SUBMISSION

by the Department of the Environment

to the

National Hearing

of the

Inquiry on Federal Water Policy

December, 1984

Ottawa

Issues and Options

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Water Quantity Issues - Availability

1. Ground Water Availability

It has been estimated for 1981 that more than 6.3 million Canadians rely on ground water as their primary source for domestic water use and that collectively, municipal, rural, industrial and agricultural users obtain 1.5 billion cubic metres annually (or about 10% of the water use for all purposes) from ground water sources.

The quality of ground water varies throughout Canada. Climate, geology, origin and depth are major factors that determine ground water quality. In some regions, particularly the western plains, ground water, even at shallow depths, can contain more than 1000 ppm total dissolved solids (TDS). Deeper ground waters in these regions can exceed this TDS value by an order of magnitude or more. In addition to concerns about natural quality, there is a growing concern about the contamination of groundwater supplies as a result of various activities, including the underground disposal of toxic wastes.

The characteristics of ground water, its source and movement in the earth, are complex, and very expensive to monitor. The provinces, which are involved to varying degrees with the detailed management of ground water resources in Canada, have a direct need for ground water data, both quantity and quality. Each has built up a data base relative to aquifers in common use for water supply. Since these aquifers are generally the shallowest and most accessible, information on deeper ground waters tends to be sparse. Such information could be important for the evaluation of the magnitude of Canadian ground water resources. The depths to which it might be desirable to collect groundater data would be determined by such factors as quality deterioration with depth and the potential for utilization of both fresh and brackish ground waters for human or animal consumption, as heat sources, or other industrial or commercial uses. There may be a federal role to determine the extent and water-resource potential of deeper Canadian aquifers.

Provincial ground water data banks have been designed to enable the provinces to meet their individual requirements to manage their own ground water resources. In general they serve this purpose very well. Problems of federal concern are likely to occur in the vicinity of international or interprovincial boundaries. Large-scale development of boundary aquifers could give rise to a need for federal mediation or other involvement and, in particular, for a federal monitoring network localized in boundary areas. Some of the aquifers monitored in these circumstances could well be those deep-lying aquifers on which more information is required.

Since it is recognized that the federal government should be able to respond to concerns about the national ground water resource, a report on ground water use in Canada has been commissioned and a draft is now being reviewed by provincial agencies. When provincial input has been received, the report, updated occasionally, should assist the federal managers to address national ground water concerns.

Issues and Options

1. There is concern that the withdrawal of water from aquifers in the United States at ever increasing rates will affect the availability of ground water in Canada, especially adjacent to the U.S. mid-west. Similar concerns may arise with regard to ground water development in the vicinity of interprovincial boundaries.

   - Do nothing and wait for clearer signs that U.S. or Canadian withdrawal is affecting ground water in boundary areas.
   - Establish and monitor several key long-term ground water level stations in areas near the Canada-U.S. and/or interprovincial boundaries.
   - Undertake a formal program of studies to obtain baseline information on aquifers of interjurisdictional interest to facilitate assessment of the impact of future ground water development.

2. Ground water depletion has a serious effect on surface water availability. Through much of the year, surface water flow in many rivers is sustained by ground water sources, but the relationship is not well enough understood to utilize this fact in managing surface water (or conversely, in managing ground water).

   - Retain the status quo and continue to lack an understanding of the relationships between surface and ground water.
   - Place one or more contracts with universities to promote research on surface water/ground water relationships.
   - Establish a joint federal-provincial agreement between Environment Canada, Saskatchewan and Manitoba to promote research on surface water/ground water relationships (since it is known that these two provinces have an interest in this subject).

3. There is growing concern about the contamination of ground water supplies.

   - Limit activities to the current research role, except in cases where federal responsibilities are directly impacted.
   - Develop a more comprehensive national strategy in cooperation with the provinces, including monitoring needs and control options.

2. Diversions

Diversion or water transfer is the artificial withdrawal of water by canal, pipeline or other means from its natural channel, for use within the basin or in another drainage basin. Approximately 60 interbasin water transfers have been identified across Canada, resulting in a total transferred flow of 4450 m^3/s. This total is greater than that transferred in the next leading countries, the U.S. and the U.S.S.R., combined.

Historically, most large diversions in Canada have been designed to increase hydroelectric power generation, and this use is expected to continue into the future. At the same time, diversion of water for irrigation purposes and to provide for the needs of municipalities, as yet at a much smaller scale, is also projected to increase.

Over the next few years in Canada, major intra or interbasin transfer projects are unlikely given the long lead time required for planning and design, the high capital costs and environmental uncertainties associated with them. On the other hand, plans and studies are well advanced for small and medium scale storage projects and regional supply systems on the Oldman, Bow, Souris and Assiniboine rivers, as well as supply systems for the Red River valley and southeastern Saskatchewan. Many of the current plans envisaged here are based on federal-provincial supply studies carried out in the early 1970s under the aegis of the Saskatchewan-Nelson Basin Board.

The social and environmental impacts of large diversions in Canada only started to receive consideration in the 1970s (James Bay, Churchill-Nelson). With a few exceptions, existing interbasin diversions have been contained within provincial boundaries. However, an increasing number of proposed water-related projects would have impacts outside the province, and in some cases beyond the country in which they are sited. Diversion proposals which would result in impacts outside the country of origin include, for example, the Grand Canal scheme and the Garrison.

In contrast to the ground rules embodied in the Boundary Waters Treaty to govern the use of boundary waters by Canada or the United States, legislation is lacking and there are few precedents to govern the allocation and use of provincial and territorial (trans) boundary waters.

Issue and Options

From some quarters, pressure is being exerted on the provincial and federal governments to reduce water constraints to continued economic development in regions of high growth such as the prairies. At the same time, controversy exists concerning the merits of major projects to store and divert northward flowing rivers and streams because of their cost, their dislocation of established native cultural and economic activities, and feared environmental impacts. Many questions associated with inter-basin transfers remain unresolved and include, for example, the potential impacts, the responsibilities of the receiving basin and fairness to the donor basin.

- Maintain the status quo with the knowledge that donor basins and the livelihood of persons in donor basins can be adversely affected.
- The federal government could encourage the provinces to not approve future water transfers without first: developing detailed forecasts of water requirements in the areas concerned, taking into account potential impacts of future climate changes, and identifying alternative means as well as consequences of meeting such requirements; and identifying clearly the social, economic and ecological impacts on donor and receiving basins resulting from the diversions.
- The federal government could undertake independent strategic planning studies of critical areas, for example, the southern Prairies, to guide and coordinate any federal involvement in future water diversions.
- The federal government could take the lead in protecting donor basins (and receiving basins if necessary) from adverse transboundary impacts by enacting new legislation to deal with the problem.

3. Flood Damage Reduction

As flood damages across Canada mounted through the 1960s and 1970s, the federal government adopted a new approach to flood damage reduction. The program, begun in 1975, calls for several objectives to be met. In the first phase: clear identification of flood risk areas; communication of flood hazard information to the public, industry and government agencies; discontinuance of investment of public funds for structures subject to flood damage in flood risk areas; a stop to flood disaster assistance for future development once a flood risk area has been designated and publicized; and consideration of restrictions on land use in flood risk areas by provinces and municipalities. In the second phase, various means of protecting existing development is examined. Flood control schemes may be constructed provided preceding studies show they are warranted.

In phase 1, good progress has been made but Alberta and British Columbia still have not joined the program.

To August 31, 1984, there have been 42 designations, covering 300 communities with a population of 7 million people. Toronto, Montreal and Winnipeg are the largest cities designated.

Three provinces temporarily reduced their rate of activity in the program because of public pressures or to review the specifications which they had already agreed to. One province has resumed activity again and, from preliminary discussions with the other two, it is believed they will be returning, requesting little change in the acceptable level of the program.

Phase 2 depends upon completion of the first phase, and consequently is not as far advanced. Nevertheless implementation programs are continuing in seriously threatened areas such as Montreal, and flood forecasting is practised each spring in most major river basins in an attempt to improve awareness of potential major floods as they develop.

Issues and Options

1. There will likely be resurgent pressure to de-designate and to build protective structures so that economic development in the floodplain can return to pre-designation levels. The value of federal investment in the program could be lost if this were allowed to happen.

    - Encourage communities to develop a local authority that will actively make the best compatible use of flood plain lands.
    - Keep policies of the FDR Program in place indefinitely.

2. Current federal policy requires a local contribution when structural works are funded; otherwise, the taxpayer at large pays all of the costs. Generally, when the local level shares the costs, its expectations tend to be more realistic. While local contributions to the costs of remedial works is an accepted principle by senior governments, local pressure is building toward reducing or eliminating them.

   - Continue the local contribution at the current level.
   - Raise the local contribution above current levels. This would tend to increase local interest in the search for less costly solutions.

3. Make more imaginative use of federal disaster assistance funds to reduce future flood damages. Currently, disaster assistance is free flood insurance.

   - Use funds for relocation rather than paying assistance repeatedly.
   - Greater federal say on how the provinces use this funding.
   - Only provide disaster assistance in communities practising flood plain management.

4. Resistance is being encountered at the local level from property owners who maintain that property values on the floodplain are lowered by designation. To make the program more acceptable:

   - Maintain the status quo unless there is clear evidence of general loss in value or that the program has created additional costs (such as the purchase of new serviced land off the flood-plain).
   - Government could offer to buy property at fair market value (long-term program).
   - Counter the resistance by employing more public relations to better inform the public at large who are funding the program.
   - Introduce flood insurance.
   - Increase assistance for other alternatives such as flood forecasting.

Water Quantity Issues - Natural Hazards

4. Drought on the Prairies

Recurring droughts in Canada, especially on the western plains, are symbolized by the "Dirty Thirties", when drought and worldwide recession severely damaged the Prairie economy. Since then, the federal and provincial governments have achieved considerable success in lessening the overall impact of drought - by diversifying the region's economy and by specific measures, maximizing the use of the two main sources of water supply (precipitation and streamflows), and exploiting the fact that they are to some extent independent of each other.

On the agricultural front, a major effort with considerable success was made to buttress the grain industry against future droughts by: developing drought-resistant plants and new plant varieties; adopting better cultivation methods; and providing crop insurance and income stabilization programs. Efforts continue to make even better use of the available precipitation by better soil management and other methods.

On the water supply side, the runoff from the Eastern Slopes of the Rocky Mountains began to be impounded and diverted all across the Prairies. As a result, communities, industry and agricultural livestock today have a relatively assured supply of water. These efforts and the stronger, more diverse regional economies have lessened the overall impact of drought. Current federal-provincial agreements with Saskatchewan and Manitoba concentrate on improving community and farm water supplies and on studying the economic impacts of agricultural droughts on the provincial economies.

However, water usage is already approaching available supplies in certain sub-basins, particularly in areas with irrigation. It is ironic that irrigation, which at first freed farmers from the vagaries of drought, should now threaten to cause shortages of its own. In terms of the economic impact of drought, other sectors of the economy are equal to or outweigh the agricultural sector, and must now be given due consideration in water management. For example, Manitoba alone lost $355 million from 1979 to 1983 in hydropower export due to low flows, without counting the extra cost of thermal make-up power to meet its own demand.

Issues and Options

1. Structural solutions are now more difficult and expensive to develop, since the better storage and diversion sites have been used or the available amount of water is limited. Greater public awareness also requires the consideration of environmental and economic consequences.

    - Improve supplies through non-structural means, such as conservation, reducing losses, reducing water demands.
    - Make environmental assessment less rigorous to implement.
    - Increase federal funding for water supply projects such as storage reservoirs and diversions.
    - Relate federal funding to water savings by improved water use efficiency.

2. Droughts highlight the variability of surface water supplies and climate, notably precipitation.

   - Enhance precipitation, especially in the mountainous regions.
   - Improve aquifer storage for drier periods through ground water recharge.
   - Improve headwater forestry methods and reforestation, shelter belts in the plains region and other cultural methods.
   - Study methods for evaporation suppression from open bodies of water.
   - Reduce evapotranspiration from cropland.

3. As the "safety margin" between actual usage and normal supplies decreases, it will take less drought in future to produce bigger impacts. This applies particularly to the irrigation industry, which continues to expand despite its high water consumption and impending supply limits.

   - Study the social and economic effects of not funding additional water supply systems.
   - Make medium to long-range water use and climate forecasts and develop options for keeping demand within available supplies.
   - Relate federal funding to projects showing significant improvements in water use efficiency.
   - Regional and inter-regional water supply systems connecting an area to one or more water sources could be studied and funded (such as interbasin transfers, regional pipelines).
   - Improve society's ability to adapt to the onset of drought through the development of short-term warnings and new technologies, using an appropriate mix of weather forecasts and satellite data supplemented by weather, soil and water observations.

5. Climate Change

Long-term climate change caused by the possible doubling of carbon dioxide in the earth's atmosphere over the next 100 years is expected to have a serious impact on the world's water resources. Canada's northern location makes it especially susceptible to some of the greatest climatic changes in the world, and therefore, to considerable variation in its present water resource base.

Winter temperatures at the earth's surface are expected to increase 4° - 6°C over the Great Lakes basin, 3° - 5°C over the prairies, and 6° - 8°C in the high Arctic. Summer temperatures increases would be 1° - 3°C less than winter values.

Precipitation changes are less certain, but small increases may occur over the Great Lakes basin and in the Prairie region. However, the additional precipitation would probably be too small to compensate for the 45-50 mm increased evaporation and transpiration rates associated with the increased warming.

Implications

1. The northern Prairies and northern Ontario with suitable soils will be capable of growing crops now found several hundred kilometres south. However, droughts would be much more frequent and severe on the southern Great Plains. The Great Lakes region should be drier but without serious droughts.
2. Atmospheric warming would reduce spring runoff from the Rocky mountains by 25%, and would pose a problem to water supply on the Prairies. This should result in increased demand for irrigation, particularly in the southern Prairies. The Great Lakes region probably will also need more irrigation.
3. Consumptive use of water for irrigation in the Great Lakes region, especially on the U.S. side, will lead to decreased lake levels and flows in the system. These potential demands must be considered in future US/Canada negotiations on Great Lakes water use.
4. Higher rates of evaporation in the Great Lakes could reduce annual runoff equivalent to a depth of 120 cm on the lakes, significantly affecting navigable water depths, severely reducing hydroelectric power, but increasing shorelines for recreation.
5. With the potential for more severe droughts, there will be increasing pressure for large scale diversions from the Great Lakes and from the northward flowing rivers in northwestern Canada. But diversion of northward flowing rivers could increase climate warming. The implications of diversions from northward flowing rivers are themselves an issue addressed elsewhere in this submission.
6. Design of dams and other water structures which will have a useful life into the middle of the next century could be affected by future climates.
7. Assessment of the environmental impact of climate change, such as the impact of diverting flow from northern rivers, will require a good hydrological and meteorologic data base as well as the development of suitable analytical techniques. Suitable data north of 60° N are currently sparse.

Issues and Options

1. Climate change is projected to be significant in many regions of Canada; changes in the temperature and precipitation regime as we know it could be substantial. Although current knowledge of when and how great these changes will be is inexact, some scenarios of trends are available and the question is whether these potential changes in climate should be included in our decision making process.

2. A change in climate is not of concern in regions where there is little sensitivity to changes in the water input from the atmosphere.

3. Decisions on programs whose impacts are only short-term (10-15 years) can be adequately made based on existing planning and design criteria which already consider short-term climate variability and assume that the present climate will continue into the near future.

   - Retain the status quo until the uncertainties of the climate change are reduced both as to time and quantity. (Since this issue is related to the drought and acid rain issues, the three issues should be considered simultaneously).
   - Develop the capability to produce monthly and seasonal climate forecasts in order to make optimum use of climate information in operational water management and regulation programs.
   - Enhance research with a view to developing realistic scenarios of future climates for all regions over the next century.

6. National Assessment

Water that is contaminated is not available for intended uses, and effectively diminishes water supply. Water quality is dependent upon the extent to which chemicals are released into the environment either by Waste Effluents, Acid Rain, or from other sources (for example, eutrophication caused by agricultural run off). This leads to the need to establish Water Quality Criteria, the need to sense the quality of water on a national scale and to institute remedial or preventive measures where appropriate.

Information on water quality is essential to all levels of government for the protection of present uses and the planning of future uses. In Canada during the 70s, $15 billion were spent on water works, sewage treatment, and drainage works. Good information is required to plan facilities like these. Few provinces have surface water sampling networks that provide coverage suitable for use in a national water quality assessment. Surface water monitoring efforts vary considerably from one province to another. In contrast, the provinces have gathered considerable information on the quality of their shallow ground water resources.

At the federal level a long-term national surface water quality network was established in the early 60s. This was operated successfully, but policies in the late 70s brought a decline in these efforts such that the government network became concentrated mainly in areas of federal responsibility, i.e., boundary and international areas, national parks, and areas of federal-provincial studies. This led to an inadequacy in sampling coverage to provide the required data to address water quality issues on a national basis.

The nature of the national surface water quality network enabled Environment Canada to obtain approval to negotiate separate cost-shared water quality agreements with all ten provinces. These agreements, which would have the same long-term tenure as the federal-provincial hydrometric agreements, should increase the geographical coverage of water quality sampling and provide data to the two levels of government at a cost less than if each proceeded independently. The first agreement, with Quebec, was signed in May 1984 and all other agreements are expected to be in place by April 1986.

In a related event, the Canadian Council of Resource and Environment Ministers appointed a task force in May 1984 to prepare water quality guidelines for Canada's surface waters. By the end of 1985, these guidelines, which are being coordinated by Environment Canada, should be available for use in a national assessment.

The federal government is now at the crossroads where, if all provinces join in the agreements, the basis for national assessments of surface water quality issues will be possible. However, the responsibility for water quality assessment at the federal level is shared by a number of departments and agencies. No coordinating agency exists for ensuring that the water quality work being done by each of the agencies fits into an overall clearly defined water quality assessment plan. Some idea of the various responsibilities and the proliferation of responsible agencies is shown in the following:

	Env	DFO	NH&W	Transport	DIAND	Agr.	IJC
Toxic chemicals	x	x	x			x	
Acid rain	x	x	x				
Drinking water			x		x		
Drinking water supply	x		x				
Estuaries	x	x		x			
Fish habitat	x	x					
Interprovincial	x	x		x	x		
International	x	x		x			x

Issue and Options

At present, cooperation and general coordination of activities between the various responsible agencies are arranged through the Interdepartmental Committee on Water (ICW). This has been partially successful in that it has furthered the respective goals of the participants. However, cooperative arrangements are not totally satisfactory and improvements will be mandatory if all agencies are to improve awareness of their goals in terms of the overall federal mandate.

- Retain the status quo with the knowledge that the coordination of efforts by different agencies may be achieved but with incomplete awareness of the overall federal/provincial goals.
- Attempt high level diplomacy to achieve the cooperation and coordination that is seen to be needed between agencies.
- Give ICW sufficient authority and resources to coordinate comprehensive water quality assessment.

7. Water Quality Objectives

Federal and provincial water managers are in general agreement that water quality objectives should be set at all interprovincial boundary crossings to ensure that designated water uses in the downstream jurisdiction are protected and also that high quality waters are not degraded. The same joint interest occurs in the case of northward flowing rivers that cross the international boundary because degradation of their waters could be potentially harmful to the province into which they flow. Provincial interest is not as strong in the case of the southward flowing international rivers because once they flow across the boundary, degradation becomes a U.S. problem to which the Canadian government must answer.

In practice, the setting of objectives requires criteria which define the effects of each potentially damaging pollutant, for example, the effect of copper on fish. Such criteria must be available for every conceivable toxic material, in different concentrations, as well as for every possible mix of such materials and concentrations to show how they would affect water uses downstream. For certain chemicals, it would be necessary to prohibit all uses because no exposure to them is acceptable.

If we can determine the effects of such materials, it should be possible to establish water quality guidelines which take into account such effects plus a factor of safety. Thereafter, it should be possible to set objectives at each boundary crossing based upon natural environmental conditions and water uses upstream and downstream from that crossing.

The establishment of water quality guidelines has already begun under the auspices of the Canadian Council of Resource and Environmental Ministers by Environment Canada in cooperation with the provinces .

Issues and Options

1. The scientific information with which to establish guidelines is lacking.

   - Retain the status quo and establish the guidelines using the limited information available from government sources in Canada and the United States.
   - Step up the program by contracting research to universities and the National Research Council for missing criteria pertinent to the Canadian scene.

2. The provinces are showing little interest in the study of guidelines on southward flowing international rivers. While the federal government has the primary responsibility for responding to problems caused on the U.S. side, remedial action depends on the full cooperation of the province on the Canadian side.

- Continue to seek the cooperation of the provinces in setting objectives for all interprovincial and international boundary crossings.
- Where provincial cooperation is not forthcoming for southward flowing international rivers, the federal government could use the Boundary Water Treaty Act to gain compliance.

8. Acid Rain - Canada/U.S. Options
- Canadian Options

Acid rain, a phenomenon common to industrialized nations, is damaging agriculture, water resources, fish and wildlife, and buildings. Acid rain may also be threatening forests and human health. It is estimated that sulphur dioxide (SO_2) accounts for about 70% of acid rain while oxides of nitrogen (NO_x) account for the remainder. In eastern Canada, sulphur dioxide comes primarily from (60 per cent) from non-ferrous smelters; electric power plants which burn fossil fuels such as oil and coal to produce electricity produce 15 per cent of SO_2 emissions. In the United States, 70 per cent of SO_2 originates from the burning of fossil fuels to produce electricity. In both countries, over half of the NO_x emissions come from the transportation sector, including automobiles. Other combustion sources account for the rest.

The most serious economic and environmental damage from acid rain is being felt in eastern Canada. An area over 260 million hectares (1 million square miles) is affected. The extent and intensity of damage will increase unless action is taken to reduce emissions. Of the lakes surveyed in Ontario, about 45 per cent are categorized as vulnerable to acidification. In many of them, there are already critical signs of stress from acid deposition. A similar situation exists in Quebec. In Nova Scotia, salmon no longer run in about 10 per cent of the former salmon rivers, and acidification is beginning in another 20 per cent. Acidification of untreated drinking water supplies causes increased levels of toxic chemicals such as lead, aluminum, and mercury, which are leached from the distribution systems and soils.

The provinces and the federal government are committed to limiting wet sulphate deposition to less than 20 kilograms per hectare per year, the level required to protect our moderately sensitive aquatic areas. The Canadian contribution to achieving this objective will include a 25 per cent reduction in eastern Canadian SO_2 emissions by 1990 and a further 25 per cent reduction by 1994. The specifics of the first 25 per cent reduction have been agreed to. A federal/provincial ministerial working group is now determining the specifics of the additional control actions required.

Scientists estimate that over half of acidic pollutants falling in Canada originate in the U.S. In turn, Canada is the source of about 10-15 per cent of acidic pollutants falling in the northeastern United States.

Canada is seeking a transboundary air quality agreement with the United States that would include: commitment to reducing the wet sulphate deposition in vulnerable areas to 20 kg/ha/yr ; implementation of abatement actions to achieve the objective; and creation of bilateral mechanism to monitor progress and recommend changes in abatement programs.

Issue and Options

Canada's resource base, particularily east of the Manitoba-Saskatchewan boundary is being damaged by acid rain, much of which is generated in the United States.

- Attain the environmental objective of limiting wet sulphate deposition to less than 20 kilograms per hectare per year in moderately sensitive areas, by reducing sulphur dioxide emissions in eastern Canada to 2.3 million tonnes (one-half the 1980 levels); and urging the United States to undertake compatible emission reductions.

- Pursue multilateral commitments, under the auspices of the O.E.C.D. and the United Nation's Economic Commission for Europe, on reductions of SO_2 and NO_x emissions.

- Develop in cooperation with provincial governments and with industry the Canadian acid rain abatement program, in particular the definition of the second 25 per cent SO_2 emission reduction.

- Develop in cooperation with provincial governments and industry the extent and nature of government financial participation in the implementation of Canadian abatement measures.

- Continue to monitor the effects of acid rain, to develop environmental objectives for terrestrial resources at risk, objectives to protect human health and to refine the objective for aquatic resources.

9. Toxics - Remedial and Preventive Options

The discharge of toxic substances to the environment is one of the most serious water pollution problems that Canada and other industrialized nations face. The source of such pollution is diverse ranging from mining, agriculture and manufacturing plants to households, commercial establishments and transportation facilities.

Toxic pollutants pose a particularly difficult problem. For many, their precise effects over time are unknown. For others, the damages to biological organisms have been assessed only for doses that are acutely toxic. The effects of small dosages over long periods are unknown. To add to the problem, two or more toxic materials acting together can display a greater total effect than the sum of the individual effects taken simultaneously.

Also, chemicals undergo a very wide variety of usage patterns ranging from wide area, large quantity uses such as those for herbicides and pesticides to very specific, low volume uses such as those for laboratory analytical chemicals. These differences in levels of use add an extra degree of complexity to the developing of control philosophies for, although one chemical may be highly toxic, it may have a very low or controlled usage while another less toxic chemical, because of its high usage, may be of much more ecological concern.

In seeking to meet this enormous challenge, Environment Canada is developing an assessment and control program framework, basically a system of steps which, when taken together, will lead to effective reduction of existing toxic chemical problems and the prevention of new ones. Included in the steps are requirements for measurement of the incidence and accumulation of substances, inventorying, research, assessment, a plan of action, and evaluation of effectiveness.

There is already within the different levels of government a variety of specific programs which can contribute to effective management of toxic chemicals. At the federal level, a number of these programs are operated under separate legislative mandates designed to fulfill a specific purpose. It should be possible during the development of the Plan of Action to recommend which program will provide the most effective control for a particular toxic chemical.

Issue and Options

There is a need for 1) a remedial strategy to influence responsible parties to lessen the adverse impacts of chemicals now in the environment and 2) a preventive strategy to limit the use of chemicals to ways that will protect human and environmental health over the long term.

- Do nothing and have a proliferation of contaminated areas containing toxic dumps posing serious risk to human life.

- Step up environmental effects monitoring to sense trends in the aquatic environment and the effectiveness of controls, analyze human activities to eliminate or modify practices which contribute most significantly to improper handling and discarding of toxic substances, intervene through use of legislation and regulations, and improve communications between jurisdictions involved.
- Strengthen existing legislation at the federal level to cover all components of the toxic cycle (production, transportation, use and disposal).
- Encourage the development of cheaper and better remedial and prevention/containment technologies through government assistance.

10. Waste Effluents - Regulatory/Management Options

Industrial and municipal waste effluents contain a wide variety of water pollutants. The indiscrimate discharge of these effluents have been shown to have an adverse effect on the quality of the receiving water. One of the roles of Environment Canada is to reduce, minimize or prevent the release of pollutants to the environment from these sources. In fulfilling this role, Environment Canada has opted for control of pollution at source and has developed effluent quality standards on an industry-by-industry basis. The objective is to provide a national baseline standard for pollution control within each industrial sector.

Effluent requirements to date have been established, using the Fisheries Act, for the following industrial sectors: pulp and paper, chlor-alkali (mercury process), petroleum refining, metal finishing, metal mining, fish processing, potato processing, and meat and poultry processing. The requirements include regulations, guidelines and codes of good practice. They are based on the concept of best practical technology (BPT) which means the use of such steps as process modifications, recycling practices and pollutant removal processes that have been demonstrated by current usage within the industry to be environmentally sound and economically viable. Such effluent requirements have resulted in a substantial reduction of gross pollutants discharged from the above-mentioned industrial sectors.

Other industrial sectors are under review. However, since the emergence of the toxic chemicals issue in the late 70s, there has been a shift of emphasis in effluent control from conventional water pollutants to toxic chemical pollutants. There has also been a shift in emphasis from remedial to preventive as well as from regulatory to advocacy.

As the issue of toxic chemicals emerged, there has been growing awareness that the control of effluent discharges now not only has to deal with conventional and acutely toxic pollutants but also with those that are chronically toxic, persistent and bioaccumulative. The waste effluent problem has become much more complex and the implications much wider. This change in emphasis has been accompanied by some uncertainty as to whether the department should continue to have a strong regulatory role in the future.

Issues and Options

1. There are difficulties in characterizing the effluents and in setting acceptable concentration limits for the pollutants: As both the long-term effects of minute quantities as well as the possible synergistic effects of combinations of toxic pollutants have to be dealt with, it is difficult to assess the risk and hazard of the effluents as well as establish acceptable effluent limitations.

   . Use the best practical/best available technology to minimize the discharge of toxic pollutants;

- Increase research to advance the science in these fields such as developing toxicity/biological tests as an indicator for effluent quality.

2. Pollution abatement is costly: As the pollutants now include minute quantities of toxic pollutants, the cost for reducing them to an acceptable level in the effluents will sometimes be extremely high.

   - Encourage the development of cheaper abatement technology through government assistance;
   - Promote preventive measures.

3. Environment Canada's role in the development of national effluent regulations for industrial sectors is uncertain.

   - Discontinue the concept of national standards and provide a research and knowledge base for use only where federal authority is clear.
   - Continue to use the Fisheries Act to develop effluent control requirements.
   - Provide Environment Canada with a clear mandate to develop effluent control requirements. This could require new legislation. Adding impetus to this option is the issue associated with infrastructures elsewhere in this section which points at the inability (or unwillingness) of major cities to finance local works (including sewage systems).

11. Overall Trends in Water Use

When population was sparse, the apparent abundance of water in Canada assured Canadians that they could draw upon their water resources unsparingly for domestic, agricultural, mining and other industrial uses. At the same time, the instream uses for fish, wildlife, recreation, navigation and hydroelectric production also appeared to be fulfilled to a remarkable degree. Slowly but surely, however, many areas of Canada, and particularly areas on the Prairies, are being shown to be short of water.

Over the past decade, Environment Canada has conducted surveys of water users in most major water use categories, and has undertaken special studies of water uses in the Great Lakes basin and prairie region with the provinces concerned. These studies and surveys have addressed water withdrawals only because the technology for assessing instream uses (navigation, fish, wildlife, recreation and hydroelectric power) is not available.

Some of the results to date give a good indication of trends. Since 1951, agricultural water use, largely for irrigation, the largest consumptive use, increased 300%. At the same time, hydroelectric generation, the largest non-consuming use, grew by 200%. Between 1940 and 1972, the number of persons served by municipal water supply systems climbed by 220%.

Recent surveys reveal that 90% of water withdrawals are for various industrial purposes, with water for cooling in thermal plants representing the largest user, followed by manufacturing, agriculture and mining. The remaining 10% is used for municipal and rural purposes.

While there is no limit to the number of times water can be withdrawn and returned to source, a portion of it will be depleted mainly through evaporation each time it is used. Rates of consumption are generally small, however, except for irrigation, evaporative losses from reservoirs, stockwatering, and some special processes such as deep well injection in the petroleum industry, where consumption is large. For the most part, the large consumptive uses occur in the Prairie region where water supplies are least. Superimposed on projections of future consumptive uses are the resulting impacts of changes in climate, which may result in increases in irrigation, yet decrease the amount of water used for hydro-electric generation.

Issues and Options

1. While it is often possible to relate the water available to water use in an area the size of a river basin, the technology for developing a national relationship is not available.

2. Withdrawal uses of water can readily be monitored, but the technology for establishing and regulating instream uses must still be developed.

3. Of the withdrawal uses, agriculture has the highest consumptive rates and drastically reduces the amount of water available to other users in the Prairie region.

4. It is a fact that less water would be used in most (if not all) categories if more efficient water use methods were employed.

5. The practice of transferring water from water surplus areas to water short areas is expected to continue, but there is as yet no assurance that resolving a problem of water shortage by this method will not result in other problems in either the donor basin or the receiving basin.

- The federal government could maintain the status quo and continue to provide leadership in analysing withdrawal water uses on a Canada-wide basis in order to assess current use.
- The federal government could convene a national seminar to seek the concerns as well as cooperation of all provinces in water resources conservation in Canada.
- The federal government could expand its current programs by encouraging the provinces to priorize all water uses and through a system of grants or subsidies promote improved water use efficiencies so that current supplies will go further.
- The federal government could empower the Interdepartmental Committee on Water or a new similar body to develop the technology and undertake the federal role in water resources conservation.

12. Irrigation on the Prairies

Over 50 million hectares of land are devoted to agriculture in the Prairie region, of which about one percent is irrigated.

The southern Prairies, where the region's population and agriculture are concentrated, has the poorest usable water resources in Canada; yet, it has the largest area under cultivation.

Prairie agricultural water withdrawals accounted for about 2500 million cubic metres in the late 1970s, an increase of 300% over the corresponding use in 1951. This increase has occurred and is continuing despite the fact that the total area under farming has declined by 2 or 3 percent since 1961. On the other hand, the amount of agricultural production has been generally rising through irrigation, improved farmland techniques, a greater use of chemicals, and more intensive use of the land. Furthermore, the need for further improvements is recognized and is being undertaken by farmers on the Prairies.

Of the water withdrawn on the Prairies, a much higher proportion is consumed than in other regions. This is because the principal consumer in Western Canada is irrigation. All other consumptive uses are relatively minor. Technological measures may reduce this figure by up to 50% (although not without significant cost). Studies in the United States indicate that open-ditch systems of irrigation use almost six times as much water as the more expensive sprinkler systems, and 100 times as much as drip irrigation. The U.S. General Accounting office has concluded that more than 50% of all that country's irrigation water is wasted.

Significant steps are being taken by the Province of Alberta to rehabilitate old irrigation systems to improve efficiency of water use. The pricing of water for irrigation and other purposes has been discussed for many years and its under-valuation blamed for excessive use or wastage, as well as for conflicts with other water users, water-logging and salinity problems.

The need for substantial trade-offs is emerging for both the water and soil resources as agriculture, industry, mining, power generation and other uses compete for these basic resources in an expanding economy. Upstream and downstream conflicts are emerging, particularly in drought years, where many uses depend on the same limited water supply. Resolution of such trade-offs will become a priority in the 1980s and 1990s.

Issues and Options

1. An internal Environment Canada study revealed that the Gross Domestic Product for goods and services producing industries on the Prairies totalled $59 billion, including mining $11.5 billion, agriculture $5.5 billion (20% at most from irrigation) and manufacturing $5.3 billion. This raises the question as to whether irrigated agriculture (albeit an important industry) producing no more than 2% of the GDP should continue to consume over 80% of the water resources.

2. The potential for expansion of irrigated land on the Prairies is significant, suggesting that conflicts between irrigation and other users could grow much greater.Recent estimates of water withdrawals and consumption on the Prairies point to serious consequences if consumptive practices are not improved.

   - Maintain the status quo and reserve remaining supplies for other uses.
   - Reduce irrigation demand by encouraging current and future irrigators to use the most efficient irrigation methods to conserve water through metering, pricing and subsidies.
   - Promote the growing of crops that are less water intensive.
   - Transfer water from northward flowing rivers.

(Note: while most of these actions would have to take place at the Provincial level, federal research and/or other incentives could exert a significant influence).

13. Consumptive Use of Water in the Great Lakes

Consumptive use of Great Lakes basin water could increase more than five times by the year 2035, according to findings of a study completed in 1981 by the International Great Lakes Diversions and Consumptive Uses Study Board for the International Joint Commission. The Commission itself will be reporting shortly to Governments, and while they are expected to lower these estimates somewhat, the projected growth will remain a cause for serious concern.

One effect of the increase in water consumption would be lower water levels on the lakes and reduced flows in the St. Lawrence River system. Lower levels would be viewed as positive by shore property owners, who blame high lake levels for erosion and flooding that damages or destroys their property. But it would be viewed as negative by lake carriers, who prefer high levels to give ships more draft, and by hydroelectric power producers on connecting rivers and the St. Lawrence River, who need high levels and flows to maximize their output.

Issues and Options

1. Assumptions about water demand in the 1981 study have been brought into question, thereby raising doubts as to the validity of the findings of that study. Nevertheless, consumptive use is already significant, and will increase substantially whatever set of assumptions is chosen.

2. According to the 1981 study, water consumption in the Great Lakes region of Canada and the United States is forecast to increase fivefold over the next 50 years equivalent to a flow decrease of about 10 percent at the outlet of Lake Ontario (most likely projection), with the United States accounting for 82% and Canada, 18%.

3. The Boundary Waters Treaty establishes equal and similar rights for both countries, and is reflected in the sharing of the water on the Niagara and on the international reach of the St. Lawrence River for hydro development. But the basis for sharing does not take into consideration the higher water consumption already taking place in the region (in favour of the United States), nor are subsequent increases (again in favour of the United States) considered.

4. The water in the basin is an abundant resource shared among persons, manufacturers, utilities, and other users. Nevertheless, a fivefold increase, while not leading to a water shortage, could cause conflicts among the water's users.

5. Canadians must not only take note of the uncertainty and needed improvements in economic and technologic forecasting as addressed elsewhere under the issue of "forecasting", but must also take care to incorporate the impact of possible future climatic change in any future forecasts for the Great Lakes system.

- Maintain the status quo with the knowledge that actual use favours the United States and does not fulfill the "equal and similar rights for both countries" in the Boundary Waters Treaty Act.
- Encourage basin-wide planning to reduce the rate of increase in consumption (the eight states and two provinces bordering the Great Lakes - St. Lawrence River are already looking into this possibility). This would favour the United States since Canada has the right to equal use and "joint planning" would likely lead to equitable use based on population and economic activity.
- Encourage the eight Great Lakes States to develop an inter-State framework for managing the U.S. portion of the Great Lakes, and encourage more general arrangements between Ontario, Quebec and the States which would provide for general cooperation, as well as exchange of information and plans, but would reaffirm the principles of the Boundary Waters Treaty.
- Attempt to increase Canada's share for hydro purposes at Niagara and on the international St. Lawrence based on 1) the greater consumption of water in the United States at present and 2) the forecast increase in consumption in the United States over the next fifty years.
- Propose another IJC Reference on consumptive use with a view to reducing water use and ensuring equal use.
- Propose use of water based on each country's proportion of inflow to the lakes.

14. Instream Uses

Instream uses are those which use the water in its natural course as opposed to withdrawal uses which withdraw the water, use it, and then discharge it back usually to the same stream. For the latter uses, water is an important input; for the former, water is the most important input to survival, production or enjoyment. For example, navigation would cease to exist without water, as would hydroelectric power generation. Recreation would be vastly altered in the absence of water. Fish and wildlife areas rely upon adequate supplies of high quality water. Heritage areas would likewise be much less valuable in the absence of water and water scapes.

The conflicts in withdrawal uses, discussed elsewhere in the submission, have their counterparts among instream users too. In particular, large-scale hydro development can have a negative inpact on the fishery and navigation, while storage facilities associated with hydro developments inundate wildlife areas. On the other hand, recreation can benefit from the water areas and longer shorelines resulting from the storage facilities.

Instream uses requiring minimum flow setting:

One critical feature of many instream uses is having sufficient water in the water course (after withdrawal uses are satisfied) to ensure fish and wildlife requirements are met and to meet the needs of the recreationist. The quality of the water is also a critical factor for most instream users.

Legislation is available at both the provincial and federal levels to regulate the quality of the water in a river but, guidelines establishing minimum flows where needed, and legislation ensuring that such guidelines are adhered to, are for the most part lacking.

Other instream uses

Commercial navigation and hydro power developments share a common need - high water levels, to provide sufficient depth for navigation and to ensure the greatest output from a hydroelectric station. These conditions are not essential to other instream users but are usually acceptable to fishing interests and recreational users.

Both navigation and hydro power development can be negatively affected by water transfers out of the water course and by water consumption. Of the main commercial navigation routes in Canada (St. Lawrence, Mackenzie and lower Fraser rivers) primarily the Mackenzie River is threatened by potential water transfers out of its headwater streams; navigation on the Mackenzie River could also be affected, however, by regulation of the Liard River which would tend to reduce spring flows and delay the start-up of spring navigation.

Although there are exceptions, hydro power developments are usually located on "power rivers" that have few consumptive uses to impact on power output. Notable exceptions are the Saskatchewan River system and the Niagara-St. Lawrence system. As consumptive uses in these systems grow, the effect on power is bound to become appreciable unless consumptive uses are brought under control or new supplies introduced into the system.

Issues and Options

1. Not enough is known about the minimum flow requirements to sustain instream water uses.

   - Retain the status quo with the knowledge that instream uses could lose out to withdrawal uses.
   - Seek the cooperation of the provinces in a nominal study to determine minimum water requirements for instream uses.
   - Seek the cooperation of the provinces in a program to priorize all water uses with a view to not only protecting instream uses but also enhancing them (eg., where opportunities for fish propagation and improved recreation are present).

2. Legislation at the federal level does not directly address the problems associated with instream uses.

   - Use the Fisheries Act and the cooperative feature of the Canada Water Act to initiate discussions with the provinces.
   - Encourage the provinces to prepare new or revised legislation (and regulations) to meet this need.
   - Produce new or revised federal legislation specific to this problem.

3. Consumptive uses and water transfers pose a threat to hydro development. This question (as it applies to boundary waters) is dealt with in issue 28 federal-provincial-territorial issues and also in issue 13, Consumptive Use of Water in the Great Lakes. The issues and concerns for rivers entirely within a province are usually not of national concern and are not addressed here.

15. Improved Water Use Forecasting

Developments in all economic sectors, which are interlinked in complex ways, have impacts on both the quantity and quality of the water resource. There is a crucial need to examine these complex interactions and effects with respect to their impacts on and implications for future water management. Therefore, improved water use forecasting is an essential component of future federal water management. In particular, federal water management program areas which require improved forecasting activity include (but are not limited to): the identification of regions where water uses will approach or exceed future water supplies; the impact of economic growth on water quality; international studies such as the examination of Great Lakes consumptive water uses; and examination of the need for federal financial assistance for water development projects, and for federal policy on such matters as water export.

Priority areas for increased forecasting activity include the Saskatchewan-Nelson basin (water shortages, poor water quality, energy development, conflicts between users), southern B.C. (water shortages) and the Great Lakes basin (consumptive uses, need for large-scale funding to improve water supplies and quality, conflicts between users).

While the provinces are generally responsible for economic activities and resource use (including forecasting) within provincial borders, federal responsibilities in interjurisdictional water issues also require the use of improved forecasting. The federal focus should be on broad regional questions and regional water use forecasting, complementing the provincial role within provincial borders.

One of the tools required to implement a demand management approach is an effective way of anticipating future water demands and conflicts between users, i.e., improved forecasting.

Issue and Options

Historically, at the federal level, water use forecasting has been under-emphasized in comparison to efforts to investigate water supply matters. Principal activities have been data collection (water use surveys), analysis of historic and current water uses (Prairie Provinces Water Demand Study) and a limited amount of forecasting (Great Lakes consumptive uses). Future issues such as water shortages, increasingly high costs of water developments, possible requirement for interbasin transfers, the need to examine the implications of climatic change for water management, and increasing Great Lakes consumptive uses give impetus to the need for more emphasis on water demand forecasting.

- Maintain the current level of activity. This would enable the recent low level of forecasting to continue. As noted elsewhere in this submission, however, problems are arising that require extensive forecasting work for which the proper tools are not available; as a result, support of federally stated needs for demand management and continued reliance on ad hoc methods would be inadequate.
- Increase the resources available for water use forecasting. This would provide federal water managers with techniques for investigating future water use problems, an improved capability to anticipate problems before they become critical, and independent federal models for use where interjurisdictional problems arise.

16. The Conflicting Demand for Water

Water is an integral component of most socio-economic activities, serving a countless number of purposes. As populations increase and economic development proceeds, competition for water becomes progressively more accute until conflict occurs between different users. These conflicts are held in precarious balance by a system of regulations and licenses (provincial) that either allocate a withdrawal or allow the use of water for pollution dilution or as a waste depository. Mechanisms for dealing with actual water shortages are limited to naturally water-short areas in the country (eg., the Prairies).

The federal role in water allocation specifically is limited to the following issues: fish and navigation, upstream-downstream interprovincial conflicts, and international situations.

A number of comprehensive planning studies in the 1960s and 70s began to address water conflicts for various river basins in Canada.

It is obvious, however, that the resolution of these and other water use conflicts could be eased significantly by beginning to price water like other valuable resources and other economic goods and services - rather than regarding it as a free common good as is done now (see issue 18).

Issues and Options

1. Water use conflicts are inherent in the semi-arid Prairies and parts of interior British Columbia, where the demand is getting ever closer to the naturally available supplies. The issue is to live with this constraint (as dryland farming has done), or to import water by means of long distance and costly interbasin water transfers.

2. This is quite different from the situation in other parts of Canada (and for most Canadians) where pollution has rendered many of our abundant water supplies unusable or very expensive to treat before being re-usable.

- No action. The case may be made that, since most allocative conflicts are provincial in nature, federal initiatives in this area are an intrusion on provincial affairs. However, no action would mean that important opportunities to influence provincial policies directed to better mitigation of conflicting demand, through research and cost sharing of improved management methods, would be missed.
- Increased research and publicity. The research on this topic has been insufficient. Although individual conflict situations have been studied and solutions found, the subject of "water use conflicts" has not been dealt with comprehensively. The results of conflict-oriented research could be publicized so that other water management agencies would be better informed as to the range of solutions in conflict situations.

- Tying federal funding to consideration of all measures for conflict resolution. In past development situations, structural solutions to resolving water use conflicts have been employed. Since these types of solutions are generally expensive, and since they often cause environmental damage, there is a need in the future to consider options related to the management of demands. As a major financing agent for water projects, the federal government could make consideration of a full range of alternative solutions a prerequisite for federal financial assistance.
- Increase research, emphasizing water demand and supply forecasting to identify areas of potential conflicts in the future.

17. Water Pricing

In Western societies, most resource allocation is accomplished through the use of the price system and the interplay of the forces of supply and demand. Low prices or, at worst, an absence of pricing leads to overuse and deterioration of the resource - a typical problem for common resources such as water. In Canada, water prices, if established at all, bear little resemblance to the resource's replacement cost, which is a measure of its true economic value. The consequences are felt in many areas of water use. Examples abound: the overbuilding of municipal and industrial water supply systems to meet inflated "demands"; the discharge of grossly polluting materials into water courses; the expansion of irrigated land in semi-arid areas, furthered in some but not all cases by other public subsidies; and continuing pressure for more water development and the pressure this puts on the environment. If the latest climatic change projections are accurate, or even partly accurate, the problems caused by inadequate water pricing will become much more serious in the future. Federal action in relation to many of these issues must, for constitutional reasons, be indirect.

Issues and Options

1. Much of the problem encountered in addressing water pricing is attitudinal in nature. For a variety of reasons, mainly abundant supply, Canadians have chosen to "regulate and control" by administrative fiat, rather than to allow economic forces to govern water allocation and water quality maintenance. The fundamental need is to change perceptions of Canada as a nation of endless water supply. Without these perceptual and attitudinal changes, there is little that can be done to bring pricing into the mainstream of water management.
2. Legal conventions governing water allocation must be overhauled if water pricing is to be used seriously as an allocative mechanism. Existing riparian doctrine, such as orders of precedence for water use, and arrangements governing upstream-downstream problems, must be reexamined and revised.
3. Water pricing reforms would have to be introduced gradually, in order to facilitate the adjustment in water-dependent operations. Research shows that economic growth would continue without general hardship as semi-arid areas began to use water more efficiently and the rest of the region and nation ceased to underwrite their development.
4. Governments have, at various times and locations, used their powers to control water by placing prices on at least some water uses. The cities of Edmonton and Calgary offer a striking example of different municipal approaches to water conservation. Residential consumers in Edmonton, where water use is metered, use only half as much water per capita as those in Calgary. Only 20% of residential users who have the option are metered in Calgary. The unmetered users here use 20-40% more water than the metered users. Examples of the power of the price system to regulate water use can be found in other sectors as well, such as manufacturing.

- Maintenance of the status quo. Water pricing and water allocation are primarily provincial responsibilities, and the most obvious federal option is to take no action on this issue. However, federal funding is often required for water development projects, notably in Western Canada, in many cases to improve water availability. Without a pricing mechanism, there is practically no possibility that current, let alone new, water supplies will be allocated efficiently. In other words, there is a high probability that public funds will be wasted by being devoted to inefficient water uses. This problem will become especially severe in the future as demands for interbasin water transfers increase.
- Research on water pricing. Possibly the biggest stepping stone to effective water pricing is a change in attitudes on the part of consumers and water managers. Practical research is needed for documenting the effectiveness of water pricing in water conservation. The federal government has a research mandate under the Canada Water Act, but would still need provincial interest and cooperation to achieve effective results. This research could be contracted out to consultants or to the university community.
- Federal incentives for pricing. For practical implementation, federal water development funds or taxation itself could be allocated preferentially to those projects with rational pricing systems to ensure efficient water use. This could be based on the research proposed above. Again, provincial cooperation is essential.

18. Cooperative Planning

Until the late 1960s, federal water planning activities concentrated on specific engineering projects, often in response to provincial priorities, without much concern for multiple objectives or means. In response to increasing competition among water uses and changing social values, the planning horizon expanded in the late 1960s to the river basin and to a wider range of possible uses and project alternatives. Although comprehensive in scope and normally undertaken jointly between the senior levels of government, basin planning tended to be costly in time and resources expended, with detailed plans for relatively small basins sometimes quickly becoming out of date. As a result, comprehensive planning is now being replaced by both issue-oriented and framework investigation. The impetus of the Flood Damage Reduction Program and other programs associated with federal responsibilities in interprovincial waters is now accounting for more of the activities formerly undertaken under the broader approach. The cooperative nature of the various programs has continued unabated, tempered only by the resources available.

With provincial planning and management capability developing rapidly, federal efforts are expected to become more oriented towards direct federal responsibilities - international and interprovincial river and lake systems as well as accelerated assistance for water development related to regional economic expansion, and northern development.

Under the provisions of the Canada Water Act, Environment Canada will continue to undertake cooperative federal-provincial water resources planning and implementation to fulfill both its specified legislative powers and general obligation to protect the national interest in freshwater management. Such undertakings are expected to be limited mainly by the resources available and other departmental priorities.

Issues and Options

1. Various agencies have been experimenting with different approaches to planning.

   - Promote comprehensive planning on a river basin basis.
   - Shift more of the federal effort to broader regional, issue-oriented approaches.

2. Federal involvement usually has been dictated by federal responsibility; occasionally, however, federal assistance has been made available on a work-shared basis when the federal mandate is not clear but where federal expertise has been deemed essential.

   - Refrain from contributing to provincial programs when the federal mandate is not clear.

- Continue to be flexible and contribute to provincial programs when the federal expertise is a critical factor, but limit the contribution to work sharing.
- Contribute to all requests from the provinces (even though it could affect more important requests).

3. Cost sharing in federal-provincial agreements differs between federal agencies.
   - Retain the status quo. By doing so, the provinces will tend to seek contributions from the highest contributor.
   - Unless specifically for federal purposes, the federal share should not exceed the provincial share, and there should be a local share whenever possible.

4. Implementation of recommendations has been slow or non-existent in some cases.

   - Maintain status quo, conduct planning studies with membership of federal and provincial water management agencies only.
   - Integrate planning and implementation at the planning stage. Include all relevant federal and provincial agencies (outside water management functions) with a direct stake in implementation in the planning process. This will ensure that planning meets identified management needs, and will build agency support for implementation. The disadvantage is that with more agencies involved, the planning process may become too cumbersome and time consuming in coordinating agency interests.

19. Strategic Regional Planning

Strategic planning differs from the cooperative approach which characterized river basin planning in the 1970s in that it focusses on broader trends and issues and on longer time horizons. It is inherently difficult to do and requires complementary planning and consultation, which have not been developed to any extent at either the federal and provincial levels, or between them. In fact, some provinces have been adamantly against any kind of federal involvement in strategic planning involving their water resources. Others have been more positive in terms of joint strategic water planning in a regional development context.

Issue and Options

A number of major water issues looming on the horizon invite strategic planning - be it large-scale diversions, water export, the economics of water development, toxics, or others. While these can be addressed by the senior levels of government separately, and eventually do result in federal-provincial cooperation, it is the growing mutual implications of these issues and the advantages of lead time that get lost. The issue is one of defining and promoting these larger and mutually important aspects as a basis for cooperation in strategic planning.

- Retain the status quo. This would amount to waiting for events to happen, or for proposals from one or more provinces and reacting to them on an ad hoc basis.
- Develop an initiative for cooperative strategic planning with the provinces.
- Initiate strategic planning federally, with respect to national, federal and international interests and issues.
- Proceed with as much provincial cooperation as possible and continue seeking full participation.

20. Water Use Modelling

Water use modelling has been an on-going, but relatively small, activity of the Inland Waters Directorate for the past ten years. One early output of this activity was the Canadian consumptive water use forecasts, recently completed for the International Joint Commission. Two principal models are currently under development. An input-output based structural model has been developed for Canada and its five economic regions. A simulation model has also been developed at the major river basin level. Only the latter model includes water supply considerations to allow the computation of basin level water supply-demand balances. It exists currently for the Prairie region only. Both of these models are currently being used in forecasting work for the Inquiry on Federal Water Policy.

It is possible, unless care is taken, to devote a large amount of resources to modelling activities. The approach being used in the current efforts is to proceed incrementally, i.e., to develop the broad outlines of a working model, to implement the broad model for major areas and then to make the model more sophisticated. This approach offers the advantage of relatively rapid development, useful interim results and the scope to ultimately produce an adequately detailed model. It has been chosen in preference to developing the full model initially before any results are produced.

There arises frequently some confusion over the output of models, and criticism about "inteference in the economic destinies of regions or provinces". It needs to be stressed that water demand models, like models in any other scientific area, are tools of the trade. Once developed, the water use models can be used to examine the impact of a broad range of development options on water uses and supplies. The user, not the model, governs the nature and veracity of the forecasts.

Issue and Options

1. Funding for the river basin water use simulation model has come from the Department of Energy, Mines and Resources under the terms of a study entitled "Water Supply Constraints to Energy Development". While this funding has been fortuitous in enabling the construction of a preliminary model for one region, it will inevitably come to an end, requiring DOE funding. Also, certain features (e.g. extension to non-energy producing areas) cannot easily be accomplished under current funding arrangements.

    - Continue current development of models at existing resource levels and arrangements. Advantages to this course of action lie in the use of extra-departmental resources. Disavantages are lack of freedom to develop the model for the entire country, the need to focus the work on energy-related issues, the lack of justification under current funding arrangements for developing the model in desirable directions (e.g. water pricing impacts, water conservation practices, recreational water use), and the inevitability of current funding arrangements expiring.

- Increasing substantially the level of funding for model development. Advantages here lie in the development of a more complete approach to modelling, with all major water uses covered, removal of the energy-oriented constraints to the model, and the ultimate availability of a useful technique, or investigatory package for examining future water demand related issues as they arise. Disadvantages relate to the need to devote more resources to this area.
- Gradual increase in level of funding for model development. Advantages are the same as for the second option above except that model development and results take longer to achieve.

21. Water Quantity Information Services

The Water Survey of Canada (WSC) of Environment Canada has been engaged in the collection and dissemination of water quantity data since 1908. The Atmospheric Environment Service (AES) has collected, disseminated and archived data from the meteorological and climatological networks since 1839. The information collected by both agencies is essential for a wide range of engineering, environmental and scientific projects involving Canada's fresh water resources, including that in international and interprovincial watersheds.

The types of data collected by WSC include water levels, discharges, depths, velocities, temperatures, presence of ice and, since 1961, sediment concentrations in Canadian rivers. AES observations include air temperature, precipitation (rainfall, snowfall) amount, and quality, snow cover, wind, humidity, radiation, lake evaporation, as well as ice conditions including ice thickness and other specialized meteorological observations.

A study of water data collected conducted in the early seventies by an independent consultant and corroborated by two additional analyses revealed that the benefits of data collected outweigh its cost of collection by a margin of 8 to 1.

The cost of construction and operation of the approximately 3500 existing gauging stations is shared with the provinces and with the Department of Indian and Northern Affairs under formal cost-sharing agreements. The AES network of 2670 principal and climatological stations are operated by volunteers and observers contracted by AES with co-operation from other federal and provincial departments. Other related data collected by WSC, AES and other agencies, but for which systematic direction would be weak includes snow depth, water equivalent and areal extent, glacier changes, and ice in fresh water bodies. AES currently publishes annually the snow survey data collected by 19 Canadian agencies, monitors areal extent of snow in selected regions and publishes data on ice conditions in Canadian waters, including fresh water bodies. Other related data, collected by the WSC and other agencies for various periods of time but for which no systematic direction is available includes depth, water equivalent, and areal extent of snow, glacier changes, and ice in water bodies.

Overall trends in water use (issue 11), climate change (issue 5) and water quality implications (issues 6 to 10) will each in its own way result in demands for information on the state and availability of the resource. To meet this challenge, basic data from observation networks will be needed to provide a clear and continuing picture of the state of the resource.

While it is generally acknowledged that there is no substitute which will give more reliable information on streamflow and sediment than direct measurement at the sites of interest, it is possible to improve the efficiency and effectiveness of the hydrometric information system by using analytical methods to provide approximate data for ungauged locations as well as to improve the quality of information for the gauged locations. Analytical and interpretive studies also provide a means of identifying redundant stations and gaps in the network. Such analytical studies are also necessary for assessing gaps in the climatological network.

Implicit in the above approach is the recognition that, by combining interrelated data such as those of the hydrometric and meteorological networks, more and better information will be produced at less cost than for each set of data independently. This would be an effective means of filling data gaps in the meteorological network in remote regions of Canada. Properly managed, such strategies can ensure that adequate information will be collected effectively and efficiently for both the current needs and the needs of future generations.

Historically, much of the instrumentation, equipment and methodology used in the collection of surface water data in Canada since the organized beginning of this activity in 1908 has been of U.S. design and manufacture. Where necessary it has been modified to suit Canadian conditions. Generally speaking this situation has served us well and was quite realistic because the market in Canada was simply too small and the international market too uncertain to entice private Canadian companies to begin the design, development and testing of hydrometric equipment on the speculation of a competitive sale to the WSC or a sale abroad. The situation, however, has been gradually changing as newer types of instrumentation and methods are being acquired to meet changing demands. For example, by 1988 it is planned to have about 500 devices installed to transmit data from remote locations via satellite. Most of these will have been designed and built in Canada to specifications developed by WSC. Similarly the AES automation of meteorological stations has promoted Canadian products. There are many more examples of changing needs in Canada that should be met by Canadian products and procedures.

The importance of fluvial processes, and specifically the entrainment, transportation and deposition of sediment in Canada's inland waterways has never been considered in depth nor in its entirety. However, the demand for information makes it clear that the potential benefits of increased knowledge would substantially exceed necessary costs. Sediment quality concerns are being increasingly focused upon the fate and pathways of chemicals and nutrients where sediment is being recognized as a significant transport and storage agent. Traditional sediment quality concerns for ecosystem stability, drinking water and industrial water uses will continue and require both broadly based and more comprehensive knowledge.

Despite the importance of snow in Canada, no single agency co-ordinates data collection on a national basis; currently 19 different agencies conduct snow surveys. AES operates the only national snow survey network, publishes the data collected by all 19 agencies and provides direction on snow survey equipment and procedures. However, no single agency has been designated or accepted a controlling or coordinating role for snow investigations. WSC is discontinuing its existing activities because of uncertain mandates. AES is continuing its network operation and data handling function.

Alpine glaciers and ice fields can be considered as long-term fresh water reservoirs and as an influence on local climate. In certain areas of the country this is obviously of considerable importance but no clear, specific mandate exists for the measurement of this resource. Limited surveys conducted for nearly two decades have been discontinued while research has been reduced.

To meet the challenge of providing better information it will be necessary to marginally expand the existing network, to do considerably more analysis and interpretation of data, to improve instrumentation and the distribution of data and provide an improved sediment information service.

Issue and Options

The limitation on resources for existing water quantity programs results in serious shortfalls.

- Continue with the existing level of service even though it is not now meeting the expressed needs of the provinces and other federal departments. The adaptation of new technology would also suffer.
- Reallocate resources within existing programs by increasing sediment studies and analysis of data at the expense of basic data collection. This would not be discharging the federal government's obligations under federal-provincial cost-sharing agreements.
- Contract out more studies, analyses and associated research, again at the expense of basic data collection.
- Provide a short-term increase (5-8 years) in level of resources for specific purposes - analyses, computer programming, sediment studies - to permit modernization of procedures and instrumentation (such a surge would have to be repeated every decade in the absence of steady development).
- Designate one or more lead agencies to be responsible for direction and coordination in collecting, disseminating, archiving and analyzing snow and ice information. (The lack of these data affects our knowledge of water availability.)

22. Wetlands Preservation

Wetlands by definition are a unique intermediary stage between terrestrial and aquatic environments. They provide one of the most productive natural ecosystems in the world. Wetland hydrology governs many of the basic characteristics of these ecosystems including productivity, habitat potential, nutrient cycling and aesthetics.

Wetlands are important to the nation's economy. They maintain and improve water quality, help wildlife and contribute substantial social and economic benefits. These include outdoor recreation and tourism benefits from such activities as hunting, fishing and bird watching. They serve as outdoor classrooms for all levels of education. Wetlands also contribute to the ecological diversity of the landscape and provide habitat for some threatened and endangered species. They provide protection against flooding by holding rainfall during peak periods and releasing it over the following months. They are a source of many renewable resource products, such as fur, wood and wild rice. The benefits they provide and the overall federal interest in wetlands should be taken into account in any related planning action.

When natural uses and development plans tend to conflict, wetlands often have been viewed as expendable. Traditionally, therefore, the wetlands base has been reduced in deference to the wishes of expanding agriculture, urban encroachment and coastal development. The subtlety of the wetland losses or changes often have been overshadowed by the scale of the development (e.g., Cumberland Delta, Peace-Athabasca) seemingly making the losses appear acceptable despite the cumulative impacts on the basin.

Drainage, filling or dyking profoundly modifies the hydrologic regime, alters the nature of the water ecosystem and drastically reduces available habitat.

Because of joint jurisdiction, Environment Canada has historically cooperated with provincial agencies through formal and informal arrangements on resource management matters of common concern.

In 1966, Canada's National Wildlife Policy and Program was tabled in the House of Commons. It recognized the survival of migratory birds was dependent upon the maintenance of habitat, particularly wetlands. In 1973, the policy was expanded through the passing of the Canada Wildlife Act to provide the Minister with the power to take action with all non-domestic animals, not just migratory birds. The additional authority was needed to address the problems of wildlife habitat degredation and loss throughout the country and to further foster federal-provincial cooperation.

Federal interests in water quality and quantity research and sediment transport often focus on wetland issues. The consideration of wetlands in federal water resource management is also evident in reports released by federal-provincial study boards and committees.

Environment Canada is currently involved in a three-phase program with provincial governments to: 1) identify and map essential migratory bird habitat; 2) priorize these areas and develop strategies for their protection; and 3) develop an information and extension program. Since 1966, there has also been a "wetland" acquisition program along the Great Lakes - St. Lawrence Corridor, coastal estuaries and key areas on the Prairies.

Dyking and water control in wetlands, as a management practice to improve productivity, is conducted cooperatively with non-government agencies (such as Ducks Unlimited) to improve public wetland habitat. Paradoxically, federal funding provided by DRIE contributes to major losses with respect to agricultural drainage of wetlands.

Activities which interfere with natural drainage such as road construction, irrigation and reservoir construction may possibly increase wetland area but these new wetlands are usually less productive and functional than natural wetlands.

Federal commitments to wetlands on a national level include recent efforts to develop a comprehensive national policy and approach to wetlands use and management within the federal leadership role. Recent international commitments to wetland conservation have been demonstrated in Canada's signing of the Convention on Wetlands of International Importance Especially as Waterfowl Habitat. Canadian wetlands nominated to the list of Wetlands of International Importance account for 50% of world designations to date. Canada and the U.S. are in the midst of negotiating a North American Waterfowl Management Plan. One of the major items is preservation of migratory waterfowl habitat which includes wetlands preservation in many cases.

Issues and Options

1. The destruction or gradual disappearance of wetlands has resulted in major losses of coastal salt marsh habitat and prairie and eastern wetlands while northern wetland ecosystems are increasingly threatened.

2. There has been, until recently, an inability to demonstrate on a national scale the importance of wetlands as a heritage resource of considerable economic value.

3. Our predictive capabilities in assessing wetland impacts are limited as is the expertise we can apply to these problems.

4. Fragmented jurisdiction spreads responsibility for wetlands conservation among many federal, provincial and municipal agencies, and has resulted in an inconsistent, uncoordinated approach to research and management strategy design.

   - Retain the status quo which is to approach the issues on an ad hoc basis.
   - Encourage all governments to include wetlands protection in their landuse planning processes.
   - Cooperate with the provinces to audit wetland areas, and to encourage the preservation of significant wetland areas.

- Acquire and manage essential wetlands for the protection and maintenance of migratory birds and other wildlife.
- Develop a better understanding of the economic, intrinsic cultural values of wetlands and wetlands ecology through a national research program jointly with the provinces.
- The federal government could take a lead role in developing a comprehensive national interdisciplinary approach to wetlands management and conservation through cooperative planning and research with the provinces.
- Expand the public information program to provide a better awareness of the value of wetlands and their increasing loss to society.

23. Estuaries and Deltas

In their natural state, estuaries and deltas, as special wetlands, provide complex hydrological, ecological, recreational and other functions vital to the well-being of Canadians. These wetlands and their periphery areas represent critical habitat for fish, migratory and non-migratory birds, and furbearing mammals; replenishment of water supply to ground water, lake and river systems; reduction of the potential for flooding; improvement to water quality by trapping sediments and pollutants; protection to shorelines by providing a physical buffer to wave energy impact. Wetlands are increasingly being converted from their natural state to support alternative land uses such as urban, agricultural, recreational and industrial development.

Recent studies associated with the Fraser River estuary, the Mackenzie River and its delta, and the Peace-Athabasca Delta have revealed both the complexity and the uniqueness of this type of wetland, and have identified the need for more definitive policies to handle the increasing pressures in such areas.

Issues and Options

1. Study attempts have been fragmented due to the interjurisdictional and interdisciplinary nature of the studies required and the variation in development pressures imposed by the many users of water that affect these areas.

2. Evidence of a decline in the wetlands base, including deltas and estuaries, and implications of that decline, as well as a growing number and intensity of land use conflicts, clearly indicate that a change in the approach to such wetlands management in Canada is essential. At present, three major factors hinder wise management of this wetlands resource: 1) significant knowledge gaps, 2) a more exact and updated status of the resource including the need to identify land use events, 3) fragmented jurisdiction between the three levels of government concerning responsibility for these wetlands.

    - Retain the status quo. While study attempts have been made, delta and estuarine wetlands are in danger of deteriorating because:

        - the relative responsibilities of the federal and provincial governments (and the roles of agencies within each government) are not always clear, nor are they always coordinated;
        - the information required to both analyse their complex processes and to form a sound basis for their management is not available;
        - the techniques to hydraulically model their complex processes are only now developed;
        - development in the surrounding watershed area often is undertaken on an ad hoc basis, without concern for the area as a whole.

- Initiate a Task Force to study and make recommendations on a multi-agency disciplinary group that would coordinate all federal agencies involved as well as provide federal-provincial coordination where needed. The main task of the new agency would be to improve upon coordination between agencies, and to undertake to collect, store, interprete and disseminate data for the common good.

- Establish a data collection, and coordinating, agency as in the second option above but give it the additional role of assessing the effects of development on the area in question. The overall mandate would be to develop a comprehensive long-term plan for the estuaries, deltas and surrounding watershed areas which would ensure their widest possible use along with the protection required by their delicate systems.

24. Water Infrastructure

Public works facilities such as sewer, water, street systems, bridges, parks, community centres are collectively referred to as urban infrastructure. The elements we are vitally concerned with are the condition, adequacy and availability of sewer and water systems necessary for the economic health of not only urban but rural areas also.

Until the 1970s, the maintenance of facilities to provide piped, potable water of adequate quality was acceptable, partly because of good economic conditions in Canada and partly because so many facilities were relatively new.

In a 1984 study (Phase I), a Task Force prepared a report on this issue for the Canadian Federation of Canadian Municipalities. It indicated that the costs to bring the most seriously deteriorated forms of infrastructure (sewer, water, roads and bridges) back to acceptable levels amount to $598 per capita; about half of which would apply to water and sewer infrastructure. Even when spread over a 10-year period, these costs represent an increase in current public works budgets of about 25%, which is beyond the ability of many local governments. Therefore, some assistance from other levels of government is required.

Isolated studies show that while all cities do not exhibit similar degrees of need in the same area, almost all municipalities have some infrastructure needs which they are unable to satisfy.

In Europe, sewer and waterworks are financed largely from user charges which until recently have been adequate. Central governments are very significantly involved in urban infrastructure works through grants and cost sharing arrangements with local governments.

A study carried out for the Ontario Ministry of the Environment suggested that rehabilitation costs of approximately $25 per capita per year would be needed to maintain water systems at an acceptable level. For Canada as a whole this would come to some $500 million per year, about $350 million more than current spending.

Federal support for municipal infrastructures in Canada amounting to about $100 million per year had been allocated under several different programs since 1961. However, in November, 1980, the then Minister of Public Works announced the decision not to renew the CMHC Community Services Contribution Program. Although Cabinet later decided to make $65 million available for the construction of sewerage facilities over a three-year period under the Canada-Ontario Great Lakes Water Quality Agreement (to meet its obligations under the related Canada-U.S. Agreement), and to undertake certain ad hoc water and sewage treatment programs, such federal assistance was effectively reduced. This reduction, when added to the inadequacy of local government funding is resulting in a worsening of the revenue shortfall situation.

On the part of local governments, there has been a reluctance not only to shift funding priorities to infrastructure work but also to borrow money at high interest rates.

Issue and Options

Lack of maintenance and under-investment in new urban infrastructures will impose growing inefficiencies and service problems in Canada and, by the end of the century, force a major overhead and expansion beyond municipal fiscal and economic capacity.

- Leave this responsibility with local governments on a pay-as-you-go, underfunded basis dealing mainly with emergency repairs. Operational and maintenance costs will steadily rise and eventually, the system will break down.
- Provide financial support to the proposed Phase II study which will analyse in greater detail the problems identified in the Phase I study, and the full range of solutions.
- All levels of government (federal, provincial, regional, municipal) could cooperate in a national program to study the problem through combined and cooperative efforts.
- Adopt "a priori" a policy encouraging municipalities to institute pricing policies that provide sufficient revenue to maintain and operate their own infrastructure.

25. Water Research

Water resources research is funded and conducted by the federal government, provincial governments, universities and, to some extent, by private industry. Environment Canada (DOE) is the only department funding and conducting research of a national scope with a focus on the total range of water resource issues. Several mechanisms exist under the Interdepartmental Committee on Water, the Interdepartmental Committee on Toxic Chemicals, and the Climate Planning Board to coordinate related research activities.

Historical Trends: The funding level for Research for water resource management in 1979 was about 2 1/2 times the level in 1968, a rate of increase approximately 1/3 of that recommended in the 1968 Science Council report. Towards the beginning of this period the Department of the Environment brought together several units into the National Hydrology Research Institute (NHRI) based in Ottawa and the National Water Research Institute (NWRI) at the Canada Centre for Inland Waters (CCIW). New resources were added to aid in developing interdisciplinary work and to deal particularly with the Great Lakes. Research emphasis has shifted in this period from collecting extensive data about lakes, rivers, underground waters, snow and ice to intensive efforts to integrate these data for a more comprehensive understanding of aquatic systems or for policy and regulatory actions. The International Hydrological Decade program and the research program for the Canada/U.S. Great Lakes Water Quality Agreement were instrumental in accelerating water research. At present a substantial part of operating and capital funding for in-house research is obtained by annual application to central program funds for such topics as Acid Rain, Climate Change, Toxic Chemicals, Energy, Great Lakes Water Quality or Nuclear Fuel Waste Management Programs.

Research Management: The roles served by DOE water research units are clearly supported in the Task Force report to MOSST on "Federal Policies and Programs for Technology Development". Nevertheless, given the distribution of responsibility for water resource management, both across Canada and at different governments levels, better ways to enhance communication between the water managers and water researchers are required. The primary client for water research done in the two national institutes is, and must remain, the Department itself and, within the Department, the Inland Waters Directorate. The variety of other clients for research includes the Federal Environmental Assessment Review Office, other parts of DOE, provincial agencies, and the private sector. Increasingly and appropriately, there is an outside clientele for federal water management research. There is a corresponding need to review the role of research and to establish whether new directions are required in order to meet these new challenges.

Issues and Options

1. There is the potential to strengthen our ability to identify the overall required level of research funding and its distribution among key issue-oriented sectors of research need - especially for the longer term.

   - A national research review at regular intervals.
   - A National Board for Water Research.
   - An Advisory Board for each National Institute or agency, with a broader representation of the research clientele.

2. The proportion of research that is to be specifically user-driven; the role of the research institutes in influencing DOE water policy and water strategy (in contrast to a role subordinated completely to routine operations); the criteria against which research results and institute research effectiveness are to be judged; the coordination of information on water data and research; the dissemination of research results nationally; the facilitation of federal/provincial collaboration; the regional/national balance of resources for research; the case for regionalization of research activities on the basis of the institutes' geographical locations; and the interactions between the national research institutes and the academic community and the role of the latter in furthering national research aims - all of these could be addressed by the options in #1 above, or could be specified by the respective senior line managers.

   - Establishment of a National Data Centre for water resource management data, research activity data and publication data , linked to the existing National Climatological Archives operated by the Atmospheric Environment Service.
   - Establishment of a program for more formal federal/provincial agreements on cost-shared/work-shared research of a general or specific nature.
   - Establishment of a regular and open workshop/symposia program under NRC (or others) auspices where there is better representation of all aspects of water research than exists presently in the variety of NRC Associate Committees.
   - Establishment or renewal of research communication, coordination technology transfer functions within the research Institutes themselves.
   - Establishment of more positive links with the academic sector through increased federal funding of mission-related water research, establishment of joint research studies, joint planning to both meet summer and full-time hiring needs and provide career training and orientation to students.
   - Establishment of mechanisms, including centralized funding, for interdisciplinary research studies.

26. Cooperative Implementation

Environment Canada and its predecessors have cooperated with the provinces in numerous water management programs associated with regulating or apportioning waters in Canadian river basins. The earliest such agreement involved the Lake of the Woods Control Board in 1919, and the most recent is the Ottawa River Regulation Board, established in 1983. On a similar time schedule, Regulatory or Study Boards were established in cooperation with U.S. agencies under the auspices of the International Joint Commission (including a few outside the IJC). While these programs involve a measure of implementation in order to maintain levels or flows, they usually do not require major funding to operate. Major programs to implement the recommendations of planning projects are of more recent vintage, involving a few major flood control works in the 1950s and 1960s and a variety of programs following passage of the Canada Water Act in 1970, such as the Peace-Athabasca Delta project, the Metropolitan Toronto Flood Control project, and the Okanagan basin project.

One would expect that an implementation stage should follow each planning project but that is not the case. Some recommendations in planning reports often are never expected to be implemented. They are included primarily to make people think about alternatives and implications without expecting any concrete action to occur. A good number of the recommendations which are seen to be emerging may be implemented before the planning phase is concluded. Thus, when action is taken during the planning stage, there will be no observable response to such action during the implementation stage. The key issues are not how many recommendations are subsequently implemented but rather how effectively problems are being resolved.

A concern has been voiced regarding the apparent delay between the conclusion of the planning phase and the commencement of implementation. This waiting period has been as long as two years, and many believe that such a delay causes the enthusiasm and momentum which were built up during the planning phase to be lost. But this delay involves a tradeoff which must be recognized. The time between planning and implementation is required to examine and debate the nature and costs of the recommendations. In a system where elected officials are accountable for their decisions, time is required for review and assessment.

A further cause for delay lies in the fact that water and water-related responsibilities are not all vested in one federal or provincial department. As a result, negotiations on the federal side alone could involve not only Environment Canada, but also Fisheries and Oceans, Indian and Northern Affairs, Canada Mortgage and Housing, and Regional Economic Expansion. Unless they formed part of the planning phase, they would not always be receptive to planning recommendations likely to emerge that would influence their other departmental priorities. However, coordination through the Interdepartmental Committee on Water is keeping all federal departments abreast of water happenings at key stages in an attempt to overcome this problem.

Issue and Options

The effective handling of resource needs and flexibility are important requisites for the implementation stage. Implementors experience difficulty when the implementation agreement does not provide sufficient resources.

- Maintain the status quo, in which planning and implementation are considered separate and distinct commitments.
- Make a commitment to meet the federal share of implementation costs before entering into a planning arrangement.

27. Canadian Involvement

Canadian involvement in freshwater programs overseas falls into two phases - 1) the provision of bilateral help to developing countries, and 2) the fostering of scientific advancement through scientific and technical exchange. This is in recognition of Canada's obligation to lesser developed countries and the fact that the promotion of links with other countries will benefit Canada scientifically and commercially.

Canadian involvement occurs through three main groups: 1) the United Nations Family (eg. World Meteorological Organization (WMO), United Nations Educational, Scientific and Cultural Organization (UNESCO)), other ... organizations (eg. International Association of Hydrological Sciences of the International Union of Geodesy and Geophysics - IAHS/IUGG) 2) other multinational organizations (OECD and NATO) and 3) International Scientific Organizations.

The type of Canadian involvement includes 1) the provision of grants and concessionary loans to assist developing countries in the investigation, development and operation of water resources, 2) provision of field assistance by Canadians in the study or development of water resources in developing countries, 3) provision of training or demonstration to visitors to Canada and 4) participation and presentations at meetings of scientific organizations.

Issues and Options

The proliferation of international organizations doing similar work has made it difficult to know where to focus Canada's own international effort.

- Environment Canada in cooperation with External Affairs, could undertake a step by step development of a specific international policy, and identify this policy clearly in the department's strategic plan.

- For assisting developing countries, Canada could:

  - maintain the status quo;
  - continue assistance and involvement at a suitable level but include the training programs in departmental work plans to ensure increased effectiveness;
  - plan the development of water experts for both short-term and long-term assignments to developing countries in place of current ad hoc arrangements;
  - increase the level of funding when finances permit.

- For fostering scientific and technical exchanges Canada could:

  - continue to give priority to developing the international resources needed for dealing with toxic substances, acid rain, climatic change and assorted international water problems;
  - develop bilateral relations with other northern countries;
  - enter into exploratory discussions with External Affairs regarding the possibility of setting up a Northern Environmental Community.

Jurisdictional Needs - Intergovernmental

28. Federal-Provincial Territorial Issues

The federal government has assumed a leadership role in bringing together various provincial and territorial governments to assess prospects for cooperating in the use of their interjurisdictional watercourses. Thus far, the experience has been rewarding, on the Ottawa, the Saskatchewan-Nelson, the Mackenzie and the Yukon in particular.

Issues and Options

1. An increasing number of water-related projects and proposals today have implications beyond the province in which they are sited. Important examples include Newfoundland's Lower Churchill hydro proposals, Alberta's Slave River Project and British Columbia's Liard dams investigations.

2. Interjurisdictional issues are particularly critical in the Mackenzie River basin where upstream provinces may act unilaterally to store and divert substantial flows before an acceptable agreement respecting minimum flows, seasonal regime and water quality can be negotiated at boundary crossings to protect downstream users. Bilateral agreements at the seven provincial and territorial boundaries together with a single umbrella agreement are under discussion in the hope of obtaining mutual agreement on future development in the basin. Because of the sensitivity of northern environments, this kind of agreement would have to be more complex than that administered by the Prairie Provinces Water Board for the eastward-flowing Prairie rivers.

    - The federal government could continue with cooperative approach to interjurisdictional planning by seeking joint studies with the affected provinces;

        - to identify clearly the social, economic, and ecological impacts on northern basins resulting from proposed projects;
        - to develop detailed forecasts for water requirements in the water short areas, and identify alternative means, including associated consequences, to meet such requirements;
        - to work with the affected provinces in an honest broker role to urge completion of negotiatons for interjurisdictional agreements (Mackenzie basin) and to undertake new negotiatons (Yukon basin).

    - The federal government could take the lead in protecting downstream jurisdictions and interests from adverse transboundary impacts by enacting new legislation. The first step would be to determine if the federal government has the constitutional right to pass such legislation, and, if so, whether that legislation should be active as indicated above, or passive (utilized only on the request of an agrieved downstream jurisdiction).

Jurisdictional Needs - Intergovernmental

29. Canada-United States Issues

The long and generally amicable relationship between Canada and the United States in dealing with problems and opportunities respecting (trans)boundary waters is largely due to the safeguards embodied in the Boundary Waters Treaty 1909. The Treaty sets out the rules and principles which govern the use and development of the water resources of common interest to the two countries.

On several occasions, as in the case of the Niagara and Columbia River Treaties, the two governments have commissioned their own government agencies to jointly plan and manage the resources in question. Usually, however, this coordinating role is assigned to the International Joint Commission (IJC), composed equally of Canadians and United States citizens. Thus far, well over 100 subjects have been placed by the national governments before the Commission. In all but four or five cases, the Commission has reached unanimous decisions, and for the most part the governments have accepted its recommendations.

In addition to establishing the Commission, the Boundary Waters Treaty contains several provisions respecting equality of rights and priority of issues. This guarantee of equality is of fundamental importance for defining the bilateral relationship. Without the knowledge that the Commission would respect the principle of equality in its deliberations, Canada would undoubtedly be reluctant to assign any significant investigatory role to the IJC, given the fact that the scale of U.S. activities continues to dominate Canada-U.S. relations in boundary waters.

Canada-U.S. boundary water issues currently under review bilaterally or by the IJC, or to be reviewed shortly, are proposed coal development in British Columbia which could affect designated heritage waters in the U.S. portion of the Flathead Basin; potential pollution and introduction of foreign biota into Manitoba's waters from an "on-again, off-again" segment of the Garrison irrigation development; diversions and consumptive uses of water in the Great Lakes basin, and contamination by the U.S. of shared waters such as the Niagara River.

These issues point to a shift of emphasis in bilateral water relations away from joint development (eg., St. Lawrence Seaway, Columbia) of past years towards mitigation of environmental impacts in the downstream country.

Issues and Options

1. Issues are emerging which do not appear to be adequately covered by the Treaty developed 75 years ago; however, to date neither Canada nor the U.S. have proposed opening the Treaty to amendment or revision.

2. One issue relates to concerns which are mounting over the contamination of shared waters (eg. Niagara). The Boundary Waters Treaty prohibits each country from polluting boundary waters to the extent of "injury to health or property" to the other country. Some suggestions have been made that the Treaty should be amended to specify more clearly what constitutes "injury" to "health" and "property" as well as stipulating remedies in case of violations.
3. Another issue that is becoming more imminent with the passage of time and increasing water shortage in the American southwest is the demands that will likely be made by the United States on Canadian waters by the end of this century. The Boundary Waters Treaty does not specifically deal with water export, but other federal legislation exists which may more readily deal with the question (International River Improvements Act). In the near term, Canada is concerned about the "export by default" which occurs as a result of greater consumption of boundary waters by the United States, eg., in the Great Lakes region the U.S. consumption rate is five times greater than Canada's and projected to increase. There is a need to ensure that Canada's share of boundary waters is protected for its future uses.

- Retain the status quo in which Canada reacts to various issues on an ad hoc basis.
- Continue to assign special studies to agencies other than the IJC when the two governments jointly feel that this is the "way to go".
- Develop a management strategy for international waters which will enable Canada to anticipate the stance it must take for many of the new issues arising.
- Renegotiate the Boundary Waters Treaty to ensure that it will deal with the new issues arising.

30. Water Export

Due to the prospect of water shortages in the American southwest, concern is growing among the public, the media and some government officials, that sooner or later the U.S. will exert pressure on Canada to export Canadian waters across the boundary southward via large diversions. Canada has consistently opposed such transfers on the grounds that we should first look after our own water needs; that water once exported is lost forever; that by exporting water, we promote economic development in the United States that could otherwise take place in Canada and, that there is considerable scope for much more effective management of the United States' own substantial water resources. To date, these views had been supported by the provincial governments.

Canada is presently being asked to consider a different means of exporting water. Various entrepreneurs are exploring the possibility of transporting Canadian freshwater via large tankers to arid areas around the world. This development is being monitored by the Departments of Trade, External Affairs, and Environment.

Issues and Options

1. The Canadian policy of no export is not based on specific legislative provision and has not been substantiated by investigations of the economic feasibility or the legal-political implications of possible bilateral trade arrangements for water.

   - Take no further action in view of the fact that there has been no formal request from the United States, and unlikely to be one over the next few decades.
   - Amend existing legislation e.g. International Rivers Improvement Act, to extend federal control to diversion of Canadian waters to the United States, by artificial means such as canals and pipelines. At present, the Act refers only to natural flows in (trans)boundary rivers.
   - Examine the implications of Canadian water exports to the U.S. in the context of broader political and economic trade relations and the export of other resource commodities (e.g. oil, gas, electricity).

2. Water export by tanker is a new issue for both federal and provincial governments. It differs from export by diversion in substantial ways. No specific formal policies, legislative arrangements, nor applicable common or statute law exist to handle such export. Provinces do have licensing procedures for using water which they "own"; however, export is not specifically mentioned.

   - Take no further action on the assumption that the volumes of water exported would not be significant, and leave it up to the provinces involved to institute licensing measures, unless federal interests such as fisheries and navigation are affected.

- Assume a nominal licensing role under new or amended legislation to determine, for example, how much is being exported, to what destinations and at what price. At present such a data base does not exist.
- Assume a more dominant role to ensure Canada is paid proper value for its resources and that all federal interests such as ecological effects are considered. The government might under certain circumstances actively promote such export opportunities.

Jurisdictional Needs - Organization, Coordination

31. Federal

There are a total of 22 federal departments and agencies with an interest in water matters in Canada, including Environment, Agriculture, Fisheries and Oceans, Transport, Indian and Northern Affairs, Public Works and External Affairs. Others with water-related responsibilities include National Health and Welfare; the National Energy Board; Energy, Mines and Resources; and the Atomic Energy Control Board.

The roles of these various departments were reviewed during a recent evaluation of Environment Canada's river basin planning and implementation programs. The evaluation team concluded that there appeared to be no significant conflicts or duplications in roles among federal agencies but, in practice, coordination of their respective activities prior to negotiations with provinces was not always achieved.

Issues and Options

1. The Interdepartmental Committee on Water (ICW), which represents these 20 departments and agencies, is the main federal body concerned with federal water programs at the departmental level. Environment Canada makes positive use of ICW in terms of obtaining interdepartmental views on its federal- provincial programs as well as other activities, and as a means of disseminating information on water activities in general. Major differences in points of view are usually left for further resolution between Environment Canada and the other agency. In Environment Canada, itself, with its many Services, there is no explicit mechanism for interservice coordination of water programs, although Senior Management Committee and the Regional Directors General weigh significant developments and proposals relating to water against all departmental programs and interests.

2. There have been instances of federal agencies negotiating with provinces for joint water investigations and development assistance without prior consultation with either ICW or other federal water agencies. In one instance in 1982, the Committee of Deputies turned back a proposal and insisted on an interdepartmental review. The outcome was a third department with interest in the arrangement was enabled to join the original two agencies involved.

3. While some consideration could be given to strengthening ICW's decision making role, an overall policy making advisory role seems to be ruled out by practical considerations. Such considerations would include: questions on the mandate of the Secretariat by other policy groups, and on whether the policy advice represents Environment Canada's position or independent advice; lack of experience in many water policy areas; and the possible reversal of that advice at higher policy levels.

- Departmental Work Plans offer some potential for improving coordination and for providing an "early warning" to other departments on ongoing activities and new initiatives. ICW could devote one meeting annually to review the activities and new initiatives expected to be undertaken over the following five-years.
- As an alternative to ICW, an organization with a stronger mandate than ICW, but independent of any one department, might be considered. The chairmanship could rotate among the departments having major water legislation. A Committee of Deputies of these departments could be formed to sit in judgement on any issues that could not be resolved in the lower committee.
- There is another way available for Environment Canada to influence the actions of other departments in the exercise of their duties toward environmental quality and conservation of resources - through more aggressive use of the "horizontal powers" expressed in the Government Organization Act of 1979. This would parallel the influence exerted by Environment Canada on other departments with respect to restrictions on federal investments in designated floodplains.
- Establishment of a recognized "water advisory service" in an appropriate federal agency.

32. Federal-Provincial

Over the years, water issues have evolved with emphasis in the 1950s on flood control structures and hydro-electric development, in the 1960s on gross pollution and river basin planning, and subsequently on toxic pollutants and water management programs in general.

Both federal and provincial governments have gradually reorganized to meet the new situations. Even recently, there have been significant water agency reorganizations at the provincial level, in particular on the Prairies. The attempts by the federal and provincial governments to reorganize and meet new situations are seen to be effective but coordination between the two levels of government has not grown in unison. For that reason, the issues addressed largely relate to coordination.

Issues and Options

1. The Canadian Council of Resource and Environment Ministers (CCREM) serves as a high level federal-provincial forum for the exchange of information on broad policies and programs. It proved useful in clarifying government priorities and attitudes to cooperative water undertakings in the 1960s but its concerns extend to all natural resources and the environment.

2. Specific federal-provincial consultation and coordination mechanisms exist for some water-related matters, one prominent example being the Federal-Provincial Advisory Committee on Environmental and Occupational Health, which addresses drinking and recreational water qualities. But there is by no means any effective mechanism at a senior level for intergovernmental discussion of broad long-range needs, policies or priorities specifically dealing with water.

3. Consultative Committees, established at the outset under the Canada Water Act (1970) to provide continuing consultation between the federal and provincial governments, are now largely dormant. Only the Canada-Saskatchewan Consultation Committee has continued to meet. There appears to be little provincial interest in receiving visits from senior Ottawa officials to discuss governmental priorities and longer-term objectives, particularly when federal regional officials are more accessible. Other, more specific federal-provincial mechanisms appear to have at least partly filled the need foreseen for the Consultative Committees.

4. Although lacking formal coordination facilities, water management in Canada has progressed since 1970, with approximately 30 federal-provincial preplanning, planning, implementation, regulation, monitoring and apportionment projects completed, and 23 other projects still under way (including seven long-term projects).

5. How best can federal-provincial coordination evolve?

- Establish a consultative function under the auspices of CCREM.
- Attempt to revive the formal Consultative Committees, even though only one province (Saskatchewan) has been satisfied with this form of consultation.
- Continue to depend upon federal regional representatives to provide ad hoc coordination. Unfortunately, the role intended of the Consultative Committees to anticipate issues and needs and compare federal and provincial priorities is not seen to be achieved effectively.
- Hold annual federal-provincial-territorial water conferences, comparable to the intergovernmental meetings held by parks and wildlife services.
- Establish several specific federal-provincial consultation and coordination mechanisms on water, comparable to the Advisory Committee on Environmental and Occupational Health.
- Promote the interests of the water sector within the Canadian Climate Program through the Regional/Provincial Climate Advisory Committees, where better utilization of climate and water information and networks by provincial and federal agencies are planned and coordinated.