The Slave River Hydro Project: Evaluation of Federal Environmental Impact Interests.

by

Nicholas M.R. Winston

A practicum in partial fulfillment of the degree
Master of Natural Resources Management

University of Manitoba
Natural Resources Institute
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EVALUATION OF FEDERAL ENVIRONMENTAL IMPACT INTERESTS

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Nicholas M.R. Winston

A practicum submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of Master of Natural Resources Management.

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ABSTRACT

The primary objective of this study was to evaluate the federal environmental impact interests regarding the proposed Slave River Hydro project. While still in the planning stages , it is expected that the project will eventually proceed. Environment Canada requested this study be carried out because of federal jurisdictions that could be involved.

Areas of possible impact include the transmission corridor, stretching from Ft. McMurray, Alta. to the dam site, Lake Athabasca and the Peace-Athabasca Delta, the Slave River valley above and below the dam site, and Great Slave Lake. Within the project region are endangered whooping cranes, important fish stocks, unique salt plains and karst features, a colony of white pelicans, and the bison of Wood Buffalo National Park. Native people also use the proposed project area for hunting, trapping and fishing. Commercial fishing also stands to be impaired by possible invasion of arctic lamprey. It is recommended that a dam site and operating regime be chosen that minimizes impacts in federal jurisdictions.

Questions of jurisdiction, whether federal or provincial, have emerged, with no easy answers. In some instances there is overlapping jurisdiction. As owner of the resource (the Slave River in Alberta) the province of Alberta has ultimate jurisdiction. However, there are areas under federal jurisdiction present in the project region. Before the project proceeds, it is recommended that provincial and federal authorities resolve questions of jurisdiction. The legal framework for this being in place at present.

An environmental impact assessment (EIA) will be required before project approval is given. At the moment, two sets of guidelines for such report preparation exist, one federal and one provincial. To avoid possible conflict and duplication of EIA preparation, co-ordination between the two sets of guidelines is recommended. Joint review of the EIA by Alberta and the federal government is recommended. A final recommendation is made that Environment Canada should take a stance of maintaining the natural environment, as opposed to restoring it to a past state. This encompasses prior recommendations of restricting the amount of flooding upstream towards of not damaging critical habitat, and to allow the previously impacted Peace-Athabasca Delta to continue changing in a natural fashion.

ACKNOWLEDGEMENTS

Although written by one person, this practicum is by no means the result of only one influence. Many other people provided input, assistance, support, and editorial help throughout the entire period of study.

Mr. H.C.R. Gavin of Environment Canada provided financial support and guidance during preparation of this document. Other committee members, Dr. R.A. Bodaly of the Freshwater Institute in Winnipeg and Prof. D. Young, an adjunct at the Natural Resources Institute provided critical comments and helpful suggestions with research. My advisor, Dr. W. Henson, Director of the Natural Resources Institute, always had an open door and valuable solutions to problems at hand.

Other faculty at the Natural Resources Institute provided considerable input in the early stages of research. Thanks also go out to the staff, Ms. C. Hofer and Mrs. E. Novotny, who handled administrative matters and assisted in report preparation.

While in Fort Smith, accommodation was graciously supplied by Canadian Wildlife Service. Staff, wardens and interpreters of Wood Buffalo National Park went out of their way to ensure my stay in Fort Smith was informative. Mr. J van Pelt of Subarctic Wilderness Adventures Ltd. introduced me to the beauty of the Slave River area and provided insight to local issues. Special thanks also go out to the Natural Resource Conservation staff, Parks Canada, Prairie Region Offices, Winnipeg, who provided much information and insight to the task at hand.

Last, but not least, I would like to thank my fellow students at the Natural Resources Institute. Without their continual support and interchange of ideas, I would have been unable to complete this report.

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INTRODUCTION

1.1 PREAMBLE

Hydroelectric developments, even when managed properly can have detrimental environmental effects. Impacts are not only limited to the immediate vicinity of the dam and resulting transmission lines, but can extend considerably upstream and downstream of the development and to transmission corridors. To ensure all aspects of the environment are taken into consideration, legislation emphasizing the planning stages of development has been introduced in an attempt to mitigate as many impacts as possible and to reduce the possibility of unanticipated effects resulting from major industrial developments (e.g. Land Surface Conservation and Reclamation Act, 1973, Alberta).

The Slave River Hydro Project in northern Alberta (see figure 1), is a proposal , which, if developed, can potentially affect and disturb the balance of ecosystems not only in the vicinity of the development site, but also further away. The proposal calls for a dam, a spillway and a powerhouse with an approximate generating capacity of 1800 MW.

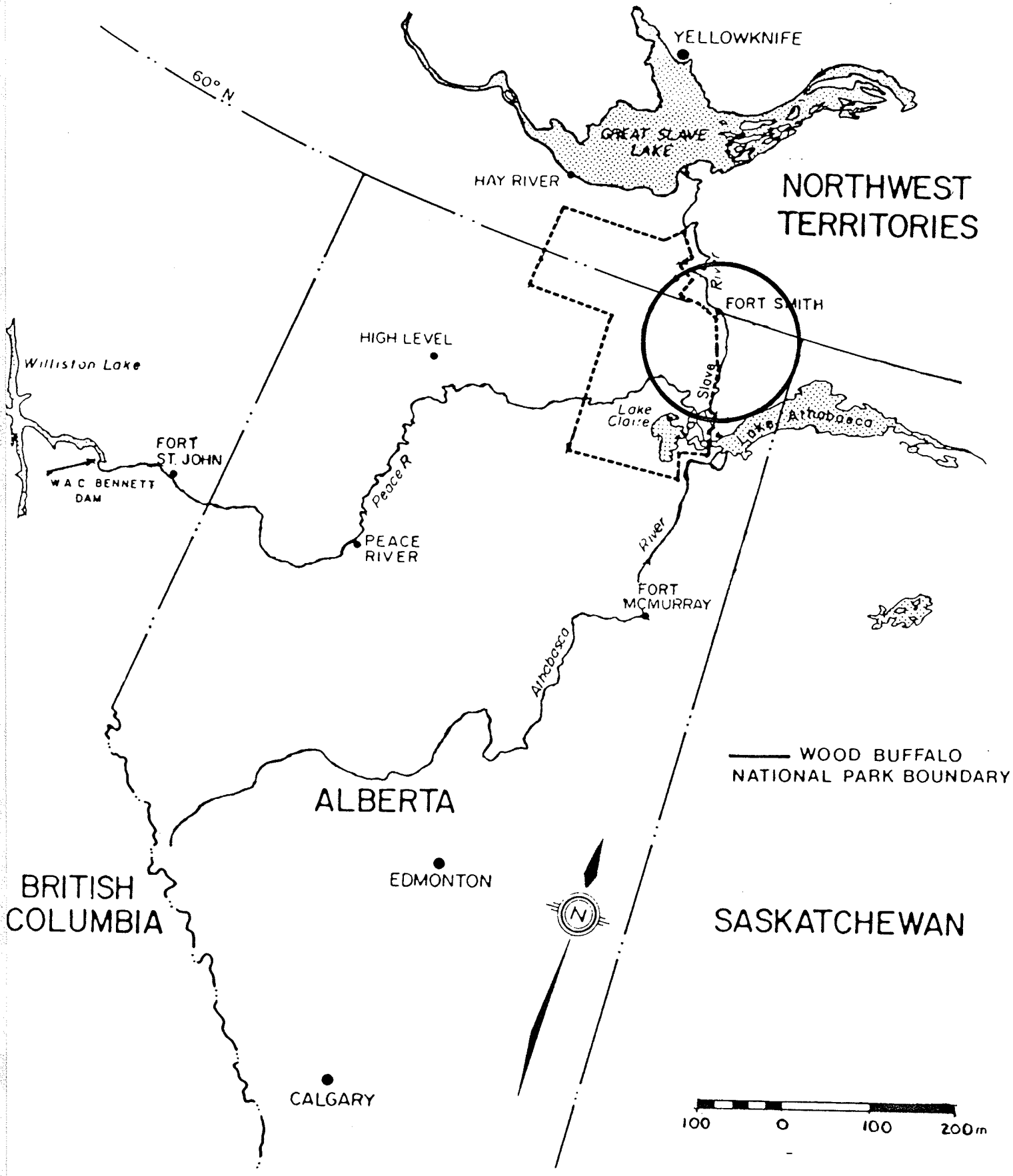

Figure 1: Location of the Slave River Project

When a specific site has been chosen for development, a detailed joint Alberta/federal environmental impact statement could be required and approved before construction can begin. Negative impacts may arise from development on the Slave River, and mitigative measures could be suggested to alleviate , or avoid, as many impacts as possible. Since effects may be felt in Alberta, Saskatchewan and the Northwest Territories, concerns of interprovincial environmental impacts of development would require evaluation at the federal level.

Currently, the project is in the pre-investment stage (the project was shelved in August of 1985 until there is sufficient demand for electrical power, that development is feasible). A feasibility study of hydroelectric development on the Slave River has been completed which considered alternatives to this development in order to meet the projected demand for power in the province (Pearce, 1984). The Alberta government and two investor owned utility companies Alberta Power and Transalta Utilities, are involved in the pre-investment stage of development. No development proponent exists at the current time, and one must be named if further planning is to take place. Once a proponent emerges a specific site for the dam, spillway and powerhouse must be decided upon, and a route(s) for transmission lines designated, followed by the implementation of detailed environmental impact assessment.

In 1984 the Alberta Department of the Environment and Federal Department of the Environment released draft information requirements for the environmental impact studies relating to the Slave River project. These two levels of government, plus those of Saskatchewan and the Northwest Territories possess the legal framework to require environmental impact assessment review processes. It may be necessary to combine some of these review processes to speed up regulatory approval and to avoid duplications. For the purposes of public participation, an Energy Resources Conservation Board/ Federal Environmental Assessment and Review Office (ERCB/FEARO) document will be developed and the proponent will be expected to meet both Alberta and FEARO guidelines.

1.2 PROBLEM STATEMENT

Environment Canada has expressed interest in the Slave River project and would like federal concerns regarding environmental impacts of project alternatives examined. The legal framework concerning the Slave River Hydro project is a complex one, with both provincial and federal legislation being pertinent. Federal legislation is under the jurisdiction of several government departments:

1. Environment Canada
2. Department of Indian and Northern Affairs

3. Department of Fisheries and Oceans

4. Transport Canada

Although the project is being assessed by provincial authorities, the federal government has interests because of the possible impacts on Wood Buffalo National Park, the fisheries on Great Slave Lake and Lake Athabasca, impacts on migratory birds, and possible impacts on Indian lands.

It is possible to develop hydroelectric generating facilities at many sites on the Slave River. If development is to occur, the purpose of an environmental impact assessment would be to inventory resources in the area, predict possible environmental impacts and recommend mitigative measures. Alternative means of generating electrical power, such as nuclear generation, thermal coal generation or gas combustion exist. Environmental impacts and feasibility of these alternatives should be examined before development on the Slave River is to proceed.

1.3 OBJECTIVES

The primary objective of this study was to evaluate federal environmental impact interests surrounding the proposed Slave River Hydro project alternatives in northern Alberta. Specific objectives were:

1. to describe the project area in terms of its environmental resources and outline possible project configurations;
2. to describe the legal framework surrounding the project;
3. to identify and describe anticipated environmental impacts of the Slave River Hydro project;
4. to identify and describe implications for the federal government deriving from responsibilities defined in the existing legal framework;
5. to briefly describe the anticipated EIA process for this project and to evaluate available information requirements established by federal and provincial authorities for the Slave River project; and
6. to recommend strategies for the federal government as a result of the information gathering, synthesis and analysis.

1.4 METHODS

The methodology used in this study involved three separate research methods to evaluate the policy issues of the federal government regarding the proposed Slave River Hydro project in northern Alberta. The intent of using more than one research method was to ensure that many views on the project and environmental implications were represented. The methodologies used were reviewing related literature, interviews with people having concerns regarding the project and a site visit for the purpose of interviewing people in the project area and observing environmental characteristics in the project area.

1.4.1 Review of Related Literature

A large amount of literature existed regarding the potential of developing the hydroelectric resources of the Slave River and environmental implications of such a project. A major task was synthesizing pertinent information into report form.

It was necessary to provide an overview of the project area through a description of the biophysical and geophysical aspects of the Slave River. Technical reports and past and present feasibility studies were researched. Research journals also provided knowledge on the scope of the project.

The project proposal and alternative developments at the site were summarized and evaluated. A feasibility study of developing the Slave River's hydroelectric potential was published in 1982 by the Alberta Government. Much of the information regarding the project layout was found in this document and associated reports.

Environmental implications of the project were found in the feasibility report and other similar reports. Journal and industry publications were also evaluated to help determine as many of the environmental implications as possible. Some of these were found in news magazines which aided in highlighting important public environmental concerns regarding the project. Federal interests in terms of the environmental implications were also evaluated.

The complex legal issues surrounding project approval and environmental assessment were researched in terms of federal interests. This entailed analysis of pertinent federal statutes and regulations.

1.4.2 Personal Interviews

Interviews were conducted with people involved with development and those having concerns with the project. Interview techniques were informal, with the goal of gaining as many viewpoints as possible. People contacted included potential project proponents, people who would be adversely

affected, and environmental concern groups. People contacted are listed in Appendix A.

1.4.3 Site Assessment

To gain an appreciation of the scope of the project proposal, it was necessary to visit the possible development site. To appreciate environmental implications of the project it was necessary to visit sites both upstream and downstream of the development area. Included was a trip to the Peace-Athabasca Delta and Lake Athabasca. In addition, the site visit allowed contact to be made with local residents, who would have otherwise not been contacted.

1.5 LIMITATIONS

Recognizing the large task involved in this study, it is not possible to delineate all impacts that may result from the Slave River project. The scope of this study was to examine possible impacts affecting matters within federal jurisdiction. Federal interests may still be omitted from this report even with this narrowed scope.

1.6 SUMMARY

The proposed Slave River Hydro project in northern Alberta has the potential to affect vast areas of land, resources, wildlife and people. While the province of Alberta has ultimate jurisdiction over the management of its hydroelectric resources, the federal government has interests in the project because of possible impacts on land and people under federal jurisdiction, and interprovincial effects. No plans for further development have currently been made, but Environment Canada would like federal interests with respect to possible environmental impacts adequately identified. Identification of federal concerns regarding the project, in the early stages of planning, will allow adequate representation at future regulatory hearings and avoid possible provincial-federal conflict.

Chapter II

BIOPHYSICAL AND GEOPHYSICAL CHARACTERISTICS OF THE AREA AND POSSIBLE IMPACTS

2.1 INTRODUCTION

Assessment of environmental effects of a hydroelectric development on the Slave River requires knowledge of flora, fauna, landforms and people potentially affected. Development on the Slave River can impact sites far removed from the development site. For instance, one possible project configuration calls for regulation of water levels in Lake Athabasca. To determine possible impacts of such action, it is necessary to have information on biophysical and geophysical characteristics of Lake Athabasca and area. Baseline information collected during environmental studies, is used in predicting the environmental impacts of potential development.

This chapter describes biophysical and geophysical characteristics of the project area and discusses possible environmental impacts. First, a general description of the area is provided followed by a more detailed description of environmental characteristics. The project area has been divided into a number of regions for ease of study.

They are:

1. Region 1- Transmission Corridor
2. Region 2- Peace-Athabasca Delta
3. region 3- Slave River Upstream of Dam
4. Region 4- Slave River Downstream of Dam
5. Region 5- Great Slave Lake and Mackenzie River

2.2 DESCRIPTION OF THE AREA

From its origin at the confluence of the Peace River and the Riviere des Rochers, the main outflow from Lake Athabasca, the Slave River flows 440 km north before discharging into the Slave River Delta and Great Slave Lake (Alberta Government, 1982). The Slave River is an integral part of the Mackenzie river system (see Figure 2). This river system drains an enormous portion of Canada, encompassing an area equivalent to the summed areas of Great Britain, France, Germany, Spain, Portugal, and Italy. This is equivalent to 20% of Canada's landmass draining into one area, the Mackenzie Delta and Arctic Ocean (James and Foerstl, 1982). The Slave River itself has a drainage area of 660,000 km^2 and an average flow recorded at Fitzgerald, Alberta of, 3720 m^3/s (Grover and Primus, 1981). In contrast to a river such as the North Saskatchewan, with a peak flow of 700 m^3/s at Edmonton (Anon, 1980), the Slave River has extremely high relative flow rates.

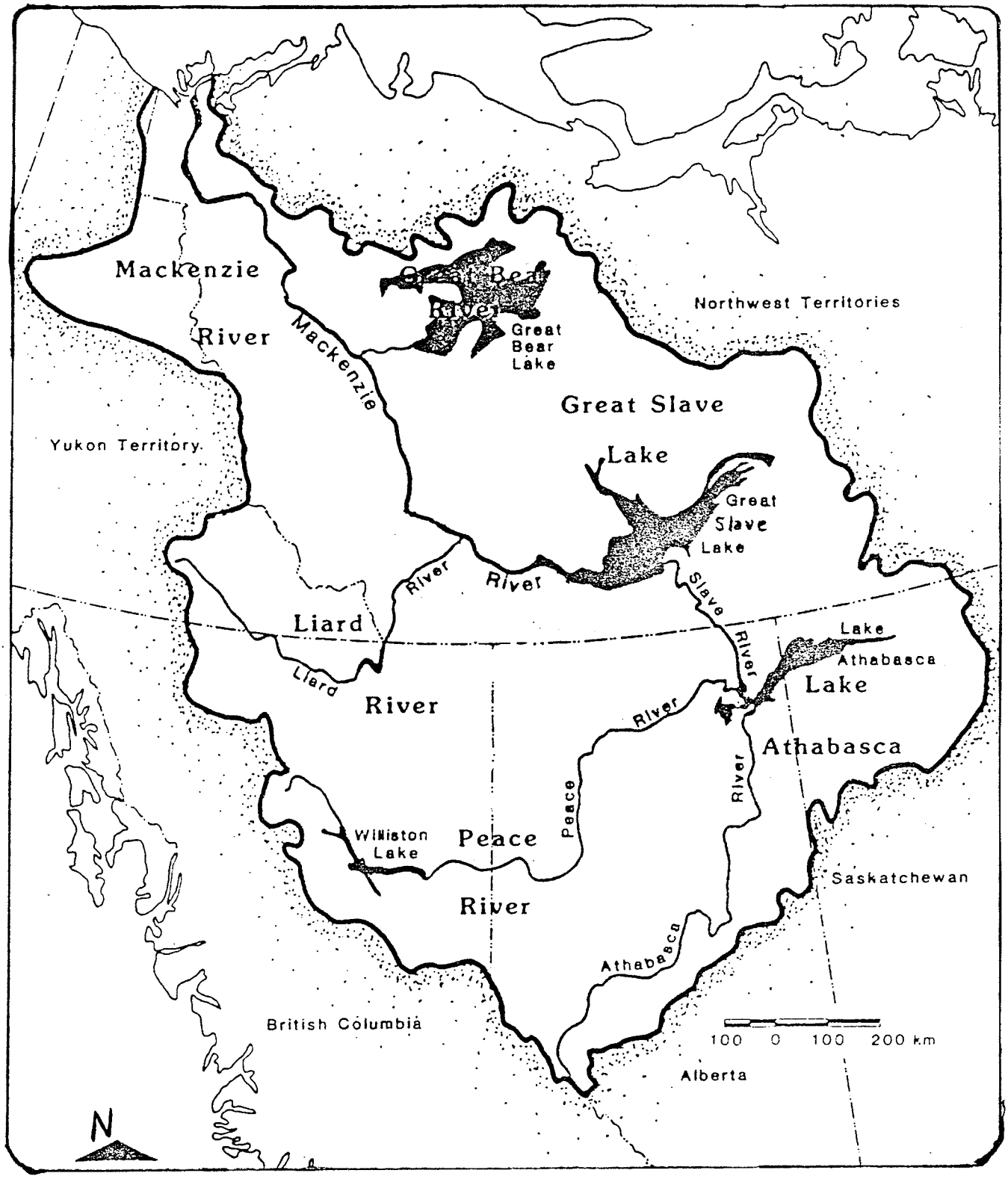

Figure 2: Slave/Mackenzie River Drainage Basin

Although the Slave River has a relatively high mean discharge, it is characteristic of a northern river, in that flow rates can vary quite substantially from month to month (Gill, 1973). During the winter months discharge is relatively low compared to summer months. Maximum power benefits from natural flow therefore fall in the summer months. Mean monthly flow rates for the Slave River are shown in Table 1.

The principal tributaries of the Slave River are the Peace River, Athabasca River and Fond du Lac River (see Figure 3). The Peace River rises in the northeastern Rocky Mountains of British Columbia and flows through Alberta to meet Riviere des Rochers and form the Slave River. It contributes approximately 60% of the discharge of the Slave (Government of Alberta, 1982). Twenty-one percent of the discharge of the Slave River is contributed by the Athabasca River, which rises in the west-central Rocky Mountains of Alberta (Grover and Primus, 1981). The remainder of the inflows are derived from the Fond du Lac River in Saskatchewan, Birch River in Alberta, and local drainage into the Peace-Athabasca Delta and Lake Athabasca (Alberta Government, 1982).

Of the Slave's major tributaries, only the Peace River has been modified and regulated for exploitation of its water resources.

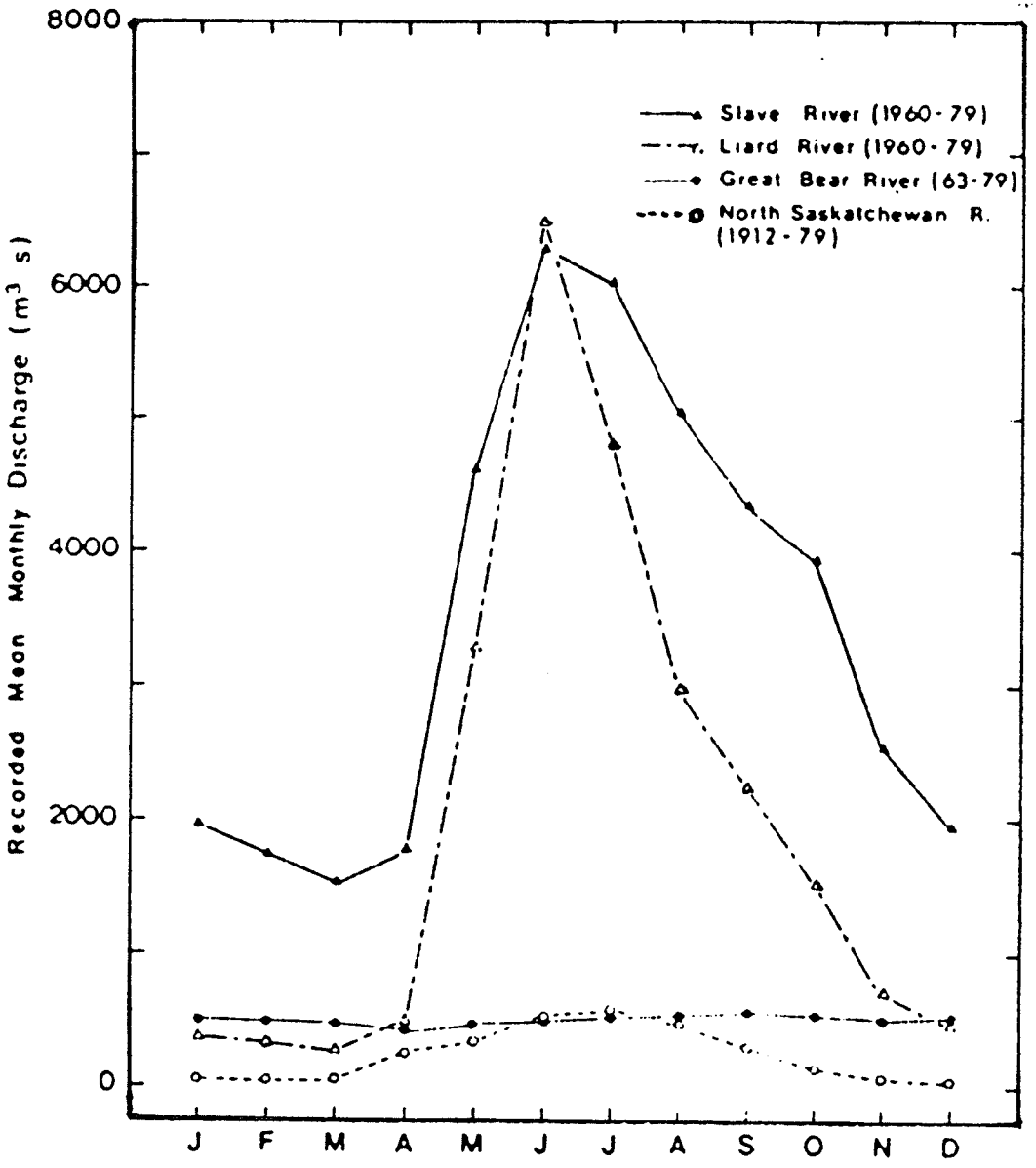

TABLE 1

Mean Monthly Flow Rates of the Slave River

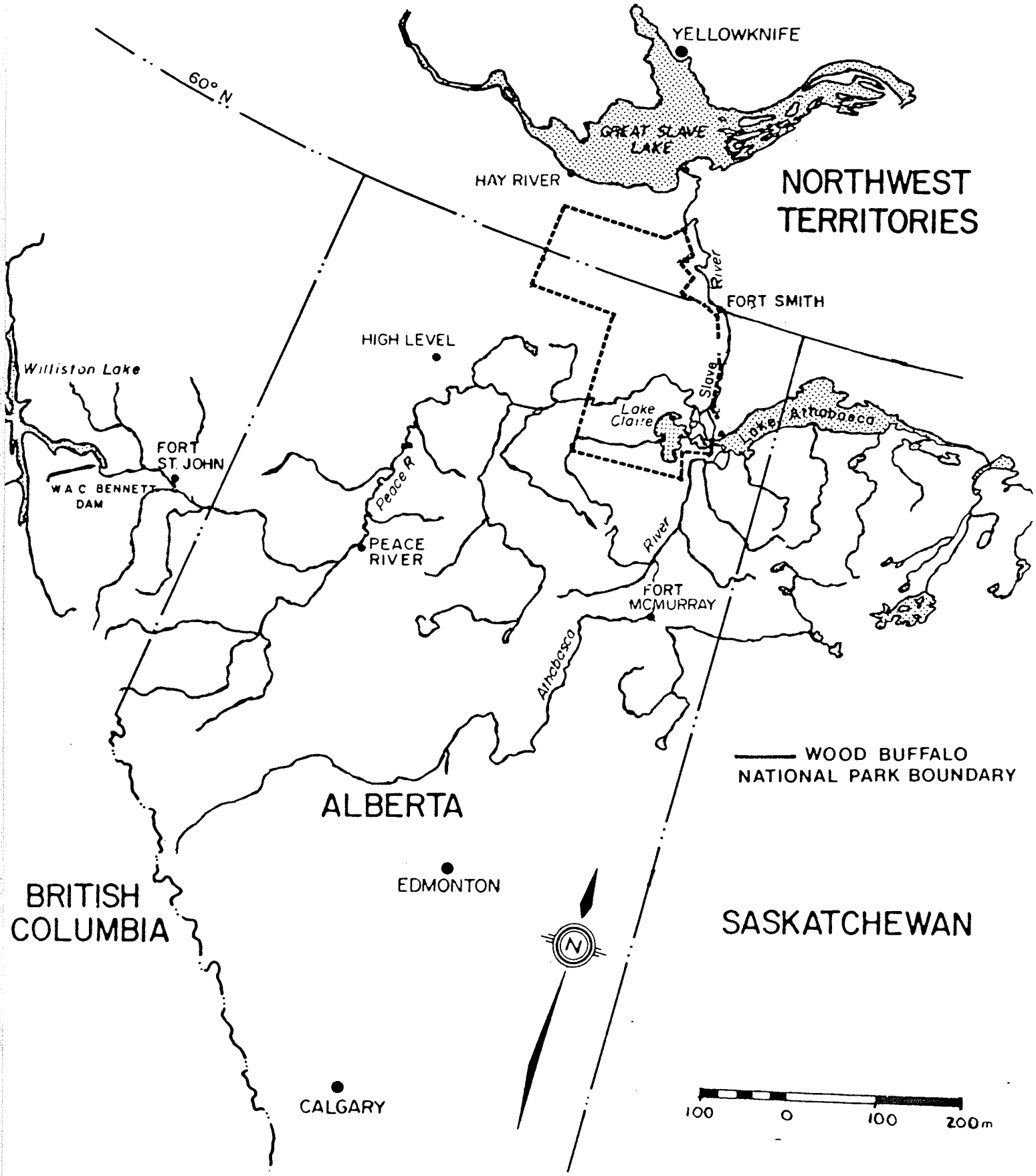

Figure 3: Major Tributaries of the Slave River

During the late 1960's the W.A.C. Bennett Dam was constructed by British Columbia Hydro, with its reservoir Williston Lake, used to store spring runoff in the summer months for discharge during winter (Alberta Government, 1982). Storage of water in this manner provides additional power benefits that were required to make the project more economically viable. Filling of the reservoir from 1968-1971 coincided with lower water levels in the ecologically sensitive Peace-Athabasca Delta (Lane and Sykes, 1982), downstream from the dam. The coincident effects on the delta have been called "the most serious unplanned consequence of the construction of a dam that has occurred in Canada" (Baxter and Glaude, 1980).

Early in 1971, the Governments of Canada, Alberta and Saskatchewan formed the Peace-Athabasca Delta Project Group. The for this group were two-fold. First, the group needed to determine an immediate solution to the problem of lowered water levels (Peace-Athabasca Delta Implementation Committee, 1983). During the fall of 1971 the group erected a temporary dam that raised water levels until more permanent measures could be taken.

The second task of this group was to undertake studies of the delta aimed at finding a more permanent and environmentally acceptable solution to the problem of lowered water levels (Peace-Athabasca Delta Implementation Committee, 1983). The result of these studies was the construction of

rock-fill weirs on Riviere des Rochers and Revillon Coupe to regulate outflow from Lake Athabasca. Since then results of the weir construction have been monitored and monitoring is ongoing (Peace Athabasca Delta Implementation Committee, 1983).

Most of the drop in elevation of the Slave River is concentrated along a 30 km reach, collectively known as the Smith Rapids (Alberta Government, 1982), located in Alberta near the N.W.T. border (see Figure 4). Along this reach is where two thirds of the 52 m drop between Lake Athabasca and Great Slave Lake occurs, giving the great hydroelectric potential. The Smith Rapids reach stretches between Fitzgerald, Alberta and Fort Smith in the Northwest Territories (Sweet, 1981). Depending on the site chosen, it is possible to raise the reservoir level as much as 40 m, extending up the Slave River valley 115 km upstream of Fitzgerald (Alberta Government, 1982). Also affected will be sites downstream of the development because of flows varying from hour to hour, as a result of the peaking operations essential to maximize benefits (Alberta Government, 1982).

Within the project region, the Slave River follows a preglacial valley carved on or near the boundary between the Precambrian Shield in the east and the Interior Plains in the west (Alberta Government, 1982).

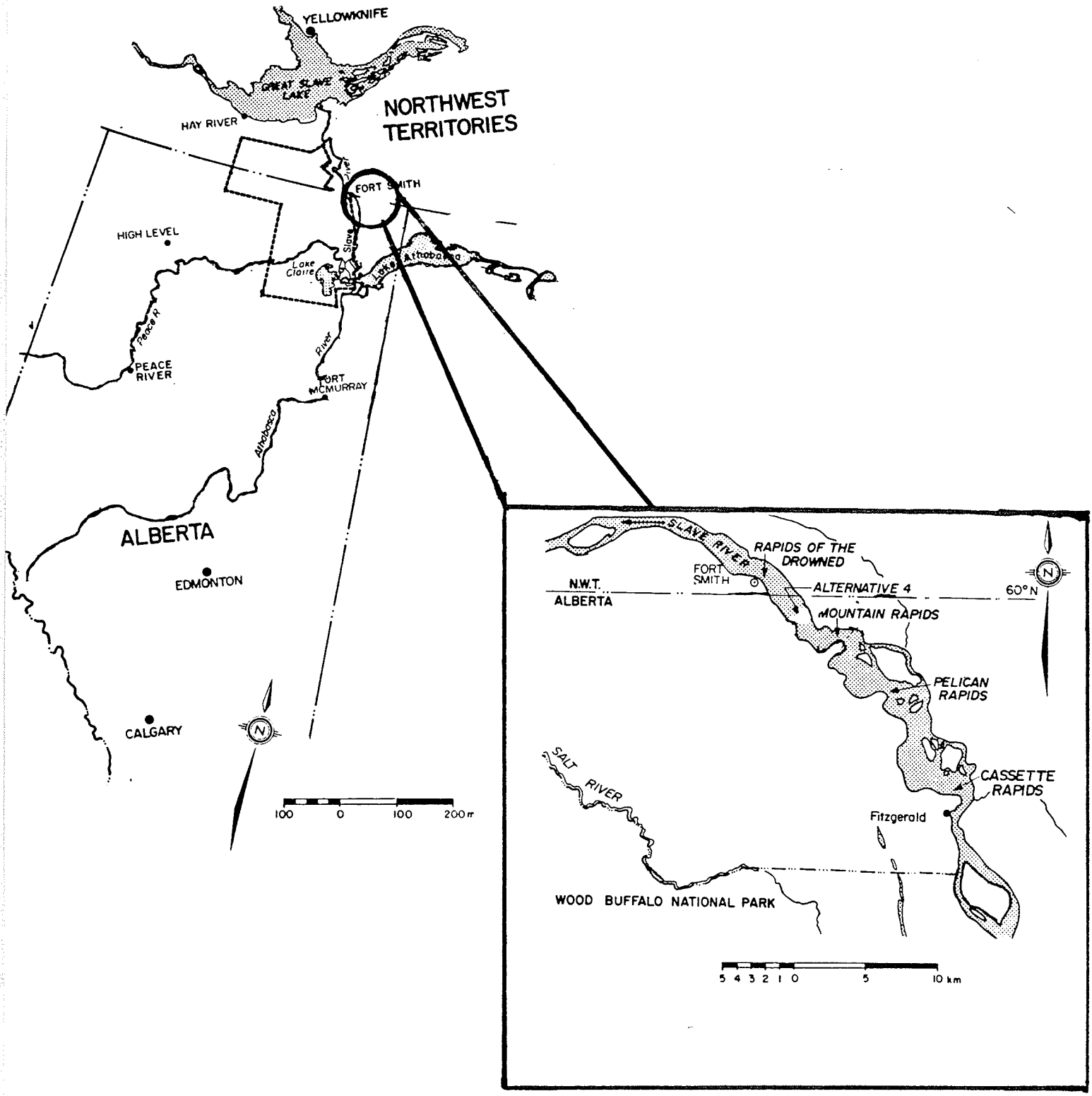

Figure 4: Location of the Smith Rapids

In the Slave River valley the relief is flat to undulating, with only gradual changes in elevation taking place (Alberta Government, 1982). Just south of the Alberta-Northwest Territories border the river cascades over the Smith Rapids reach, a series of four granite ridges over approximately 24 km (Geddes, 1982a). Downstream of the Smith Rapids the, Slave River flows within its own alluvial lowlands into Great Slave Lake.

Situated at the southwest end of Lake Athabasca is the Peace-Athabasca Delta, the largest boreal freshwater delta in the world (Champagne, 1984). The Delta's formation is due to the proximity of the Peace and Athabasca rivers, with silt deposition occurring as a result of overland flooding in the spring (Townsend, 1984). Lake Athabasca and the Athabasca River supply the water for the flooding process, while the Peace River serves to retard flow into the Slave River from Lake Athabasca (Iker, 1984). In the spring, water in the Peace River rises to an elevation higher than Lake Athabasca, thus reversing the outflow from the lake. Overland flooding from Lake Athabasca and the Athabasca River recharge the Peace-Athabasca Delta with nutrient-rich water (Iker, 1984). Lake Athabasca may, on its own, contribute to overland flooding and delta replenishing. Strong northeasterly winds may be sufficient to cause a rise in water levels at the southeast end of the lake, leading to flooding (Westworth and Associates, 1982).

Within the Delta there are three main lakes; Claire, Mamawe and Baril. These lakes are connected directly to Lake Athabasca, therefore their levels fluctuate with water level changes in Lake Athabasca (Westworth and Associates, 1982). All lakes in the delta are shallow, their average depths being between 1.5 m and 3.0 m (Stanley Associates, 1982). There are also smaller lakes, restricted basins and perched basins. Restricted basins are connected to Lake Athabasca and other rivers, but only in high water seasons, and perched basins have no apparent connections to these water bodies (Stanley Associates, 1982). For perched basins to become replenished, overland flooding is required. Eighty percent of the Delta is situated within the boundaries of Wood Buffalo National Park (Champagne, 1984). Five per cent of the delta lies within the Fort Chipewyan indian reserve (I.R. 201) and the remainder is provincial crown land.

Wood Buffalo National Park constitutes a sizeable tract of land within the project region. Park boundaries are outlined in Figure 5. As shown on the map, the eastern park boundary is coincident with the middle of the Slave River channel from Fitzgerald to the Rochers confluence, around the southeast shore of Lake Athabasca, and the middle of the Athabasca River channel south of Lake Athabasca.

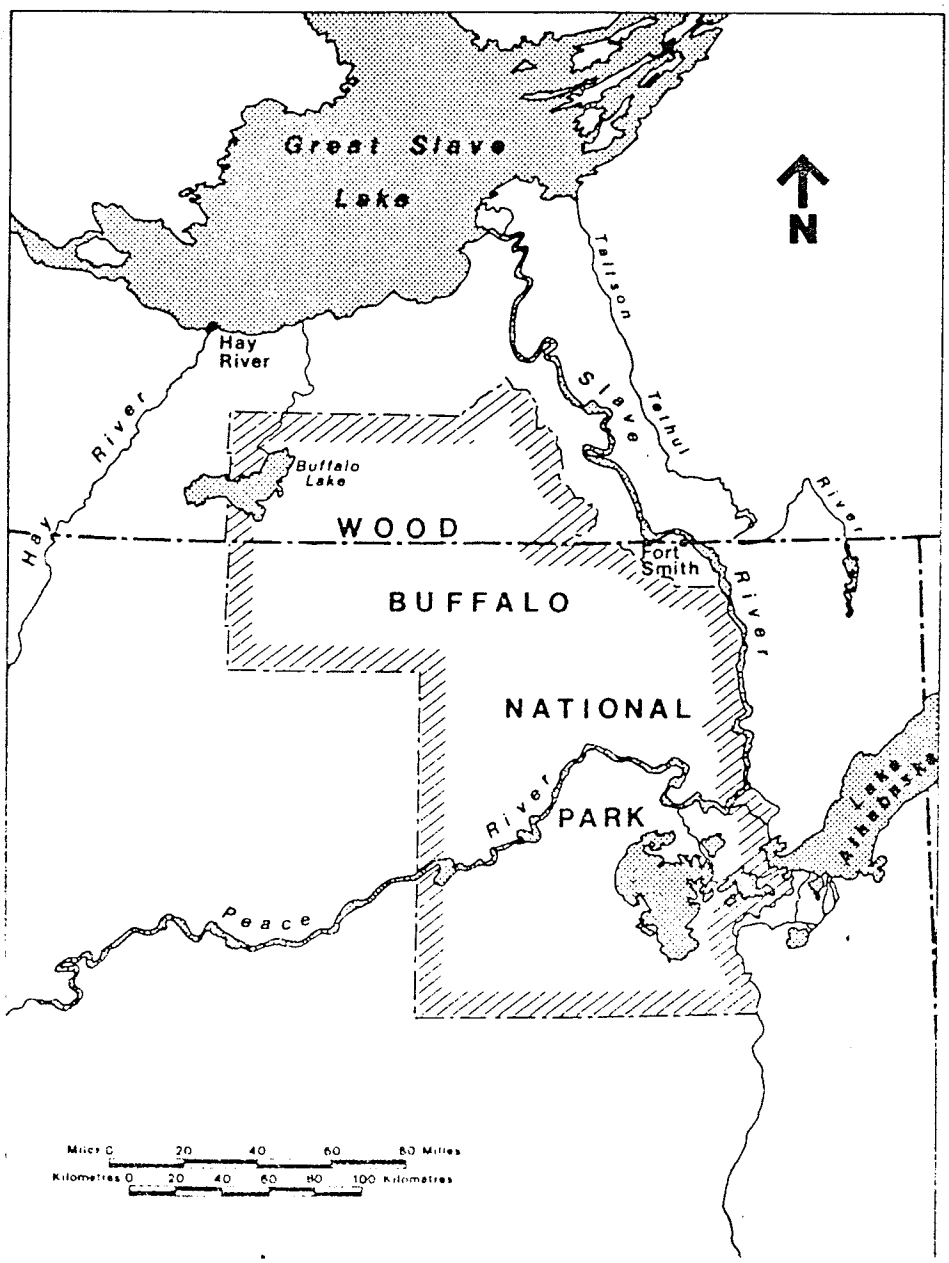

Figure 5: Wood Buffalo National Park Boundaries

Prior to the introduction of bison to the park its boundaries had not included lands south of the Peace River. During the first few winters it was noted that bison were moving south over the Peace River, and wintering in the Peace-Athabasca Delta. Park boundaries were expanded to accommodate these movements in 1926 (Parks Canada, 1979).

2.3 DESCRIPTION OF BIOPHYSICAL AND GEOPHYSICAL CHARACTERISTICS AND POSSIBLE ENVIRONMENTAL IMPACTS

Before damming of the Slave River can be considered, it is necessary to discuss the environmental and biophysical characteristics of the area. With knowledge of this information, environmental impacts and mitigative measures may be suggested well ahead of construction and operation of the facility (Pearce, 1984).

2.3.1 Region 1 - Transmission Corridor

Depending on the route taken by transmission lines the environmental characteristics encountered and potentially affected land will vary. Areas affected could include Lake Athabasca, Peace-Athabasca Delta and Wood Buffalo National Park. The corridor will be a cleared strip of land approximately 100 m wide stretching from the damsite to Fort McMurray in north-central Alberta. From there, the electricity will be dispersed along the Alberta Interconnected Supply System (AIS) to various markets throughout the province (Al-

berta Government, 1982). The possibility of exporting excess power to markets in the United States has also been explored (Fraser, personal communication).

The main environmental characteristics in the transmission corridor consist of those of wildlife. Moose, bison, sometimes caribou, muskrat, beaver, mink, waterfowl, falcons, and whooping cranes are found in the area (Monenco Consultants, 1977). Uncertainty exists as to what heritage resources exist along the different transmission routes and this would have to be further explored before a final route for the lines is decided upon (Monenco Consultants, 1977). A brief aerial reconnaissance in 1980 by Heitzman Consultants resulted in no large archaeological finds, but indicated historic resources would be encountered along the transmission route. Recommendations for further more specific studies once a specific route for the transmission lines were made (Heitzman Consultants, 1982).

For the most part, the transmission line route is outside areas of federal jurisdiction. Impacts of clear cutting a narrow strip of land, such as the transmission route, can be both beneficial and detrimental. Erosion on steep slopes would have to be minimized and steps taken to ensure the silt load in local streams and rivers is not increased (Monenco Consultants, 1977). With these impacts minimized small mammals and waterfowl would not be adversely affected except for a minor reduction in vegetative cover (Monenco Consult-

ants, 1977). Conversely, reduced cover along the transmission route would provide less cover for escape, and possibly drive small animals away from the area. Clearing could provide more grazing for the ungulates in areas that would have otherwise been wooded (Monenco Consultants, 1977).

Concern has been generated regarding increased recreational access to the area, brought about by the requirement of a construction and maintenance road for the power lines (Falk, 1982b). Hunting activities are not allowed in national parks, but outside park boundaries the possibility of this occurring exists. Conversely, local trapping and fishing activities may be augmented by increased access to the area. Fishing and hunting, both commercial and recreational, are important components of the local native economy, and increased access could improve these industries (Dirschl, 1972).

Much opposition to the project is centered around the endangered whooping cranes that breed in Wood Buffalo National Park during the summer months. (see Figure 6). Biologists fear that the birds will die if they fly into the transmission lines, something that has happened to them in the past (Griffiths 1984, Gorrie 1982, Geddes 1982b).

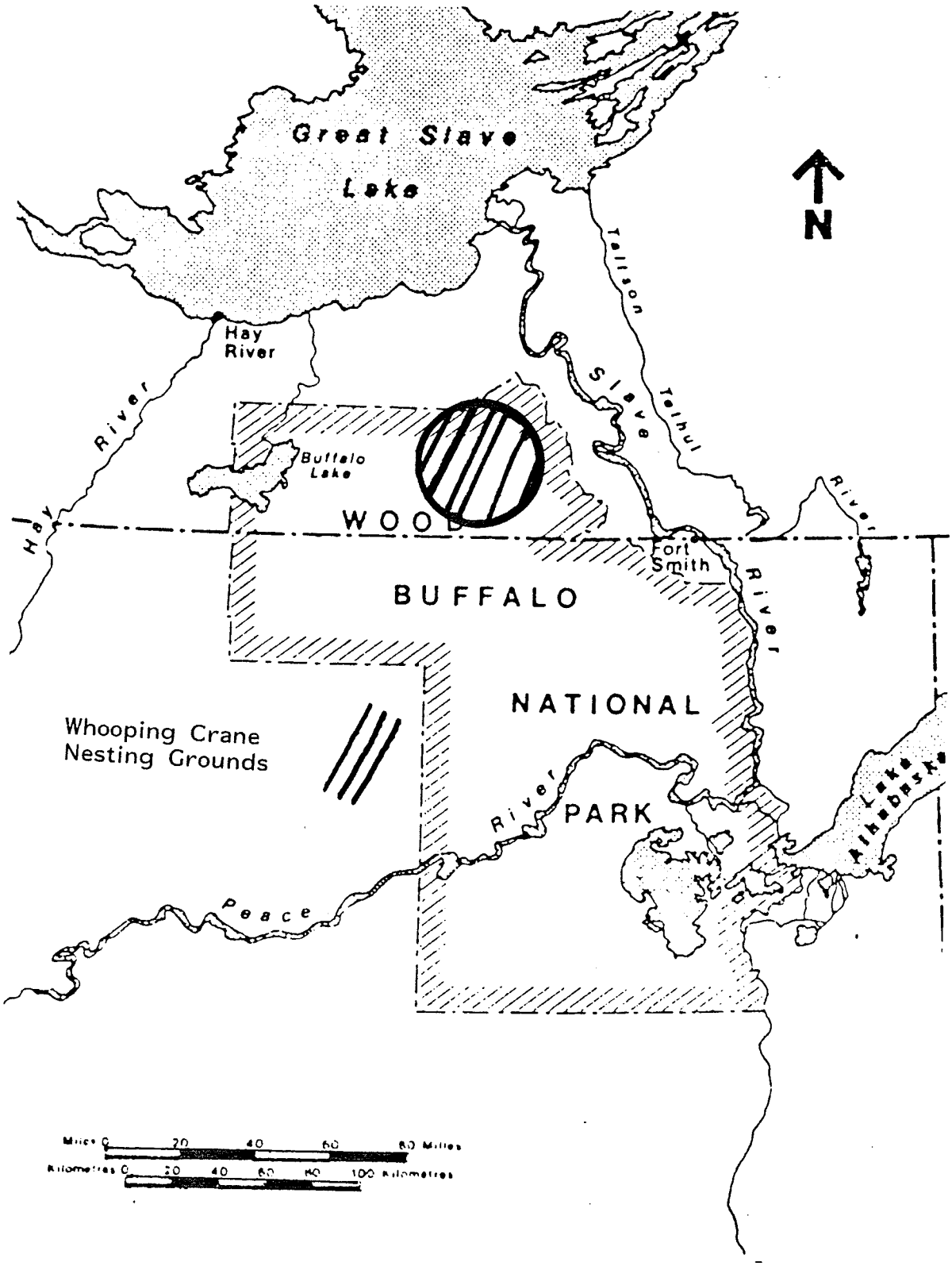

Figure 6: Whooping Crane Nesting Grounds

The transmission lines will run perpendicular to the initial southerly migration route of the cranes, thus increasing the chances of collision (Kuyt, pers.comm.). Presently, there approximately 100 whooping cranes nesting in the area (Kuyt, pers.comm.), but nesting will not be directly affected by any development because these grounds are far removed from any construction (Kuyt from Monenco Consultants, 1977). Whooping crane nesting habitat in Wood Buffalo National Park is in a marshy area interspersed with shallow potholes, separated by shrub and coniferous vegetation (Novakowski, 1966). Due to the nature of the nesting ground, modification to the hydrological regime in the area can have detrimental effects on nesting success. In the past, low water levels have been thought to have resulted in low reproductive success (Sacquet, pers.comm.).

Peregrine falcons have been reintroduced to the Fort Chipewyan area by the Canadian Wildlife Service (Monenco Ltd., 1982). Their nesting sites are located in the transmission corridor and would likely be disrupted by clearing of a transmission right of way and construction of lines. Much of the land surface crossed by transmission lines is covered by forest, of deciduous, mixed and coniferous types. The transmission line route, apart from portions of Wood Buffalo National Park, is entirely within the Athabasca Provincial Forest (Ondro and Williamson, 1978) (see Figure 7).

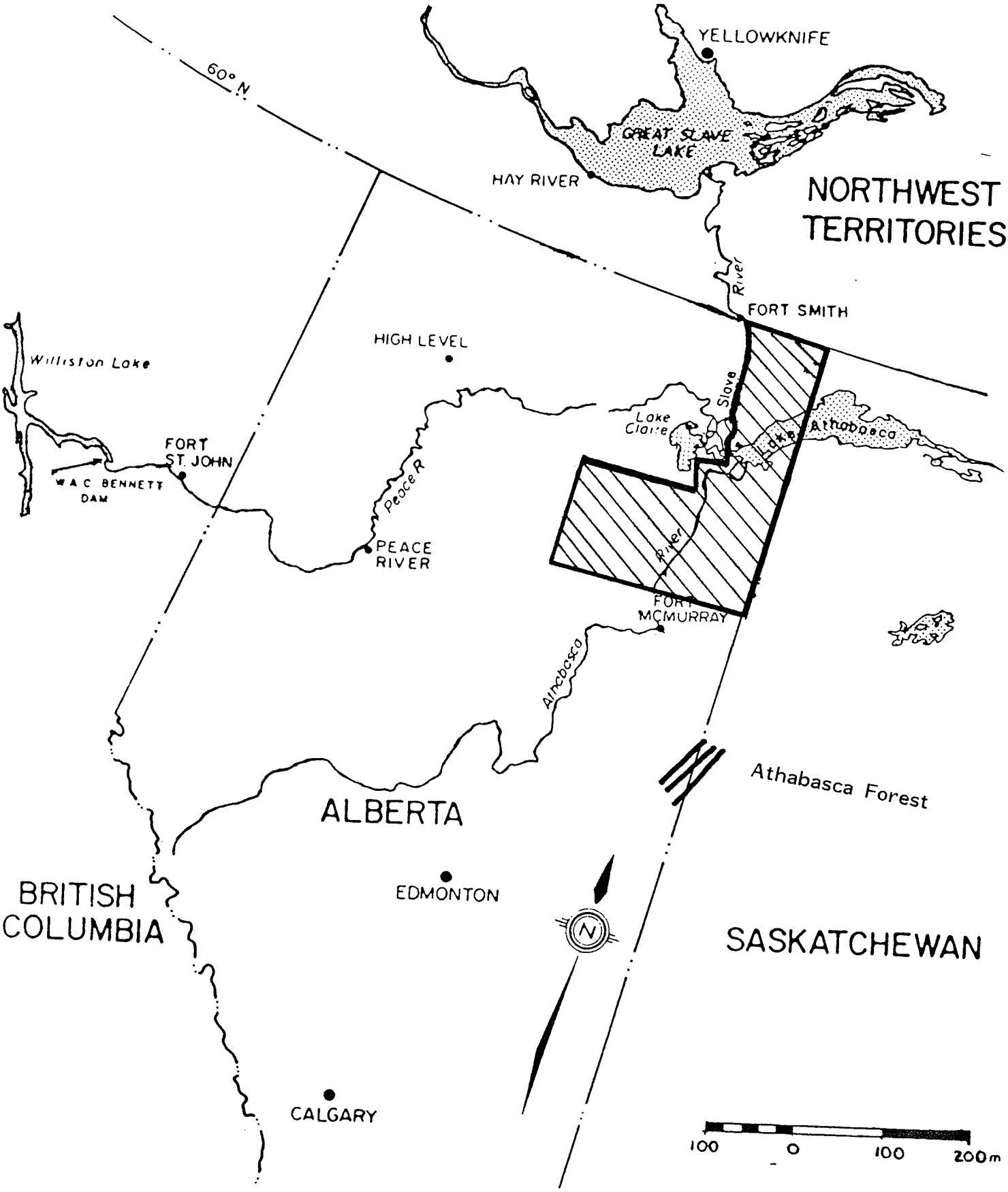

Figure 7: Athabasca Forest Boundaries

At the moment, there is little forestry in the project region, with the sawmill in the Fort Smith area not operating at the current time (Heron, pers.comm.). The Athabasca Forest has been slated as a future timber development area (Ondro and Williamson, 1978). This is despite the fact that the land in the region is capability class 5 and 6. Such land possess severe limitations to the growth of commercial forests mainly due to availability of moisture, amount of soil and organic material, and length of growing season (Alberta Energy and Natural Resources, 1979).

2.3.2 Region 2 - Peace-Athabasca Delta

The Peace-Athabasca Delta contains a diverse array of resources and resource activities. Large areas of open water and early successional vegetation support considerable numbers of waterfowl yearly (Townsend, 1984). Larger lakes in the area serve as staging grounds for the four North American migratory flyways which, converge at the south end of Lake Athabasca and the Delta (Peace-Athabasca Implementation Committee, 1983). Smaller ponds and emergent vegetation play an important role in the other lifecycle functions of waterfowl, such as molting, breeding and nesting (Westworth and Associates, 1982). As many as 600,000 ducks are produced yearly within the confines of the Delta (Townsend, 1984). Pressure on the Delta for waterfowl breeding habitat is especially high when drought conditions on the prairies

dry up prime breeding potholes, forcing waterfowl northward (Westworth and Associates, 1982).

Vast early successional sedge meadows exist in the Delta, comprising much of the primary range of bison introduced into Wood Buffalo National Park (Falk, 1983). Bison populations have risen such that the herd is the largest free roaming and self-regulating herd in the world (Townsend, 1984). From 1926 to 1928 over 6600 plains bison were introduced to the park from Wainright, Alberta (Mitchell, 1976), and since then populations have fluctuated from a high of 9800 in 1972 to a low of 4600 in 1980 (Falk, 1983). Annual calf production averages 17% of total population, with considerably lower recruitment for breeding (Tempany, 1976). Predation of bison by timber wolves serves to aid in controlling populations, but the extent of this has been the subject of much discussion due to highly variable counts over the years (Westworth and Associates, 1982).

Seasonal bison movements in the Delta are well documented (Briscoe, 1980). It is of importance to note that the Delta is virtually devoid of bison during the summer months when water levels are high and flooding occurs. During winter months sedge meadows in the Delta are critical feeding areas for the park's bison (Falk, 1983).

Muskrats are by far the most economically important furbearers in the delta region (Westworth and Associates,

1982). They rely on adequate water levels within perched basins and marshes because their primary habitat is located in the emergent vegetation of bulrushes, cattails, sedges and horsetails (Townsend, 1984). Fluctuating water levels are important for maintenance of muskrat habitat because emergent vegetation thins out during periods of high water levels (Westworth and Associates, 1982). Muskrats are the mainstay of the local trapping economy, with total production being as many as 200,000 annually (Monenco Consultants, 1977), and accounting for 70% of the revenues from trapping (Fuller and la Roi, 1971). In 1971 populations had declined drastically, postulated to be brought about by decreased water levels in the Delta, resulting in increased winter predation and mortality (Ambroch and Lorraine, 1972).

Moose are also present in the Delta, with a population well below that of carrying capacity, due to interspecific competition with bison and intensive hunting by the residents of nearby Fort Chipewyan (Monenco Consultants, 1977). Since the construction of the Bennett Dam, moose habitat has increased because water levels have stabilized (Alberta Government, 1982). Increased moose habitat is expected to be short-lived because of rapid succession from their preferred willow habitat to boreal forest (Gill, 1973).

Fish in the delta travel widely throughout its expanse, typically during migration to spawning areas (Monenco Consultants, 1977), or to overwintering areas outside the delta

where water bodies do not freeze to the bottom (Stanley Associates, 1982). Twenty-four species of fish have been identified, the prominent ones being goldeye, walleye, lake whitefish and northern pike (Alberta Government, 1982). As late as the mid 1960's the delta area supported commercial fishing, but overexploitation resulted in closure of the fishery (Stanley Associates, 1982). At present there is only commercial fishing in Lake Athabasca and domestic and recreational fishing in the entire delta region (Stanley Associates, 1982). While lake whitefish are the most abundant species, walleye are commercially more important because of the level of parasitism in whitefish, leading to reduction of their market value (Stanley Associates, 1982).

The degree of environmental impact on the Peace-Athabasca Delta will largely depend on what operating regime is chosen. The most important features of the operating regime to the Delta are forebay level and whether or not a gated control structure will be placed across the Riviere de Rochers to control flows from both the Delta and Lake Athabasca (Alberta Government, 1982). The higher the forebay level the greater the degree of flooding that will take place in the Delta. In the feasibility study, operating regimes utilizing forebay levels between 203 m above sea level (a.s.l.) and 208.5 m a.s.l. were examined (Alberta Government 1982). At forebay levels up to 204 m a.s.l. water levels in the Delta would not be modified without a control structure on

the Riviere des Rochers (Falk, 1982b). Placement of a control structure on the Riviere des Rochers could help restore the Delta to levels that existed prior to the operation of the Bennett Dam (Fraser, 1984). This is despite the fact that water regimes in the Delta and those of a hydroelectric development are mutually exclusive (high water periods in a delta exist in the spring and early summer, while this period occurs during fall and winter months for a hydro development) (Allen, 1984). Sparling (1986) acknowledged the fact that fluctuations in water levels are most important in restoring the natural deltaic regime, not merely maintaining lon term average water levels. A control structure on the Riviere des Rochers would have to vary water levels along the lines of natural processes to be considered effective.

Impacts on waterfowl in the Delta depend on the operating regime chosen. Recently, stabilization of water levels, as a result of operation of the Bennett Dam, has permitted many miles of shore land to become dry land, mud flats to become sedge meadows and sedge meadows to become willow stands (Monenco Consultants, 1977). Due to spring capture of water upstream, the open water area of the Delta's nine largest lakes has decreased 28% (Dirschl, 1972). Although this is natural succession, the process has been accelerated. Habitat diversity that is necessary for continued well being of waterfowl is being lost by the accelerated succession (Westworth and Associates, 1982). Conversely, waterfowl produc-

tion could be adversely affected if a large amount of flooding in the Delta were to occur (Fuller and la Roi, 1971). At a forebay level of 206 m a.s.l. the area of open water would increase by approximately 8% from present conditions , while emergent vegetation would decrease by approximately 32% from present conditions (Alberta Government, 1982). Opportunities for waterfowl staging in spring and fall would be increased, but other lifecycle functions, such as breeding, molting and nesting would decrease (Griffiths, 1984). At the moment, the precise extent of flooding in the Delta is unclear because a detailed inventory and topographical study of perched basins, the major breeding grounds of waterfowl, has not been carried out. Because these basins are not connected to Lake Athabasca or any of the local rivers, it is not known to what extent these will become flooded (Westworth and Associates, 1982).

The greater the flooding potential in the Peace-Athabasca Delta, the greater the impact on bison and their habitat (Falk, 1983). For example, at a forebay level of 206 m a.s.l. a 14% decrease in sedge meadows and grassland habitat would result (Alberta Government, 1982). This would decrease available grazing areas for bison above and beyond those due to stable water levels in the past number of years (Monenco Consultants, 1977). Water levels in the Delta could also be manipulated in order to increase bison habitat by employing a gated control structure on the Riviere des

Rochers, as discussed earlier. Decreased power benefits occur from utilizing the control structure in such a manner (Alberta Government, 1982).

As with other wildlife resources in the Delta, muskrat could be adversely affected by, or benefit from, hydroelectric development on the Slave River. Muskrats survive where there is a good supply of emergent vegetation for food, cover and house building, and an adequate water depth for overwinter survival (Alberta Government, 1982). This is similar to conditions required by waterfowl, so the impacts on these species would be expected to be similar (Westworth and Associates, 1982). Most Muskrat production occurs in perched basins and effects of flooding on these will be variable depending on the elevation of each individual basin (Westworth and Associates, 1982).

Low water levels in the Delta, as they exist now, can impede movement of fish throughout its entirety, decreasing the number of feeding and spawning sites available (Monenco Consultants, 1977). It would appear that there are no negative environmental impacts of downstream development on the fisheries of the Peace-Athabasca Delta, but positive ones are possible if water levels are raised.

The overall impact of development on the Peace Athabasca Delta depends again on the operating regime chosen. Raised water levels may have positive impacts on some parts of the

environment, and have negative impacts on other parts. Manipulation of water levels in the Delta is viewed by Parks Canada as not being favorable (Parks Canada, 1983). A control structure on the Riviere des Rochers could be employed as a more permanent solution to the low water levels in the Delta which have existed since operation of the Bennett Dam commenced (Peace-Athabasca Delta Implementation Committee, 1983).

2.3.3 Region 3 - Slave River Upstream of Dam

This region is about an 140 km length of the Slave River above the dam, comprising the river valley from the Peace-Athabasca Delta to the damsite near Fort Smith (Monenco Consultants, 1977). Only the last 15 or 20 km of the river will be flooded to a considerable depth, since from its formation to Fitzgerald, the river only drops 5 m. Due to the generally flat topography on the west side of the river, the extent of flooding corresponding to the various operating regimes cannot be readily determined (Alberta Government, 1982).

Along the west side of the river there are low-lying fen areas which may become flooded. This is ideal habitat for bison and a reduction of these would be reflected in a decrease in bison numbers (Alberta Government, 1982). Bison utilize the west side of the river all year round (Briscoe, 1980). Bison are able to use these sedge and fen meadows

because of decreased frequency of flooding compared to the Peace-Athabasca Delta. Forebay levels above 200 m a.s.l. would flood critical bison habitat that is considered irreplaceable.

Salt plains in the eastern portion of Wood Buffalo National Park constitute a unique and important area of the park. The saline nature of the local environment is a result of deep groundwater dissolving salt buried in vast beds below the surface, and surfacing in the plains area (Parks Canada, 1978). Common dissolved salts include the sulphates and chlorides of sodium and calcium (Alberta Government, 1982). Flanking the plains on the northeast side is an escarpment, whose granitic rock steers the saline water onto the plain (Parks Canada, 1978). Impermeable shale underlies the plains, resulting in relatively poor drainage and accumulation of saline water.

The presence of saline water results in special halophytic plant communities inhabiting the plains. Distinct bands of vegetation occur, the banding being due to varying degree of salt tolerance amongst the different species (Parks Canada, 1978). In places where salinity is too high for the most salt-tolerant plants, stretches of barren ground exist. Bison, pelicans and shorebirds are a few of the species of wildlife that use the salt plains for feeding purposes (Parks Canada, 1978). Until the end of the 19th century approximately 4 tons of pure salt was collected annually, constituting a valuable trading commodity.

Of international importance to this unique region is its recognition as an International Biological Programme (IBP) ecological site (Reid Crowther and Partners, 1982). Briefly, the IBP was inaugurated in 1964 and operated until 1976, with one of its mandates being the preservation of natural and semi-natural areas (Worthington, 1975). Worldwide, areas were set aside as examples of different biomes, for study and recognition by future generations.

Increased groundwater pressure, resulting from possible reservoir seepage (Falk, 1982b), could have detrimental effects on the salt plains. Water flowing to the surface would contain greater concentration of salt, upsetting the delicate balance of the plains. An increase in saline conditions would limit the number of vegetation species that could grow there (Reid Crowther and Partners, 1982). Barren salt flats would be expected to increase in area if groundwater increases in salinity.

Important gypsum and limestone karst features in the northeastern portion of Wood Buffalo National Park may also be affected by an increase in groundwater pressure (Falk, 1982b). Larger collapse sinkholes and smaller solution sinkholes found there offer the best examples of gypsum karst terrain found in North America (Parks Canada, 1985). Due to the exceptionally soft bedrock, these sinkholes have formed in a relatively short time (10,000 years as opposed to the 100,000 years this process normally takes). Any

change in groundwater regimes around the karst terrain would upset the balance of these features (Parks Canada, 1984).

The presence of a colony of white pelicans just below the Mountain Rapids, has raised considerable concern regarding development on the Slave River (Adams, 1978). Flooding would inundate the islands where as many as 80 nesting pairs and 400 bachelors have been seen (Sweet, 1981). Regardless of the damsite chosen, construction noise will likely disrupt the colony, forcing the birds relocate (Alberta Government, 1982). This colony is of particular interest because it is the northern most nesting colony of white pelicans in Canada (Griffiths, 1980) and is unique because the nests are on river islands as opposed to lake island sites which are usually preferred (Townsend, 1984). Whether or not the colony would relocate once construction had ceased is questionable, thus possibly jeopardizing what is felt to be an important characteristic of the area (Sweet, 1981). The colony has relocated once, from an island just above the Mountain Rapids to its present location, due to placement of a hydro pylon on the island by Northern Canada Power Commission (Van Pelt, pers.comm.). The fact that the colony relocated once should not be used as a precedent that it will move again. Disruption and damage created by erection of a hydro pylon is considerably less than that of damming the Slave River.

Other waterfowl have been seen nesting on the banks of the Slave River upstream of the development site. Flooding caused by river impoundment would greatly reduce nesting on the river banks, as well as in nearby tributaries (Monenco Consultants, 1977).

Spawning areas for fish would be affected immediately upstream of the damsite by deepening of the reservoir (Alberta Government, 1982), but overall fish habitat may be increased because of an increase in available river area (Geddes, 1982a). Concern over sedimentation in the reservoir has been raised (Monenco Consultants, 1977), but the feasibility study showed that most of the sediment would be carried downstream because of its fine nature and the fast flow of the river (Alberta Government, 1982). Contradicting this is the final report prepared by Reid Crowther and Partners Limited (1982). This report examined environmental effects of upstream impoundment. Water quality studies showed an annual sediment load of approximately 33 million tonnes travelled down the river, 85% silt/clay composition and 15% sand. Initially after impoundment 65% of the silt and all of the sand will be deposited in the reservoir and a half-life of reservoir filling of 60 years. These figures suggest sedimentation in the reservoir is more serious than the feasibility study indicates.

Of great concern to the local native population is the possibility of bio-accumulation of mercury in the reservoir

(Bear pers.comm.). Fish constitute an important part of the native diet, especially in times of high unemployment. There is no mercury contamination present at the moment, but this phenomenon may be related to flooding of new substrates (Reid Crowther and Partners Limited, 1982). In the past, several studies have implicated reservoir formation as the cause of such bio-accumulation after flooding, especially in fish stocks (Abernathy and Cumbie, 1977). Bodaly and Hecky (1979) hypothesized that observed mercury level increases were due to bacterial methylation of naturally occurring mercury found in flooded soils. Mercury in the methylated form, incorporated into fish tissues, is passed on to those who eat the flesh.

Due to the high flushing rate in the main channel of the reservoir brought about by large river flow volumes, bio-accumulation of mercury is expected to be reduced (Reid Crowther and Partners Ltd., 1982). Associated backwater channels and stillwater bays still have the potential for bio-accumulation because their flushing rate is considerably lower (Reid Crowther and Partners Ltd., 1982). Much of the fish stock exploited in the river is found in these areas (Bear, pers.comm.), therefore the threat of mercury contamination in fish in the reservoir is potentially serious. This situation should be evaluated closely, and mitigative measures with the potentially affected population outlined prior to construction.

The increased water pressure due to upstream impoundment has the potential of destabilizing the already unstable banks, creating a greater silt load in the reservoir (Vicars, 1980). Steps will have to be taken to stabilize the banks where absolutely necessary before impoundment is to take place.

2.3.4 Region 4 - Slave River Downstream of Dam

Region 4 is the portion of the river stretching from the damsite to the Slave River Delta on the southern side of Great Slave Lake. The area potentially affected by development follows a corridor parallel to the river. Environmental effects downstream are centered around hour to hour fluctuations in water levels corresponding to the demand for electrical power (Alberta Government, 1982). This has the potential to uncover fish spawning and wintering sites (Griffiths, 1982) of importance to the commercial fishery downstream in Great Slave Lake (Geddes, 1982b). The river, immediately downstream of the Rapids of the Drowned, is an extremely important source of fish for residents in the Fort Smith area (Bear, pers.comm.). Disruption of the Slave River immediately downstream of the dam would likely jeopardize the domestic fishing at this location.

Also of importance to the fishing, both on the river and upstream in Lake Athabasca, is the possibility of invasion of the parasitic arctic lamprey (Falk, 1982b Griffiths,

1982). Currently, lamprey are unable to proceed upstream of the Mountain Rapids, the granite ridges acting as a barrier to their upstream movement (Griffiths, 1984). Development at the Mountain Rapids site could allow lamprey upstream of this site. Parks Canada is opposed to the presence of lamprey in its national park waters (Parks Canada, 1984). The arctic lamprey could also adversely affect commercial and domestic fishing in the Peace-Athabasca Delta and Lake Athabasca (Griffiths, 1982). To prevent invasion, no fish ladder will be employed on the dam and the use of a chemical lampreycide undertaken following completion of the dam (Alberta Government, 1982).

The Slave River Delta downstream of any development on the river could be adversely affected by a change in water regime. Reduced suspended sediment load, due to settling in the reservoir would result in a lower amount of nutrient recharging in the delta, leading to lowered productive potential (Bodden, 1981). If storage of water in Lake Athabasca occurs, the delta will incur lower water levels and a decreased frequency of flooding (Griffiths, 1982). Since the Slave River Delta is solely dependent on the river for flooding and nutrient recharging, lowered water levels could promote accelerated succession in the delta (Griffiths, 1982).

With flow through the dam changing to meet peak electrical demands water levels can vary greatly below the dam. In

winter the result will be ice jamming and slumping (Alberta Government, 1982). The Slave River is frequently crossed in winter time by residents of Fort Smith and local hunters and trappers (Bear pers.comm.). and ice slumping up to 50 km downstream will prevent this. Ice slumping and jamming can also lead to scouring of the river bank and removal of vegetation used by many species of wildlife (Griffiths, 1982).

2.3.5 Region 5 - Great Slave Lake and Mackenzie River

The feasibility study states that water levels in Great Slave Lake will be kept within 0.1 m of normal before, during and after dam construction (Alberta Government, 1982). This should not seriously affect region 5. However, small reductions of flow in the Slave River could reduce levels in Great Slave Lake and the Mackenzie River to the point where navigation may be hampered (Griffiths, pers.comm.). A detailed environmental impact assessment would have to analyze potential effects in this region more closely.

2.4 SUMMARY OF KEY POINTS

The area potentially affected by development on the Slave River at the Smith Rapids is extremely large, and the information presented in this chapter is by no means an exhaustive list of resources and potential impacts. Matters that fall within federal mandates have been outlined, and the most important ones are summarized below.

Of greatest concern with regard to the transmission lines and transmission corridor are possible effects on whooping cranes. Development on the Slave River has the potential to disrupt both migration and nesting of these birds. Recent re-introduction of peregrine falcons to the region of the transmission corridor may also be disturbed by development.

The Peace-Athabasca Delta, most of which lies within the confines of Wood Buffalo National Park, may be adversely affected, depending on the operating regime chosen. Forebay levels up to 204 m a.s.l. will not increase water levels in the delta, therefore it would continue to evolve in response to modified water regimes brought about by the Bennett Dam. Waterfowl that use the delta for breeding, as well as spring and fall staging, will be adversely affected by increased water levels. Bison using the delta as critical wintering habitat are likely to be affected by increased water levels. Economically important furbearers and fish rely on adequate water levels for their continued welfare. A gated control

structure has been considered in order to restore lowered water levels in the delta, but it would also have to provide hydroelectric benefits.

Upstream of the dam, several important federal jurisdictions can be found. Bison heavily utilize low-lying land along the west side of the river. Forebay levels above 200 m a.s.l. will flood these lands, which are not likely to be replaced with similar habitat because similar habitat does not exist in the region. Internationally important salt plains and karst terrain in Wood Buffalo National Park could be disrupted by increased groundwater pressures. White pelicans are caught in the centre of development controversies because where they nest is in the immediate vicinity of proposed construction. Areas of study that have been inadequately addressed in the past are those of reservoir sedimentation and bioaccumulation of mercury in the reservoir.

Downstream of possible development sites, fish spawning may be adversely affected by peaking operations of the generating station. Damming of the Slave River might also allow invasion of parasitic arctic lamprey into national park waters. Lamprey could also make their way into Lake Athabasca and affect the quality of fish stocks landed. Sediment loads to the Slave River Delta are likely to be reduced, potentially affecting productivity in the delta, as well as commercial fishing in Great Slave Lake. Further downstream, in Great Slave Lake and the Mackenzie River, no significant effects due to development have been outlined.

Chapter III

REVIEW OF PROJECT PROPOSAL

3.1 INTRODUCTION

The construction of hydroelectric generating facilities requires a large layout of capital for materials, labour and site preparation. Return on the original investment does not occur until many years later. Operating costs of hydroelectric facilities are traditionally lower than other forms, because only a few technical staff are required to operate the facility. A rather large initial financial risk is undertaken when considering such developments. In order to be considered economically feasible hydroelectric dams must operate for a sufficient period that the large capital investment is returned. Sedimentation rates in the reservoir behind the dam usually dictate the life of a particular project.

The proposed Slave River Hydro project is a typical hydroelectric project. Costs of construction are projected to be approximately $2.5 billion (in 1982 dollars) (Alberta Government, 1982). Taking into account inflation, possible delays and cost overruns the price tag of the project may rise as high as $8.0 billion. Required time for completion

of the project is expected to be seven years. Water could start flowing through the turbines and start generating power as soon as 5 years after commencement of construction (Alberta Government, 1982).

This chapter discusses briefly the layout of facilities for the proposed Slave River Hydro project. The hydro potential of the Slave River is discussed and the project proposal briefly outlined. A more complete discussion of the technical layout of the project is contained in the feasibility study concerning hydroelectric development on the Slave River, completed in 1982 (Alberta Government, 1982).

3.2 HYDROELECTRIC POTENTIAL OF THE SLAVE RIVER

The potential of using the water resources of the Slave River for hydroelectric development has long been recognized. As early as 1923 the Commission of Conservation examined the potential of harnessing the power of the Slave River (Energy Resources Conservation Board, 1981). Since then, investigations have been undertaken in 1953, 1960 and 1966 regarding the use of the river's potential to supply local requirements in mining communities in the north (Grover and Primus, 1981). In particular, Consolidated Mining and Smelting examined a series of rapids between Fitzgerald, Alberta and Fort Smith in the Northwest Territories. The proposed development schemes were deemed uneconomical because only a portion of the river's flow would be used to generate

the small amount of power required (Energy Resources Conservation Board, 1981). In 1977 Calgary Power Ltd. (now Transalta Utilities) undertook a study to determine whether or not the Slave River could be developed in a manner to help restore the ecology of the Peace-Athabasca Delta (Energy Resources Conservation Board, 1981). More recently the Government of Alberta has undertaken a more indepth investigation of the technical, economic, social and environmental aspects of development of the Slave River's hydro potential (Energy Resources Conservation Board, 1981).

3.3 PROJECT PROPOSAL

In July of 1982 the Government of Alberta released the results of a Slave River Hydro Feasibility Study, comprising a 4 year, 10 million dollar study initiated by the Department of the Environment and other government agencies (Pearce, 1984). The study report was composed of 37 volumes, dealing with a number of engineering, environmental, archaeological, social, community, economical and financial topics. A single preferred alternative for development was not recommended, instead the number of possible sites was narrowed to three (Pearce, 1984).

The feasibility study chose the alternatives on the basis of a number of issues. It should be noted that some issues were given less consideration than others because it was felt they are best dealt with through the regulatory process

that will follow emergence of a project proponent (Alberta Government, 1982). The issues were:

1. environmental issues;
2. locations within the Smith Rapids where it is possible to develop a dam and power facilities;
3. community issues;
4. the evaluation of different forebay levels created by the dam; and
5. installed capacity and operation of power facilities and its effects upon water levels up and down stream of the dam (Alberta Government, 1982).

The possible sites identified in the study are located at the Mountain Rapids, the Alternative 4 site and the Rapids of the Drowned, the former two being located in Alberta and the latter in the Northwest Territories (Fraser, 1984) (see Figure 8). The Power potential at these sites is 1512 MW at Mountain Rapids, 1570 MW at Alternative 4 and 1753 MW at the Rapids of the Drowned (Alberta Government, 1982). A two stage development at Pelican Rapids and the Rapids of the Drowned, with a power capacity of 1690 MW, was also considered, but due to high capital costs it was not pursued (Alberta Government, 1982).

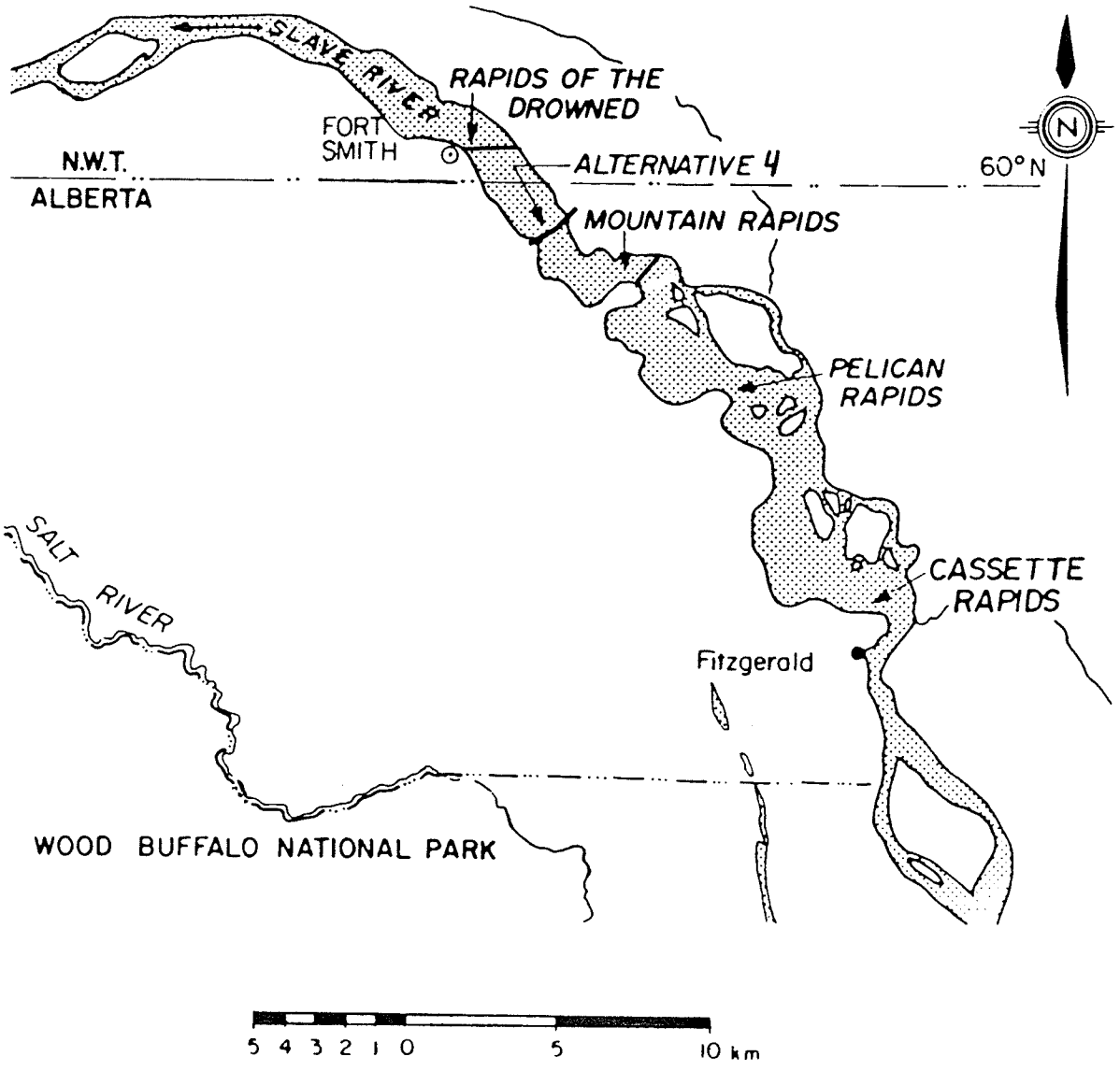

Figure 8: Sites of Alternative Hydroelectric Development

Selection of three possible alternatives for development allowed more detailed analysis of the technical aspects of the project. It should be noted that no preferred alternative of the three was chosen, but more attention was paid to development at the Alternative 4 site. This site is an intermediate one between the Rapids of the Drowned and Mountain Rapids, allowing for easy analysis at both of these other alternatives. Alternative project parameters are shown in Table 2.

TABLE 2

Alternative Project Parameters

Parameter	Rapids of the Drowned	Alternative 4	Mountain Rapids	Variations
Forebay m a.s.l.	203-208.5	203-208.5	203-208.5	-
Minimum River Flow m^3/s	1000 m^3/s	1000 m^3/s	1000 m^3/s	500, 1500
# of Turbines	12	12	12	8,10,14
Max. Usuable Discharge	5000 m^3/s	5000 m^3	5000 m^3/s	6000 m^3/s
Plant Capacity	-	1656-1955 MW	-	-
Annual Energy Production at 206 m a.s.l.	9700 GWh	8900 GWh	8500 GWh	-

from Alberta Government, 1982

As shown in Table 2, technical aspects at each of the three alternatives are similar. However, the further downstream development occurs, the higher the annual energy production that can be attained. While this is true, capital costs in-

crease in further downstream sites. Development at the Rapids of the Drowned would incur the highest capital cost of the three alternatives.

Also addressed, were operating scenarios that seasonally adjusted forebay levels, but these scenarios were considered less environmentally desirable because they were not consistent with natural river flows (Monenco Consultants, 1977). Another alternative of a gated control structure on the Riviere des Rochers to increase winter flows from Lake Athabasca was considered. This could restore levels approximating the natural regime in the Peace-Athabasca Delta before the construction of the Bennett Dam (Fraser, 1984).

Demand for electrical power is not constant throughout a 24 hour period. Peak demand for electricity normally falls in the mid-morning, late afternoon and early evening (Alberta Government, 1982). Additional demand for power is usually met by peaking operations of the power plant, whereby more water passes through the turbines. When peaking occurs, large and rapid changes that result from fluctuating water levels be destructive to the downstream aquatic environment (Ward, 1976).

3.3.1 Components of Hydroelectric Development

At the point of any of the three proposed developments the Slave River is relatively wide, between 2 and 3 kilo-

meters across the valley (Geddes, 1982a). The three principal components of a hydroelectric development, the powerhouse, spillway and dam (Alberta Government, 1982) would be approximately 50 m high and 100 m thick at the points of highest stress (Geddes, 1982a). The powerhouse could contain as few as 8 or as many as 14 generating turbines, with two working constantly to maintain minimum downstream flow. Turbines would be located on the downstream side of a concrete gravity intake structure (Alberta Government, 1982). The concrete spillway section, made up of 10 vertical gates would allow for the passage of flood waters. The main dam, because of costs and the availability of construction materials, would be a rock fill structure, completing closure of the river. Some amount of concrete would be required to facilitate a tight seal between concrete and rock components (Alberta Government, 1982). Separate from the structures retarding the downstream flow of the Slave River will be several closure dykes. These are required to contain the forebay at topographic low points (Alberta Government, 1982).

The power generated from a hydroelectric development on the Slave River could be transmitted south and fed into the Alberta Interconnected System by a variety of feasible transmission routes. Six possible routes for transmission lines from Fort Smith to a point west of Fort McMurray were identified in the feasibility study. Alternatives include

routes through Wood Buffalo National Park and the Peace-Athabasca Delta and routes avoiding national park land, but crossing Lake Athabasca (Alberta Government, 1982) (see Figure 9).

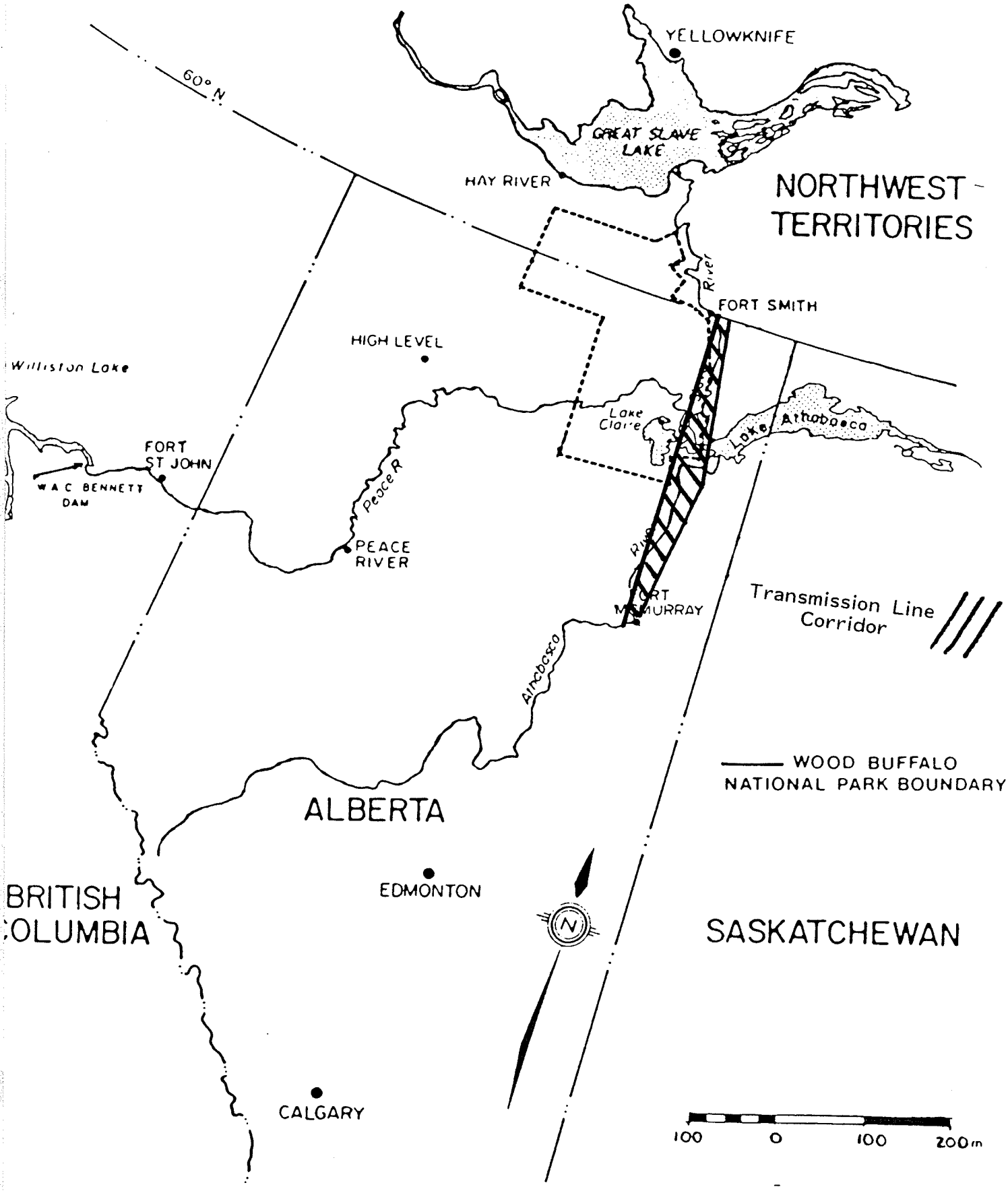

Figure 9: Transmission Line Corridor

3.3.2 Operating Regime

The powerhouse, once built, could operate at forebay levels between 200 m a.s.l. and 208.5 m a.s.l. at any of the alternatives (Alberta Government, 1982). The most economical forebay levels in terms of development occur between 203 m a.s.l. and 208.5 m a.s.l.. Constant or seasonally varied forebay levels could be employed, with winter drawdown occurring, in order to maximize power potentials during critical winter months (Alberta Government, 1982). Seasonally adjusted forebay levels are not considered viable, partially because of the degree of environmental destruction that takes place in such an operating regime (Monenco Consultants, 1977). High forebay levels and plant capacity do not necessarily mean the highest net benefits are attained because construction, social, economic, engineering and environmental costs must be subtracted. In fact, a forebay level of 206 m and plant capacity of 1816 MW would provide the greatest net benefits of the 5 levels examined (Alberta Government, 1982).

Compared to the power potential, the required reservoir impoundment area would not be large due to the fact that high flows in the Slave River would allow the filling of a reservoir in a short period of time (Grover and Primus, 1981). However, size of the reservoir depends on local topography, and raising water levels a few centimeters over the banks could result in a large area being flooded. A

minimum river flow of 1000 m^3/s is considered to be adequate downstream discharge (Alberta Government, 1982). It should be noted that minimum flow standards for discharge from development on the Slave River have not been established. Prior to construction and operation of the facility such measures should be established.

3.4 SUMMARY

As shown in this chapter, a large number of development alternatives to harness the power on the Slave River exist. Variables include development site, forebay operating level and transmission line route. No firm commitment has been made to developing any one combination of variables. When it is deemed there is sufficient demand for power from the Slave River, it is likely a preferred configuration will be chosen

Chapter IV

LEGAL IMPLICATIONS SURROUNDING THE PROJECT

4.1 INTRODUCTION

For project approval and construction of the dam, generating facilities, and transmission lines for the Slave River facility to occur a complex array of legal guidelines, both federal and provincial, will have to be followed. Provinces hold the majority of jurisdictional control in issues concerning water resources, the power being delegated to them by the Natural Resources Transfer Agreement of 1930 (Percy, 1982). Because the Slave River crosses provincial boundaries and runs through federal lands the federal government is also able to exert power over the management of water resources. As neighboring jurisdictions, Saskatchewan and the Northwest Territories are able to ensure their concerns are also met. While legislation is in place, the question of jurisdiction over certain aspects, whether it is federal or provincial, remains unresolved (Geddes, 1982a). This chapter highlights relevant legislation pertaining to the Slave River Hydro project, both federal and provincial, discusses possible gaps in the legislation, and points out areas of overlap and potential areas of conflict.

4.2 FEDERAL LEGISLATION

Federal legislation pertaining to the proposed development can be divided into four parts, each part associated with a federal government department having jurisdiction over the particular aspect. The relevant government departments are:

1. Environment Canada
2. Department of Indian and Northern Affairs
3. Department of Fisheries and Oceans
4. Transport Canada

4.2.1 Environment Canada

The federal Department of the Environment has jurisdiction over a number of statutes and regulations pertinent to any possible development on the Slave River. On the basis of five acts Environment Canada is able to protect its interests over the environmental aspects of the proposed hydroelectric development on the Slave River. Legislation includes:

1. Canada Water Act
2. Canada Wildlife Act
3. Government Organization Act(1979)
4. Migratory Birds Convention Act
5. National Parks Act

(1) Canada Water Act

The Canada Water Act, RSC 1970, 1st. sup. c. 5, was enacted to handle on general terms, the management of the water resources of Canada. Section three of the Act states:

> "... , the Minister may consult with one or more province on water resource matters, advise on the formulation of water policies and facilitate the coordination and implementation of water policies and programs."

Policies and agreements on water management and water quality management may be implemented with one or more province with respect to interjurisdictional waters (water flowing between provinces) where there is significant national interest. What constitutes significant national interest is not defined in the Act. Agreements may be for six purposes.

1. for inventory of water resources;
2. to assess water quality;
3. to conduct research;
4. to formulate water management plans;
5. to design projects; and
6. to implement any of 1 to 5

The Canada Water Act could be employed for purpose number 5, perhaps formulating a federal-provincial water management plan regarding construction and operation of the dam. According to Percy(1982) interjurisdictional agreements are

the only short-term means of resolving legal uncertainties. It would appear the Canada Water Act could be employed to reduce some of these uncertainties. Unfortunately this has never been subjected to a court review, therefore it is unclear if the federal jurisdiction would be upheld if a court challenge occurred (Environmental Law Centre, 1984).

(2) Canada Wildlife Act

Although it is the responsibility of the provinces to enact laws protecting wildlife (responsibility is derived from the Constitution Act, 1867) (Environmental Law Centre, 1984), the federal government enacted the Canada Wildlife Act, S.C. 1973-74 c. 295. While general in nature, the Canada Wildlife Act allows and encourages provincial-federal coordination of wildlife policies and programs. The Act could be utilized by Environment Canada to implement policies for further protection of endangered species and non-endangered species in the area affected by the proposed hydro project. In 1980 regulations pursuant to the Act established a list of species that were rare and endangered; included on this list were white pelicans (Griffiths, 1980).

(3) Government Organization Act(1979)

Part III of the Government Organization Act, S.C. 1978-79, c. 13, allows the minister of the Environment to

> "...initiate, recommend and undertake programs and coordinate programs of the Government of Canada that are designed to

ensure new federal projects, programs and activities are assessed early in the planning process for potential adverse effects on the quality of the natural environment leading to further review if adverse effects are noted."

(section 6)

Federally administered lands in the project area include Wood Buffalo National Park and lands Indians use or occupy(Environmental Law Centre, 1984). The Act provides a framework for establishing guidelines relating to environmental quality. In 1984, pursuant to the Act, guidelines were established setting a broad framework for environmental impact assessments as defined by the Federal Environmental Assessment Review Process (EARP).

In 1980, Parks Canada referred the Slave River Project to the Minister of the Environment for a panel review by EARP (Environmental Assessment Panel, 1982). Parks Canada's concerns were alteration of water levels in the Peace-Athabasca Delta, inundation in the Slave River behind the dam, and potential effects on whooping cranes due to collisions with transmission lines and habitat effects (Falk, 1982b). Flooding of federally administered native lands and effects of commercial fisheries in Lake Athabasca, Peace-Athabasca Delta and Great Slave Lake were also issues. Draft guidelines for an environmental impact assessment were released in August of 1982, before the naming of a project proponent (Environmental Assessment Panel, 1982). Areas to be addressed in the review were:

1. demand for the project, alternatives and associated projects;
2. project proposal and general layout;
3. description of existing environment and resource use;
4. environmental and social impacts and mitigating measures;
5. residual impacts; and
6. monitoring.

(Environmental Assessment Panel, 1982)

More recently the guidelines have been revised following public consultation and discussions with the Alberta government (Environmental Law Centre, 1984). To avoid duplication of effort, specific requirements, such as need for the project, were excluded by the federal assessment panel in their second document (Pearce, 1984). It is expected these impact study guidelines will be combined for a joint Alberta-Federal review of the environmental impacts of the project (Pearce, 1984).

(4) Migratory Birds Convention Act

The Migratory Birds Convention Act, R.S.C. 1970, c. M-12, was passed in conjunction with an international treaty between the United States and the United Kingdom (Canada did not yet have the power to sign international treaties)(Environmental Law Centre, 1984), protecting certain migratory birds, both game and non-game. Specific measures are laid out for migratory birds, including protection of whooping cranes and their habitat, where absolutely no hunting is allowed. Other migratory birds are protected under the Act, which prohibits the deposition of substances harmful to migratory birds in waters frequented by them, as well as prohibiting the destruction of nests, eggs and shelter (Environmental Law Centre, 1984). White Pelicans are not protected under the Convention, but receive protection under the Canada Wildlife Act (Griffiths, 1980).

(5) National Parks Act

The National Parks Act, R.S.C. 1970, c. N-13, sets aside federal lands for two purposes.

1. for the use, benefit and enjoyment of the people of Canada.
2. to preserve, protect and maintain them so as to leave them unimpaired for use by future generations.

In the Act and associated regulations flooding is not an authorized use (Environmental Law Centre, 1984) and the past Minister of the Environment, John Roberts, was not willing to authorize such action (Falk, 1982b). The stance of the current Minister of the Environment on issues regarding the flooding of land in Wood Buffalo National Park is not known.

By an Act of Parliament it is possible to excise land from a national park for use and development (Alberta Government, 1982). A precedent for this procedure occurred in Nova Scotia, whereby a portion of national park land was annexed for a hydro development and another piece of land of equal natural value was returned to the park (Environment Canada, 1976). The former Minister of the Environment stated he was not willing to recommend such action to his colleagues (Falk, 1982b).

Parks Canada's position on the proposed Slave River Hydro project is as follows.

1. Perpetuation of the resources of Wood Buffalo National Park and the Peace-Athabasca Delta are important.
2. Flooding of lands in the Peace-Athabasca Delta or any associated negative impact that may result from a dam constructed on the Slave River cannot be accepted.
3. No changes in the boundaries of the park to excise critical Delta lands that may be flooded will be permitted and parliamentary approval to effect this action will not be sought.

4. Parks Canada will continue to provide input into and participate in the EARP so the full impact of any dam on park resources and the region will be identified.

(Parks Canada, 1984)

4.2.2 Department of Indian and Northern Affairs

Several statutes pertinent to the Slave River Hydro project are administered by the Department of Indian and Northern Affairs. A few are dependent on which site is chosen for development because they are pertinent to the Northwest Territories not Alberta. Questions of jurisdiction can be unclear and it is felt they must be cleared up before development on the Slave River (Percy, 1982). The main avenues of authority are:

1. Dominion Water Power Act
2. Indian Act

while other potentially important pieces of legislation include

3. Arctic Waters Pollution Act
4. Northern Inland Waters Act

(1) Dominion Water Power Act

Under the Act, R.S.C. 1970. c. W-6, the Minister of Indian and Northern Affairs is able to authorize the undertaking

of storage and pondage, energy generation, surveying and construction. The Act applies to federal crown lands and those lands the federal government has the power to dispose. Approval is required for the construction of hydroelectric facilities on Dominion waterpowers (water on public lands). If development takes place in the Northwest Territories the Act will be most pertinent, but the portion of the Slave River flowing through Wood Buffalo National Park is also classified as a Dominion waterpower therefore falls under the jurisdiction of the Minister.

(2) Indian Act

The Indian Act, R.S.C. 1970,c. I-6, is administered to the Minister of Indian and Northern Affairs. This act places all Indian lands under trusteeship of the Minister for the use and benefit of the of respective Indian bands for which they were set aside. The Minister acts as a representative of the Indians views and ensures their best interests are kept. Five percent of the Peace-Athabasca Delta lies within the Fort Chipewyan Indian Reserve (I.R. 201), which, as a result of development may become flooded. These lands fall under the jurisdiction of the Minister and the impacts on the people and land are expected to be represented in the environmental assessment and review process. Development on the Slave River and ensuing environmental effects could also affect Indian land claim settlements on the south shore of Lake Athabasca and at Peace Point in Wood Buffalo National Park.

(3) Other Possible Legislation

If development occurs in the Northwest Territories the project approval process could be affected by the Arctic Waters Pollution Act and the Northern Inland Waters Act. These require ministerial approval for deposition of any wastes or pollution of northern waters. Protective downstream measures would be dealt with in this manner.

4.2.3 Department of Fisheries and Oceans

The Fisheries Act R.S.C. 1970, c. F-14, designates all the water in the fishing zone of Canada and all internal waters under the jurisdiction of the Minister of Fisheries and Oceans. Jurisdiction over fisheries is divided between federal and provincial governments. The federal government is responsible for the regulation of fish habitat and for management and conservation programs, while the provinces being responsible for private fishing (Environmental Law Centre, 1984). The Act requires departmental clearance for all major industrial projects affecting fish habitat, to ensure some measures of fish protection are provided (Percy, 1982).

The Fisheries Act specifies construction of a fishway around a dam or major obstruction, or if this is not feasible or too costly, a hatchery must be maintained to supply migratory fish downstream. This requirement has not been

strongly enforced in the past (Bodaly, pers. comm.). Fish stops might be required up and downstream of the dam to prevent destruction of fish or assisting their assent. The operator of the dam or obstruction must provide sufficient flow over the spillway at all times to allow for the downstream passage of fish, and provide enough water for a river bed below the dam. Pollution of waters by slash and stumps is not allowed under the Act, as it will disrupt fish habitat.

4.2.4 Department of Transport

Federal approval is required for works to be built on a navigable river under the Navigable Waters Protection Act, R.S.C. 1970, c. N-19. The Act, under jurisdiction of the Minister of Transport refers to anything that may interfere with navigation. The courts have previously taken a wide view of what constitutes a navigable river (Percy, 1982). Pertaining to project development are several possible contraventions to the Act. If water levels are raised in Lake Athabasca navigation beacons are likely to be destroyed or damaged and remedial measures would have to be taken to correct the damage (MacLaren Plansearch, 1982). In the past, the Slave River was part of western/northern Canada's major water transportation system (Gamble, 1982). The Smith Rapids reach is the only break in the 2700 km route to the Arctic form north central Alberta (Geddes, 1982a). It is in-

teresting to note that the dam area has traditionally been portaged, therefore river obstruction at this point would not interfere with navigation. Whether or not dam construction could be blocked under the Act is unclear.

4.3 PROVINCIAL LEGISLATION

Provincial jurisdiction regarding the proposed Slave River Hydro project starts with the provinces controlling hydroelectric energy as a result of the Constitution Act, 1867 (Environmental Law Centre, 1984). Pursuant to this Alberta has enacted the Hydro and Electric Energy Act, R.S.A. 1980, c. H-13. The administering body is the Energy Resources Conservation Board (ERCB), which requires proponents to obtain approval from them for a hydroelectric development to occur. ERCB hearings may be required in order for approval to take place. Also under the Act, it is possible to make regulations to protect wildlife during the construction of any hydroelectric facility. The terms of the ERCB license issued after approval must be adhered to. If upon inspection, the terms are found to be broken, cessation of any further activity takes place until matters are adequately rectified.

The Water Resources Act, R.S.A. 1980. c. W-5, requires that before construction may begin, a license under the Act must be obtained. This responsibility lies solely with Alberta since it is the owner of the water resource and has

the jurisdiction to manage water, control development, regulate flow and issue licenses. Public hearings for the purposes of hearing briefs and submissions on any matter pertaining to the management of water resources are initiated under the Water Resources Commission Act, R.S.A. 1980, c. W-6.

Approval of any project affecting both air and water quality is required under the Clean Air Act, R.S.A. 1980, c. C-12, and the Clean Water Act, R.S.A. 1980, c. C-13. Permits and approvals under the Director of Standards and Approvals is required and minimum air and water quality standards must be maintained. Measures taken to maintain the standards are left up to the operator, with frequent inspection reports to ensure the standards are maintained.

Clearing of forest lands will be required for both dam site, reservoir and also transmission line right of way. Under the Forest Act R.S.A 1980, c. F-16, approval for any timber cutting is required from the Minister of Energy and Natural Resources. A clearing plan and a re-forestation program, if required, must be formulated prior to approval. Only clearing around the dam site would require re-forestation as the reservoir area will be inundated, and access to and clearance around the transmission route is necessary.

The heritage resources in the area of the Slave River project are protected under the Historical Resources Act,

R.S.A. 1980, c. H-8. Regulations are set up to prohibit or regulate and control the use, development or occupation of land or buildings designated as being historic. Also, marking, damaging or altering an archaeological or paleontological resource is prohibited unless a valid permit is issued or ministerial permission is received. The Slave River rapids and surrounding project area have not been designated as historic, but the heritage resources are protected under the Act, prohibiting damage to such resources.

An environmental impact assessment report may be required to be submitted to the Minister of the Environment when a proposed operation is likely to result in a surface disturbance. The Land Surface Conservation and Reclamation Act, R.S.A. 1980, c. L-3, establishes the basic format for environmental impact assessments in the province. More detailed guidelines pertaining to the preparation of environmental impact assessments have been published in order to aid the proponents of proposed developments in meeting the goals of the assessment (Alberta Environment, 1977).

In the past, much of the legal and regulatory approval under Alberta statutes and government departments has been co-ordinated by one regulatory organization, the ERCB (Alberta Government, 1982). The purpose of this was to avoid duplication of effort and avoiding the possibility of approvals being overlooked. The ERCB has published guidelines for the preparation of an environmental impact assessment,

taking in to account the various departmental mandates, and requirements and regulatory approvals (Pearce, 1984).

4.4 JURISDICTIONAL HOLES, OVERLAP AND POSSIBLE CONFLICT

The most obvious area of jurisdictional overlap lies in the area of environmental impact assessment. Both provincial (ERCB, 1984) and federal (FEARO, 1982) departments concerned with the assessment process have published guidelines with respect to assessing the impacts of the proposed Slave River Hydro project. In order to possibly reduce conflict, the most recent guidelines published (a joint Alberta/Federal document published in 2 separate sections) contained several compromises on the federal side. Now, a section pertaining to the need for the project will be assessed by provincial authorities only. It is felt that with the information from an environmental impact assessment being public, the federal government will be able to analyze the material for their own assessment (Environmental Law Centre, 1984).

An apparent hole and possible conflict in the legal framework surrounding the Slave River Hydro project exists with respect to the Slave River White Pelican Colony, one of six remaining in the province. Pelicans are not listed as protected birds under the Migratory Birds Convention Act. In 1977 the Government of Alberta enacted legislation to secure its last few pelican colonies, however the Slave River

colony was not protected because it is considered to be a "special case". The colony could not be protected because the area was designated as a Hydro Reserve in 1944 and remains that until this status is lifted (Griffiths, 1980), thus blocking the formation of a wildlife sanctuary or ecological reserve. Under the Canada Wildlife Act pelicans were placed on the list of threatened or endangered birds in 1980. Hunting, possession, pursuing, stalking, trapping or molesting them is now forbidden. Conflict could arise as a result of a bird considered to be endangered by federal authorities, in a provincial area slated for future hydro development. Whether development at the Smith Rapids could be stopped by the pelican colony remains to be seen. Some sort of conflict seems unavoidable.

The legal framework surrounding the Slave River Hydro project is complex and somewhat confusing. Because the province of Alberta is the owner of the resource it has central responsibility for regulation of the project and any possible environmental effects (Environmental Law Centre, 1984). There are specific interests under federal jurisdiction that can act as a barrier in the regulatory approval process (Geddes, 1982b) (i.e. Migratory Birds Convention Act, Indian Act, National Parks Act). Percy (1982) feels it is of utmost importance to work out agreements prior to major developments on inter-provincial waters rather than let the courts deal with these interjurisdictional problems.

Federal legislation, such as the Canada Wildlife Act and Canada Water Act could be utilized to smooth out jurisdictional problems, with agreements between all levels of government involved.

Chapter V

EIA AND THE ANTICIPATED EIA PROCESS

5.1 INTRODUCTION

Environmental impact assessment (EIA) is defined " as a means of identifying, predicting and evaluating the environmental effects of projects, plans and policies using systematic interdisciplinary analysis at a stage where environmental damage can be minimized or avoided" (Armour, 1977). EIA is not the only tool utilized in the decision-making process of project planning, but is oriented towards consideration of possible environmental impact or damage. "Go" or "no go" decisions regarding a project rarely hinge on the results of an environmental impact assessment, rather these results may help decide if the project is feasible to undertake.

EIA, as a method to evaluate projects, arose from inadequacies presented by previous methodologies. Benefit-cost analysis and cost-effectiveness analysis were precursors to EIA, but fell short of meeting requirements regulatory agencies demanded. These methods listed the gains and losses of a particular project by attaching monetary values to various aspects, but were unable to account for aspects of the environment that are difficult to quantify.

In the past, insufficient attention has been paid to the environmental aspects of developing major energy projects in Canada. Pressure from an environmentally informed public sector in Canada has helped form the basis of EIAs in the country. Prior to this movement, many projects were poorly planned, resulting in serious negative impacts (Reynolds and Ujjainwalla , 1981). For example, the James Bay hydroelectric project environmental studies were undertaken once project development was underway (Reynolds and Ujjainwalla, 1981). In this and other projects, environmental impacts of development were examined as an after the project occurrence, when it was too late to make alterations to the project configuration, with intent of minimizing negative impacts (Reynolds and Ujjainwalla 1981).

Before development on the Slave River is able to proceed, a proponent must prepare a detailed EIA, followed by review and critique of the document. As owner of the resource (the Slave River in Alberta), by virtue of the Natural Resource Transfer Agreement of 1930, the province is responsible for initiating studies leading up to release of an environmental impact assessment (Environmental Law Centre, 1984). Due to federal jurisdictions in the area, the federal government may also enter into the EIA proceedings (Environmental Assessment Panel, 1982).

In contrast to smaller projects, such as oil refineries and gas plants, the area potentially affected by developing

the Slave River for hydroelectric purposes is large. Areas that may be impacted stretch from the damsite on the Alberta/ NWT border, south to Lake Athabasca and along the route of the transmission lines. North of the damsite, impacts of development could be felt in the Slave River Delta and Great Slave Lake, and also could extend to the Mackenzie River system. Due to the size of the project area, information requirements are large. Both federal (Environmental Assessment Panel, 1982) and provincial governments (Canada/Alberta, 1984) have published draft information requirements for the preparation of an environmental impact assessment of the proposed project. This chapter describes briefly the anticipated environmental impact assessment (EIA) process for this project and evaluates available information in light of information requirements established by federal and provincial authorities for the Slave River project.

5.2 ANTICIPATED EIA PROCESS FOR THE PROJECT

In light of the somewhat confusing legal implications surrounding the project, the EIA process leading to regulatory and construction approval may also present the same sort of problems. The two major potential participants in this process are the Government of Alberta and the Federal Government. Because of potential effects in Saskatchewan and the Northwest Territories, these governments could press for their requirements for an EIA to be met in separate pro-

ceedings. As a measure to increase the efficiency of the process and reduce duplication of effort territorial concerns have been encorporated with the federal EIA requirements. Saskatchewan's information needs have been included in Alberta requirements for project approval (Canada/Alberta, 1984).

For an EIA, a proponent is expected to meet information needs which may be broken down to a number of distinct units. First, technical aspects of the project, such as construction details, layout considerations, and economic considerations must be presented, making it possible to integrate such considerations with those of the environment.

Second, the proponent must gather and present baseline environmental information on the project area, that is, condition of the environment before construction. Because land far up and downstream of development may be affected, the project area is not just confined to the area around the damsite and reservoir. Thus, the project area is considered to stretch as far as the impacts of development on the Slave River do.

Third, it is expected of the proponent that possible environmental impacts of development be considered. Not only are impacts on the physical and biological environment considered, but impacts on the socio-economic environment must also be included in this section of the EIA. Definition of

the environment as consisting of physical, biological and sociological entities requires considering socio-economic impacts in conjunction with more traditional impacts on physical and biological aspects.

A fourth information requirement for the EIA process is prediction of environmental conditions without the project, used as a comparison to those with the project. Computer simulation, given past environmental information, often allows this to be undertaken. Condition of the environment without the project is not necessarily that of baseline, therefore this is a necessary information requirement (Duffy, 1975).

Another information requirement for an EIA for the Slave River project is what steps will be taken to mitigate possible impacts. Methods for identification of impacts that are unable to be mitigated must be outlined. Also, proposals for monitoring of residual impacts and compensation must be outlined in this section.

Before, during and after the information gathering it is expected that consultation with the public is to take place. Hearings in the project region, as well as in southern centres will be necessary to complete regulatory approval. Public participation in all phases of an EIA is recognized as a key factor in the process. Modifications to information requirements and EIA results may occur from interaction between the public sector and the proponent.

Meeting EIA needs and requirements does not necessarily lead to acceptance of the environmental impact statement (EIS) and commencement of construction. Detailed review of the EIS by an appointed panel (federal, provincial or both) eventually will help decide the fate of the proposed project. Approval may be denied, accepted, or accepted subject to the proponent meeting certain criteria before proceeding with the construction phase of the project.

At the moment it is unclear which agency (federal or provincial or both) will coordinate regulatory review of the project. Most people involved with the regulatory review of the project agree a joint federal/provincial panel must be formed to successfully carry out a review of environmental impacts surrounding Slave River Hydro construction and operation. When there is renewed interest in the viability of the project, it is expected that federal and provincial authorities will hold a joint review of the project (Pearce, 1984). Until such a time there exists two sets of guidelines for the preparation of an EIA for the Slave River Hydro project, one meeting current federal information requirements and the other meeting provincial information requirements. Ease of the regulatory process depends on combination of the two sets of information requirements.

5.3 FEDERAL EIA GUIDELINES

In 1977 a Federal Cabinet Directive established the basis for EIA at the federal level. The purpose of the Environmental Assessment and Review Process (EARP) is to ensure that the environmental consequences of all federal projects, programs and activities are assessed before final decisions are made and to encorporate these results into planning and decision-making (Couch, 1982). The process is essentially one of self-assessment in the initial stages, with the project proponent being responsible for providing initial information regarding possible environmental effects of the project. If impacts of the project are deemed high, the project must undergo more formal review. An environmental assessment panel pertaining to the project in question is appointed. This panel has the responsibility of publishing guidelines for a more formal environmental impact assessment. Proponents are expected to follow these guidelines, leading to panel review of the EIS and recommendations for the future of the project.

Federal participation in the EIA process began early in 1980 when Parks Canada formally referred the Slave River Hydro Project to the Federal Environmental Assessment and Review Office (FEARO) (Falk, 1982b). At the time of referal the government of Alberta, Transalta Utilities and Alberta Power were in the middle of a 2 year, $10 million feasibility study to determine if development on the Slave River was

technically, economically and environmentally feasible (Geddes, 1982a).

Initial concerns were those relating to the integrity of Wood Buffalo National Park. Parks Canada's primary concern was that land within Wood Buffalo National Park might be lost as a result of flooding that may result from construction and operation of a dam on the Slave River (Environmental Law Centre, 1984). Other concerns included further impairment of water levels in the Peace-Athabasca Delta, potential effects on endangered whooping cranes that nest in the park, effects on migratory birds and the potential for altered groundwater flow in the park (Falk, 1982b). Potential environmental effects extend beyond the park also. Effects on commercial fisheries on Lake Athabasca and Great Slave Lake have emerged as issues to be addressed in an EIA. Loss of traditional land use by native people through flooding or other detrimental effects is another issue of federal concern.

Shortly after referal of the Slave River project to FEARO, an environmental assessment panel (EAP), a group of experts selected on the basis of their knowledge and expertise of the project under review, was appointed. The role of the EAP is to issue specific guidelines which must be used in the preparation of an EIS. Also, the EAP reviews information in an EIA, looking at environmental and related implications of the project, and reports back to the Federal

Minister of the Environment (Falk, 1982a). The report contains recommendations concerning the fate of the project-acceptance, acceptance under certain conditions, or refusal of further project development.

On August 9, 1982 the Government of Alberta released the final report of the Slave River Hydro Feasibility Study. The study stated that it was technically, economically and environmentally feasible to develop the Slave River for hydroelectric purposes at a number of different sites. Plans for immediate undertaking of further engineering and environmental studies were announced at that time.

In response to this the EAP released draft guidelines for the preparation of an EIS pertaining to the project (Environmental Assessment Panel, 1982). Written comments were solicited on these guidelines, and a series of public hearings conducted in the project area and in Edmonton (Falk, 1982a). Public consultation resulted in refinement of the original guidelines, encompassing concerns highlighted in the hearings. The refined guidelines for federal EIA preparation were released in April of 1984, along with requirements for the province of Alberta (Canada/Alberta, 1984). Information required for preparation of an EIS are as follows:

1. Electricity demand, project alternatives and associated projects

a) Project plan alternatives

b) Associated projects and developments

2. The project proposal

a) General layout

b) Site preparation and construction details

c) Operation and maintenance

d) Abandonment

3. Description of the existing environment and resource use

a) Physical environment

b) Biological environment

c) Socio-economic environment, including use of the resources

4. Environmental and social impacts and mitigating measures

a) Effects on the physical environment

i) Climate and air quality

ii) Terrain

iii) Hydrology and water quality

b) Effects on the biological environment

c) Effects on the socio-economic environment

5. Residual impacts

6. Monitoring

7. Summary and conclusions

(Canada/Alberta, 1984).

These guidelines are by no means finalized and will be subject to further refinement when renewed interest is shown in developing the Slave River for hydroelectric purposes. Emergence of a proponent or indication that the project will proceed to the regulatory process will lead to modification of the information needed against a more clearly defined project description (Canada/Alberta, 1984). A single integrated set of guidelines, a joint ERCB/FEARO document is expected to be developed (Pearce, 1984) once development is reconsidered.

It is evident from the legal framework, from the presence of federal lands in the project region and from possible environmental impacts in the area that the federal government will be represented in EIA proceedings for the Slave River project. Possible impacts on federal jurisdictions are sufficient to warrant a separate review, but to decrease duplication and to aid the process they will likely be reviewed along with provincial environmental concerns. The detail in which federal concerns are dealt with depends whether or not the government presses its legal authority, outlined in the previous chapter.

5.4 PROVINCIAL EIA GUIDELINES

The legislative authority governing the preparation and submission of EIAs in Alberta is contained in the Land Surface Conservation and Reclamation Act, 1973 (Alberta Environment, 1977). Authority to order preparation and submission of reports assessing environmental impacts of proposed developments rests with the Department of the Environment. The purpose of the provincial EIA process is to facilitate the early identification and resolution of potentially significant environmental effects of natural resource development projects on the biophysical and human environment (Couch, 1983). While it is the responsibility of the project proponent to seek clarification from the Minister of the Environment if an EIA is required, projects may also be referred from the public, other elected representatives or other provincial agencies (Couch, 1982).

Guidelines for the preparation of environmental impact assessments in the province have been published in order to aid proponents of proposed developments in meeting the goals of the assessment (Alberta Environment, 1977). In April of 1984 the Alberta Energy Resources Conservation Board (ERCB) and Alberta Environment released draft guidelines pertaining to the Slave River project. It was recognized that license approval for other Alberta legislation is required, but this requirement was not incorporated in the guidelines for the preparation of an EIA (Canada/Alberta, 1984). Other approv-

als required were mentioned briefly in the section pertaining to provincial legislation. Much like the federal EIA process, refinement of these guidelines is expected when further steps are taken in the planning and regulatory process.

5.5 POSSIBLE PROBLEMS WITH THE EIA PROCESS

Current guidelines and information requirements for the preparation of an EIA for the Slave River project are not in a form considered useful to a proponent. As mentioned earlier, the two sets of guidelines (federal and provincial), unless combined will result in much duplication of effort. Steps have been taken to combine both review of the project from an EIA guidelines standpoint and coordinated panel review and public participation (Canada/Alberta, 1984). Reduction of the number of review processes through harmonization of such procedures has been recently recommended by the Royal Commission on the Economic Union and Development Prospects for Canada (Canada, Government of, 1985) as a means of remedying "regulatory lags". Fate of the project in the future will dictate the next step taken with regard to Alberta and the federal government combining forces for environmental review of the project. Both levels of government are willing to cooperate in order to relieve possible overlap in the EIA process. Further steps towards governmental co-operation will likely occur when further interest is shown in the project.

A potential problem exists in the very nature of the EIA pertaining to the project. Whether or not an EIA is carried out will depend on whether or not the project will be seriously be considered. The prevailing attitude seems to be one that treats the EIA process as a formality prior to commencement of construction. In fact, it is possible that regulatory approval will not be granted because impacts of development may be deemed too high, even with outlined mitigating measures. An EIA should not be used to justify the project. If utilized in the manner intended, an EIA pertaining to the Slave River Hydro project can become a meaningful decision making tool in the planning process for possible development.

Potential proponents (the Alberta government and the two power utilities) have advocated choosing a site with which to base environmental impact studies around (Alberta Government, 1982). Perhaps a more useful approach is to use EIA in the planning procedure with which to choose the best site for development from both environmental and engineering standpoints. While involving additional cost, this approach may reduce long term costs, making the project more economically viable.

Chapter VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 SUMMARY

The proposed Slave River project offers approximately an additional 2000 MW of electrical generating capacity to Albertans, at a capital cost of $2.5 billion (1982 dollars). Projected construction time for the project is 7 years, with 2 to 3 years allotted before construction, for regulatory approval. Siting of the dam extremely important. The further downstream construction takes place, the higher its generating capacity, because higher reservoir forebays can be achieved. The magnitude of environmental impacts also depends on site location. No preferred alternative of the three possible sites outlined has been suggested.

Decisions on developing the hydroelectric potential of the Slave River are not ones of yes or no, for development. First, it must be determined if there is demand for the electrical power that would be supplied if the project were constructed. Alternative means of generating electrical power must be considered prior to consideration of the Slave River project as a viable alternative. Other means include coal-fired thermal generating plants, nuclear generating

plants, obtaining power through the Western Power Grid (plans for such a scheme have never materialized) and new technologies in the field of electrical energy production. At the end of August, 1985, a decision was made to halt further development planning because electrical outputs from the Slave River would far exceed projected future demand. Commissioning of two coal-fired thermal generating plants was also delayed because of decreased demand. Environmental impacts of development on the Slave River must be determined, weighed against those of alternatives to the project, and evaluated in terms of costs to mitigate impacts relative to the cost of the project.

The federal government has several jurisdictional mandates pertaining to the environment in the area potentially affected by the Slave River project. Responsibilities are Wood Buffalo National Park, migratory birds, federally controlled native lands, and commercial fisheries in Lake Athabasca and Great Slave Lake. Of greatest concern are possible impacts on Wood Buffalo National Park and maintaining the integrity of the park. It is possible to develop the Slave River in such a manner that there are no direct effects on the park, but this reduces power benefits, and thus the economic attractiveness of the project.

Depending on the operating regime chosen there may be a varying degree of impact on the commercial fisheries on Lake Athabasca and Great Slave Lake. Overexploitation of fish

stocks has already lead to collapse of the Peace-Athabasca Delta commercial fishery and quantity of catch is lower in Lake Athabasca because of poor quality fish stock. Fish spawn in the Slave River and migrate downstream to Great Slave Lake. Damming the Slave River may impede the movement of migrating fish, and important fish habitat could be destroyed.

If an operating regime is chosen that alters water levels in the Peace-Athabasca Delta, the Fort Chipewyan Indian Band will be directly affected. Five per cent of the delta lies within this band's reservation (I.R. 201). The surrounding land is used heavily for subsistence hunting, fishing and trapping. Impacts that impair traditional land use in this area, and also in similar areas used by native people, are considered serious and must be dealt with prior to regulatory approval.

The existing federal legal framework serves to ensure areas under federal jurisdiction are adequately protected. Federal departments having jurisdiction in the area include Environment Canada, the Department of Indian and Northern Affairs, the Department of Fisheries and Oceans, and Transport Canada. Environment Canada has the most jurisdiction pertaining to possible environmental impacts of the Slave River project. Perhaps the most powerful legislation is the National Parks Act, with a mandate to preserve and protect the Canada's national parks for future use and enjoyment by

Canadians. Hydroelectric developments are not compatible with provisions in the National Parks Act because flooding and impairment of the natural environment are not considered to be authorized uses of national park lands.

An EIA for the project will be required prior to approval of construction. Federal concerns will be addressed in a joint federal/Alberta review of possible impacts of development. Two sets of guidelines pertaining to assessing impacts of development exist (federal and provincial) and these are expected to be combined for assessment and review purposes. The extent to which federal concerns are considered in the review process will depend on whether or not its legal mandates are pressed. As one of the decision-making tools in further planning and development, EIA must relate technical aspects of the project to possible environmental effects, suggesting mitigating measures to alleviate impacts.

6.2 CONCLUSIONS

The conclusions that follow are the result of consideration of environmental, technical, legal and practical aspects of the proposed Slave River Hydro project.

1. No preferred project configuration has been indicated and as a result, it is difficult to ascertain the extent of possible environmental impact on lands and people under federal jurisdiction.

2. Land and people under federal jurisdiction will likely be affected as a result of development on the Slave River, but the extent of impacts is a range of possibilities at the moment. These include Wood Buffalo National Park, migratory birds, fisheries in Lake Athabasca and Great Slave Lake, and native lands and traditional land use.
3. There is considerable overlap with respect to legal jurisdiction pertaining to the project. Both federal and provincial jurisdiction is pertinent in some instances and there exists conflict in some jurisdictions.
4. Both federal and provincial authorities require environmental impact assessment as a part of the regulatory approval process for the project. It seems necessary to combine the two sets of information requirements to maximize efficiency of the process.
5. Environment Canada has not taken a definitive stance with respect to the project. The natural environment may be maintained in its present state or attempted to be restored to a past state. Environment Canada's position with respect to the project will be more clear when either of these options are exercised.

6.3 RECOMMENDATIONS

Recommendations made consider one accounting stance, that of Environment Canada.

1. Instead of choosing a preferred project alternative prior to the environmental impact assessment and regulatory process, a site should be chosen as a result of the process. This will allow complete consideration of possible environmental impacts with technical and engineering studies. Potential project proponents have not indicated such a process will take place; rather they consider a specific site should be chosen first.
2. Environmental impacts on lands under federal jurisdiction should not be permitted. No flooding of land in Wood Buffalo National Park will occur at forebay levels up to 200 m a.s.l.. Land adjacent to the Slave River above this level is critical year round bison habitat that cannot be replaced by similar land outside park boundaries. It is recommended a project proponent consider this alternative as a means around some of the complex legal arrangements.
3. Plans to operate the proposed development above levels of 200 m a.s.l. should be met with opposition using the appropriate legal framework (i.e. National Parks Act, Fisheries Act, Dominion Water Power Act, etc.).

4. It is recommended that the route for the transmission corridor skirt lands under federal jurisdiction. This includes Wood Buffalo National Park and the Peace-Athabasca Delta, and the Fort Chipewyan Indian Reserve. Choosing such a route would minimize impacts in ecologically sensitive areas and at the same time, reduce possible federal/provincial jurisdictional conflict. While viewed as less feasible, power lines crossing Lake Athabasca should be viewed as a viable alternative.
5. Jurisdictional overlap and conflict between the governments of Canada and Alberta should be resolved before the regulatory process takes place. Federal legislation, such as the Canada Water Act and Canada Wildlife Act allows formation of federal/provincial agreements with respect to managing these natural resources. Steps should be taken to formulate an agreement with respect to managing these resources in the Slave River Hydro project.
6. It is recommended that federal and provincial authorities actively pursue combining their individual information requirements for an environmental impact assessment.
7. A neutral stance should be taken with respect to an EIA. The process should not be applied to justify the project; rather it should review impacts of the project from an independent point of view. EIA is

just one of the tools in the regulatory process, whose final results are considered with those of the other tools.

8. Environment Canada's stance should be one of maintaining the natural environment as it is today as opposed restoring it to a past state. Given this stance, an operating regime of 200 m a.s.l. or less is recommended for the dam. This regime offers the least amount of environmental damage to areas under federal jurisdiction. Manipulation of water levels in the Peace-Athabasca Delta is not possible without employing a gated control structure on the Riveire des Rochers and one is not recommended. Taking a stance of maintenance of the present environment requires past damage in the delta (as a result of the WAC Bennett Dam) to be left, allowing this environment to continue changing in a natural fashion. Attempts to manipulate the delta may result in further damage.

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Appendix A

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