



CLIMATE CHANGE

Ecosystems, Infrastructure and Adaptive Capacity

How is climate change affecting the Great Lakes Basin?

GREAT LAKES FACT SHEET



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Background

The potential implications of climate change for the Great Lakes were recognized as early as the mid-1980s, and scientific evidence developed since then has only intensified concerns about its possible effects. Compounding the challenge of climate change are the stresses already facing the Great Lakes, including land use changes, the presence of harmful pollutants, elevated levels of phosphorus, aging infrastructure and invasive species. Many of these stresses may become more severe as a result of climate change.

The capacity of the Great Lakes region to adapt to these changes in climate and to take action to limit them is key to the future of the region and its long-term resilience. Access to technology and economic resources are indicators generally used to determine the resilience of a region. By these standards, the communities of the Great Lakes possess a relatively high adaptive capacity. Adaptive capacity is the ability to react to both internal socio-political pressures and to external circumstances, such as climate change, in such a way that effective adaptation strategies can be put in place. Because the impacts of climate change have the potential to be so pervasive, protecting the resilience of the Great Lakes region will require a holistic, interdisciplinary approach and the co-operation and commitment of all the region's institutions and residents.



WHAT IS CLIMATE CHANGE?

As a key factor in the regulation of ecosystems, climate plays an important role in shaping life in the Great Lakes Basin. Weather conditions and climate affect the way we design roads and drainage systems, the types of crops we grow and the capacity to generate hydroelectric power. There is international scientific agreement that the world is getting warmer, but climate change is more than just a global warming trend. Climate affects so much of our lives that even small changes can have far-reaching health, environmental, social and economic consequences.

Greenhouse gas (GHG) emissions, including carbon dioxide, are one of the main contributors to climate change. These gases can be emitted from homes and businesses, vehicles and the burning of fossil fuels. GHGs form an atmospheric blanket that traps solar heat, warming the Earth. While a certain level of atmospheric heat is necessary to sustain life on Earth, increasing levels of GHGs can magnify this effect, resulting in warmer climates. It is thought that this enhanced greenhouse effect is the main reason for the changes in weather events and patterns now being experienced worldwide.

Over the past several years, the Great Lakes Basin has been showing signs of many of the impacts consistent with a changing climate, including an increasing number of extreme weather events such as rainstorms, floods, blizzards and droughts. Scientists are projecting warmer winters, more extreme heat waves in summer, increased lake evaporation and warmer water temperatures throughout the region.

HOW IS CLIMATE CHANGE AFFECTING THE GREAT LAKES?

Climate change ...

- **can alter weather patterns:** Climate change is expected to continue to affect both average and extreme weather conditions in the Great Lakes Basin. Recent predictions indicate that by 2050, average temperatures in the region could increase anywhere from 2.5 to 5 °C. It is generally agreed that increases of more than 2 °C will result in significant environmental, social and economic disruption. Heat extremes are also expected to increase in the region during the summer months. The number of days with temperatures exceeding 30 °C will likely double by the year 2050. Temperature increases in the Great Lakes region could lead to more evaporation of lake water and, in turn, higher precipitation. More moisture in a warmer atmosphere is expected to cause an increase in extreme weather, including tornadoes, floods, and wind, rain, snow and ice storms.
- **can increase lake-effect snow:** Heavy snowfall known as lake-effect snow occurs when cold Arctic air masses rapidly warm as they pass over the comparatively warm open water of the Great Lakes. The Arctic air becomes unstable and forms clouds and precipitation in the form of snow. Rising water temperatures resulting from climate change may create less ice coverage on the lakes and more surface area open to passing Arctic air. Over the longer term, as temperatures rise, lake-effect precipitation may take the form of rain rather than snow.
- **can affect water levels:** Climate change is expected to cause low water levels as a result of evaporation and changes in precipitation and runoff but at the same time to cause more frequent flooding from extreme storms. As average temperatures rise during the summer months, demand for water for agricultural irrigation and household use will increase. Reduced water levels could have far-reaching implications, including decreased crop yields, reduced shoreline property values, restricted hydroelectric generating capacity and costly repairs or redesign of water intake pipes for water treatment facilities.
- **can affect biodiversity:** Extreme weather can disturb ecosystems, increasing their vulnerability to invasive species and making them less hospitable to native species. Projected decreases in water levels may reduce shoreline habitat and spawning grounds for native fish species, forcing them to find suitable habitat elsewhere. This redistribution of

species around the lakes has the potential to cause significant disruption to the balance of ecosystems. Reduced ice cover on the Great Lakes could also affect the food supply and spawning grounds of aquatic organisms and cause birds to change their migration patterns. With warming water, there will be a reduction in habitat for cold-water fish, such as lake trout, while warm-water species, such as the smallmouth bass, will benefit. Warmer water temperatures are also ideal for many invasive species. Rising average temperatures and shorter, milder winters may also promote the growth of pathogens that threaten native species, increasing their susceptibility to disease.

- **can encourage the growth of harmful algae:** As the frequency of extreme weather increases, greater volumes of untreated water may be discharged into the lakes from storm runoff and sewer overflows. This can result in elevated levels of phosphorus in the lake water, a factor that contributes to algal overgrowth.
- **can affect human health:** The wetter weather and rising air temperatures associated with climate change may stimulate the growth of harmful pathogens and promote the spread of diseases, such as Lyme disease and West Nile virus, that are carried by ticks and mosquitoes, which thrive in warm, wet weather.

CHALLENGES AHEAD

Climate change has the potential to present a host of challenges to the resilience of the region. The following are just a few examples of these challenges:



Economic costs: Because warming lake water temperatures threaten the habitat of cold-water fish, climate change could have a devastating effect on the productivity of cold-water fisheries in the Great Lakes. Lower water levels could also reduce the depth of navigation channels throughout the Great Lakes system. Container ships may be required to reduce capacity and make more frequent trips in order to transport the same

amount of cargo. The impact will also be felt in sectors as diverse as agriculture and tourism.



Energy generation: Changes in the regional climate are likely to present challenges in terms of both the supply and the cost of energy. Lower water levels could reduce the capacity to generate hydroelectric power, and warmer water temperatures could make it more difficult to provide cooling for power plants. The costs associated with damage to transmission and distribution infrastructure from more frequent severe weather are also likely to rise.

Developing alternative energy sources and making a real commitment to conservation and efficiency will become increasingly important factors in meeting peak demand, particularly during the hot summer months.



Infrastructure: Much of the infrastructure of the Great Lakes region – buildings, roads, bridges, transmission lines, stormwater drainage and water treatment services – was built before the weather trends associated with climate change were evident and was not designed to withstand their effects. Extreme weather can soften tarmac during heat waves, crack concrete during freeze-thaw cycles, wash out roads from flooding and cause extensive ice and wind

damage. Repairing existing infrastructure and building new infrastructure capable of handling new conditions will be a significant financial and logistical challenge in the region.

WHAT IS BEING DONE?

The following are some examples of the initiatives and strategies that are currently in place to address climate change:

International Collaboration

- » **Great Lakes Water Quality Agreement (GLWQA):** In 1972, Canada and the United States signed the GLWQA to "restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes." The 2012 amendment to the GLWQA includes new, more comprehensive measures to address climate change.
- » **United Nations Framework Convention on Climate Change (UNFCCC):** The main objective of the UNFCCC, which entered into force in 1994, is to stabilize GHG concentrations at a level that would prevent dangerous human-induced interference with the climate system. By 1995, the international community realized that emission reduction provisions under the convention were inadequate and began negotiations to strengthen the global response to climate change. This resulted in the adoption of the Kyoto Protocol two years later, which legally binds developed countries to emission reduction targets. Originally a signatory to the protocol, Canada has now formally withdrawn from it.
- » **Copenhagen Accord (2010):** This international, legally non-binding accord establishes emission reduction commitments from major emitter countries and provides for international review of the targets and measures taken to achieve them. Under the accord, the Government of Canada submitted an economy-wide target of reducing GHG emissions by 17 per cent from 2005 levels by 2020. The federal government has outlined a variety of initiatives to help achieve its GHG reduction goals, including setting a target requiring 90 per cent of Canada's electricity to be provided by non-emitting sources by 2020.

Federal Initiatives

- » **Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations (2010):** These regulations establish standards to limit GHG emissions from new passenger automobiles and light trucks in Canada, beginning with the 2011 model year, and are aligned with U.S. standards.
- » **Heavy-Duty Vehicle and Engine Greenhouse Gas Emission Regulations (2013):** These regulations establish mandatory GHG emission standards for new heavy-duty vehicles, beginning with the 2014 model year, and are aligned with U.S. standards.

Federal-Provincial Collaboration

- » **Canada-Ontario Agreement Respecting the Great Lakes Basin (COA):** This agreement, ratified in 1971 and currently being updated to reflect recent amendments to the GLWQA, makes provision for the federal and provincial governments to work together to support the development of climate projections and better understand the impacts of climate change on the Great Lakes Basin ecosystem.

Provincial Initiatives

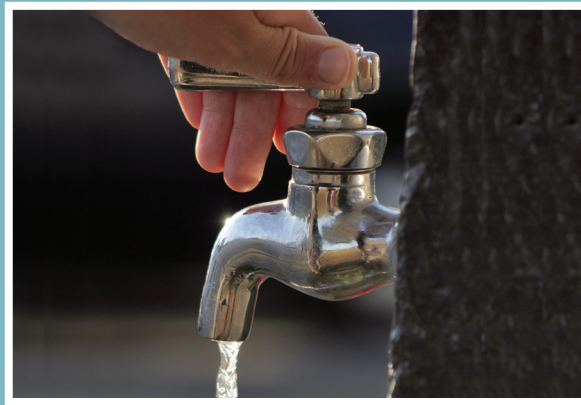
- » **Climate Ready: Ontario's Adaptation Strategy and Action Plan (2011–2014):** This strategy outlines five broad goals with over thirty actions to help Ontario prepare for the impacts of climate change.
- » **GoGreen: Ontario Action Plan on Climate Change (2007):** This plan sets out climate change mitigation initiatives for Ontario. The province is seeking to reduce GHG emission levels by 15 per cent of 1990 levels by 2020.

Municipal Initiatives

- » **Federation of Canadian Municipalities (FCM):** The FCM coordinates the Partners for Climate Change Protection, a network of Canadian municipalities committed to reducing GHG emissions and to developing an action plan on climate change.

WHAT CAN YOU DO?

- **Conserve water:** By using less water, you can help to conserve the water supply and reduce the demand for energy used to produce it. Switching to a low-flow showerhead or toilet, replacing old dishwashers and washing machines with new, more efficient ones, and using rainwater instead of municipal water to water the garden all contribute to conserving water and energy.
- **Conserve energy:** Energy consumption accounts for the majority of the world's carbon emissions. In addition to conserving water, you can reduce your energy use in a whole range of other ways. Turning off electronic equipment such as computers, monitors and printers at the end of the day helps to reduce unnecessary energy use. Turn off the lights when you leave a room, unplug your cell phone charger after use, and wash your clothes in cold water and hang them to dry. Switch to compact fluorescent lamps (CFLs) and buy ENERGY STAR® appliances. Running major appliances such as dishwashers and washing machines during off-peak hours lets you take advantage of lower rates based on time of use and helps to reduce the demand for energy during peak hours. Many electronic devices, such as TVs, DVD players and cable boxes, draw power even when they are turned off. You can reduce your use of this standby power by plugging electronic equipment into a power bar that can be turned off or shuts off automatically.
- **Cut down on GHG emissions from transportation:** Choose more sustainable modes of transportation when commuting to work or running errands – take public transit, carpool, bike or walk. Choosing a fuel-efficient vehicle and telecommuting when you can will also help to reduce your contribution to GHG emissions.
- **Make informed purchasing and lifestyle choices:** Whenever possible, choose foods that are locally produced. Local foods require less transportation, reducing vehicle emissions. Eating less meat is another way to reduce emissions associated with climate change. Livestock are a significant source of methane from digestion and carbon dioxide from respiration, and farming livestock often requires the clearing of forests, which play a key role in offsetting carbon emissions.
- **Get involved:** Look for opportunities to get involved in public consultations on important issues such as climate change and on agreements and legislation related to the Great Lakes. Urge government, businesses and other organizations to take action on Great Lakes issues.



SELECTED RESOURCES

For more information on climate change and the Great Lakes, consult the following resources:

Environment Canada. Canada's Action on Climate Change. <http://www.climatechange.gc.ca>

Environment Canada. Climate Change. <http://www.ec.gc.ca/cc/Default.asp?lang=En&nav=9853BFC5-1>



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Health Canada. Climate Change and Health.

<http://www.hc-sc.gc.ca/ewh-semt/climat/index-eng.php>

Natural Resources Canada. From Impacts to Adaptation: Canada in a Changing Climate, 2007. <http://www.nrcan.gc.ca/earth-sciences/climate-change/community-adaptation/assessments/132>

Ontario Ministry of the Environment. Climate Ready: Ontario's Adaptation Strategy and Action Plan 2011-2014. http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_085423.pdf

Ontario Ministry of Natural Resources. Climate Change. <http://www.mnr.gov.on.ca/en/Business/ClimateChange/index.html>

Pollution Probe. Primer on Climate Change and Human Health. <http://www.pollutionprobe.org/report/climatechangeprimer.pdf>

United States Environmental Protection Agency. Climate Change. <http://www.epa.gov/climatechange/>

PHOTOS

Energy generation: Robert Moses Niagara Hydroelectric Power Station, New York

Infrastructure: Burlington Bay James N. Allan Skyway, Ontario