The Fresh Waters of Quebec

97th 1971

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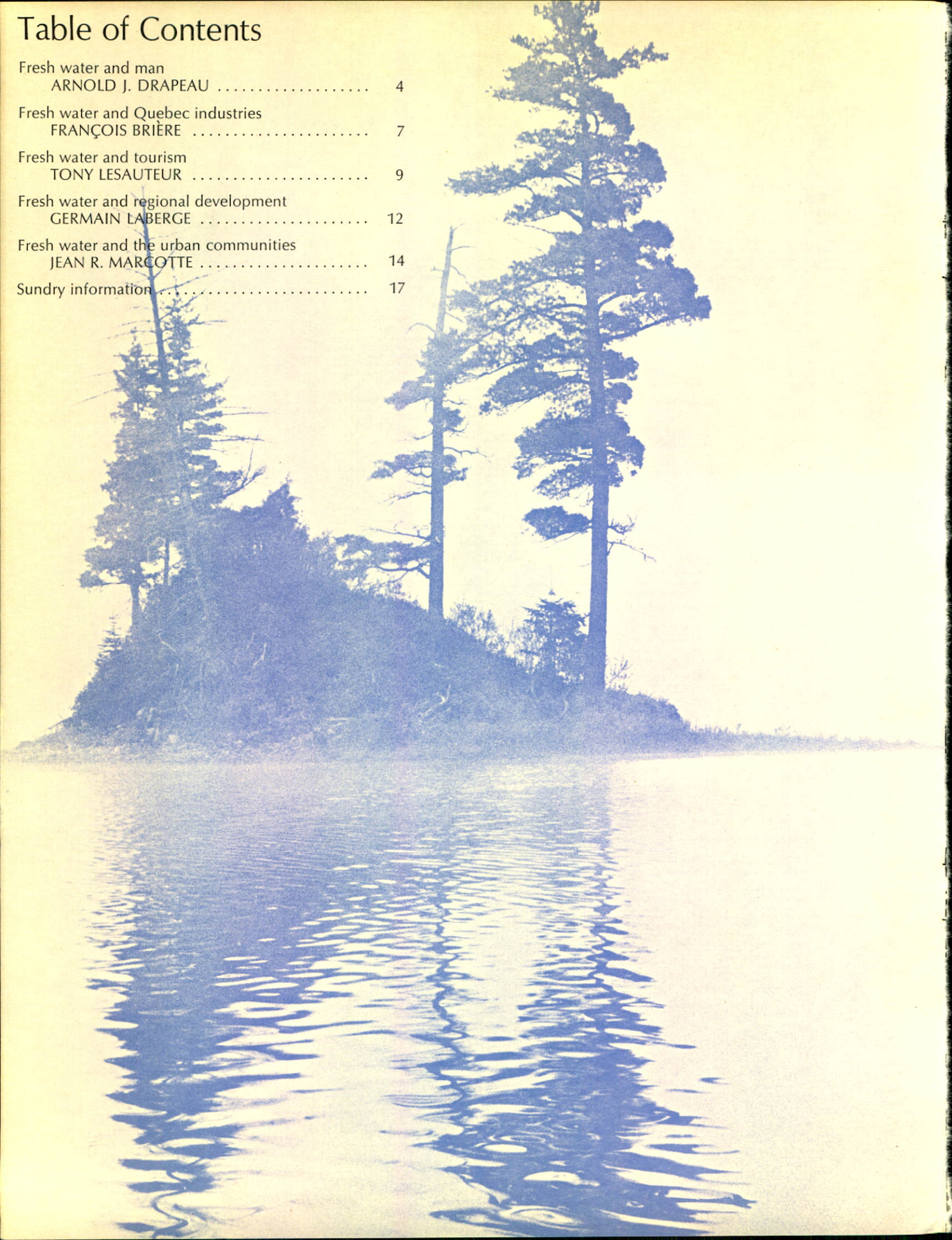


The Fresh Waters of Quebec

Last year at this time we told you something about the Forests of Quebec and their myriad riches — a source of wealth which you could almost say is inexhaustible. This year, the story is about another of Quebec's great natural resources, beyond a doubt even more valuable: our Fresh Waters.

Wherever you visit, wherever you go in Quebec, you are never far from one or more shimmering expanses of water. We have become so accustomed to finding water easily and in abundance that we often fail to realize just how important it is to us. We take for granted every day the water we drink, swim in, wash with and run lavishly through the hose.

We forget that without water we cannot make anything, build anything . . . cannot eat, cannot exist! Since nobody has reminded us until very recently, we even forget that if we had to pay as much for water as it is actually worth to our very survival, then famine, sickness and untold hardships would stalk the land.

Unlike so many parts of the world, Quebec possesses such an abundance of fresh water that we share a moral obligation to do everything in our power to preserve it.

The Management

then into the twilight of primeval chaos
burst the glorious spring of life itself
water—dividing rock from firmament
while centuries of patient tides
carve the shape of continents
and moons and civilizations wax and wane

water—filling pitchers, fountains, oases
enticer of shadows, wooer of flowers
balm for summer's noontide glare
furrowing the paths for seas and dreams
water—breath of the universe
elusive sustenance of Life.

A poem of Guy Robert
adapted by Lesley Kelley-Régnier

Fresh water and man

Arnold J. Drapeau
École Polytechnique de Montréal

100 billion mouths...

It took mankind about eight million years to reach the 300 million population mark. In the next 2,000 years the number climbed to one billion. Then the explosion began in earnest. Just a century later, there were 3½ billions. Less than 30 years from now, in 2000 A.D., the population will have doubled (Fig. 1). By the year 2100, according to the demographers' calculations, 20 billion people will be crowding this planet. The world can support a maximum of only 100 billion people, says E. S. Devy. That's a really disturbing estimate which is going to call for some upsetting decisions in the not too distant future.

The explosion...

This fantastic population growth raises a perplexing question about the limited quantity of fresh water available. People are increasing at a faster rate than is food production. But the amount of fresh water remains practically constant. It might be asked: just where will that lead?

Just a century ago, the world's population was growing at an annual rate of less than one percent. A generation ago, it had reached one percent. Today, it is two percent. Thus, mankind's very survival already looms as one of the most staggering problems to be solved. It will become even graver in future.

A glass of water, or two TV sets...

Without fresh water, nothing can grow. Every year, a large oak tree draws about 40,000 gallons of water from the earth and evaporates it into the air. An acre of corn transfers 3,000 to 4,000 gallons of water into the air every day. Two billion people, about two-thirds of all humanity, already suffer from hunger. Moreover, 500 millions are afflicted by illnesses caused either directly or indirectly by polluted water. Another 300 million people lack enough fresh water to supply their needs. Right here in Canada, in fact, 215,000 of the country's 5,394,000 homes had no running water in 1968. Nevertheless, 953,000 homes had two television sets, 834,000 had two automobiles and 640,000 boasted four or more radios.

The year 2050...

The world's total volume of water, both fresh and salt, amounts to 326 million cubic miles. Of this, 2.5 percent or eight million cubic miles make up the total available reserves of fresh water on the planet. However, some seven million cubic miles of this amount is frozen in the polar ice caps, leaving just one million cubic miles of fresh water available for use either from underground sources, lakes, rivers and streams.

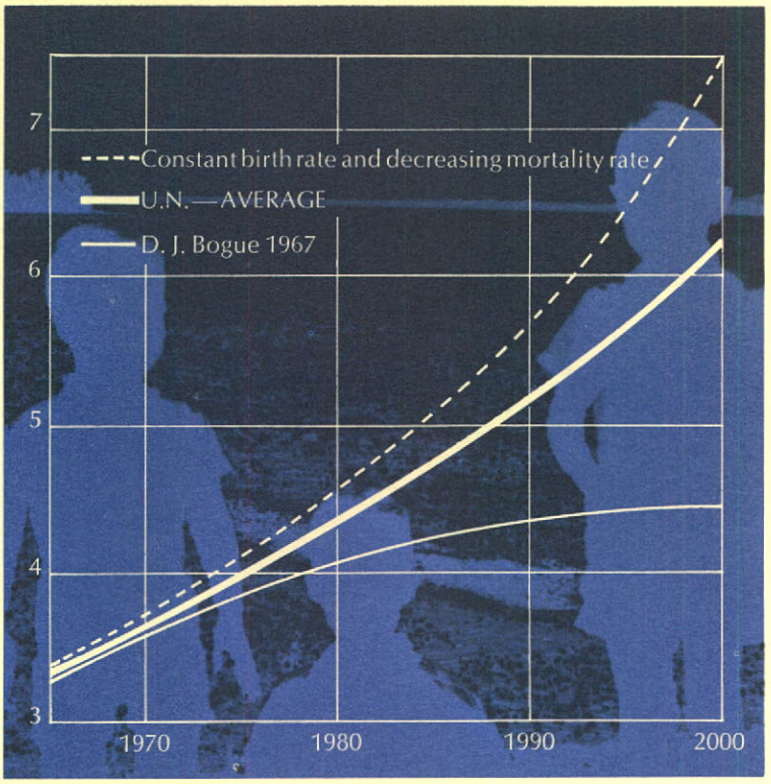
By about the year 2000 almost half of the world's fresh water reserves will be in use. By 2050, rapidly increasing human needs will make it necessary to tap every drop of our planet's theoretically usable water resources.

350 million Quebecers...

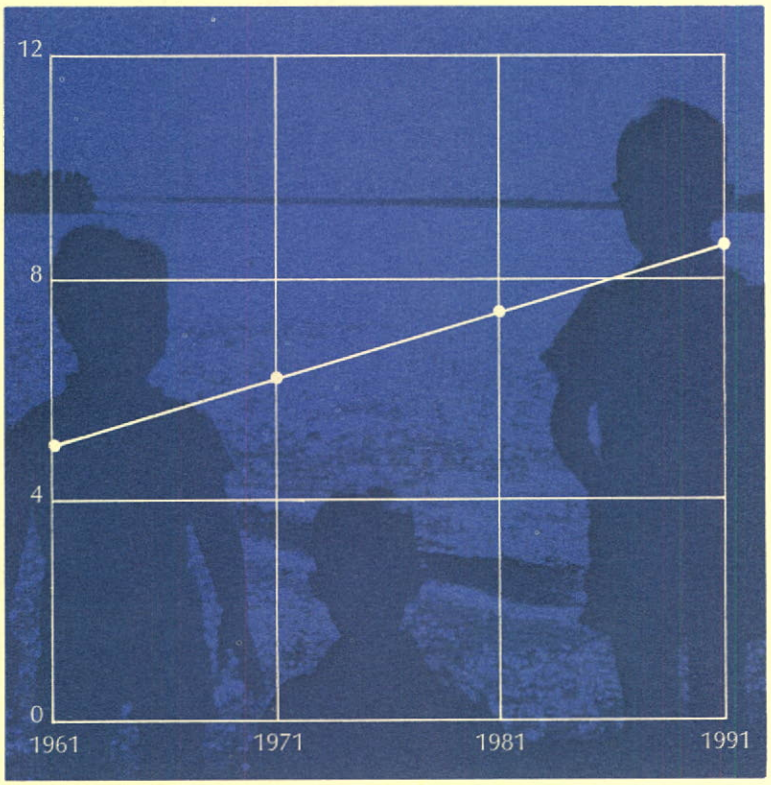
Quebec now has a population of about 6,046,000, and this will grow to more than nine millions by the year 2000 (Fig. 2). The maximum admissible population for Quebec's land area is 350 millions.

Once 80 percent rural, Quebec's population is now just the reverse: 80 percent urban. This migration to the cities, accompanied by industrial development, is creating more and more regional shortages of fresh water. Nearly 72 percent of Quebec's people are now supplied by surface water and 28 percent by underground reserves.

THE WORLD POPULATION EXPLOSION Fig. 1
(In billions of people)



POPULATION PROJECTIONS FOR QUEBEC Fig. 2
(In millions of people)

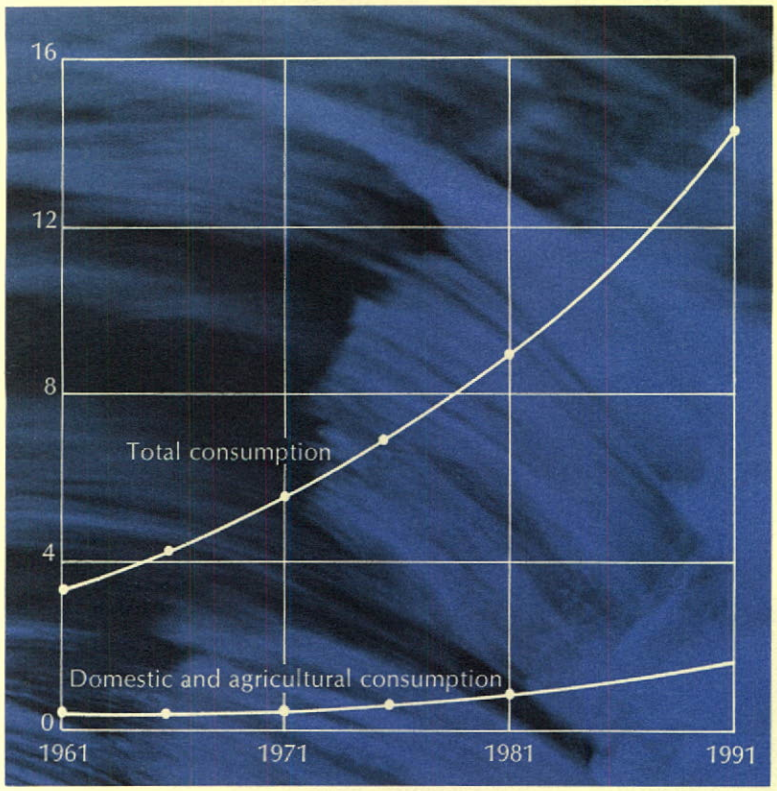


$600,000,000 for our lack of foresight...

A recent study by a commission set up by the Quebec government to look into legal problems concerning water revealed that total water consumption will have tripled by 1981. Annual domestic consumption will grow by 70 percent between 1971 and 1981, rising from the present 484 billion to 816 billion imperial gallons (Fig. 3).

QUEBEC'S GROWING NEEDS FOR FRESH WATER Fig. 3

(In trillions of imperial gallons annually)



This increased consumption will result not only from a growing population but also from higher personal incomes. The industrial sector is the largest user of fresh water (Table I).

A study made by the Quebec Water Board in 1970 has been used to show the cost of fighting water pollution in Quebec for the next 15 years. The Board estimates that it will cost $600,000,000 for the major works called for by the existing situation.

Table I

PRINCIPAL USERS OF FRESH WATER IN QUEBEC

Homes	9%
Agriculture	1%
Industries	90%

A mere million...

During the 1966-67 fiscal year, Quebec spent only one-third as much on research into water problems as did Ontario, according to figures compiled by the Science Secretariat of the Office of the Privy Council.

Table II

Area	Number of projects	Expenditures	% of total expenditures for all Canada
Quebec	71	$1,049,800	12.5
Ontario	155	$2,835,700	33.8

Land of myriad lakes...

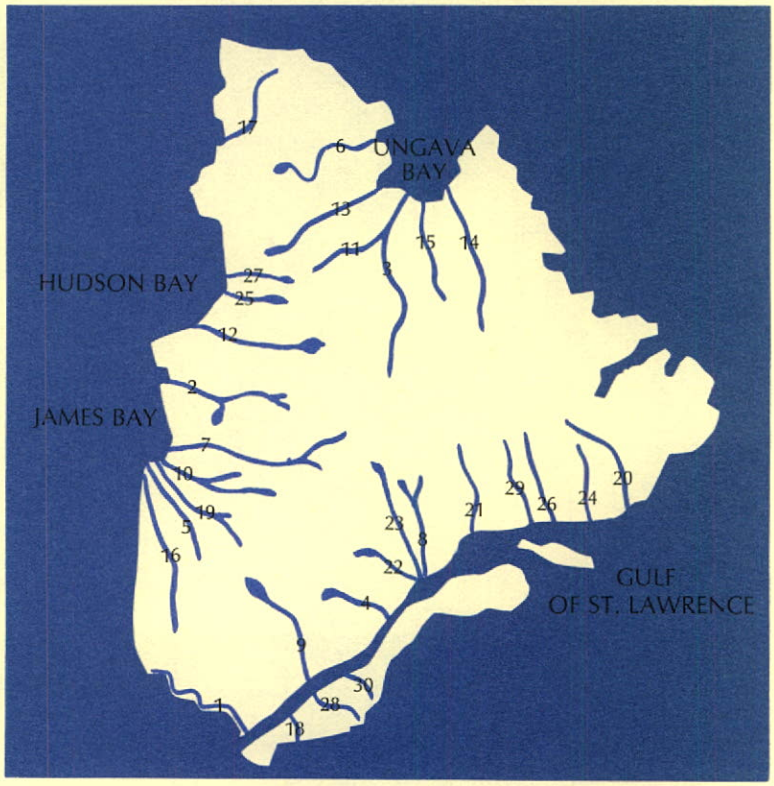
Quebec has a total surface area* of 636,400 square miles. Land masses account for 82.4 percent, or 523,860 square miles, of this total. Water bodies make up the remaining 17.6 percent, or 112,540 square miles. Of this latter total, 71,000 square miles consist of fresh water bodies and 41,540 square miles of salt water. South of the St. Lawrence River, there are more than 1,800 lakes in an area of 33,332 square miles. North of the river, in the 65,000 square miles so far inventoried by the Department of Natural Resources, some 18,000 lakes have been counted. Yet nearly five-sixths of Quebec's total area still has to be charted and inventoried. There are vast and precious resources still to be counted!

*Includes Quebec claims in Gulf of St. Lawrence area.

Ranks 11th in the world...

Quebec has one of the world's largest networks of waterways, in proportion to its total area. Following its inventory of major drainage basins and sub-basins within Quebec territory, it has already counted about 2,000 important rivers. The 30 largest are shown in Fig. 4. The St. Lawrence ranks as the 11th largest river in the world.

30 MAJOR RIVERS IN QUEBEC Fig. 4



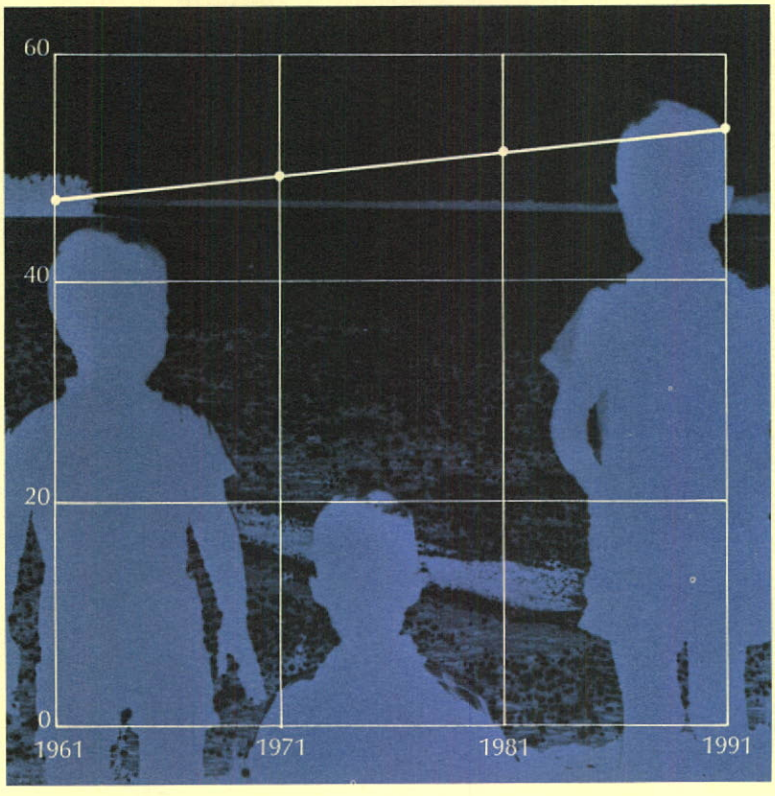
1. Ottawa River
2. La Grande Rivière
3. Kaniapiskau River
4. Saguenay River
5. Nottaway River
6. Arnaud River
7. Eastmain River
8. Manicouagan River
9. St. Maurice River
10. Rupert River
11. Larch River
12. Great Whale River
13. Leaf River
14. George River
15. Whale River
16. Harricana River
17. Povungnituk River
18. Richelieu River
19. Broadback River
20. Little Mécatina River
21. Moisie River
22. Outardes River
23. Betsiamites River
24. Natashquan River
25. Little Whale River
26. Romaine River
27. Nastapoka River
28. St. Francis River
29. Magpie River
30. Chaudière River

A century from now...

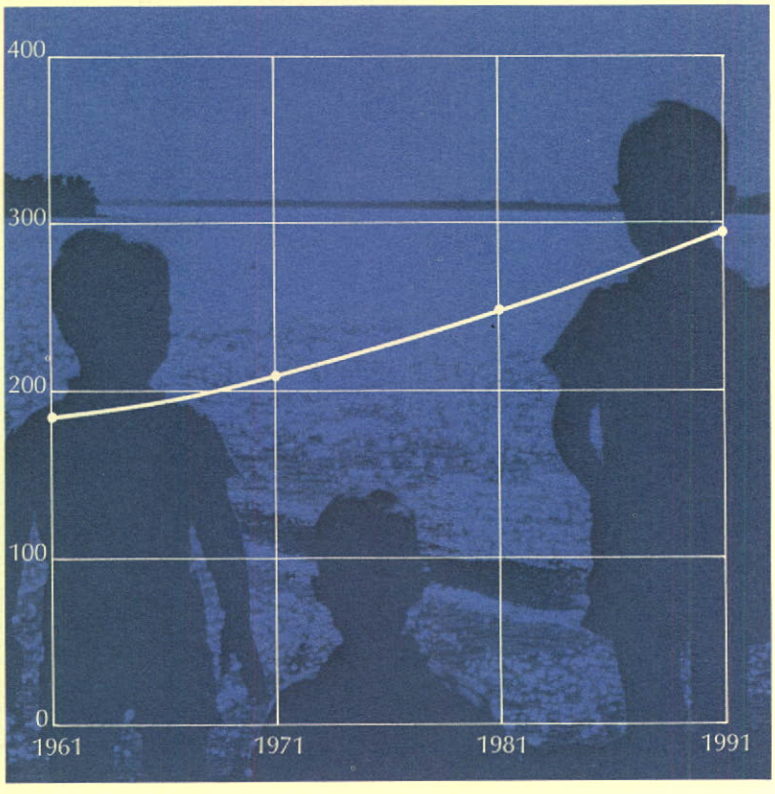
Fresh water supplies will represent a crucial problem throughout the world within a century. The French government's *Commission de l'Eau,* set up under its *Commissariat au plan,* forecasts that consumption of potable water will triple within the next 100 years; industrial consumption will be five times greater; agricultural usage will triple in the same period. Overall water needs will be five times greater (Figs. 5 & 6).

The population of the United States, with a present annual growth rate of one percent, has doubled since 1900. Yet per capita consumption of fresh water has quadrupled, due mainly to greater industrial and agricultural needs. That country's total consumption of fresh water, now 315 billion U.S. gallons daily, will soar to 593 billion gallons by the year 2000 (Figs. 7 & 8). By that time, nearly 300 million Americans will have to face a shortage of fresh water in their own country.

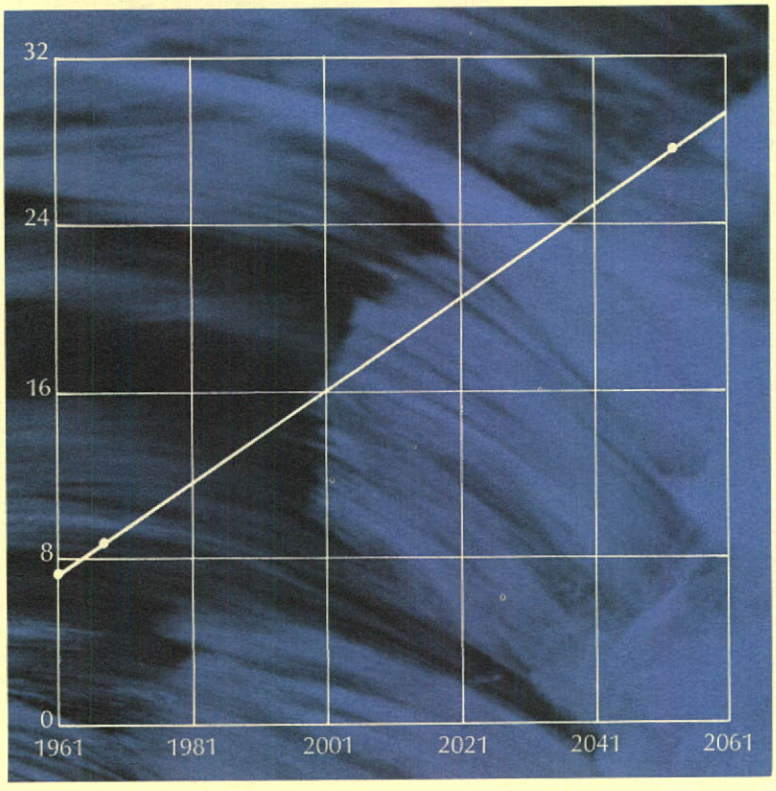
POPULATION PROJECTIONS FOR FRANCE Fig. 5
(In millions of people)



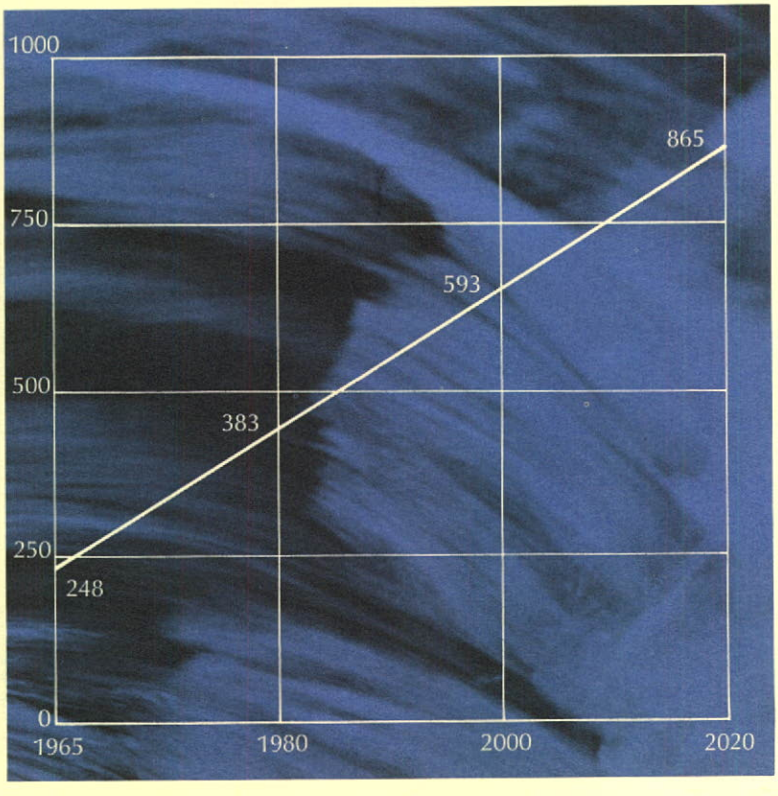
POPULATION PROJECTIONS FOR THE U.S. Fig. 7
(In millions of people)



GROWING FRESH WATER NEEDS IN FRANCE Fig. 6
(In trillions of imperial gallons annually)



GROWING FRESH WATER NEEDS IN THE U.S. Fig. 8
(In billions of U.S. gallons daily)



A look to the future . . .

The *Conseil international de la langue française* has defined the environment as follows:
"Together, at a given moment, the physical, chemical and biological agents and social factors apt to have a direct or indirect, immediate or long-term effect on living creatures and human activities."

Today's concept of the environment and the need to protect it demonstrate a new way of thinking by the world's peoples who are now fashioning the way of life of the 21st century. The world population explosion, today's longer average life span and the incessant changes in man's natural surroundings demand a mobilization of all possible technological and scientific methods in order to avoid extinction of the human species. It becomes more and more vital to have an organizational structure which allows a global concept of land development and management which can help to preserve mankind from destruction.

A group of prominent American bankers recently made a study to determine to what extent the efforts already made, and those about to be carried out to preserve the quality of the environment, can affect the national economic structure. Most of them concluded that the nation is facing a fundamental challenge: how to produce goods profitably, while at the same time taking environmental quality into account in all calculations of productivity. Whatever the answer, it must be done, and man must take a hand. Organized action is imperative.

Fresh water and Quebec industries

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Industries would rapidly stifle and die if deprived of the huge quantities of water they need to operate—water often of far higher quality than that required for human consumption.

The table below gives some idea of the immense amounts of water used by modern industries to manufacture and process the goods demanded by modern civilization.

Item	Production	Quantity of water* (in U.S. gallons)
a) Manufactured products		
Automobile	1 vehicle	10,000
Cotton	1,000 lbs.	20,000 - 100,000
Leather	1,000 sq. ft. of hide	200 - 64,000
Paper	1 ton	2,000 - 100,000
Wood pulp	1 ton	4,000 - 60,000
b) Food products		
Alcoholic beverages	1 U.S. gallon	125 - 170
Meats	1,000 lbs. (live weight)	600 - 3,500
Milk	1,000 lbs.	340
Cheese	1,000 lbs. of milk	200
Canned vegetables	1 case	3 - 250
Beer	1 barrel	470
c) Metals		
Aluminum	1 ton	56,000
Copper		
—mining	1 ton	10,000
—smelting	1 ton	4,000
—manufacture	1 ton	200 - 1,000
Steel	1 ton	1,500 - 50,000
Petroleum	1 barrel crude oil	800 - 3,000

*Many different factors can affect quantity of water used.

In its report for October, 1970, the government's study commission on legal problems concerning water estimated that by 1981 Quebec industries would be consuming 8,200 billion gallons of water annually, while domestic consumption would increase to 816 billion gallons. Industrial use at that time will account for 90 percent of total consumption.

As the table shows, industry requires a huge quantity of water for each unit produced. Thus, it is far from surprising that factories are usually built on the banks of large rivers or lakes, or even near the ocean.

Quality

The quality of water used varies considerably from one industry to another. Water needed only for cooling purposes, for example, need not be of especially high quality. The main thing is that it does not leave deposits in the pipes. However, most industrial processes require water of far higher quality than that used for cooling. Canneries, dairies and breweries, in particular, demand far more rigid quality standards than those set for domestic drinking water supplies.

Not only must such industrial water supplies be disinfected, but they also must alter as little as possible the colour, smell and natural taste of the foods being processed. In other manufacturing processes, the presence of calcium or magnesium can be undesirable. In the manufacture of paper, not even the slightest trace of iron or manganese can be tolerated in the water used. However, breweries, distilleries and bakeries prefer hard water containing calcium and/or magnesium.

In addition to these and other special requirements, turbidity and the acidity or alkalinity of the water are often important considerations.

Supply and treatment

For these reasons, industries generally find it best to supply their water needs themselves. Despite the lack of complete statistics on this matter, it is known that the food industry buys about 50 percent of its water from public sources. On the other

hand, the chemical industry, oil refineries and steel plants get only 10 percent of their needs from public waterworks.

About 98 percent of the water used by industries comes from surface sources. Although cooler and purer in summer, underground water is often too hard for industrial purposes.

Industrial water treatment methods are often similar to those used for domestic drinking supplies. Some industries (iron smelting and sugar refining, for example) require only settled and decanted river water. Others use filtered and chlorinated water. Some prefer hard water. Others need water that has had the minerals removed. Chlorinated water can be tolerated in the food industry, but pharmaceutical and chemical processing plants insist upon distilled water in order to turn out products of the highest quality.

Waste water

For some years now, a great deal of attention has been directed to the water pollution caused by industrial wastes. Industrial progress and urbanization have increasingly underlined the difficulty of finding new water sources and of protecting the environment.

Two-thirds of industrial waste waters come from cooling processes. These unavoidably raise the temperature of the water bodies into which they are discharged, thus affecting aquatic animal and plant life. Waste waters from washing processes are also plentiful in industry. These contain polluting agents of many different kinds, depending upon the material being washed, the quantity and the treatment methods used in the particular factory. The volume of water used in actual manufacturing processes is often relatively low, but the resulting pollution can be serious. The table below, which shows the B.O.D. (Biochemical Oxygen Demand) of various industrial wastes, emphasizes the magnitude of industrial pollution.

Industry	B.O.D. (mg./litre)*
Textile	125 - 250
Canning	100 - 6,000
Paper	5,000 - 40,000
Distilling	375 - 20,000
Abattoir	450 - 2,200

*1 lb./cu. ft. = 16,050 mg./litre

These figures are impressive, considering that the B.O.D. of domestic waste water is generally lower than 125 mg./litre.

The physical, chemical and biological properties of industrial waste waters vary considerably. The presence of pathogenic organisms (which can cause illness) is rare. They are found mostly in waste waters from meat processing plants, tanneries and other operations handling animal products.

By contrast, the effluents poured into rivers and lakes by mining, chemical and electroplating operations, as well as pulp and paper mills, oil refineries and textile plants, contain a wide variety of pollutants. These range from oil and other floating materials to acids, dyes and similar materials either in suspension or solution. All of these can change the taste, colour and basic properties of the water into which they are fed.

From the hygienic point of view, waste waters from the food, pulp and paper, textile and organic chemistry plants have properties analogous to those of domestic waste waters. It is only natural, then, to treat both types of waste water at the same time, with or without pre-treatment at the industrial plants. On the other hand, waste waters containing toxic substances can only be treated in municipal installations if their flow is carefully regulated, if concentrations are low enough or if the waste waters have been properly treated at the plant beforehand.

Target: classification

Throughout America, the classification of waterways is being talked about more and more. Quebec is no exception to this trend. In fact, it is entirely logical that each hydrographic basin (the watershed area in which all streams and lakes feed one main river) should be considered as an entity and that all those living within the area should agree what use should be made of the waterway upon which they depend.

These uses can be numerous, and vary from one area to another. Residents can decide whether the water is to be used for human consumption in one place, for bathing and sport fishing in another. Somewhere else, offensive odours must be eliminated. Once these general objectives are set, the competent public authorities must impose standards for the treatment of municipal and industrial waste waters which will permit the desired targets to be reached. The necessary degree of purity for waste waters can then vary from region to region.

It should be noted, however, that the treatment of industrial wastes before they are dumped into the waterways is not the only solution available to the industries concerned. They can also:

1) reduce the volume of rinsing water by improving their methods and equipment;
2) recycle waste water after partial purification;
3) recover certain materials from their effluents.

As for the public authorities, they can play their part by assessing taxes and distributing subsidies equitably within a particular industry to encourage balanced competition and ensure industrial decentralization.

Conclusion

The vigorous effort to combat pollution which Quebec must mount demands the wholehearted co-operation of industry. Those who govern and those who are governed must bend every effort to work together closely, in every possible way that economic conditions and restraints allow. For its part, industry must put all its creative imagination to work to bring an end to the pollution which it causes, while retaining its profit capabilities.

The Quebec Water Board for several years now has been working with major industries to achieve this objective. We all hope that its efforts will not be too long in achieving tangible results.

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Fresh water and tourism

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All the inland waters of the world, fresh and salt alike, make up only 2.5 percent of our planet's total water content. Usable fresh water is even scarcer, since much of the world supply is locked up in the polar ice caps and glaciers, suspended in the atmosphere or drained into undrinkable salt lakes and inland seas. A mere 0.6341 percent of the world's total water supply, in fact, is available for human consumption. Yet fresh water has always had its special allure. Relatively speaking, the world's lakes and rivers attract as many tourists, vacationers and weekend pleasure seekers as do the oceans.

Fresh water can be divided into three categories:

1. Underground water
2. River water
3. Lake water

By percentages, fresh water is distributed as follows:

Source	Total percentage of water
Underground	0.6250
Rivers	0.0001
Lakes	0.0090

Blessed with thousands of lakes, rivers and streams and the majestic St. Lawrence, Quebec ranks high among those areas most richly endowed with accessible water resources. Thus, it is not too surprising that tourism is Quebec's second largest industry, grossing an estimated $950 million last year. Yet this is only the beginning! With the dawning of the leisure civilization the Quebec tourist industry is due for even more spectacular developments.

Tourists and tourism

By definition, a tourist is someone who travels for pleasure. The tourist industry as we know it today began to spring into life toward the end of the 19th century, with the development of mass transportation facilities. At that time, however, tourists belonged mainly to the leisure classes. Only they had the money, and time, to travel abroad, vacation at the seashore or "take the waters" at the fashionable spas.

As vacations and paid holidays became the general rule and road and rail transportation developed and made travelling so easy, tourism came more and more into its own. Today, countless millions can afford to be tourists. Tomorrow, when the leisure civilization really arrives, we will see a true "tourist democracy". But you don't need to be rich nor to travel great distances to be a tourist. The picnicker or overnight camper, the Sunday driver taking in the sights, everyone who travels for pleasure, is a tourist.

All such pleasure excursions have happy consequences for the Quebec economy. As good highways multiply, this inside-Quebec tourism brings business and prosperity to previously isolated areas. Tourists from abroad, in turn, contribute to a balanced Quebec economy by bringing in precious foreign currency.

Tourist trade development

Tourism must be well organized in order to develop properly. That demands careful planning. Since much of the Quebec tourist trade centres around inland water bodies, the orderly development of lake and river resources assumes special importance. They provide the key to growth of the tourist industry, which in turn will encourage Quebec to conserve its priceless water resources.

So as to reap the maximum returns from all investments, it is essential to develop facilities which will interest the largest body of tourists of all, the homegrown variety. It's all too easy to think in terms of attracting only foreign tourists, while neglecting those who travel only short distances but are numbered in the millions. This is a mistake which has been made elsewhere in the past. Regional tourism was never as important as it is today. Happily, its importance has now been recognized. The development of water resources is responding more and more to the needs of the masses.

The recent creation of new parks to serve the recreational needs of people in the Montreal area is a case in point and, hopefully, just the beginning. One day, and soon, serious thought must be given to the lakes and rivers on whose banks many of our cities and towns have grown and flourished. Today, all too many of these waters are horribly polluted. For the sake of future generations, we must plan now not only to rid our waters of pollution but also to develop them properly. The citizens of tomorrow deserve a chance to enjoy nature at its unspoiled best. It could be said that development work on rivers flowing through the cities should be oriented more toward recreational pleasures and relaxation rather than tourism. Still, so that urban people can better survive the hectic pace of their activities, it could be desirable to have a happy blend of tourism and relaxation.

Underground waters

During its infancy in Europe, tourism was founded mainly on visits to the many health spas. The noted spa at Vichy in France attracted hundreds of thousands of visitors. At that time, the mineral waters were consumed exclusively at the source. Their curative powers were eagerly sought after, as indeed they are today. Those containing limestone, for instance, aided digestion and soothed rheumatic pains.

The great era of the spas coincided with the beginning of the 19th century, but waters with medicinal qualities have always attracted tourists. The Bible (St. John, V, 2-9) tells about a small

but miraculous spring-fed pool near the sheep market in Jerusalem. Here, an angel descended periodically from heaven to agitate the waters. The first person to plunge in after the angel's visit was said to be cured of his malady. As a result, the miraculous pool for many years was visited by travellers from afar, each hoping to be there when the angel appeared.

There are no such miraculous springs in Quebec but there are four spas, including the one at Potton in Brome County. Unhappily for the would-be pilgrim, all of Quebec's mineral waters are bottled and the spas no longer attract tourists.

In 1965, the Quebec Department of Natural Resources published a report over the signature of R. Paquet which demonstrated how rich Quebec is in mineral waters. For example, the report says that "the water from the Oka source is clear and has a slightly alkaline and pleasant taste. This water, very much in demand on the Montreal market, is recommended for persons suffering from ailments of the liver, kidney, digestive and urinary tracts".

The waters from the Chambord source in Métabetchouan township have "a very pronounced bitter saline taste" and alleviate "stomach ailments, rheumatism and laryngitis", the report says. The Joliette mineral spring, located in the municipal park, contains "salts of calcium and iron, polysulfides of sodium and potassium, as well as carbonates". Finally, it should be noted that some of Quebec's mineral waters compare very favourably with those from the most popular spas in Europe. The Potton waters are very much the equal of those from Evian, for instance.

It is ardently to be hoped that Quebec's underground springs will also attract many tourists, like Europe's spas.

Lakes and tourism

A quick glance at a map of Quebec reveals instantly that Quebec is a paradise of fresh waters. It has countless lakes. The tourist potential is enormous. Even close to Montreal, in Montcalm and Argenteuil counties among others, lakes surrounded by forests can still be found in a semi-wilderness setting. Fishermen, hunters, swimmers, vacationers, picnickers and other pleasure seekers of every kind . . . everybody . . . can find something to his taste in or near Quebec's bountiful waters.

The country cottage life, for example, has grown in popularity by such leaps and bounds over the past few years that some rural municipalities in the Laurentians see their populations multiply by ten in the summer. Nearly 800 cottages surround Lac Ouareau near St. Donat. There are 400 at Brome Lake in the Eastern Townships; 650 at Lac Simon in Papineau County; and so it goes. In a great many cases, the nearby villages depend heavily upon the dollars spent by these city tourists.

The lake has become the cornerstone of the Quebec tourist trade. Every possible effort must be made to protect the environment. The future of tourism depends upon it.

The country endangered

Too often, lake area development has been aimed only at short-term objectives. Not enough thought was given to the consequences that such changes would eventually have on the ecology and the future of tourism. Far too often, cottages and country houses were built completely around the shoreline of a lake and even to great distances from it. It's a weird sight looking at these houses packed together out there in the wilderness, for all the world like a part of the distant suburbs. Properly managed and developed, such a lake could have been a trump card for the municipality and its economy. But it has been irreparably damaged as far as ever being a tourist attraction.

A thousand and one problems, pollution being far from the least, rear their heads and cost villagers and cottagers alike ruinous expenditures. Bays which previously abounded in useful micro-organisms and aquatic plant and animal life of many kinds were once the favourite haunts of anglers. Today, they are filled in and covered over with the ubiquitous cottages. The marshes have met the same fate. All around the lake, no spot has been left untouched in its wild, natural beauty. The water has become cloudy. It's impossible to see the bottom anymore, and swimming is risky at best. The trees which once crowded thickly around the shoreline have all disappeared. Every kind of reason was dreamed up to cut them down.

Lake areas have settlement capacity limits which should be respected. For a long time, population densities in the country were so low that the lakes didn't suffer too much from deforestation, erosion and pollution. But the unstemmable tide of city dwellers rushing to find peace and relaxation in the country has created an urbanizing threat menacing the very existence of the lakes. There is an urgent need for government to set up very strict regulations for the orderly development of the lake regions.

Rational development of lake areas

The book, *Dossier Pollution,* sums up very well the regulations to be followed for developing a lake: "At least 25 percent of the perimeter of the lakes must be given absolute protection. As for the cottage and recreation zone and the commercial zone, cutting of trees can be allowed only under very strict regulations, with the aim of preventing pollution and of protecting the ecosystems. The rule is to retain a wooded area about four times the size of the space needed for location of a cottage, a septic tank installation, access road, etc. On the first green strip 35 feet in width, starting from the shoreline, tree cutting is regulated in an even stricter way."

It becomes in a way a matter of saving the life of the lake, which depends for its existence on the quality of its water, as well as the health of its forest environment. There are constant biological and physical exchanges between the lake, the shoreline and the forest environment.

These exchanges take place within the bounds of a precarious ecological balance. As soon as man interferes, this equilibrium is disturbed. Too great a disruption can launch a chain reaction which risks turning the area into a desert.

Of all the ecological imbalances the most serious is undeniably pollution, in any form. It is easy to foresee ways to avoid it when the lake is being developed. In rural areas, water is purified by being filtered through the soil. Sewage water is directed into a septic tank, where it clarifies itself and then flows through a grid of perforated sewer pipes, spread well apart, and soaks into the earth. Microbes in the soil then decompose the impurities. However, these microbes are only efficient when conditions are favourable to them. The soil must be dry down to a sufficient depth to soak up all the water without difficulty.

This is one reason why, when the land is subdivided, building of cottages must be forbidden in locations where water cannot soak in to an adequate depth. This is the case with marshlands, even if they have been filled in, stony ground and places where underground water levels are very high.

Summing up, tourist facilities in the country such as cottages, camping grounds or trailer parks, motels or hotels, must be located in areas where the soil has the necessary properties to

purify sewage waste water. Any other land must be classified automatically as a conservation zone, unsuitable for habitation.

That would achieve two highly desirable objectives at one stroke. It would prevent water pollution and preserve the lake's natural beauty and ecology.

The aim when developing natural sites must be to blend man's presence into the countryside, rather than brutally upsetting nature's balance. The future of tourism is at stake.

St. Donat, the trailblazer

Several rural communities have already realized that their economic future depends upon the tourists. But they learned from bitter experience that ill-conceived developments increased their financial burdens, rather than lessening them as they had hoped.

St. Donat, a small village in Montcalm County,was (and still is) a pioneer in efforts to control pollution and ensure orderly and rational development. In 1967, the cottage dwellers of Lac Archambault decided to clean up the lake waters. They called upon the government for help but, oddly enough, just for technical advice. For the first time ever in Quebec, citizens faced up to the pollution problem and did something about it.

Working closely with their mayor and councillors, they set up regulations for septic tank installations to halt the alarming increase of contamination in the lake. From 1967 to 1971, all property owners whose septic tanks seemed dangerously defective, rebuilt them. The municipality put in a collective septic system (Quebec's first) to serve a group of cottages where the soil was unsuitable for private septic tanks. It also laid down a collector sewer to carry the wastes from three large hotels and some 55 cottages to a sewage treatment plant. At the same time, a fulltime municipal inspector of public health was hired (once again, a Quebec first).

The dynamic spirit of the Lac Archambault property owners spread to those of Lac Ouareau, who soon fell in step. The battle against pollution is being waged briskly on this lake. Committees have been set up to protect the waters of two other lakes, Croche and Sylvestre, and for the past two years the village of St. Donat has organized a "Pure Water Festival" during the month of August.

This determined and well-managed battle against pollution has already cost the residents of the village more than $250,000, but it has been a worthwhile investment. It has ensured business for contractors, jobs for local workers, given a boost to the area's prosperity. There's your proof that wiping out pollution can bring important economic advantages along with it!

Heartened by this experience, the village has officially created a committee for the protection of the environment, similar to those existing in most states south of the border. St. Donat thus was the first rural community to take an interest in ecology. It understood perfectly that protection and development of its water resources and the forest environment were the foundation stones of its tourist industry.

About 30 other Quebec villages, parishes or townships have already decided to follow St. Donat's example. Quebec's tourist potential is growing step by step and in a good way.

The St. Lawrence

If we were to start from scratch to create the ideal tourist area out of nothing, there would be no better way to begin than by putting in a mighty river. Quebec already has that river, the St. Lawrence. Paradoxically, we take all too little advantage of it as a tourist attraction. Yet the St. Lawrence by itself offers as many possibilities for tourist trade development as several other areas lumped together. Its rugged shoreline, the countless islands, waters teeming with fish, its numerous birds and other wildlife, all make it the dreamland of hunters, fishermen and vacationers.

The Quebec Wildlife Federation and *la Société pour vaincre la pollution* have already launched an advertising campaign with the announced aim of turning a part of the river (from the Jacques Cartier bridge downriver to Sorel) into a recreational park. This would offer hundreds of thousands of Montrealers the opportunity to flee the city for nature's tranquility, without having to drive long distances.

Such a project, if carried through, would naturally have very favourable economic consequences in the region. Tourists would be able to find, right on Montreal's doorstep, a fascinating corner of unspoiled nature similar to the most remote areas of Quebec.

Quebec's ambitious tourist trade objectives, based largely on its many fresh water bodies, include the development of one of the world's most beautiful and imposing rivers, the St. Lawrence. Once this is done, Quebec will truly have earned the title of "The Paradise of Fresh Waters".

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Fresh water and regional development

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Regional development is a complex matter. Since its aim is to ensure proper use of natural resources and the most rational growth and expansion of an area, countless factors must naturally be taken into account. The planner's task is primarily that of reconciling the social, economic and political needs and aspirations of the public and governing bodies with the physical assets and liabilities of the region in question.

Once an inventory of available resources has been drawn up and a detailed knowledge of existing conditions in the region has been obtained, it is then possible to spell out the development objectives to be achieved in the main sectors under consideration. Then, in order to reach these goals, a detailed plan is drawn up for making efficient use of land resources in the various sectors. The aim is rational planning and direction of urban, industrial and agricultural development in the area as a whole.

Preparation of such a development plan is based first on precise objectives. But, in addition, it must consider the overall regional potential in such fields as agriculture, industry, environmental preservation, availability of water supplies for municipal and industrial use, types of soil and productive capacity of each, farmland zones to be preserved, etc.

Rational development obviously implies the planning and establishment of a complex infrastructure of public services. The major need is for an integrated transportation system (autoroutes, secondary roads, railways, public transport, etc.). Then, a system for supplying drinking water and a sewage network must be supplied: a modern urban system with all the necessary public services that go with it.

Everyone knows that without water no human life is possible. Water is essential to every biological, domestic, agricultural and industrial activity of mankind. More and more, it determines his leisure pursuits. It is no exaggeration to say that a supply system for potable water is one of the most essential infrastructures for the development of a region. When preparing a regional development plan, special attention must be given to the planning and installation of all necessary facilities for transporting, distributing and carrying off water, as well as maintaining or improving its quality.

The part water plays in regional development

Water's importance in human activities is easily seen in the countless ways that man uses it. These fall roughly into three main categories: domestic, industrial and agricultural usages, along with outdoor recreational activities.

Principal domestic uses are for drinking, cooking, laundry, washing and baths, sewage disposal. Industries use huge quantities of water as a raw material in making countless products. Water is used to cool equipment, to wash products during manufacture and to feed industrial boilers. Farmers use it to water their crops and irrigate their fields, water their livestock, hose down barns and buildings. Finally, the healthy outdoors recreation which is increasingly important to today's active people would be a pale imitation without fishing, swimming and pleasure boating.

These countless uses of water as a basic part of so many human activities underline its vital importance. They accentuate the undisputed need for a sufficient quantity and quality of water to meet all needs for domestic, agricultural, industrial and recreational consumption.

Water and the development of urban centres

Regional development normally involves giving priority to the growth of certain existing urban centres or the development of new cities to meet the needs of anticipated population increases. For this reason, the planner must choose from among the existing urban centres one or more large towns which will be destined for major and rapid development. Urbanization of the others will be rationally controlled and directed as part of the larger picture.

Over the past few decades it has been noticeable that water consumption in Canada's urban communities has increased considerably. Today, domestic usage ranges from 35 to 70 gallons daily per person. These quantities might seem large at first glance. But they become understandable when it's realized that 20 gallons of water are needed to take a bath and as much to do an average washing. Five gallons are used each time the toilet is flushed and washing the dishes after each meal takes five to ten gallons. Watering the lawn or washing a car, filling a swimming pool and a thousand other urban uses add inexorably to the demand. People today scarcely realize how much water they use in so many ways and are quick to show their displeasure when asked to cut down a bit on consumption during summer's hot, dry spells.

In order to supply public needs for water economically, those urban centres whose expansion is foreseen under the development plan must be located as close as possible to fresh water supply sources. This will avoid the need to set up complex and costly systems to transport raw water to the treatment centre of the town involved. This stems from the fact that transportation of water is usually the one factor that contributes most to higher costs. Costs increase rapidly the further away the sources of supply are located.

Secondly, it is imperative to plan the development of the various urban axes in such a way as to ensure that water is available in sufficient quantities to meet all future needs. Lack of planning in the choice of the towns to be developed, as well as want of foresight or erroneous forecasts of future needs in relation to supplies, could have disastrous effects on the future of these urban centres. Increasing shortages of water could then force the authorities into costly investments for water mains to bring in water from great distances. The financial burden would thus have to be shared among the residents of the entire urban conglomerate.

It is quite obvious that the quantity of water available in a region can be an important restrictive factor in the growth and development possibilities of certain urban centres in the area.

It can be concluded, then, that the two major criteria which must guide the planning and development of these axes of urbanization are the proximity of water sources and the availability of water in sufficient quantities to meet the domestic needs of future population masses in these urban centres.

Water and the development of industrial centres

The regions in the process of development are generally those destined for important industrial expansion as the result of major projects which have been launched. Prime examples are the building of the new Montreal International Airport at Ste. Scholastique and the James Bay hydro project. Such major enterprises are real catalysts for the installation of new industries in an area. At the same time they spur urban development because of the great influx of labour, hence population.

This symbiosis between population growth and industrial and commercial development is well known to the planner. He knows that water resources available in the region being developed will have to be sufficient not only to supply the domestic needs of the urban dwellers but also to satisfy the enormous demands of industry.

Water requirements for industrial purposes obviously change according to the type of plant operation, but they are always considerable. Thus, 18 gallons of water are needed to refine one gallon of gasoline but 250 tons, or 50,000 gallons, are required to produce a ton of wood pulp for the paper industry. It takes 100 gallons of water to make a gallon of alcohol; 200,000 gallons for a ton of viscose rayon fibre; 600,000 gallons of water for a ton of synthetic rubber!

That gives some idea of the scope of the problem and the importance of water in industrial development. Certain plants obtain their needs directly from the municipal water supply. But other industries such as pulp and paper, which use huge quantities in their operations, often find it preferable and more economical to set up their own water supply systems.

New industries must be welcomed and supplied with all essential services such as transportation and communications facilities, water supplies and waste disposal systems. With this aim, a complete regional development plan necessarily must include establishment of new industrial parks on sites specifically zoned for that purpose. These should be located outside of or on the outskirts of population centres. Alternatively, existing industrial centres within the municipalities should be developed.

In this latter case, water will be supplied by the existing distribution system in the municipality. It is estimated today that a well-developed industrial centre needs a water supply equivalent to about 50 to 75 gallons per person per day, based on the town's population. This is additional to domestic needs which must be met.

If the development plan foresees the creation of one or more autonomous industrial centres outside the urban centres (example: Bécancour Industrial Park) then these exclusively industrial sectors must be located near available water supply sources. This is necessary in order to avoid high transportation costs. In addition, any planning should make provision for the future installation of a complete system for the treatment and distribution of drinking water. Development of industrial sites separate from the urban centres therefore implies supplementary costs, an economic factor which must be taken into account in any such industrial development planning.

Recreation

Regional development also must take into account two other extremely important factors of which modern man is just now becoming aware. These are the environment and outdoor recreation.

Public needs in the way of outdoor sports and recreation are closely linked with the presence of superior quality water resources for aquatic sports such as swimming, boating and water-skiing. Foresighted planning must concern itself with the development and preservation of water resources to serve the public's recreational needs.

The all too numerous mistakes made in the past have taught us all the hard lesson that we cannot overexploit a region's water resources with impunity.

Through lack of foresight, man has polluted countless lakes and streams and in the process has destroyed aquatic and terrestrial wildlife, altered vegetation patterns and sometimes even the climate. The planner is determined not to repeat these past mistakes. So, to ensure really rational and complete regional development, the ecological balance must be kept in mind and emphasis should be placed on protection of the area's water assets. Waterways must be developed with an eye to their multiple end uses and primarily for their recreational value. In this respect, the needs for water are endless. If proof were needed, all we have to do is think of those countless thousands of people who rush to the lakes and streams on weekends or holidays in search of relaxation. An important and growing source of wealth, the tourist industry depends heavily upon clean, unpolluted fresh water.

Cost of supplying water

As an indication of the importance of water in the development of urban and industrial centres within a region, the following tables give certain data pertaining to the costs of supplying water to the entire area surrounding the future Montreal International Airport in Ste. Scholastique.

The Quebec Department of Municipal Affairs is preparing a plan for development of the entire airport region, comprising the area bounded by the cities of St. Jérôme, Lachute, Oka, Two Mountains, St. Eustache, Ste. Thérèse and Terrebonne.

Five development proposals have been studied, each taking into account various characteristics and possibilities of the area. The urban and industrial development axis proposed in each case has been evaluated according to the following criteria: population, manpower, urbanization, industrial development, agricultural potential, recreational potential, transportation, highway networks, water supply and sewage disposal, etc. The different axes given consideration were: Ste. Thérèse/St. Eustache; Ste. Thérèse/Terrebonne; St. Jérôme/Ste. Thérèse; St. Eustache/Lachute; St. Jérôme/Lachute.

In each case, evaluation of the possibilities for supplying potable water required a study of investments needed in the future to supply the needs of municipalities, industries and the new airport itself. These needs have been worked out, for each proposed axis, in relation to the considerable industrial and population growth which will follow the building of the airport in this area.

The first table shows the cost of new investments which would be needed to supply the region with drinkable water in the necessary quantities until the year 2000. This includes the cost of new catchment basins, new filtration plants or enlargement of existing plants, new reservoirs as well as certain trunk distribution mains. It does not include the construction of water distribution lines inside the cities concerned.

All costs have been calculated at present-day prices. Upon examining the table, it will be noted that the total estimated cost is about the same for each proposal studied. This stems from the fact that all major centres in the region are located close by such large waterways as the Mille-Îles River, Lake of Two Mountains or the North River. There is ample raw water in each of these to meet future demands.

Nevertheless, if we examine the eventual per capita costs of investments (Table II) for each of the region's municipalities, we note that it is lower for some than others. Ste. Thérèse is one such case. This is due to the fact that in these municipalities the size of the installations required will make it possible to do the work more economically through bulk purchases and streamlined construction methods.

Table I

ESTIMATED COSTS AT PRESENT PRICES (IN DOLLARS)

Development proposal	Lachute	St. Jérôme	Ste. Thérèse	St. Eustache	Terrebonne	Total under plan
Existing situation	2,281,000	2,996,500	4,564,000	2,744,000	747,000	13,332,500
Ste. Thérèse/St. Eustache axis	2,000,000	2,662,500	4,589,000	3,505,500	837,000	13,594,000
Ste. Thérèse/Terrebonne axis	2,000,000	3,012,500	4,564,000	819,000	3,143,000	13,538,500
St. Jérôme/Ste. Thérèse north-south axis	2,344,000	4,123,500	5,451,500	819,000	879,000	13,617,000
St. Eustache/Lachute	3,681,000	2,056,000	932,000	6,300,000	879,000	13,848,000
St. Jérôme/Lachute	4,093,000	5,291,500	1,997,500	1,557,500	879,000	13,818,500

Table II

ESTIMATED PER CAPITA COSTS AT PRESENT PRICES (IN DOLLARS)

Existing situation	50.68	27.24	25.35	27.44	21.34	152.05
Ste. Thérèse/St. Eustache axis	50.00	29.58	25.49	29.21	20.92	155.20
Ste. Thérèse/Terrebonne axis	50.00	33.47	25.35	16.38	28.57	153.77
St. Jérôme/Ste. Thérèse north-south axis	46.88	29.45	27.25	16.38	29.30	146.62
St. Eustache/Lachute axis	46.01	29.37	13.31	28.63	29.30	146.62
St. Jérôme/Lachute axis	51.16	26.45	19.97	25.95	29.30	152.83

Fresh water and the urban communities

Jean R. Marcotte
Montreal Urban Community

Several fundamental principles which are worth keeping in mind were expressed in the European Water Charter promulgated May 6, 1968, in Strasbourg. Here are a few of them:

"There is no life without water. It is a treasure indispensable to all human activity."

"Fresh water resources are not inexhaustible. It is essential to conserve, control, and wherever possible, to increase them."

"To pollute water is to harm man and other living creatures which are dependent on water."

"When used water is returned to a common source it must not impair the further uses, both public and private, to which the common source will be put."

Among the many thoughts which spring to mind regarding fresh water use by urban communities, it's worthwhile to consider that final statement in connection with the roles these communities play in the use and pollution of water.

When several communities agree to build works to ensure their needs in water treatment and distribution, or sewage collection and treatment, the first question often posed is: "Who should build the works and assume responsibility for their operation?"

In the past, major cities which were growing at a faster rate than their satellite communities took the initiative in building water supply and sewage works. Then they supplied these services to surrounding localities at a mutually agreed upon price or, in some cases, at rates set by a controlling authority. This procedure is a logical one as long as the supplying city is much larger than its suburbs. But once the latter increase in size and power, it becomes a source of constant friction. It also paralyzes the borrowing power of the supplying city, to a certain extent.

Water supply and waste disposal problems have been accentuated by the spectacular growth of today's suburban cities.

Nearly everywhere, solutions on a regional scale are being sought out and applied. Water management administrations and sanitary districts were the forerunners of modern urban communities which integrate not only the water and sewage works and systems but also all other services which overlap individual municipal jurisdictions.

The principle of the urban community has now been established for any function of an intermunicipal nature. The aim of such a community, as a matter of fact, is essentially to ease the way to the adoption of the necessary measures to ensure efficient intermunicipal services within a given region. All laws creating urban communities devote several articles to water management.

Public administrators are well aware that clean water supplies and proper waste treatment are so vitally important, and require such large investments and operating costs, that they must receive special attention.

Every urban community must face this problem right from its birth. Naturally, there already are several independent existing systems in the municipalities falling under the Community's jurisdiction. The first decision to be made is whether to integrate these into one system. If the answer is yes, the next step is to find the best way to do so. Generally speaking, capitalization costs of regional services, expressed in terms of dollars per citizen or per million gallons of treated water, are inversely proportional to the capacity of the services. Similar studies must also be made of operating expenses.

Another point is that large installations make it possible to supply a more flexible service. Nevertheless, it would be wrong to conclude from this that integrated water systems and regional filtration or sewage treatment plants offer a magic solution to all intermunicipal problems. Economic considerations must be examined when weighing the various available possibilities.

Integration of services should offer economic advantages to all parties concerned if it is to be attractive to them. Sometimes, however, important sanitary reasons such as available water quantity or quality, or location of waste discharge points, will impose the final decision independently of the economic considerations.

Once an urban community is created, a master plan for water services and waste disposal must be drawn up. Technical, financial and administrative studies should also be made.

Master plan

Where an urban community includes several municipalities, it is essential that all water and sewage systems as well as treatment plants in the region be developed according to a single master plan. This is the basic document which provides the framework for a rational, adequate and economical system to meet all present and future needs. Lack of planning here can have serious repercussions later, resulting in costly and difficult modifications.

Even if each municipality in the urban community has its own distinct administrative body, all face certain common technical problems which can be solved more realistically on the regional level.

The master plan must be sufficiently flexible so that it can be easily adapted to any unforeseeable changes in the urban plan regarding the eventual use of various land areas within the region. It must therefore be conceived in such a way that these changes do not alter its general applicability or original conception.

Technical studies

First step in preparing the master plan calls for technical studies to determine the locations, capacities and construction dates of the works which will be needed over the years. It requires a complete inventory of existing facilities in the area included within the Community. But a simple listing of existing installations is far from being enough. There must be an evaluation of all available technical information such as rates of consumption, discharge rates and their variations, hydraulic features of existing installations. It should also include master plans already under study or prepared by member municipalities, variations in consumption and discharge rates according to different uses made of the land, as well as water and sewage system operating methods. In a general way, all information on particular features of the water supply facilities, waste water treatment and sewers in each part of the territory should be covered.

In order to determine future demands for potable water, and the waste water flows for all parts of the urban community, population studies must be made and information from the different master plans available must be interpreted as uniformly as possible.

The master plan cannot be established without a detailed study of the various possible options for the location of water intakes, treated waste water discharge points, filtration and purification plants, reservoirs, pumping stations and water mains. As an example, location of the latter will vary according to whether they are being designed in terms of use within the existing municipal boundaries, or independently of these.

Finally, the various possibilities must be evaluated with regard to the degree of safety that can be expected from the location of various components of the overall system, the quality of the raw water to be treated for drinking purposes, along with the risk of obtaining water of doubtful or poor drinking qualities and the effects of discharging wastes into waterways.

Existing installations generally have a strong influence on the study of future developments. For example, at first glance it might seem that a certain small filtration plant should be phased out. Then comes the realization that it is so strategically located in the regional context that it would be desirable to increase its capacity considerably.

Well-planned technical studies can also supply the dates when certain installations should be closed and when new ones should be built. Everything should conform with the master plan of the integrated works.

Computers make these technical studies much easier today by handling the intricate hydraulic calculations involved. Planners now can study numerous possibilities which they were forced to neglect previously because of the arduous calculations involved.

Financial studies

Other types of studies help to determine possible methods of payment for financing the necessary integration of existing installations, and to indicate which components of the water supply and drainage systems should be the responsibility of the urban community. For instance, it is easy to say that filtration plants, reservoirs and pumping stations will be integrated in the communal system. But it is not so simple to decide which water pipes are of regional usefulness.

These pipes, generally called water mains, are very difficult to identify within a large and cross-connected network. It's a complicated task to decide whether certain mains in one municipality also supply neighbouring towns. This often leads to a decision for complete integration of all existing and projected facilities for supplying drinking water to the entire urban community.

Once all these studies have been completed, the planners must decide upon the method of paying for installations owned by members of the urban community. The law governing the Montreal Urban Community requires that for the works yielded by the municipalities, the M.U.C. must at least reimburse them the amount needed to service the debt on bonds they had issued to acquire, build or alter the various installations, minus an abatement for any federal or provincial subsidy.

This arrangement does not take into account depreciation on plants and equipment already amortized over the years out of municipal revenues. But it should not be forgotten that the municipality which has thus depreciated its capital assets now becomes in a very real sense a shareholder in the Community for an almost equivalent amount, as a partner in the operation.

So that debt servicing charges at the time of integration can be definitely known, loan by-laws adopted by the different member municipalities must be studied.

Generally, account books of the municipalities and of the Quebec Municipal Commission are examined to establish the total amount of debt liability the Community will assume when it takes over the installations. At the present time, the law does not allow participating municipalities to yield their debentures to the urban communities. As noted previously, when the urban community takes over existing installations it then assumes responsibility for debts contracted by the municipalities to build the works in question. Thus, the urban community can only enter into agreements with member municipalities after it has been decided which services are to be integrated and what amount of indebtedness existed at that time.

Profitability and financial studies also allow Community planners to work out ways and means for meeting the financial obligations assumed by taking over the water and sewage plants and systems. As a matter of fact, it is essential to know where the necessary revenues can be obtained to cover debt service charges on the installations taken over, as well as for future work and operating costs.

These revenues will come from taxes or dues collected either directly by the urban community or by the municipalities. Ideally, costs are covered by municipalities or individual consumers, in proportion to use made of the system. In other words, payment is made according to water consumption and the volume of waste water discharged into public sewers.

If it is considered that there is a direct relationship between water usage and its resulting pollution, the general service tax can be calculated on the basis of the quantity of potable water consumed. However, the structure of some existing systems often prevents use of this method. The only alternative then is to adopt a procedure which is perhaps less equitable but nevertheless practical. This involves sharing costs on the basis of real estate and rental values and, in certain cases, population figures.

Summing up, profitability and financing studies therefore provide a comparison between the cost of treating and distributing water under existing municipal administrations and the projected cost of a more or less totally integrated system. In each case, long-term financing methods must be considered.

Administrative studies

Once technical and financial studies have been completed, the groundwork is laid for the master plan. Its aim is to provide the most economical possible water treatment and supply system for the entire urban community area. It is generally preferable to leave the administration of the integrated network in the hands of the personnel already handling that task. But a study must be made of the existing administrative procedures and makeup of the various organization charts. Armed with this information and guided by the experience of similar regional bodies both in America and in other parts of the world, Community planners can then draw up an organization chart adapted to their own needs.

This organization chart should show all main divisions: general management; technical services responsible for planning and building the various works: plants, pumping stations, reservoirs and centralized control operations; water mains and sewers maintenance. Each department plays its part in the overall operation, contributing its skills and knowledge. All work together to develop efficient water supply and drainage systems; prepare statistics for planning and administrative use; establish standards for construction, operation, maintenance, health, workers' safety, protection against fire, espionage, sabotage and vandalism. It is also essential that these studies provide co-ordinating mechanisms for the rational integration, operation and expansion of the Community's water system with the installations of other organizations.

Conclusions

The prime necessity to provide good management of our water resources has given the initial impetus for the regrouping of water and sewage systems, filtration and waste water treatment plants. From this was born the concept of the urban community, where not only water resources but all other regional facilities and services are pooled for use by all.

The problem of obtaining adequate supplies of fresh water for consumption is fundamental and can no longer be handled adequately at the local level. Today, this is the responsibility of the urban communities. But tomorrow, when the sprawling megalopolis will be the home of more than four out of every five members of the populace, fresh water supply and pollution will be even more pressing concerns for the city dweller. This means that today's urban communities must organize and find ways to protect the environment in such measure that tomorrow's problems will not become insurmountable obstacles.

"Fresh water resources are not inexhaustible. It is essential to conserve, control, and wherever possible, to increase them."

Sundry Information

The following information has been carefully gathered together for the benefit of the general public, businessmen, organizations, associations, students and all those, in short, who are intensely interested in the essential role that fresh water plays in their lives.

Government Departments & Private Organizations

Department of Natural Resources
General Management of Waters, Parliament Buildings, Québec

Quebec Water Board
Department of Municipal Affairs, Parliament Buildings, Québec

Public Relations Department
Hydro-Québec, 600 Dorchester Blvd. W., Montréal

Centre d'étude, de recherche et de documentation sur les eaux (CERDEAU)
Division du génie de l'environnement
École Polytechnique, 2500 Marie Guyard Ave., Montréal 250

Centre québécois des sciences de l'eau
Université du Québec, 2050 St. Cyrille Blvd. W., Sainte Foy, P.Q.

Informatech France-Québec
20 Edison, Floor E, Place Bonaventure, Box 160, Montréal 114

Department of the Environment
Ottawa

Association française pour l'étude des eaux
23, rue de Madrid, Paris 8e, France

Centre français d'information sur l'eau
21 bis, avenue de Ségur, Paris 7e, France

Centre belge d'étude et de documentation sur les eaux
3, boul. du Frère-Orban, Liège, Belgium

Robert A. Taft Sanitary Engineering Center
4676 Columbia Parkway, Cincinnati, Ohio 45226, U.S.A.

Research Centres

Génie de l'environnement
École Polytechnique, 2500 Marie Guyard Ave., Montréal 250

Centre québécois des sciences de l'eau
Institut national de la recherche scientifique
2050 St. Cyrille Blvd. W., Sainte Foy, P.Q.

Centre de recherche sur l'eau
Université Laval, Québec 10

Interior Waters Research Centre
Burlington, Ont.

Comité français de la recherche sur la pollution de l'eau
9, rue de Phalsbourg, Paris 17e, France

Station de recherche des eaux et forêts
Ministère de l'Agriculture, Groenendael, Hoeilaert, Belgium

Institut fédéral pour l'aménagement, l'épuration et la protection des eaux
Physikstrasse 5, Zurich, Switzerland

Cebedeau
3, boul. du Frère-Orban, Liège, Belgium

The Water Research Association
Ferry Lane, Medmenham, Marlow, Bucks, England

Robert A. Taft Sanitary Engineering Center
4676 Columbia Parkway, Cincinnati, Ohio 45226, U.S.A.

International organizations dealing with water problems on continental and world levels

Europe

*Economic Commission for Europe (ECE)
Geneva, Switzerland

North America (U.S. and Canada boundary waters)

International Joint Commission (IJC)
151 Slater St., Ottawa 4

World

Food and Agriculture Organization of the U.N. (FAO)
Vialle delle Terme di Caracalla, Rome, Italy

World Meteorological Organization (WMO)
41, avenue Guiseppa Motta,
Geneva, Switzerland

International Association of Hydrogeologists (IAH)
74, rue de la Fédération, Paris 15e, France

International Association of Scientific Hydrology (IASH)
Braamstraat 61, Gentbruggen, Belgium

International Atomic Energy Agency (IAEA)
Kartner Rign 11A-1010, Vienna, Austria

International Water Supply Association (IWSA)
34 Park St., London W.1, England

*Organization for Economic Cooperation and Development (OECD)
2, rue André-Pascal, 75 - Paris 16e, France

World Health Organization (WHO)
Geneva, Switzerland

International Water Pollution Research Association
9, rue de Phalsbourg, Paris 17e, France

*These organizations study the best methods for developing water resources and fighting pollution throughout the European continent.

Regional and National Water Associations

Association québécoise des techniques de l'eau (AQTE)
6065 Sherbrooke St. W., Montréal

Association française pour l'étude des eaux (AFEE)
23, rue de Madrid, Paris 8e, France

Association nationale pour la protection des eaux
195, rue Saint-Jacques, Paris 5e, France

Société française d'hygiène, de médecine sociale et de génie sanitaire
40, rue Lionnais, 54 Nancy, France

Centre belge d'étude et de documentation des eaux (CEBEDEAU)
3, boul. du Frère-Orban, Liège, Belgium

Association industrielle pour la protection des eaux et de l'air contre la pollution
A.S.B.L., rue Ravenstein 4, 1000 Brussels, Belgium

European Water Pollution Control Federation
19, Kürbergstrasse, Zurich 8049, Switzerland

Association suisse de contrôle de la pollution des eaux
36, Herzostrasse,
5000 Aaraw, Switzerland

American Water Works Association (AWWA)
2 Park Avenue, New York, New York 10016, U.S.A.

Water Pollution Control Federation (WPCF)
3900 Wisconsin Avenue, Washington, D.C. 20016, U.S.A.

American Public Health Association
1790 Broadway, New York, New York 10019, U.S.A.

Organizations concerned with environmental quality

Conseil québécois de l'environnement
401 Sherbrooke St. E., Montréal 406

Quebec Wildlife Federation
6424 St. Denis St., Montréal 326

Société pour vaincre la pollution
Box 65, Place d'Armes, Montréal

Society to Overcome Pollution (STOP)
2052 St. Catherine St. W., Montréal

Association fédérative régionale pour la protection de la nature
14, avenue des Vosges, Strasbourg, France

Centre de recherche pour l'éducation permanente et l'action culturelle
8, rue de la Cossonnerie, Paris 1er, France

Ligue suisse pour la protection de l'eau et de l'air
Kurestrasse, 19 Zurich 80-49, Switzerland

Information Centre, European Committee for the Conservation of Nature and Natural Resources
Council of Europe, Strasbourg, France

Research sources on technical terms

Comité d'étude des termes de l'eau
Association québécoise des techniques de l'eau
6065 Sherbrooke St. W., Montréal

*Office de la langue française, Department of Cultural Affairs
Parliament Buildings, Québec

Comité d'étude des termes techniques français
23, rue Philibert-Delorme, Paris 17e, France

René Colas
21 bis, avenue de Ségur, 75 - Paris 7e, France

Swedish Centre of Technical Terminology
Box 5073, Stockholm 5, Sweden

*The Office de la langue française, upon request, distributes free the bulletins published by the Comité d'étude des termes techniques français.

Water Manuals

Water and Man : World Survey — (free) —
United Nations Educational, Scientific and Cultural Organization (UNESCO)
Place de Fontenoy, 75 - Paris 7e, France

Premier Rapport de la Commission juridique des Problèmes de l'Eau —
Department of Natural Resources
Parliament Buildings, Québec

L'Eau : les Besoins et les Ressources du Canada —
Éditions du Jour, 1651 St. Denis St., Montréal

Water Research in Canada — Special Study No. 5 —
Science Secretariat, Ottawa

Dossier Pollution —
Éditions du Jour, 1651 St. Denis St., Montréal

Water, Source of Life — (free) —
Department of Energy, Mines and Resources, Ottawa

La Pollution des Eaux —
Collection « Que sais-je ? » (983)
Presses Universitaires de France, 108, boul. Saint-Germain, Paris, France

La Soif du Monde et le Dessalement des Eaux —
Collection La science vivante
Presses Universitaires de France, 108, boul. Saint-Germain, Paris, France

Lexique anglais-français des Techniques des Eaux —
Association québécoise des techniques de l'eau
6065 Sherbrooke St. W., Montréal

Water Publications

Water & Pollution Control
1450 Don Mills Rd., Don Mills, Ont.

Civic Administration
481 University Ave., Toronto 2

Towns & Cities
1215 Green Ave., Montréal 215

Eau du Québec
Association québécoise des techniques de l'eau
6065 Sherbrooke St. W., Montréal

La Revue municipale
Suite 310, 3500 Parc Lafontaine, Montréal

Cités et Villes
2055 Peel St., Montréal

La Tribune du Cebedeau
3, boul. du Frère-Orban, Liège, Belgium

La Technique de l'Eau et l'Assainissement
9, rue du Monastère, Brussels 5e, Belgium

Information : Eaux
23, rue de Madrid, Paris 8e, France

Terres et Eaux
92, rue de Bonaparte, Paris 6e, France

Techniques et Sciences municipales et Revue l'Eau
9, rue de Phalsbourg, Paris 17e, France

Vie et Milieu
Masson & Cie, 120, boul. Saint-Germain, Paris 6e, France

Eau pure
195, rue Saint-Jacques, Paris 5e, France

Hygiène et Confort des Collectivités
46, rue Ampère, Paris 17e, France

Nature et Ressources
Place de Fontenoy, 75 - Paris 7e, France

Films About Water

Title	Code No.	Agent*
The Waste of Waters	6742	Q.F.B.
Le Prix de l'Eau	6682	Q.F.B.
Fleuves en Péril	7290	Q.F.B.
Un Don du Ciel	7289	Q.F.B.
La Clarification des Eaux boueuses	7229	Q.F.B.
A River with a Problem	106 C 0161 015	N.F.B.
Une Rivière en Danger	6491	Q.F.B.
A Matter of Attitude	106 C 0168 111	N.F.B.
Une Question d'Attitude	106 C 0268 111	N.F.B.
Water	106 C 0161 070	N.F.B.
L'Eau	106 C 0261 070	N.F.B.
Element 3	105 C 0165 126	N.F.B.
Élément 3	105 C 0265 126	N.F.B.
The Origin of Weather	106 C 0163 004	N.F.B.
Phénomènes atmosphériques	106 C 0263 004	N.F.B.

*Q.F.B. : Quebec Film Board, 360 McGill St., Montréal
*N.F.B. : National Film Board, 3155 Côte de Liesse, Montréal