Section 2

The State of the Basin

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Source: Bruce Litteljohn

2.1 What is the state of the Great Lakes and St. Lawrence River basin? There is no single answer to this question; it can be answered from many viewpoints. We have chosen three: historical, science-based, and international.

2.2 **Historical perspective.** While a snapshot would give a useful look at the basin, it would be a limited view. Time-lapse photography would give us a better understanding of its state. Looking back at the basin over the past 100 years, we see how dramatically it has changed as a result of our growing presence. This suggests not that we need to return to a simpler time or a more pristine wilderness but that we need to learn from our past.

2.3 **Science-based perspective.** Scientists in both Canada and the United States are working to understand the state of the basin. We have summarized their latest efforts and findings.

2.4 **International perspective.** The St. Lawrence River and Great Lakes basin is one of the most famous freshwater resources in the world. One of the most infamous is the Aral Sea. What can we learn from the environmental disaster there?

A brief history of the basin

A constantly growing population

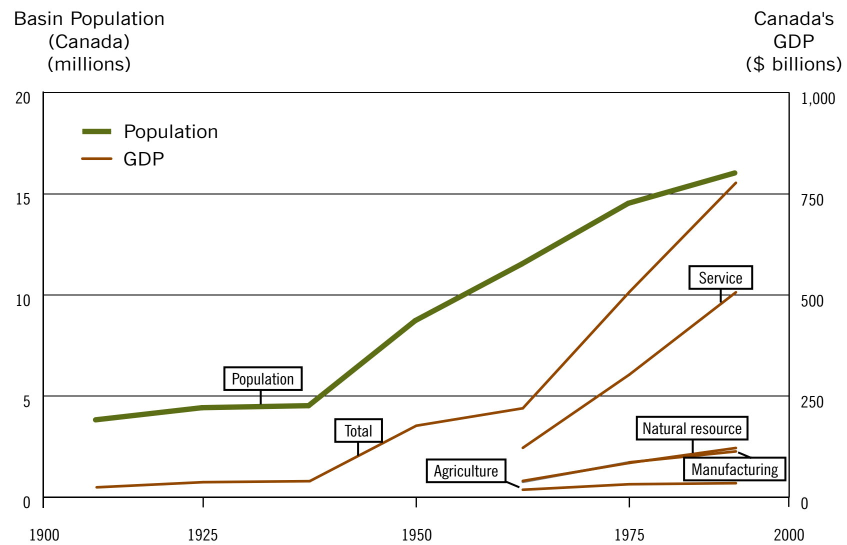
2.5 As the 20th century began, the population of Quebec was 1.5 million; Ontario's was about 2.2 million. In both provinces the population had increased almost fivefold by 1996, to over 7.1 million in Quebec and 10.7 million in Ontario.

2.6 Not only has the size of the population changed significantly but so has its location. The mainly rural population of the 19th century began to shift to one increasingly concentrated in urban centres. The growth of Quebec's population continued mainly along the banks of the St. Lawrence River, and almost six million of the province's inhabitants—more than 80 percent—lined its shores by the mid-1990s. In Ontario, over nine million people—close to 90 percent of the population—live around the Great Lakes.

Fuelling the industrial engine

2.7 As the population has grown, so has the level of economic activity (Exhibit 2.1). The resource-rich basin has increasingly been tapped for the raw materials the economy needs. The lakes, rivers, and tributaries of the basin have provided cheap, plentiful power to fuel industrial growth. In 1891, mining, agriculture, forestry, and fishing employed almost half of the Canadian workforce. Yet industrial plants, benefiting from access to cheap power and proximity to the U.S. manufacturing belt, needed more and more labourers. Windsor became a site of many industries; car manufacturing began there in 1904. Steel production and metal finishing were concentrated along the shores of lakes Erie and Ontario. By 1911, Toronto had become the leading industrial centre of Ontario. In the northwest, along Lake Superior, mining was developing. Beginning in the late 1800s, the railway opened up communities like Port Arthur and Fort William (now joined as Thunder Bay) that would become major centres for developing natural resources.

Exhibit 2.1 Economic activity in Canada and the population in the basin continue to increase



Source: Statistics Canada

2.8 The St. Lawrence River saw many large companies established to exploit natural resources. In the late 1800s, on tributaries of the St. Lawrence, forestry was shifting from sawmills to pulp and paper mills located near hydroelectric power sources. Later, access to cheap, abundant energy, and the ability to move imported bauxite up the St. Lawrence and Saguenay rivers, led to the construction of aluminium smelters. New communities in Quebec sprang up around major resource developments. Industry prospered and expanded from the timber trade to mining, agricultural processing, textiles, and hydroelectric power.

2.9 **The development of new technologies.** The 1950s ushered in the chemical age. Technology developed largely to support the war effort was now applied to manufacturing for consumer products. Hamilton became a centre of steel production, with a capacity of over 2.7 million tonnes. New plastics and petrochemicals were developed that heralded economic prosperity and an improved quality of life for the basin's inhabitants. There was a promise of nuclear power "too cheap to meter."

2.10 The fast pace of development and the manufacture of chemicals went hand-in-hand with activity in the petroleum sector. Refineries were springing up along the waterway in Sarnia, Windsor, Hamilton, and Montreal. The refineries converted Canadian and U.S. crude oil into fuels to meet the growing demand for energy. They also produced the raw materials for the chemical industry, which required the same access to shipping, water, and abundant power. PCBs, synthetic fertilizers, and pesticides such as DDT were now manufactured along with thousands of other chemicals and products.

2.11 **A diverse mix of pollutants.** By the 1970s, the basin had developed a diverse economy with a strong emphasis on chemical, automotive, and natural resource industries. This diversity was reflected in the pollutants released into the environment. Practices of the mining and steel industries were tied to the release of poly-aromatic hydrocarbons and heavy metals such as mercury, lead, and arsenic. Dioxins and furans were associated most notably with incinerators. Pulp and paper mills were sources of dioxins, furans, and other organochlorines. PCBs were linked to the chemical industry in transformers and hydraulic oil. Organic residues, nutritive elements of all kinds, and a wide range of toxic substances were disposed of directly into the water and air of the basin.

2.12 **Industry reduces its environmental impact.** In contrast to the 1960s and 1970s, economic growth in the last 20 years has been achieved concurrent with improvements in the environmental health of the basin. Total emissions of substances targeted voluntarily by the chemical manufacturing sector decreased from 1,092 tonnes in 1988 to 324 tonnes in 2000. As levels of phosphorus have declined, so has eutrophication (excessive plant growth and subsequent decay that robs waters of oxygen). Levels of persistent toxic chemicals present in the tissues of fish and wildlife have shown a downward trend, although they levelled off somewhat in the mid-1990s and some chemicals now show a slight increase.

2.13 Regulation, voluntary measures, and the availability of chemicals that are less toxic have all contributed to improvement. Pulp and paper discharges to the lakes and the St. Lawrence have been reduced, along with discharges of solid waste per person by Ontario municipalities. Quebec has seen an increase in tonnes of waste per person in the past decade.

Some of the richest agricultural land

2.14 Agriculture has always been an important part of the basin's economy, providing food for the growing population. The area of southern Ontario and Quebec along the waterway is among the richest farmland in Canada. This portion of the basin, referred to as the Mixedwood Plains ecozone, was already highly cultivated by the turn of the 20th century. Farming was labour-intensive; tractors and other heavy equipment were not readily available. Combined harvests on small mixed farms were gradually replacing the predominant wheat crop. By 1921, Ontario and Quebec had some 335,000 farms with an average size of 120 hectares. More than 90,000 hectares were in corn, and the farms were also raising some 4 million cattle, 2 million pigs, and 21 million chickens.

2.15 **The impact of agriculture grows.** As the population grew, so did the demand for food. This meant increasing the productivity of farmland and transporting food from elsewhere. Technology was the principal factor in raising crop yields. Mechanization, concentration, specialization, and the use of pesticides and chemical fertilizers were becoming commonplace in Ontario and Quebec. Nitrogen-based fertilizer was applied to Canadian farms at a rate of 11 tonnes per thousand hectares in 1931; by 1961 it had increased to 38 tonnes. By 1951 there were 19 tractors and combines per thousand hectares in Canada, compared with just 5 in 1931. The number of agricultural workers averaged 13 per thousand hectares, fewer than half the number in 1901.

2.16 By 1970, Ontario led all provinces in the use of herbicide, at 47 percent of Canada's total. In addition to the fertilizers and manure linked to eutrophication, pesticides were now a concern. DDT was linked to the thinning of bird eggshells and the dwindling of eagle and peregrine falcon populations in the basin.

2.17 New crops such as hybrid corn led farmers in Ontario to convert permanent pasture and scrubland into cropland. The move to specialized crops continued, with more emphasis on fruit production in southern Ontario. In Quebec, the wheat crop was replaced by hay and later by mixed farming, field crops, and dairy production. Pasteurization and new refrigeration techniques allowed Quebec's dairy industry to expand. Agriculture went from an artisan activity to an industry.

2.18 **Agriculture today.** As a highly dynamic, global player, today's agriculture industry puts significant pressure on the soil and water of the basin. The use of commercial fertilizer increased significantly from the late 1960s, peaked in 1985, and has since declined. The amount of pesticide used also peaked in the 1980s, although in 1998 more than 5,000 tonnes of active ingredient were still applied in Ontario alone. New crop varieties have shorter growing seasons and higher yields, and have shifted the emphasis of crop production. We now share the basin with some 4 million cattle, 6 million pigs, and over 60 million hens and chickens; together, they generate manure equivalent to the sewage from some 100 million people.

Waters once teeming with fish

2.19 Commercial fishing in the Great Lakes, which began in the 1820s, peaked in the 1890s at a catch of about 140 million pounds. But there were already signs that stocks were being depleted. One of the most notable

A walk through the basin

The basin today is a complex mix of natural beauty and human activity.

Lake Superior

Pulp mill near Thunder Bay

North Channel, Lake Huron near Blind River casualties was the Atlantic salmon; by 1900, one of its largest populations in the world had disappeared from Lake Ontario and its tributaries.

2.20 **Growing catches of fish, declining stocks.** Commercial fishing remained viable during the first half of the 20th century, but by the mid-1950s the golden era of the fishery was over. Modern equipment, higher productivity, and the diversity of species available helped to maintain fish landings at the same levels. Refrigerated holds and warehouses helped improve the quality of fish products going to market. The Great Lakes catch increased from 35 million to 50 million pounds between 1920 and 1960. But the large, high-value species were all but gone; the harvest yielded larger volumes of smaller, less valuable species.

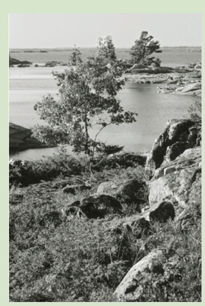
2.21 Fish stocks were declining as a result of intensive commercial fishing, disruptions to habitat, and the impact of the sea lamprey. From 1945 to 1988, about 16,000 hectares of aquatic environment between Cornwall and Île au Coudre were affected by dredging of the shipping channel, backfilling, draining of land along the riverbanks, and construction of harbour and hydroelectric facilities. All of this jeopardized the habitat of lake sturgeon, American shad, Atlantic tomcod, Atlantic sturgeon, and American eel, among others. The formerly prolific striped bass disappeared.

2.22 **A fishery in flux.** While Lake Erie contains only two percent of the total volume of water in the Great Lakes, it has the highest productive capacity for fish and yields close to 80 percent of the commercial catch. The Lake Ontario fishery is surviving, thanks to the active stocking of some populations and natural recovery helped by the control of sea lamprey. Commercial fisheries remain viable in a few locations, but they are much smaller than they were. The recreational fishing industry generates over $350 million each year. Yet consumption advisories warn of unsafe contamination levels in fish caught throughout the basin.

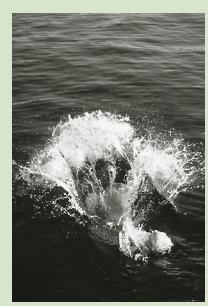
Impacts on the landscape

2.23 Throughout the 20th century, the list of concerns in the basin grew significantly longer, and many long-standing concerns continue today (Exhibit 2.2).

Fishing camp

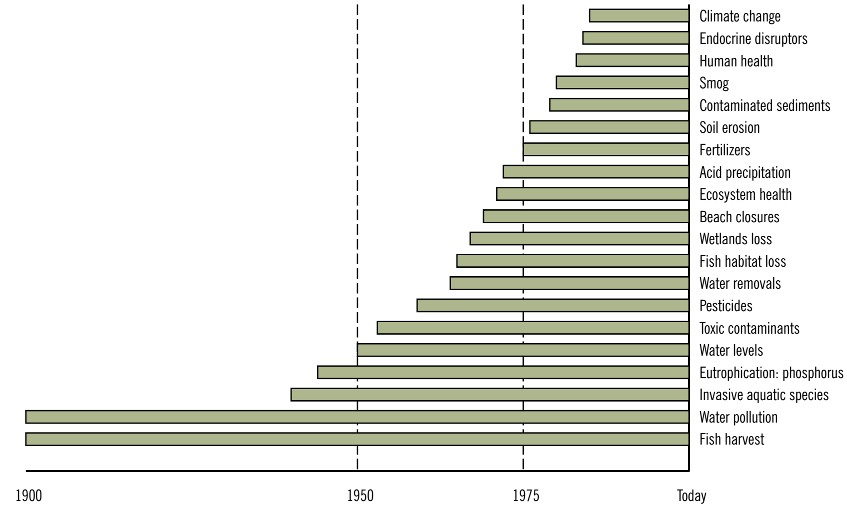


The shores of Georgian Bay



Swimming in cottage country

Exhibit 2.2 Basin concerns through time



Source: Adapted from Lake Erie: A Changing Ecosystem, SOLEC 2000 Presentation, Environment Canada

2.24 Even early in the last century, signs of stress on the landscape were emerging. Rivers and lakes were affected by the loss of shoreline vegetation, the trampling of stream banks, and the disruption of fish spawning habitats—all consequences of natural resources development. Logging had begun to exhaust the forests of the Mixedwood Plains, disrupting wildlife habitat. Only 25 percent of the forest cover remained, largely in woodlots and remnant stands. The loss of forests to agriculture contributed to soil erosion and fluctuations in local water supplies. The draining of marshes to create additional cropland began a long trend of wetland loss.

2.25 **Disappearing wetlands—key sources of life.** By 1982, 61 percent of Great Lakes wetlands had been lost. The loss was mostly in southern Ontario, due to agricultural and urban development, drainage, and pollution. Wetlands in Quebec were facing similar threats and several other problems, including riverbank erosion from shipping, and flooding from hydroelectric power generation. The considerable stress on the St. Lawrence River wetlands led to their biological deterioration and dramatically reduced their surface area.

Chemical valley near Sarnia

Fishing boats at Port Dover

Marsh grass at Rondeau Provincial Park

2.26 **Opening the St. Lawrence Seaway.** One of the most significant events in the history of the basin was the construction and development of the St. Lawrence Seaway, begun in 1954. Efforts had been made since the early 1800s to connect portions of the waterway. The Seaway was completed with a final series of locks, canals, dams, and control structures and was inaugurated in 1959. It profoundly altered shorelines, riverbeds, and fish and wildlife habitats.

2.27 Navigating the waterway successfully is a delicate operation. From 1978 to 1988, 15 maritime accidents in the St. Lawrence alone resulted in oil spills, two of them major spills. In the same period, the Canadian Coast Guard recorded 307 accidental spills of pollutants (largely petroleum products) from vessels on the St. Lawrence, mostly in ports. Navigation is becoming more problematic as water levels lower. In the 2000 shipping season, some water levels were close to a metre lower than normal, challenging navigation all along the Seaway. Lower water levels mean that ships have to lighten their loads in order to navigate safely. This cost the shipping industry an estimated US$1.2 million a week in 1998.

2.28 **The proliferation of non-native species.** Numerous non-native or invasive species of plants and fish have found their way into the basin. Some, such as tree species and crops, were introduced intentionally; others came uninvited in contaminated seed, ship ballasts, foodstuffs, and clothing. From 1930 to 1959, 33 new invasive species established themselves in the Great Lakes and the St. Lawrence River and had a tremendous impact on the economy. Sea lamprey, established earlier in the century, have caused millions of dollars of damage to the commercial fishery. Today, close to 160 invasive species have been identified in the Great Lakes.

Pollution of the waters

2.29 The growth in industry and population and the resulting pollution have been most apparent in lakes Ontario and Erie. Well into the 20th century, the basin was used for direct disposal of raw sewage, discharged into the lakes. Added to this was waste from industrial activity throughout the basin. In the early 1900s, heavy metals were a major source of contaminants entering the waters. Mercury and lead were prominent in waste streams from

Southern Ontario's urban sprawl

Sewage lagoon near Toronto

Sailing near Presqu'ile

mining and pulp and paper operations. Lead contamination in Lake Ontario almost tripled between 1880 and 1920.

2.30 Next came inorganic and synthetic fertilizers that, with industrial waste and untreated sewage, degraded the quality of drinking water and fish habitat. From 1940 to 1960, PCBs in the sediments of Lake Ontario increased 275 percent due to direct disposal of industrial chemicals into the waterway. Concentrations of DDT increased more than fivefold in the same period, largely in runoff from farms.

2.31 **Phosphorus—a major problem.** In the 1950s and 1960s, Lake Erie experienced massive algal blooms, oxygen depletion, and fish kills. By the 1970s, the Great Lakes epitomized North American environmental degradation.

2.32 It was the severe and visible degradation of Lake Erie that most aroused public concern and prompted a review of the lower lakes in 1964 by the International Joint Commission. Studies in Canada and the U.S. said the key problem was eutrophication. Untreated sewage, still a big problem, was joined by phosphorous from detergents and runoff from fertilizers and manure—all heightened by growing urban development and farming practices in the basin.

The impacts on human health

2.33 **Impact on drinking water.** For municipalities and industries, the waterway had often appeared to be a convenient and effective means of diluting and removing wastes. However, waterborne diseases were passed to the public in drinking water, and several major cholera and typhus epidemics swept through Toronto in the mid-1800s. These were the first signs that improper disposal of sewage could lead to public health disasters. In 1910, as the public health threat in Lake Ontario became evident, Toronto built its first sewage treatment facility.

2.34 Most domestic wastewater was dumped, untreated, directly into the waters of the basin—the same waters from which municipalities drew their drinking water. Efforts to introduce wastewater treatment to Quebec municipalities along the St. Lawrence River were slow. Ontario, though, led

Tour boat in the Thousand Islands near Kingston

St. Lawrence Seaway at Montreal

Research vessel

many provinces in treating its wastewater. By the 1970s, most Ontario municipalities discharging effluent to the lakes had developed basic sewage treatment.

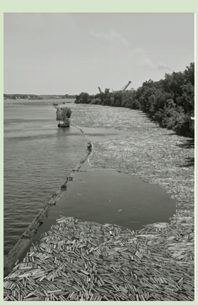
2.35 Every day, 3.2 million Canadians use about 360 litres of water each from the St. Lawrence River. Today, 78 percent of the wastewater their households generate is treated either partially or fully before being returned to the river. Improvements in sewage control and pollution management have made it safer to swim in the river.

2.36 However, a significant amount of waste is still dumped directly into the St. Lawrence. In 1992, 140 municipalities generated about 500 million litres of waste per day. A 1991 study sponsored by Health Canada concluded that about 35 percent of reported gastrointestinal illness among Montreal's tap water drinkers was water-related and preventable. Health Canada estimates that health care related to water pollution costs about $300 million a year.

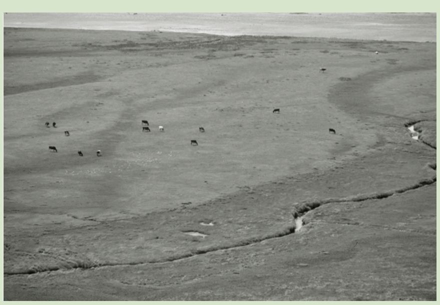
2.37 **Impact of chemical discharges.** By the late 1960s and 1970s, inhabitants of the basin were in for a rude awakening. The harmful effects of disposing of industrial waste were not yet understood; there had been little concern about dumping these effluents into the Great Lakes and the St. Lawrence River. However, signs of early development defects in bird populations around the Great Lakes raised an alarm. It was soon clear that the entire food chain contained a variety of toxic substances that accumulated at unacceptable levels in the tissues of some fish and wildlife.

2.38 In 1971, abnormally high levels of mercury were found in the flesh of fish in the St. Lawrence River. Commercial fishing was restricted in most of the area between the Ontario border and Île Verte, Quebec. The first sport fishing advisory was issued in 1971, and Ontario began to issue a biannual guide to safe fishing; these guides contained consumption advisories. The restrictions were the result of contamination by PCBs, mirex, and dioxins.

2.39 Fishing, swimming, and drinking water were all affected by pollution. Sewage is the most common cause of beach closings in the basin. In 1971, 19 beaches between Montreal and Lac Saint-Pierre were the subject of bacterial analysis. Of all the beaches in question, only one near Berthierville was considered suitable for swimming (the water there contained less than



Logs near Trois Rivières



Farm stream in Quebec

Quebec City

Source: Bruce Litteljohn

1,000 *E. coli* per 100 millilitres; the other beaches had levels above this safety threshold).

2.40 Today, more than 360 chemicals have been identified in the water, sediment, and wildlife of the basin. Roughly a third of these chemicals can have acute or chronic toxic effects. People are exposed to toxins mainly in fish they eat, and to a lesser extent in drinking water.

2.41 There has been a modest increase in the number of fish advisories issued for some sport fish species in all lakes since 1993. Consumption advisories target in particular Aboriginal people, minorities, sport anglers, the elderly, pregnant women, and nursing mothers.

Governments begin to react

2.42 Throughout the 20th century, governments responded to concerns in the basin. The end of the 19th century had seen a move toward a federal forestry policy and the creation of the first forest reserves at both the federal and provincial levels to deal with the effects of deforestation.

2.43 Acting on concerns about the wasteful and destructive use of resources and the problems caused by urbanization, the federal government created the Commission of Conservation in 1909. The Commission based its intervention in the use of rivers on three principles:

- the right of each Canadian to pure, unpolluted water;
- control of the commercial use of river resources to ensure that one type of use did not prejudice others; and
- preservation of the rivers' natural resources for future users.

2.44 Also in 1909, Great Britain (on Canada's behalf) and the United States signed the Boundary Waters Treaty, which established the principles and mechanisms to help resolve disputes over waters along the boundary between the two countries. The Treaty's articles focussed on navigation, water flow, unimpeded movement, and the use of lake water. Only one short sentence in the Treaty noted that each country agreed to not pollute the waters to the injury of the other's health or property. Still, this was a groundbreaking prohibition that would later form the basis for much government action on water quality. The Treaty also led to the creation of the International Joint Commission, a binational organization that supports Canada and the U.S. in their management of the water resources they share. The treaty gave the Commission three responsibilities for boundary waters, including the Great Lakes:

- approve applications to use, obstruct, or divert boundary waters on either side of the border in ways that would affect the natural level or flow on either side;
- investigate and provide advice on transboundary issues referred to it by the two national governments; and
- arbitrate any disputes between the two governments over boundary waters.

2.45 **Responding to invasive species.** In the 1950s, governments in Canada and the U.S. were particularly concerned about the impacts of invasive aquatic species on commercial fishing. The sea lamprey was considered one of the main culprits, and for good reason: it was a highly effective predator and was decimating the large fish populations of the Great Lakes as it moved west. As a result, the Great Lakes Fishery Commission was established in 1955 to advise on fishing issues and to control the sea lamprey. The lamprey population has been reduced 90 percent by the selective use of chemicals to kill the larvae in streams. The Great Lakes Fishery Commission also investigated other ways to control the population and begin to restore the fishery.

2.46 **Governments address water quality concerns.** A stream of new information flowed throughout the 1960s, 1970s and early 1980s, and not much of it was good news. The emphasis of the early 1970s on eutrophication soon turned to a focus on persistent organic pollutants that were showing up in wildlife. Safeguarding the environment thus became an increasing concern of the federal, provincial, and municipal governments.

2.47 While the International Joint Commission had begun studies of water quality in the 1910s, it was its third major study of pollution in the basin, begun in 1964, that would be the catalyst for action. The study findings formed the basis of the 1972 Great Lakes Water Quality Agreement between the U.S. and Canada. A revised Great Lakes Water Quality Agreement was signed in 1978, calling for an end to the discharge of persistent toxic chemicals.

2.48 The federal government has worked with the Province of Ontario since the first Canada–Ontario Agreement in 1971, the prelude to Canada's Great Lakes Water Quality Agreement with the United States in 1972.

2.49 The federal programming efforts in the Great Lakes were brought together under the Great Lakes Program launched in 1989. The program is entering its third phase, and the Canada–Ontario Agreement (which expired in 2000) is currently being renegotiated.

2.50 In Quebec, the St. Lawrence Vision partnership between the provincial government and the federal government began in 1988 to address the health of the St. Lawrence River basin's ecosystem. This partnership is currently in its third phase.

2.51 By the end of the 1970s, a range of activity by governments—legislation, regulations, monitoring, enforcement, and industrial partnerships, among others—had reduced the levels of contaminants in the lakes and rivers. For example, phosphate levels in Lake Ontario dropped 38 percent between 1970 and 1980.

2.52 The *Canada Water Act* of 1985 was an attempt to enshrine in law the comprehensive management of the water resource; however, its constitutional validity was not universally accepted. In 1987 the federal government published its Federal Water Policy to protect and enhance freshwater resources. The policy includes a commitment to prevent the bulk removal of water from Canada.

2.53 **Broader federal initiatives affect the basin.** A number of nationwide federal initiatives also affect the health of the basin.

2.54 When Canada signed the Convention on Biological Diversity in 1992, it agreed to address the impact of foreign species on Canada's ecosystems. The federal government also began to promote farming practices, including soil management practices, that have fewer negative impacts on the environment.

2.55 The first attempt to legislate the protection of endangered species was in October 1996. In February 2001, a revised version of this legislation was introduced in Parliament.

2.56 **Government responses continue to evolve.** The federal government has directed considerable activity to problems in the Great Lakes and St. Lawrence River basin. Today the basin is the focus of myriad committees, programs, treaties, agreements, and institutions. There are remedial action plans, lakewide management plans, ecosystem approaches, and sustainable development strategies. All of these seek to improve the health of the basin and its inhabitants.

What have we learned?

2.57 We began this historical journey to answer the question, What is the state of the basin? As we have seen, the basin has changed considerably over the past 100 years. According to the International Joint Commission in its Ninth Biennial report, "The Great Lakes environment has improved dramatically over the past quarter-century." This is evident in pollution abatement, the emergence of more sustainable agricultural practices, recovery of some species, and efforts to protect wetlands and vital remaining habitats.

2.58 We have also seen more types and a changing mix of industrial, agricultural, and other human activities, with consequences both anticipated and unanticipated. And while we have seen their impacts on the basin multiply, we have also seen some issues persist over time. Others that we thought were being managed effectively appear to be recurring.

2.59 Local conditions—a growing population, continued urban and industrial growth, current agricultural practices, and increasing recreational demands—continue to pose a significant challenge to the health of the basin. So do global influences, such as climate change and long-range transport of air pollution.

2.60 It is important to note that the successes of the last 30 years were hard won, through targeted and sustained attention. They were based on a significant scientific capacity that grew out of the environmental awareness of the 1970s. That scientific capacity will continue to be needed as new issues emerge such as climate change and endocrine disrupters (chemicals that may have an adverse effect on human and ecological health by disrupting normal hormonal systems) and as urban development and technological advances continue to change the face of the basin.

Scientific assessment of the state of the basin

2.61 In 1992, the State of the Lakes Ecosystem Conferences (SOLEC) were established by the governments of Canada and the United States to provide a forum for exchanging information on the ecological condition of the Great Lakes ecosystem. While there is no comparable mechanism for reporting on the state of the St. Lawrence River, a number of indicators have been reported in the past. A new set of state-of-the-river indicators was developed in 2000 for future reporting.

2.62 SOLEC is a science-based reporting forum. It is the main forum for government decision-makers to exchange scientific information on the state of the lakes and the stresses on them. It does not focus on government programs or their achievements.

2.63 In 1996, those involved in SOLEC saw the need to develop a comprehensive, basin-wide set of indicators that would allow both Canada and the U.S. to report on their progress in maintaining and improving the quality of the lakes. They proposed 80 indicators. Progress measured by 19 of these indicators was reported at the Conference in 1998. One of the conclusions was, “Given the incomplete nature of the information available for the 80 indicators, the Parties cannot provide a detailed quantitative assessment of the State of the Lakes.”

2.64 At SOLEC 2000, the state of the lakes as measured by 33 of the indicators was reported, using five qualitative ratings: poor, mixed deteriorating, mixed, mixed improving, and good. The state of the St. Lawrence River and lakes Superior, Michigan, Huron, and Ontario was found to be “mixed.” Lake Erie was considered “mixed deteriorating.” Overall, while drinking water was rated “good,” and fish consumption advisories and swimming advisories “mixed improving,” many indicators raised concerns about the state of the Great Lakes and St. Lawrence River basin (exhibits 2.3 and 2.4).

An international perspective

Many watersheds are threatened

2.65 While the Great Lakes and the St. Lawrence River are unique resources, many of the threats and challenges they face are encountered throughout the world. These include jurisdictional conflicts; population pressures; physical alteration of inland water systems; habitat degradation; excessive water withdrawal (especially for agriculture); pollution from industrial, municipal, and agricultural sources; mismanagement of fisheries; introduction of non-native species; and the loss of freshwater biodiversity.

2.66 From the Rhine River and the Baltic Sea in Europe to Lake Victoria and Lake Chad in Africa, from the Rio Grande in North America to the Aral Sea in Central Asia, human activity is leaving its footprint. Some of the problems in these other watersheds are more serious than those in the Great Lakes and St. Lawrence River basin (Exhibit 2.5). Many are expected to get worse—not better—over time.

Exhibit 2.3 State of the Great Lakes—rated by indicator

← decreasing ✦ steady
→ increasing ? unknown

	Indicator	Poor	Mixed deteriorating	Mixed	Mixed improving	Good
COASTAL WETLANDS	Amphibians		←			
	Snapping turtles			✦		
	Bird diversity and abundance		←			
	Area by type		←			
	Effects of water levels		←			
HUMAN HEALTH	Air quality			✦		
	Swimming advisories				→	
	Drinking water					✦
	Fish consumption advisories				→	
LAND	Alvars			✦		
	Hardened shoreline		←			
	Bald eagles				→	
	Urban density			?		
	Brownfields					✦
	Mass transit			?		
	Sustainable agriculture			✦		
OPEN AND NEARSHORE WATERS	Walleye			✦		
	Hexagenia				→	
	Preyfish			✦		
	Sea lamprey			✦		
	Lake trout				→	
	Scud		←			
	DELT (Lake Erie)	✦				
	Phytoplankton			?		
	Phosphorous concentration / loads			✦		
	Contaminants in water birds					✦
	Zooplankton			?		
	Atmospheric deposition				→	
	Toxic chemicals in offshore waters			✦		
SOCIETAL UNBOUNDED	Acid rain			✦		
	Non-native species (aquatic)		←			
	Water use			?		
	Economic prosperity			✦		

Source: SOLEC Indicator, Issue Number 1

The Aral Sea—an extreme example of mismanagement

2.67 The Aral Sea is perhaps the most graphic example of the serious impacts that mismanagement and poor planning can have on a water body. In the 1960s, the Aral Sea was the world's fourth-largest inland body of water. By 1995, it had lost 75 percent of its water volume and its surface area had shrunk by half. Water levels had fallen by 19 metres, 33 square kilometres of its sea bed had been exposed, and 94 percent of the flow from its main tributaries no longer reached it (Exhibit 2.6).

2.68 The consequences have been enormous. More than 36,000 square miles have been turned into salt flats and desert. Two million hectares of fertile land have been lost to agriculture due to secondary salinity. Dust storms carry toxic salts and afflict three quarters of the region's 3.5 million people with serious illnesses. The Sea's salinity levels have tripled, and 20 of its 24 fish species have disappeared. The fish catch, which once weighed 40,000 tonnes and supported 60,000 jobs, is now non-existent. Drinking water is in short supply, due to contamination by toxics and salt. The damage is considered irreparable. Efforts are under way to see if a portion of the Aral Sea can be saved, but it may be too late.

Exhibit 2.4 State of the St. Lawrence River—rated by indicator

↔ mixed   → increasing   ✦ stable   ? unknown

Indicator	Deteriorating	Mixed	Improving
Sediment quality			→
Water quality (river)			→
Water quality (tributaries)			→
Biodiversity		?	
Natural spaces and protected species		?	
State of biological resources		↔	
Marine transportation		↔	
Modification of bottom and hydrodynamics			→
Modification of shorelines		?	
Urban waste water emissions			→
Industry waste water emissions			→
Commercial fisheries		↔	
Recreational hunting and fishing		✦	
Access to shoreline and river		?	
Human health		?	

Most of the data are for the period ending in 1996 or 1995.

Source: L'État du Saint-Laurent, rapport technique, Mise à jour des indicateurs environnementaux, SLV 2000

Exhibit 2.5 **Problems in watersheds around the world**

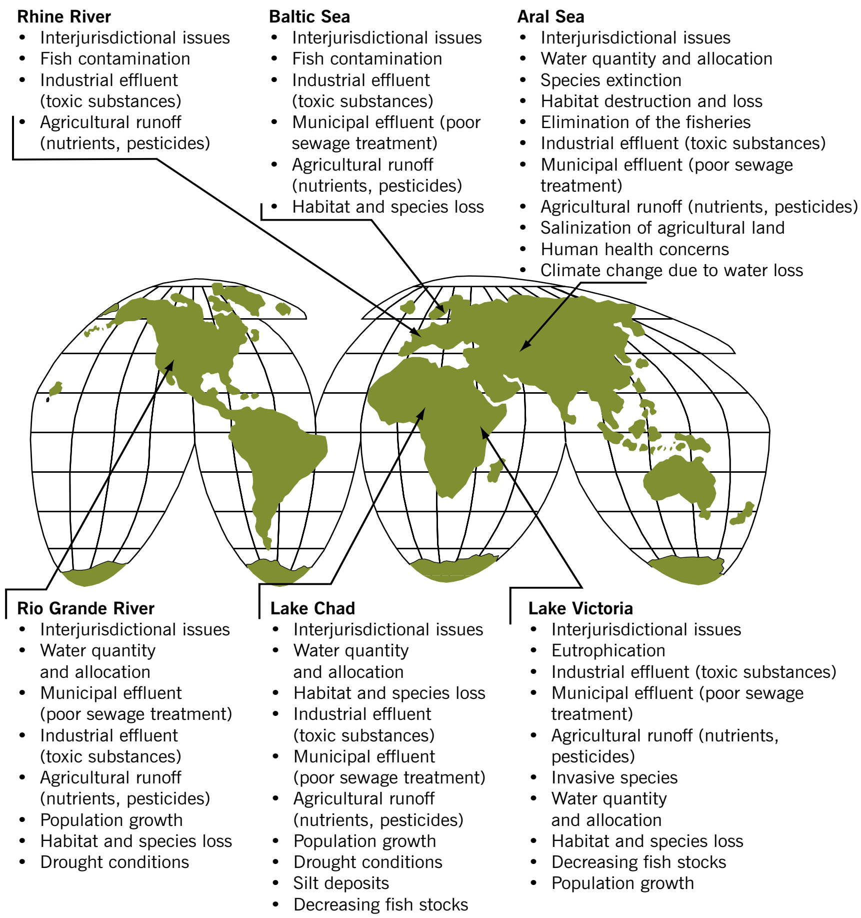
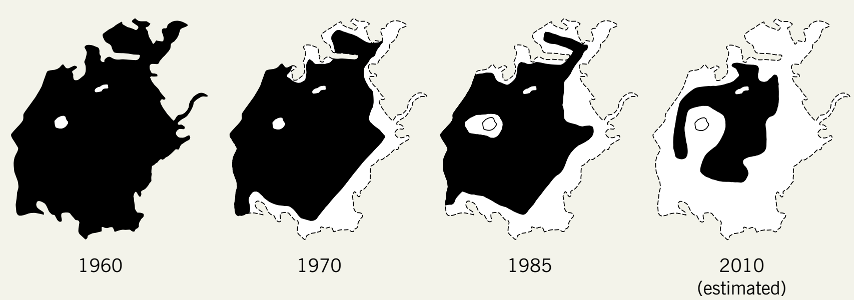


Exhibit 2.6 **Damage to the Aral Sea**



In the 1960s, the Aral Sea was the world's fourth largest inland body of water. By 1995, it had lost 75 percent of its water volume and its surface area had shrunk by half.

The basin in 2020: Looking to the future

2.69 Looking a generation ahead, the Canadian population surrounding the basin is predicted to grow by 20 percent—some three million people. Gross domestic product in Ontario and Quebec is expected to be 60 percent higher than today.

2.70 This growth will increase the demands on the basin's drinking water, land, fish, agricultural products, sewage treatment facilities, parks and wilderness areas, transportation services, housing, energy, and infrastructure (such as roads, bridges, and communication networks). And we will see a corresponding increase in waste generated, natural resources used up, and energy consumed. The basin our children will inherit will be quite different from today's basin.