Annual Report of the Great Lakes Regional Water Use Database

Representing 2015 Water Use Data

Prepared by the Great Lakes Commission for the
Great Lakes-St. Lawrence River Water Resources Regional Body and the
Great Lakes-St. Lawrence River Basin Water Resources Council

Great Lakes Commission
des Grands Lacs

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Acknowledgments

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Preface

This is the Annual Report of the Great Lakes-St. Lawrence River Regional Water Use Database, representing 2015 water use data. These data are provided by the Great Lakes-St. Lawrence River states and provinces to the Great Lakes Commission (GLC), which serves as the database repository, under the Great Lakes-St. Lawrence River Basin Water Resources Compact (Compact) and the Great Lakes St. Lawrence River Basin Sustainable Water Resources Agreement (Agreement).

The Great Lakes-St. Lawrence River Regional Water Use Database has been operational since 1988. It was established by the states and provinces in response to a provision of the 1985 Great Lakes Charter, which called for the establishment and maintenance of a regional system for the collection of data on major water uses, diversions and consumptive uses in the binational Great Lakes-St. Lawrence River Basin (Basin). The Charter (a precursor to the Compact and Agreement) was a non-binding, "good faith" agreement signed by the Great Lakes governors and premiers that set forth a series of principles and procedures for strengthening water management activities in the Basin. The Charter envisioned a centralized database as an important tool to support a regional water resources management program that guides the future development, management and conservation of the water resources of the Basin. In 1988, the GLC was selected to serve as the repository for the regional water use database. The maintenance and operation of the database has been provided by the GLC since that time, in partial fulfillment of the Charter obligations and since 2009 supporting the requirements under the Compact and Agreement through a new set of water use data collection and reporting protocols.

After two decades of collecting water use data and issuing the annual water use reports under the Charter, the database has been revised and upgraded to meet the requirements set forth by the Compact and Agreement. In 2008, to help implement the needed improvements in jurisdictional water use data collection and reporting programs, the Conference of Great Lakes and St. Lawrence Governors and premiers (formerly the Council of Great Lakes Governors), through its Great Lakes Water Use Information Initiative, led the states and provinces through a process that culminated in the drafting of new water use data collection and reporting protocols. The Compact Council and Regional Body adopted the new protocols in 2009. The protocols offer guidance to ensure that water use data provided to the database by the states and provinces is accurate, of the highest quality, and reported in a common and consistent manner. The 2015 annual water use report presents the fourth dataset that was assembled using the 2009 water use data collection and reporting protocols.

While the common data protocols are an important step in support of a more robust regional water management regime, it is recognized that much additional work needs to be done and that improvements in

data collection, reporting, quality, accuracy and compatibility must continue to occur. The following section describes the progress made in 2016 to improve data quality and describes the quality of the data for the 2015 annual report.

Overview

Improving Data Quality

Together with the Conference of Great Lakes-St. Lawrence Governors and Premiers, the GLC is working with the Great Lakes and St. Lawrence River states and provinces to improve data collection, reporting, quality, accuracy and compatibility. To guide the preparation of 2015 data and this report, several steps have been made to improve data quality.

Starting with the 2014 water use year, GLC collected information from each jurisdiction that describes water use data and includes information related to data sources, reporting compliance rates by water use sector, documenting the year for which the data is collected, any significant changes in the data between the current year and previous years, and describing reasons for those changes. To achieve this, GLC created an online data management system that assists in the creation of metadata. For this report, the states and provinces have submitted metadata along with the associated 2015 water use data to the GLC. Project staff met by phone with representatives from each jurisdiction to discuss year to year changes in compliance and reported water use. Implementing this process and the follow up phone meetings has resulted in improvements to the database in both compliance and data quality.

The GLC will continue to work with the states and provinces to identify additional areas for improvement. While this report contains the best available information as of its publishing date, the states and provinces may continue to update their data which is maintained in the online water use database (projects.glc.org/waterusedata). Discrepancies between the data online and those summarized in this report may appear. In all cases, the online database will contain the best-available data.

In compiling this report, the project team noted specific steps being taken by each jurisdiction to improve reporting compliance and data quality. In particular, Ohio has very high rates of compliance supported by cooperation from their Office of the Attorney General, which encourages compliance by communicating directly with water use permit holders. Similarly, Minnesota's compliance program successfully emphasizes permit holders' obligations to report their water withdrawals. The most notable improvement in this year's report is the level of compliance. In previous years, not every sector of every jurisdiction was up-to-date with reporting. This is the first year that every jurisdiction reported current data across all required sectors (with the exception of two facilities in Michigan).

Data Reporting by Jurisdiction

The states and provinces have water use reporting programs in place that require water users to report their water use each year to their jurisdiction. The reporting compliance, (i.e., the percentage of water users submitting the required water use reports to the jurisdiction), varies across the Basin and affects the quality of the data. Reporting compliance varies across sectors for most jurisdictions. Illinois, Minnesota and Ohio report a 100 percent reporting compliance for all sectors. Québec is still developing its reporting program so reporting compliance could not be calculated for the commercial and institutional, livestock and other self-supply sectors.

With the exception of two facilities that are reporting 2013 and 2014 data in Michigan, all jurisdictions are reporting 2015 data for this annual report. Table 1 summarizes reporting compliance rates by jurisdiction.

Table 1. Reporting Compliance to the Jurisdiction by Water Use Sector

Sector	IL	IN	MI	MN	NY	OH	ONT	PA	QC	WI
Public Water Supply	100	98	99	100	94	100	98	91	100	100
Self-Supply Commercial & Institutional	100	96	85	100	97	100	96	100	N/A**	95
Self-Supply Irrigation	100	96	75	100	91	100	95	67	N/A	95
Self-Supply Livestock	-	100	75	100	80	100	94	90	N/A	95
Self-Supply Industrial	100	96	85	100	93	100	87	89	100	96
Self-Supply Thermoelectric Power Production (Once-through cooling)	100	100	95	100	92	100	96	-	-	100
Self-Supply Thermoelectric Power Production (Recirculated cooling)	-*	100	95	100	92	100	-	-	-	100
Off-Stream Hydroelectric Power Production	-	-	-	100	100	100	-	-	-	-
In-Stream Hydroelectric Water Use	-	-	-	100	100	-	96	-	-	-
Other Self-Supply	100	93	85	100	100	100	96	-	N/A	100

*A blank indicated that the jurisdiction did not report any water use figures for that particular sector.

**N/A indicated that reporting compliance percentage could not be calculated.

Great Lakes Regional Water Use for 2015

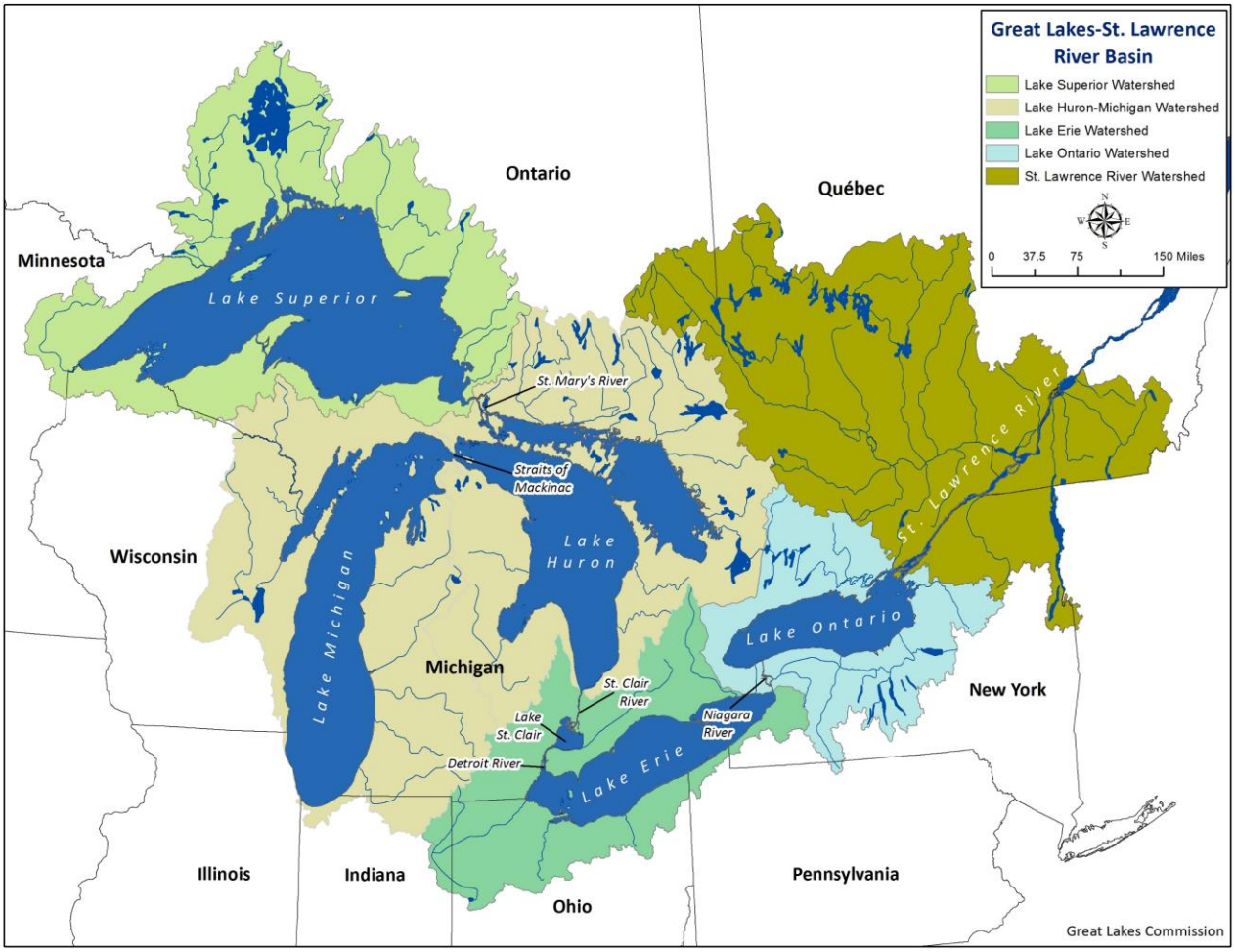

Figure 1. Great Lakes-St. Lawrence River Basin

The Great Lakes and the St. Lawrence River – the world's largest freshwater system – span an area of 289,600 square miles (750,000 square kilometers). Its total volume is 6.5 quadrillion gallons (25 quadrillion liters), an amount that would fill 9 billion Olympic size swimming pools.[1]

In 2015, the total reported withdrawal amount for the Great Lakes-St. Lawrence River Basin, excluding in-stream hydroelectric water use was 42,714 million gallons per day (mgd) or 161,690 millions of liters per day (mld). This total represents a 0.6 percent increase from the 2014 reported withdrawal amount total of 42,449 mgd (160,688 mld). Nearly five and a half percent of the total reported amount withdrawn (2,331 mgd or 8824 mld) was consumed or otherwise lost to the basin.

Water withdrawals for all water use sectors, excluding the in-stream hydroelectric water use sector, are presented in the pie chart below. The 10 water use sectors are defined in Appendix C. Thermoelectric power production, industrial and public water supply are the primary water use sectors, (i.e., those withdrawing the largest volumes of water).

[1] An Olympic size swimming pool holds at least 2.5 million liters.

Water Withdrawals by Water Use Sector (excluding in-stream hydroelectric water use)

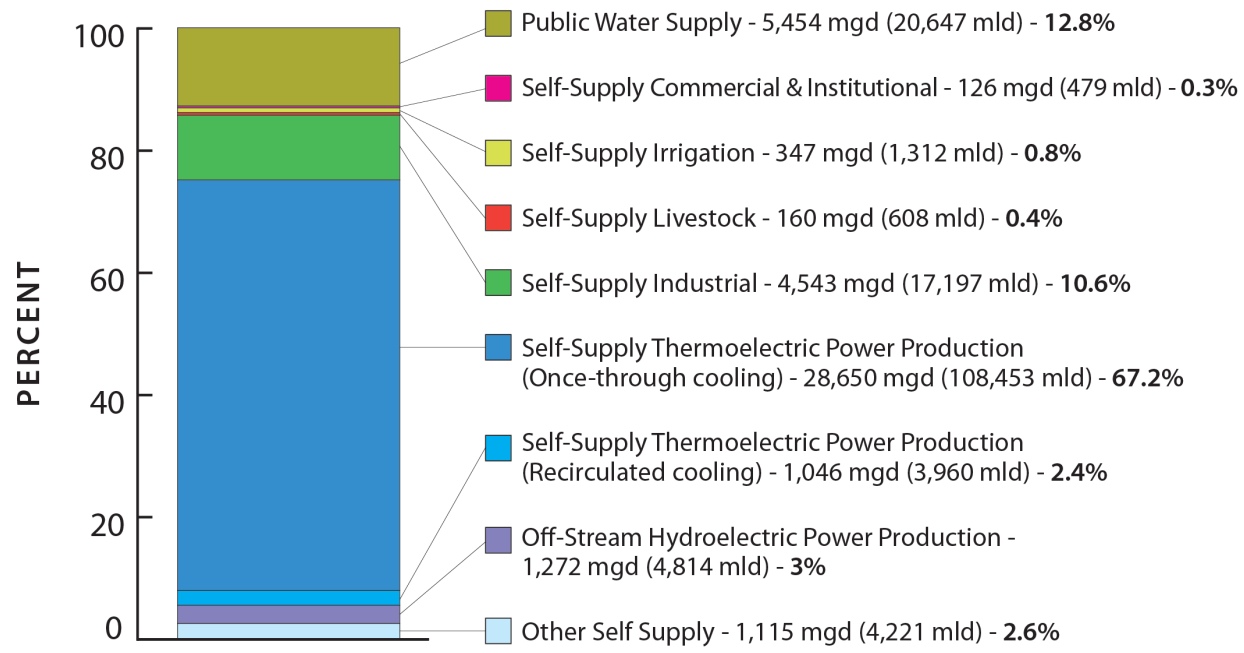

Figure 2.

The Lake Michigan watershed has the greatest withdrawal, followed by Lakes Ontario and Erie, respectively. The graph below shows withdrawals by watershed broken down by water source, e.g., Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW).

Water Withdrawals by Watershed in mgd (excludes in-stream hydroelectric water use)

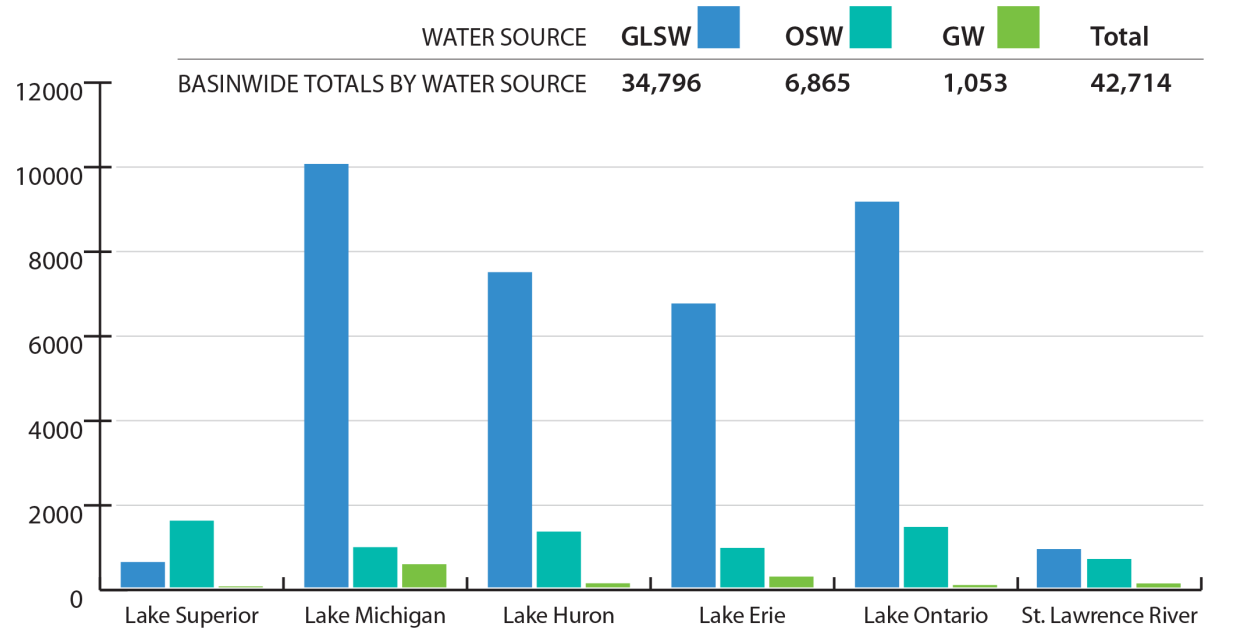

Figure 3.

The pie chart below shows total withdrawals portioned by jurisdiction, excluding in-stream hydroelectric water use. It should be noted withdrawals are not a measure of water consumed or lost to the basin as much of the water withdrawn is returned to the basin after use. Ontario, which has the largest land area of the ten jurisdictions (108,680 square miles or 281,377 square kilometers), spanning five watersheds was the largest withdrawer of Great Lakes water. Facilities in Ontario withdrew 16,835 mgd (63,729 mld) or 39 percent of the total withdrawal amount across all jurisdictions. In contrast, Pennsylvania, which has the least land area (508 square miles or 1316 square kilometers), withdrew just 36 mgd (135 mld).

Water Withdrawals by Jurisdiction (excludes in-stream hydroelectric water use)

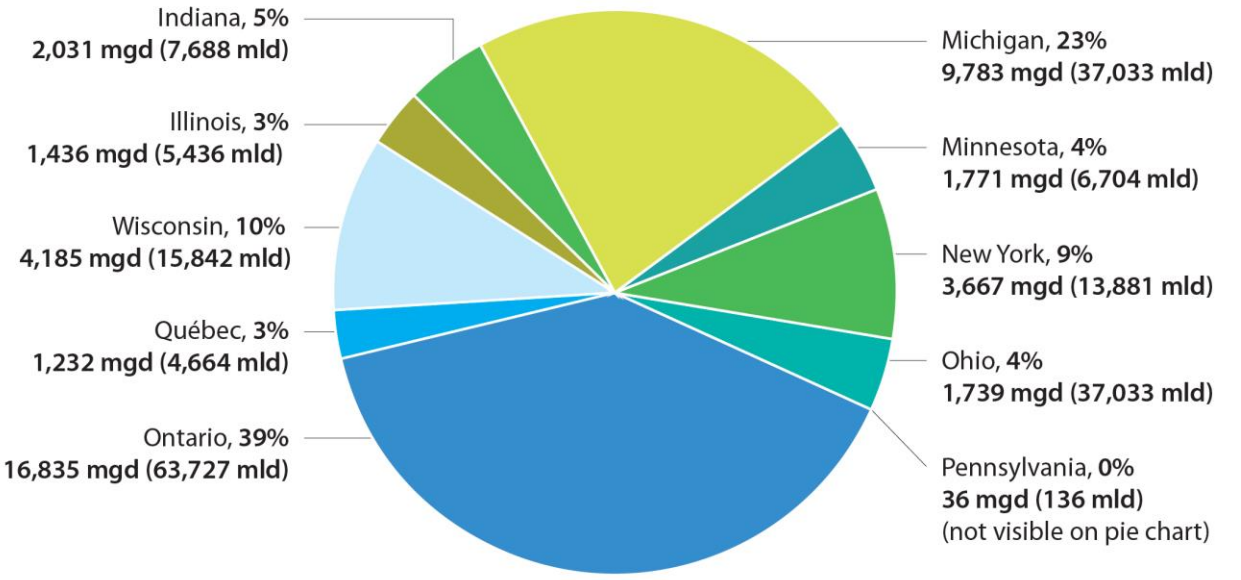

Figure 4.

Hydroelectric Power Generation

In past years of reporting annual water use, withdrawals for hydroelectric purposes (both in-stream and off-stream) have been the largest single sector of use, typically representing more than 95 percent of the region's total water withdrawals. In-stream hydroelectric power production continues to be a major water use for the Great Lakes-St. Lawrence River region (e.g., New York produced more hydroelectric power than any other state east of the Rocky Mountains in 2011[2]). Under the 2009 water use data collection and reporting protocols, the reporting of in-stream hydroelectric power production data became optional so the database and report do not represent this water use by all jurisdictions. In-stream hydroelectric power water use is not considered a withdrawal because the water remains in the water body and is not associated with water consumption.

[2] U.S. Energy Information Administration. 2012. http://www.eia.gov/state/?sid=NY

Off-stream hydroelectric power generation is considered a withdrawal since the water is removed to a retention area or a reservoir that serves as a storage system. This storage substantially increases the surface area of the water body, and in so doing, increases the evaporation resulting in a consumptive use of water. After being used for power generation, the water is returned to the original water source. Both off-stream and in-stream totals are described in the watershed and jurisdiction summaries in this report. In 2015, a total withdrawal of 1272 mgd (4814 mld) was reported for the off-stream hydroelectric power production sector, contrasting with 2014 reported data of 41 mgd (156 mld). This substantial increase in withdrawals was caused by a facility in Minnesota, which had been offline for most of 2014, returning to operation in 2015.

Diversions and Consumptive Uses

Diversions and consumptive uses of water are key components of the regional water use database. See Appendix B for the Compact and Agreement definitions for diversions and consumptive. Consumptive uses and diversions (less return flow) reflect water not returned (i.e., lost) to the source watershed. These water use data are considered particularly informative for assessing the cumulative hydrologic effects of water use in the region.

The total reported 2015 diversion from the Great Lakes-St. Lawrence River Basin was 1,186 mgd or 4,486 mld. More than 88 percent (1,044 mgd/3,952 mld) of this amount was associated with the Illinois diversion, which takes water from Lake Michigan and discharges it into the Mississippi River watershed. The reported amount associated with the Illinois diversion decreased by 7 percent compared to the 2014 reported amount of 1,123 mgd (4,251 mld). Smaller diversions throughout the region make up the balance of the total, and some of the diverted water is returned to the source watershed as return flow. There are a number of diversions into the Basin, including the Long Lac and Ogoki diversions (incoming diversions from the Hudson Bay watershed into northern Lake Superior) which contributed 4,068 mgd (15,401 mld) to the entire Basin in 2015. This is a slight decrease from the 2014 reported amount of 3,587 mgd (13,578 mld). This increase is well within the range of flow variability observed from 1944-2014. The flow from these diversions has ranged from 1,643 mgd (6,219 mld) to 5,181 mgd (19,612 mld).[3] When conditions in the Long Lac and Nipigon (downstream of Ogoki) watersheds are wet, the diversions are often reduced, and water that otherwise would have been diverted into Lake Superior is instead directed through natural outlets that flow toward Hudson Bay. Conversely, when conditions are dry in the downstream watersheds, the diversion flow may be higher. Overall, the net diversion, i.e., incoming diversions minus outgoing diversions, is a gain of 2,872[4] (10,870 mld), meaning that more water is diverted into the Basin than is diverted out of the Basin.

Consumptive use is that portion of the water withdrawn or withheld from the Basin that is lost or otherwise not returned to the Basin due to evaporation, incorporation into products or other processes. Consumptive use is most often calculated by applying a consumptive use coefficient to the reported withdrawal amount. The database documents the consumptive use coefficient used for each water withdrawal and the consumptive use that was determined through measurement. The total reported consumptive use for the Basin was 2,331 mgd (8,824 mld) – a decrease of 94 mgd (354 mld) or nearly 4 percent from the 2014 total consumptive use amount of 2,425 mgd (9,178 mld). The public water supply at 725 mgd (2,743 mld) and industrial at 713 mgd (2700 mld) were primary contributors to the total consumptive use amount. At

[3] Information on the flow variability of the Long Lac and Ogoki diversions was provided by Ontario Power Generation.
[4] The Great Lakes Regional Water Use Database records all incoming diversions with a negative sign and all outgoing diversions with a positive sign. This sign convention is different from what is used in the interim cumulative impact assessment, Appendix D.

947 mgd (3,585 mld), the Lake Michigan watershed had the largest consumptive use total among the five lake watersheds and the St. Lawrence River watershed.

Considering both consumptive use and diversions in 2015, the Basin gained 541 mgd (2,046 mld). In comparison, in 2014 the Basin lost 369 mgd (1,1397 mld). Tables 2a to 4b summarize water withdrawals, diversions and consumptive uses by watershed, sector, and jurisdiction for 2015.

Table 2a. Basin 2015 Water Use Data Summary by Watershed in mgd [5]

Watershed	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Lake Superior	597	37,786	20	38,403	0	-4,056	45
Lake Michigan	10,011	946	543	11,500	0	1,138	947
Lake Huron	7,452	17,582	93	25,127	42	0	135
Lake Erie	53,115	1,469	250	54,834	5,410	-2	433
Lake Ontario	50,262	98,026	52	148,340	-5,448	41	357
St. Lawrence River	160,940	51,139	94	212,173	0	7	415
Total	282,378	206,947	1,053	490,377	4	-2,872	2,331

In millions of gallons per day; Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 2b. Basin 2015 Water Use Data Summary by Watershed in mld

Watershed	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Lake Superior	2,261	143,034	77	145,372	0	-15,353	169
Lake Michigan	37,895	3,579	2,057	43,531	2	4,309	3,585
Lake Huron	28,210	66,555	353	95,118	157	0	510
Lake Erie	201,063	5,559	947	207,569	20,478	-8	1,639
Lake Ontario	190,262	371,070	197	561,530	-20,622	156	1,352
St. Lawrence River	609,226	193,581	354	803,161	0	26	1,569
Total	1,068,916	783,378	3,985	1,856,280	15	-10,870	8,824

In millions of liters per day; Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

[5] Note: For readability, withdrawals, consumptive use and diversions out of the basin are shown as positive values. Negative diversion values indicate water flows into the respective watershed.

Table 3a. Basin 2015 Water Use Data Summary by Sector in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	4,233	772	450	5,454	4	933	725
Self-Supply Commercial & Institutional	60	55	11	126	0	2	21
Self-Supply Irrigation	2	105	239	347	0	0	303
Self-Supply Livestock	1	104	56	160	0	0	13
Self-Supply Industrial	3,112	1,155	276	4,543	0	36	713
Self-Supply Thermoelectric Power Production (Once-through cooling)	26,155	2,493	2	28,650	0	0	257
Self-Supply Thermoelectric Power Production (Recirculated cooling)	1,012	28	6	1,046	0	14	256
Off-Stream Hydroelectric Power Production	0	1,272	0	1,272	0	0	0
In-Stream Hydroelectric Water Use	247,581	200,082	0	447,663	0	-4,068	0
Other Self Supply	221	880	14	1,115	0	213	44
Total	282,378	206,947	1,053	490,377	4	-2,872	2,331

In millions of gallons per day; Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 3b. Basin 2015 Water Use Data Summary by Sector in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	16,023	2,922	1,702	20,647	15	3,531	2,743
Self-Supply Commercial & Institutional	227	209	43	479	0	7	80
Self-Supply Irrigation	9	398	906	1,312	0	0	1,147
Self-Supply Livestock	3	395	210	608	0	-1	49
Self-Supply Industrial	11,782	4,371	1,045	17,197	0	134	2,700
Self-Supply Thermoelectric Power Production (Once-through cooling)	99,008	9,438	7	108,453	0	0	971
Self-Supply Thermoelectric Power Production (Recirculated cooling)	3,831	108	21	3,960	0	51	969
Off-Stream Hydroelectric Power Production	0	4,814	0	4,814	0	0	0
In-Stream Hydroelectric Water Use	937,197	757,393	0	1,694,590	0	-15,401	0
Other Self Supply	836	3,333	52	4,221	0	807	165
Total	1,068,916	783,378	3,985	1,856,280	15	-10,870	8,824

In millions of liters per day; Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 4a. Basin 2015 Water Use Data Summary by Jurisdiction (includes in-stream hydro) in mgd

Jurisdiction	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Illinois	1,436	0	0	1,436	0	1,044	1
Indiana	1,874	73	84	2,031	0	82	409
Michigan	7,906	1,406	471	9,783	0	0	478
Minnesota	311	3,639	7	3,957	0	13	31
New York	131,756	82,259	27	214,042	0	45	241
Ohio	1,223	432	83	1,739	0	-10	133
Ontario	133,361	118,385	192	251,938	4	-4,068	357
Pennsylvania	32	1	3	36	0	0	4
Quebec	782	381	68	1,232	0	3	383
Wisconsin	3,698	370	118	4,185	0	20	294
Total	282,378	206,947	1,053	490,377	4	-2,872	2,331

In millions of gallons per day; Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 4b. Basin 2015 Water Use Data Summary by Jurisdiction (includes in-stream hydro) in mld

Jurisdiction	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Illinois	5,434	0	0	5,434	0	3,953	2
Indiana	7,095	276	318	7,689	0	309	1,548
Michigan	29,926	5,323	1,783	37,032	2	0	1,810
Minnesota	1,176	13,776	25	14,977	0	48	118
New York	498,751	311,383	104	810,238	0	169	914
Ohio	4,629	1,636	316	6,581	0	-37	502
Ontario	504,827	448,136	726	953,688	14	-15,401	1,352
Pennsylvania	120	5	10	135	0	0	14
Quebec	2,960	1,444	258	4,662	0	12	1,451
Wisconsin	13,998	1,399	446	15,843	0	76	1,114
Total	1,068,916	783,378	3,985	1,856,280	15	-10,870	8,824

In millions of liters per day; Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Lake Watershed Summaries

Lake Superior

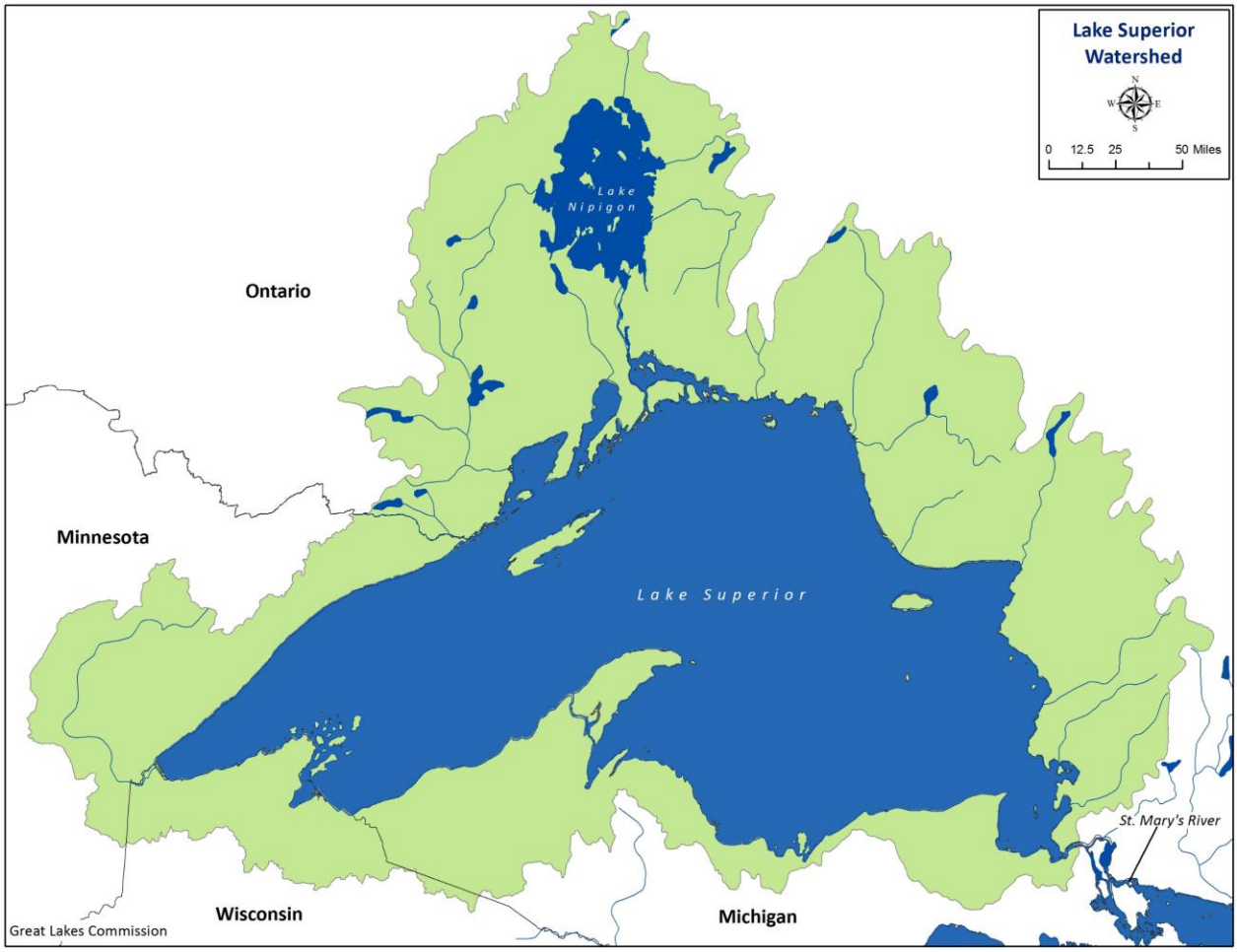

Figure 5. Lake Superior Watershed

Overview of Watershed Characteristics

Lake Superior is the largest of the Great Lakes and the world's third-largest freshwater lake by volume, holding about 2,900 cubic miles (12,100 cubic kilometers) of water. Lake Superior can hold all the water in the other

Basic Stats of Lake Superior

Length: 350 mi / 563 km

Breadth: 160 mi / 257 km

Elevation: 600 ft / 183 m

Depth: 483 ft / 147 m average, 1,330 ft / 406 m maximum

Volume: 2,900 cubic mi / 12,100 cubic km

Lake Surface Area: 31,700 square mi / 82,100 square km

Watershed Drainage Area: 49,300 square mi / 127,700 square km

Outlet: St. Marys River to Lake Huron

Retention / Replacement Time: 191 years

Population in the Watershed: United States 444,000; Canada 229,000. Total: 673,000

Great Lakes, plus three more Lake Eries.[6] Its surface area is roughly the size of South Carolina, or approximately 31,700 square miles (82,103 square kilometers).

Water Withdrawals

Four jurisdictions share the Lake Superior watershed – Michigan, Minnesota, Ontario and Wisconsin – which collectively withdrew 2,193 mgd (8,300 mld) of water, excluding in-stream hydroelectric water use, of 36,210 mgd (137,071 mld). This amount is a 116 percent increase from the 2014 total withdrawal amount of 1,013 mgd (3,835 mld). This is explained by an increase in withdrawals in Minnesota's off-stream hydroelectric power production sector, which grew from 15 mgd (58 mld) in 2014 to 1,227 mgd (4,644 mld) in 2015. This substantial increase in withdrawals was caused by a facility in Minnesota, which had been offline for most of 2014, returning to operation in 2015. The off-stream hydroelectric power production sector now represents 55 percent of all withdrawals from the watershed. Thermoelectric power production, once-through and recirculated cooling (575 mgd or 2,177 mld) and industrial (295 mgd or 1,118 mld) were the other significant water use sectors.

Other surface waters within the Lake Superior watershed were primarily used to generate electricity with in-stream hydroelectric. Excluding in-stream hydroelectric water use, 72 percent (1,575 mgd or 5,963 mld) of the total reported withdrawal amount from the watershed came directly from other surface waters. The remaining withdrawals came directly from Lake Superior (27 percent or 597 mgd or 2,261 mld) and groundwater (0.9 percent or 20 mgd or 77 mld). In 2014, most withdrawals (60 percent) came directly from Lake Superior. This change from Lake Superior to other surface waters being the dominant source of withdrawals is explained by the aforementioned facility in Minnesota that withdraws its water exclusively from other surface waters.

Water Diversions and Consumptive Uses

The total watershed consumptive use for all four jurisdictions was 45 mgd (169 mld). Industrial use (29 mgd or 110 mld), use for thermoelectric power, recirculated cooling (7 mgd or 26 mld) and the public water supply (7 mgd or 27 mld) sectors were the largest contributors, respectively, to the total consumptive use for the watershed.

Reported net water gain (4,068 mgd or 15,401 mld) in the Lake Superior watershed came from the Long Lac and Ogoki diversion in Northern Ontario. On average, these diversions into the basin together are about two times by volume larger than the Illinois diversion out of the Basin.

[6]Retention time is the calculated quantity expressing the mean time water spends in the lake
Minnesota Sea Grant. 2012. http://www.seagrant.umn.edu/superior/facts

Table 5a. Lake Superior Watershed 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	47	3	16	65	0	0	7
Self-Supply Commercial & Institutional	1	1	0	1	0	0	0
Self-Supply Irrigation	0	0	1	1	0	0	1
Self-Supply Livestock	1	25	3	28	0	0	1
Self-Supply Industrial	152	142	1	295	0	13	29
Self-Supply Thermoelectric Power Production (Once-through cooling)	397	178	0	575	0	0	7
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	1,227	0	1,227	0	0	0
In-Stream Hydroelectric Water Use	0	36,210	0	36,210	0	-4,068	0
Other Self Supply	0	0	0	0	0	0	0
Total	597	37,786	20	38,403	0	-4,056	45

In millions of gallons per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 5b. Lake Superior Watershed 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	177	10	59	246	0	0	27
Self-Supply Commercial & Institutional	3	2	0	5	0	0	1
Self-Supply Irrigation	0	1	2	3	0	0	3
Self-Supply Livestock	3	94	10	107	0	0	3
Self-Supply Industrial	574	539	6	1,118	0	48	110
Self-Supply Thermoelectric Power Production (Once-through cooling)	1,504	673	0	2,177	0	0	26
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	4,644	0	4,644	0	0	0
In-Stream Hydroelectric Water Use	0	137,071	0	137,071	0	-15,401	0
Other Self Supply	0	0	0	0	0	0	0
Total	2,261	143,034	77	145,372	0	-15,353	169

In millions of liters per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Lake Michigan

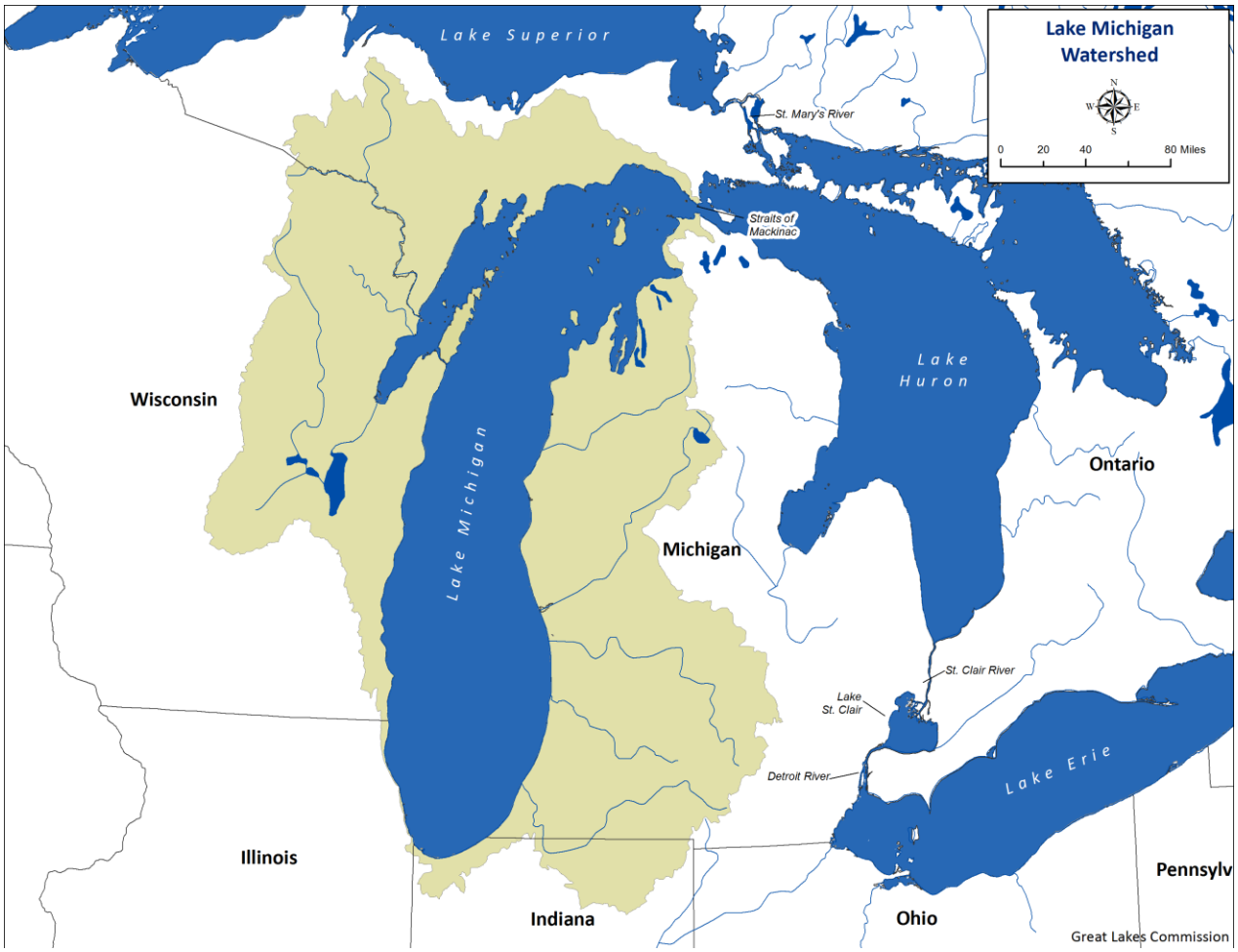

Figure 6. Lake Michigan Watershed

Overview of Watershed Characteristics

Lake Michigan is the only Great Lake entirely within the United States. It is the second largest of the Great Lakes by volume, holding about 1,180 cubic miles (4,918 cubic kilometers) of water. Its surface area is roughly the size of West Virginia, approximately 22,300 square miles (57,753 square kilometers). More than 12 million people call the Lake Michigan watershed home; about a third of the entire population of the Great Lakes-St. Lawrence River Basin lives in the Lake Michigan watershed.

Water Withdrawals

Four jurisdictions share the Lake Michigan watershed – Illinois, Indiana, Michigan, and Wisconsin – and collectively withdrew 11,500 mgd (43,531 mld). The primary water uses were thermoelectric power, both once-through and recirculated cooling (7,547 mgd or 28,567

Basic Stats of Lake Michigan

Length: 307 mi / 494 km

Breadth: 118 mi / 190 km

Elevation: 577.5 ft / 176 m

Depth: 279 ft / 85 m average, 923 ft / 281 m maximum

Volume: 1,180 cubic mi / 4,918 cubic km

Lake Surface Area: 22,300 square mi / 57,753 square km

Watershed Drainage Area: 45,600 square mi / 118,095 square km

Outlet: Straits of Mackinac to Lake Huron

Retention / Replacement Time: 62 years

Population in the Watershed: 12,052,743

mld), industrial use (1,936 mgd or 7,329 mld) and public water supply (1,502 mgd or 5,686 mld). Lake Michigan (87 percent of total withdrawals or 10,011 mgd or 37,896 mld) was the primary source of water withdrawals in the watershed.

Water Diversions and Consumptive Uses

Reported net water loss in the Lake Michigan watershed, totaling 2,085 mgd (7,894 mld), represents 18 percent of total withdrawals. Total water loss was comprised mainly of the Illinois diversion (1,100 mgd or 4,163 mld) for public water supply and other purposes, additional small diversions totaling 39 mgd (146 mld) and the total consumptive use of the four jurisdictions (947 mgd or 3,585 mld). Self-supply thermoelectric (254 mgd or 962 mld), industrial use (383 mgd or 1451 mld), irrigation (219 mgd or 829 mld) and public water supply (81 mgd or 307 mld) were the water use sectors that contribute the majority of the consumptive uses in the watershed.

Table 6a. Lake Michigan Watershed 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	1,257	21	223	1,502	0	896	81
Self-Supply Commercial & Institutional	2	3	7	13	0	2	1
Self-Supply Irrigation	0	43	210	252	0	0	219
Self-Supply Livestock	0	17	19	37	0	0	8
Self-Supply Industrial	1,644	222	70	1,936	0	23	383
Self-Supply Thermoelectric Power Production (Once-through cooling)	6,465	612	1	7,077	0	0	49
Self-Supply Thermoelectric Power Production (Recirculated cooling)	438	27	5	469	0	14	205
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	204	1	8	213	0	204	0
Total	10,011	946	543	11,500	0	1,138	947

In millions of gallons per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 6b. Lake Michigan Watershed 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	4,759	81	846	5,686	2	3,391	307
Self-Supply Commercial & Institutional	9	12	27	49	0	7	5
Self-Supply Irrigation	1	161	793	955	0	0	829
Self-Supply Livestock	0	66	74	139	0	0	30
Self-Supply Industrial	6,225	839	265	7,329	0	87	1,451
Self-Supply Thermoelectric Power Production (Once-through cooling)	24,472	2,315	4	26,791	0	0	185
Self-Supply Thermoelectric Power Production (Recirculated cooling)	1,657	101	18	1,776	0	51	777
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	772	5	29	806	0	772	1
Total	37,895	3,579	2,057	43,531	2	4,309	3,585

In millions of liters per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Lake Huron

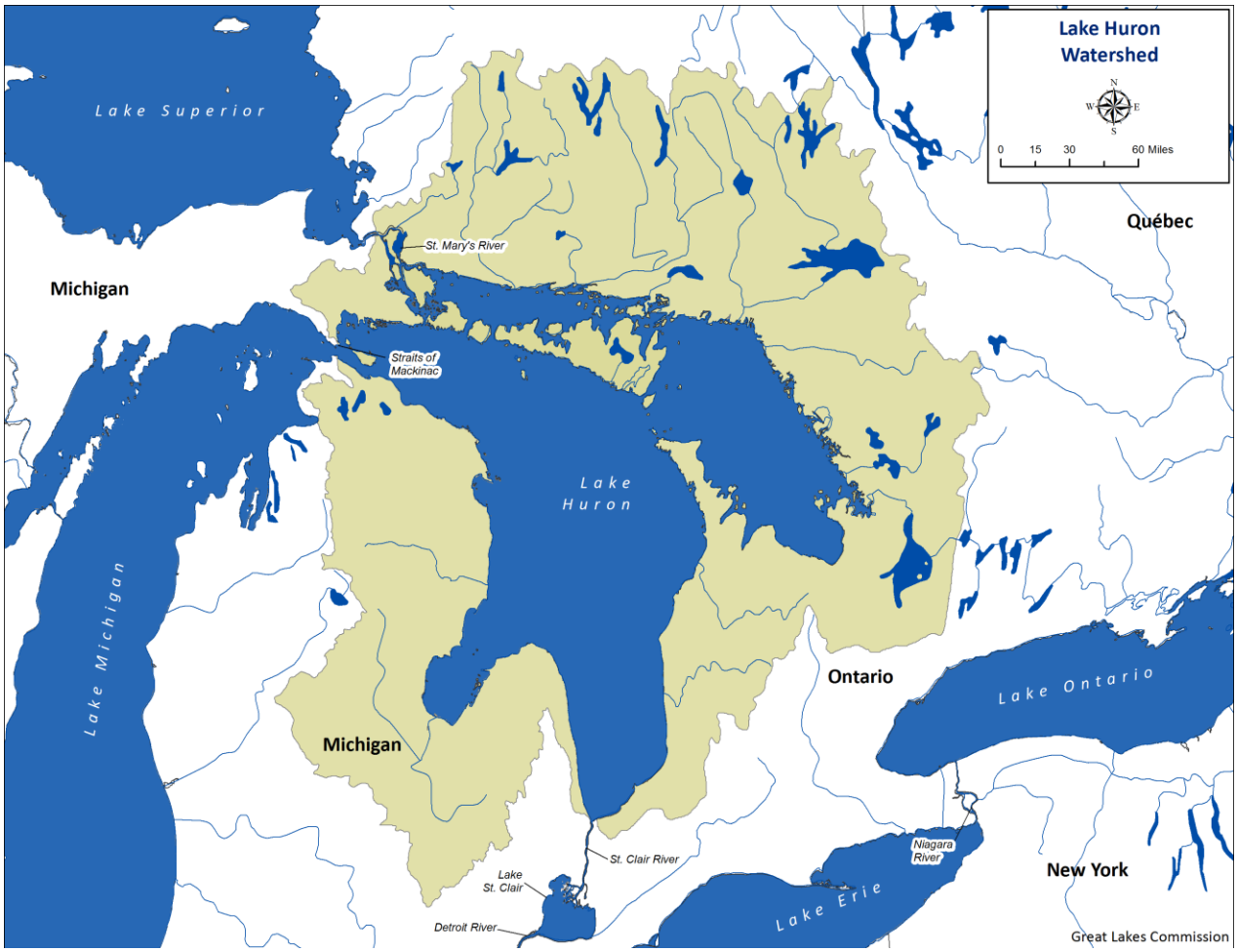

Figure 7. Lake Huron Watershed

Overview of Watershed Characteristics

By surface area, Lake Huron is the second-largest of the Great Lakes. It covers 23,000 square miles (59,600 square kilometers), making it the third-largest fresh water lake on Earth. By volume however, Lake Huron is only the third largest of the Great Lakes.

Basic Stats of Lake Huron

Length: 206 mi / 332 km

Breadth: 183 mi / 295 km

Elevation: 577.5 ft / 176 m

Depth: 195 ft / 59 m average, 750 ft / 229 m maximum

Volume: 849 cubic mi / 3,538 cubic km

Lake Surface Area: 23,000 square mi / 59,565 square km

Watershed Drainage Area: 50,700 square mi / 131,303 square km

Outlet: St. Clair River to Lake Erie

Retention / Replacement Time: 21 years

Population in the Watershed: United States 1,483,872; Canada 1,476,487. Total: 2,960,359

Water Withdrawals

Two jurisdictions – Michigan and Ontario – share the watershed and collectively withdrew 8,861 mgd (33,543 mld) of the water, excluding in-stream hydroelectric water use (16,266 mgd or 61,575 mld). This is an eight percent decrease from the 2014 water withdrawal amount of 9,660 mgd (36,565 mld).

The primary water uses were industrial use (169 mgd or 640 mld), thermoelectric power, once-through cooling (8,398 mgd or 31,797 mld) and public water supply (228 mgd or 862 mld). Excluding in-stream hydroelectric

water use, Lake Huron surface water was the source of 84 percent of the total withdrawals in the watershed.

Water Diversions and Consumptive Uses

Reported net water loss to the Lake Huron watershed was 177 mgd (667 mld), which represented nearly two percent of the total withdrawal amount. This total includes an intrabasin transfer of 42 mgd (157 mld) for public water supply in Ontario. While hydrologically this intrabasin transfer remained in the Great Lakes-St. Lawrence River Basin, it represented a loss to the Lake Huron watershed and a net gain to the Lake Erie watershed. Public water supply (28 mgd or 106 mld) and thermoelectric power production (70 mgd or 266 mld) made up the majority (73 percent) of the consumptive uses in the watershed.

Table 7a. Lake Huron Watershed 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	148	41	39	228	42	0	28
Self-Supply Commercial & Institutional	0	3	0	3	0	0	0
Self-Supply Irrigation	0	5	14	19	0	0	17
Self-Supply Livestock	0	17	16	33	0	0	0
Self-Supply Industrial	28	118	23	169	0	0	17
Self-Supply Thermoelectric Power Production (Once-through cooling)	7,276	1,122	0	8,398	0	0	70
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	1	1	2	0	0	1
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	16,266	0	16,266	0	0	0
Other Self Supply	0	8	0	9	0	0	0
Total	7,452	17,582	93	25,127	42	0	135

In millions of gallons per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 7b. Lake Huron Watershed 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	558	155	148	862	157	0	106
Self-Supply Commercial & Institutional	0	11	1	13	0	0	2
Self-Supply Irrigation	0	21	52	73	0	0	66
Self-Supply Livestock	0	64	61	125	0	0	1
Self-Supply Industrial	105	447	87	640	0	0	65
Self-Supply Thermoelectric Power Production (Once-through cooling)	27,544	4,247	0	31,791	0	0	266
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	4	3	6	0	0	5
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	61,575	0	61,575	0	0	0
Other Self Supply	2	30	1	33	0	0	0
Total	28,210	66,555	353	95,118	157	0	510

In millions of liters per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Lake Erie

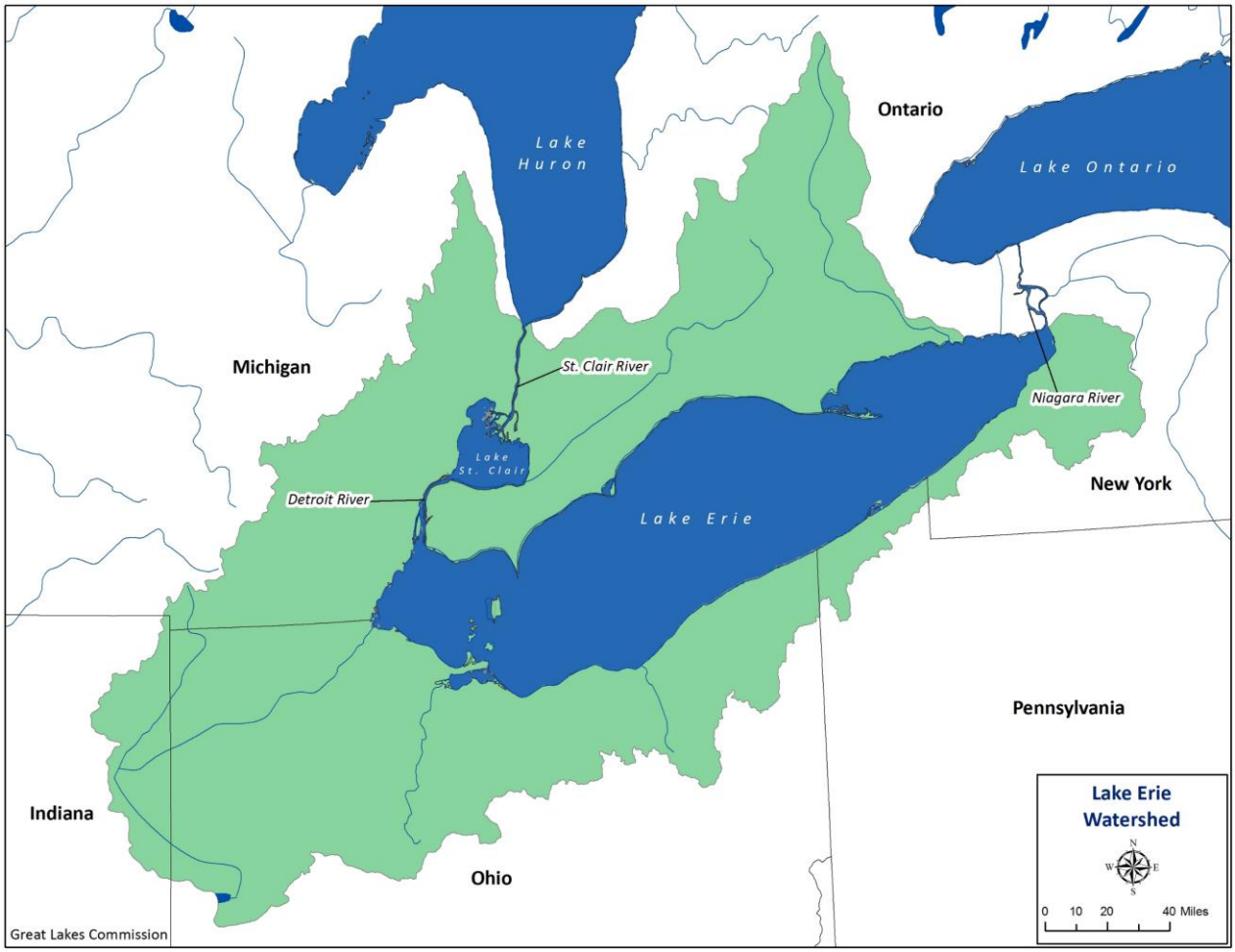

Figure 8. Lake Erie Watershed

Overview of Watershed Characteristics

By surface area, Lake Erie is the 12th largest freshwater lake in the world. The shallowest of the Great Lakes, it has an average depth of 62 feet and a maximum depth of 210 feet. The lake holds about 116 cubic miles (4,863 cubic kilometers) of water. Lake Erie is warmer than the other Great Lakes, which also helps make it the most productive. However, its size also makes it more ecologically sensitive than the other Great Lakes.

The watershed is home to more than 12.5 million people, representing more than one-third of the entire population of the Great Lakes-St. Lawrence River Basin.

Water Withdrawals

Six jurisdictions – Indiana, Michigan, New York, Ohio, Ontario and Pennsylvania – share the watershed and

Basic Stats of Lake Erie

Length: 241 mi / 388 km

Breadth: 57 mi / 92 km

Elevation: 569.2 ft / 173.5 m

Depth: 62 ft / 19 m average, 210 ft / 64 m maximum

Volume: 116 cubic mi / 483 cubic km

Lake Surface Area: 9,910 square mi / 25,655 square km

Watershed Drainage Area: 22,700 square mi / 58,788 square km

Outlets: Niagara River and Welland Canal

Retention/Replacement Time: 2.7 years

Population in the Watershed: United States, est. 10,640,671; Canada est. 1,892,306. Total: est. 12,532,977

collectively withdrew 7,891 mgd (29,872 mld) of the water, excluding in-stream hydroelectric water use, which accounted for 46,943 mgd (177, 697 mld). This amount is a two percent decrease from the 2014 total withdrawal amount of 8,083 mgd (30,596 mld). Aside from water used for hydroelectric power generation purposes, the primary water uses were thermoelectric power, both once-through and recirculated cooling (5,028 mgd or 19,032 mld), public water supply (1,639 mgd or 6,204 mld) and industrial use (1,142 mgd or 4,321 mld).

Lake Erie surface water was the source of 85 percent of the total withdrawals in the watershed. However, other surface water and groundwater were the only sources of Indiana's water use, primarily supporting the public water supply sector.

Water Diversions and Consumptive Uses

Reported net water loss in the Lake Erie watershed totaled 5,841 mgd (22,109 mld). This amount includes a diversion (going into the Lake Erie watershed) of 23 mgd (87 mld), a net intrabasin diversion of 5,410 mgd (20,478 mld), and a total consumptive use of 433mgd (1,639 mld). The largest intrabasin diversion is the Welland Canal for other self-supply and navigation purposes (5,449 mgd or 20,628 mld). The Welland Canal was constructed in 1830 as a ship canal in Ontario, Canada, connecting Lake Erie to Lake Ontario. The major consumptive uses were for public water supply (211 mgd or 798 mld) and industrial uses (97 mgd or 368 mld).

Table 8a. Lake Erie Watershed 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	1,352	181	106	1,639	-40	21	211
Self-Supply Commercial & Institutional	0	4	2	6	0	0	1
Self-Supply Irrigation	1	35	13	49	0	0	44
Self-Supply Livestock	0	6	6	12	0	0	1
Self-Supply Industrial	747	276	119	1,142	0	0	97
Self-Supply Thermoelectric Power Production (Once-through cooling)	4,439	418	0	4,858	0	0	46
Self-Supply Thermoelectric Power Production (Recirculated cooling)	169	0	0	170	0	0	29
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	46,403	540	0	46,943	0	0	0
Other Self Supply	3	9	4	17	5,449	-23	5
Total	53,115	1,469	250	54,834	5,410	-2	433

In millions of gallons per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 8b. Lake Erie Watershed 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	5,117	687	399	6,204	-150	80	798
Self-Supply Commercial & Institutional	1	13	7	21	0	0	3
Self-Supply Irrigation	5	132	50	187	0	0	168
Self-Supply Livestock	0	21	23	44	0	-1	3
Self-Supply Industrial	2,828	1,044	449	4,321	0	0	368
Self-Supply Thermoelectric Power Production (Once-through cooling)	16,805	1,583	2	18,389	0	0	173
Self-Supply Thermoelectric Power Production (Recirculated cooling)	641	2	0	643	0	0	109
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	175,654	2,043	0	177,697	0	0	0
Other Self Supply	11	35	17	63	20,628	-87	17
Total	201,063	5,559	947	207,569	20,478	-8	1,639

In millions of liters per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Lake Ontario

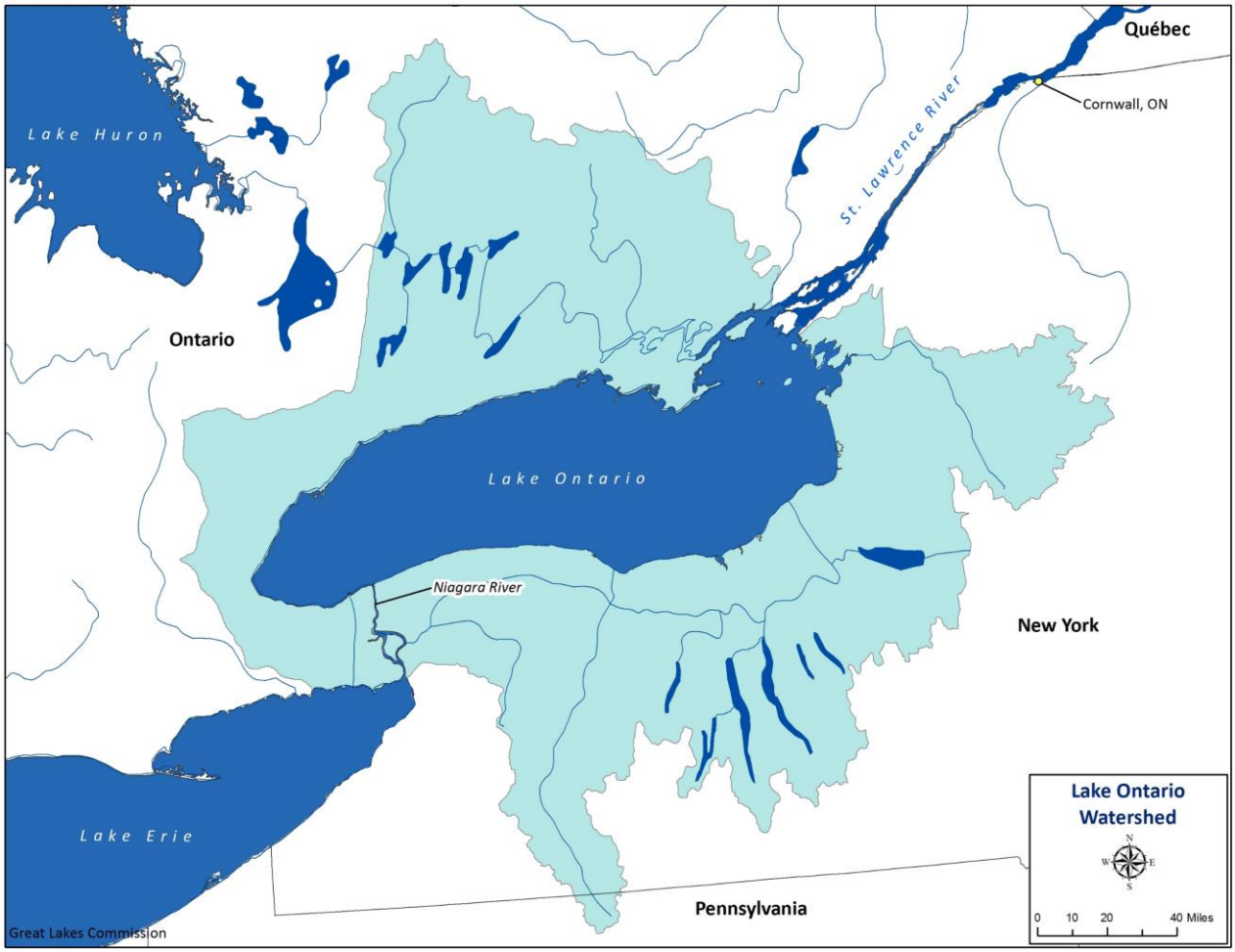

Figure 97. Lake Ontario Watershed

Overview of Watershed Characteristics

Lake Ontario is the easternmost of the Great Lakes and the smallest in surface area (covering 7,340 square miles, 18,960 square kilometers). It is extremely deep (e.g., 802 feet maximum) in some areas and exceeds Lake Erie in volume (393 cubic miles, 1,639 cubic kilometers). By surface area, it is the 14th largest lake in the world.

Water Withdrawals

Three jurisdictions – New York, Ontario and Pennsylvania – share the watershed and collectively withdrew 10,598 mgd (40,117 mld) of the water, excluding in-stream hydroelectric water use, which accounted for 137,742 mgd (521,412 mld). This amount is a 1.5 percent increase from the 2014 withdrawal amount of 10,444 mgd (39,535 mld). Aside from withdrawals for hydroelectric power generation purposes, the primary water uses were for public water supply (964

Basic Stats of Lake Ontario

Length: 193 mi / 311 km

Breadth: 53 mi / 85 km

Elevation: 243.3 ft / 74.2 m

Depth: 283 ft / 86 m average, 802 ft / 244 m maximum

Volume: 393 cubic mi / 1,639 cubic km

Lake Surface Area: 7,340 square mi / 19,009 square km

Watershed Drainage Area: 23,400 square mi / 60,601 square km

Outlet: St. Lawrence River to the Atlantic Ocean

Retention / Replacement Time: 6 years

Population in the Watershed: United States, est. 2,856,360; Canada est. 2,835,818. Total: est.5,692,178

mgd or 3648 mld), other self-supply uses (750 mgd or 2,839 mld) and thermoelectric power generation, both once-through and recirculated cooling (8,096 mgd or 30,646 mld).

Lake Ontario surface water was the source for 86 percent of the total withdrawals in the watershed. It was the source for most of the water use sectors, except for irrigation, livestock and other self-supply where other surface water in the watershed was the predominant source.

Water Diversions and Consumptive Uses

Reported water loss in the Lake Ontario watershed totaled 398 mgd (1,508 mld). This amount includes diversions totaling 41 mgd (156 mld), an intrabasin diversion of 2 mgd (6 mld) and a combined consumptive use amount of 357 mgd (1,352 mld). The major consumptive uses were from public water supply (119 mgd or 450 mld), thermoelectric power production (104 mgd or 395 mld) and industrial uses (67 mgd or 254 mld).

Water gained (5,449 mgd or 20,628 mld) in the Lake Ontario watershed came from the Welland Canal, which diverts water from the Lake Erie watershed for navigation purposes. Reported net water gain totaled 5,050 mgd (19,116 mld).

Table 9a. Lake Ontario Watershed 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	755	195	13	964	2	9	119
Self-Supply Commercial & Institutional	56	36	1	93	0	0	16
Self-Supply Irrigation	0	16	1	18	0	0	16
Self-Supply Livestock	0	21	4	25	0	0	3
Self-Supply Industrial	372	203	33	608	0	0	67
Self-Supply Thermoelectric Power Production (Once-through cooling)	7,528	162	0	7,690	0	0	84
Self-Supply Thermoelectric Power Production (Recirculated cooling)	405	0	0	405	0	0	20
Off-Stream Hydroelectric Power Production	0	45	0	45	0	0	0
In-Stream Hydroelectric Water Use	41,143	96,599	0	137,742	0	0	0
Other Self Supply	1	749	0	750	-5,449	32	32
Total	50,262	98,026	52	148,340	-5,448	41	357

In millions of gallons per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 9b. Lake Ontario Watershed 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	2,859	740	49	3,648	6	34	450
Self-Supply Commercial & Institutional	214	135	3	351	0	0	60
Self-Supply Irrigation	2	60	5	67	0	0	60
Self-Supply Livestock	0	80	16	96	0	0	10
Self-Supply Industrial	1,410	768	123	2,302	0	0	254
Self-Supply Thermoelectric Power Production (Once-through cooling)	28,497	613	1	29,111	0	0	318
Self-Supply Thermoelectric Power Production (Recirculated cooling)	1,533	1	0	1,535	0	0	77
Off-Stream Hydroelectric Power Production	0	170	0	170	0	0	0
In-Stream Hydroelectric Water Use	155,745	365,667	0	521,412	0	0	0
Other Self Supply	3	2,835	0	2,839	-20,628	121	123
Total	190,262	371,070	197	561,530	-20,622	156	1,352

In millions of liters per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

St. Lawrence River

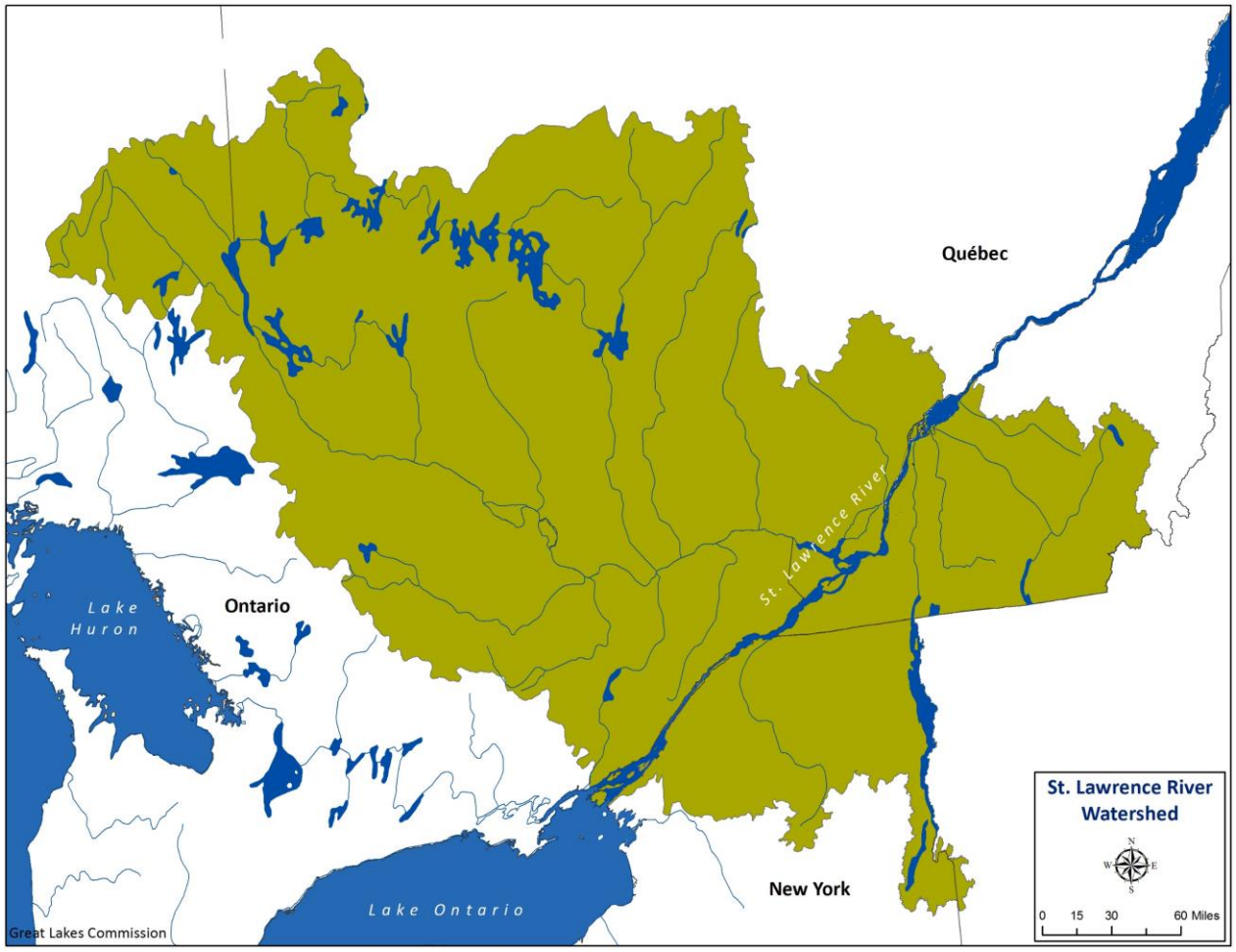

Figure 10. St. Lawrence River Watershed

Overview of Watershed Characteristics

Running 744 miles (1,198 kilometers) in length, the St. Lawrence River is considered a major river of North America. Mostly located in the province of Québec, it links the Great Lakes to the Atlantic Ocean.

Basic Stats of the St. Lawrence River

Length: 744 mi / 1,197 km

Elevation: 245 ft/74.7 m at the source and 0 ft/0 m at the mouth

Average Annual Flow (Montréal): 7,660 cubic meters/second

Volume: 393 cubic mi / 1,639 cubic km

Watershed Drainage Area: 519,000 square mi / 1,344,200 square km

Outlet: Gulf of St. Lawrence/ Atlantic Ocean

Water Withdrawals

Three jurisdictions – New York, Ontario and Québec – share the watershed and collectively withdrew 1,671 mgd (6,327 mld) of the water, excluding in-stream hydroelectric water use, which accounted for 210,501 mgd (796,834 mld). This amount is a 3 percent decrease from the 2014 withdrawal total of 1,718 mgd (6,505 mld). Aside from hydroelectric, the primary water uses were public water supply (1,057 mgd or 4,002 mld), and industrial use (393 mgd or 1487 mld).

St. Lawrence River surface water was the source for over half (54 percent) of the watershed's total withdrawal amount. Other surface water within the St. Lawrence River watershed accounted for 40 percent of the total. The remaining portion of the total withdrawal amount (6 percent) came from groundwater sources.

Water Diversions and Consumptive Uses

Net water loss in the St. Lawrence River watershed totaled 422 mgd (1,595 mld). This total includes a diversion amount of 7 mgd (26 mld) for public supply purposes in New York and Québec and a combined consumptive use amount of 415 mgd (1,569 mld). The largest consumptive uses were the public water supply sector at 279 mgd (1,056 mld) and industrial at 119 mgd (452 mld).

Table 10a. St. Lawrence River Watershed 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	674	330	53	1,057	0	7	279
Self-Supply Commercial & Institutional	0	9	1	11	0	0	3
Self-Supply Irrigation	0	6	1	7	0	0	6
Self-Supply Livestock	0	18	7	25	0	0	1
Self-Supply Industrial	169	194	30	393	0	0	119
Self-Supply Thermoelectric Power Production (Once-through cooling)	49	2	0	51	0	0	0
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	160,035	50,466	0	210,501	0	0	0
Other Self Supply	13	113	1	127	0	0	6
Total	160,940	51,139	94	212,173	0	7	415

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 10b. St. Lawrence River Watershed 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	2,552	1,249	201	4,002	0	26	1,056
Self-Supply Commercial & Institutional	0	35	5	40	0	0	11
Self-Supply Irrigation	1	24	3	28	0	0	21
Self-Supply Livestock	0	69	26	96	0	0	3
Self-Supply Industrial	639	733	114	1,487	0	0	452
Self-Supply Thermoelectric Power Production (Once-through cooling)	187	7	0	194	0	0	2
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	605,798	191,036	0	796,834	0	0	0
Other Self Supply	47	428	5	481	0	0	24
Total	609,226	193,581	354	803,161	0	26	1,569

In millions of liters per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Jurisdiction Reports

Illinois

The Illinois portion of the Lake Michigan watershed is only about 100 square miles, which accounts for less than 0.2 percent of the total area of the state. The Lake Michigan coastline of Illinois is 63 miles long, which is a small fraction of the 1,640 miles that make up the total Lake Michigan shoreline. Despite its relatively small size, the Illinois Lake Michigan service area is home to half of the total population of Illinois and the lake itself is the largest public drinking water supply in the state, serving nearly 7 million people.

The total withdrawal amount from the Basin for Illinois in 2015 was 1,436 mgd (5,435 mld), an 11 percent decrease from 2014 (1,611 mgd or 6,099 mld). The largest uses of reported water were public water supply at 837 mgd or 3,170 mld (58 percent of the total withdrawal amount) and thermoelectric power production, once-through cooling at 362 mgd or 1,369 mld (25 percent of the total withdrawal amount). The primary source for all withdrawals was Lake Michigan.

The Illinois Diversion, which takes water from Lake Michigan and discharges it into the Mississippi River watershed, is comprised of three elements: public water supply; stormwater runoff; and support for control structures for navigation and discretionary diversion for other purposes such as low flow augmentation and water quality enhancement. The amount of water diverted for public water supply and self-supply commercial and institutional was 839 mgd (3,177 mld). The diversion amount supporting other uses (i.e., discretionary diversion) was 204 mgd (772 mld).

Data collected for this report came from multiple sources including Illinois Department of Natural Resources, Illinois State Water Survey and the Metropolitan Water Reclamation District of Greater Chicagoland. These data were generated with a 100 percent reporting compliance from permitted water withdrawal facilities.

Notable changes in 2015 water use by Illinois facilities include:

- A 4 percent reduction in water withdrawals by the City of Chicago for public water supply;
- A 21 percent reduction in water withdrawals for self-supply thermoelectric cooling due to gradual decommissioning of one plant; and,
- An 18 percent reduction in water withdrawals by the Metropolitan Water Reclamation District of Greater Chicagoland for discretionary dilution of treated water discharge.

Table 11a. Illinois 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	837	0	0	837	0	837	0
Self-Supply Commercial & Institutional	2	0	0	2	0	2	0
Self-Supply Irrigation	0	0	0	0	0	0	0
Self-Supply Livestock	0	0	0	0	0	0	0
Self-Supply Industrial	31	0	0	31	0	1	0
Self-Supply Thermoelectric Power Production (Once-through cooling)	362	0	0	362	0	0	0
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	204	0	0	204	0	204	0
Total	1,436	0	0	1,436	0	1,044	1

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 11b. Illinois 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	3,170	0	0	3,170	0	3,170	0
Self-Supply Commercial & Institutional	7	0	0	7	0	7	0
Self-Supply Irrigation	0	0	0	0	0	0	0
Self-Supply Livestock	0	0	0	0	0	0	0
Self-Supply Industrial	117	0	0	117	0	4	2
Self-Supply Thermoelectric Power Production (Once-through cooling)	1,369	0	0	1,369	0	0	0
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	772	0	0	772	0	772	0
Total	5,434	0	0	5,434	0	3,953	2

In millions of liters per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Indiana

The state of Indiana uses the water resources of the Lake Michigan and Lake Erie watersheds. Indiana's portion of Lake Michigan encompasses a total of 241 square miles. Four Indiana counties lie partially within Indiana's portion of the Lake Michigan watershed, but three of these four counties (Lake, Porter and LaPorte) constitute more than 99.5 percent its land area. Abundant freshwater from Lake Michigan has promoted the development of an extensive urban and industrial belt along Indiana's coastline. Water supplies in Indiana's non-coastal counties in the Lake Michigan watershed are drawn primarily from groundwater.

Indiana shares a portion of the Maumee River watershed that flows into Lake Erie. The Maumee River watershed encompasses a total of 1,283 square miles of northeast Indiana. Six Indiana counties lie partially within this watershed. The largest withdrawals, for public supply and industrial purposes, come from the surface waters of the St. Joseph (a major tributary within the Maumee watershed) and Maumee Rivers, . Groundwater withdrawals in the Maumee River watershed are used primarily for public water supply and industrial dewatering.[7]

In 2015, the total reported water withdrawal amount from the Basin for Indiana was 2,031 mgd (7,689 mld). The largest uses were industrial (1,586 mgd or 6,003 mld), thermoelectric power (246 mgd or 930 mld) and public water supply (168 mgd or 636 mld).

The total reported diversion amount for Indiana was 82 mgd (309 mld). Because a small, 65 square mile, portion of Indiana drains into the Illinois River (as a result of the Illinois Diversion), water transferred from the Lake Michigan watershed into this area is considered a diversion of water from the Great Lakes-St. Lawrence River Basin. The majority of reported diversions for Indiana (51 mgd or 195 mld) were distributed for public supply purposes from Lake Michigan surface water and discharged to the "Illinois Diversion" area, with about 1 mgd (3 mld) reported as a diversion from groundwater for public supply. The industrial sector was responsible for about 22 mgd (82 mld) of the reported diversion from the Lake Michigan watershed to the Illinois River.

For the Lake Erie watershed, a portion of the town of Fort Wayne's public water supply distribution system is located in the Upper Wabash watershed. The amount of water (about 8 mgd or 29 mld, primarily from other surface water with a small portion from groundwater) distributed through that portion of the system was reported as a diversion from the Lake Erie watershed.

Consumptive use in Indiana totaled 409 mgd (1,548 mld), with the industrial sector in the Lake Michigan watershed (348 mgd or 1,317 mld or 85 percent) as the primary contributor to the total.

Data collected for this report came from the Indiana Department of Natural Resources. These data were generated with reporting compliance rates from permitted water withdrawal facilities ranging from 93 to 100 percent depending on the water use sector. Withdrawals and consumptive uses are not estimated for facilities that did not report.

[7] Indiana Dept. of Natural Resources. 1996. http://www.in.gov/dnr/water/files/lakemich_basinsums.pdf http://www.in.gov/dnr/water/files/maumee_basinsums.pdf

Notable changes in 2015 water use by Indiana facilities include:

- A substantial reduction (47 percent) in water withdrawals for self-supply irrigation. More precipitation in the summer of 2015 reduced the need for irrigation;
- An estimated 3 percent increase in withdrawals from Lake Michigan surface water for industrial self-supply, although there is some uncertainty around this estimate. A facility with large withdrawals is using an old pump whose functional capacity may be below its rated capacity; and,
- A 25 percent reduction in withdrawals for self-supply thermoelectric (recirculated) cooling from Lake Michigan surface water. This was due to outages at a facility being fitted with new environmental equipment.

Table 12a. Indiana 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	89	35	44	168	0	60	20
Self-Supply Commercial & Institutional	0	0	2	2	0	0	0
Self-Supply Irrigation	0	4	21	25	0	0	22
Self-Supply Livestock	0	1	4	5	0	0	3
Self-Supply Industrial	1,568	9	9	1,586	0	22	350
Self-Supply Thermoelectric Power Production (Once-through cooling)	207	0	0	208	0	0	4
Self-Supply Thermoelectric Power Production (Recirculated cooling)	10	24	3	38	0	0	9
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	0	0	1	1	0	0	0
Total	1,874	73	84	2,031	0	82	409

In millions of gallons per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 12b. Indiana 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	338	132	167	636	0	227	77
Self-Supply Commercial & Institutional	0	0	6	6	0	0	1
Self-Supply Irrigation	0	15	80	95	0	0	84
Self-Supply Livestock	0	4	13	17	0	0	9
Self-Supply Industrial	5,934	33	36	6,003	0	82	1,326
Self-Supply Thermoelectric Power Production (Once-through cooling)	785	0	1	786	0	0	16
Self-Supply Thermoelectric Power Production (Recirculated cooling)	39	93	12	144	0	0	36
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	0	0	3	3	0	0	0
Total	7,095	276	318	7,689	0	309	1,548

In millions of liters per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Michigan

Home to more than 9.8 million people, Michigan borders four of the Great Lakes (Superior, Michigan, Huron and Erie). Some unique features of Michigan include:

- 57,022 square miles of land area in two peninsulas (40,583 square miles in the Lower Peninsula and 16,439 square miles in the Upper Peninsula);
- Virtually the entire land area of the state lies within the Great Lakes basin;
- 38,575 square miles of Great Lakes water area; and
- 3,126 miles of Great Lakes shoreline (more fresh water coastline than any other state).[8]

In 2015, the total reported water withdrawal amount from the Basin for Michigan was 9,783 mgd (37,032 mld), a decrease of 1 percent from the 2014 total water withdrawal amount of 9,904 mgd (37,494 mld). The largest use was thermoelectric power production, once-through and recirculated cooling, totaling 7,799 mgd (29,523 mld) or 80 percent of the total withdrawal amount. The four Great Lakes were the largest source for withdrawals at 80 percent of the total. Nearly half of the total water withdrawal amount (4,807 mgd, 18,197 mld or 49 percent) came from the Lake Erie watershed, mainly used for thermoelectric power production. Forty percent of total withdrawal amount (3,943 mgd or 14,925 mld) came from the Lake Michigan watershed, followed by the Lake Huron watershed at 795 mgd or 3008 mld (8 percent) and the Lake Superior watershed at 239 mgd or 903 mld (2 percent).

Michigan reported no diversions. The total amount of consumptive use was 478 mgd or 1,810 mld (5 percent of the total withdrawal amount), with self-supply irrigation being the largest contributor to consumptive use at 204 mgd (771 mld).

Data collected for this report came from multiple sources: Michigan Department of Environmental Quality and the Michigan Department of Agriculture and Rural Development. These data were generated with estimated reporting compliance rates ranging from 75 to 99 percent of total water use reporters, depending on the water use sector. Withdrawals and consumptive uses are not estimated for facilities not in compliance with reporting for most water use sectors except for self-supply livestock and self-supply thermoelectric power production once-through cooling, which were partially estimated by the state agency each for a single facility due to a missing 2015 report.

[8] Michigan Dept. of Transportation. http://www.michigan.gov/mdot/0,4616,7-151-9622_11033_11151-67959--,00.html

Table 13a. Michigan 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	841	16	192	1,049	0	0	131
Self-Supply Commercial & Institutional	0	3	4	7	0	0	1
Self-Supply Irrigation	0	48	178	226	0	0	204
Self-Supply Livestock	0	29	9	38	0	0	1
Self-Supply Industrial	310	268	77	654	0	0	65
Self-Supply Thermoelectric Power Production (Once-through cooling)	6,580	1,038	1	7,619	0	0	44
Self-Supply Thermoelectric Power Production (Recirculated cooling)	174	4	2	180	0	0	33
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	0	1	7	9	0	0	0
Total	7,906	1,406	471	9,783	0	0	478

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 13b. Michigan 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	3,184	60	728	3,972	2	0	497
Self-Supply Commercial & Institutional	0	11	17	28	0	0	4
Self-Supply Irrigation	1	182	673	856	0	0	771
Self-Supply Livestock	0	111	33	144	0	0	3
Self-Supply Industrial	1,172	1,013	292	2,476	0	0	248
Self-Supply Thermoelectric Power Production (Once-through cooling)	24,907	3,928	5	28,841	0	0	165
Self-Supply Thermoelectric Power Production (Recirculated cooling)	660	13	9	682	0	0	123
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	2	4	27	32	0	0	0
Total	29,926	5,323	1,783	37,032	2	0	1,810

In millions of liters per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Minnesota

The Minnesota part of the Lake Superior watershed encompasses approximately 6,200 square miles. Major river watersheds in the basin include the Cloquet, Nemadji and St. Louis River systems, as well as the north shore tributaries to Lake Superior.[9]

Excluding in-stream hydroelectric water use (2,186 mgd or 8,274 mld), the total withdrawal amount from the Basin for Minnesota was 1771 mgd (6,703 mld), an increase of 210 percent from the total withdrawal amount for 2014 (571 mgd or 2,161 mld). This is explained by off-stream hydroelectric power production sector withdrawing a total amount of 1227 mgd (4,644 mld) compared to 15 mgd (57 mld) in 2014, which is an increase of 1212 mgd (4,587 mld). Other major water use sectors include industrial at 210 mgd (794 mld) and thermoelectric power production, once-through cooling at 296 mgd (1,119 mld). In 2014, these water use sectors were about equally supplied by Lake Superior and other surface water within the Lake Superior watershed. In 2015, 82 percent of total withdrawals (1453 mgd or 5,502 mld) came from other surface water within the Lake Superior watershed, 18 percent or 311 mgd (1,176 mld) came from Lake Superior. This change is explained by the off-stream hydroelectric power production sector withdrawing exclusively from other surface water within the watershed.

The total reported diversion amount of 13 mgd (48 mld) was for industrial purposes. Total consumptive use was 31 mgd (118 mld), which has decreased by 1 mgd (4 mld) every year since 2013. The majority of that amount (21 mgd or 79 mld) was for industrial purposes.

The water use data was provided by the Minnesota Department of Natural Resources which collected measured water use data from water withdrawal permit holders with a 100 percent reporting compliance from permitted water withdrawal facilities.

Notable changes in 2015 water use by Minnesota facilities include:

- A 1.3 percent reduction in withdrawals for self-supply thermoelectric cooling as two plants are converted to new fuels; and,
- An increase of 1,212 mgd (4,587 mld) in withdrawals for off-stream hydroelectric supply as a facility came back online after being disabled by flooding for substantially all of 2014

[9] Minnesota Pollution Control Agency. 2013. http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/basins/lake-superior-basin/index.html

Table 14a. Minnesota 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	29	2	6	37	0	0	4
Self-Supply Commercial & Institutional	1	1	0	1	0	0	0
Self-Supply Irrigation	0	0	0	0	0	0	0
Self-Supply Livestock	1	0	0	1	0	0	1
Self-Supply Industrial	123	87	0	210	0	13	21
Self-Supply Thermoelectric Power Production (Once-through cooling)	158	138	0	296	0	0	6
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	1,227	0	1,227	0	0	0
In-Stream Hydroelectric Water Use	0	2,186	0	2,186	0	0	0
Other Self Supply	0	0	0	0	0	0	0
Total	311	3,639	7	3,957	0	13	31

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 14b. Minnesota 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	110	6	23	138	0	0	14
Self-Supply Commercial & Institutional	3	2	0	5	0	0	0
Self-Supply Irrigation	0	0	0	0	0	0	0
Self-Supply Livestock	3	0	0	3	0	0	2
Self-Supply Industrial	464	328	2	794	0	48	79
Self-Supply Thermoelectric Power Production (Once-through cooling)	597	522	0	1,119	0	0	22
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	4,644	0	4,644	0	0	0
In-Stream Hydroelectric Water Use	0	8,274	0	8,274	0	0	0
Other Self Supply	0	0	0	0	0	0	0
Total	1,176	13,776	25	14,977	0	48	118

In millions of liters per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

New York

Approximately 80 percent of New York State's fresh surface water, over 700 miles of shoreline and nearly 48 percent of New York lands are contained in the drainage watersheds of Lake Erie, Lake Ontario and the St. Lawrence River, which includes the Lake Champlain/Lake George watersheds. More than four million New Yorkers depend on the fresh water of these watersheds for drinking water, and hundreds of miles of waterways and border waters for navigation.[10]

Excluding in-stream hydroelectric water use (210,375 mgd or 796,356 mld), the total withdrawal amount from the Basin for New York was 3,667 mgd (13,882 mld), a 0.5 percent decrease from 2014 (3,686 mgd or 13,953 mld). The Lake Ontario watershed was the source of the majority of New York's water withdrawals at 2,953 mgd (11,177 mld) or 81 percent of the total withdrawal amount. Thermoelectric power production (both once-through and recirculated cooling) at 1,966 mgd (7,440 mld) represented 54 percent of the total withdrawal amount; public water supply (491 mgd or 1,859 mld) represented nearly 13 percent of the total; and industrial (327 mgd or 1,238 mld) represented 9 percent of the total. For the Lake Erie and Lake Ontario watersheds, Great Lakes surface water was the primary source of water, when in-stream hydroelectric is excluded. For the St. Lawrence River watershed, other surface water was the primary source of water, when in-stream hydroelectric is excluded.

The 2015 total diversion amount for New York was 45 mgd (169 mld) of which 13 mgd (48 mld) was for public supply and 32 mgd (121 mld) for other self-supply purposes. The total consumptive use amount was 241 mgd (914 mld). The largest consumptive use was attributed to industrial purposes at 67 mgd (253 mld).

The water use data was provided by the New York State Department of Environmental Conservation. The data collected was metered and estimated water use. Reporting compliance varies among the water use sectors from 91 percent for the irrigation sector to 100 percent for the hydroelectric power sector. New York State does not estimate the water use for facilities that did not report their use. New York's 5-year implementation of permits for water withdrawal will be completed during 2017. These permits include a requirement to report use, which should support continuing improvement in compliance.

[10] Great Lakes Basin Advisory Council. 2013. Our Great Lakes Water Resources: Conserving and Protecting Our Water Today for Use Tomorrow Final Report. http://www.dec.ny.gov/docs/regions_pdf/glbacfrpt.pdf

Table 15a. New York 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	306	168	17	491	0	13	60
Self-Supply Commercial & Institutional	0	43	1	44	0	0	8
Self-Supply Irrigation	0	19	2	21	0	0	19
Self-Supply Livestock	0	24	1	25	0	0	3
Self-Supply Industrial	162	160	5	327	0	0	67
Self-Supply Thermoelectric Power Production (Once-through cooling)	1,416	144	0	1,560	0	0	31
Self-Supply Thermoelectric Power Production (Recirculated cooling)	405	0	0	405	0	0	20
Off-Stream Hydroelectric Power Production	0	45	0	45	0	0	0
In-Stream Hydroelectric Water Use	129,467	80,908	0	210,375	0	0	0
Other Self Supply	0	747	1	748	0	32	33
Total	131,756	82,259	27	214,042	0	45	241

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 15b. New York 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	1,159	636	64	1,859	0	48	229
Self-Supply Commercial & Institutional	0	164	4	168	0	0	31
Self-Supply Irrigation	1	71	6	78	0	0	70
Self-Supply Livestock	0	89	5	95	0	0	13
Self-Supply Industrial	613	606	20	1,238	0	0	253
Self-Supply Thermoelectric Power Production (Once-through cooling)	5,360	545	1	5,906	0	0	118
Self-Supply Thermoelectric Power Production (Recirculated cooling)	1,533	1	0	1,535	0	0	77
Off-Stream Hydroelectric Power Production	0	170	0	170	0	0	0
In-Stream Hydroelectric Water Use	490,086	306,270	0	796,356	0	0	0
Other Self Supply	0	2,829	4	2,833	0	121	123
Total	498,751	311,383	104	810,238	0	169	914

In millions of liters per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Ohio

Ohio's portion of the Lake Erie watershed drains 11,649 square miles and is home to 4.65 million people. Ohio's 312 mile-long shoreline includes the cities of Toledo, Sandusky and Cleveland. Agricultural row crops account for 59 percent of the land use in the Ohio watersheds draining to Lake Erie, followed by urban residential and commercial land use at a combined 16 percent. Another 16 percent are forested lands and wetlands, and pasture land makes up another 5 percent of total land use.[11]

The 2015 total reported withdrawal amount from the Basin for Ohio was 1,739 mgd (6,582 mld), a 7 percent decrease from the total withdrawal amount for 2014 (1,875 mgd or 7,098 mld). Primary water use sectors included thermoelectric power production (once-through and recirculated cooling) at 956 mgd (3,620 mld), representing 55 percent of total withdrawal amount; public water supply (517 mgd or 1,957 mld), representing 30 percent; and industrial (224 mgd or 849 mld), representing 13 percent. The source for 70 percent of the total withdrawal amount was Lake Erie. However, within the irrigation and industrial water use sectors, other surface water was the primary source at 91 percent and 52 percent of the total withdrawal amount, respectively.

Overall, 13 mgd (51 mld) was diverted out of the Lake Erie watershed, all for public water supply purposes. This diversion quantity is reported in Tables 16a and 16b, below. It should be noted 12 mgd (44 mld) of this diversion was returned to the watershed after use. Outgoing diversions were offset by incoming diversions totaling 23 mgd (87 mld), primarily for other self-supply purposes, resulting in a net diversion of 10 mgd (37 mld) into the Lake Erie watershed. Total consumptive use was 133 mgd (502 mld). Fifty-nine percent of the total consumptive use was attributed to the public water supply sector.

The water use data was provided by the Ohio Department of Natural Resources, Division of Water Resources with a 100 percent reporting compliance from every water use sector.

Notable changes in 2015 water use by Ohio facilities include:

- A 19 percent reduction in water use for Self-Supply Thermoelectric Power Production (Once-through cooling) from Lake Erie surface water due to lower demand for energy.

[11] Ohio Environmental Protection Agency. 2010. Ohio Lake Erie Phosphorus Task Force Final Report. http://www.epa.ohio.gov/portals/35/lakeerie/ptaskforce/Task_Force_Final_Report_April_2010.pdf

Table 16a. Ohio 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	388	101	27	517	0	13	78
Self-Supply Commercial & Institutional	0	0	0	0	0	0	0
Self-Supply Irrigation	0	26	2	28	0	0	25
Self-Supply Livestock	0	0	1	1	0	0	0
Self-Supply Industrial	55	117	52	224	0	0	4
Self-Supply Thermoelectric Power Production (Once-through cooling)	656	180	0	836	0	0	8
Self-Supply Thermoelectric Power Production (Recirculated cooling)	120	0	0	120	0	0	12
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	2	8	1	12	0	-23	5
Total	1,223	432	83	1,739	0	-10	133

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

**No data was provided for this sector.*

Table 16b. Ohio 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	1,470	384	103	1,957	0	51	294
Self-Supply Commercial & Institutional	1	0	0	1	0	0	0
Self-Supply Irrigation	2	97	8	106	0	0	96
Self-Supply Livestock	0	0	2	2	0	-1	2
Self-Supply Industrial	208	443	198	849	0	0	17
Self-Supply Thermoelectric Power Production (Once-through cooling)	2,485	681	0	3,166	0	0	32
Self-Supply Thermoelectric Power Production (Recirculated cooling)	454	0	0	454	0	0	45
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	9	32	5	46	0	-87	17
Total	4,629	1,636	316	6,581	0	-37	502

In millions of liters per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

**No data was provided for this sector.*

Ontario

More than 98 percent of Ontario residents (more than 12 million people) live within the Great Lakes-St. Lawrence River Basin. Most live along the coast in eight of Canada's 20 largest cities, which include Toronto, Hamilton, Windsor and Sarnia.[12] Ontario's portion of the Great Lakes forms the longest freshwater coastline in the world stretching more than 6,800 miles (11,000 kilometers)[13] across five major watersheds in the Great Lakes-St. Lawrence River system: Lake Superior, Lake Huron, Lake Erie, Lake Ontario and the St. Lawrence River watersheds.

Excluding in-stream hydroelectric water use (reported amount of 235,102 mgd or 889,960 mld), the total water withdrawal amount from the Basin was approximately 16,835 mgd (63,729 mld). The three largest water use categories were thermoelectric power (once-through cooling) at 14,347 mgd (54,309 mld) or 85 percent of the total withdrawal amount; public supply at 1,160 mgd (4,389 mld); and industrial at 1,091 mgd (4,131 mld). Except for the Lake Superior and St. Lawrence River watersheds, where other surface water was the primary source for withdrawals, the primary source for withdrawals came from Great Lakes surface water.

No diversions out of the Great Lakes-St. Lawrence River Basin were reported for Ontario, while diversions into the basin were approximately 4,068 mgd (15,401 mld). The total consumptive use amount was approximately 357 mgd (1,352 mld). Three water use sectors, representing the largest consumptive uses, included thermoelectric power at 129 mgd (489 mld), public water supply at 139 mgd (527 mld) and industrial at 77 mgd (290 mld). Ontario reported intrabasin diversions totaling 5,449 mgd (20,628 mld).

These data were provided collaboratively by the Ontario Ministry of Natural Resources and Forestry and the Ontario Ministry of Environment and Climate Change, and were collected primarily through the provincial water taking and reporting system. Additional estimates were provided by water use sector to capture water use that was not reported. Reporting data varied among water use sectors from 88 percent for the industrial sector to 100 percent for thermoelectric power production (once-through cooling).

Notable changes in 2015 water use by Ontario facilities include:

- A relatively large (93 percent) reduction in self-supply industrial water use Lake Huron surface water primarily attributed to reduced pumping days of a larger facility
- Reclassification of a facility withdrawing approximately 100 mgd (379 mld) from instream hydroelectric power to self-supply industrial use

[12] Ontario Ministry of Natural Resources. 2012. http://www.mnr.gov.on.ca/en/Business/GreatLakes/2ColumnSubPage/STEL02_173888.html
[13] Ontario Ministry of the Environment. 2012, http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_096933.pdf

Table 17a. Ontario 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	870	222	67	1,160	4	0	139
Self-Supply Commercial & Institutional	56	5	2	63	0	0	9
Self-Supply Irrigation	1	2	0	3	0	0	2
Self-Supply Livestock	0	26	24	50	0	0	0
Self-Supply Industrial	731	264	97	1,091	0	0	77
Self-Supply Thermoelectric Power Production (Once-through cooling)	13,587	759	0	14,347	0	0	129
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	118,114	116,988	0	235,102	0	-4,068	0
Other Self Supply	1	119	2	122	0	0	0
Total	133,361	118,385	192	251,938	4	-4,068	357

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 17b. Ontario 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	3,293	842	255	4,389	14	0	527
Self-Supply Commercial & Institutional	214	19	6	238	0	0	35
Self-Supply Irrigation	4	6	0	10	0	0	9
Self-Supply Livestock	0	97	91	189	0	0	2
Self-Supply Industrial	2,765	998	367	4,131	0	0	290
Self-Supply Thermoelectric Power Production (Once-through cooling)	51,434	2,875	0	54,309	0	0	489
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	447,111	442,848	0	889,960	0	-15,401	0
Other Self Supply	5	451	7	463	0	0	0
Total	504,827	448,136	726	953,688	14	-15,401	1,352

In millions of liters per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Pennsylvania

The Pennsylvania Lake Erie watershed spans 508 square miles. The largest land uses in Pennsylvania's portion of the Basin are agriculture and forest.[14] While it is the smallest watershed in the state, it is home to more than 240,000 people concentrated along the 76.6 miles of Lake Erie coastline.

The total withdrawal amount from the Basin for Pennsylvania was 36 mgd (135 mld). The majority (30 mgd or 115 mld or 83 percent of the total withdrawal amount) was used for public water supply purposes.

No diversions were reported in 2015. The total consumptive use was 4 mgd (14 mld). The public water supply sector made up the vast majority (85 percent) of the total consumptive use amount compared to 51 percent in 2014.

The water use data were provided by the Pennsylvania Department of Environmental Protection (DEP). Reporting compliance varied among water use sectors from 67 percent for the irrigation sector to 100 percent for the self-supply commercial and institutional sector. Pennsylvania DEP did not include estimated water use for the facilities that failed to report their water use to the state.

Table 19a. Pennsylvania 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	29	0	2	30	0	0	3
Self-Supply Commercial & Institutional	0	0	0	0	0	0	0
Self-Supply Irrigation	0	0	0	0	0	0	0
Self-Supply Livestock	0	1	1	2	0	0	0
Self-Supply Industrial	3	0	0	3	0	0	0
Self-Supply Thermoelectric Power Production (Once-through cooling)	0	0	0	0	0	0	0
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	0	0	0	0	0	0	0
Total	32	1	3	36	0	0	4

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

[14] Email communications with David Skellie, Pennsylvania Sea Grant. 2013.

Table 19b. Pennsylvania 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	109	0	6	115	0	0	12
Self-Supply Commercial & Institutional	0	0	0	0	0	0	0
Self-Supply Irrigation	0	1	0	1	0	0	1
Self-Supply Livestock	0	5	3	8	0	0	0
Self-Supply Industrial	11	0	0	11	0	0	1
Self-Supply Thermoelectric Power Production (Once-through cooling)	0	0	0	0	0	0	0
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	0	0	0	0	0	0	0
Total	120	5	10	135	0	0	14

In millions of liters per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Québec

The majority of Québec's population lives in the Great-Lakes St. Lawrence River watershed. The portion of the St. Lawrence River included in the Great Lakes – St. Lawrence Basin Agreement territory includes the Montreal metropolitan area that represents nearly 50 percent of Québec's population. Some of the tributaries with the greatest flow within that portion are the Outaouais (Ottawa) River, the Richelieu River and the St. François River.

The total withdrawal amount from the Basin for Québec was 1,232 mgd (4,662 mld) – a 3 percent decrease from the 2014 withdrawal total of 1,270 mgd (4,806 mld). The majority (72 percent) of this amount was used for public water supply purposes at 889 mgd (3,366 mld). The next major water use, industrial sector, made up a quarter of the total withdrawals at 308 mgd (1,165 mld).

The total diversion amount was 3 mgd (12 mld) for public supply purposes. The total consumptive use amount was 383 mgd (1,451 mld), representing 31 percent of the total withdrawal amount. The primary water use sectors contributing to the total consumptive use were public supply at 256 mgd (970 mld) and industrial at 115 mgd (434 mld).

Starting with 2012 water use data, the province of Québec began its water use data collection program which gathers estimated or metered water use data reported by water users. Being rather new, this program has made progress in identifying and correcting reporting errors, and increasing reporting compliance for all the water use sectors. Québec will begin to collect water use reports from the irrigation (agricultural users) and livestock users in 2016. Therefore, the 2015 data for this sector should be considered as incomplete and unrepresentative of this water use sector in Québec.

Table 20a. Québec 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	638	206	45	889	0	3	256
Self-Supply Commercial & Institutional	0	3	1	4	0	0	2
Self-Supply Irrigation	0	4	1	5	0	0	4
Self-Supply Livestock	0	8	2	9	0	0	0
Self-Supply Industrial	131	156	20	308	0	0	115
Self-Supply Thermoelectric Power Production (Once-through cooling)	0	0	0	0	0	0	0
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	13	3	0	16	0	0	6
Total	782	381	68	1,232	0	3	383

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 20b. Québec 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	2,414	781	171	3,366	0	12	970
Self-Supply Commercial & Institutional	0	11	2	14	0	0	8
Self-Supply Irrigation	1	17	3	20	0	0	15
Self-Supply Livestock	0	30	6	36	0	0	0
Self-Supply Industrial	497	592	75	1,165	0	0	434
Self-Supply Thermoelectric Power Production (Once-through cooling)	0	0	0	0	0	0	0
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	47	13	1	61	0	0	24
Total	2,960	1,444	258	4,662	0	12	1,451

In millions of liters per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Wisconsin

About 10,000 square miles of Lakes Michigan and Superior lie within Wisconsin's borders.[15] The state has more than 1,000 miles of Great Lakes shoreline and more than 20 percent of the state's land area lies within the Basin where half the population of the state also lives. More than 1.6 million Wisconsin citizens get their drinking water from Lake Michigan or Lake Superior.[16]

The total reported water withdrawal amount from the Basin for Wisconsin was 4,185 mgd (15,843 mld), a six percent increase from the 2014 water withdrawal total of 3,965 mgd (15,009 mld). The majority (99 percent) of the withdrawals came from the Lake Michigan watershed. The primary water use sectors were thermoelectric power production (once-through and recirculated cooling) at 3,726 mgd or 14,104 mld (89 percent of the total withdrawal amount), public water supply at 276 mgd (1,044 mld), and industrial at 109 mgd (414 mld).

The total reported diversion was 20 mgd (76 mld) from the Lake Michigan watershed, mainly for thermoelectric power production (recirculated cooling) purposes. The total consumptive use was 294 mgd (1,114 mld), which decreased by 17 percent from last year's 356 mgd (1,348 mld) total consumptive use. This difference is explained by a decrease in the amount of water used by facilities in the self-supply thermoelectric power production sectors from one year to the other. The primary consumptive uses came from the thermoelectric power (216 mgd or 817 mld), irrigation (27 mgd or 102 mld) and public water supply (33 mgd or 125 mld) sectors.

The water use data were provided by the Wisconsin Department of Natural Resources. Reporting compliance varied among water use sectors from 94 percent for the industrial sector to 100 percent for the public supply sector. Data was not estimated for the facilities that did not report water use.

Table 21a. Wisconsin 2015 Water Use Data Summary in mgd

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	205	21	49	276	0	6	33
Self-Supply Commercial & Institutional	1	0	2	3	0	0	0
Self-Supply Irrigation	0	3	36	38	0	0	27
Self-Supply Livestock	0	15	15	30	0	0	5
Self-Supply Industrial	0	94	15	109	0	0	14
Self-Supply Thermoelectric Power Production (Once-through cooling)	3,189	234	0	3,423	0	0	34
Self-Supply Thermoelectric Power Production (Recirculated cooling)	303	0	0	303	0	14	182
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	0	1	1	3	0	0	0
Total	3,698	370	118	4,185	0	20	294

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

[15] Wisconsin Sea Grant. 2013. http://seagrant.wisc.edu/Home/AboutUsSection/PressRoom/Details.aspx?PostID=796
[16] Wisconsin Department of Natural Resources. 2013. http://dnr.wi.gov/topic/greatlakes/learn.html

Table 21b. Wisconsin 2015 Water Use Data Summary in mld

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	778	81	185	1,044	0	24	125
Self-Supply Commercial & Institutional	2	1	8	11	0	0	1
Self-Supply Irrigation	0	10	136	146	0	0	102
Self-Supply Livestock	0	58	56	114	0	0	18
Self-Supply Industrial	1	357	56	414	0	0	51
Self-Supply Thermoelectric Power Production (Once-through cooling)	12,071	887	0	12,958	0	0	130
Self-Supply Thermoelectric Power Production (Recirculated cooling)	1,146	0	0	1,146	0	51	687
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	0	5	5	10	0	0	0
Total	13,998	1,399	446	15,843	0	76	1,114

In millions of liters per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Appendices

Appendix A. General Definitions from the Compact and Agreement

Basin or Great Lakes-St. Lawrence River Basin means the watershed of the Great Lakes and the St. Lawrence River upstream from Trois-Rivières, Québec.

Consumptive Use means that portion of the water withdrawn or withheld from the basin that is lost or otherwise not returned to the basin due to evaporation, incorporation into products or other processes.

Diversion means a transfer of water from the basin into another watershed, or from the watershed of one of the Great Lakes into that of another by any means of transfer, including but not limited to a pipeline, canal, tunnel, aqueduct, channel, modification of the direction of a water course, a tanker ship, tanker truck or rail tanker but does not apply to water that is used in the basin or a Great Lake watershed to manufacture or produce a product that is then transferred out of the basin or watershed.

Divert has a corresponding meaning.

Withdrawal means the taking of water from surface water or groundwater.

Source Watershed means the watershed from which a withdrawal originates. If water is withdrawn directly from a Great Lake or from the St. Lawrence River, then the Source Watershed shall be considered to be the watershed of that Great Lake or the watershed of the St. Lawrence River, respectively. If water is withdrawn from the watershed of a stream that is a direct tributary to a Great Lake or a direct tributary to the St. Lawrence River, then the Source Watershed shall be considered to be the watershed of that Great Lake or the watershed of the St. Lawrence River, respectively, with a preference to the direct tributary stream watershed from which it was withdrawn.

Appendix B. Water Use Sector Definitions

Public Water Supply

Water distributed to the public through a physically connected system of treatment, storage and distribution facilities serving a group of largely residential customers that may also serve industrial, commercial and other institutional operators. Water withdrawn directly from the basin and not through such a system shall not be considered to be used for Public Water Supply purposes.

Self-Supply Commercial and Institutional

Commercial uses include water used by motels, hotels, restaurants, office buildings and institutions, both civilian and military. This category also includes water for mobile homes, hospitals, schools, air conditioning and other similar uses not covered under a public supply. In addition, this category includes amusement and recreational water uses such as snowmaking and water slides.

Self-Supply Irrigation

Water artificially applied on lands to assist in the growing of crops and pastures or in the maintenance of recreational lands, such as parks and golf courses.

Self-Supply Livestock

Water used by animals such as horses, cattle, sheep, goats, hogs and poultry. Water used in fish hatchery operations is also included under this category.

Self-Supply Industrial

Industrial water includes water used in the manufacture of metals, chemicals, paper, food and beverage and other products. Mining water use includes water used in the extraction or washing of minerals, for example solids, such as coal and ores, and liquids such as crude petroleum and natural gas. Water used in quarrying and milling is also included in the industrial category. Brine extraction from oil and gas operations is not included. Withdrawals and consumptive uses for industrial and mining purposes (including dewatering operations) recorded under another category (e.g., public supply) will not be recorded here. Once initially reported, water used in a closed cycle (recirculation) will not be reported as a withdrawal. "Make-up water[17]" will be reported once upon entering the system. Other situations should be evaluated on a case-by-case basis.

Self-Supply Thermoelectric Power Production (Once-through cooling)

Withdrawals and consumptive uses already recorded under another category (e.g., public supply) will not be reported here.

Self-Supply Thermoelectric Power Production (Recirculated cooling)

Withdrawals and consumptive uses already recorded under another category (e.g., public supply) will not be reported here. Once initially reported, water used in a closed cycle (recirculation) will not be reported as a withdrawal. "Make-up water" will be reported once upon entering the system.

[17] For industrial boiler systems, make-up water is the raw water, softened water or demineralized water required for steam generation. http://www.pdhcenter.com/courses/m165/m165content.pdf

Off-Stream Hydroelectric Power Production

Water removed from a stream channel and used to drive turbines that generate electric power. This category also includes "off-stream use" for pumped-storage systems [e.g., reservoir storage] that return water to the source.

In-Stream Hydroelectric Water Use

This category includes "run of the river" use, which is not considered a water withdrawal or consumptive use. Reporting for this category is voluntary.

Other Self Supply

Water used for purposes not reported in categories 1-9. Examples include, but are not limited to, withdrawals for fish/wildlife, environmental, navigation and water quality purposes. Specifically, water used to maintain levels for navigation, for fish and wildlife habitat creation and enhancement (excluding fish hatchery operations included in category four), for flow augmentation (or diversion), for sanitation, pollution confinement, and other water quality purposes, and agricultural activities (services) other than those directly related to irrigation.

Appendix C. Interim Cumulative Impact Assessment

Executive Summary

This interim cumulative impact assessment, as part of the 2015 Annual Water Use Report, covers the years 2014 and 2015. It is considered interim assessment and is the fourth in a series of cumulative impact assessments for the Great Lakes and St. Lawrence River basin (Basin).

1. *Cumulative Impact Assessment of Withdrawals, Consumptive Uses and Diversions*, published in 2013, covered 2006 to 2010 (2006-2010 Cumulative Impact Assessment).
2. *Interim Cumulative Impact Assessment of the 2013 Annual Water Use Report*, published in 2014, compared the years 2011 and 2012 (2011-2012 Interim Assessment).
3. *Interim Cumulative Impact Assessment of the 2014 Annual Water Use Report* published in 2015, compared the years 2013 and 2014 (2013- 2014 Interim Assessment).
4. *Interim Cumulative Impact Assessment of the 2015 Annual Water Use Report*, provided in this report (this interim assessment), covers the years 2014 and 2015.

These cumulative impact assessments fulfill the requirements of the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement and the companion Great Lakes-St. Lawrence River Basin Water Resources Compact. While the 2006-2010 Cumulative Impact Assessment was the first full assessment covering a five-year period, the subsequent, interim cumulative impact assessments have been prepared to track annual water loss to the Basin between full cumulative impact assessments. Water loss is defined as consumptive uses and diversions less return flow. It reflects water not being returned to the source watershed. A Cumulative Impact Assessment covering the years 2011-2015 will be developed by the Conference of Great Lakes and St. Lawrence Governors and Premiers following the publication of this report.

The approach used for this interim assessment is similar to that of the 2006-2010 Cumulative Impact Assessment. The analysis focuses on the hydrologic effects of consumptive uses and diversions on water supply and flow at the watershed (i.e., lake basin) scale as well as for the entire Basin.

For comparative purposes, longer data sets for flows, covering the period from 1948 to 2010, were presented to provide a historical context for the assessment. The Basin water budget was used to account for the water flows into and out of the Basin as outlined below.

1. *Accounting for Inflows*
   The inflows included precipitation on the surface of the Great Lakes, surface water runoff to the Great Lakes or the St. Lawrence River, diversions, and connecting channel flows into each of the Great Lakes or the St. Lawrence River, except for Lake Superior which is the headwater to the system.

2. *Accounting for Outflows*
   Outflows included evaporation from the surface of the Great Lakes, diversions from some Lake watersheds, connecting channel flows out of each of the Lakes, and consumptive uses. The St. Lawrence River is the outflow for Lake Ontario and for the entire Basin.

3. *Hydrologic Effect Assessment*
   Although withdrawals are a component of the water budget, the 2006-2010 Cumulative Impact Assessment considered only the hydrologic effect of consumptive uses and diversions. The hydrologic effect is defined as the consumptive uses plus net diversions. Consumptive use is

defined as the portion of water withdrawn but not returned due to evaporation, incorporation into products, and other processes.

The following observations were made in the 2006-2010 Cumulative Impact Assessment:

- *Diversions and consumptive use were very small relative to inflows.*
  The cumulative hydrologic effect of consumptive uses and diversions were small relative to inflows. While inflows fluctuated from 2006-2010, the cumulative hydrologic effect of consumptive uses and diversions was fairly constant for this time period. The net effect of consumptive uses and diversions was positive for the Basin's water budget. In other words, more water was diverted into the Basin than the total combined amount of water diverted out of the Basin or withdrawn and not returned.
- *The uncertainty associated with estimated inflow and outflow data was significantly larger than total consumptive use for the Basin.*
  It is difficult to assess the cumulative impact of diversions and consumptive uses apart from the natural variability of inflows and outflows of the Great Lakes-St. Lawrence River system. Uncertainty in the Basin water budget components was more than twelve and a half times the total reported consumptive uses in 2008.To illustrate, total runoff to the Basin in 2008 was 259,888 cubic feet per second (cfs). Assuming a 15 percent uncertainty, the amount of calculated runoff may be off by over 38,000 cfs. In comparison, consumptive use in 2008 was only 3,016 cfs. As a result of this, the hydrologic effects of consumptive uses on flows and water levels are difficult to discern relative to uncertainties in the natural inflows and outflows.

The 2006-2010 Cumulative Impact Assessment includes detailed information on the definitions, methodology, assumptions, uncertainty, data sources used as well as specific factors affecting each watershed. Refer to that assessment for clarification of the methods used in this assessment. The full report, *Cumulative Impact Assessment of Withdrawals, Consumptive Uses and Diversions, 2006-2010,* is available at http://glslregionalbody.org/ or http://www.glslcompactcouncil.org/.

The most recent data submitted to the Great Lakes-St. Lawrence Regional Water Use Database indicate a reported increase in incremental water losses[18] to the Basin between 2012 to 2013 of 857 cubic feet per second [cfs]. From 2013 to 2014, the total reported water loss for Basin decreased by 581 cfs. In 2015, we reported a total water gain of 830 cfs, a positive variation of 1010 cfs compared to 2014, where we reported water loss of 180 cfs. A more detailed description of these variations for 2014 and 2015 are provided in the diversion and consumptive uses section of the 2015 Annual Water Use Report.

For this interim assessment, the following observations are made:

- For 2015, more water entered the Basin than left (from consumptive uses and outgoing diversions) the Basin from incoming diversions. This contrasts with 2014 where more water left the Basin than entered the Basin.
- For 2014 and 2015, diversions and consumptive uses remained very small relative to inflows. For example, diversions and consumptive uses reported for the Lake Superior watershed in 2015 made up 5.1 percent of the average total inflows (from 1948-2010) into the watershed. For the Lake Michigan-Huron watershed in 2015, diversions and consumptive uses made up 1.2 percent of the average total inflows into the watershed over this same period.

[18] Incremental water loss is defined as new or increased outgoing diversions plus consumptive uses.

Approach

Similar to the approach of previous assessments, this interim assessment focuses on the hydrologic effects of consumptive uses and diversions on water supply and flow at watershed and Basin scales. These hydrologic effects are presented in the context of watershed and Basin water budgets. The analysis focuses on the consumptive uses and diversions components of the water budget, instead of describing and analyzing all components of the water budget. Annual estimates of inflows and outflows are not provided for the years 2012, 2013, 2014 and 2015. Supplemental inflow data presented as a 62-year average (1948-2010) in the 2006-2010 Cumulative Impact Assessment are provided for each watershed and the Basin for comparative purposes.

Following standard scientific procedures, inflows are presented as positive numbers and outflows and consumptive uses are presented as negative numbers. This convention is used to help relate different flows to one another and to supply. It is not intended to communicate the effect of these flows on the Basin. All flows are given in cubic feet per second (cfs). The reader should note that, for readability, the body of the Annual Report follows a different convention.

Great Lakes-St. Lawrence River Basin

Figure 1 shows diversions and consumptive uses for the Basin by year for 2012-2015. Net diversions are shown as positive (or incoming) flows into the Basin, mainly due to the Long Lac and Ogoki diversions which divert water from the Hudson Bay watershed into Lake Superior for power generation purposes. These diversions have offset the consumptive uses (displayed as negative numbers in Figure 2) and outgoing diversions.

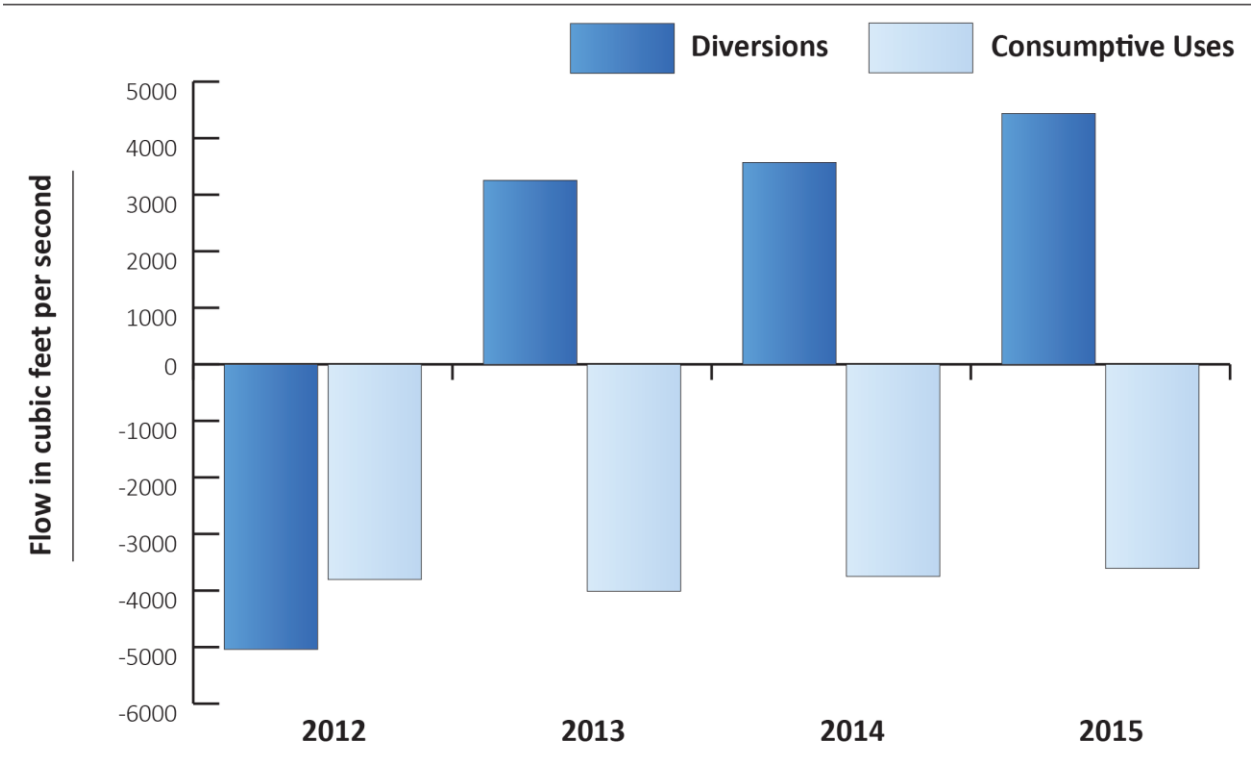

Figure 1. Diversions and Consumptive Uses for the Great Lakes – St. Lawrence Basin

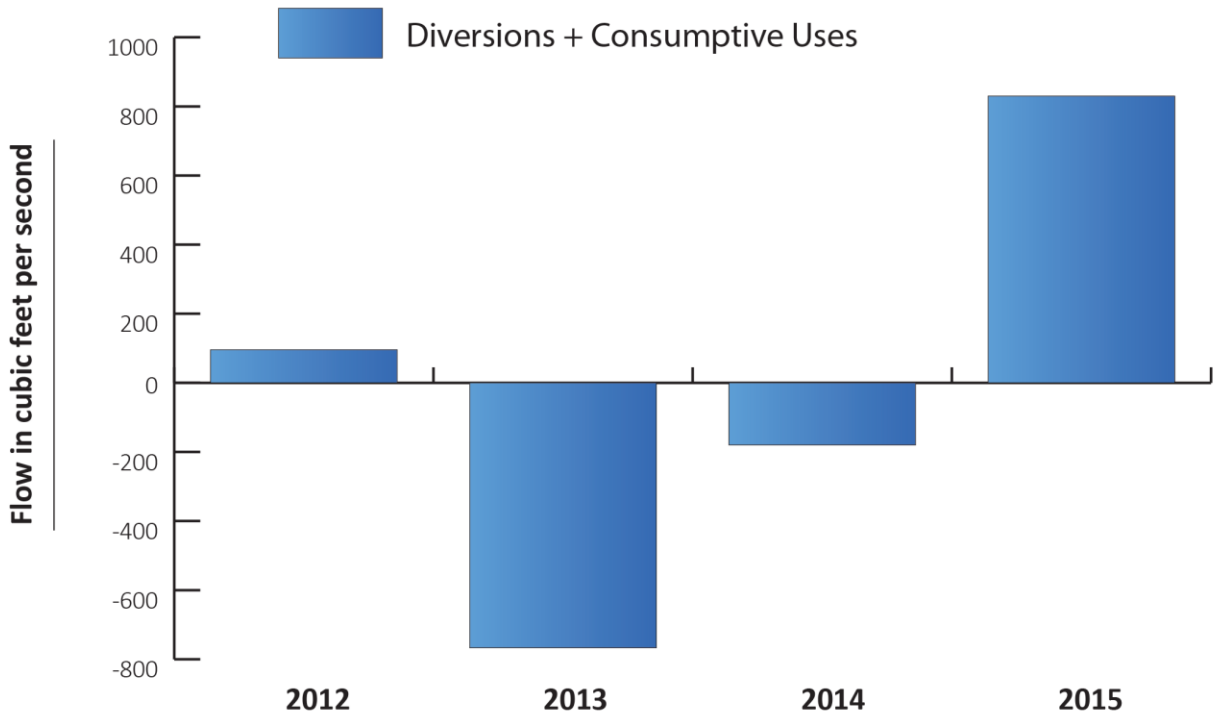

Figure 2. Net Diversions and Consumptive Uses for the Great Lakes – St. Lawrence River Basin.

The numbers in Table A below (presented graphically in Figure 2), indicate for the Basin the cumulative hydrologic effect of consumptive uses and diversions (annual averages) are small relative to inflows (runoff plus precipitation). In general, the cumulative hydrologic effect of consumptive uses and diversions has fluctuated for 2012-2015. Between the years 2012 to 2013 consumptive uses and diversions increased by 857 cfs (96 cfs to -761 cfs). From 2013 to 2014, consumptive uses and diversions for Basin decreased by 581 cfs (from -761 cfs to -180 cfs). From 2014 to 2015, consumptive uses and diversions increased by 1,010 cfs (from -180 cfs to 830 cfs).

For 2012, the net effect of consumptive uses and diversions was positive for the Basin. In other words, more water was diverted into the Basin than the total combined amount of water diverted out of the Basin or withdrawn and not returned. In 2013 and 2014 the net effect of consumptive uses and diversions was negative for the Basin. More water was consumptively used or diverted out of the Basin than the total combined amount of water diverted into the Basin. In 2015, the net effect of consumptive uses and diversions was positive again.

Year	Runoff + Precipitation	Consumptive Uses + Diversions
2012	434,161*	96
2013	434,161*	-761
2014	434,161*	-180
2015	434,161*	830

Table A. Water budget values in cubic feet per second for the Great Lakes-St. Lawrence River Basin, 2012-2015.
*62-year flow average

Lake Superior Watershed

The data in Figure 3 and Table B summarize the hydrologic effects of consumptive uses and diversions for the Lake Superior watershed water budget. For purposes of comparison, Figure 3 depicts all components of the water budget (e.g., runoff, precipitation, evaporation and the flow of the St. Marys River) using the annual average for the years 1948-2010.

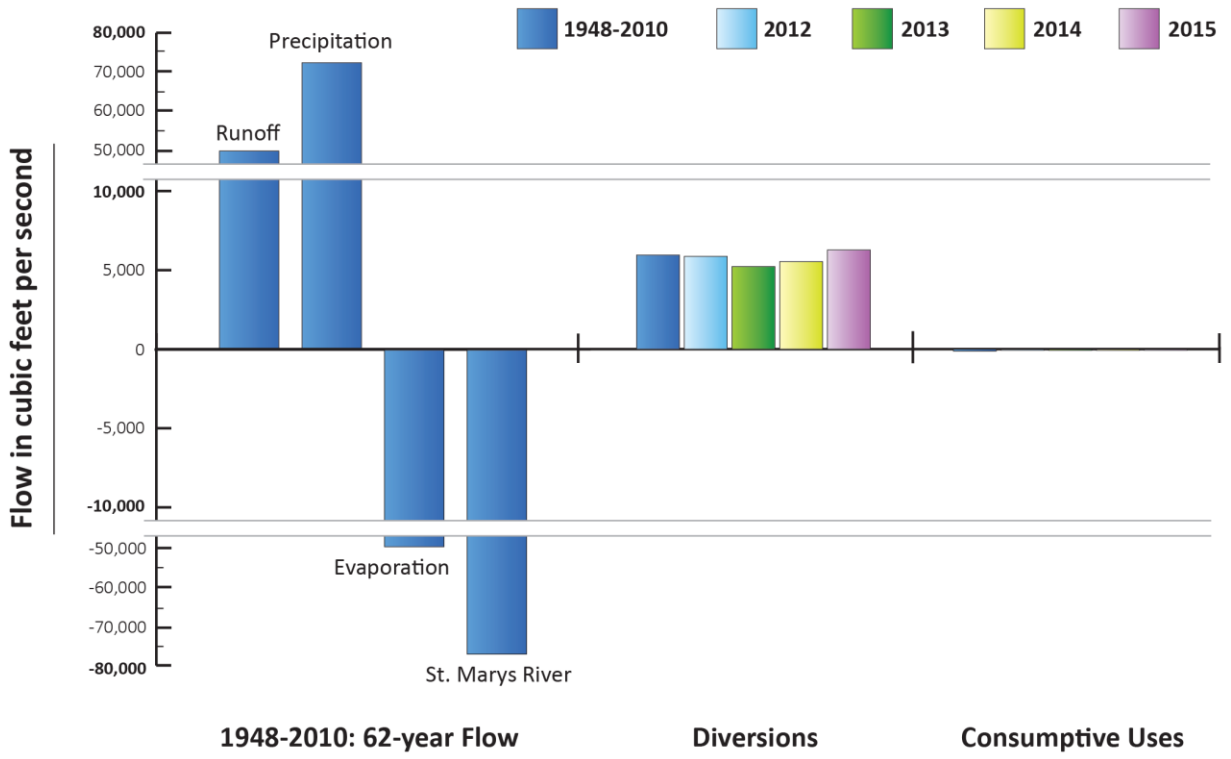

Figure 3. Water budget average flows for Lake Superior, comparing 2012-2015 to a historical 62-year period (1948-2010). (in cfs)

Water Budget Component	1948-2010 62-year Flow	2012	2013	2014	2015
Diversions	5,950	5,863	5,220	5,533	6,275
Consumptive Uses	-117	-70	-74	-71	-69

Table B. Diversions and consumptive uses for Lake Superior, comparing 2012-2015 to a historical 62-year period (1948-2010). (in cfs)

Consumptive Uses: Consumptive uses in the Lake Superior watershed have remained relatively constant over the years from 2012 to 2015.

Diversions: Diversions, mainly comprised of the Long Lac and Ogoki Diversions, fluctuate with the weather conditions of the watersheds. When conditions in the Long Lac and Nipigon (downstream of Ogoki) watersheds are wet, the diversions are often reduced, and water that otherwise would have been diverted into Lake Superior is instead directed through natural outlets that flow toward Hudson Bay. Conversely, when conditions are dry in the downstream watersheds, the diversion flow may be higher.

As illustrated in Table C below, for the Lake Superior watershed the hydrologic effect of consumptive uses and diversions (annual averages) are small relative to inflows. The estimated net volume of consumptive uses and diversions decreased by 26 percent from 2012 to 2013, and then increased from 2013 to 2014 by 6 percent. Finally, from 2014 to 2015, it increased by 14 percent.

Year	Total Inflow	Consumptive Uses +Diversions	Consumptive Uses + Diversions (as a percentage of total inflow)
62-year avg.	122,218*	5,833	4.77 percent
2012	122,218*	6,957	5.69 percent
2013	122,218*	5,148	4.21 percent
2014	122,218*	5,462	4.47 percent
2015	122,218*	6,206	5.08 percent

Table C. Water budget values in cubic feet per second for Lake Superior, 62-year average for 1948-2010, 2012-2015. (in cfs)
*62-year flow average

Lakes Michigan-Huron Watershed

The data in Figure 4 and Table D summarize the hydrologic effects of the consumptive use and diversion components of the Lakes Michigan-Huron watershed water budget. For purposes of comparison, Figure 4 depicts the all components of the water budget using the annual average for the years 1948-2010.

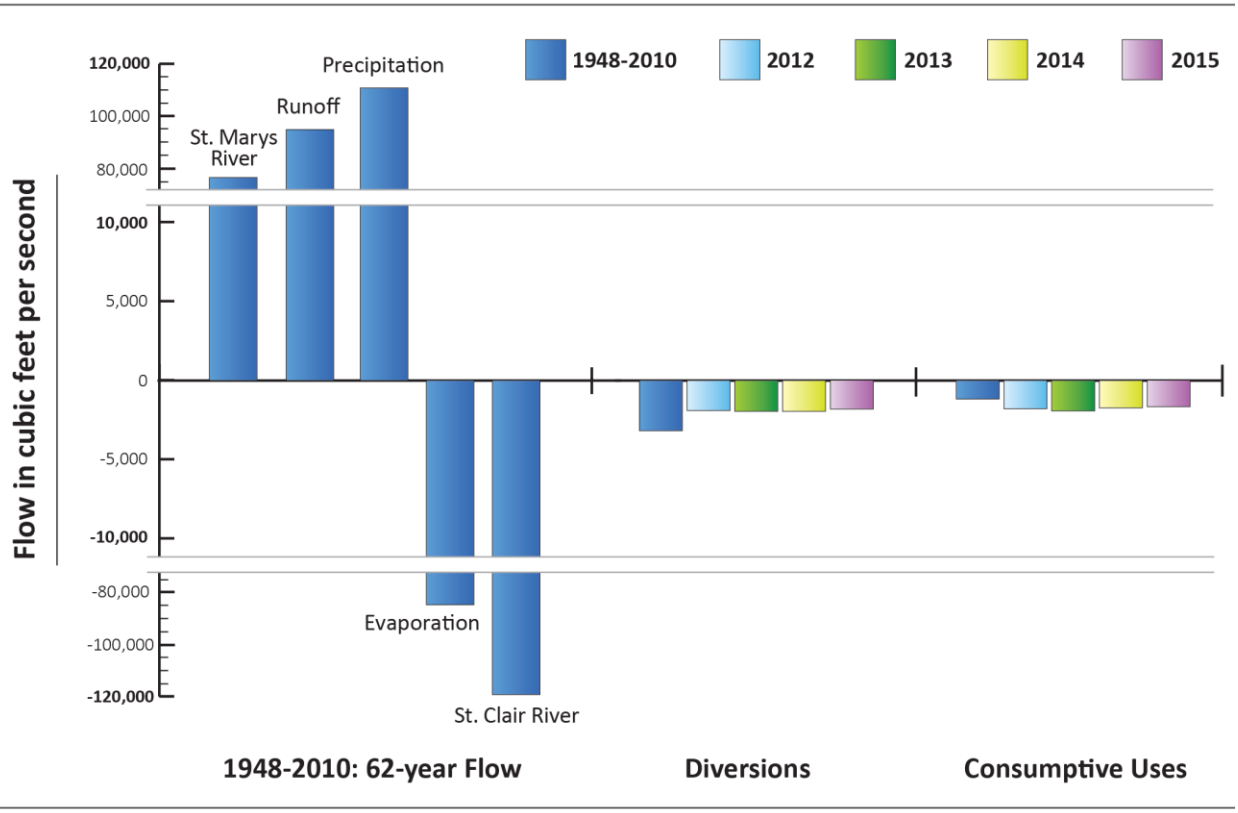

Figure 4. Water budget average flows for Lakes Michigan-Huron, comparing 2012-2015 to a historical 62-year period (1948-2010). (in cfs)

Water Budget Component	62-year Flow	2012	2013	2014	2015
Diversions	-3,171	-1,894	-1,948	-1,950	-1,826
Consumptive Uses	-1,166	-1,779	-1,925	-1,726	-1,674

Table D. Diversions and consumptive uses for Lakes Michigan-Huron, comparing 2012-2015 to a historical 62-year period (1948-2010). (in cfs)

Consumptive Uses: Consumptives use flows fluctuated from 2012 to 2015.

Diversions: Diversions increased by 3 percent between 2012 and 2013, then maintained a constant level in 2014. Between 2014 and 2015, diversions decreased by 124 cfs or 6 percent. Diversions, mainly comprised of the Illinois Diversion which diverts water from Lake Michigan to the Chicago Sanitary and Ship Canal and the Illinois and Des Plaines Rivers, contributed to the flows out of the watershed.

As illustrated in Table E, for the Lakes Michigan-Huron watershed the hydrologic effect of consumptive uses and diversions (annual averages) were small relative to inflows (about 1.3 percent of the 62-year average for inflows into the watershed). The estimated net volume of diversions and consumptive uses decreased constantly throughout the last four years. From 2012 to 2013 it decreased by 12 percent, then by 5 percent between 2013 and 2014, and again by 5 percent between 2014 and 2015.

Year	Total	Consumptive Uses +Diversions	Consumptive Uses + Diversions
62-year avg.	282,054*	-4,337	1.53 percent
2012	282,054*	-4,413	1.56 percent
2013	282,054*	-3,876	1.37 percent
2014	282,054*	-3,676	1.30 percent
2015	282,054*	-3,500	1.24 percent

Table E. Water budget values in cubic feet per second for Lakes Michigan-Huron, 62-year average for 1948-2010, 2012-2015. (in cfs)
*62-year flow average

Lake Erie Watershed

The data in Table F and used in Figure 5 summarize the hydrologic effect of the consumptive use and diversion components of the Lake Erie watershed water budget. For purposes of comparison, Figure 5 depicts all components of the water budget using the annual average for the years 1948-2010. In 2013 and 2014, these diversion and consumptive use flows were smaller than the 62-year average flows and the 2012 values.

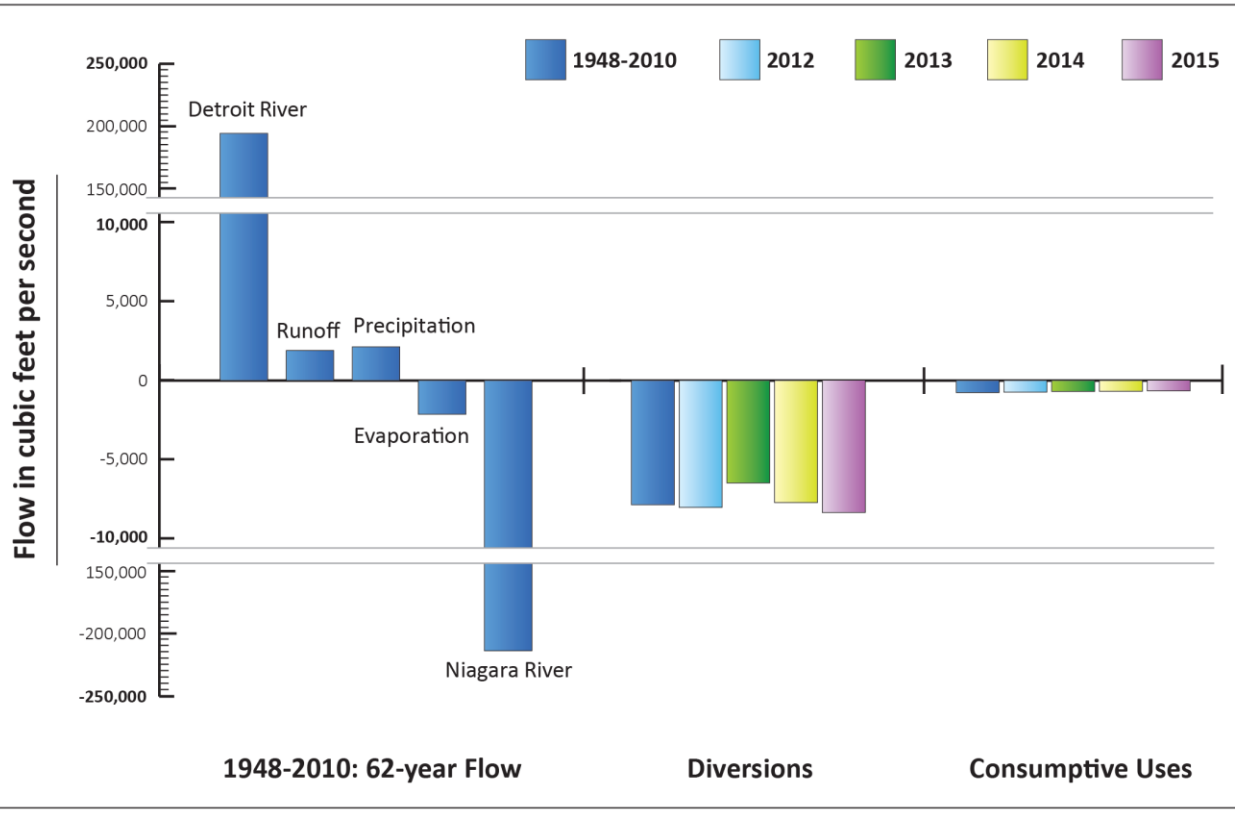

Figure 5. Water budget average flows for Lake Erie, comparing 2012-2015 to a historical 62-year period (1948-2010). (in cfs)

Water Budget Component	62-year Flow	2012	2013	2014	2015
Diversions	-7,851	-8,017	-6,476	-7,712	-8,367
Consumptive Uses	-763	-736	-690	-677	-670

Table F. Diversions and consumptive uses for Lake Erie, comparing 2012-2015 to a historical 62-year period (1948-2010). (in cfs)

Consumptive Uses: Consumptive uses have constantly decreased from 2012 to 2015. The 2015 consumptive use amount of 670 cfs is about 12 percent less than the annual average for the years 1948-2010.

Diversions: Diversions[19] have contributed to the overall flows out of the watershed. Contrasting with the consumptive uses trend, diversions have fluctuated during the past four years. They decreased by 19 percent from 2012 to 2013. Diversions then increased by 19 percent between 2013 and 2014, and increased again by 8 percent from 2014 to 2015.

[19] Diversion data for the Lake Erie watershed include an intrabasin diversion at Welland Canal.

As illustrated in Table G, for the Lake Erie watershed the hydrologic effect of consumptive uses and diversions (annual averages) was small relative to inflows. The estimated net volume of consumptive uses and diversions fluctuated significantly from 2012 to 2015. It decreased by 18 percent from 2012 to 2013. It then increased by 17 percent between 2013 and 2014, and increased again by 8% between 2014 and 2015.

Year	Total Inflow	Consumptive Uses +Diversions	Consumptive Uses + Diversions (as a percentage of total inflow)
62-year avg.	244,739*	-8,614	3.51 percent
2012	244,739*	-8,753	3.58 percent
2013	244,739*	-7,166	2.93 percent
2014	244,739*	-8,389	3.43 percent
2015	244,739*	-9,037	3.69 percent

Table G. Water budget values in cubic feet per second for Lake Erie, 62-year average for 1948-2010, 2012-2015. (in cfs)
*62-year flow average

Lake Ontario Watershed

The data in Table H and used in Figure 6 summarize the hydrologic effects of the consumptive use and diversion components of the Lake Ontario watershed water budget. For purposes of comparison, Figure 6 depicts all components of the water budget using the annual average for the years 1948-2010.

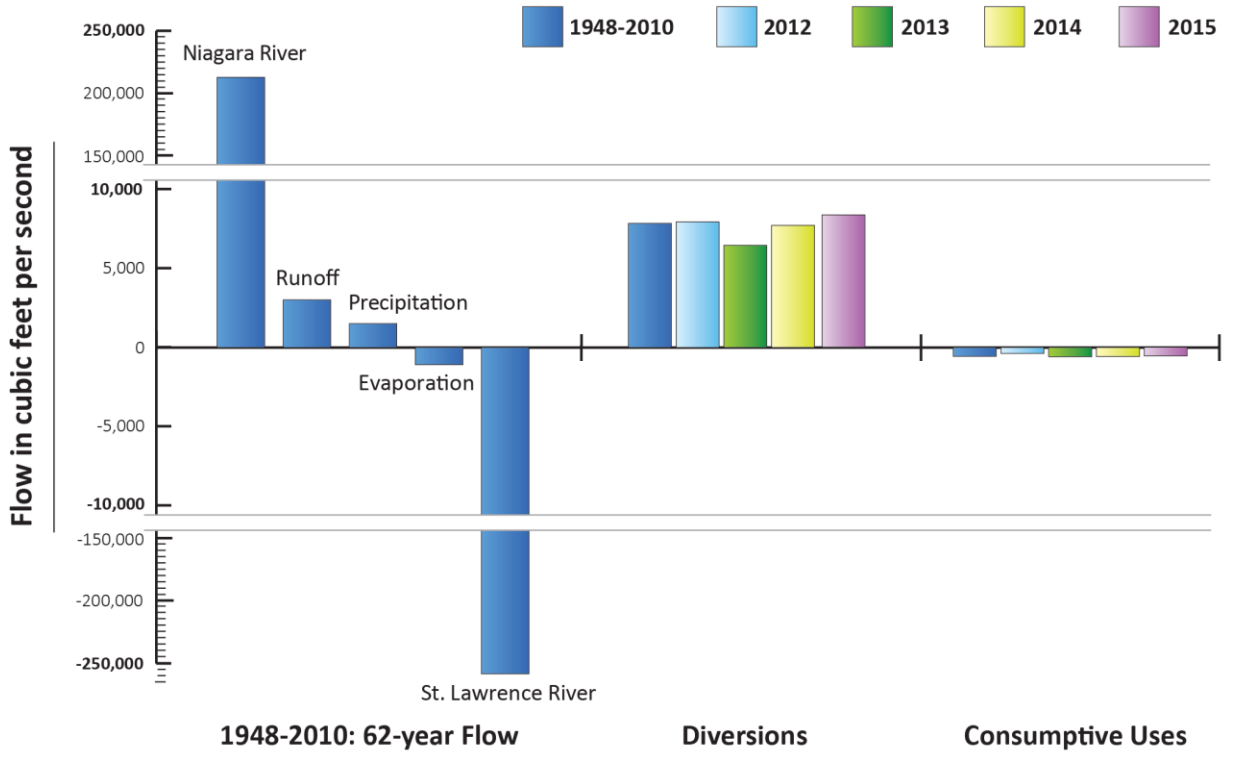

Figure 6. Water budget average flows for Lake Ontario, comparing 2012-2015 to a historical 62-year period (1948-2010). (in cfs)

Water Budget Component	62-year Flow	2012	2013	2014	2015
Diversions	7,851	7,942	6,466	7,730	8,365
Consumptive Uses	-561	-375	-573	-570	-553

Table H. Diversions and consumptive uses for Lake Ontario, comparing 2012-2015 to a historical 62-year period (1948-2010). (in cfs)

Consumptive Uses: Consumptive use flows have increased by 53% from 2012 to 2013. Reported amounts then slightly decreased by 3 percent between 2013 and 2015.

Diversions: There was a notable decrease in diversion flows from 2012 to 2013 (19 percent). This was followed by an increase of 20% from 2013 to 2014. Diversion flows then increased by 8 percent between 2014 and 2015,

As illustrated in Table I, for the Lake Ontario watershed the cumulative hydrologic effect of consumptive uses and diversions (annual averages) were small relative to inflows. The estimated net volume of diversions and consumptive uses decreased by 22 percent from 2012 to 2013 and increased by 21 percent between 2013 and 2014. It increased again from 2014 to 2015, this time by 9 percent.

Year	Total Inflow	Consumptive Uses +Diversions	Consumptive Uses + Diversions (as a percentage of total inflow)
62-year avg.	269,041*	7,290	2.71 percent
2012	269,041*	7,567	2.81 percent
2013	269,041*	5,894	2.19 percent
2014	269,041*	7,150	2.66 percent
2015	269,041*	7,813	2.90 percent

Table I. Water budget values in cubic feet per second for Lake Ontario, 62-year average for 1948-2010, 2012-2015. (in cfs)
*62-year flow average

St. Lawrence River Watershed

The water budget for the St. Lawrence River watershed is different than those for the Lakes. Inflow consists of the St. Lawrence River flow measured at Cornwall, Ontario. Outflow mainly consists of the river's flow modeled at Trois-Rivières, Québec and consumptive uses throughout the watershed.

As illustrated in Table K and Figure 7, for the St. Lawrence River watershed the hydrologic effect of consumptive use and diversions was small relative to inflows. From 2012 to 2013, the net estimated volume of consumptive uses and diversion increased by 21 percent, then decreased by 6% between 2013 and 2014, and decreased by 7% between then and 2015[20].

[20] The implementation of the 2009 Water Use Data Protocols and the corresponding jurisdictional data collection and reporting programs began with the collection of 2012 water use data. Therefore, the increase of the net estimated volume of consumptive uses and diversions between 2012 and 2015 may reflect the improvements in data collection.

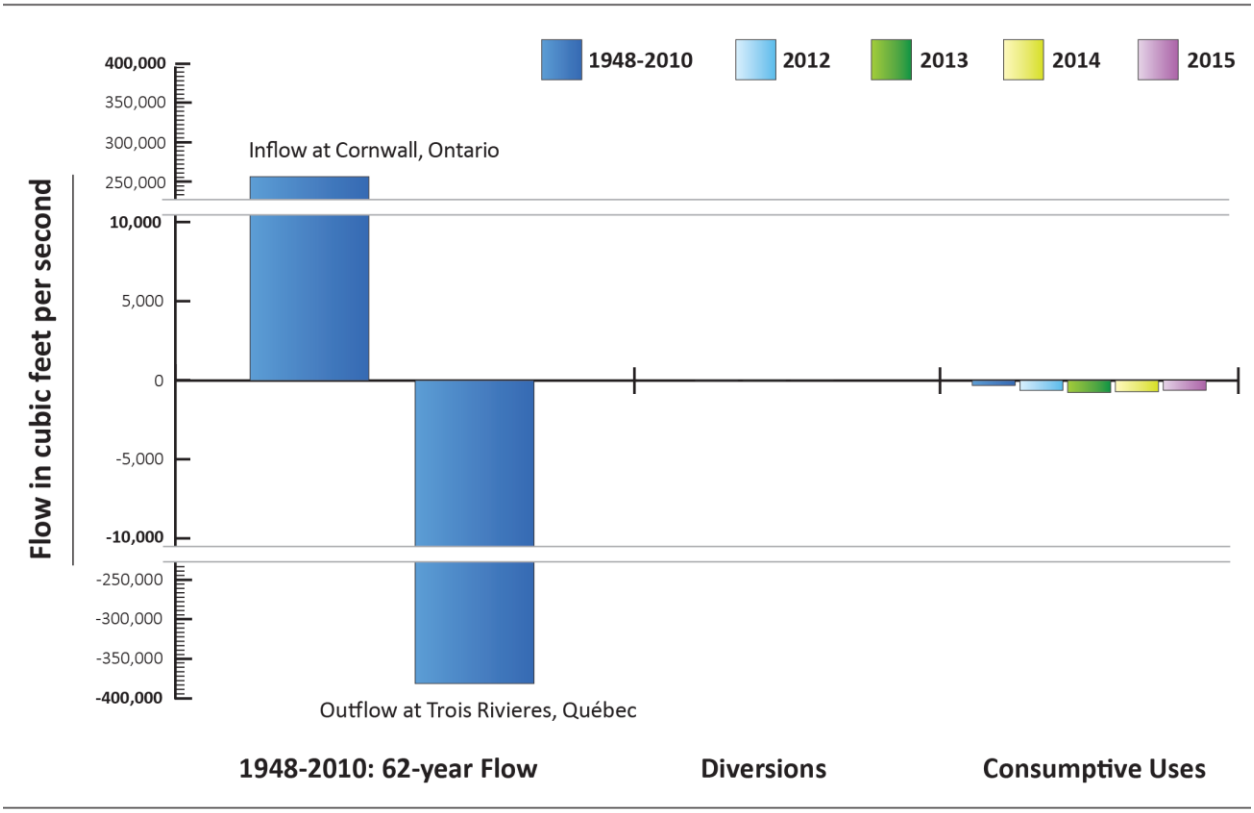

Table 7. Water budget values in cubic feet per second for the St. Lawrence River comparing 2012-2015 to a historical 62-year period (1948-2010). (in cfs)

Water Budget Component	62-year Flow	2012	2013	2014	2015
Diversions	N/A	-7	-9	-10	-10
Consumptive Uses	-313	-625	-753	-707	-641

Table J. Diversions and consumptive uses for St. Lawrence River, comparing 2012-2015 to a historical 62-year period (1948-2010). (in cfs)

Consumptive Uses: As summarized in Table J, consumptive uses have fluctuated, increasing by 20% from 2012 to 2013, decreasing by 6% between 2013 and 2014, and decreased by 9% between 2014 and 2015.

Diversions: Diversions have made up on average about 1 percent of the total annual water loss from the St. Lawrence River watershed. Starting in 2012, both Québec and New York reported diversions totaling 7 cfs in 2012, 9 cfs in 2013, 9 cfs in 2014 and 11 cfs in 2015 for public supply purposes. For previous years (1948-2010), diversions have not been reported.

As illustrated in Table K, for the St. Lawrence River watershed the cumulative hydrologic effect of consumptive uses and diversions (annual averages) were small relative to inflows.

Year	Total Inflow	Consumptive uses +Diversions	Consumptive Uses + Diversions (as a percentage of total inflow)
62-year avg.	256,797*	-313**	0.12 percent
2012	256,797*	-632	0.25 percent
2013	256,797*	-762	0.30 percent
2014	256,797*	-717	0.28 percent
2015	256,797*	-651	0.25 percent

Table K. Water budget values in cubic feet per second for the St. Lawrence River, 62-year average for 1948-2010, 2012-2015. (in cfs)
*62-year flow average
**This figure only is consumptive use only. No diversions were reported.