Environment Canada Environnement Canada

Environment
UPDATE

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A Large Subject

Water is all around us -- in our oceans, lakes and streams, in our glaciers and the ground beneath our feet, in rain and snow and the air we breathe. But today we no longer take it for granted, as we all too often did in years gone by. Water now is a key concern in our national, regional and local planning -- yes, and our global planning too.

This is reflected in the shared jurisdiction over water resources by governments at every level, and by the involvement of numerous world organizations and international agencies. Occasionally this concern flares into disagreements and disputes, even between the best of friends and neighbours.

Water is so important that practically every sector of Environment Canada is occupied with it to some extent. For some, like the scientific and technical staff of the Inland Waters Directorate, it is a primary and overriding interest.

Quite reasonably, then, this issue of Environment Update is devoted entirely to water and water-related problems. As the range of the articles indicates, the subject is large as well as important.

John Roberts
Minister

Prairie Focus on Water

Water continues to be a major environmental issue in the prairies and northern Canada.

In Alberta a prime concern is the increasing demand for water by petrochemical and tar sands developments, and the quality of that water when returned to the environment. There is also concern over the construction of dams for hydroelectric and irrigation development on such rivers as the Oldman, Peace, Slave, Bow and Battle, and possible construction of an Alberta inter-basin water transfer system moving northern waters to the south for irrigation.

Saskatchewan is faced with increasing levels of pollutants in river systems originating in Alberta, groundwater contamination from chemical spills and waste disposal, and the overcommitment of water to southern areas of the province.

Manitoba's prime concern is still the potential effects of the Garrison water diversion project, described in a separate article. But there is also apprehension over increased dam construction on the Churchill River, and the effects of acid rain in northern lakes. In both Manitoba and Saskatchewan, there is special concern over the effects of acid rain on northern lakes caused by emissions from the petrochemical and energy industry in Alberta.

In the Northwest Territories the main problems still are water quality and the potential impact of increased industrial development. In particular, there are concerns about the downstream impact of major development projects in British Columbia, Alberta and Saskatchewan on the Mackenzie River system and delta.

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Setting Our Priorities

We have always recognized, however imperfectly, that economic development depends to some extent on the environment. But so far the nature and importance of this dependence have been poorly understood. Consequently, environmental concerns are often treated as lower priority issues which should not be allowed to impede economic growth.

Current studies should help to correct this situation, by improving our understanding of the relation between economic activity and the environment. Thus they should help us arrange our priorities in a proper, more reasonable way.

A promising area of study is the role of water in economic development. Water-dependent industries such as agriculture and pulp and paper production account for some 40 per cent of Canada's gross national product. The economic value of Canada's water is estimated at roughly 5 percent of the GNP--about $15 billion a year.

Water has an obvious economic role in shipping, power production and industrial cooling. It has a less obvious economic role as a medium for disposing of wastes. The user of water rarely if ever pays the full cost of the service it provides him; nevertheless, somebody pays--and this brings us to the distribution of costs.

Sometimes government pays the costs on behalf of the taxpaying public. But often there are no direct financial costs, but rather costs in terms of human health, convenience and enjoyment. It is difficult to identify such costs, let alone determine who pays or should pay them.

Besides the cost problems there are also physical problems, such as the availability of adequate quantities and quality of water. Then, too, we are faced with problems arising from the multiple uses of water--uses which often compete or conflict with each other. For example, damming a river to generate power may interfere with valuable fisheries, navigation or other uses.

Some competing uses are not usually related to economic activity. Among them are recreation and sheer aesthetic enjoyment, to which we can fix no realistic price tag. Such uses, though, are too important to ignore.

This competition between different uses of water is an area requiring more detailed study, if we are to achieve the kind of economic growth we want. The question is not just what water is worth, or what are the costs of using it. We must also determine whether there is enough water of the right quality at the right time and place.

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The Inland Waters Directorate

Until recently, Canadians used water without much thought or care. In some areas, however, water shortages now are hampering social and economic development. The Inland Waters Directorate (IWD) works with provincial governments to deal with such problems and to plan for the future. Currently IWD is reviewing federal government strategies for the next quarter century.

A major activity of IWD is water management and planning, based on an understanding of social needs and priorities. River basin plans are generally developed and implemented under federal-provincial agreements, with public participation. They consider existing and potential uses of water, in the light of national, provincial and local objectives. IWD is especially involved with interjurisdictional basins--watersheds shared by provinces, territories or countries.

Flood damage reduction is another major aim of water planning and management. In 20 years federal and provincial governments have spent more than $200 million on flood control. Yet flood relief payments remain high. IWD is cooperating with the provinces to complete flood risk maps and to identify flood-prone areas where development should be discouraged.

Public and political pressure over water problems has intensified as expanding development--particularly in the United States--has made heavier demands on water and the environment. Canadian concerns include the increasing use of Great Lakes water to serve American interests which may preempt Canada's own requirements. Then, too, there are concerns for water quality along our international border.

Many contentious Canada-U.S. water matters are referred to the International Joint Commission (IJC), established in 1909. IWD is the principal Canadian federal agency providing specialists who cooperate with U.S. officials in studies for the IJC.

Collecting data is fundamental to water planning and management--for hydroelectric schemes, irrigation projects, navigation channels, dams and dikes, bridges and culverts, flow forecasting and interjurisdictional water allocation.

The Water Survey of Canada has published streamflow and water level data regularly since 1908, and data on sediment transport and accumulation since 1961. Under cost-sharing agreements with provinces and territories, it processes data from 2 700 hydrometric gauging stations.

Water quality data are important in monitoring and surveillance of lakes and rivers, including the Great Lakes, at international and interprovincial borders. Chemical and bacteriological analyses of samples from 4 000 locations in Canada are carried out in IWD laboratories.

An important priority is the development of guidelines or objectives for water quality. Data from federal and many provincial programs are stored in a National Water Quality Data Bank (NAQUADAT) and published regularly for governments, universities, consultants and environmental groups.

Research provides fundamental knowledge on which to base sound water management decisions. Studies by the National Water Research Institute and National Hydrology Research Institute are focused on the effects of acid rain on lakes and river systems, the movement of toxic substances in groundwater and elsewhere in the aquatic environment, and the dynamics and effects of river ice. Other research is contracted to industry, and a subvention program supports research at Canadian universities.

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New Steam-Electric Code

A code of good practice for the Canadian steam-electric industry is being developed by the Environmental Protection Service. The code will help identify ways to incorporate environmental protection measures in the siting, design, construction and operation of power plants, at minimal cost to consumers of electricity.

A federal-provincial-industry task force is assisting in the development of the code, intended to promote environmentally responsive technologies and practices.

Although not a legal instrument, the code will reflect Environment Canada's position on appropriate water pollution control practices.

The code will be published as a number of manuals, the first of which will focus on design aspects. The development of this document will soon be announced in the Canada Gazette.

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Focus on Toxic Wastes

Concern is mounting about contamination of the aquatic environment by toxic chemicals. Increasing evidence indicates that exposure even to minute concentrations of certain chemicals may be creating serious environmental and human health problems.

Particular concern centres around chemicals that do not break down, but get locked into the food chain after penetrating living organisms.

Major points of entry into the environment are wastewater discharges from municipal and industrial sources. The National Water Pollution Control Program, conducted by the Environmental Protection Service provides a focus for federal government activities dealing with this problem.

Pollution control efforts previously concentrated on long-familiar pollutants with short-term localized effects. Current methods are being evaluated to determine their adequacy in controlling the discharge of persistent toxic pollutants. And now it seems new technologies and control measures may be required.

EPS is collaborating with provincial agencies, industry associations and individual companies to identify, measure and control the stresses on the aquatic environment from municipal and industrial wastewater. Specific surveys seek to identify toxic chemicals from various sources, including :

- selected industry and municipal effluents veing discharged into the St. Clair River and the Ottawa River at Cornwall
- petroleum refinery effluents
- steel mill effluents
- coal-fired power plants
- fertilizer plants
- leather tanning operations
- chloralkali plants.

Results of these surveys, combined with findings from wastewater quality studies, will be used in developing federal environmental protection codes.

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Water Issues Down East

Major water issues in Canada's Atlantic region include acid rain, toxic and hazardous waste disposal, flooding, energy development, and domestic and industrial pollution. Water supply is also a problem in some places.

Although acid rain is an international problem, Atlantic Canada is particularly vulnerable because of its proximity to major industrial centres in eastern Canada and the United States.

An emerging problem is the general proliferation of toxic substances. Those that have received extensive study in the Atlantic region include polychlorinated biphenyls (PCBs), mercury, cadmium and chlorobenzenes.

Flooding has long been a problem in the region, especially during the annual spring runoff. During the 1970s, some $19 million in federal-provincial disaster compensation payments were made in New Brunswick alone. Parts of Nova Scotia and Newfoundland also experience significant flooding.

There are numerous opportunities for energy development in the region, many of which have important implications for water management; for example, hydroelectric power in Labrador, coal development in Nova Scotia and New Brunswick and the tidal power development in the Bay of Fundy.

Domestic and industrial pollution have a serious impact on Atlantic fisheries. Two pressing issues are the deterioration of salmon stocks and other fish that leave the ocean to breed upstream, and bacterial contamination of shellfish beds in the estuaries. In a region where most of the population lives on or near the coast, pollution of the estuaries is a major concern.

Water supplies are generally adequate to meet most needs, but some areas experience intermittent shortages. This is especially true in coastal communities, where saltwater contamination of groundwater is often a problem.

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Saving the Shellfish Industry

Environment Canada's Shellfish Water Quality Program is designed to protect the public from eating contaminated shellfish. Under this program, the Environmental Protection Service carries out sanitary and bacteriological surveys of shellfish-growing areas in the Maritimes--principally in river estuaries --to determine whether the quality of the water is acceptable for harvesting shellfish.

Waters are classified as approved, conditionally approved, restricted or prohibited, according to the procedures and standards stipulated under the National Shellfish Sanitation Program. These were agreed upon by Canada and the United States in the Bilateral Shellfish Agreement signed in 1948.

Molluscan shellfish, such as oysters, clams and mussels, are highly susceptible to contamination because they are filter-feeders. Because they accumulate and concentrate bacteria, viruses and toxic chemicals from the overlying waters, they may become contaminated even at some distance from sewer outfalls and other waste discharge points. Contamination of shellfish-growing waters can be caused by untreated municipal and industrial wastes, seepage from poorly operating tanks and tile fields, runoff from agriculture, pastures and feedlots, or direct discharges from pleasure craft and fishing boats.

The health hazard in consuming contaminated shellfish is particularly high because shellfish are often eaten raw or only slighted cooked. This may cause such diseases as hepatitis, typhoid, cholera, salmonellosis, gastroenteritis and paralytic shellfish poisoning.

Coastal pollution is extremely detrimental to the Maritime shellfisheries. This year 240 shellfish-growing areas covering some 100 000 hectares were closed to the direct harvesting of shellfish. Unless adequate measures are taken to control this pollution, available harvesting areas will inevitably be further reduced.

The adverse economic impact of coastal pollution on a local shellfish industry may be seen at Caraquet Bay in northeastern New Brunswick--one of the most productive oyster areas in the Maritimes. Nearly 2 500 hectares in Caraquet Bay now are closed to direct harvesting of shellfish because of fecal contamination. If the pollution problems there were eliminated, the local oyster industry could increase its annual earnings from $550 000 to $2 million.

The Environmental Protection Service is working with provincial and other federal agencies to alleviate the pollution of Maritime shellfish-growing waters. Effective pollution abatement and control measures could result in the reopening of substantial areas for the harvesting of shellfish.

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N.B. Flood Forecast Centre

A New Brunswick flood forecasting centre has significantly reduced flood damage in the Saint John River basin. The cost of this damage has recently averaged some $3 million a year.

The centre, a component of Environment New Brunswick, has been allocated $1.4 million in funding between 1977 and 1987, contributed equally by the federal and provincial governments. This is used to calibrate and test mathematical computer models, cover computer costs, operate data networks, purchase equipment and pay some of the centre's staff.

Regular staff include a director, an engineer and several technologists. During critical forecast periods, including every spring, additional staff are supplied by the New Brunswick Electric Power Commission and the Inland Waters Directorate of Environment Canada.

The N.B. Electric Power Commission and the Inland Waters Directorate are two of many agencies supplying data and other assistance to the centre. Others include the Atmospheric Environment Service, the New Brunswick Emergency Measures Organization, the United States Geological Survey and the U.S. National Environment Satellite Service.

Tidal Power Nears Realization

Harnessing the tides in the Bay of Fundy --among the highest in the world--has long been the dream of engineers and visionaries. In 1980 the Tidal Power Corporation, a Nova Scotia crown corporation, began work on a project to turn this dream into reality.

A single 17.8 MW turbine, of a design never before used in Canada, is being installed on an island linked by causeways to the shore of the Annapolis River, near the mouth of the estuary. Power will be generated by the outgoing tides, nearly 7 metres high at this point.

Annapolis Royal is one of the oldest European settlements in Canada, and beside the river above the town is the most fertile agricultural land in Nova Scotia. The extensive historical restoration in the area, tourism, agriculture and the local fishery thus were prominent concerns of a federal-provincial working group established to review the impact study by the Tidal Power Corporation.

Represented on the working group were Environment Canada's Inland Waters Directorate and Environmental Protection Service, the Department of Energy, Mines and Resources, the Department of Fisheries and Oceans, and the Nova Scotia Departments of Agriculture and the Environment.

The review focused on the flooding of agricultural land with salt water, or increasing salinity in the root zone of crops; sedimentation in the headpond; erosion of the river banks; scour and deposition downstream of the turbine; floodwater forecasting and routing; fish passage; and interference with the visual landscape and tourist traffic.

The Annapolis tidal power project incorporates the same type of turbine that might be used in a much bigger project to generate power using the Bay of Fundy tides. Such a project, now under review by the Government of Nova Scotia, would employ up to 128 similar turbines with a total capacity of 4 028-4 864 MW.

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Flooding the Skagit Valley

Environmentalists are still nervous about plans to raise the Ross Dam in northern Washington state, which would flood a large part of British Columbia's Skagit valley. This proposal has been a controversial issue since 1967, but in fact it goes back much further.

The Ross Dam, 50 km south of the international boundary, was the farthest upstream of several dams built on the Skagit River for the Seattle City Light Company. When the dam was first proposed in 1942, the International Joint Commission issued an order of approval to allow a final reservoir level of 525.8 metres.

In 1953 the dam began operating at the first stage maximum elevation of 488.4 metres, flooding some 200 hectares of land in British Columbia. When the reservoir is at less than maximum level, unsightly stumps are exposed in this small area just north of the border.

If the dam is raised to the approved second-stage level of 525.8 metres, the reservoir will extend a further 14.5 km into Canada, flooding about another 2000 hectares. Public opposition to this move convinced the provincial government that the project should not proceed. The provincial and federal governments have since been firmly opposed to the flooding of the Skagit.

Following years of hearings, attempts by B.C. to negotiate a settlement in lieu of completing the High Ross Dam have been unsuccessful. During this time, B.C. and Seattle have been seeking an acceptable arrangement whereby no further flooding of the valley would take place if an alternative supply of power were provided from another project in B.C.

Last year British Columbia, after trying unsuccessfully to negotiate such an agreement, asked the IJC to rescind the 1942 order permitting the raising of the water level in the reservoir. On April 28 the IJC refused this request, but imposed a one-year moratorium on the flooding of the Skagit to allow more time for a negotiated settlement.

That the raising of the Ross Dam level is so controversial is not surprising, if we consider the immediate and long-range effects of such an act. It would have profound environmental and ecological consequences for the Skagit valley and for many people on both sides of the B.C. - Washington border.

Just 125 km east of Vancouver, the picturesque Skagit valley is in a transition zone. It supports an unusual mixture of plant species, from the wet coastal forests of the west and the dry interior forests of the east.

The flooding of this valley would inundate some 2600 hectares of forests in addition

to 210 hectares of present reservoir, 145 hectares of river and swamp, 20 hectares of meadow and 12 hectares of roads. Seventy-five per cent of the valley's natural floodplain would be lost, as well as small pond ecosystems and backwater channels.

The inundation of the valley floor would affect the hunting, fishing, educational, research, recreational and commercial potential of the area. The loss of the river and valley bottom would destroy important habitats and spawning areas for fish -- rainbow trout, cutthroat, eastern brook trout and dolly varden char -- and reduce the numbers of wildlife, notably deer, cougar and ruffed grouse.

The area now is uninhabited, accessible only by a gravel road from Hope, B.C. But it offers opportunities for hunting, fishing and other recreation associated with this unique environment. The development of better roads, beaches, campgrounds, boat docks and other facilities would make it more useful to the four million people in the province's lower mainland and the Seattle metropolitan area.

If fluctuations in lake levels were controlled during the major recreational season and if shorelines were suitably cleared, recreational use of the valley would be greatly increased by the raising of Ross Reservoir. This would have a major impact on the delicate ecosystem of the valley, especially on wildlife, fish populations and water quality.

Social pressures reflect a preference for keeping the Skagit valley in its present state. This social preference for conservation and preservation of natural areas has led many to deplore the possibility that an untouched ecology, accessible but wild, may be replaced by and artificial reservoir. Uncertainty about the future strengthens this preference and reinforces the concern that future generations have some say about irrevocable environmental changes.

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Manuals Help Clean Up Spills

The threat of oil spills along British Columbia's scenic coastline is a major ecological problem for those involved in their cleanup.

The Pacific and Yukon Region of the Environmental Protection Service has prepared an invaluable resource manual to aid in the protection, cleaning and rehabilitation of environmentally sensitive areas along B.C.'s southern coastline.

Guide to the Preparation of Shoreline Protection and Cleanup provides detailed scientific and environmental data for government agencies and industry directly involved in coping with environmental emergencies in the area. It helps reduce communication problems during an actual spill response, thus facilitating a faster and more effective cleanup.

The manuals identify and classify sensitive areas according to biological and human importance, currents, shoreline types and overall environmental impact. Each regional description is accompanied by a series of large and small scale maps, giving an overview of how serious the problem is and symbolic and narrative advice on shoreline protection and cleanup strategy.

Spill countermeasures are suggested for each specific site. These techniques are graphically illustrated to provide a comprehensive picture of cleanup methods.

Another publication, Oil Spill Countermeasure Equipment in the Pacific Coastal Region, will familiarize cleanup crews with the location of countermeasure equipment nearest a spill site. It lists types of dispersants, clothing, equipment type and size available from private industry, along with contact persons and their phone numbers.

Supplementing the manuals is a series of videotapes showing a continuous oblique aerial view of the shoreline. The videotapes serve as a permanent record of shoreline landmarks.

The videotapes and manuals have already proved their worth.

In October 1981, an extensive black oil slick was reported on the Canadian side of Juan de Fuca Strait, but cleanup was impossible because of thick fog. However, a videotape of the area gave a clear view of the existing shoreline; and with the help of the videotape and the area manuals, the Coast Guard and other government agencies predicted the movement of the slick and took the appropriate measures to protect the shoreline. The slick dispersed naturally at sea.

The B.C. Petroleum Association has realized the benefits of the manual system and in cooperation with EPS is devising a manual for the Port of Vancouver.

Manuals and demonstration tapes can be obtained from the Pacific Region office of the Environmental Emergency Branch, Capilano 100 Park Royal, West Vancouver, (604) 666-6711, Woodward-Clyde Consultants Ltd., 16 Bastion Square, Victoria.

Garrison Dispute Still Goes On

Controversy still swirls around the Garrison water diversion project in North Dakota. Farmers there view the project as a boon to agriculture, but across the border many Manitobans regard it as a plan for environmental disaster.

The dispute has made headlines for over a decade--but what's it really all about?

Garrison itself is a $300 million dam on the Missouri River in central North Dakota which was actually completed back in 1955. But there has since been planning and discussion of a massive water diversion scheme--now projected to cost $1 billion--to use the water retained by the dam for irrigation.

The diversion project, initially designed to irrigate 250 000 acres of semi-arid grasslands in central and northern North Dakota, would take water from the southward-flowing Missouri-Mississippi river system across the continental divide, for use in parts of the Hudson Bay drainage basin.

Water would be lifted from Lake Sakakawea, a reservoir formed by the Garrison Dam on the Missouri, and moved by a complex system of canals, pumps and reservoirs to the north-central part of the state. The wastewater would then be drained into the northward-flowing Sheyenne, Souris and Red River systems, flowing through Manitoba into Hudson Bay.

Should the whole project be completed as planned, it would provide a direct link between the Missouri River drainage basin and the Hudson Bay drainage basin. These waters have been separate since the last ice-age some 10 000 years ago, and linking the two systems would have a serious environmental impact.

The plan has drawn fire not only from the Canadian and Manitoba governments, but from environmentalists in both Canada and the United States. Not only would the project introduce "foreign" species of fish, fish parasites, diseases and other organisms into Canadian waters; in addition, the discharge from the irrigation systems would be heavily contaminated with nitrates, phosphates, sodium and dissolved solids.

Increased levels of chemicals in the water would cause serious problems for downstream cities and towns in both countries drawing their water supplies from affected rivers and lakes. And although the water could be made safe for drinking, this would require expensive and sophisticated filtration systems.

The introduction of foreign fish (particularly the gizzard shad and rainbow smelt) along with their parasites and diseases could be disastrous for Canadian fish species in Manitoba. Should the alien fish become established in Canadian waters, especially Lakes Winnipeg and Manitoba, some critics claim up to 50 per cent of the province's sports and commercial fish would be destroyed.

Since the initial proposals were made, much has taken place. Plans have been modified to reduce the scale of the project, and studies have been conducted on fish screens and filter systems in an attempt to reduce the potential negative effects. The International Joint Commission reviewed the project in 1977, resulting in a recommendation that "those portions of the Garrison Diversion Unit which could affect waters flowing into Canada not be built at this time."

The National Audubon Society in the United States challenged the project in the federal courts, gaining a ruling that the project must be given new approval by Congress. Different U.S. federal administrations have given the project widely varying levels of support, and numerous options and alternatives have been explored.

However, despite the major opposition to the project in both the U.S. and Canada, and despite some of the temporary setbacks it has received, the Garrison diversion scheme has continued to inch forward. And each step brings it closer to the ultimate decision either to proceed or not to proceed. Many people believe a go-ahead would violate the Boundary Waters Treaty between Canada and the United States.

The Manitoba government now has appointed Crown Attorney Dirk Belvins as its representative in Washington in the ongoing fight against the project. Although his salary will be paid by the province, he will be stationed in the Canadian embassy and work under the direction of the Canadian ambassador. In addition, Manitoba has hired a Washington law firm to advise on the representation of the province's interests in Congress and the executive branch of the U.S. government.

The future of Garrison is still undecided. But the project will face continued opposition in both countries until the matter is resolved.

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Cleanup Promised for Niagara River

We owe a lot--besides a serious pollution problem--to an American chemical company that uses the Niagara River as a sewer. Among other things, it has triggered a move for a full-scale cleanup of the river.

In February 1977, the Ontario Region of Environment Canada began its review of SCA Chemical Services' proposal to build a pipeline to the Niagara River to discharge treated industrial waste. The controversy over the proposal was widespread and fierce, but the pipeline was eventually built.

Other problems along the United States side of the Niagara soon came to light, apparently much more severe than the SCA discharge.

Earlier fears were confirmed. It was established that about 99 per cent of the known toxic organic loading into the river comes from American sources.

One of the worst offenders is the Niagara Falls (New York) Sewage Treatment Plant. Since it began operations in December 1977, the plant has experienced serious operational problems with its carbon adsorption beds, vital to the removal of organic chemicals from the water. The beds were taken out of service completely in July 1978, rendering the plant ineffective.

In the following March, a New York State task force released a report which still raises eyebrows today. The task force identified 215 chemical waste dumps in the Niagara-Erie County area, including the infamous Hyde Park site. The 6 hectare property was used by Hooker Chemical between 1953 and 1974 following the closure of its Love Canal dump site. Some 80 000 tonnes of chemical waste were deposited over the life of the site, including at least 119 kg of 2,3,7,8 dioxin, one of the most toxic chemicals known to man.

It has been demonstrated that a direct hydraulic link exists between the dump site and the Niagara Gorge, and that chemicals from the dump are reaching the river. Two additional Hooker dump sites, 102nd Street and "S" area, are also known to have leaked chemicals into the Niagara.

For the past five years, Environment Canada has pressured the U.S. government to clean up the most urgent problem discharges. Meanwhile the department has stressed the need for an overall cleanup plan for the region, covering all of the chemical dumps, industrial discharges and chemical waste treatment facilities.

The Canadian government has sent numerous diplomatic notes to Washington protesting the condition of the American dischargers to the Niagara River, demanding acknowledgement of the problem and immediate action.

Canadian public interest groups, backed by technical assistance from Environment Canada, have set a precedent by intervening in U.S. courts to ensure Canadian interests are considered when discharge permits and dump site cleanup agreements are negotiated between the U.S. government and major chemical companies. At Canada's suggestion, the Niagara River Toxics Committee was formed to identify potential areas of research and coordinate activities on the Niagara.

These activities have resulted in a number of moves by the United States to clean up the Niagara River. The U.S. Environmental Protection Agency (EPA) recently allocated $7 million to rebuild the inoperative carbon filtration beds of the Niagara Falls Sewage Treatment Plant. State effluent discharge permits are being rewritten to tighten control of priority pollutants.

The EPA has also announced plans for a two to three-year accelerated cleanup. This should speed remedial action at a number of abandoned dumps near the river and tighten controls on direct industrial dischargers.

The success of this plan will be measured by improvements in the quality of the water in the Niagara. Environment Canada will be watching closely.

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Joint Action on Great Lakes

Canadians and Americans are working together to combat two major forms of pollution in the Great Lakes. These are nutrient enrichment--mainly by phosphorus from sewage and agricultural runoff--and contamination by persistent toxic chemicals.

The Great Lakes basin is the industrial heartland of both Canada and the United States, supporting some 37 million people within its boundaries. Responsibility for the quality of the lakes rests with the federal governments of both countries, the Province of Ontario and the eight Great Lakes states.

As parties to the 1972 Canada-U.S. Great Lakes Water Quality Agreement, renewed in 1978, the two countries are completing negotiations for further reductions in phosphorus loadings. From 1982 to 1985, the Canadian government will contribute $65 million toward completion of municipal sewage treatment facilities in Ontario.

This program is paying dividends. The phosphorus control program has improved water quality, particularly in Lakes Ontario and Erie. Previous signs of phosphorus pollution--tainted drinking water and water intakes clogged by excessive algae growth--are not so evident today.

The problems presented by toxic chemicals are not so easily solved. Levels of mercury, mirex and polychlorinated biphenyls (PCBs) generally have not risen, and in some places have decreased; but we still find other man-made chemical compounds in water, fish, wildlife and sediment. The 1978 agreement obliges both countries to initiate a range of control programs, aimed at eliminating sources of toxic substances entering the lakes.

The most recent report of the International Joint Commission's Water Quality Board identified 39 "areas of concern" with pollutant levels that seriously impair water use and exceed the agreed objectives.

In particular, the Niagara River poses a diversity of problems because of numerous pollution sources and extraordinarily dangerous chemicals such as dioxin.

The discharge of toxic chemicals into the Niagara River from existing municipal and industrial sources and abandoned dumpsites has been widely publicized. We now know of additional pollution sources, including over 200 dumpsites in the Niagara frontier identified by the U.S. Environmental Protection Agency (EPA) and New York State authorities, as well as 75 U.S. industrial and municipal discharges to the Niagara River.

Contamination of Lake Ontario's waters has led to the banning of commercial fishing in the lake and the issuance of health advisories to anglers.

In April the U.S. government released a report describing pollution on the American side of the Niagara River, along with an agenda for accelerated cleanup (see separate article). Detailed work plans will be developed in consultation with Environment Canada staff over the next several months.

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Improving Wastewater Treatment

Scientists at the Wastewater Technology Centre (WTC), housed in the Canada Centre for Inland Waters at Burlington, Ontario, are developing new and improved technologies aimed at eliminating water pollution.

Bench-scale and pilot-plant studies are used to assess various techniques for the control of pollution from municipal and industrial wastewater discharges, along with mobile pilot-scale equipment for field or on-site demonstration.

Since its opening in 1971, WTC has gained national and international recognition as a centre of excellence in wastewater technology. Part of its success has been gained through collaborating and exchanging information with similar institutes, industries and universities around the world.

Studies of various treatment technologies support the federal government's pollution control program and cooperatively solve specific pollution problems with the provinces and industry.

Activities at the centre include:

- separation and treatment of contaminants in municipal wastewaters
- process control aids for existing wastewater treatment plants
- treatments to remove heavy metals and other contaminants from industrial discharges
- low-cost phosphorus removal technology
- land disposal of contaminant-bearing sludges
- ultimate disposal of residues and the removal of heavy metals and radioactive

materials from mining industry waste streams.

A recent study carried out with the uranium mining industry is a good example of the centre's work. In 1978, all seven Canadian uranium producers, the Department of Energy, Mines and Resources and the Atomic Energy Control Board joined to demonstrate a new technology that would enable the operators to improve the quality of their tailings pond effluents. Following successful pilot-scale investigations completed in 1981 at Rio Algom's mine in Elliot Lake, Ontario, the company has designed a full-scale effluent treatment system for its Stanleigh mine, which will be reactivated in 1983.

Technology development is currently focused on the control of toxic chemicals in industrial and certain municipal effluents. Another major concern is the safe disposal of residues from wastewater treatment.

Energy conservation is also important. During decomposition of wastewater effluents in anaerobic digesters--a widely used process--methane gas is given off. Considerable attention is being devoted to optimizing the production of this gas to make the treatment process more energy self-sufficient.

Results of research efforts at the Wastewater Technology Centre have borne fruit:

- low-cost phosphorus removal technology used in municipal wastewater treatment plants in the Great Lakes basin
- new and improved waste treatment processes in the cleanup of industrial wastewater discharges, notably in the mining and steelmaking industries
- the development of practices for the use of sewage sludge to fertilize agricultural land.

Provincial agencies, other government departments, consulting engineers and industry increasingly rely on WTC staff for advice and assistance to solve wastewater treatment problems.

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Water Levels, Flows and Floods

Changing water levels in the Great Lakes, and varying flows in their connecting channels, have long been recognized by Canada and the U.S. as an important boundary issue. In 1909 Canada and the United States established the International Joint Commission (IJC), to seek common solutions in accord with the Boundary Waters Treaty signed that year.

The Inland Waters Directorate provides support to the IJC's Lake Superior Board and St. Lawrence River Board in regulating the outflows of Lake Superior and Lake Ontario. Throughout the year, the various hydrologic factors influencing their water levels are closely studied, and the boards are advised on regulation of the lakes.

The Lake Superior Board is currently watching construction of a new Great Lakes Power Co. plant at Sault Ste. Marie, Ontario, to monitor its effects on the St. Mary's River. The board is also involved in discussions aimed at minimizing its adverse impact on fish in the St. Mary's Rapids, an important spawning area.

The IJC's International Lake Erie Regulation Board has just completed a four-year study of the proposed limited regulation of Lake Erie water levels. It concluded that such regulation would not be economically feasible, and that shoreline flooding and erosion damage can best be reduced by other preventive and educational means.

Renegotiation of the 1950 Niagara River Treaty could lead to a reapportionment of the river's flow, to serve changing hydroelectric power requirements. Discussions are already under way between Canadian and United States power companies on the possibility of U.S. interests using some of the flow rights now assigned to two small Canadian plants.

The U.S. company is currently installing more generating capacity than could be served by the flow to which it now is entitled under the treaty. Present discussions could lead to more comprehensive Canada-U.S. negotiations, resulting in a greater use of the river for power production and a reduced flow over Niagara Falls.

Meanwhile another study, by the IJC's Diversions and Consumptive Study Board, predicts that water consumption will more than double by the year 2035. This will reduce the net water supply to the Great Lakes, thereby lowering lake levels--to the benefit of coastal zone interests and the disadvantage of navigation and power interests.

Elsewhere, the Inland Waters Directorate cooperates with the Province of Ontario in a program to reduce flood damage. Environment Canada has signed an agreement with the province to provide funding for the mapping of flood risk

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areas and for other related measures. Costs of the $9.2 million program are shared equally.

Most of the mapping studies are implemented through local conservation authorities and organized municipalities. When an area has been mapped, policies come into effect aimed at discouraging further building development in high-risk areas.

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Mapping Quebec Flood Zones

Maps have many uses--and flood risk maps are especially useful. This is currently proving true in Quebec, where a 1976 federal-provincial agreement calls for the mapping of flood plains in 180 municipalities along the province's main waterways.

The maps show precisely where floods are most likely to occur, and so help government agencies, municipalities and individuals to minimize or avoid the risk of flood damage. More specifically, they can be used in the following ways:

- To inform people of the flood danger where they reside or work at present, or in the areas to which they might move
- To alert them to take precautions against possible flooding, to minimize the damage it might cause
- To discourage or prohibit unsuitable development in flood plains--for example, by helping municipalities to zone flood risk areas
- To help public officials make wise decisions in the purchase of land for public use
- To help Protection civile du Québec and Emergency Planning Canada make contingency plans against possible flooding emergencies.

Under the 1976 flood damage reduction agreement, the Quebec and federal governments will refrain from building structures vulnerable to floods in any area designated as a flood risk area. They will not subsidize any such project in a designated area, or pay any compensation for flood damage to buildings erected there after it was so designated.

Meanwhile the two governments will urge authorities under their jurisdiction to restrict or prohibit any development in a floor risk area that might be damaged by floods.

Among the agencies directly affected by the agreement are the Quebec Housing Corporation, the Canada Mortgage and Housing Corporation, Quebec's Department of Municipal Affairs and the federal Department of Regional Economic Expansion.

In 1978 greater Montreal became the first region in Canada subject to the designation of flood risk areas under the national Flood Damage Reduction Program. In May of 1979 a joint federal-provincial committee finished mapping the Chaudière River basin from St. Georges to St. Lambert; and the following October it mapped the flood-prone inhabited regions along the Gatineau River, and the Hull-Gatineau urban region along the Ottawa River.

Also completed is the mapping of Richelieu River flood plain from the international border to Sorel, of the Assumption River and the Gouffre River from St. Urbain to Baie St. Paul. Future mapping will cover certain areas along the Yamaska, Nicolet, Bécancour and St. Frances rivers.

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Water Quality in Quebec

Quebec, like Ontario, is highly vulnerable to acid rain--especially in the Canadian Shield, with its boreal forests and myriad lakes. This is because they lack the alkaline buffering capacity of lakes and streams in many other areas.

Acid rain is therefore a serious concern of the Inland Water Directorate's Quebec regional office. And its Water Quality Branch appropriately is involved in analyzing water samples from some of the more affected areas.

The branch's prime focus in Quebec, however, is still the industrialized St. Lawrence River lowlands and the Ottawa River valley. Since 1977 the branch has maintained a network of some 40 monitoring stations along the St. Lawrence River between Cornwall, Ontario, and Quebec City; since 1979 it has maintained a similar number on international rivers near the Quebec-United States border.

Besides testing water samples, the branch analyzes fish, molluscs and sediments for

such toxic substances as heavy metals, polychlorinated biphenyls (PCBs), organochlorinated pesticides and herbicides. High levels of mercury and PCBs have been found in parts of the St. Lawrence River, notably in the Montreal area and upstream.

Lakes St. Francis and St. Louis are highly contaminated. In Lake St. Francis fish and sediments have high levels of PCBs--the highest in the St. Lawrence; and small amounts of mirex have been found in some species of fish. In the southern part of Lake St. Louis, just upstream of Montreal, high mercury levels are attributed to a chloralkali plant on the south shore.

Attention is turning increasingly to water crossing the international border. Since 1979, the Water Quality Branch has monitored 20 rivers crossing the 45th parallel and 10 tributaries of the upper Saint John River crossing the Quebec-Maine border. The branch has identified three transboundary rivers as heavily polluted by domestic and agricultural wastes. Besides promoting the growth of weeds and algae, this makes them unsafe for swimming and other water sports.

Although two of the rivers, the Tomifobia and the Rock, are relatively small, they may have an important local impact on the receiving waters of Lakes Massawippi and Champlain. There is also much local concern about the water quality in the St. Francis River on the Quebec-Maine border.

Further information:
Water Quality Branch
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Data Now More Accessible

The National Water Quality Data Bank (NAQUADAT) has undergone a major conversion to make data more accessible.

Inland Waters Directorate has reorganized the data base structure to take advantage of the System 2000 data base management system. NAQUADAT is now operated at the Computer Science Centre in Ottawa, and data may be accessed interactively across Canada through the DATAPAC telecommunications network.

NAQUADAT data bases include results from water quality surveys across Canada. These are conducted largely by the Water Quality Branch but data from other agencies are also represented. An individual water sample, identified by location and time, may be subjected to more than 50 analytical measurements. Some of these are obtained from on-site tests, but most analyses are performed in the regional Water Quality Branch laboratories.

For storage, each result is associated with a method code to identify the analytical methodology employed. NAQUADAT stores results of some 1 200 different chemical, physical and biological tests, described in the 1982 Dictionary of Parameter Codes.

Major ion chemistry formerly accounted for most of the information in the data bank. Recently, however, the emphasis has shifted to toxic and trace organic contaminants.

A new NAQUADAT Guide to Interactive Retrieval explains how to use the system to obtain water quality information.

Further information:
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Reviewing Regulations

A technical review committee, including representatives of government and industry, is currently reviewing regulations and guidelines covering pulp and paper effluent and metal mining liquid effluent. The committee is seeking public input for this review, announced in the Canada Gazette.

The review is aimed at revising the regulations and guidelines to take account of recent technological developments in the industries concerned. The committee includes representatives of Environment Canada, the Department of Fisheries and Oceans, the Department of Energy, Mines and Resources, the Atomic Energy Control Board, provincial governments and private industry.

Inquiries and comments should be addressed to either:

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or

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Institute Aids Water Management

Space satellites and sediment samplers are among the many tools used by the National Water Research Institute in solving water management problems. The institute's headquarters are in the Canada Centre for Inland Waters at Burlington, Ontario, with detachments in Winnipeg and Vancouver.

More than 200 people are on staff, in five research program divisions:

- The Aquatic Ecology Division studies physical, chemical and biological processes in lake waters and their sediments. Special concerns are the aging, degradation and nutrient enrichment of lakes, and the effects of acid rain and other airborne pollutants. As part of this work, the division is seeking acceptable ways to control algae and weeds, and to assess changes in marshland ecosystems.

- The Aquatic Physics and Systems Division investigates circulation, mixing and other physical processes in inland waters, and how they affect water levels, heat balances and the dispersal of contaminants and nutrients. Staff develop numerical models of lake processes that can be operated on computers and store data essential to the Canada-U.S. Great Lakes Water Quality Program and the United Nations' Global Environmental Monitoring System.

- The Hydraulics Division studies the evolution of shorelines and the effects of protection methods, the mechanism of wave generation, jamming of ice and mixing of pollutants in rivers, sediment transport in lakes and rivers, and the movement of stormwater and pollutants in urban areas. Its laboratory facilities include a 100 metre wind-wave flume, unique in Canada; a large-scale cold room with water flumes; and an offshore instrumental research tower in Lake Ontario.

- The Analytical Methods Division develops better ways to identify and measure chemical and microbiological pollutants. It operates regional, national and international quality national quality control programs in analytical chemistry to ensure that measurements made by collaborating laboratories are comparable.

- The Environmental Contaminants Division focuses on the complex interactions and eventual fate of toxic chemicals in freshwater ecosystems--on what happens to synthetic organic compounds such as PCBs, heavy metals such as mercury, and radioactive contamination. This information is needed to trace contaminant sources and estimate hazards to people and other living things. Also under investigation are chemical processes controlling the susceptibility of lakes to acidification.

The Technical Operations Division provides vital technical support, including diving expertise. It uses a wide range of engineering skills to design research instruments and other equipment that will withstand the rigours of Canadian waters and winters.

Further information:
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What's WATDOC?

In the early '70s the Inland Water Directorate established a computerized system to manage its growing collections of scientific and technical literature. This is WATDOC (Water Documentation), one of Canada's first nationwide on-line information delivery systems.

Besides maintaining its established data bases, WATDOC continues to build new ones, and supports several others that make up a package of water-related bibliographic information sources. Researchers in Canada and the international scientific community may access them by using a standard textual terminal.

WATDOC's major data bases are Canadian Environment (English) and Environnement (French), covering material published or written in Canada, or relevant to Canadian environmental activities. Canadian Environment now contains 50 000 bibliographic and subject references, dating from 1972. Environnement contains 4 000 references to publications dating from 1975, about all aspects of the environment. The data base most recently developed by WATDOC is Canadian HOMS (CHOMS).

Other data bases currently available are Delft Hydro, referencing world literature on hydromechanics and hydraulic engineering; Aquatic Sciences and Fisheries Abstracts, referencing international literature on science, technology and management of marine and fresh waters; and D-Ref, referencing collections of water data managed by the department and other agencies.

Further information:
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Facilities Aid Research

What controls lake levels? What chemicals are in our lakes and rivers? What's happening to the fish there?

These are just some of the many complex problems that occupy scientists at the Canada Centre for Inland Waters at Burlington, just inside Hamilton Harbour on Lake Ontario.

CCIW is one of the world's leading water research centres, where Environment Canada shares facilities with the federal Department of Fisheries and Oceans. As the lead agency, Environment Canada is responsible for overall management of the centre; Fisheries and Oceans operates a fleet of ships serving both departments.

More than 600 scientific and support staff work in the offices and laboratories, and aboard the vessels based at the centre. Among them are hydrographers, oceanographers, geographers, land use specialists, geologists, physicists, chemists, biologists, microbiologists, toxicologists, engineers, economists, shipwrights and computer systems analysts.

They work closely with provincial and state agencies and with industry and universities on both sides of the Canada-U.S. border, conducting joint programs and exchanging data and ideas. Publications produced at the centre command international interest and respect, and CCIW experts lecture abroad and participate in international forums.

Facilities include a hydraulics laboratory; a cartographic unit; laboratories to analyze contaminants in fish, wildlife, water and sediment; and a laboratory complex for the study of wastewater treatment technology. There are also facilities for ships and launches, engineering and mechanical shops, a computer centre and a water science library.

Five different elements of Environment Canada operate from CCIW: the National Water Research Institute, the Wastewater Technology Centre the Ontario regional offices of the Inland Waters Directorate, the Lands Directorate and the Canadian Wildlife Service. The Department of Fisheries and Oceans operates the Great Lakes Fisheries Research Branch and the Bayfield Laboratory of Marine Science and Surveys.

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Underground Water Cools Building

The Atmospheric Environment Service is usually associated with happenings high in the sky. But one pioneer project is nearly 50 metres below ground--right under the AES Downsview parking lot.

It involves tapping a huge, clay-walled subterranean reservoir or aquifer and using its slow-moving water supply to air-condition a large government building throughout the summer.

This energy-saving project, carried out by Public Works Canada, is called Aquifer Thermal Energy Storage (ATES). Two pumps withdraw water from the aquifer and send it through a cooling tower at ground surface. The groundwater is then chilled by heat exchange with the outside air and returned to the aquifer by an injection well.

Chilled water is stored in the aquifer from late winter until summer. Then well flows are reversed and chilled water is withdrawn, pumped through the heat exchange system and returned to the aquifer at a warmer temperature.

Aquifers have long been used on a small scale in various parts of North America. But the current aquifer project is the first involving a large building.

Work began in 1980 after drilling tests revealed the huge, gravelly, natural reservoir under what had once been farmland. Last April, Public Works began a 20-day experiment to discover how well the aquifer responded to warm-water injections. If tests are successful, the aquifer could be in regular use for air-conditioning by 1984.

Total costs of the project over a five-year period were estimated at $1 million. Half of this will be funded by the Department of Energy, Mines and Resources under the National Energy Program.

Southern Ontario has many aquifers like the one under the AES site. They are usually several kilometres long and several metres high. Their underground water supply remains at a constant 8.8 C° all year round.

Further information:
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Wetlands in Danger

Canada's wetlands--an undervalued natural resource--are threatened with destruction because of widespread ignorance of their vital importance. But the Canadian Wildlife Service is doing something about this.

As CWS points out, marshes, ponds, swamps and bogs are important habitats for wildlife. At the same time, they act like giant sponges, soaking up rain and snowmelt, slowly releasing water in drier seasons. Thus they help reduce floods and ease droughts, adding to our supply of fresh drinking water. And much like human kidneys, wetlands filter our lakes, rivers and streams, thereby reducing pollution.

Wetlands are home to many fish, birds and other animals, meeting essential breeding, nesting and feeding needs. Of 45 endangered species in Canada, nearly half depend on wetlands.

Small mammals in wetlands, such as the beaver and muskrat, are important to Canada's fur trade. Millions of game birds and fish reared in our wetlands support a growing recreation and tourist industry.

Over the last century prime wetland areas in southern Canada have been destroyed:

- In the St. Lawrence River estuary 60 per cent of the marshes have been lost.
- Along the Fraser River 70 per cent of the marshes have been filled in.
- In the Maritimes 65 per cent of the tidal marshes have been destroyed.
- On the prairies 1.2 million hectares of wetlands have been drained and put to the plow.
- Three-quarters of the wetlands along the north shore of Lake Ontario have been lost.

Changing public attitudes is the essential first step in preserving wetlands. Governments have an important role to play by acquiring wetlands for parks, sanctuaries and reserves. The Canadian Wildlife Service is already doing this through its habitat program.

Contact your local Canadian Wildlife Service office for more information.

A Resource to Enjoy

We are all familiar with the domestic, industrial and agricultural uses of water. But Parks Canada is promoting its use for healthful recreation and enjoyment.

Within the national parks, lakes, streams and coastal waters are used by swimmers, canoeists, boaters and fishermen. Meanwhile, Canada's historic canals give access to thousands of kilometres of pleasant and attractive waterways.

At Lake Champlain, southeast of Montreal, you can begin a round trip down the Richelieu River, up the Saint Lawrence and through the Great Lakes.

The Chambly Canal bypasses the rapids between St. Jean and Chambly, and the St. Ours Canal opens the way to Sorel. It's clear sailing through the St. Lawrence Seaway to the Ottawa River and the single locks of the Ste. Anne and Carillon canals. From Ste. Anne to the foot of the Rideau Canal in Ottawa the distance is 192 km.

At Ottawa, a flight of eight locks raises boats up from the river into the Rideau Canal. Most of the locks along the canal's 200 km route are still operated by hand.

At Kingston, turn right into Lake Ontario and on to the Trent-Severn Waterway. This will take you some 390 km to Georgian Bay and Lake Huron through canal locks, a marine railway, and lake and river channels. From Georgian Bay the route is open to Lake Superior through the Sault Ste. Marie Canal.

You can return by the Soo to Lake Huron and Lake Erie, then into Lake Ontario by way of the Welland Canal.

This round trip passes each of Ontario's four national parks and many historic sites in both Ontario and Quebec.

In Nova Scotia, the St. Peters Canal cuts through the isthmus that separates Bras d'Or Lake from St. Peters Bay in Cape Breton Island. Passage is free of charge, and there are picnic grounds and camping sites in a nearby provincial park.

Further information:
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New National Hydrology Research Centre

The National Hydrology Research Institute (NHRI) is preparing to move its head office from Hull, Quebec, to Saskatoon. The move will be completed in 1985, after construction of a big new building scheduled to start in 1983. The new facility will be known as the National Hydrology Research Centre (NHRC) and will house, in addition to NHRI, units from the National Water Research Institute (NWRI), AES and IWD's Water Quality Branch (WQB).

The NHRI now has its principal offices in Hull, subsidiary offices and laboratory facilities in Ottawa, Gatineau, Vancouver, Calgary and Canmore, Alberta. These will all be relocated under one roof, close to scientists and technicians at the University of Saskatoon and at the Saskatchewan Research Council.

The move will provide easier access to field areas for a number of the institute's scientific investigations. These include research into prairie water supplies and northern and alpine hydrologic systems and their response to different environmental factors.

NHRI specializes in research related to surface waters (rivers and streams), groundwater and continental snow and ice. Its concerns include possible effects of radioactive waste and of acid rain on groundwater, the role of ice jams and glaciers in flooding, effects of northern development on permafrost, and reconstruction of past climatic changes based on glacier studies.

The NWRI contingent will be made up of the two research detachments now in Winnipeg and Vancouver. These detachments will still be greatly concerned with limnology and water chemistry in lakes and rivers of the Western and Northern and the Pacific and Yukon regions.

The AES and WQB units will also be derived from units already in western Canada. The WQB group will staff a small regional laboratory to perform analyses of water samples not destined for handling by DOE's centralized laboratory facilities. The AES unit will provide valuable hydrometeorological input into the research studies of both NHRI and NWRI.

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New Ice Centre

Improved ice information services have become a major Environment Canada priority. This was demonstrated with the June 1 opening of the Atmospheric Environment Service's brand new Ice Centre in downtown Ottawa.

The new centre houses most AES ice services under one roof--in spacious ultra-modern premises occupying two-thirds of an entire floor of the Journal Tower South. Previously, sections such as Ice Central, Ice Climatology and Ice Research had occupied sites in the federal capital.

At the opening ceremony, Environment Minister John Roberts emphasized the important part played by federal ice services in the development of Canada's north and in the expansion of its offshore resources. He said the coordination of ice services in the Ice Centre was further evidence that Environment Canada programs were being linked in a major way with the government's energy and economic priorities.

The importance of the new centre was emphasized by the holding of the opening ceremony in the middle of National Environment Week (May 30 - June 5).

Federal ice services moved to Ottawa from Halifax in 1971. Gradually, over the years, more sophisticated monitoring and control facilities have been added.

The Ice Centre is currently responsible for ice reconnaissance services, using long-range reconnaissance aircraft and side-looking airborne radar. It runs a daily ice forecasting and advisory service to aid shipping and fishermen, and prepares seasonal outlooks and 30-day forecasts.

The centre's Climatology Service includes a library of "historical" ice information and other publications, and a consultation service. The Ice Research and Development Service carries out studies in such areas as improved ice motion and growth models, digitized forecasting techniques and all-weather satellite data.

Further information:
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Data on Request

Historical information on water levels, discharges, volumes, rates of flow, temperatures and sediments is readily available to engineering and research establishments across Canada--thanks to HYDAT, the national hydrological data bank.

HYDAT is maintained by the Water Resources Branch of Environment Canada's Inland Waters Directorate, which stores and retrieves the data in metric (SI) units.

Basic hydrometric data are collected and processed by the branch's regional offices in Vancouver, Yellowknife, Calgary, Regina, Winnipeg, Guelph, Longueuil and Dartmouth, along with data from various other organizations. They are sent to Ottawa on magnetic tape, for storage by the CDC CYBER 174 computer of the Department of Energy, Mines and Resources.

The HYDAT system has eight data files:
- HYDEX: descriptive information for all hydrometric gauging stations
- FLOW: daily discharges in cubic metres per second
- LEVELS: daily water levels in metres
- PEAKS: annual maximum instantaneous discharges and water levels
- SEDEX: descriptive information for sediment stations
- SUSCON: daily sediment concentrations in milligrams per litre
- PARTSIZE: daily particle size
- TEMPERATURE: daily water temperature in degrees Celsius.

The Water Resources Branch supplies data on request on magnetic tape, computer cards, computer listings, microfiche or hydrograph plots. It also produces the following data publications series from HYDAT:
- Surface Water Data
- Historical Streamflow Summary
- Historical Water Levels Summary
- Surface Water Data Reference Index
- Sediment Data Canadian Rivers
- Historical Sediment Data Summary
- Sediment Data Reference Index.

Further information:
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Canada Sharing Technology

Canada is sharing its hydrological technology with 50 other countries under a program sponsored by the World Meteorological Organization.

Under HOMS--the Hydrological Operational Multipurpose Subprogram--the participating countries share information on field and office procedures for collecting data, computerized procedures for processing and analyzing data, hydrological models, and equipment and instrument specifications and drawings.

The program aims at providing efficient technology, increasing and improving data available to decision-makers, and creating an international framework for integrating techniques and procedures used in collecting and processing data. It is also intended to assist in its members' field projects, and in training and the application of appropriate technology--especially in developing countries.

The Canadian HOMS data base (CHOMS) is maintained by WATDOC, described in a separate article. It is accessible to anyone through Teleglobe in Europe, Telenet and Timenet in the United States and Datapac in Canada.

The Canadian HOMS National Reference Centre (CHNRC) stores summaries of Canada's contributions to the World Meteorological Organization HOMS Centre in Geneva, along with contributions from other countries. The longer-term objective is to develop the CHNRC as a documentation centre for all hydrological techniques used in Canada.

So far the centre has received queries from such countries as Bangladesh, Bulgaria, India, Niger, Panama, Switzerland, Thailand and the United States.

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