilities Commission and the Provincial

Cabinet, in accordance with the process established by the Utilities Commission Act.

The Act requires that an applicant for a project provide certain detailed information and an analysis of the impacts created by the project. It makes provisions for a public hearing process which can allow for input from the general public and other interested parties. The Act also provides that the Commission will report and make recommendations after such hearings. On receiving the report and recommendations of the Commission, the Cabinet will decide whether to approve or reject the proposal and may set down terms and conditions that it believes to be appropriate.

4.0 ENGINEERING STUDIES

(a) Study Region

The Liard River rises in the Yukon and flows southeasterly into British Columbia near Lower Post. The river flows in an easterly direction through British Columbia for about 480 kilometres (km = 5/8 mile) before crossing into the Northwest Territories. A further 370 km downstream, the Liard discharges into the Mackenzie River at Fort Simpson. From there, the Mackenzie flows 1390 km to the Beaufort Sea. (See Fig. 1).

The Alaska Highway runs parallel to the Liard River over the western half of the river's course through British Columbia, as shown in Fig. 2. The principal settlements and facilities in the Liard study area are located along the highway. Two communities, Lower Post, B.C., and Upper Liard, Y.T., are located near the B.C. - Yukon boundary. The residents of these communities are predominantly native Indians belonging to the Liard River Band

(1975 population, 595). The Muddy River Indian Reserve, located near the confluence of the Liard and Kechika rivers, has an area of 71 hectares (ha = 2.47 acres). The Liard River Hot Springs and the associated 670 ha Class A provincial park are located at Mile 496 of the Alaska Highway, near Lower Liard Crossing. Large areas between Lower Post and Liard River Hot Springs park were burned by forest fires in 1982.

(b) Alternative Development Schemes

The Liard River development, consisting of projects at Devils Gorge and Beavercrow, could provide an installed capacity of about 4410 megawatts (MW = 1 million watts) and generate about 26 000 gigawatt-hours (GW.h = 1 million kilowatt-hours) of electricity annually. This is greater than the combined output of B.C. Hydro's two largest generating stations - G.M. Shrum on the Peace River and Mica on the Columbia River.

The decision to select the Devils Gorge and Beavercrow scheme for detailed investigation was based on preliminary studies of 11 potential development schemes involving various combinations of six project sites. Studies of alternative project combinations are reviewed and brought up-to-date from time to time for comparison with the Devils Gorge-Beavercrow scheme.

The Devils Gorge (572) project would form a reservoir extending upstream to a point near Lower Post, and Beavercrow (390) would impound water back to Devils Gorge. [Numbers in brackets refer to the nominal maximum normal reservoir elevations, expressed in metres (m = 3.28 feet) above sea level.] Devils Gorge, previously called Site E, is located at the head of the Grand Canyon of the Liard approximately 25 km downstream from Lower Liard Crossing, while Beavercrow, previously called Site A, is about 110 km upstream from the B.C.-N.W.T. boundary.

Due to the nature of the foundation rock at Beavercrow there may be advantages in developing the river with a three-project scheme rather than with the two-project scheme described above. The three-project scheme would include projects at Devils Gorge (572), Hell Gate (390) and Beavercrow (342). The Devils Gorge dam would be identical to the one in the two-project scheme, while the Beavercrow dam would be approximately 48 m lower than in the two-project scheme. The profile of the river (Fig. 3) shows the differences in the two schemes. Preliminary studies of the three-project scheme indicate that it would produce slightly less energy than the two-project scheme but might have certain offsetting benefits. Following are descriptions of the components of the two schemes.

(i) Devils Gorge (572) Project

The Devils Gorge site is located approximately 25 km downstream from Lower Liard Crossing at the upstream end of the Grand Canyon of the Liard. Facilities at this site would consist of an earthfill dam, 200 m high, an underground powerhouse with a capacity of 2490 MW and a gated concrete spillway. Two saddle dams would be required on the perimeter of the reservoir, one 4 km east and the other 8 km southwest of the main dam.

Devils Gorge reservoir would have a surface area of about 890 square kilometres (km^2 = 0.3861 $mile^2$) and would be 240 km long at the normal maximum elevation. It would provide 21 x $10^9 m^3$ of usable water storage capacity, slightly more than half that of Williston Lake, the largest reservoir in British Columbia.

The Devils Gorge reservoir would store water during the spring - summer high runoff period, and the stored water would

be discharged through the turbines during the low-flow fall-winter period. In a year of average runoff in the Liard River basin, the lowest water level in the Devils Gorge reservoir would be about 17 m below normal maximum reservoir level. Maximum drawdown in a year of extreme low flows would be 30 m. Normally the Devils Gorge reservoir would reach its lowest level of the year in April, just before the onset of spring runoff. The reservoir would fill or reach its highest level in late summer or early fall.

(ii) Beavercrow (390) Project

The Beavercrow project would be located about 110 km upstream from the B.C. - N.W.T. boundary, about 50 km upstream of the confluence of the Fort Nelson and Liard rivers. This project would include an earthfill dam approximately 160 m high with a 1920 MW, surface powerhouse and a gated concrete spillway.

At its normal maximum elevation of 390 m, the Beavercrow reservoir would have a surface area of about 190 km^2 and would extend 125 km upstream to Devils Gorge.

Under normal operating conditions the Beavercrow reservoir would be held at or near its normal maximum level. However, to meet short-term storage requirements and to minimize the amount of water that would have to be spilled, it would be subject to relatively small (about 2 m) water level fluctuations, daily and weekly.

(iii) Beavercrow (342) Project

The Beavercrow (342) project would consist of an earthfill dam approximately 112 m high, a gated concrete spillway and an 1150 MW surface powerhouse. The reservoir at a normal maximum

level of 342 m would extend to Hell Gate. Reservoir operating conditions would be the same as for Beavercrow (390).

(iv) Hell Gate (390) Project

Hell Gate is located about 40 km downstream from Devils Gorge and 85 km upstream of Beavercrow. Facilities at this site would include a concrete gravity dam and gated spillway and a 720 MW surface powerhouse. The reservoir at a normal maximum elevation of 390 m would extend back to Devils Gorge.

5.0 ENVIRONMENTAL AND SOCIO-ECONOMIC STUDIES

(a) Studies Upstream of Beavercrow

1. Physical - Terrain and soil mapping of the Liard River valley has been completed and the information will be used in various other studies, including those concerning highway and access route location. B.C. Hydro plans to continue collecting information about sediment, temperature and other hydrological matters. Further studies on the physical characteristics of the proposed reservoirs have been deferred.

2. Biological - Fisheries studies in the upper Liard drainage have been completed. Eighteen species of fish occur naturally in the rivers and smaller tributaries. At least 14 species are expected to be able to colonize the proposed reservoirs; whitefish and longnose suckers would probably be the dominant ones. The large drawdown zone of the Devils Gorge storage reservoir would be an impediment to productivity; most fish species would rely on inflowing tributaries for spawning and rearing habitat. Large proportions of whitefish in the

drainage have been found to harbour tapeworm cysts (Triaenophorus species, not infective to humans).

Studies of wildlife and wildlife habitat are near completion. Although detailed mapping and study of wildlife habitats within the future reservoir area have been completed, these and other studies such as those concerning forestry will likely have to be revised due to the changes in vegetation caused by extensive forest fires in mid-1982.

3. Socio-Economic - A preliminary study of suitable sites and corridors for location and relocation of highways, access roads, construction camps and townsites is being completed. Several potentially suitable corridors for relocation of the Alaska Highway have tentatively been identified, based on engineering, economic and environmental considerations. Specific alignments would be examined in detail in later investigations. Several sections of the existing Alaska Highway and several small settlements would require relocation, but Lower Post and Upper Liard would not be flooded.

Heritage resource surveys have been undertaken throughout the parts of the the Liard River valley that would be flooded. Prehistoric artifacts are sparse throughout the area but relatively more numerous at the confluences of major streams. A prehistoric quarry was found close to the Devils Gorge damsite. The remains of Fort Halkett, established at the mouth of the Smith River during the fur trade era, form the most significant historic discovery recorded to date.

No further socio-economic studies within B.C. have taken place, although liaison has been maintained with communities close to the project areas.

(b) Studies Downstream of Beavercrow

1. Physical - Hydrological studies have been done of the Liard River below Beavercrow, the mainstem Mackenzie River below the Liard confluence, the Mackenzie delta and adjacent portions of the Beaufort Sea. B.C. Hydro has maintained a program of hydrological data collection in addition to making use of information collected by various federal government agencies.

The effects of the proposed hydroelectric development would generally be to reduce high summer flood peaks and increase low winter flows. The effects would diminish with distance downstream from the Beavercrow damsite. Summer flows in the Liard near its confluence with the Mackenzie would average approximately 40 percent lower than non-regulated summer flows, while winter flows would be increased by three to four times. Summer flows in the Mackenzie River just above the delta would be reduced by about 15 percent, while winter flows would be increased by 30 to 40 percent. Considerable variation in flows, sediments and ice occurs within the present system from year to year. This would continue to occur if hydroelectric development took place; however, there would be changes in the timing and degree of the variations.

Although the Liard is a major contributor of suspended sediment to the MacKenzie system, much of the suspended sediment in the Liard River originates in tributaries below the Beavercrow site. Construction of impoundments on the Liard is expected to reduce average suspended sediments in the lower Liard by about 20 percent. A 10 percent reduction in suspended sediments in the Mackenzie River and delta is predicted on the basis of the preliminary studies.

B.C. Hydro has recorded water levels in the Mackenzie delta since the beginning of 1981. Fluctuations in various types of lakes and small channels are monitored throughout the open water season. This information is being used to study the distribution and seasonal changes in delta vegetation, and to predict how vegetation and wildlife habitats might change following Liard River flow regulation.

Extensive investigations of annual break-up and freeze-up on the Liard and Mackenzie rivers and in the delta have been undertaken. Under regulated conditions break-up near Fort Liard would probably occur from 1 to 2 weeks earlier, while freeze-up would take place 3 to 4 weeks later than under natural conditions. Break-up and freeze-up dates on the Mackenzie River are not expected to change by more than 2 or 3 days. Observations of break-up and freeze-up are continuing. Satellite imagery of the Beaufort Sea is being used as a means of studying any possible effects of Mackenzie River flow changes on the seasonal distribution of ice along the coast and in the offshore areas north of the delta.

2. Biological - Detailed mapping of vegetation in seven study areas in the Mackenzie delta has been completed, and factors such as sedimentation rates, flooding frequency, and various plant and lake characteristics have been measured. Studies of colonization of point bars by willow seedlings are being undertaken.

Studies of muskrats and waterfowl in the Mackenzie delta have been under way since spring 1982. The major objectives are to relate the distribution, local abundance, breeding success and other population parameters to hydrological and vegetational characteristics. Studies may not extend beyond 1982, due to the present fiscal restraint program, but may be resumed

later. Surveys of the migratory waterfowl populations using the Mackenzie River valley as a flyway were undertaken in 1981 and 1982. The largest concentrations of geese and ducks tend to make use of the valley during the annual spring break-up.

Fisheries studies have proceeded throughout the lower Liard River, the Mackenzie River, and in specific study areas in the Mackenzie delta. The Beavercrow dam would block upstream migrations of some fish such as Arctic cisco and inconnu, and flow changes within the mainstem Liard may affect habitats of some species. Fish habitat changes in the mainstem Mackenzie would be expected to be small in relation to naturally-occurring variations. The main aspects being studied in Mackenzie delta lakes include seasonal influx of nutrients following flooding, movements of young and adult fish into and out of the lakes, and the productivity of lakes, some of which are flooded annually, others periodically and some very seldom.

3. Socio-Economic - A preliminary socio-economic study of N.W.T. communities along the Liard and Mackenzie is being completed, based on published and other data in federal and territorial government files. The purpose of this study is to identify communities, areas and resources which would be affected by the proposed project, and to enable B.C. Hydro to formulate detailed study plans. Detailed socio-economic studies have been deferred for the present, pending further project decisions. Extensive liaison with communities in the N.W.T. would be part of the eventual detailed socio-economic study program.

6.0 TRANSMISSION STUDIES

Extra high-voltage transmission lines would be needed to take power generated by the Liard River development to the existing province-wide transmission network. Liard transmission probably would be connected to the provincial system in the Prince George area.

Transmission systems rated at 500 kV, 800 kV and 1000 kV are being considered, as well as direct current systems that would take Liard power directly to the Lower Mainland. At present, the most favourable alternative appears to be three 500 kV lines. However, more study would be required before a final decision could be made on transmission voltage, type and number of lines.

The choice of transmission routes (see Fig. 4) would depend on the environmental and social impacts, transmission line design and construction constraints, costs, and long-range requirements of the provincial electric system.

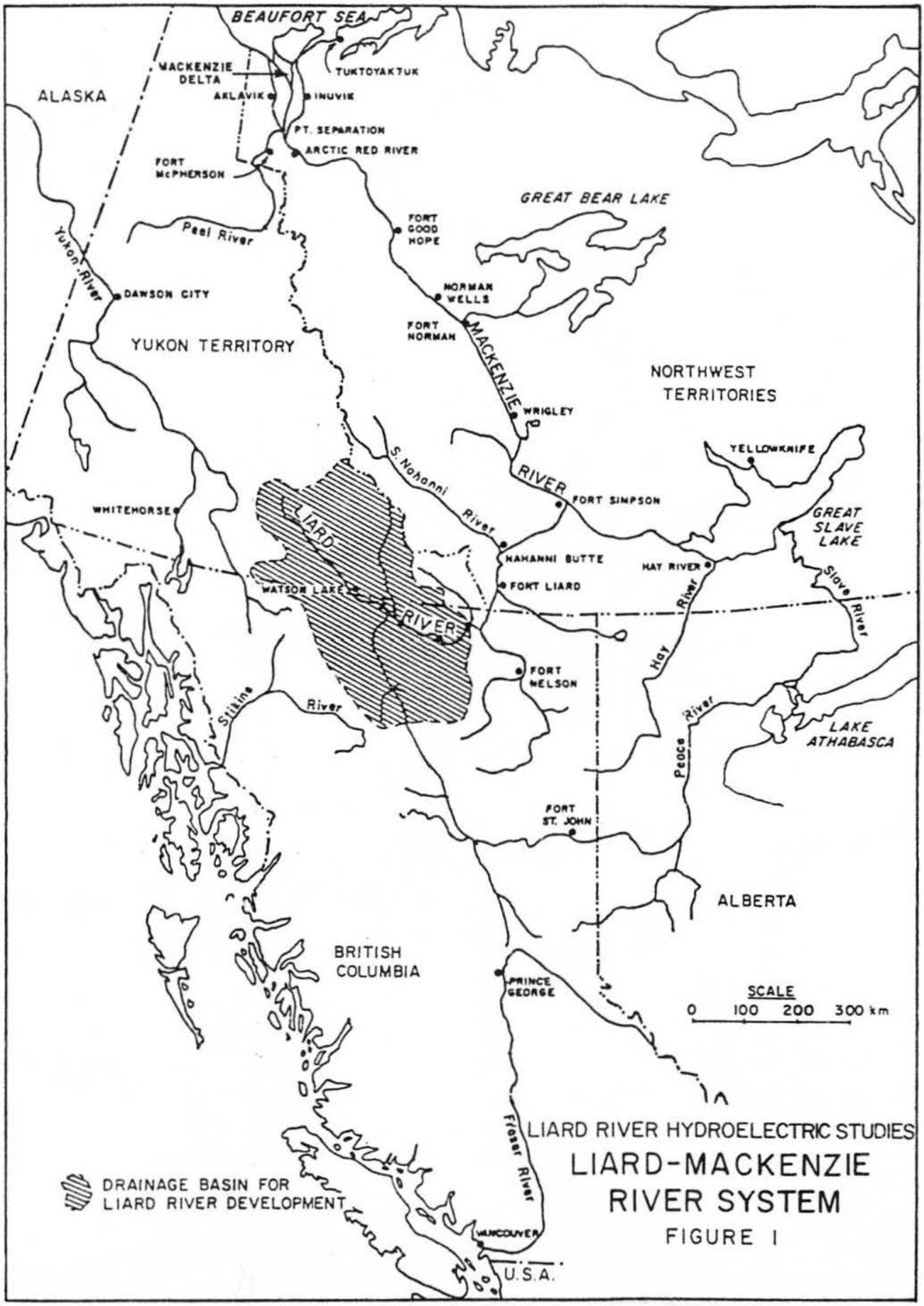
An overview study identifying potential transmission line corridors from the Liard and Stikine-Iskut hydroelectric developments has been completed. (See Prospectus - Northern Transmission Studies, July 1980).

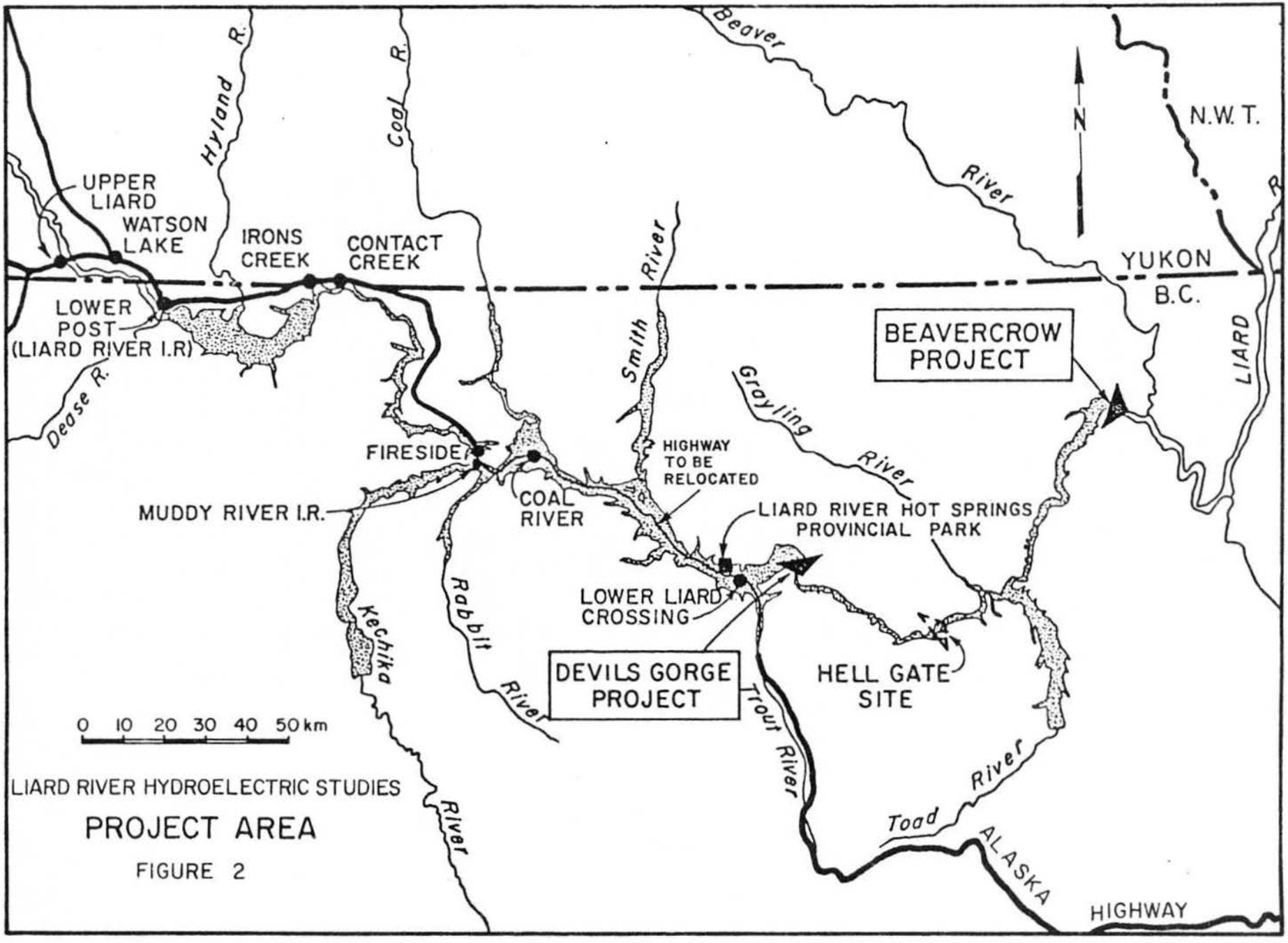
One of the most notable effects of transmission lines from the northern hydroelectric projects could be the creation of motor vehicle access into wilderness areas by rights-of-way and roads required to construct and maintain the lines. Transmission lines following any of the routes being considered would pass near Indian reserves and lands used by local residents.

Environmental and technical studies have begun to determine which of the potential routes might be preferable. Among the factors that are being considered are the impacts that could occur to wildlife habitat,

fisheries, recreation potential, vegetation, heritage sites and land use. The studies are also examining the cost and technical difficulty of transmission line construction on each of the potential routes.

Field studies have been carried out. No further work is scheduled, however, because of the current restraint program and the uncertainty as to when development of the Liard might be required.

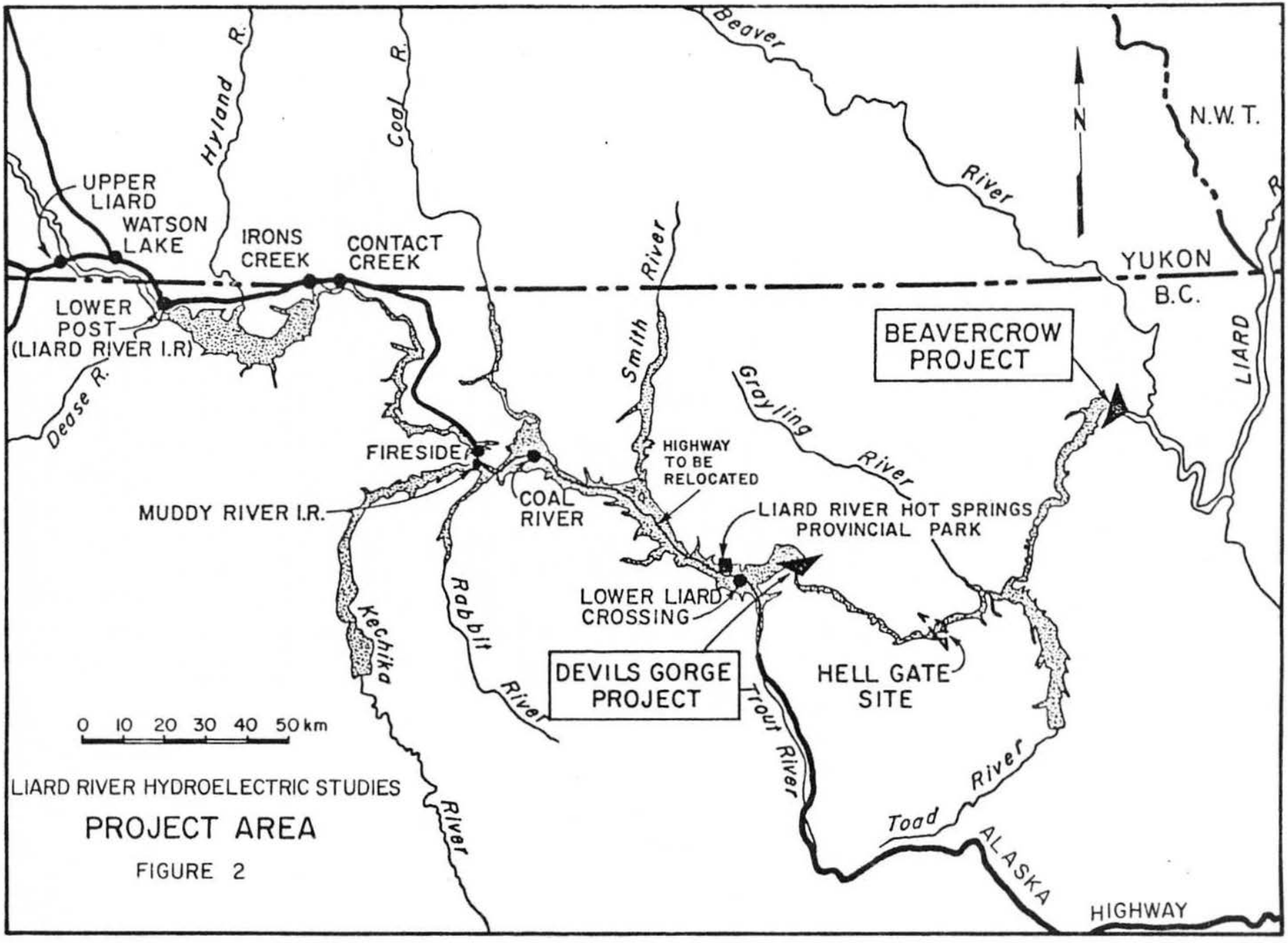

BEAUFORT SEA
MACKENZIE DELTA
TUKTOYAKTUK
ALASKA
AKLAVIK
INUVIK
PT. SEPARATION
ARCTIC RED RIVER
FORT McPHERSON
GREAT BEAR LAKE
FORT GOOD HOPE
Peel River
Yukon River
DAWSON CITY
NORMAN WELLS
FORT NORMAN
YUKON TERRITORY
MACKENZIE
NORTHWEST TERRITORIES
WRIGLEY
YELLOWKNIFE
S. Nahanni River
RIVER
FORT SIMPSON
WHITEHORSE
LIARD
GREAT SLAVE LAKE
NAHANNI BUTTE
HAY RIVER
WATSON LAKE
FORT LIARD
LIARD RIVER
Slave River
Hay River
FORT NELSON
Stikine River
Peace River
LAKE ATHABASCA
FORT ST. JOHN
ALBERTA
BRITISH COLUMBIA
PRINCE GEORGE
SCALE
0 100 200 300 km
Fraser River
VANCOUVER
U.S.A.
DRAINAGE BASIN FOR LIARD RIVER DEVELOPMENT
LIARD RIVER HYDROELECTRIC STUDIES
LIARD-MACKENZIE RIVER SYSTEM
FIGURE 1



LIARD RIVER HYDROELECTRIC STUDIES

PROJECT AREA

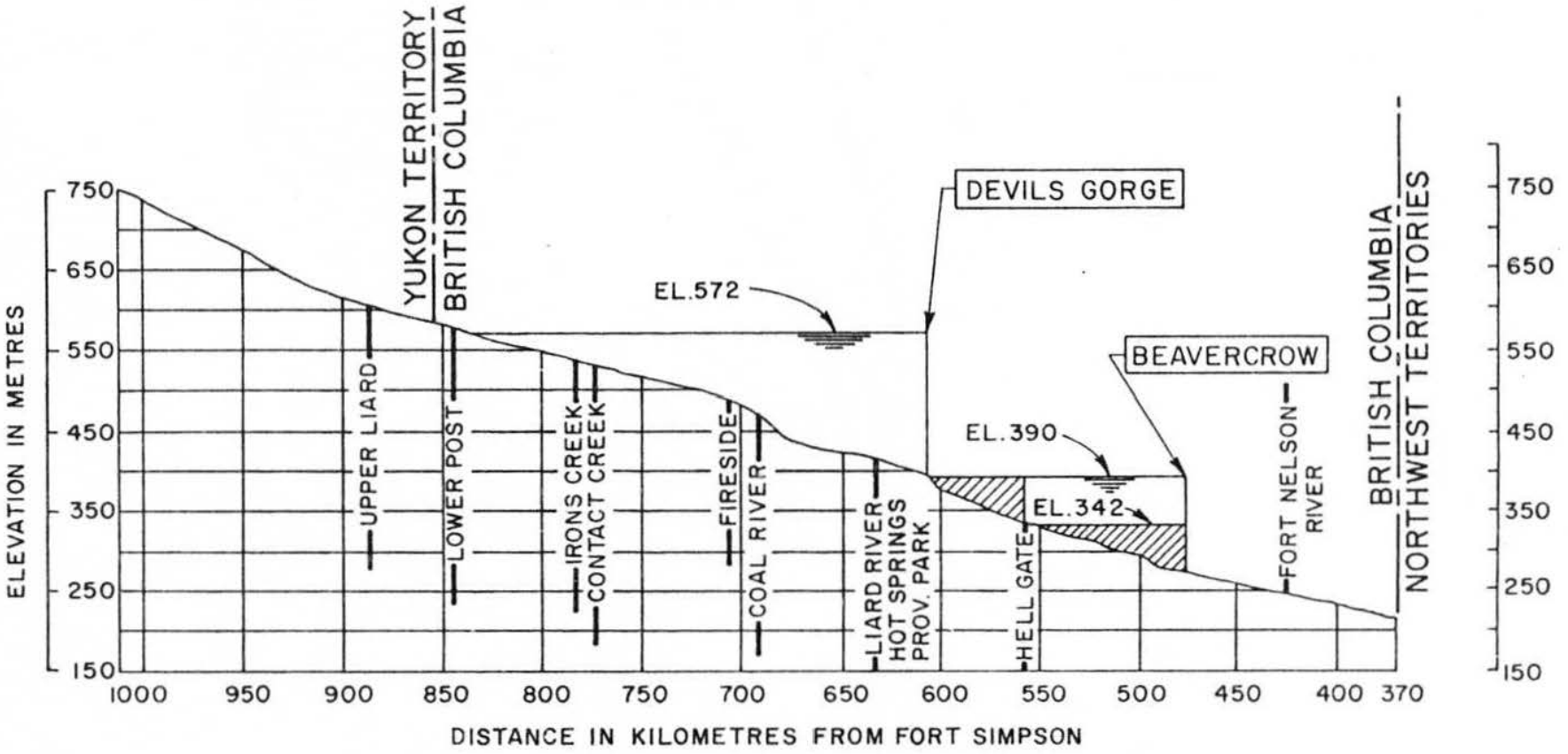
FIGURE 2



LIARD RIVER HYDROELECTRIC STUDIES

PROJECT AREA

FIGURE 2



LIARD RIVER HYDROELECTRIC STUDIES

RIVER PROFILE

FIGURE 3


LIARD RIVER HYDROELECTRIC STUDIES
TRANSMISSION LINE STUDY CORRIDORS
FIGURE 4
100 0 100 200km
YUKON
N.W.T.
Liard River
Beavercrow Project
Devils Gorge Project
Cassiar
Fort Nelson
ROCKY MOUNTAIN TRENCH CORRIDOR
FOOTHILLS CORRIDOR
Dease Lake
Telegraph Creek
Iskut
Stikine River
Wrangell
Stewart
ALASKA
Fort St John
Peace River
Dawson Creek
Terrace
Smithers
PRINCE RUPERT
Skeena
Kitimat
PRINCE GEORGE
EXISTING GRID
GRID REINFORCEMENT
Quesnel
Williams Lake
ALBERTA
Fraser River
Revelstoke
Kamloops
Vernon
Kelowna
Penticton
Kimberley
Cranbrook
Trail
Port Hardy
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FEB

25 January 1983

Mr. W. J. Wilson, Supervisor
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Dear Mr. Wilson:

Liard River Hydroelectric Studies
Information Bulletin No. 4, December 1982

Enclosed for your information is a copy of the above bulletin. Hydro is in its fifth year of studies of the engineering and environmental feasibility of developing the hydroelectric potential of the Liard River. This bulletin outlines the nature of these investigations, and describes some preliminary findings.

The bulletin has been distributed to elected representatives, government officials, community organizations, university and local public libraries and other interested individuals in the project area.

Should you require further information or additional copies, please contact me at B. C. Hydro's Community Relations Department, 970 Burrard Street, Vancouver, B. C., V6Z 1Y3 or telephone 663-2405.

Sincerely,

E. D. Powell

Eric D. Powell
Community Relations Coordinator

Enclosure