

PROTECTION OF THE WATERS OF THE GREAT LAKES

2015 Review of the Recommendations
from the February 2000 Report

December 2015

International Joint Commission
Canada and United States



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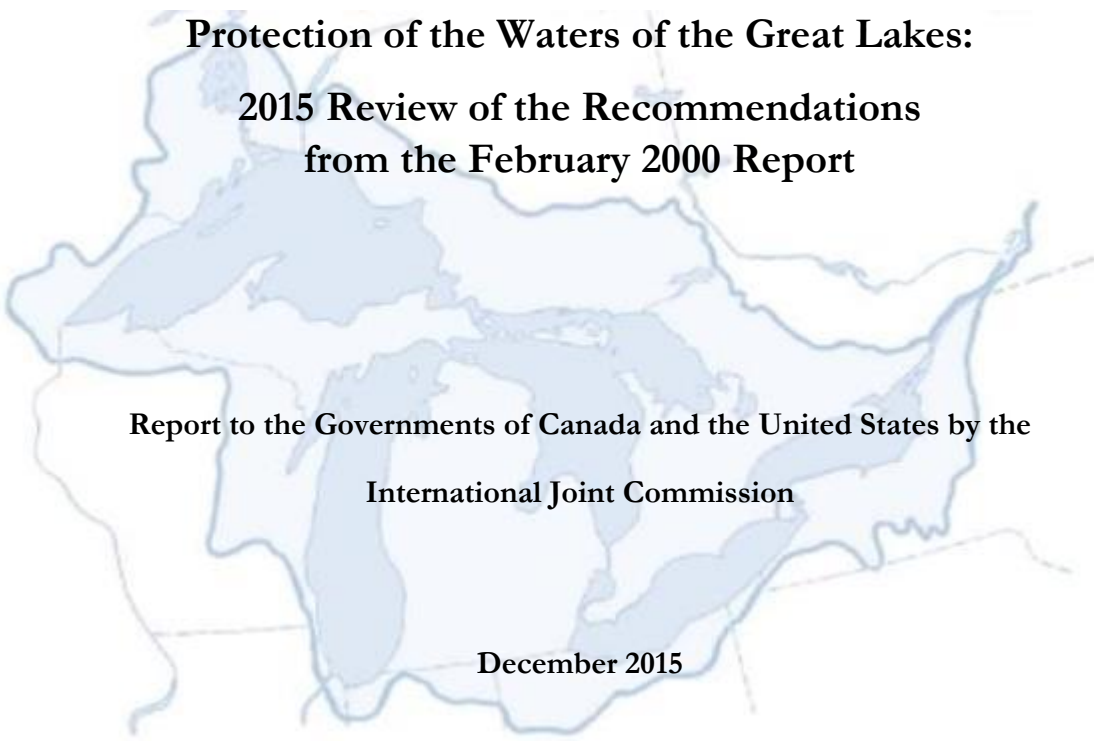
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**Protection of the Waters of the Great Lakes:
2015 Review of the Recommendations
from the February 2000 Report**

**Report to the Governments of Canada and the United States by the
International Joint Commission**

December 2015

Introduction

This report summarizes the International Joint Commission's findings and recommendations on the protection of the waters of the Great Lakes from potentially harmful consumptive uses and diversions. These findings and recommendations result from a consultants' review of recommendations originally made in a report issued by the Commission in the year 2000, [*Protection of the Waters of the Great Lakes*](#). That report, and the consultants' review, dealt with a 1999 reference from the Canadian and U.S. governments to examine matters that might affect levels and flows of Great Lakes waters, including consumptive uses and diversions and related laws and policies.

The Commission endorses the consultants' findings that the Great Lakes states and provinces have made great strides since the 2000 report in protecting the waters of the Lakes from the potentially harmful effects of consumptive uses and diversions. In particular, the Commission applauds the states and provinces for enactment of the 2008 Great Lakes Compact and parallel Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement. These historic agreements provide a great degree of protection for the waters of the Basin and are likely to serve the people of the Basin well in the decades to come.

Release of the consultants' review in draft form yielded a number of substantive submissions during the public comment period and public webinar in May and June of 2015. While the comments were generally supportive, they broadened the Commission's considerations and strengthened the report, including the addition of a new recommendation that the states and provinces consider the advisability of developing, harmonizing and implementing a binational public trust framework as a backstop to the Agreement and Compact.



Signing of Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement in December 2005. Standing from left are Dan Injerd, Kyle Hupfer, Ken DeBeaussaert, Abass Kamara, Lynette Stark, Brad Moore, Thomas Mulcair and seated from left are Governor Jim Doyle, Governor Bob Taft and Premier Dalton McGuinty. Credit: Council of Great Lakes Governors

Assuring the full benefits of the Compact and Agreement will require additional actions by state, provincial and federal governments in the areas of policy and science. These actions are highlighted below. The full consultants' report, which was transmitted by the Commission to the Governments of Canada and the United States, is available from the Commission's offices and on its website at IJC.org.

The Commission wishes to acknowledge its consultants on this project, Ralph Pentland, president of Ralbet Enterprises Incorporated and Alex Mayer, professor, Department of Civil and Environmental Engineering, Michigan Technological University.

Commission Recommendations

In February 2000¹, the International Joint Commission released a report entitled [*Protection of the Waters of the Great Lakes*](#). In the report, the IJC recommended that it conduct a review of the report's recommendations after three years and at 10-year intervals thereafter. The Commission released its [*first review in 2004*](#)². In 2014, the Commission agreed to undertake its first 10-year review. This report deals primarily with issues related to Great Lakes water uses and diversions since the year 2000 report.

What is described in this report is for the most part a good news story. The policy gaps identified by the IJC in 2000 have been largely filled. No new inter-basin or intra-basin diversions which would have significant negative impacts on the ecological integrity of the Great Lakes have been approved, the growth in consumptive use appears to have been at least temporarily arrested, and institutional arrangements, such as the Regional Body, are in place to continue those positive trends. But both ongoing management vigilance and additional scientific advances will be required to maintain that positive momentum.

In this report, a historical background is provided first followed by the findings and recommendations.

1. A Brief Historical Perspective

The Great Lakes Basin, illustrated in Figure 1, is defined here as comprising the watersheds of the Great Lakes and the St. Lawrence River upstream from Trois-Rivières, Québec. To understand the current situation in the basin with respect to consumptive water uses and diversions, one must go back at least 30 years. In January of 1985, the IJC released its first major report on [*Great Lakes Diversions and Consumptive Uses*](#)³ in response to a reference from Governments of Canada and the United States in 1977. That report called for, among other things, improved information on consumptive use, and “a process of notice and consultation before additional new or changed diversions are approved.” As that reference was winding down, the eight Great Lakes states and two Canadian provinces were already negotiating the Great Lakes Charter⁴, which they signed on February 11, 1985.

The Great Lakes Charter provided that no Great Lakes State or Province would approve or permit any major new or increased diversion or consumptive use of the waters of the Great Lakes Basin without notifying and consulting with all affected Great Lakes states and provinces. In order to participate in the notice and consultation process, jurisdictions had to be in a position to provide accurate and comparable information on withdrawals, and have the authority to manage and regulate diversions and consumptive uses. The Charter also required states and provinces to develop and maintain a common data base, the

¹ International Joint Commission, Protection of the Waters of the Great Lakes Final Report to the Governments of Canada and the United States, February 22, 2000, <http://www.ijc.org/files/publications/C129.pdf>

² International Joint Commission. 2004. Protection of the Waters of the Great Lakes Review of the Recommendations in the February 2000 Report, August 2004, www.ijc.org/files/publications/ID1560.pdf, accessed October 22, 2014.

³ International Joint Commission, 1985. Great Lakes Diversions and Consumptive Uses (January, 1985)

⁴ Council of Great Lakes Governors, 1985. The Great Lakes Charter Principles for the Management of Great Lakes Water Resources (February 11, 1985)

systematic exchange of data and information, and the creation of a Water Resources Management Committee.

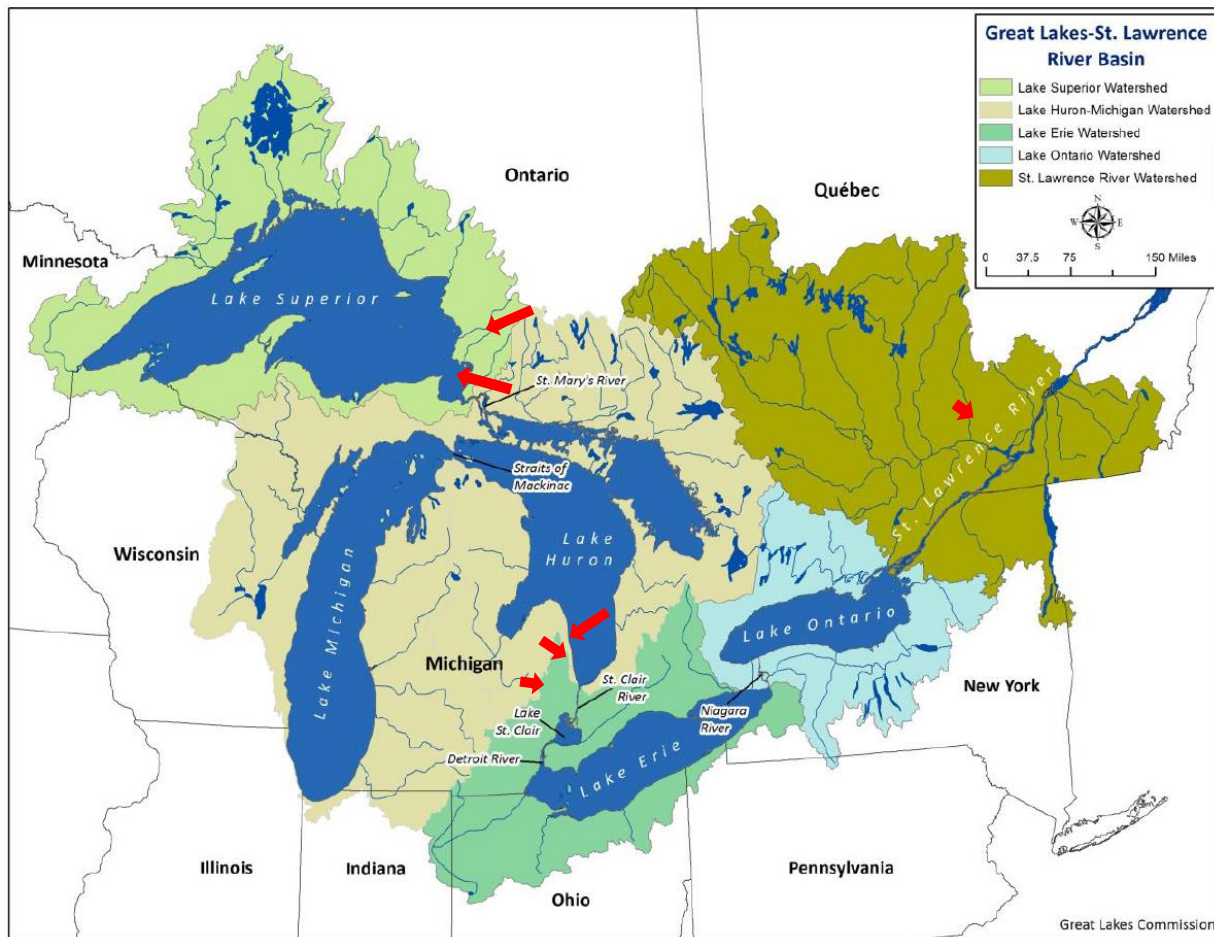


Figure 1. Map of Great Lakes basin. From *Cumulative Impact Assessment of Withdrawals, Consumptive Uses and Diversions 2006-2010*. Credit: Great Lakes-St Lawrence River Water Resources Regional Body and Great Lakes-St Lawrence River Basin Water Resources Council
<http://www.glscompactcouncil.org/Docs/Misc/2013%20Cumulative%20Impact%20Assessment%2012-6-13.pdf>

The communities of Pleasant Prairie, Wisconsin in 1990 and Akron, Ohio in 1998 won the support of Great Lakes states for diversions outside the Basin on the condition that they would return an approximately equivalent amount of water. These diversions were authorized pursuant to the U.S. *Water Resources Development Act* of 1986, which required approval of any proposed diversion of Great Lakes waters by the governors of all Great Lakes states. The Governor of Michigan in 1992 disapproved a diversion sought by the town of Lowell, Indiana.

In 1998, shock waves spread across the region when a Canadian entrepreneur proposed to ship Lake Superior water to Asia by marine tanker. Even though clearly impractical, that proposal, along with media speculation about possible large scale diversions to the U.S. Southwest, raised the specter of commercial trade in the resource, possibly even on a global scale, something quite different in nature from the regional or local development goal which had previously characterized diversion projects.

Governments at all levels acted quickly and decisively. The U.S. Government passed legislation which, among other things, reconfirmed its 1986 prohibition on new diversions from the Great Lakes without the approval of each of the Great Lakes states and expanded the requirement to prohibit water exports. The Canadian Government initiated legislation to prohibit new removals from the Canadian boundary waters of the Great Lakes, with minor and well-defined exceptions. The two national Governments issued a new reference to the IJC, with instructions to report back with its findings and recommendations within a year.

On October 15, 1999, the Great Lakes Governors and Premiers issued a statement renewing their commitment to the principles contained in the Great Lakes Charter, and pledged to develop a new agreement that would bind the states and provinces more closely to collectively planning, managing and making decisions regarding the protection of the Great Lakes. The Governors also pledged to develop a new common standard, based on the ecological integrity of the Great Lakes ecosystem, against which projects would be reviewed.

The IJC released its recommendations on February 22, 2000. The Council of Great Lakes Governors, in full partnership with the Premiers, proceeded with its negotiations until December 13, 2005, at which time the Governors of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin, and the Premiers of Ontario and Québec signed the *Great Lakes – St. Lawrence River Basin Sustainable Water Resources Agreement* (hereafter referred to as “Agreement”). Following ratification by the eight State legislatures and the U.S. Congress, the parallel *Great Lakes-St. Lawrence River Basin Water Resources Compact* (hereafter referred to as “Compact”) was signed into law by U.S. President Bush on October 3, 2008 and came into force on December 8, 2008.

2. Findings and Recommendations

In its 2000 report, the IJC recommended that the governments of the Great Lakes states and provinces should not permit any proposal for removal of water from the Great Lakes to proceed unless the proponent could demonstrate that the removal would not endanger the integrity of the ecosystem of the Great Lakes and that certain other conditions be met. The most critical of these conditions was that there be no greater than a 5% loss, and that the water be returned in a condition that protects the quality of and prevents the introduction of alien invasive species into the waters of the Great Lakes.



Figure 2. Great Lakes Tanker. Credit: Transport Canada

The Agreement and Compact include similarly stringent requirements. New or increased diversions outside the Basin are prohibited, with limited and conditional exceptions for municipal water supply to communities straddling the Basin divide, and for communities within straddling counties. Before they may be authorized, excepted diversions must meet strict requirements and comply with a specific Standard for Exceptions, including the obligation that the flow must be returned to the Great Lakes-St. Lawrence Basin. The Agreement requirement regarding actual return flow rather than the 5% recommended by the Commission is essentially the same with respect to average loss, but it is much more practical to implement. Intra-basin diversions (from one Great Lakes watershed to another) are also subject to clearly defined standards. It should be noted that Illinois is exempt from the Compact provisions governing both diversions and withdrawals, because virtually all withdrawals from the Lake Michigan Basin within Illinois continue to be governed by an earlier U.S. Supreme Court Decree⁵.

In 2000, IJC recommendations regarding consumptive use suggested that major new or increased consumptive uses should only be permitted subject to full consideration of their cumulative impact, the implementation of effective conservation measures, and the application of sound planning practices.

The provisions regarding withdrawals and consumptive use in the Agreement and Compact include both a prior notification requirement for any proposal leading to a water loss of 19,000 m³/day or greater in any 90-day period, and a decision-making standard. The decision-making standard provides for the return of the withdrawn water to the same watershed, no significant individual and cumulative impact, the application of conservation measures, and reasonable use from a sustainable development perspective. The states and provinces also committed to conducting an assessment of the cumulative impact of water withdrawals at least every five years, taking climate change into account.

The Agreement and Compact provide a level of overall protection similar to that recommended by the International Joint Commission in 2000. The Agreement and Compact, if fully and rigorously implemented, will provide a solid foundation for managing Great Lakes diversions and consumptive uses into the foreseeable future.

Findings: The Agreement and Compact have been successful to date. There have been no new inter-basin or intra-basin diversions approved that would have significant negative impacts on the ecological integrity of the Great Lakes, the growth in consumptive use has slowed and institutional arrangements, such as the Regional Body, are in place.

2015 RECOMMENDATION 1: The existing Agreement and Compact should continue to be rigorously implemented to minimize loss of water from the Basin, including full implementation of existing legislation to ensure that the Great Lakes are protected as intended by the Agreement and Compact.

⁵ U.S. Supreme Court 1967/1980. Lake Michigan Diversion Supreme Court Consent Decree 388 U.S. 426 1967) Modified 449 U.S. 48 (1980)

It is well recognized that the Agreement and Compact are critically important and essential to protect the common good for both current and future generations. Nevertheless, looking ahead, the terms of the Agreement and Compact may not be sufficient to deal with all potential future water issues and emerging trends in common and statutory law. In response to these risks, the bi-national adoption of public trust principles may provide a backstop or supplementary framework to the Agreement and Compact.

Findings: While the Agreement and Compact are necessary, they will not necessarily be sufficient in the future to protect the long-term ecological integrity and the many public and private uses of the Great Lakes. Bi-national adoption of public trust principles could provide an effective backstop in that regard.

2015 RECOMMENDATION 2: Great Lakes states and provinces should consider the advisability of developing, harmonizing and implementing a bi-national public trust framework as a backstop to the Agreement and Compact, in order to fill gaps and to deal with as yet undefined stresses likely to impact negatively on the Great Lakes in the future.

Diversions and Other Removals

Since the Agreement was signed in 2005, most of the basic legal framework necessary to support implementation of both the Agreement and the Compact has been put in place. In 2009, Québec enacted enabling legislation. In 2007, Ontario enacted the *Safeguarding and Sustaining Ontario's Water Act* for the same purpose. In the case of Ontario, the provisions came into force on January 1, 2015 following adoption of regulations affecting new or increased transfers of water from one Great Lakes watershed to another. The new regulations fully comply with Agreement Standards. The Agreement came into force 60 days after the Premier of Ontario notified the Regional Body that Ontario had completed the measures required to implement the Agreement. That formal notification took place on January 7, 2015.

In the United States, all eight state legislatures and their respective governors ratified the Compact, beginning with Minnesota on February 20, 2007, and ending with Michigan on July 9, 2008. The Compact was passed by the U.S. Senate on August 1, 2008, by the U.S. House of Representatives on September 23, 2008 and signed by the President on October 3, 2008. Since 2008, state legislatures and regulatory agencies have adopted numerous additional laws, regulations and guidelines in support of Agreement and Compact implementation, as have sub-state governments (e.g. municipalities).

The first successful request for a straddling community diversion exception was a proposal from the City of New Berlin, which was approved by the state of Wisconsin on May 21, 2009⁶. That approval enables New Berlin to receive additional Lake Michigan water from Milwaukee to supply parts of the City lying outside the Great Lakes Basin. Under the approval, the City will continue to return water to the Lake Michigan Basin via the Milwaukee Sewage District, resulting in no net loss of water to the Great Lakes Basin. The application was also deemed to have met all other Compact terms, including enhanced conservation efforts and strict monitoring and reporting requirements to ensure that the water withdrawal and return flow quality are closely tracked.

⁶ Milwaukee Journal Sentinel 2009. New Berlin's Request for Lake Water Approved, a First under the Great Lakes Compact, by Darryl Enriquez (May 21, 2009)

The first and only application to date under the straddling county provisions is one by the City of Waukesha, Wisconsin and it is still pending⁷⁸. The City of Waukesha is located within the straddling county of Waukesha, but lies outside the Lake Michigan watershed. The application asserts that Waukesha needs a new source of water to address water quality (radium) and quantity concerns. The City currently obtains its public water supply primarily from groundwater wells in a deep aquifer.

Under the Compact process, the State must satisfy itself that the application is approvable before submitting it to the Regional Body made up of representatives of the Great Lakes states and provinces. In December 2015, the State of Wisconsin announced it would forward Waukesha's application for regional consideration early in 2016. The Regional Body is now scheduled to review the Waukesha application. It must then issue a declaration of finding, and the Compact Council (whose members are the Governors) must then approve the application before it can move forward. If approval under the Compact is obtained, the State would have the authority to complete the necessary permit reviews and issue a final decision.

There continues to be some longer-term public concerns about larger-scale diversions. The mega-diversion era ended in the United States with the Central Arizona Project in the 1970s and in Canada with the La Grande Project in the early 1990s. But the possibility remains that climate change or other unforeseen circumstances could conceivably change that calculus. The Great Lakes Region needs to continue to be vigilant and precautionary⁹ in its approach to diversions.

Findings: To date, the precautionary approach adopted in the Agreement and Compact to deal with diversion proposals has been rigorously followed.

2015 RECOMMENDATION 3: The precautionary approach regarding diversions must continue to guide the states and provinces in order to protect the Great Lakes from an ever-increasing number of larger-scale removals.

⁷ Government of Wisconsin 2015. City of Waukesha Water Diversion Application. Current Status (December 2015). <http://dnr.wi.gov/topic/wateruse/waukeshadiversionapp.html>

⁸ Sarah Gardner, 2015, Waukesha Fights for a Share of Lake Michigan Water, Marketplace (February 4, 2015)

⁹ The precautionary approach was defined by The United Nations Conference on Environment and Development, in the 1992 Rio Declaration on Environment and Development in the following: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

<http://www.unep.org/Documents.Multilingual/Default.asp?documentid=78&articleid=1163>, accessed July 16, 2015.

Water Use Data and Related Information

Box 1 summarizes recent (2012) information on water use in the Basin. The numbers indicate that basin-wide consumptive water use is small (0.4%) compared to basin-wide renewable supply.

Box 1. Great Lakes Basin Water Use Facts (2012)^{10 11}

- Total withdrawals as volume per time: 42,324 MLD^a (11,200 MGD^b)
- Total withdrawals as fraction of basin-wide renewable supply^c: 7%
- Total consumptive use as volume per time: 2,332 MLD (616 MGD)
- Total consumptive use as fraction of basin-wide renewable supply: 0.4%
- Average consumptive use coefficient: 6%^d
- Consumptive use by water use sector as a fraction of total consumptive use
 - public water supply: 34%
 - self-supplied irrigation and livestock: 17%
 - self-supplied industrial: 31%
 - self-supplied thermoelectric: 15%
 - self-supplied other: 3%

^a millions of liters per day

^b millions of US gallons per day

^c basin-wide renewable supply equals long-term average St Lawrence River outflow

^d consumptive use coefficient equals total consumptive use divided by total withdrawals

U.S. withdrawals in the Basin peaked in 2007, and decreased afterwards at a rate of 4% per year. For the U.S. as a whole, total withdrawals declined by 13% from 2005 to 2010. It is not possible to detect trends accurately in Canadian data because of data deficiencies and changing methodologies for data collection. Nevertheless, Environment Canada reports that in the public water supply sector, national per capita water use decreased by 14% from 2006 to 2009, but cautions that some of the decrease could have been due to climatic factors.

The Great Lakes Regional Water Use Database (GLRWUD)¹² is the longest-running source of withdrawal and consumptive use data derived exclusively for the Great Lakes-St. Lawrence River Basin. The database relies on measures and estimates provided by the states and provinces, based on a combination of mandatory and voluntary reporting by individual users. Recent attempts have been made to standardize water use reporting basin-wide. In 2009, interim protocols for reporting water withdrawals were adopted by the Great Lakes Compact Council and Regional Body. The protocols aim for consistency in reporting for large water users, defined as having an average withdrawal of 378,000 liters per day (100,000 US gallons per day) or more on average on any 30 day period.

Significant gaps occur in historical Canadian data, attributed to a lack of assessment tools, staff and regulatory statutes. U.S. state agencies also reported that budgetary constraints have limited the quality and completeness of their databases. Discrepancies have been noted between water use estimates by the

¹⁰ Great Lakes Regional Water Use Database <http://projects.glc.org/waterusedata/index.php>

¹¹ Great Lakes Regional Water Use Database http://projects.glc.org/waterusedata/data_about_cuc.php

¹² Great Lakes Regional Water Use Database <http://projects.glc.org/waterusedata/index.php>

U.S. Geological Survey ¹³ and the GLRWUD for 2005. However, the magnitude of the discrepancies is not unusual, given typical levels of confidence in water use data. Protocols for reporting water withdrawals to the GLRWUD ¹⁴ adopted by the Great Lakes Compact Council and Regional Body in 2009 should improve the accuracy of water use data.



Figure 3. Coal-Fired Thermoelectric Power Plant Cooling Tower, Lake Michigan. Credit: USGS

Most forecasts since the 1960s have substantially overestimated future withdrawals. Perhaps the most credible prediction at this time is one to the year

2090 based on a series of climate and socioeconomic scenarios.¹⁵ Averaging over the climate scenarios, the forecasts suggest a decline in total withdrawals between 2005 and 2090 due to a wetter climate, a relatively constant population, and increases in water use efficiencies.

Findings: A complete understanding of consumptive use is critical to careful water management throughout the Basin, including evaluations of the impact of new diversions. Consumptive use in the Great Lakes Basin is small relative to renewable supply¹⁶, and given recent trends is unlikely to increase substantially in the next few decades, but increases in temperature and decreases in precipitation during summers could drive increases in water use. Substantial improvements in water use data collection practices by the states, provinces and Regional Body have occurred over the last five years. The reliability of water use reporting and consumptive use calculations remains questionable, given inconsistency in different sources of water withdrawal estimates, lack of consistent quality control procedures in water use reporting, and the use of consumptive use coefficients that have been criticized as inadequate. It should be noted that the Great Lakes Commission is currently in the process of collecting and reporting metadata to improve the GLRWUD.

¹³ Mills, P.C., and Sharpe, J.B. 2010. Estimated withdrawals and other elements of water use in the Great Lakes Basin of the United States in 2005: U.S. Geological Survey Scientific Investigations Report 2010–5031, 95 p.

¹⁴ Resolution #9 - Adoption of Water Use Reporting Protocols Adopted by the Great Lakes-St. Lawrence River Basin Water Resources Council on December 8, 2009
(http://www.glscompactcouncil.org/Docs/Resolutions/GLSLRBWRC_Resolution_9--Water_Use_Reporting_Protocols.pdf)

¹⁵ Brown, T. C., R. Foti, and J. A. Ramirez (2013), Projected freshwater withdrawals in the United States under a changing climate, *Water Resources Research*, 49, 1259–1276, doi:10.1002/wrcr.20076

¹⁶ Great Lakes Governors and Premiers 2013. Resolution: Water Monitoring (1 June, 2013).

2015 RECOMMENDATION 4: The Great Lakes states and provinces, in collaboration with the two federal governments, should develop methodologies for improving the accuracy of water use and consumptive use estimates, with priority given to the largest water users or water use sectors in the basin within the next five years. Given uncertainty in the drivers of water use in key use sectors, states and provinces should carefully monitor water use trends, highlighting the need for accurate reporting in withdrawals and consumptive use.

Cumulative Impacts

The first mandatory cumulative impact assessment was released by the Regional Body and Council in December of 2013¹⁷. The primary theme running through that assessment is the uncertainty in water balance components, especially runoff, direct precipitation, direct evaporation, and consumptive use. It is clear that, unless the scale of new consumptive use or diversion proposals is substantially larger than the current totals, the impacts of these proposals on lake water balances, lake levels and ecological integrity on a lake-wide scale will be so small as to be impossible to estimate. There is also considerable uncertainty about how to gauge ecological or socio-economic impacts of lake level fluctuations.

The December 2013 cumulative impact assessment raises the question as to whether assessments only at the Great Lakes or Lake watershed scale are appropriate. It is possible that local consumptive uses at the sub-basin scale are large relative to local watershed outflows. For example, the Great Lakes Commission's "Value of the Great Lakes Initiative" report identified several watersheds in the U.S. portion of the Great Lakes Basin where consumptive uses exceed 20% of summer monthly flows.¹⁸

Findings: The current magnitude of consumptive uses and diversions is smaller than the level of uncertainty in the water balance components. Unless new proposals for consumptive uses and diversions are substantially larger than current levels or the science of lake hydrologic balances improves, the impacts of these proposals on lake water balances, levels and ecological integrity on a lake-wide scale will be too small to estimate. Continued work to reduce the uncertainty in water balance components is needed to support decision making.

2015 RECOMMENDATION 5: Further refinement of water balance components should continue to occur through federal agencies such as the USGS, NOAA, US Army Corps of Engineers, and Environment Canada. Assuming that the science will continue to evolve rapidly, the Regional Body/Council should continuously review new knowledge regarding lake-wide hydrology and incorporate new advancement in decision-making processes for existing and new withdrawals and diversions. This review should focus on state-of-the-art lake-wide hydrology, identifying key information gaps, and determining how to close the gaps.

¹⁷ Great Lakes Compact Council, 2013. Cumulative Impact Assessment of Withdrawals, Consumptive Use and Diversions 2006 – 2010

¹⁸ Great Lakes Commission. 2011. The Value of Great Lakes Water Initiative: Final Report, <http://glc.org/files/docs/Value-of-Great-Lakes-Water-Final-Feasibility-Report-10-24-2011.pdf>, accessed July 28, 2015.

Climate Change

The climate in the Great Lakes Basin is changing. Average air and surface water temperatures are rising, precipitation and evaporation are both increasing, and average annual ice cover is decreasing^{19 20 21 22 23 24}. For the Lake Michigan-Huron Basin, the increases in evaporation are being mostly balanced by increases in local precipitation over the last 60 years.^{25 26} But, in the Lake Superior Basin, increased precipitation has not compensated for increased evaporation, explaining a trend towards declining water supplies in Lake Superior over the last 60 years.^{27 28 29} While the trends may be weak with respect to the inter-annual climate variability and magnitude of uncertainty in the hydrologic components of the lake water balance, there has likely been a modest trend of declines in total Great Lakes supplies in recent decades, although recent (2013 and 2014) high runoff and precipitation levels have resulted in significant rebounds in Lakes Superior and Michigan Huron.

Findings: There is little agreement among studies of the impacts of future shifts in temperature and precipitation on water balances and lake levels. There does, nevertheless, seem to be a meta-trend in predictions, where earlier studies suggesting large declines are giving way to newer studies suggesting smaller declines. If the current trend of progress in the science of climate change and translation of climate change into hydrologic responses continues, it is expected that uncertainty will decrease.

¹⁹ Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.

²⁰ Kling, G.W., Hayhoe, K., Johnson, L.B., Magnuson, J.J., Polasky, S., Robinson, S.K., Shuter, B.J., Wander, M.M., Wuebbles, D.J., Zak, D.R. (Eds.), 2003. Confronting climate change in the Great Lakes region: impacts on our communities and ecosystems, 104 pp. UCS Publications, Cambridge, MA.

²¹ Pryor, S. C., K. E. Kunkel, and J. T. Schoof, 2009a: Ch. 9: Did precipitation regimes change during the twentieth century? Understanding Climate Change: Climate Variability, Predictability and Change in the Midwestern United States, Indiana University Press, 100-112.

²² Austin, J. A., & Colman, S. M. (2007). Lake Superior summer water temperatures are increasing more rapidly than regional air temperatures: A positive ice-albedo feedback. Geophysical Research Letters, 34(6).

²³ Dobiesz, N. E., and N. P. Lester, 2009: Changes in mid-summer water temperature and clarity across the Great Lakes between 1968 and 2002. Journal of Great Lakes Research, 35, 371-384, doi:10.1016/j.jglr.2009.05.002.

²⁴ Lenters, J. D., 2004: Trends in the Lake Superior water budget since 1948: A weakening seasonal cycle, J. Great Lakes Res., 30, Supplement 1, 20-40.

²⁵ Cumulative Impact Assessment of Withdrawals, Consumptive Uses and Diversions 2006-2010 <http://www.glscompactcouncil.org/Docs/Misc/2013%20Cumulative%20Impact%20Assessment%2012-6-13.pdf>

²⁶ NOAA Great Lakes Environmental Research Laboratory, Great Lakes Water Level Dashboard, <http://www.glerl.noaa.gov/data/dashboard/data/>, accessed December 9, 2014.

²⁷ Cumulative Impact Assessment of Withdrawals, Consumptive Uses and Diversions 2006-2010 <http://www.glscompactcouncil.org/Docs/Misc/2013%20Cumulative%20Impact%20Assessment%2012-6-13.pdf>

²⁸ NOAA Great Lakes Environmental Research Laboratory, Great Lakes Water Level Dashboard, <http://www.glerl.noaa.gov/data/dashboard/data/>, accessed December 9, 2014.

²⁹ International Upper Great Lakes Study Board 2012. Lake Superior Regulation: Addressing Uncertainty in Upper Great Lakes Water Levels, Final Report to the International Joint Commission.

2015 RECOMMENDATION 6: Considering the large uncertainties surrounding climate change and other human impacts on the hydrologic cycle, federal, provincial and state governments should, in addition to continuing to take an adaptive management³⁰ approach in decision-making, incorporate climate resilience into policies and management practices regarding decision-making for diversions, consumptive use, and lake level management. Provincial and state governments should survey how widespread the development and adoption of adaptation strategies are across the Basin. Advancements in the state of science on climate change impacts in the Great Lakes should be encouraged by federal, state and provincial governments through further funding and a synthesis of the state of the science. As part of a precautionary approach for limiting climate change impacts on Great Lakes water resources, state and provincial governments should urge the federal governments of Canada and the United States to aggressively pursue strategies for reducing greenhouse gas emissions.

Groundwater

Although temporal trends in overall withdrawals appear to be flat or even declining, groundwater uses in the Basin increased by 3% between 1995 and 2005. Areas in the basin experienced large groundwater declines over the last several decades, such as in the Chicago-southeastern Wisconsin area in the U.S. and the Waterloo-Kitchener region in Canada. However, groundwater levels in some of these areas have stabilized or are rebounding as communities in the Chicago-southeastern Wisconsin area have switched to the Great Lakes for their water supplies or growth in water demand have slowed in these communities. Excessive groundwater withdrawals can and, in some areas, actually do shift the groundwater divide in the aquifer system. This shift can negatively impact surface waters that are hydraulically connected to near-surface aquifers, sometimes reducing base flow of streams with resultant degradation of habitat. Over-pumping of water supply aquifers can also result in degradation of water quality and human health as naturally-occurring contaminants like radium and fluoride are drawn in from adjacent aquifers.



Figure 4. Credit: Shutterstock

Many of these factors come into play in Agreement and Compact implementation. For example, in the case of the Waukesha, Wisconsin diversion application, aquifer drawdown has impacted negatively on water quality³¹, and some have asserted that groundwater use outside the Basin is likely drawing water

³⁰ Adaptive management was defined in the Agreement/Compact as “mean[ing] a water resources management system that provides a systematic process for evaluating, monitoring and learning from the outcomes of operational programs and adjustment of policies, plans and programs based on experience and the evolution of scientific knowledge concerning water resources and water dependent natural resources.”

³¹ US Geological Survey, Ground water in the Great Lakes Basin: the case of southeastern Wisconsin, <http://wi.water.usgs.gov/glpf/>, accessed April 14, 2015.

from aquifers in the Basin³². The Compact and Agreement recognize these issues by assuming the surface water and groundwater divides coincide, which is rarely the case, but at the same time requiring substantive consideration as to whether or not the existing water supply is derived from groundwater that is hydraulically connected to waters within the Basin.

Findings: While overuse of groundwater or degradation of water quality are localized problems, groundwater is a regionally important water resource in the basin. Communities that have chosen to discontinue groundwater use have usually adopted Great Lakes water as their new supplies. Although groundwater levels have stabilized in some areas where groundwater use has been intensive in the past, groundwater levels are continuing to decline in other areas of the basin. While the focus on groundwater withdrawals usually considers impacts on groundwater supply availability, e.g. groundwater overdrafts, the impacts of groundwater withdrawals on groundwater quality are increasingly important, especially as these impacts relate to new requests for diversions. Achieving a better understanding of the relationship between land uses and groundwater quality, and how degraded groundwater quality can adversely affect surface water, should be a priority for governments.

2015 RECOMMENDATION 7: Great Lakes states and provinces should fully factor the adverse ecological and water quality impacts of groundwater withdrawals into both water use permitting procedures and decisions regarding consumptive use. Great Lakes states and provinces should identify where groundwater levels are continuing to decline and recommend management strategies for stabilizing groundwater levels. Federal, state and provincial research should continue to improve mapping and understanding groundwater aquifers in the basin, determining where groundwater supplies may be degraded in the future, identifying management methods for avoiding these problems, and achieving an improved understanding of the relationship among land uses and groundwater and surface water quality and stream habitat.

Conservation

In 2000, the Commission recommended the development of a coordinated basin-wide water conservation initiative. In the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement, the states and provinces committed to the setting of regional goals and objectives, and the implementation of voluntary or mandatory programs for the conservation and efficient use of water. The chapter of the consultants' report on conservation provides a cursory jurisdiction-by-jurisdiction review of progress with respect to the establishment of baseline information, the development of goals, objectives and associated programs, the registration of withdrawals, and programs for regulating new or increased withdrawals and consumptive use. That cursory review points to many impressive accomplishments by the states and provinces over the past decade.

³² Feinstein, D.T., Eaton, T.T., Hart D.J., Krohelski, J.T., Bradbury, K.R. 2005, Regional aquifer model for southeastern Wisconsin – Report 2: Model results and interpretation, Technical Report 41, Southeastern Wisconsin Regional Planning Commission, http://www.sewrpc.org/SEWRPCFiles/Publications/TechRep/tr-041_aquifer_simulation_model.pdf, accessed April 14, 2015.

Generally, water use in North America has levelled off and the Great Lakes Basin has made gains in water use efficiency since the signing of the Agreement. However, the region holds significant untapped potential to improve water efficiency performance in the areas of infrastructure maintenance.



Figure 5. Pokegama Bay, Lake Superior. Credit: NOAA

The state of the region’s deteriorating water infrastructure undercuts water conservation. Aging pipes commonly leak and waste significant amounts of water. The single largest need is repair, replacement and construction of transmission and distribution systems.

Prudent leadership and investment by Governments at all levels in maintaining and improving the delivery of drinking water can significantly enhance efficiency and may limit local impacts from drawdown on surface and groundwater, reduce energy required to treat and transport water, and preserve water to meet the needs of the multiple users and future generations.

Findings: The IJC commends the Great Lakes states and provinces for impressive strides in enacting water conservation measures but additional conservation potential exists. However, leaking distribution systems are negatively impacting water efficiency basin-wide.

2015 RECOMMENDATION 8: The IJC recommends broad-based collaboration among public and private sectors to enhance water stewardship by fixing leaking public water infrastructure, supporting innovation, and increasing funding to close the region’s water infrastructure deficit, unlock water conservation potential and encourage a water stewardship focus region wide.

Conclusion

Moving forward, it is important to remember that there really is no “surplus” water in the Great Lakes Basin. From an ecosystem perspective, it is all in use, even in periods of high supply. There continues to be large voids between our knowledge regarding levels and flows, and the impact they have on the ecosystem of the basin. Due to prevailing uncertainties such as those posed by climate change and the sheer threat of the unexpected, the precautionary principle needs to be continually applied by basin jurisdictions to ensure, to the extent possible, adequate supplies for all socio-economic and ecosystem uses for the long term. Finally, awareness and education of public and private sectors as to the critical current issues facing the Great Lakes are essential to ensure the protection of this unique and valuable ecosystem and associated services.

The Commission commends the actions taken by the governments of Canada, the United States, and the Great Lakes states and provinces to implement the recommendations in the original February 2000 report. In light of future uncertainties, the Commission reiterates its commitment to review progress to protect the waters of the Great Lakes every 10 years.

The full consultants’ report, which was an essential component of the Commission’s deliberations in this review, is available from the Commission’s offices and on its website at IJC.org.

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