DICKEY LINCOLN

STUDY OF IMPACT REPORT

AND CONSIDERATIONS ON

AFFECTED ZONES IN QUEBEC

PRESENTATION

This document includes a short description of affected zones in Quebec, and an analysis of the impact report prepared by the U.S. Corps of Engineers in August 1977, in addition to a list of parameters to be considered for a study of environmental repercussions of the Dickey reservoir in the Quebec region. Government information sources are identified and the data now available concerning the whole basin of the St. John River in Quebec and adjacent territories completes that work.

The impact report had been distributed to the persons in charge of impact evaluations of the S.G.E. branches, and the analysis was followed by a discussion on November 4, 1977, in which the following persons took part :

Messrs.	H. Leblanc	Forest Branch
	D. Lehoux	Fauna Branch
	Y. Vigneault	Inland Waters Branch
	M. Couture	Inland Waters Branch
Mrs.	Lise Bernier-Arcand	Inland Waters Branch

Mrs. Lise Bernier-Arcand has prepared the bibliography, and Mr. Claude St-Charles had prepared a summary plan of environmental repercussion studies.

Marcel Couture,
Inland Waters Branch,
Quebec Region.

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I - SUMMARY DESCRIPTION OF FLOODED AREAS IN QUEBEC

The Dickey reservoir will directly flood more than 4,000 acres of land along the St. Roch River in the county of L'Islet, the brook at Eau Claire and the Petite Rivière Noire in the county of Kamouraska.

Table I presents the main characteristics of the flooded territory:

Table I - Characteristics of flooded areas

	St. Roch River	Brook at Eau Claire	Petite Rivière Noire
County	L'Islet	Kamouraska	Kamouraska
- Area (acres	Approx. 1 200	Approx. 600	Approx. 2 200
- Length (miles)	6.5	2.5	5.0
- Minimum elevation (Water at border)	885	885	870
- Highways affected	4 ranges and 6 roads	Logging roads and 2 bridges	
- Buildings affected	Approx. 10	None	Approx. 3
- Utilization of land	Forest and Agriculture	Forest	Forest
- Logging concession	None	Yes	Yes
- Mining concession	None	None	None
- Hunting	Yes	Yes (deer)	Yes (deer)
- Fishing	Yes	-	Yes
- Tenure of land			
- Crown lands	11%	100%	100%
- Private property	89%		

St. Roch River area

The cleared parts of the flooded area bordering the St. Roch River are used for agricultural purposes. However, the use of the land for that purpose appears to be very marginal in the valley itself of the river. Four (4) concession roads will be cut by the reservoir, including a very important one connecting the villages of Saint-Pamphile and Saint-Omer.

Logging operations (woodcutting, transportation, sawmill and doors and sash factory) constitute the main source of income for the inhabitants of the Saint-Pamphile region. The forests of Maine supply a large part of the wood used by the industries located in Saint-Pamphile. Access roads have been built over distance of up to 60 miles inland across the American border. The first consequence of the construction of the Dickey reservoir will be to substantially limit access to forests in the state of Maine, thus reducing the economic activity of the Saint-Pamphile region.

Rivière Noire and Eau Claire area

The areas to be flooded are completely covered with timber and are used for logging and for hunting. The area is accessible through logging roads which will be cut by the reservoir. Moreover, a few maple groves on the hill located between the two (2) branches (Rivière Noire and Eau Claire) will be isolated by the flooding of the territory. Deer hunting is extensively carried on in

the area. It will be in order to evaluate what repercussion the filling of the reservoir will have on the migrations of ungulates.

It is interesting to note that a study of the region of Saint-Pamphile and of Petite Rivière Noire had already been conducted in the beginning of the sixties with a view to setting up a provincial or regional park.

II - ANALYSIS OF EVALUATION OF IMPACTS PREPARED BY THE U.S. CORPS OF ENGINEERS

The impact report (EIS - August 1977) prepared by the U.S. Corps of Engineers deals with environmental repercussions on the American territory. However, several factors considered in that study are also liable to affect the Quebec region. That is why we shall analyze in this chapter all the elements considered in the American impact report covering directly or indirectly the Canadian territory located above the Dickey reservoir.

1. Floods and level fluctuations (sections 1.08.1 and 5.02)

At the maximum planned elevation of 910 (geodesic elevation), the Dickey reservoir will directly flood 4,047 acres of land in Quebec (see table 2). Moreover, it must be expected that the phreatic water level will be raised and that erosion problems will occur, thus increasing the area affected by the reservoir.

Table 2 - Area and volume of reservoir based on the level (data provided by the U.S. Corps of Engineers)

	UNITED STATES		QUEBEC	
Elevation	Area (acres)	Volume (ft-acres)	Area (acres)	Volume (ft-acres)
910	81 979	7 642 332	4 047	65 189
900	75 500	6 856 178	2 493	32 251
890	68 376	6 137 252	1 451	13 248
880	61 472	5 490 543	814	2 561
870	54 849	4 910 347	33	24
860	48 872	4 393 611	0	0

In Quebec, fluctuations in the level will have important consequences since large areas will emerge during certain periods of the year. During the summer (June to October), normal variations in the level will not exceed two (2) feet and the emerged area will represent about 350 acres. However, the maximum level of 910 will not be reached each year (simulation indicates that the level is obtained approximately 50% of the time), and it must therefore be anticipated that the emerged zones will be larger during the summer. At the end of the winter with the expected normal drop of 22 feet, the area of exposed territory will reach 2,700 acres, namely close to 70% of the total flooded area in Quebec. The drop of the level to the minimum elevation of operation (El 868) will completely drain away the water stored in Quebec.

2. Relocation of roads (Design Memorandum No. 4A, pp 113, 114)

Five (5) roads and six (6) bridges cross the St. Roch River valley in Quebec, as well as a logging road in the Petite Rivière Noire area. The Americans have determined that the works would be affected, basing themselves on a minimum elevation of 915 for the roads and of 920 for the bridges in order to permit yatchting.

Tables 3 and 4 present the characteristics of the bridges and roads as provided by the Department of Transport to the American engineers.

Table 3 - Bridges

No.	Type	Span	Length	Level of roadway (approx. Geo. El)
1.	Wooden roadway Steel structure Concrete abutments	63	28.5	902
2.	Concrete	120	30	906
3.	Concrete	75	30	905
4.	Steel and concrete	85	20	911
5.	Concrete	25	24	912
6.	Steel and wood	30	20	915

The number refers to the location map (Plate 4A-3).

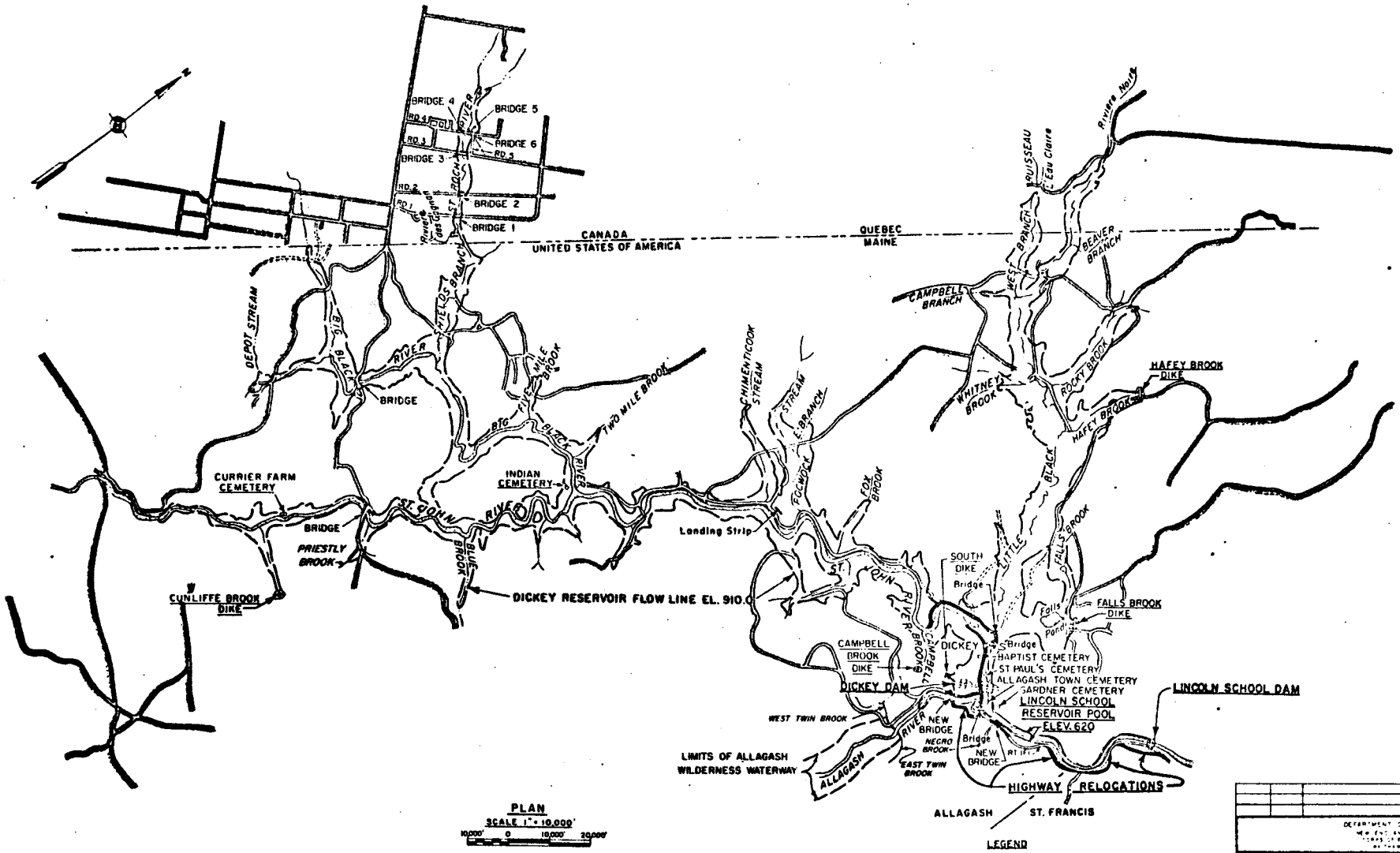
Table 4 - Roads

No.	Surface	Length affected (approx.) (ft)
1	Gravel	2,200
2	Gravel	2,500
3.	Asphalt	2,000
4.	Gravel	5,000
5.	Gravel	500

3. Aquatic environment

- Quality of water (2.07, 4.05.1.1)

Measurements were taken from the spring to the fall in 1975 and 1976.



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WATER RESOURCES DEVELOPMENT PROJECT
SAINT JOHN RIVER BASIN, MAINE
DICKEY-LINCOLN SCHOOL LAKES
HIGHWAY & CEMETERY
RELOCATIONS

APPROVED DATE

SCALE AS SHOWN SPEC NO

PLATE 4A-3

In addition to the work done by laboratories of the U.S. Corps of Engineers, EPA, USGY, DEP, the Department of Natural Resources of Quebec has conducted a certain number of analyses.

The Petite Rivière Noire, Grande Rivière Noire and Allagash River had the highest levels of turbidity. The turbidity of the Grande Rivière Noire would be caused by the developed zone in Quebec, that is the Saint-Pamphile area. For the other tributaries, logging is the main cause.

The highest concentrations of nutritive elements were measured in the Grande Rivière Noire and Petite Rivière Noire. The probable causes are agriculture in Quebec for the Grande Rivière Noire and logging for the other river.

An analysis of heavy metals has shown that normal concentrations were found for all the elements which were measured except iron, zinc and mercury. As there are no industries in the drainage basin, the presence of those metals in the water is attributed to natural causes (geological origin).

Bacteriological analyses have shown that some contamination is caused by fecal coliforms. The main cause of contamination would be the presence of fur-bearers and household refuse from the inhabited zone in Quebec (Saint-Pamphile).

It is difficult to know what the quality of the water will be in the future reservoir. However, in the shallow areas, the method of clearing the land and the quality of inflow from tributaries will be preponderant factors.

The temparature simulation model is not valid for the shallow areas of the reservoir. The report anticipates that there will be weak dissolved oxygen concentrations (2mg/l) during the summer on account of the higher temperature and the greater biological activity in shallow areas, such as the flooded areas in Quebec. The reservoir clearing practices will affect the quality of water, particularly during the filling up before a chemical equilibrium is reached. The decomposition of organic matter on the bottom will be an important source of nutritive elements which may cause the enriching of the lake and anaerobic conditions at the water-ground interface.

The quality of water has been considered for the whole of the reservoir, but it will be necessary to analyze further the conditions prevailing in shallow areas, such as those anticipated in the Quebec territory.

- Aquatic fauna (2.11, 4.09, 5.02 and Appendix E)

Most of the rivers and brooks support a variable population of trout. In Quebec, 20.4 miles of brooks will be flooded by the Dickey reservoir. Of course, the report anticipates major changes in the aquatic ecosystems.

Phytoplankton will be the main constituent of the primary productivity since aquatic plants (macrophytes, etc.) will not be able to establish roots on account of large fluctuations in the water level (erosion, frost). Extremely large drops in the level during the winter will prevent the development of an important benthonic fauna near the banks, thus annihilating a good part of the species of fishes which spawn during the fall. Those repercussions will be all the more felt in Quebec as large areas will be emerged particularly during the winter. The impact report proposes the stocking of new species of fishes which would adapt to the conditions of the future reservoir; it will be necessary to evaluate possible consequences on the fauna in the tributaries in Canada.

The Dickey reservoir will act as a huge sediment trap. The contamination of inflow by heavy metals, mercury and selenium in particular, as well as the pesticides used in the basin may become more available to living organisms of the lake. The arrival of additional poisons in the food chain may cause restrictions with respect to the consumption of fishes on the one hand and, on the other hand, require more severe controls on the use of pesticides in the St. John River basin, both in Canada and the United States.

4. Land environment

Vegetation (2.12.1, 2.12.2, 4.10.1, 4.10.2)

The basin is covered by a second generation forest which includes spruce,

fir and mixed hardwood. According to the report of U.S. Corps of Engineers, that combination promotes the presence of varied and sometimes unique habitats for plants and for the fauna. That summary description is a priori just as valid for the Canadian territory except for the St. Pamphile area where the site of the future reservoir has to a large extent already been cleared and includes marshland.

In terms of impact, of course, the American report underlines the complete destruction of land vegetation in the depression of the future reservoir and mentions also the elimination of part of the forest near the banks on account of erosion, of the rise of the phreatic water level, of the accrued risk of illness or epidemy and of the dead wood around the lake.

Some endemic species have been identified in the St. John River basin across the American border. It is therefore possible that some also exist in the Quebec territory.

Fauna

More than 50 species of mammals, numerous species of birds and of reptiles have been identified in the future reservoir area. However, deer and moose are the mammals which interest us most. It is estimated that the density of the deer population in that region varies between 2.2 and 8.6 deer/mi^2. Fifty-three (53) deer yards have been counted in the area that will be flooded by the Dickey reservoir. The Department of Tourism, Fish and Game indicates that one 16-deer yard only would be affected in the areas flooded in Quebec. However, the Canadian Wildlife Service believes that it will be necessary to conduct a study of populations as a whole before drawing conclusions on the exact effects of the reservoir on ungulates. "It is possible that of the animals present in winter in the 53 yards in Maine, some of them, at least, are on this side of the border earlier in season". "If that hypothesis were verified, the 50% decrease in the number of deer present within the future basin would result in a decrease of the same order on the Quebec side" (Note of 3-11-77), Denis Lehoux). The impact report of the U.S. Corps of Engineers states that the clearing of timber from the reservoir can have an important effect on the populations of mammals. The latter would be less affected, it appears, if the clearing started from the dam site to the maximum elevation concurrently with the filling up of the reservoir; that procedure would enable the animals to move gradually.

As regards the wildfowl, we shall reproduce here a text prepared by Dehis Lehoux of the Fauna Branch, Quebec Region, which explains the conse-

quences of the establishment of the Dickey reservoir.

Wildfowl

Among the three rivers flooded on the Quebec side of the border, only the Rivière Noire offers some potential for wildfowl (class 5). No in situ inventory data is however available to enable to advance an accurate figure about the number of birds involved. However, inventories conducted farther to the north on rivers of the same class (5 and 6) show us that the latter usually support from 0.3 to 0.5 ind./linear mile. The flooding of 20.4 miles of rivers would therefore have relatively small effects on wildfowl populations. Of course we must suppose that no other river (beaver type river) will suffer from the effects of that flooding.

The wildfowl "population" could be negatively affected as follows :

- flooding of nests in the spring if the water level continues to fluctuate until the middle of June.
- less riparian vegetation and less food available for waterfowl.

The potential beneficial effects would be :

- formation of floating peat bogs which could be used as nesting and rearing sites for species such as the Black Duck, the Ring-necked Duck and the Common Loon. The phenomenon has already been noted in the Cabonga reservoir (S.E.B.J., 1977). In view of the proportion of peat bogs which now exist within the future basin

(2%), we are led to believe however that that new habitat will be a marginal one.

- accrued use of flooded woodland by species such as the Common Goldeneye, the Hooded Merganser and the Wood Duck. Tables 4.10.1 of the report also mention that hypothesis. The two following limiting factors lead us to believe that that phenomenon will also be of little importance.
  a) The arborescent species bordering the reservoir are mostly of the coniferous type. The above-mentioned ducks nest in deciduous trees (holes).
  b) The trees in the areas where the water level fluctuates will probably be dead trees. A study conducted in New Brunswick shows that more than 90% of Wood Ducks and Common Goldeneyes nesting in trees nest in living trees (Prince, 1968).
- possible formation of shallow bays with little change in water level, which would then be the sites which are most used, with the floating peat bogs, inside the basin."

5. CLIMATIC CHANGES

A comparison of the future reservoir with lakes of similar size in the North-Eastern States indicates that the project will not cause any change in the macro-climate. However, on a more local level (meso-climate), some climatic effects can be expected, including :

- local increase in temperature ($1^{o}F$ to $3^{o}F$) when the lake water is warmer than the ambient atmosphere, that is during the fall (November).
- local decrease in temperature ($1^{o}F$ to $3^{o}F$) when the lake water is colder than the ambient atmosphere (May).
- increased fog in the morning during the month of August.

Those effects are greater on the side located in the direction of the wind. The northern sector (Quebec) is favourably located in this case during the summer period.

6. DEVELOPMENT OF RESOURCES

1. Mining resources (2.0.3.4)

A magnetic survey of the region, conducted in 1976, did not register any anomaly that could indicate the presence of minerals. Information exchanged with the Quebec Government (by the U.S. Corps of Engineers) confirmed that there are no known mineral resources in that area.

2. Agriculture

That impact report practically disregards that aspect since there is no agricultural activity directly affected by the project in the United States.

3. Logging operations (1.083.2, 1.09.2.1, 2.09.11, 2.12.2, 4.07.1.9, 4.10.2, 5.02)

The development of the Dickey reservoir will have extremely important consequences on logging operations in the region. That element is undoubtedly the most important one for Quebec since logging operations in the St. John River basin are largely conducted by Quebecers. Access roads to those forests have been developed from Canada and the wood is imported to a large extent here for processing, namely 90% of the sawn timber according to the impact report.

Short term repercussions (During construction)

The clearing of timber from the bottom of the reservoir between elevations 828 and 913, namely an area of 54 000 acres, will put on the market enormous additional quantities of wood. Those effects will be attenuated by the length of the construction period (6 to 8 years) and by the transfer of present logging operations to the area where the reservoir will be located.

On account of that transfer of activities, less attention will be paid to the management and exploitation of surrounding forests. For example, in Quebec this could prevent small wood lot owners from selling their wood because the market might be saturated.

Conifers represent the main species growing on the lowlands, the first to be flooded. As cutting will no longer be selective in the future reservoir area, it is possible that the wood will be used to a greater extent for the production of pulp rather than for sawn timber. That change would affect the Canadian sawing industry located near the border (St. Pamphile, etc.), which imports 90% of the wood cut for this purpose in the St. John River basin, whereas the importation of pulpwood is negligible.

The filling up of the reservoir will cut 75 miles of private logging roads used mainly by Quebecers who engage in logging operations in that region of Maine.

Long term repercussions

More than 80 000 acres of timberland will be eliminated (40 000 to 50 000 cords per year. This does not include 30 000 additional acres, the acquisition of which is planned for the creation of protection zones for the fauna, thus making them inaccessible to the logging industry.

The most productive coniferous forest is located in the lowlands bordering the St. John River and its tributaries. That more productive area, .8 cord/acre/year, as compared with the average growth of .58 cord/acre/year, is completely eliminated.

Logging costs will be higher on the one hand on account of the transportation that is made more difficult because roads have been cut and, on the other hand, because it is more difficult to cut and transport timber in mountanous zones.

There is more hardwood on the higher ground, but that product has a much more limited market, and this may cause economic losses to logging companies and workers.

Finally, the U.S. Corps of Engineers require that there be no intensive cutting on a 300-foot strip bordering the banks of the reservoir in order to prevent the accumulation of debris in the latter.

4. Fish and Game - Recreation (2.13, Appendix)

Hunting constitutes the main recreational activity in that region. In 1975, 8 292 visitors were recorded in the area of the project, approximately 60% of whom came from Quebec and Massachusetts. Fishing is also an important recreational activity in that region, but we have no evaluation of the participation of Quebecers in that activity. Canoeing and wilderness camping are also carried on across the American border.

The creation of the reservoir will have an important impact on deer hunting, the population of which may be reduced by 50% in the area, whereas river fishing will become a lake fish fishing activity. A certain amount of work is planned by Americans to facilitate access to the future reservoir and recreational use. Quebec had already considered, during the 60's, the setting up of a regional park approximately located between the St. Roch River and the brook at Eau Claire, two branches affected by the Dickey reservoir.

III - IMPACT STUDY REQUIRED FOR THE QUEBEC PORTION

This part gives a list of elements of the environment to be considered for a study of the environmental repercussions of the Dickey reservoir in Quebec.

Aquatic environment

Hydrology

- Flow of tributaries
- Effect on water level in brooks across the lake
- Ice problems : (Jams - floods)
- Rise due to wind
- Subterranean waters

For the purpose of evaluating the fluctuation effects, it would be necessary to prepare a chart with contour lines every two (2) feet in the zone located between elevations 868 and 920.

Quality of water

Quality of water during the four (4) seasons (Spring, Summer, Fall and Winter).

Parameters to be considered :

- Bacteriology

- Physico-chemistry
- Major ions
- Nutrivite elements
- Heavy metals
- Fertility

Aquatic fauna and flora

Aquatic fauna:

Ichtyological inventory of all tributaries in the drainage basin on the Quebec side of the border.

Zone affected:

- Benthic fauna
- Aquatic insects
- Semi-aquatic fauna (muskrat, beaver, etc.)
- Waterfowl
- Endemic species

Land environment

Vegetation

- Forest inventory (plant groups and their dynamism)

- Riparian vegetation
- Endemic species

Land fauna

- Large mammals: Ungulates and carnivorous animals
- Small mammals : Avifauna,
  - songbirds
  - birds of prey
- Pollinators
- Reptiles
- Endemic species

Geomorphology

- Geology
- Pedology

Climate

Utilization of resources

Human population

- Jobs - occupation
- Demography
- Displaced population
- Income

Agriculture

- Analysis of agricultural structure
- Income

Forestry

- Present operations
- "Acériculture"
- Cedar groves
- Timber
- Sawn timber
- Pulp
- Maine timber processed in Quebec

Fish and Game

- Modification of cynegenetic and halieutic conditions

Recreation

- Camping, canoeing, loss of access

Transportation

- Highways and bridges

Culture - archeology

Study of other possibilities

1. No floods in Quebec
2. To create stable water plans
3. Lowest maximum level
4. Less important fluctuations

Compensatory improvements

- Improvement of the land habitats in the region

  - Conservation park
  - Protected game zone

- A study of compensatory improvements would require a biophysical inventory on a regional scale.

IV - SOURCES OF INFORMATIONS AND DATA AVAILABLE

1. Departments able to provide information about the territory. Province of Quebec.

- Department of Lands and Forests
- Department of Tourism, Fish and Game
- Department of Natural Resources
- Quebec Development and Planning Office
- Department of Agriculture
- Department of Industry, Trade and Commerce
    - Bureau of Statistics of Quebec
- Quebec Economic Development Office
- Environment Protection Services
- Department of Transport

Federal Government

- Fisheries and Environment Canada
- Department of Mines, Energy and Resources
- Department of Regional Economic Expansion
- Transport Canada

2. Data available concerning the territory draining into the St. John River above the planned reservoir (in Quebec)

Hydrometric data

- Daily flows registered on the Daaquam River, St-013001 since 1967

Data on the quality of water

- Quality of water (DNR analysis, 1976)

Meteorological data

- Measurements of precipitations and of atmospheric temperature are taken at the following stations (1)

- Sainte-Perpétue	-	since 1949
- Saint-Pamphile	-	" 1950
- Rivière bleue	-	" 1950
- Saint-Eleuthère	-	" 1950
- Tour Pelletier	-	" 1968
- Saint-Camille	-	" 1963
- Sainte-Lucie	-	" 1963

(1) Source: Department of Natural Resources, Meteorology Service, Meteorologic Bulletin, 1973 supplement, Quebec, Vol XII, No. 13

Geology and pedology

- Geology of Quebec
- Inventory of lands of Canada

Topographical maps and air photographs

- 1:50,000 scale federal maps
- 1:20,000 scale planimetrical maps (west part)
- 1:15,840 scale planimetrical maps (east part)
- 1:200,000 scale cadastral maps
- 1:40,000 scale air photographs (1966-73)
- 1:31,680 scale air photographs (1956-65)
- 1:20,000 scale air photographs (1973, part only)
- 1:15,840 scale air photographs (1952-62)
- 1:15,000 scale infrared air photographs (1971-74)
- 1:10,000 scale air photographs (1967-74)

Data on forest

- Inventory of the St. John River basin

Data on fauna

- The Department of Tourism, Fish and Game expected to conduct a survey of the land fauna in that area in the summer of 1976.

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