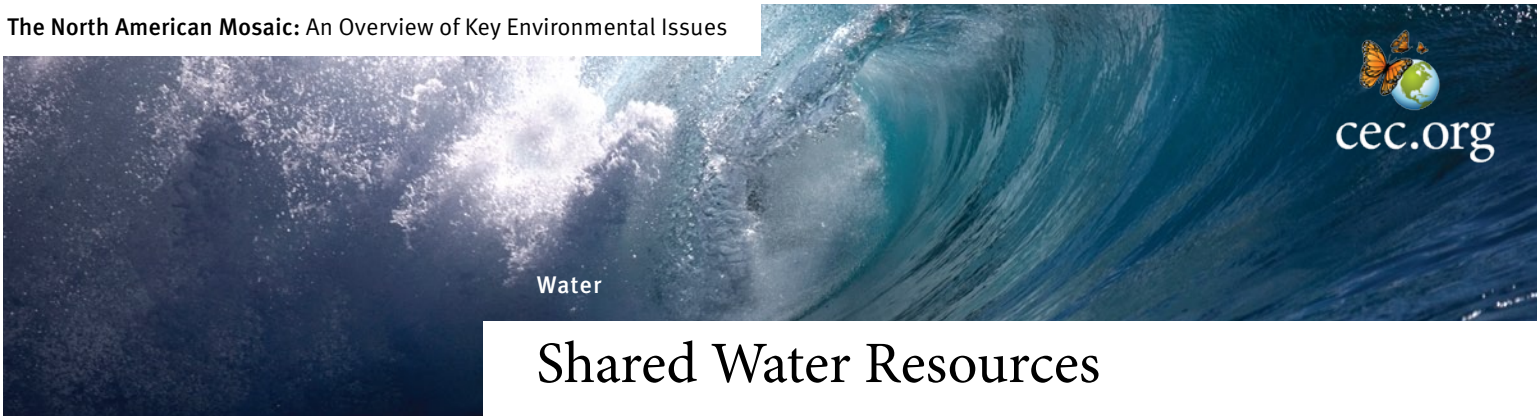


Shared Water Resources

Key Findings

- Shared water resources are water bodies that span political boundaries. Along the borders of the United States with Canada and Mexico, the effective management of the quality and use of these water bodies is a shared responsibility.
- Climate change, population growth, pollution, invasive species and land use change affect the quantity and quality of shared water resources and their ability to support aquatic ecosystems.
- In 2005 the US Environmental Protection Agency rated several important shared water bodies. The Gulf of Mexico was rated as in "fair" condition and the Great Lakes as in "fair to poor" condition. The Gulf of Maine was in generally better condition than the rest of the northeastern coastal region, which was rated as in "poor" condition.
- It is difficult to characterize overall trends across all the important features of shared water resources. In the Great Lakes, for example, trends in ecosystem conditions show improvement in some areas and worsening in others.

Shared water resources **are the rivers and estuarine regions that form borders or flow across borders, the lakes that span political boundaries, marine areas with multiple jurisdictions, and the groundwater aquifers that lie beneath political boundaries.**

What Is the Environmental Issue?

Water is a shared global resource. The hydrologic cycle transports water around the globe through atmospheric vapor and ocean currents. On land, water (streams and rivers) forms the political borders between many nations. Countries also share the lakes that span their political boundaries and the groundwater aquifers that lie beneath those boundaries.

Because water is essential for supporting all life processes, many nations view its adequate availability as a fundamental human right. Conflicts over water rights were recorded as early as 2500 B.C., and such conflicts are expected to arise more frequently in the future as human populations and economic development continue to grow and climate patterns change.

Why Is This Issue Important to North America?

North America has extensive shared water resources, but there are vast differences in the

A view of the Rio Grande river bordering the United States (left) and Mexico as seen from an international bridge in the border city of Ciudad Juárez, Mexico. Photo: REUTERS/Tomas Bravo.

quality and quantity of those resources across the continent. Along the northern border between Canada and the United States and the southern border between Mexico and the United States, the management of shared water resources—both for quantity and quality—is an important issue.

Management of Shared Water Resources

Canada and the United States share water along their almost 9,000-kilometer border from the Atlantic to the Pacific, and across a gradient from the relatively water-rich areas in the east to the more arid regions in the west. Likewise, Mexico and the United States share water along their 3,000-kilometer border, which runs amid the arid regions from Texas to California. But even with these gradients, many of the water quantity and quality issues among North American countries are similar. Potential conflicts over shared water resources in North America are addressed through bilateral water treaties, agreements and protocols.

The largest shared water resource between Canada and the United States is the Great Lakes–St. Lawrence River system, which contains one-fifth of the freshwater in the world. Other shared Canada-US resources range from the Gulf of Maine in the east to the Red River of the North in the central region to the Pacific Ocean in the west. Over the years, the United States and Canada have negotiated agreements to resolve water issues. As early as 1909, the Boundary Waters Treaty established the International Joint Commission to prevent and resolve disputes between the two countries. In 1972 Canada and the United States signed the first Great Lakes Water Quality Agreement (later revised in 1978 and 1987) to control pollution in these waters and to clean up wastes from industries and communities. The 1987 revisions introduced the concepts of Areas of Concern, Lakewide Management Plans and other elements generally recognizing an ecosystem approach toward restoration and maintenance of the Great Lakes.

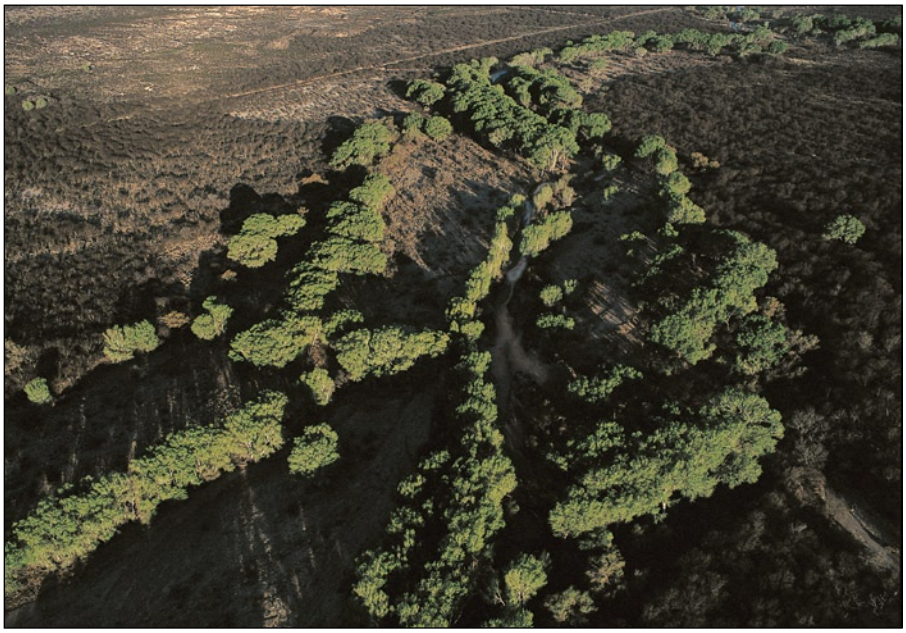
The water quantity and elevations of the Great Lakes are a concern for both Canada and the United States. Recently, the water levels of some of the Great Lakes have declined (notably Lakes Michigan and Huron). Some of the environmental consequences of lower water levels are smaller wetland areas, nursery areas, fish habitat and wildlife habitat, including resting and nesting areas for migratory waterfowl. As lake levels fall, dredging will be required to maintain shipping lanes. But dredging can disturb and resuspend contaminated sediments throughout the Great Lakes. Associated economic consequences are lower shipping tonnage because of shallower drafts in harbors, loss of recreation and less-efficient thermoelectric power generation.

Major shared resources between Mexico and the United States are the Colorado River and Rio Grande/Rio Bravo and the Gulf of Mexico. Many other surface water and groundwater resources important to local communities, states and provinces also lie along these borders. Ensuring that both countries have sufficient shared water resources has been one of the driving factors in treaties, agreements and protocols along the Mexico-US border. The Convention of 1906 between Mexico and the United States addressed water distribution issues for the Rio Grande. Several decades later, the US-Mexico Water Treaty of 1944 distributed waters in the lower Rio Grande, the Colorado River and the Tijuana River and also created the US-Mexico International Boundary Water Commission. In 1983 Mexico and the United States enacted the Border XXI Agreement to prevent, reduce and eliminate sources of pollution.

Water Quality

Since 1994, Environment Canada and the US Environmental Protection Agency have jointly evaluated the Great Lakes, publishing the results

Case Study – Resolving Water Quantity Issues in the San Pedro River



The San Pedro River. Photo: Adriel Heisey.

The San Pedro, which has its headwaters in Sonora, Mexico, and flows north into southern Arizona, is the largest undammed river in the southwestern United States. Water quantity is an issue for this river because the San Pedro is in an evaporation-dominated region, with low rainfall. During dry months, groundwater maintains flow in portions of the San Pedro, and so it is an oasis in the arid Chihuahua and Sonoran Deserts. However, groundwater has been depleted because of withdrawals for mining and ranching in Mexico and domestic withdrawals by Sierra Vista and Ft. Huachuca in Arizona. In response, citizens formed the San Pedro National Conservation Area in 1988, and those on both sides of the border implemented collaborative measures, management measures—such as creating land preserves, implementing county codes for water use and promoting water conservation practices (e.g., low-flow water fixtures, toilets, washers)—and stakeholder outreach and education programs. Monitoring programs are in place to track progress toward achieving goals for sustainable groundwater levels in order to restore and protect the San Pedro River.

Case Study – Addressing Water Quality Issues in Lake Erie

During the late 1960s and early 1970s, water quality in Lake Erie deteriorated to the point that the lake was declared "dead." Because Lake Erie is the shallowest of the Great Lakes, high phosphorus concentrations were contributing to serious eutrophication problems such as beaches covered with algal scum, loss of oxygen to support fish and other aquatic life in the bottom waters, and replacement of fish such as walleye with pollution-tolerant species such as carp.

In 1972 Canada and the United States signed the Great Lakes Water Quality Agreement and began to work on reducing phosphorus loading to the Great Lakes. Great Lakes provinces and states worked to reduce phosphorus in municipal and industrial effluents and to eliminate phosphorus from detergents. As a result, total phosphorus and chlorophyll concentrations decreased dramatically. Fish species richness increased with the return of pollution-intolerant species such as burbot, lake whitefish, smallmouth bass and white sucker and a decline in pollution-tolerant species such as brown bullhead, common carp and white crappie.

Over the last decade, however, Lake Erie's concentrations of phosphorus have been on the rise again. Tributary loadings of dissolved phosphorus are increasing. Hypoxia and anoxia in the central basin are more extensive and occur over a longer period of time. Blooms of the hazardous cyanobacteria *Microcystis* and the extensive growth of *Cladophora,* a clinging filamentous green alga, are beginning to rival those of the 1970s. As a result, nutrient management, particularly for phosphorus, remains the top priority for improving the lake, and the United States and Canada are developing a new binational nutrient management strategy for the lake. Although yellow perch stocks are now recovering throughout the lake, the top predator species populations of walleye, lake trout and lake whitefish continue to struggle.

Lake Erie shore.

in the *State of the Lakes Ecosystem* (SOLEC) report. SOLEC assesses the Great Lakes basin ecosystem components using a suite of ecosystem health indicators. For 2007, the overall status of the Great Lakes ecosystem was assessed as mixed because some conditions or areas were good or improving, and others were poor or worsening. Some of the improving conditions were declining levels of most contaminants in herring gull eggs and predator fish, the achievement of phosphorus targets, improving lake trout stocks, and the partial recovery of mayfly (*Hexagenia*) populations. Some of the negative trends were the increasing concentrations of the flame-retardant polybrominated diphenyl ethers (PBDEs) in herring gull eggs, the nuisance growth of the green alga *Cladophora*, the persistence of pervasive non-native species, unsustainable groundwater withdrawals, the growing number of impervious surfaces in urban areas, the long-range atmospheric transport of polychlorinated biphenyls (PCBs) and other contaminants, the ongoing shoreline development, and the declining populations of some species of amphibians and wetland-dependent birds.

In 2005 the US Environmental Protection Agency scored several large shared water bodies based on a large amount of monitoring data collected between 1997 and 2000. In this assessment, the Gulf of Mexico was rated as in "fair" condition and the Great Lakes as in "fair to poor" condition. The Gulf of Maine was in generally better condition than the rest of the northeastern coastal region, which was rated as in "poor" condition, but signs of degraded water quality condition were still noted throughout the area north of Cape Cod and along the coastline of Maine.

Many of the water quality issues along country borders are similar. DDT and other chlorinated hydrocarbon pesticides, as well as PCBs and associated arochlors (aromatic chlorinated hydrocarbons), have contaminated fish tissue from the Gulf of Maine to the Great Lakes to the Gulf of Mexico. PCB and DDT concentrations are also a concern in the Rio Grande separating Mexico and the United States. Mercury contamination of fish tissue is widespread as well, not only in North America, but also globally. The mercury concentrations in top predator fish, such as walleye and largemouth bass, have been so high that fish consumption advisories have been issued for tributaries to the Great Lakes and along the Canada-US border. King mackerel have mercury concentrations high enough to trigger consumption advisories throughout the Gulf of Mexico.

Salinity is another problem—it rises as irrigation water seeps through mineral-rich soils and then returns to surface water, thereby transporting these dissolved minerals. In the Colorado River, salinity rose over the first half of the twentieth century as irrigated acreage increased in the Colorado River Basin. In 1973 the International Boundary and Water Commission adopted Minute 242 to address the salinity issues in the Colorado River.

Rivers and streams throughout North America also exhibit degraded water quality because of the loading of oxygen-consuming organic matter, sedimentation that decreases water clarity and water depth and volume and nutrients that contribute to nuisance and harmful algal blooms.

What Are the Linkages to Other North American Environmental Issues?

Shared water resources are vitally linked to other important environmental topics such as climate change, land use, biodiversity and pollutants.

Climate Change

As climate patterns change, precipitation and runoff patterns are likely to change, with more drought in some areas and greater flooding in others. The warming temperatures of the Great Lakes have increased their evaporation during winter when they used to freeze, which, in turn, has contributed to lower lake levels. Warmer future temperatures are also expected to further reduce the Colorado River's stream flow and water supplies. Meanwhile, increased runoff will result in greater loading of sediment, organic matter, nutrients and toxic contaminants to aquatic ecosystems throughout North America. Overall, reduced water quantity and degraded water quality will make it more difficult for all three countries to satisfy international treaty requirements.

Land Use

Along with climate change, population growth and changes in land use will play a greater role in the scarcity of water resources over the next 25 years because of the growing urbanization and competition among water users, both within countries and along international borders. In view of the spatial differences in the distribution of renewable and available water within countries and across geographic areas, certain areas of North America are likely to have greater water shortages than others.

Biodiversity and Ecosystems

Biodiversity in aquatic ecosystems is affected by both water quantity and quality, as illustrated by the examples of the San Pedro River and Lake Erie (see case studies). Biodiversity is also affected by the introduction of invasive species, which have already affected biodiversity in shared resources. Examples are zebra mussels in the Great Lakes and water hyacinth in the Rio Grande. Zebra mussels not only outcompete native mussels for habitat, but also affect food web dynamics by filtering the food needed by other organisms out of the water column. Water hyacinth are clogging the Rio Grande and its tributaries with their dense growth, blocking sunlight for native plants and depleting the water of oxygen needed to support fish and other aquatic organisms.

Pollutants

Pollutants often cross political boundaries. Although DDT has been banned and PCB use has been restricted for decades, the atmospheric transport and deposition of these compounds are continuing to maintain concentrations in fish tissue from the Great Lakes to the Gulf of Mexico. Canada and the United States have identified Areas of Concern and developed Remedial Action Plans for the Great Lakes (see map). Nutrient overenrichment has contributed to the hypoxia problem in the Gulf of Mexico and to eutrophication of lakes, reservoirs, streams and rivers throughout North America. Atmospheric nitrogen contributes as much as 30 percent of the nitrogen loading to Chesapeake Bay. Atmospheric sources also contribute nitrogen to the Great Lakes and Gulf of Mexico.

Areas of concern identified for water quality improvement in the Great Lakes by Canada and the United States

1	Nipigon Bay	15	White Lake	30	Eighteen Mile Creek
2	Thunder Bay	16	Saginaw Bay	31	Rochester Embayment
3	St. Louis Bay/River	17	St. Clair River	32	Oswego River (delisted)
4	Torch Lake	18	Clinton River	33	St. Lawence River/ (Cornwall/Massena)
5	Deer Lake – Carp Creek/River	19	Detroit River	34	Bay of Quinte
6	Manistique River	20	Rouge River	35	Port Hope
7	Menominee River	21	River Raisin	36	Toronto and Region
8	Fox River/Lower Green Bay	22	Maumee River	37	Presque Isle Bay
9	Sheboygan River	23	Wheatley Harbour	38	Severn Sound (delisted)
10	Milwaukee Estuary	24	Black River	39	Sapnish Harbour
11	Waukegan Harbor	25	Cuyahoga River	40	St. Marys River
12	Grand Calumet River/ Indiana Harbor Canal	26	Ashtabula River	41	Penisula Harbor
13	Kalamazoo River	27	Presque Isle Bay	42	Jackfish Bay
14	Muskegon River	28	Buffalo River		
		29	Niagara River		

Source: International Joint Commission.