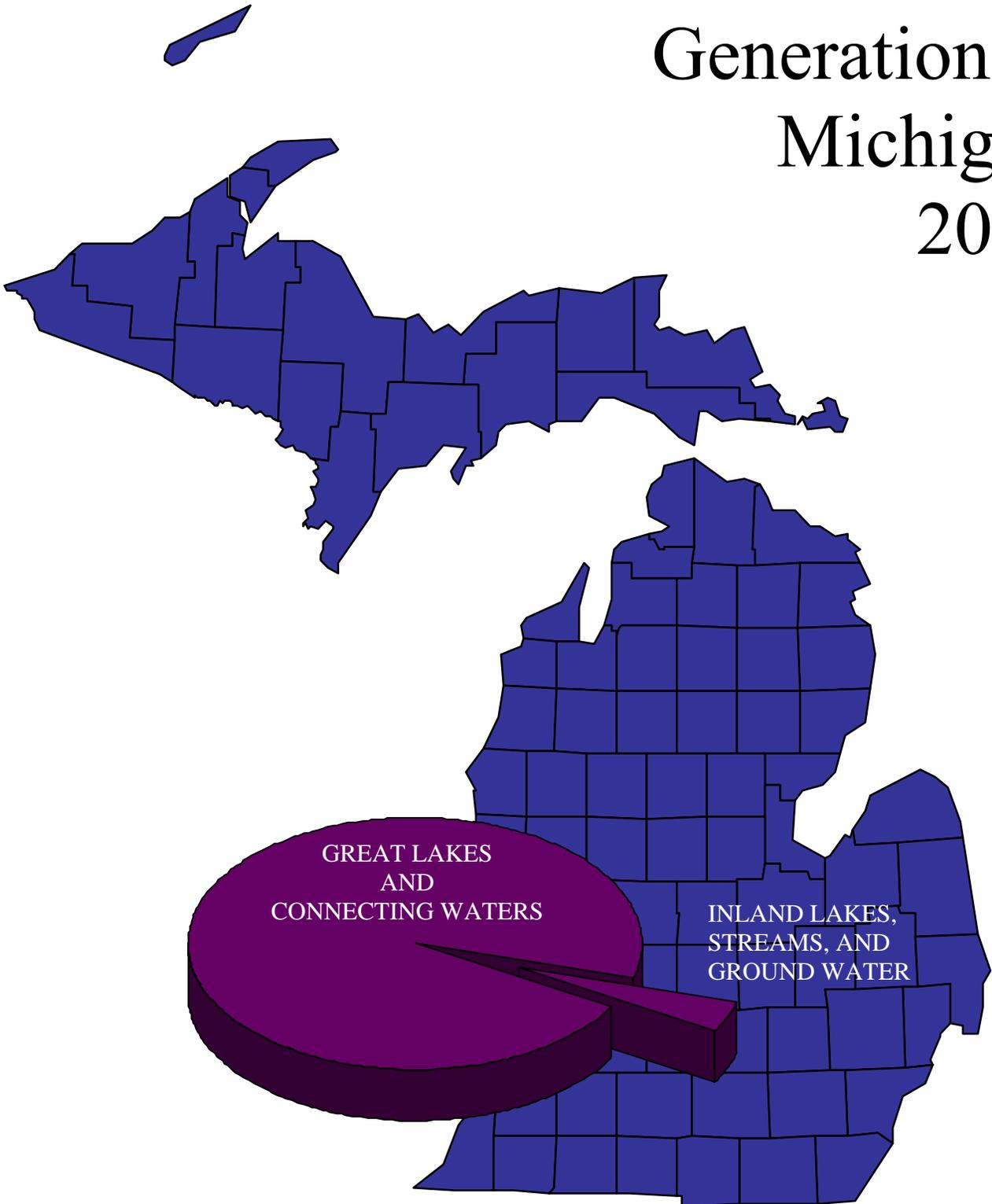


Water Withdrawals for Thermoelectric Power Generation in Michigan 2006



Water Withdrawals for Thermoelectric Power Generation in Michigan: 2006

Introduction

This report has been prepared by the Michigan Department of Environmental Quality to summarize thermoelectric power generation information compiled in Michigan's Water Use Reporting Program. The overall goal of the program is to establish an environmental baseline and continuing assessment of major water uses in the state, including power generation, industrial, irrigation, and public water supply. This fulfills key requirements of the Great Lakes Charter, a regional agreement signed by the Great Lakes states and Canadian provinces in 1985, the Great Lakes Charter Annex 2001, and Michigan's water use reporting law (Part 327, Great Lakes Preservation, Natural Resources and Environmental Protection Act, 1994 PA 451, as amended).

Detailed water use information from the states and provinces is maintained by the Great Lakes Commission to facilitate regional policy-making and strengthen the legal defense against unwarranted diversions of Great Lakes water. It also provides essential water use information for state and regional water resources planning to support power generation, industrial, irrigation, and public water supply activities in a manner consistent with sound environmental management.

Background

The production of thermoelectric energy in Michigan requires water as a process feed for steam, as a cooling medium, and in some cases for cleaning and pollution control. The primary use of water is for cooling, which typically accounts for most of the water withdrawn by thermoelectric power plants. This water is passed through or circulated in various types of cooling systems to dissipate waste heat produced in the power generation process. It is then returned to receiving waters or further cooled and utilized for recirculation.

The amount of water withdrawn for thermoelectric power generation is primarily a function of power plant size and the type of cooling system utilized. In general, there are three types of cooling systems: open, closed, or combination. An open cooling system, such as once-through cooling, withdraws water continuously from a natural water body, circulates the water through condensers in the plant once to remove waste heat, then discharges the water back into a receiving water body. A closed system, such as a cooling pond, cooling tower, or radiator heat exchanger, recycles the same cooling water more than once, requiring only periodic withdrawals to replace water losses. In some cases, a power plant may use a combination of cooling systems for the same generating unit.

The type of cooling system selected during the design of a thermoelectric power plant is generally determined by the size of the plant, water availability, and site conditions. Open cooling systems often are used where water supplies are adequate and adverse water quality effects are not expected. These systems require larger withdrawals, but consumptive water losses from evaporation during the cooling process are smaller. Closed cooling systems are more likely to be used where water supplies are limited or there are other restrictions. These systems withdraw significantly less cooling water, but they consume a larger portion of it than in open systems.

Michigan Summary

Ninety-one thermoelectric power plants were identified during the initial registration phase of Michigan's Water Use Reporting Program. The largest utilities in the state are Detroit Edison Company, Consumers Energy Company, and Indiana Michigan Power Company. The remaining power plants are operated by municipalities, rural electric cooperatives, universities, and corporations. During 2006, forty three of the power plants in the state had the capacity to withdraw self-supplied water above the Great Lakes Charter threshold of 100,000 gallons per day during any 30-day period. All of these facilities reported information on monthly and annual water withdrawals, discharges, and power generated.

Michigan's reporting thermoelectric power plants withdrew a total of 8,543 million gallons of water per day (MGD) for cooling and other uses and generated 111,206,197 megawatt-hours (MW-HRS) of energy in 2006. This represents nearly a seven percent decrease in water withdrawals from 2005, with a corresponding decrease in energy generated of five percent. Michigan's three nuclear power plants (D.C. Cook, Palisades, and Enrico Fermi II) accounted for 26 percent of the water withdrawn and about 29 percent of the energy generated statewide. Nearly 96 percent of the water withdrawn for all plants in Michigan came from the Great Lakes and their connecting waters. The remaining four percent was withdrawn from inland lakes, streams, or ground water.

Table 1 summarizes water withdrawals and thermoelectric energy generated in Michigan on a county basis. Berrien County had the largest withdrawals in 2006, resulting from the operation of the D.C. Cook nuclear plant. This single facility accounted for 24 percent of the water withdrawn and 16 percent of the energy generated statewide. The next four largest water-withdrawal counties were Monroe, Saint Clair, Wayne, and Ottawa. While the Great Lakes remain the primary source of water for thermoelectric energy generation in Michigan, facilities in interior counties or with smaller generators relied on inland water sources. Ingham County in central lower Michigan reported the largest non-Great Lakes withdrawals, with the Eckert Station power plant withdrawing 190 MGD from the Grand River. This was followed by Wayne County, where the Dearborn Industrial Generation Plant withdrew 114 MGD from the Rouge River.

Table 2 summarizes thermoelectric power generation water withdrawals by U.S. Geological Survey hydrologic basins in Michigan. Water withdrawals were made by plants in 21 of the 57 watersheds in the state. The largest withdrawals were for the D.C. Cook nuclear plant in the Little Calumet-Galien Watershed (Basin 04040001), followed by withdrawals from the Ottawa-Stony Watershed (Basin 04100001), the St Clair Watershed (Basin 04090001), the Detroit Watershed (Basin 04090004), and the Black-Macatawa (Basin 04050002). Together, plants in these five watersheds accounted for nearly 83 percent of the thermoelectric power generation water withdrawals and 79 percent of the energy generated statewide.

Thermoelectric water withdrawal data reported in Michigan's Water Use Reporting Program for the years 1997-2006 provide a continuing environmental baseline for longer-term trend analysis. This information, along with reported withdrawals from other major water use sectors such as self-supplied industrial, public water supply, and irrigation will support the continued protection and wise management of the waters of the Great Lakes Basin.

Table 1: 2006 Water Withdrawals for Thermoelectric Power Generation in Michigan, by County*

County	Thermoelectric Power		Water Withdrawn (MGD)			
	Number of Plants	Energy Generated (MW-HRS)	Great Lakes	Surface Water	Ground Water	Total
Alcona	1	158,625.00	0.00	0.00	0.46	0.46
Allegan	1	3,015.00	0.00	0.00	0.00	0.00
Alpena	1	284,842.00	111.90	0.00	0.00	111.90
Baraga	1	0.00	0.00	0.00	0.00	0.00
Bay	1	5,638,363.00	561.18	0.00	0.00	561.18
Berrien	1	18,057,269.00	2,061.09	0.00	0.00	2,061.09
Cass	1	0.00	0.00	0.00	0.00	0.00
Cheboygan	1	629.00	0.00	0.00	0.00	0.00
Crawford	1	242,551.00	0.00	0.00	0.34	0.34
Delta	1	159,202.00	21.38	0.00	0.00	21.38
Eaton	1	1,051,334.00	0.00	1.20	0.00	1.20
Genesee	1	289,599.00	0.00	0.00	0.29	0.29
Hillsdale	2	380,889.00	0.00	0.02	0.92	0.94
Huron	1	199,116.00	62.61	0.00	0.00	62.61
Ingham	1	1,787,557.00	0.00	190.14	0.00	190.14
Isabella	1	1,793.00	0.00	0.00	0.15	0.15
Kent	1	95,509.00	0.00	0.21	0.00	0.21
Manistee	1	501,608.00	1.34	0.00	0.00	1.34
Marquette	2	3,666,051.00	270.10	0.00	0.00	270.10
Midland	1	5,922,000.00	0.00	4.22	0.00	4.22
Missaukee	1	156,317.00	0.00	0.00	0.09	0.09
Monroe	3	29,081,367.00	1,752.55	0.00	0.11	1,752.66
Montcalm	1	1,382.00	0.00	0.00	0.00	0.00
Muskegon	1	1,858,160.00	216.48	0.00	0.04	216.52
Osceola	1	14,941.00	0.00	0.00	0.00	0.00
Ottawa	4	9,075,054.00	708.79	43.08	0.69	752.57
Saint Clair	3	16,990,038.00	1,385.33	0.00	0.00	1,385.33
Van Buren	1	5,903,861.00	115.63	0.00	0.00	115.63
Wayne	6	9,685,125.00	917.72	114.43	0.00	1,032.15
Total	43	111,206,197.00	8,186.11	353.29	3.10	8,542.50

*This report is provided by the Michigan Department of Environmental Quality and was generated using data collected for the water use reporting program.

Index Map of Michigan Counties

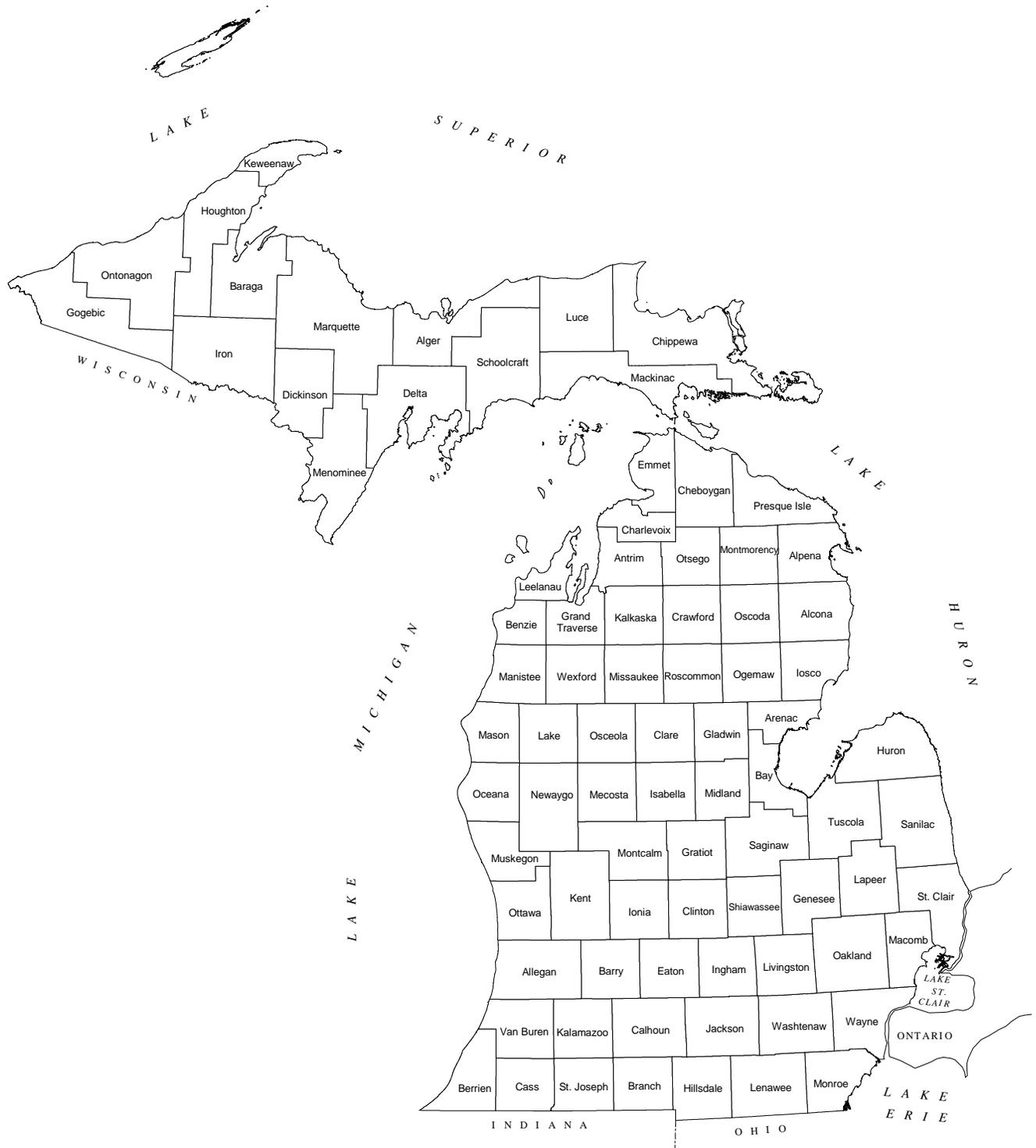


Table 2: 2006 Water Withdrawals for Thermoelectric Power Generation in Michigan, by Hydrologic Basin*

Hydrologic Basin Code	Thermoelectric Power		Water Withdrawn (MGD)			
	Number of Plants	Energy Generated (MW-HRS)	Great Lakes	Surface Water	Ground Water	Total
04020105	3	3,666,051.00	270.10	0.00	0.00	270.10
04030111	1	159,202.00	21.38	0.00	0.00	21.38
04040001	1	18,057,269.00	2,061.09	0.00	0.00	2,061.09
04050001	3	380,889.00	0.00	0.02	0.92	0.94
04050002	3	14,566,741.00	824.42	0.00	0.69	825.12
04050003	1	3,015.00	0.00	0.00	0.00	0.00
04050004	2	2,838,891.00	0.00	191.34	0.00	191.34
04050006	3	507,683.00	0.00	43.29	0.00	43.29
04060102	3	2,029,418.00	216.48	0.00	0.13	216.62
04060103	1	501,608.00	1.34	0.00	0.00	1.34
04070005	1	629.00	0.00	0.00	0.00	0.00
04070006	1	284,842.00	111.90	0.00	0.00	111.90
04070007	2	401,176.00	0.00	0.00	0.80	0.80
04080104	1	199,116.00	62.61	0.00	0.00	62.61
04080201	1	5,922,000.00	0.00	4.22	0.00	4.22
04080202	2	3,175.00	0.00	0.00	0.15	0.15
04080204	1	289,599.00	0.00	0.00	0.29	0.29
04080206	1	5,638,363.00	561.18	0.00	0.00	561.18
04090001	3	16,990,038.00	1,385.33	0.00	0.00	1,385.33
04090004	6	9,685,125.00	917.72	114.43	0.00	1,032.15
04100001	3	29,081,367.00	1,752.55	0.00	0.11	1,752.66
Total	43	111,206,197.00	8,186.11	353.29	3.10	8,542.50

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Hydrologic Basins in Michigan: U.S. Geological Survey

04020105	Dead-Kelsey	04060102	Muskegon	04080204	Flint
04030111	Tacoosh-Whitefish	04060103	Manistee	04080206	Saginaw
04040001	Little Calumet-Galien	04070005	Black	04090001	St. Clair
04050001	St. Joseph	04070006	Thunder Bay	04090004	Detroit
04050002	Black-Macatawa	04070007	Au Sable	04100001	Ottawa-Stony
04050003	Kalamazoo	04080104	Birch-Willow		
04050004	Upper Grand	04080201	Tittabawassee		
04050006	Lower Grand	04080202	Pine		

Index Map of Michigan Hydrologic Basins

