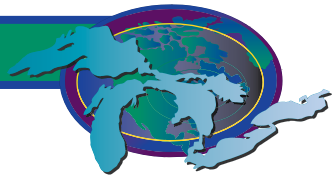


3.0 Indicator Category Assessments and Management Challenges

CONTAMINATION

Overall Assessment

Status: **Mixed**
Trend: **Deteriorating**
Rationale: **The transfer of natural and human-made substances from air, sediments, groundwater, wastewater, and runoff from non-point sources is constantly changing the chemical composition of the Great Lakes. Over the last 30 years, concentrations of some chemicals or chemical groups have declined significantly. There is a marked reduction in the levels of toxic chemicals in air, water, biota, and sediments. Many remaining problems are associated with local regions such as Areas of Concern. However, concentrations of several other chemicals that have been recently detected in Great Lakes have been identified as chemicals of emerging concern.**

Levels of most contaminants in herring gull eggs continue to decrease in all the Great Lakes colonies monitored, although concentration levels vary from good in Lake Superior, to mixed in Lake Michigan, Lake Erie and Lake Huron, to poor in Lake Ontario. While the frequency of gross effects of contamination on wildlife has subsided, many subtle (mostly physiological and genetic) effects that were not measured in earlier years of sampling remain in herring gulls. Concentrations of flame-retardant polybrominated diphenyl ethers (PBDEs) are increasing in herring gull eggs.

Concentrations of most organic contaminants in the offshore waters of the Great Lakes are low and are declining, indicating progress in the reduction of persistent toxic chemicals. Indirect inputs of in-use organochlorine pesticides are most likely the current source of entry to the Great Lakes. Continuing sources of entry of many organic contaminants to the Great Lakes include indirect inputs such as atmospheric deposition, agricultural land runoff, and resuspension of contaminated sediments. Overall, mercury concentrations in offshore waters are well below water quality guidelines. Mercury concentrations in waters near major urban areas and harbors, however, exceed water quality criteria for protection of wildlife. The spatial distribution of polycyclic aromatic hydrocarbons (PAHs) reflects the major source from the burning of fossil fuels. Concentrations of PAHs are therefore higher in the lower lakes, where usage is greater.

The status of atmospheric deposition of toxic chemicals is mixed and improving for polychlorinated biphenyls (PCBs), banned organochlorine pesticides, dioxins, and furans, but mixed and unchanging or slightly improving for PAHs and mercury across the Great Lakes. For Lake Superior, Lake Michigan, and Lake Huron, atmospheric inputs are the largest source of toxic chemicals due to the large surface areas of these lakes. While atmospheric concentrations of some substances are very low at rural sites, they may be much higher in some urban areas.

Juvenile spottail shiner, an important preyfish species in the Great Lakes, is a good indicator of nearshore contamination because the species limits its distribution to localized, nearshore areas during its first year of life. Total dichlorodiphenyltrichloroethane (DDT) in juvenile spottail shiner has declined over the last 30 years but still exceeds GLWQA criteria at most locations. Concentrations of PCBs in juvenile spottail shiner have decreased below the GLWQA guideline at many, but not all, sites in the Great Lakes.

The status of contaminants in lake trout, walleye and smelt as monitored annually in the open waters of each of the Great Lakes is mixed and improving for PCBs, DDT, toxaphene, dieldrin, mirex, chlordane, and mercury. Concentrations of PBDEs and other chemicals of emerging concern such as perflourinated chemicals, however, are increasing. Both the United States and Canada continue to monitor for these chemicals in whole fish tissues and have over 30 years of data to support the status and trends information.

Phosphorus concentrations in the Great Lakes were a major concern in the 1960s and 1970s, but private and government actions have reduced phosphorus loadings, thus maintaining or reducing phosphorus concentrations in open waters. However, high phosphorus concentrations are still measured in some embayments, harbors, and nearshore areas. Nuisance growth of the green alga *Cladophora* has reappeared along the shoreline in many places and may be related, in part, to increased availability of phosphorus.

Management Challenges:

- Presently, there are no standardized analytical monitoring methods and tissue residue guidelines for new contaminants and chemicals of emerging concern, such as PBDEs.
- PCBs from residual sources in the United States, Canada, and throughout the world enter the atmosphere and are transported long distances. Therefore, atmospheric deposition of PCBs to the Great Lakes will still be significant at least decades into the future.
- Assessment of the capacity and operation of existing sewage treatment plants for phosphorus removal, in the context of increasing human populations being served, is warranted.
- Monitoring of tributary, point source, and urban and rural non-point source contributions of phosphorus will allow tracking of various sources of phosphorus loadings.
- Investigating the causes of *Cladophora* reappearances will aid in the reduction of its impacts on the ecosystem.

CONTAMINATION

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
Nutrients						
111	Phosphorus Concentrations and Loadings — open lake	?	➡	?	?	➡
	Phosphorus Concentrations and Loadings — nearshore	?	?	?	?	?
7061	Nutrient Management Plans	2005 Report				
Toxics in Biota						
114	Contaminants in Young-of-the-Year Spottail Shiners	➡	?	➡	➡	➡
115	Contaminants in Colonial Nesting Waterbirds	➡	➡	➡	➡	➡
121	Contaminants in Whole Fish	➡	➡	➡	➡	➡
124	External Anomaly Prevalence Index for Nearshore Fish	?	?	?	◆	◆
4177	Biologic Markers of Human Exposure to Persistent Chemicals	?				
4201	Contaminants in Sport Fish	➡	➡	➡	➡	➡
4506	Contaminants in Snapping Turtle Eggs	?	?	?	?	?
8135	Contaminants Affecting Productivity of Bald Eagles	➡	2005 Report			
8147	Population Monitoring and Contaminants Affecting the American Otter	?	2003 Report			
Toxics in Media						
117	Atmospheric Deposition of Toxic Chemicals — PCBs & others	➡				
	Atmospheric Deposition of Toxic Chemicals — PAHs & mercury	◆	&	➡		
118	Toxic Chemical Concentrations in Offshore Waters	?	?	?	?	?
119	Concentrations of Contaminants in Sediment Cores	➡	&	?		
4175	Drinking Water Quality	◆				
4202	Air Quality	➡				
9000	Acid Rain	➡	2005 Report			
Sources and Loadings						
117	Atmospheric Deposition of Toxic Chemicals — PCBs & others	➡				
	Atmospheric Deposition of Toxic Chemicals — PAHs & mercury	◆	&	➡		
4202	Air Quality	➡				
7065	Wastewater Treatment and Pollution	Progress Report				
9000	Acid Rain	➡	2005 Report			

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined

Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend

Chemical Integrity of the Great Lakes - What the Experts are Saying

In addition to the ecosystem information derived from indicators, six presentations on the theme of "Chemical Integrity of the Great Lakes" were delivered at SOLEC 2006 by Great Lakes experts. The definition of Chemical Integrity proposed by SOLEC is "the capacity to support and maintain a balanced, integrated and adaptive biological system having the full range of elements and processes expected in a region's natural habitat." James R. Karr, 1991 (modified)

The presentations focused on the status of anthropogenic (man-made) contaminants and imbalances in naturally occurring chemicals in the Great Lakes basin. The key points of each presentation are summarized here.

Anthropogenic Chemicals

Ron Hites, Indiana University: While concentrations of banned or regulated toxic substances such as PCBs and PAHs have decreased over the past 30 years, the rate of decline has slowed considerably over the past decade. Virtual elimination of most of these chemicals will not occur for another 10 to 30 years despite restrictions or bans on their use. Further decreases in the environmental concentrations of PCBs, PAHs, and some pesticides may well depend on emission reductions in cities.

Derek Muir, Environment Canada: Some 70,000 commercial and industrial compounds are now in use, and an estimated 1,000 new chemicals are introduced each year. Several chemical categories have been identified as chemicals of emerging concern, including polybrominated diphenyl ethers (flame retardants), perfluorooctanyl sulfonate (PFOS) and carboxylates, chlorinated paraffins and naphthalenes, various pharmaceutical and personal care products, phenolics, and approximately 20 currently used pesticides. PBDEs, siloxanes and musks are now widespread in the Great Lakes environment. Implementation of a more systematic program for monitoring new persistent toxic substances in the Great Lakes will require significant investments in instrumentation and researchers.

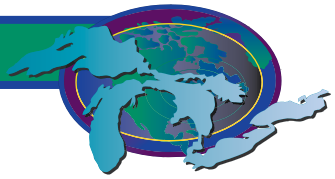
Joanne Parrot, Environment Canada: Some pharmaceuticals and personal care products appear to cause negative effects in aquatic organisms at very low concentrations in laboratory experiments. Some municipal wastewater effluents within the Great Lakes discharge concentrations of these products within these ranges. There is some evidence that fish and turtles show developmental effects when exposed to municipal wastewater effluent in the laboratory. Whether these effects appear in aquatic organisms including invertebrates, fish, frogs, and turtles, in environments downstream of municipal wastewater effluent is not known, indicating the need for more research in this area.

Naturally-occurring Chemicals

Harvey Bootsma, University of Wisconsin-Milwaukee: Changes in levels of nitrate, chloride and phosphorus in Great Lakes waters are attributed to human activities, with potential effects on phytoplankton and bottom-dwelling algae. Changes in lake chemistry, shown through variations in calcium, alkalinity, and even chlorophyll, are linked to the biological activity of non-native species. Non-native species also appear to be altering nutrient cycling pathways in the Great Lakes, by possibly intercepting nearshore nutrients before they can be exported offshore and transferring them to the lake bottom.

Susan Watson, Environment Canada: The causes and occurrences of taste and odor impairments in surface waters are widespread, erratic, and poorly characterized but are likely caused by volatile organic compounds produced by species of plankton, benthic organisms, and decomposing organic materials. In recent years, there has been an increase in the frequency and severity of nuisance algae such as *Cladophora* outbreaks in the Great Lakes, particularly in the lower Great Lakes. Type E botulism outbreaks and resulting waterbird deaths continue to occur in Lake Michigan, Lake Erie and Lake Ontario.

David Lam, Environment Canada: Models and supporting monitoring data are used to predict Great Lakes water quality. A post-audit of historical models for Great Lakes water quality revealed the general success of setting target phosphorus loads to reduce open water phosphorus concentrations.



BIOTIC COMMUNITIES

Overall Assessment

Status:	**Mixed**
Trend:	**Undetermined**
Rationale:	**Despite improvements in levels of contaminants in the Great Lakes, many biological components of the ecosystem are severely stressed. Populations of the native species near the base of the food web, such as Diporeia and species of zooplankton, are in decline in some of the Great Lakes. Native preyfish populations have declined in all lakes except Lake Superior. Significant natural reproduction of lake trout is occurring in Lake Huron and Lake Superior only. Walleye harvests have improved but are still below fishery target levels. Lake sturgeon are locally extinct in many tributaries and waters where they once spawned and flourished. Habitat loss and deterioration remain the predominant threat to Great Lakes amphibian and wetland-dependent bird populations.**

The aquatic food web is severely impaired in all the Great Lakes with the exception of Lake Superior. Zooplankton populations have declined dramatically in Lake Huron, and a similar decline is occurring in Lake Michigan. Populations of *Diporeia*, the dominant native benthic (bottom-dwelling) invertebrate in offshore waters, continue to decline in Lake Huron, Lake Michigan, and Lake Ontario, and they may be locally extinct in Lake Erie. The decline of *Diporeia* coincides with the introduction of non-native zebra and quagga mussels. Both zooplankton and *Diporeia* are crucial food sources for many other species, so their population size and health impact the entire system.

The current mix of native and non-native (stocked and naturalized) prey and predator fish species in the system has confounded the natural balance within most of the Great Lakes. In all but Lake Superior, native preyfish populations have deteriorated. However, the recent decline of non-native preyfish (alewife and smelt) abundance in all Great Lakes except Lake Superior could have positive impacts on other preyfish populations. Preyfish populations are important for their role in supporting predator fish populations, so the potential effects of these changes will be a significant factor to be considered in fisheries management decisions.

Despite basin-wide efforts to restore lake trout populations that include stocking, harvest limits, and sea lamprey management, lake trout have not established self-sustaining populations in Lake Michigan, Lake Erie, and Lake Ontario. In Lake Huron, substantial and widespread natural reproduction of lake trout was observed starting in 2004 following the near collapse of alewife populations. This change may have been due to the reduced predation on juvenile lake trout by adult alewives and the alleviation of a trout vitamin deficiency problem caused by trout consuming alewives. In Lake Superior, lake trout stocks have recovered such that hatchery-reared trout are no longer stocked.

Reductions in phosphorus loadings during the 1970s substantially improved spawning and nursery habitat for many fish species in the Great Lakes. Walleye harvests have improved but are still below target levels. Lake sturgeon are now locally extinct in many tributaries and waters where they once spawned and flourished, although some remnant lake sturgeon populations exist throughout the Great Lakes. Spawning and rearing habitats have been destroyed, altered or access to them blocked. Habitat restoration is required to help re-establish vigorous lake sturgeon populations.

From 1995 to 2005, the American toad, bullfrog, chorus frog, green frog, and northern leopard frog exhibited significantly declining population trends while the spring peeper was the only amphibian species that exhibited a significantly increasing population trend in Great Lakes coastal wetlands. For this same time period, 14 species of wetland-dependent birds exhibited significantly declining population trends, while only six species exhibited significantly increasing population trends. The Great Lakes are now facing a challenge from viral hemorrhagic septicemia (VHS). This virus has affected at least 37 fish species and is associated with fish kills in Lake Huron, Lake St. Clair, Lake Erie, Lake Ontario, and the St. Lawrence River.

Management Challenges:

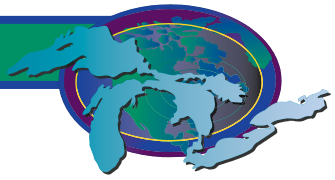
- Management actions to address the decline of *Diporeia* may be ineffective until the underlying causes of the declines are identified.
- The decline of *Diporeia* coincides with the spread of non-native zebra and quagga mussels. Cause and effect linkages between non-native species in the Great Lakes and ecological impacts may be difficult to establish.

- Identification of remnant lake sturgeon spawning populations should assist the selection of priority restoration activities to improve degraded lake sturgeon spawning and rearing habitats.
- Protection of high-quality wetland habitats and adjacent upland areas will help support populations of wetland-dependent birds and amphibians.

BIOTIC COMMUNITIES

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
Fish						
8	Salmon and Trout	➡	➡	➡	➡	◆
9	Walleye	?	?	◆	◆	◆
17	Preyfish Populations	➡	⬅	⬅	⬅	⬅
93	Lake Trout	➡	⬅	➡	◆	⬅
125	Status of Lake Sturgeon in the Great Lakes	?➡	?➡	?➡	?	➡
4502	Coastal Wetland Fish Community Health	Progress Report				
Birds						
115	Contaminants in Colonial Nesting Waterbirds	➡	➡	➡	➡	➡
4507	Wetland-Dependent Bird Diversity and Abundance	?	⬅	⬅	⬅	⬅
8135	Contaminants Affecting Productivity of Bald Eagles	➡ 2005 Report				
Mammals						
8147	Population Monitoring and Contaminants Affecting the American Otter	? 2003 Report				
Amphibians						
4504	Wetland-Dependent Amphibian Diversity and Abundance	?	◆	⬅	⬅	◆
7103	Groundwater Dependent Plant and Animal Communities	2005 Report				
Invertebrates						
68	Native Freshwater Mussels	2005 Report				
104	Benthos Diversity and Abundance - Aquatic Oligochaete Communities	◆	◆ ⬅	◆	◆ ⬅	◆
116	Zooplankton Populations	◆	?	?	?	?
122	*Hexagenia*	?	?	?	⇆	?
123	Abundance of the Benth Amphipod *Diporeia* spp.	◆	⬅	⬅	⬅	⬅
4501	Coastal Wetland Invertebrate Community Health	2005 Progress Report				
Plants						
109	Phytoplankton Populations	? 2003 Report				
4862	Coastal Wetland Plant Community Health	◆	◆	⬅	◆	◆
8500	Forest Lands - Conservation of Biological Diversity	?				

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined
Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend								



INVASIVE SPECIES

Overall Assessment

Status:	**Poor**
Trend:	**Deteriorating**
Rationale:	**Activities associated with shipping are responsible for over one-third of the aquatic non-native species introductions to the Great Lakes. Total numbers of non-native species introduced and established in the Great Lakes have increased steadily since the 1830s. However, numbers of ship-introduced aquatic species have increased exponentially during the same time period. High population density, high-volume transport of goods, and the degradation of native ecosystems have also made the Great Lakes region vulnerable to invasions from terrestrial non-native species. Introduction of these species is one of the greatest threats to the biodiversity and natural resources of this region, second only to habitat destruction.**

There are currently 183 known aquatic and 124 known terrestrial non-native species that have become established in the Great Lakes basin. Non-native species are pervasive throughout the Great Lakes basin, and they continue to exert impacts on native species and communities. Approximately 10 percent of aquatic non-native species are considered invasive and have an adverse effect, causing considerable ecological, social, and economic burdens.

Both aquatic and terrestrial wildlife habitats are adversely impacted by invasive species. The terrestrial non-native emerald ash borer, for example, is a tree-killing beetle that has killed more than 15 million trees in the state of Michigan alone as of 2005. The emerald ash borer probably arrived in the United States on solid wood packing material carried in cargo ships or airplanes originating from its native Asia.

Introductions of non-native invasive species as a result of world trade and travel have increased steadily since the 1830s and will continue to rise if prevention measures are not improved. The Great Lakes basin is particularly vulnerable to non-native invasive species because it is a major pathway of trade and is an area that is already disturbed.

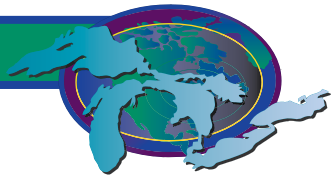
Management Challenges:

- A better understanding of the entry routes of non-native invasive species would aid in their control and prevention.
- Prevention and control require coordinated regulation and enforcement efforts to effectively limit the introduction of non-native invasive species.
- Prevention of unauthorized ballast water exchange by ships will eliminate one key pathway of non-native aquatic species introductions to the Great Lakes.
- The unauthorized release, transfer, and escape of introduced aquatic non-native species and private sector activities related to aquaria, garden ponds, baitfish, and live food fish markets need to be considered.

INVASIVE SPECIES

ID #	Indicator Name	2007 Assessment (Status, Direction)				
		Lake				
		SU	MI	HU	ER	ON
Aquatic						
18	Sea Lamprey	➡ 2005 Report				
9002	Non-Native Species (Aquatic)	◆	⬅	⬅	⬅	⬅
Terrestrial						
9002	Non-Native Species (Terrestrial)	?				

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined
Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend								



COASTAL ZONES AND AQUATIC HABITATS

Overall Assessment

Status:	**Mixed**
Trend:	**Undetermined**
Rationale:	**Coastal habitats are degraded due to development, shoreline hardening and establishment of local populations of non-native invasive species. Wetlands continue to be lost and degraded. In addition to providing habitat and feeding areas for many species of birds, amphibians and fish, wetlands also serve as a refuge for native mussels and fish that are threatened by non-native invasive species.**

The Great Lakes coastline is more than 17,000 kilometers (10,563 miles) long. Unique habitats include more than 30,000 islands, over 950 kilometers (590 miles) of cobble beaches, and over 30,000 hectares (74,131 acres) of sand dunes. Each coastal zone region is subject to a combination of human and natural stressors such as agriculture, residential development, point and non-point sources of pollution, and weather patterns. The coastal zone is heavily stressed, with many of the basin's 42 million people living along the shoreline.

Wetlands are essential for proper functioning of aquatic ecosystems. They provide a refuge for native fish and mussels from non-native predators and competitors. The Great Lakes coastline includes more than 200,000 hectares (494,000 acres) of coastal wetlands, less than half of the amount of wetland area that existed prior to European settlement of the basin. An inventory of Great Lakes coastal wetlands in 2004 demonstrated that Lake Huron and Lake Michigan still have extensive wetlands, especially barrier-protected wetlands. Reductions in wetland area are occurring, however, due to filling, conversion to urban, residential, and agricultural uses, shoreline modification, water level regulation, non-native species invasions, and nutrient loading. Stressors, such as these, may also impact the condition of remaining wetlands and can threaten their natural function.

Coastal wetland plant community health, which is indicative of overall coastal wetland health, varies across the Great Lakes basin. In general, there is deterioration of native plant diversity in any wetlands as shoreline alterations may cause habitat degradation and allow for easier invasion by non-native species.

Naturally fluctuating water levels are essential for maintaining the ecological health of Great Lakes shoreline ecosystems, especially coastal wetlands. Wetland plants and biota have adapted to seasonal and long-term water level fluctuations, allowing wetlands to be more extensive and more productive than they would be if water levels were stable. In 2000, Great Lakes water levels were lower than the 140-year average water level measured from 1860-2000. Furthermore, many climate change models predict lower water levels for the Great Lakes. Coastal wetlands that directly border the lakes and do not have barrier beaches may be able to migrate toward the lakes in response to lower water levels. Inland and enclosed wetlands would likely dry up and become arable or forested land.

Shoreline hardening, primarily associated with artificial structures that attempt to control erosion, can alter sediment transport in coastal regions. When the balance of accretion and erosion of sediment carried along the shoreline by wave action and lake currents is disrupted, the ecosystem functioning of coastal wetlands is impaired. The St. Clair, Detroit, and Niagara Rivers have a higher percentage of their shorelines hardened than anywhere else in the basin. Of the five Great Lakes, Lake Erie has the highest percentage of its shoreline artificially hardened, and Lake Huron and Lake Superior have the lowest percentages artificially hardened. Groundwater is critical for maintaining Great Lakes aquatic habitats, plants and animals. Human activities such as groundwater withdrawals for municipal water supplies and irrigation, and the increased proportion of impervious surfaces in urban areas, have detrimentally impacted groundwater. On a larger scale, climate change could further contribute to reductions in groundwater storage.

Management Challenges:

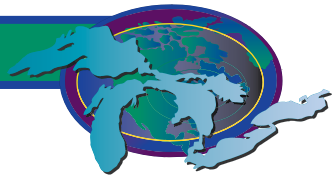
- Despite improvements in research and monitoring of coastal zones, the basin lacks a comprehensive plan for long-term monitoring of these areas. Long-term monitoring should be an important component of a comprehensive plan to maintain the condition and integrity of the coastal zones and aquatic habitats.
- An educated public is essential to ensuring wise decisions about the stewardship of the Great Lakes basin ecosystem.
- Protection of groundwater recharge areas, conservation of water resources, informed land use planning, raising of public awareness, and improved monitoring are essential actions for improving groundwater quality and quantity.

COASTAL ZONES and AQUATIC HABITATS

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
COASTAL ZONES						
Nearshore Aquatic						
4861	Effect of Water Level Fluctuations	? 2003 Report				
8131	Extent of Hardened Shoreline	⬅ 2001 Report				
Coastal Wetlands						
4501	Coastal Wetland Invertebrate Community Health	2005 Progress Report				
4502	Coastal Wetland Fish Community Health	Progress Report				
4504	Wetland-Dependent Amphibian Diversity and Abundance	?	◆	⬅	⬅	◆
4506	Contaminants in Snapping Turtle Eggs	?	?	?	?	?
4507	Wetland-Dependent Bird Diversity and Abundance	?	⬅	⬅	⬅	⬅
4510	Abundance of the Benth Amphipod *Diporeia* spp.	◆	⬅	⬅	⬅	⬅
4861	Effect of Water Level Fluctuations	? 2003 Report				
4862	Coastal Wetland Plant Community Health	◆	◆	⬅	◆	◆
4863	Land Cover Adjacent to Coastal Wetlands	Progress Report				
Terestrial						
4861	Effect of Water Level Fluctuations	? 2003 Report				
8129	Area, Quality and Protection of Special Lakeshroe Communities - Alvars	? 2001 Report				
8129	Area, Quality and Protection of Special Lakeshroe Communities - Cobble Beaches	⬅ 2005 Report				
8129	Area, Quality and Protection of Special Lakeshroe Communities - Islands	?				
8129	Area, Quality and Protection of Special Lakeshroe Communities - Sand Dunes	2005 Progress Report				
8131	Extent of Hardened Shoreline	⬅ 2001 Report				
AQUATIC HABITATS						
Open Lake						
111	Phosphorus Concentrations and Loadings — open lake	?	➡	?	?	➡
	Phosphorus Concentrations and Loadings — nearshore	?	?	?	?	?
118	Toxic Chemical Concentrations in Offshore Waters	?	?	?	?	?
119	Concentrations of Contaminants in Sediment Cores	➡ & ?				
8131	Extent of Hardened Shoreline	⬅ 2001 Report				
Groundwater						
7100	Natural Groundwater Quality and Human-Induced Changes	2005 Report				
7101	Groundwater and Land: Use and Intensity	2005 Report				
7102	Base Flow Due to Groundwate Discharge	⬅				
7103	Groundwater Dependent Plant and Animal Communities	2005 Report				

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined

Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend



HUMAN HEALTH

Overall Assessment

Status:	**Mixed**
Trend:	**Undetermined**
Rationale:	**Levels of PCBs in sportfish continue to decline, progress is being made to reduce air pollution, beaches are better assessed and more frequently monitored for pathogens, and treated drinking water quality continues to be assessed as good. Although concentrations of many organochlorine chemicals in the Great Lakes have declined since the 1970s, sportfish consumption advisories persist for all of the Great Lakes.**

The quality of municipally-treated drinking water is considered good. The risk of human exposure to chemicals and/or microbiological contaminants in treated drinking water is generally low. However, improving and protecting source water quality (before treatment) is important to ensure good drinking water quality.

In 2005, 74 percent of monitored Great Lakes beaches in the United States and Canada remained open more than 95 percent of the swimming season. Postings, advisories or closures were due to a variety of reasons, including the presence of *E. coli* bacteria, poor water quality, algae abundance, or preemptive beach postings based on storm events and predictive models. Wildlife waste on beaches can be more of a contributing factor towards bacterial contamination of water and beaches than previously thought.

Concentrations of organochlorine contaminants in Great Lakes sportfish are generally decreasing. However, in the United States, PCBs drive consumption advisories of Great Lakes sportfish. In Ontario, most of the consumption advisories for Great Lakes sportfish are driven by PCBs, mercury, and dioxins. Toxaphene also contributes to consumption advisories of sportfish from Lake Superior and Lake Huron. Monitoring for other contaminants, such as PBDEs, has begun in some locations.

Overall, there has been significant progress in reducing air pollution in the Great Lakes basin. However, regional pollutants, such as ground-level ozone and fine particulates, remain a concern, especially in the Detroit-Windsor-Ottawa corridor, the Lake Michigan basin, and the Buffalo-Niagara area. Air quality will be further impacted by population growth and climate change.

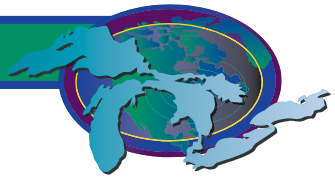
Management Challenges:

- Maintenance of high-quality source water will reduce costs associated with treating water, promote a healthier ecosystem, and lessen potential contaminant exposure to humans.
- Although the quality of treated drinking water remains good, care must be taken to maintain water treatment facilities.
- One-fourth of monitored beaches still have beach postings or closures.
- A decline in some contaminant concentrations has not eliminated the need for Great Lakes sportfish consumption advisories.
- Most urban and local air pollutant concentrations are decreasing. However, population growth may impact future air pollution levels.

HUMAN HEALTH

ID #	Indicator Name	2007 Assessment (Status, Direction)				
		Lake				
		SU	MI	HU	ER	ON
4175	Drinking Water Quality	◆				
4177	Biological Markers of Human Exposure to Persistent Chemicals	?				
4200	Beach Advisories, Postings and Closures	?	?	◆?	?	?
4201	Contaminants in Sport Fish	➡	➡	➡	➡	➡
4202	Air Quality	➡				

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined
Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend								



LAND USE - LAND COVER

Overall Assessment

Status:	**Mixed**
Trend:	**Undetermined**
Rationale:	**The Great Lakes basin encompasses an area of more than 765,000 square kilometers (295,000 square miles). How land is used impacts not only water quality of the Great Lakes, but also biological productivity, biodiversity, and the economy.**

Data from 1992 and 2002 indicate that forested land covered 61 percent of the Great Lakes basin and 70 percent of the land immediately buffering surface waters, known as riparian zones. The greater the forest coverage in a riparian zone, the greater the capacity for the watershed to maintain biodiversity, store water, regulate water temperatures, and limit excessive nutrient and sediment loadings to the waterways. Urbanization, seasonal home construction, and increased recreational use are among the general demands being placed on forest resources nationwide. Additional disturbances caused by lumber removal and forest fires can also alter the structure of Great Lakes basin forests. However, the area of forested lands certified under sustainable forestry programs has significantly increased in recent years, exemplifying continued commitment from forest industry professionals to practices that help protect local ecosystem sustainability. Continued growth in these practices will lead to improved soil and water resources and increased timber productivity in areas of implementation.

Under the pressure of rapid population growth in the Great Lakes region, urban development has undergone unprecedented growth. Sprawl is increasing in rural and urban fringe areas of the Great Lakes basin, placing a strain on infrastructure and consuming habitat in areas that tend to have healthier environments than those that remain in urban areas. This trend is expected to continue, which will exacerbate other problems, such as longer commute times from residential to work areas, increased consumption of fossil fuels, and fragmentation of habitat. For example, at current development rates in Ontario, residential building projects are predicted to consume some 1,000 square kilometers (386 square miles) of the countryside, an area double the size of Toronto, by 2031. Also, vehicle gridlock could increase commuting times by 45 percent, and air quality could decline due to an estimated 40 percent increase in vehicle emissions.

In 2006, The Nature Conservancy Great Lakes Program and the Nature Conservancy of Canada Ontario Region released the *Binational Conservation Blueprint for the Great Lakes*. The Blueprint identified 501 areas across the Great Lakes that are a priority for biodiversity conservation. The Blueprint was developed by scientifically and systematically identifying native species, natural communities, and aquatic system characteristics of the region, and determining the sites that need to be preserved to ensure their long-term survival.

Management Challenges:

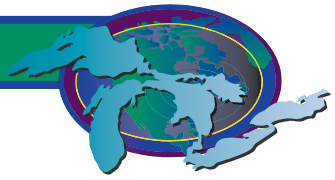
- As the volume of data on land use and land conversion grows, stakeholder discussions will assist in identifying the associated pressures and management implications.
- Comprehensive land use planning that incorporates “green” features, such as cluster development and greenway areas, will help to alleviate the pressure from development.
- Managing forest lands in ways that protect the continuity of forest cover can allow for habitat protection and wildlife species mobility, therefore maintaining natural biodiversity.
- Policies that favor an economically viable forestry industry will motivate private and commercial landowners to maintain land in forest cover versus conversion to alternative uses such as development.

LAND USE - LAND COVER

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
General						
4863	Land Cover Adjacent to Coastal Wetlands	Progress Report				
7002	Land Cover - Land Conversion	?	?	?	?	?
7054	Ground Surface Hardening	2005 Progress Report				
7101	Groundwater and Land: Use and Intensity	2005 Report				
Forest Lands						
8500	Forest Lands - Conservation of Biological Diversity	?				
8501	Forest Lands - Maintenance and Productive Capacity of Forest Ecosystems	?				
8503	Forest Lands - Conservation & Maintenance of Soil & Water Resources	?	?	?	?	?
Agricultural Lands						
7028	Sustainable Agriculture Practices	2005 Report				
7061	Nutrient Management Plans	2005 Report				
7062	Integrated Pest Management	2005 Report				
Urban/Suburban Lands						
7000	Urban Density	?				
7006	Brownfields Redevelopment	➡				
7054	Ground Surface Hardening	2005 Progress Report				
Protected Areas						
8129	Area, Quality and Protection of Special Lakeshroe Communities - Alvars	?	2001 Report			
8129	Area, Quality and Protection of Special Lakeshroe Communities - Cobble Beaches	⬅	2005 Report			
8129	Area, Quality and Protection of Special Lakeshroe Communities - Islands	?				
8129	Area, Quality and Protection of Special Lakeshroe Communities - Sand Dunes	2005 Progress Report				
8164	Biodiversity Conservation Sites	Proposed Indicator				

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined

Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend



RESOURCE UTILIZATION

Overall Assessment

Status:	**Mixed**
Trend:	**Undetermined**
Rationale:	**Although water withdrawals have decreased, overall energy consumption is increasing as population and urban sprawl increase throughout the Great Lakes basin. Human population growth will lead to an increase in the use of natural resources.**

The population of the Great Lakes basin is approximately 42 million. Growth forecasts for the western end of Lake Ontario (known as the Golden Horseshoe) predict that this portion of the Canadian population will grow by an additional 3.7 million people by 2031. Population size, distribution, and density are contributing factors to resource use in the basin, although many trends have not been adequately assessed. In general, resource use is connected to economic prosperity and consumptive behaviors.

Although the Great Lakes and their tributaries contain 20 percent of the world's supply of surface freshwater, less than one percent of these waters is renewed annually through precipitation, run-off and infiltration. The net basin water supply is estimated to be 500 billion liters (132 billion gallons) per day. In 2000, water from the Great Lakes was used at a rate equal to approximately 35 percent of the available daily supply. The majority of water withdrawn is returned to the basin through discharge or run-off. However, approximately seven percent is lost through evapo-transpiration or depleted by human activities. Due to the shutdown of nuclear power facilities and improved water efficiency at thermal power plants, water use in Canada and the United States has decreased since 1980. In the future, increased pressures on water resources are expected to come from population growth in communities bordering the basin, and from climate change.

Population size, geography, climate, and trends in housing size and density all affect the amount of energy consumed in the basin. Electricity generation was the largest energy-consuming sector in the Great Lakes basin due to the energy required to convert fossil fuels to electricity. Population growth and urban sprawl in the basin have led to an increase in the number of vehicles on roads, fuel consumption, and kilometers/miles traveled. Over a ten year period (1994-2004) fuel consumption increased by 17 percent in the U.S. states bordering the Great Lakes and by 24 percent in the province of Ontario. Kilometers/miles traveled within the same areas increased 20 percent for the United States and 56 percent for Canada. The increase in registered vehicles continues to outpace the increase in licensed drivers.

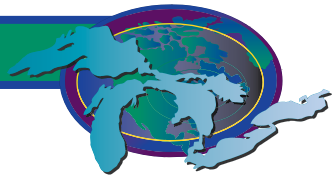
Management Challenges:

- Increasing requests for water from communities bordering the basin where existing water supplies are scarce or of poor quality will require careful evaluation.
- Energy production and conservation need to be carefully managed to meet current and future energy consumption demands.
- Population growth and urban sprawl are expected to challenge the current and future transportation systems and infrastructures in the Great Lakes basin.

RESOURCE UTILIZATION

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
3514	Commercial/Industrial Eco-Efficency Measures	2003 Report				
7043	Economic Prosperity	? 2003 Report				
7056	Water Withdrawls	◆ 2005 Report				
7057	Energy Consumption	? 2005 Report				
7060	Solid Waste Disposal	?				
7064	Vehicle Use	⬅				
7065	Wastewater Treatment and Pollution	Progress Report				

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined
Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend								



CLIMATE CHANGE

Overall Assessment

> *A qualitative assessment of the indicator category Climate Change could not be supported for this report because the indicators are incomplete at this time. Some observed effects in the Great Lakes region, however, have been attributed to changes in climate. Winters are getting shorter; annual average temperatures are growing warmer; extreme heat events are occurring more frequently; duration of lake ice cover is decreasing as air and water temperatures are increasing; and heavy precipitation events, both rain and snow, are becoming more common.*

Continued declines in the duration and extent of ice cover on the Great Lakes and possible declines in lake levels due to evaporation during the winter are expected to occur in future years. If water levels decrease as predicted with increasing temperature, shipping revenue may decrease and the need for dredging could increase. Northward migration of species naturally found south of the Great Lakes region and invasions by warm water, non-native aquatic species will likely increase the stress on native species. A change in the distribution of forest types and an increase in forest pests are expected. An increase in the frequency of winter run-off and intense storms may deliver more non-point source pollutants to the lakes.

Management Challenges:

- Increased modeling, monitoring, and analysis of the effects of climate change on Great Lakes ecosystems would aid in related management decisions.
- Increased public awareness of the causes of climate change may lead to more environmentally-friendly actions.

CLIMATE CHANGE

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
4858	Climate Change: Ice Duration on the Great Lakes	←				

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined
Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend								