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Detroit District

Great Lakes Update

Frequently Asked Questions

This issue of the Great Lakes Update has been dedicated to address a number of frequently asked questions that have arisen due to lower water levels. It contains the best available answers to many concerns that have been sent to us. Additional questions can be addressed to any of the various contacts located at the conclusion of this article.

Current Conditions

Why are water levels in the Great Lakes so low?

Great Lakes water levels are affected by several natural and man-made factors. The largest factors are evaporation and precipitation. Water levels were generally within inches of record high levels during 1997 following two years of above normal rain and snowfall across the northern Great Lakes. Since that time, precipitation has been below average across the Great Lakes, especially on the Lake Superior basin. Since the headwaters of the Great Lakes have seen below average precipitation over the last 30 months, the lower lakes have also responded by falling rapidly.

Lakes Michigan-Huron have experienced their most dramatic year-to-year fall on record over the last 140 years. Lakes St. Clair and Erie experienced their second largest year-to-year fall ever.

This autumn, water level declines are also occurring at a faster than average rate. This is primarily due to a continuation of the overall drought conditions and increased evaporation. Colder than average air masses during September teamed with warmer than average Great Lakes water temperatures to produce extensive evaporation. The net result is a greater than anticipated seasonal decline in the levels of the lower Great Lakes.

When was the last time the Great Lakes were this low?

The level of Lake Superior has been nearly constant since July 1999, being 10 to 15 centimeters (4 to 6 inches) less that long-term average for these months. However, lakes Michigan-Huron, St. Clair and Erie have not experienced levels this low since 1966; Lake Ontario was last at its current level in 1991.

How low have the Great Lakes fallen and how do they compare with all-time records?

Lake Superior's level fell .7 meters (2.2 feet) between July 1997 and March 1999; lakes Michigan-Huron and St. Clair's levels have plummeted nearly a full meter (3 feet) between July 1997 and September 1999; Lake Erie's level has tumbled 1 meter (3.2 feet) between June 1997 to present; Lake Ontario fell an astounding 1.1 meters (3.75 feet) in only 8 months (April through December 1998).

Since all of the Great Lakes were within a few centimeters of record high levels when the rapid decline began, the current levels are closer to their long-term averages than to record low levels.

How has precipitation compared to average over the past 12 months?

According to Detroit District records for the period October 1998 through September 1999, Lake Superior experienced 116% of its average precipitation, with most of it falling during the months of June through September 1999. Conversely, the remainder of the Great Lakes were averaging near 80% of normal precipitation during that same period. The Great Lakes as a whole have experienced 82% of normal precipitation amounts since October 1998.

What role does evaporation play on the Great Lakes?

The evaporation process, for the most part, is an invisible but very significant factor in the loss of water from the Great Lakes.

Maximum evaporation occurs when the Great Lakes are much warmer than the air moving across them, such as occurs from early fall until the lakes freeze over. This evaporation results in many more cloudy days in Michigan than occur in Wisconsin, and is responsible for the "lake effect" snows that are common to the region.

Under average weather conditions, Lake Michigan loses around 2.5 centimeters (1 inch) of water a week to evaporation in October. If an unseasonably cold airmass settles in over the lake while the water temperatures are much warmer, evaporation may reach 2.5 centimeters (1 inch) or more in just a few days. As water temperatures cool into December, evaporation will slow, but will not cease until the lakes freeze over.

How have recent conditions affected the groundwater supply?

Water that nourishes the Great Lakes also comes from other sources other than rain falling directly in the lakes. One of the greatest stores of water is the water table (or "groundwater") which is the primary source of the base flow for inland lakes and streams. Water table supplies are slow and steady, and can tolerate short to moderate droughts. However, lengthy periods of dry weather, such as the Great Lakes region has experienced during the last 30 months can stress water tables severely. When rainfall increases again across the region, much of the water will be absorbed into the ground and used to recharge the water table. Thus, several months of above average precipitation will be needed before lake levels will show any appreciable rise.

What are the expected water levels for the next 6 months?

For the remainder of 1999 the lakes will continue their seasonal decline. The rate of decline for each lake will vary but should be four to six inches through mid-December. The seasonal decline will flatten by January and February 2000. The rate of the seasonal rise in March and April will depend upon the amount of snowfall received over the winter and the amount of spring rain that is received on the basin.

If snowfall and rainfall are above average through spring, water levels on all the lakes should be about what they were during 1999. However, if the Great Lakes receive less than average precipitation and have a winter temperature regime similar to the winter of 1998-99, we can expect the Great Lakes to peak earlier then normal and be even lower than in 1999.

What impacts do low water levels have?

Depending on your point of view, the impacts can be either positive or negative. Shoreline property owners generally benefit over the short term due to expanded beachfront property but may have their pleasure craft grounded in a boat well, or have little water under a boatlift.

Great Lakes bulk carriers have been negatively impacted by lower water levels as cargo loads have to be reduced to allow the ships to navigate through shallower channels. The net result is more trips per season and higher operating costs, mainly in fuel and labor.

Marina operators suffered one of their worst seasons in years as many pleasure boaters decided not to risk a cracked hull or ruined propeller on shallow hazards. Meanwhile, marine towing services have charged up to $10 a foot to liberate a grounded boat. A cracked hull can cost over $2000 to repair. Some marinas were just too shallow to accommodate much more than a rowboat. Dredging services were overwhelmed with work. One dredging crew dug a canal 2,500 feet long before getting to four feet of water on Lake St. Clair.

The Corps issues over 200 dredging permits to industries, marinas, and local governments in the Great Lakes. This number is anticipated to increase due to low water levels across the Great Lakes.

One very positive benefit is to the shoreline ecosystem. Significant changes in water levels promote "biodiversity" among the aquatic plants and fishes. Higher water levels tend to mute certain aquatic plant species that thrive under lower water conditions. Dynamic water levels allow the natural system of "checks and balances" to play out to the benefit of the ecosystem. Changes in water levels also effect the thermal characteristics of the nearshore water column, which influences the habitation patterns of fish and amphibians.

Do low water levels stop shoreline erosion?

Shoreline erosion is a continual process that is unaffected by water levels over the long term. When water levels are high, the erosion energy is focused much higher on the shoreline profile, where the process is more obvious. When water levels recede, the erosion energy is undermining the nearshore shelf, often where the process goes unnoticed. If levels stay low for a long enough period, erosion will begin eroding the toe of the bluffline, resulting in slumping and shoreline recession.

Is additional sedimentation occurring as a result of low water levels?

While there appears to be more sandy material on the beaches and in the nearshore during low water, the total amount of sand in the system has not increased. When the lake levels are high, storms ten to move sand offshore and deposit it on sandbars. During low water, these sandbars move towards shore and fuse with the beach, giving the appearance of a more sand-rich environment. This circuit of migrating sand from offshore bars to the beach and back is a continual process. The impacts of sedimentation, occurring in both high and low water regimes, is most visible when lake levels recede.

Note: Precipitation, evaporation, and groundwater processes can be accurately represented in the Hydrologic Cycle. The figure displayed at the end of this update shows the Hydrologic Cycle for Great Lakes water system.

Water Level Controls

Can extreme low water levels be prevented?

Humans have limited control over this massive fresh water system, and no control over Mother Nature. If a drought occurs, levels will fall and man can do little, if anything, to alleviate the condition.

Where are the major outflow control points in the Great Lakes basin?

Limited water level control is achieved by regulating the outflows from Lakes Superior and Ontario, in accordance with the International Joint Commission (IJC) Orders of Approval for each lake. The outflows from the other Great Lakes depend exclusively on their levels.

Regulating the outflow from Lake Superior affects the level of lakes Superior, Michigan-Huron, and to a lesser extent, St. Clair and Erie. Lakes Michigan and Huron are considered as a single lake since the wide and deep Straits of Mackinac connect them and thus remain at the same level.

Regulating the outflow from Lake Ontario affects levels on the lake and on the St. Lawrence River from the Thousand Islands to downstream of Montreal, Quebec. It has no effect on levels on the upper lakes since Lake Ontario is separated from them by the Niagara Falls.

Could the flow out of Lake Superior be reduced to raise the water level on Lake Superior?

Yes, it is possible to reduce the Lake Superior outflow in order to either slow the fall, or raise the level of Lake Superior. However, this influence on the level is small and several months may be needed to raise the lake an inch or more. The outflow cannot be reduced to less than a "one-half gate open" setting at the Compensating Works in order to maintain enough water in the St. Mary's rapids for fish spawning.

Could the flow out of Lake Superior be increased to raise water level on lakes Michigan-Huron, St. Clair, and Erie?

Yes, increasing the Lake Superior outflow may raise the water levels on lakes Michigan-Huron and to a lesser extent St. Clair and Erie. However, the determination of Lake Superior outflows takes into consideration several factors. One aspect of the outflow determination process considers the levels of lakes Superior and Michigan-Huron. The objective of this "systemic regulation" is to help maintain the levels of all three lake relative to their long-term seasonal averages. Historic ranges of fluctuation and differing drainage basin sizes are considered. The Lake Superior regulation, Plan 1977-A, works to attain this balance by making the amount of water stored on each of the lakes, as represented by their water levels, proportionally the same. If, for example, Lake Superior's water level was well above long-term average and lakes Michigan-Huron were below average, the flows may be increased from Lake Superior to help balance the levels. Conversely, if Lake Superior levels are lower than seasonal average and lakes Michigan-Huron are above average, Lake Superior outflows may be similarly reduced. If both lakes Superior and Michigan-Huron levels are significantly below average, outflows from Lake Superior are generally below average.

How does control of Lake Ontario outflow affect water levels on Lake Ontario?

The IJC has granted limited discretionary authority to their International St. Lawrence River Board of Control to enable it to temporarily set flows different from the Lake Ontario regulation plan, Plan 1958-D. Regulation has reduced the occurrence of extreme high and low water levels on Lake Ontario, but recently we have seen lower than average water levels.

For a short period of time during the month of August, flow out of Lake Ontario was reduced 200 cubic meters per second (7063 cubic feet per second) below typical regulation flow. This effort allowed an additional 10-centimeters (4 inches) to the lake levels for riparians and recreational boaters. The lower lake levels have been reduced from 70-centimeters (27.5 inches) below average, earlier in the summer, to 40-centimeters (16 inches). The continual efforts of reduction in flow and additional precipitation over the basin will aid marinas in taking their boats out of the water for the winter season.

Are Lake Erie water levels controlled?

No, the level of Lake Erie is not regulated. The natural outlet from Lake Erie is the Niagara River. In addition, a small amount of water leaves the lake through the Welland Canal and is discharged into Lake Ontario. The flow out of Lake Erie through the Niagara River is not controlled. The amount of this flow is dependent upon the level of Lake Erie and the shape of the river channel. The diversion of water through the Welland Canal provides water to the navigation locks used to allow ships to travel between lakes Erie and Ontario, around the Niagara Falls.

In 1950, the governments of the United States and Canada signed a treaty that governs the use of water from the Niagara River above the Niagara Falls for hydro-electric power generation purposes. Under this treaty, certain amounts of water are guaranteed for flow over the Falls. The remainder of the available water is split equally between the United States and Canada for use in their hydroelectric plants. The International Niagara Committee was created under the terms of the 1950 Niagara Treaty to determine and monitor this water usage. Only the distribution of the total flow above the Falls is controlled, not the amounts of total flow leaving Lake Erie.

Remedial works were constructed above the Falls to facilitate the use of the river's waters, while maintaining required minimum flows over the falls. These works include the Chippawa-Grass Island Pool Control Structure. This structure used only to help with the distribution of flow, not to control the total amount of flow in the river. The International Niagara River Board of Control oversees the operation and maintenance of this structure.

Diversions

What are the diversions and how much can they affect Great Lake water levels?

The major diversions in the Great Lakes basin, see Figure 1, that affect water levels to a measurable extent are: (1) diversions into Lake Superior at Long Lac and Ogoki; (2) a diversion out of Lake Michigan at Chicago; (3) a diversion between lakes Erie and Ontario through the Welland Canal; and (4) the New York barge canal diversion. These diversions have a minor effect on water levels compared to natural factors and regulation of lakes Superior and Ontario. The present flow rates into Lake Superior from the Long Lac and Ogoki diversions average 150 cms (5,300 cfs). The flow through the Lake Michigan diversion at Chicago is 91 cms (3,200 cfs) and the flow from Lake Erie to Lake Ontario through the Welland Canal is 221 cms (7,800 cfs). This compares to the average outflow of 2,210 cms (78,000 cfs) from Lake Superior and 7,000 cms (247,000 cfs) from Lake Ontario.

The combined effect of these three diversions has been to permanently raise Lake Superior by an average of 2.1 centimeters (.8 inch), lower lakes Michigan-Huron by .6 centimeters (.2 inches), lower Lake Erie by 10 centimeters (4 inches) and raise Lake Ontario by 2.4 centimeters (1 inch).

Figure 1

Could the outflow be decreased from the Lake Michigan Diversion at Chicago to keep more water on Lakes Michigan-Huron?

The Lake Michigan Diversion at Chicago has the physical capacity to flow up to 283 cms (10,000 cfs), although flooding, erosion and negative impacts to navigation would occur at this flow rate. The diversion has been the subject of legal actions by Great Lakes states throughout the century to limit the amount of water being diverted. The dispute reached the U.S. Supreme Court, whose 1980 decree sets the flow rate average 91 cms (3,200 cfs). Proposals have occasionally been made in the U.S. Congress to increase the amount of the Chicago diversion, but none of the proposals have been successful. Canada has objected to any proposed unilateral action by the United States to change the flow through this system.

Could the flow from the Long Lac and Ogoki diversions be increased to raise Lake Superior water levels?

These diversions are entirely in the Province of Ontario and were authorized between the U.S. and Canada in 1940. The diversions have dual purposes: to provide enough flow for hydropower production and to provide additional inflow to Lake Superior for regulatory purposes. Although the diversions are under private control, there has been consultation and cooperation between the Governments of the Unites States and Canada to request changes in the outflows from these diversions during emergency periods.

Shown in the table below, dry conditions during much of 1998 resulted in 48% of average flows through the Long Lac and Ogoki diversions. January to August 1999 flow has been 99% of average for the same time period. As a result of below average precipitation and warmer temperatures increased diversion would be difficult.

Combined Long Lac & Ogoki Diversion

	Mean* 1944-1998	***Mean* 1998***	***Mean* 1999***
JAN	130 (4591)	80 (2825)	140 (4944)
FEB	111 (3920)	80 (2825)	100 (3531)
MAR	94 (3320)	50 (1766)	90 (3178)
APR	89 (3143)	40 (1412)	70 (2472)
MAY	185 (6533)	60 (2119)	180 (6357)
JUN	260 (9182)	30 (1059)	250 (8829)
JUL	202 (7134)	40 (1412)	200 (7063)
AUG	164 (5792)	40 (1412)	198 (6992)
SEP	144 (5085)	40 (1412)	-
OCT	141 (4979)	80 (2825)	-
NOV	150 (5297)	160 (5650)	-
DEC	147 (5191)	160 (5650)	-
Annual	151 (5332)	72 (2543)	154 (5438)

* units - cms (cfs)

Could the flow at the Welland Canal be decreased to keep more water on Lake Erie?

The Welland Canal is primarily designed as a deep draft navigational waterway to circumvent the Niagara Falls and rapids. Also, the canal provides some hydropower generation. The present flow is approximately 283 cms (8,000 cfs). The Welland Canal has basically little to no effect on the levels of lakes Erie and Ontario. Also, the water through the canal is not free flowing; a series of eight locks slows the flow considerably through the 43.4-kilometer (26 mile) long Welland Canal. Conceivably, the canal could be shut down; however, the only practical navigation course between the western Great Lakes and Atlantic Ocean would be severed.

Is water being siphoned off and sent to other areas?

No, the financial and political support that would be needed to undertake a major diversion does not exist. There are a number of objections that usually surface when this possibility is discussed. No economic use for the water exists that could support the cost of moving enough of it out of the basin to appreciably lower the Great Lakes. Such a diversion would also likely increase flooding on any of the nearby waterways that could be used to transport the water. Those who might need it are far from the Great Lakes basin. Also, such a diversion might be difficult to shut off during low water supplies in the Great Lakes.

How are water diversion issues addressed for the Great Lakes?

Coordinated efforts between Canada and the United States established the 1985 Great Lake Charter to regulate diversions of the Great Lakes water. The signatory States and Provinces agree under Principle III, Protection of the Water Resources of the Great Lakes, that "new or increased diversions and consumptive uses of Great Lakes Basin water resources are of serious concern. In recognition of their shared responsibility to conserve and protect the water resources of the Great Lakes Basin for the use, benefit, and enjoyment of all their citizens, the States and Provinces agree to seek (where necessary) and to implement legislation establishing programs to manage and regulate the diversion and consumptive use of Basin water resources. It is the intent of the signatory states and provinces that diversions of Basin water resources will not be allowed if individually or cumulatively they would have any significant adverse impacts on lake levels, in-basin uses, and the Great Lakes ecosystem."

As recent as February 1999 the United States and the Canadian federal governments directed the IJC to initiate a new study on Great Lakes water uses, diversions, and removal of waters. An interim report of this study is available from the IJC at the address given below. The efforts of this study will build upon past principles to effectively protect and enhance the Great Lake ecosystem.

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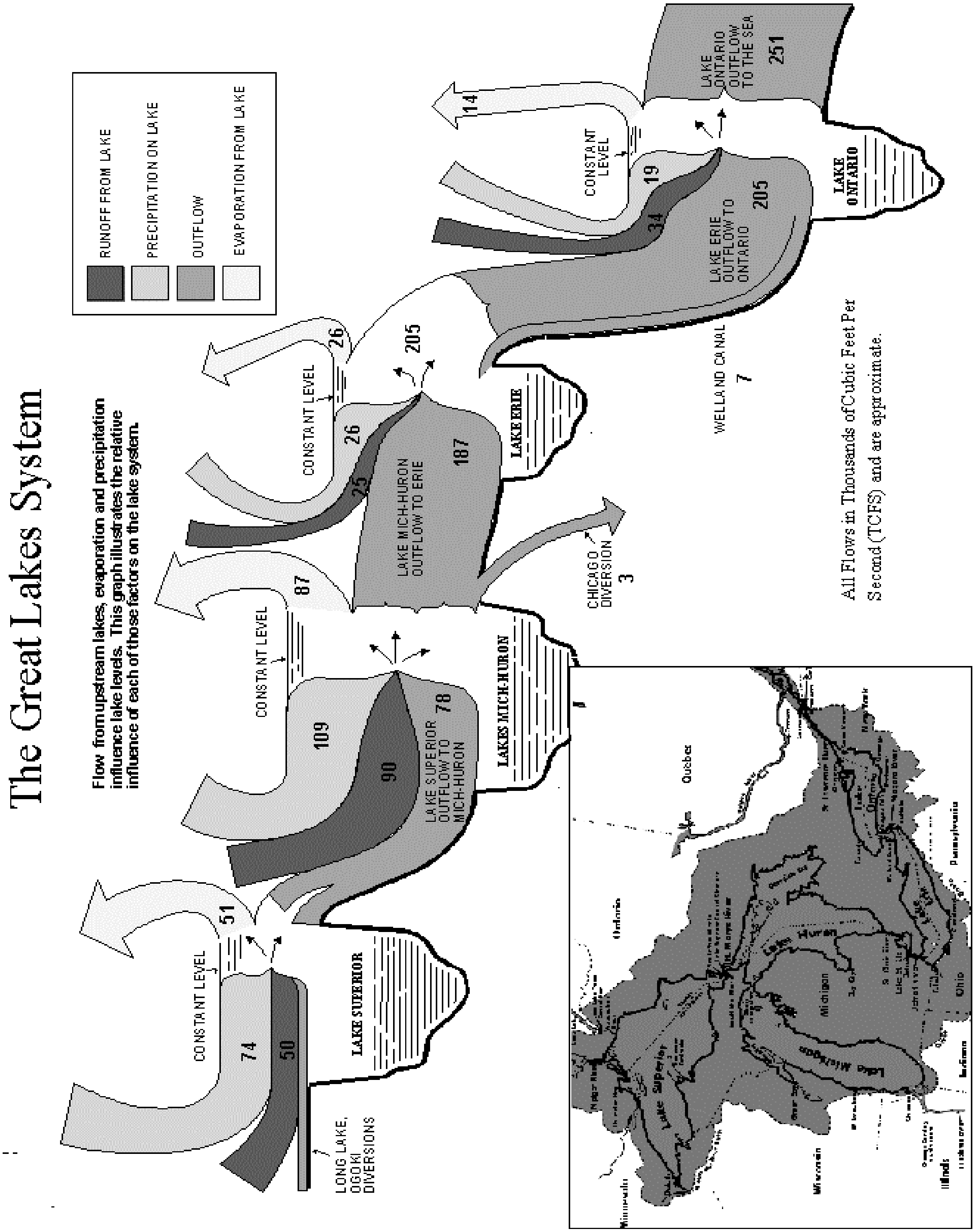
The Great Lakes System
Flow from upstream lakes, evaporation and precipitation influence lake levels. This graph illustrates the relative influence of each of those factors on the lake system.
RUNOFF FROM LAKE
PRECIPITATION ON LAKE
OUTFLOW
EVAPORATION FROM LAKE
CONSTANT LEVEL
74
50
51
LAKE SUPERIOR
LONG LAKE, OGOKI DIVERSIONS
109
90
78
LAKE SUPERIOR OUTFLOW TO MICH-HURON
87
LAKES MICH-HURON
26
25
187
LAKE MICH-HURON OUTFLOW TO ERIE
CHICAGO DIVERSION
3
LAKE ERIE
205
34
19
LAKE ERIE OUTFLOW TO ONTARIO
WELLAND CANAL
7
14
LAKE ONTARIO OUTFLOW TO THE SEA
251
LAKE ONTARIO
All Flows in Thousands of Cubic Feet Per Second (TCFS) and are approximate.
Quebec
Ontario
Lake Superior
Lake Huron
Lake Michigan
Michigan
Minnesota
Wisconsin
Illinois
Indiana
Ohio
Pennsylvania
New York