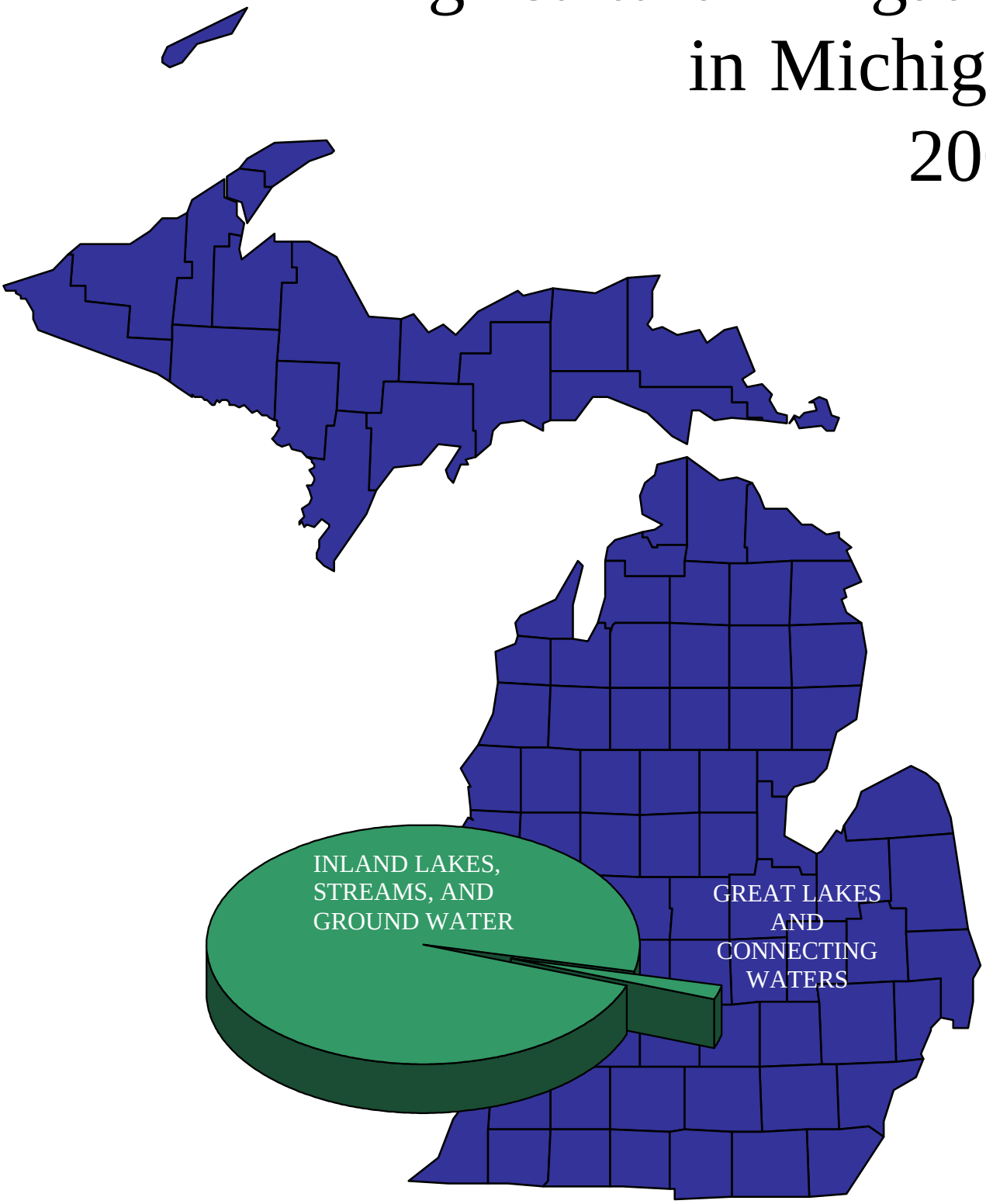
Water Withdrawals for Agricultural Irrigation in Michigan 2001



Water Withdrawals for Agricultural Irrigation in Michigan: 2001

Introduction

This report has been prepared by the Michigan Department of Environmental Quality to summarize agricultural irrigation information estimated 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, 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 artificial application of irrigation water to grow crops has become a widely practiced agricultural management technique in the Great Lakes Region. Although precipitation is generally sufficient within the Region, the ability to irrigate gives growers greater control over the timing and amount of water applied throughout the growing season. This enables them to increase the soil moisture available for plant growth, provide frost control protection for fruit and specialty crops, and protect against crop loss during periods of climatic stress. Limitations to utilizing irrigation as a management tool include the significant capital and energy costs, labor and maintenance requirements, and the availability of adequate water supplies.

The amount of irrigation water used to irrigate crops depends on a variety of environmental, economic, and legal factors. Perhaps most important is the availability of adequate surface water and ground water sources that can be used without creating water use conflicts among surrounding water users. Since consumptive water loss rates are not only high for agricultural irrigation, but are also concentrated during the summer months of naturally lowered stream flows and lake levels, water supply issues are of primary management concern. The viability of irrigation depends in large part upon a reasonable balancing of shared water rights under common law.

In Michigan, a special provision was enacted in the state water use reporting law in 1996 to develop a methodology for estimating agricultural irrigation water use. The Michigan Department of Environmental Quality, the Michigan Department of Agriculture, and Michigan State University jointly developed an experimental model to estimate agricultural irrigation water use for the period 1997 to 1999. A research team headed by Dr. Joe Ritchie and principal investigators Dr. Jeff Andresen and Dr. Thomas Moen was formed, and the team completed

preliminary work on the estimation model in 1997. Subsequent testing and refinement occurred in 1998, including weather and soils data analyses and a limited field test in St. Joseph County. Since crop and acreage information from individual irrigated farms was necessary to run model simulations, the Michigan Department of Environmental Quality and Michigan Department of Agriculture submitted a joint request to the National Agricultural Statistics Service for access to selected irrigation data from the 1997 Census of Agriculture. This request was approved in April 1999, subject to extensive security and confidentiality safeguards to ensure that individual reported farm data remained protected from disclosure. Model runs were completed for each of the three years by December 1999, and subsequent analyses were undertaken to estimate agricultural irrigation crop water demand annually. The results for 2001 are summarized in this report.

Michigan Summary

Agricultural irrigation water use in Michigan is determined by weather conditions, the availability of adequate water supplies, and basic management decisions made by irrigators. For the present study, crop and acreage data for 1,712 Michigan irrigators in the 1997 Census of Agriculture were combined with 2001 weather data and soils information to run a water use estimation model developed for Michigan's Water Use Reporting Program. All farms in the state irrigating 14 or more acres were included in the model analyses (including weighted responses for 79 non-reporting farms). While these farms represented only 44.5 percent of the 3,752 farms identified as having irrigated crop acreage, they accounted for 97.8 percent of the irrigated agricultural crop acreage reported in the census enumeration.

Crop water demand estimates were made for farms irrigating 384,828 acres in Michigan during 2001. Irrigation water withdrawals for these farms were estimated at 207 million gallons per day (MGD).***** This represents 2.8 million acre-inches of water withdrawn for the year. About 65 percent of the agricultural irrigation water withdrawn was from ground water sources. The remaining 35 percent was withdrawn from surface water sources, primarily from inland lakes and streams. Only 3 percent of agricultural irrigation water withdrawals were from the Great Lakes.

Table 1 summarizes water withdrawals for agricultural irrigators in Michigan on a county basis. There were 11 counties that reported no farms irrigating 14 or more acres, and data could not be disclosed for another 18 counties with a small number of irrigated farms. Data for these nondisclosure counties were combined and reported in Table 1 under the categories of "Other LP (Lower Peninsula) Counties" and "Other UP (Upper Peninsula) Counties". The combined irrigated acreage in these counties was relatively small, representing only two percent of the state total.

***** To be consistent with reporting in other water use categories, agricultural irrigation water withdrawal estimates are calculated by dividing totals by 365 days instead of the actual length of the irrigation season (approximately 120 days). Daily withdrawal rates are significantly larger during this irrigation season.

Saint Joseph County had the largest agricultural irrigation water use in 2001, accounting for nearly 20 percent (40.65 MGD) of the irrigation withdrawals in the state. The next largest water withdrawal counties were Montcalm, Branch, Ottawa, and Kalamazoo. These four counties accounted for an additional 28 percent of the total agricultural irrigation withdrawals and approximately 27 percent of the irrigated acreage statewide. The primary source of water for agricultural irrigation in these counties was ground water (72 percent), with the remainder withdrawn from inland surface water sources. No Great Lakes withdrawals were reported.

Table 2 summarizes agricultural irrigation water use by U.S. Geological Survey hydrologic basins in Michigan. There were 11 basins that reported no farms irrigating 14 or more acres, and data could not be disclosed for another 11 basins with a small number of irrigated farms. Data for these nondisclosure watersheds were combined and reported in Table 2 under the category of "Other Basins". The combined irrigated acreage in these basins was less than one-half percent of the state total.

The largest agricultural irrigation water withdrawals were from the Saint Joseph Watershed (Basin 04050001), which accounted for over 39 percent of the total agricultural irrigation withdrawals statewide in 2001. The next largest water withdrawal basins were the Lower Grand (Basin 04050006), the Muskegon (Basin 04060102), the Kalamazoo (Basin 04050003), and the Pigeon-Wiscoggin (Basin 04080103). Together, these five basins accounted for nearly 70 percent of the total agricultural irrigation withdrawals and 76 percent of the irrigated acreage statewide. Irrigated farms in these watersheds relied primarily on ground water (67 percent), with most of the remaining withdrawals from inland surface water sources. Less than four percent of withdrawals came from the Great Lakes.

The crops reported under agricultural irrigation in Michigan during 2001 are summarized in Table 3. These crops were classified into 27 categories generally consistent with the survey instrument used for the Federal Agricultural Census. Some modifications were made to simplify the reporting process. For example, irrigation data for over 25 individual irrigated vegetables were combined into three groups with similar water demand and/or rooting characteristics and reported in aggregate. The vegetables in each of these classification groups are identified at the end of the table. Winter and spring wheat were also combined, as were two categories of sorghum. Alfalfa, hay, and silage were similarly reported as one category.

The largest irrigated agricultural crop in Michigan during 2001 was corn grown for grain or seed. This single crop accounted for nearly 43 percent of the total irrigated acreage in the state and 34 percent of the total irrigation water withdrawn. The next four largest irrigated crop categories were soybeans, potatoes, group 2 vegetables, and nursery and greenhouse crops (including sod). Together, these five categories accounted for 75 percent of the total agricultural irrigated acreage in Michigan and 78 percent of the irrigation water withdrawn.

Longer-term trend analysis will be undertaken as agricultural irrigation water use data are compiled or estimated under Michigan's Water Use Reporting Program. Present trends suggest that the steady expansion of agricultural irrigation in the state over the past 10 years will

continue. To determine the overall demand for irrigation water in Michigan, agricultural irrigation data will be combined with water withdrawal data for golf course irrigation. This information will provide a continuing baseline to ensure the continued protection and wise management of the waters of the Great Lakes Basin.

Table 1: 2001 Estimated Water Withdrawals for Agricultural Irrigation in Michigan, by County*

County	1997 Irrigated Farms ≥ 14 Acres		2001 Estimated Water Withdrawn (MGD)			
	Number of Farms	Irrigated Acres	Great Lakes	Surface Water	Ground Water	Total
Alcona	0	0	0.00	0.00	0.00	0.00
Alger	(D)	(D)	(D)	(D)	(D)	(D)
Allegan	85	12,992	0.00	4.60	0.81	5.41
Alpena	(D)	(D)	(D)	(D)	(D)	(D)
Antrim	(D)	(D)	(D)	(D)	(D)	(D)
Arenac	(D)	(D)	(D)	(D)	(D)	(D)
Baraga	(D)	(D)	(D)	(D)	(D)	(D)
Barry	12	1,402	0.00	0.31	0.23	0.54
Bay	41	5,378	0.63	2.83	0.26	3.73
Benzie	5	154	0.00	0.01	0.09	0.10
Berrien	91	12,052	0.00	2.48	3.03	5.52
Branch	98	28,007	0.00	5.41	6.89	12.30
Calhoun	41	9,228	0.00	1.78	3.45	5.23
Cass	56	16,324	0.00	1.53	6.10	7.63
Charlevoix	(D)	(D)	(D)	(D)	(D)	(D)
Cheboygan	(D)	(D)	(D)	(D)	(D)	(D)
Chippewa	0	0	0.00	0.00	0.00	0.00
Clare	(D)	(D)	(D)	(D)	(D)	(D)
Clinton	19	1,997	0.00	0.52	0.61	1.13
Crawford	(D)	(D)	(D)	(D)	(D)	(D)
Delta	7	874	0.00	0.53	0.13	0.66
Dickinson	6	372	0.00	0.25	0.12	0.36
Eaton	9	1,063	0.00	0.53	0.35	0.89
Emmet	4	246	0.00	0.00	0.20	0.20
Genesee	10	2,771	0.00	0.96	1.71	2.67
Gladwin	0	0	0.00	0.00	0.00	0.00
Gogebic	0	0	0.00	0.00	0.00	0.00
Grand Traverse	32	1,813	0.06	0.17	0.93	1.16
Gratiot	15	2,205	0.00	0.38	0.58	0.96
Hillsdale	19	4,165	0.00	1.25	1.20	2.45
Houghton	0	0	0.00	0.00	0.00	0.00
Huron	19	2,196	0.68	0.28	0.59	1.55
Ingham	14	2,309	0.00	0.99	0.99	1.98
Ionia	14	2,553	0.00	0.33	1.00	1.33
Iosco	(D)	(D)	(D)	(D)	(D)	(D)
Iron	4	435	0.00	0.43	0.08	0.51

County	1997 Irrigated Farms ≥ 14 Acres		2001 Estimated Water Withdrawn (MGD)			
	Number of Farms	Irrigated Acres	Great Lakes	Surface Water	Ground Water	Total
Isabella	11	908	0.00	0.10	0.31	0.41
Jackson	20	3,044	0.00	0.95	0.87	1.82
Kalamazoo	71	17,911	0.00	1.64	6.19	7.83
Kalkaska	6	3,175	0.00	0.38	2.52	2.90
Kent	53	6,762	0.00	0.96	2.24	3.21
Keweenaw	0	0	0.00	0.00	0.00	0.00
Lake	0	0	0.00	0.00	0.00	0.00
Lapeer	20	2,372	0.00	1.23	0.22	1.44
Leelanau	33	2,190	0.00	0.07	1.31	1.38
Lenawee	21	2,705	0.00	0.87	0.14	1.01
Livingston	(D)	(D)	(D)	(D)	(D)	(D)
Luce	(D)	(D)	(D)	(D)	(D)	(D)
Mackinac	(D)	(D)	(D)	(D)	(D)	(D)
Macomb	20	1,867	0.06	0.82	0.29	1.18
Manistee	21	3,034	0.00	0.60	1.41	2.01
Marquette	0	0	0.00	0.00	0.00	0.00
Mason	19	2,991	0.00	0.47	1.33	1.79
Mecosta	13	5,959	0.00	0.29	3.34	3.63
Menominee	(D)	(D)	(D)	(D)	(D)	(D)
Midland	5	208	0.00	0.03	0.08	0.11
Missaukee	15	2,489	0.00	0.18	1.04	1.22
Monroe	16	4,740	0.00	2.27	0.80	3.06
Montcalm	82	45,932	0.00	4.83	25.36	30.19
Montmorency	(D)	(D)	(D)	(D)	(D)	(D)
Muskegon	23	7,916	1.80	0.23	2.48	4.50
Newaygo	22	3,357	0.00	0.68	0.56	1.24
Oakland	14	446	0.00	0.17	0.17	0.33
Oceana	25	2,977	0.00	0.65	0.65	1.30
Ogemaw	(D)	(D)	(D)	(D)	(D)	(D)
Ontonagon	0	0	0.00	0.00	0.00	0.00
Osceola	8	1,240	0.00	0.19	0.42	0.61
Oscoda	0	0	0.00	0.00	0.00	0.00
Otsego	(D)	(D)	(D)	(D)	(D)	(D)
Ottawa	125	12,739	0.00	2.18	6.21	8.39
Presque Isle	17	3,066	0.00	1.43	2.15	3.58
Roscommon	(D)	(D)	(D)	(D)	(D)	(D)
Saginaw	14	2,843	0.00	0.76	1.42	2.18
Saint Clair	7	254	0.00	0.03	0.08	0.11
Saint Joseph	199	94,908	0.00	13.82	26.83	40.65
Sanilac	15	3,396	0.00	0.45	2.54	2.99

	1997 Irrigated Farms ≥ 14 Acres		2001 Estimated Water Withdrawn (MGD)			
County	Number of Farms	Irrigated Acres	Great Lakes	Surface Water	Ground Water	Total
Schoolcraft	0	0	0.00	0.00	0.00	0.00
Shiawassee County	5	957	0.00	0.57	0.28	0.85
Tuscola	23	6,935	3.31	0.00	1.95	5.26
Van Buren	98	15,567	0.00	0.92	4.85	5.77
Washtenaw	25	4,179	0.00	1.02	1.24	2.26
Wayne	9	899	0.25	0.00	0.46	0.70
Wexford	5	222	0.00	0.02	0.14	0.16
Other LP Counties	45	7,615	0.03	0.34	5.76	6.14
Other UP Counties	6	489	0.00	0.09	0.34	0.43
Total	1,712	384,828	6.83	64.83	135.31	206.96

* This report is provided by the Michigan Department of Environmental Quality, Michigan Department of Agriculture, and Michigan State University and was generated using data from the 1997 United States Census of Agriculture.

Note: (D) represents data withheld to avoid disclosing information for individual farms.

Index Map of Michigan Counties

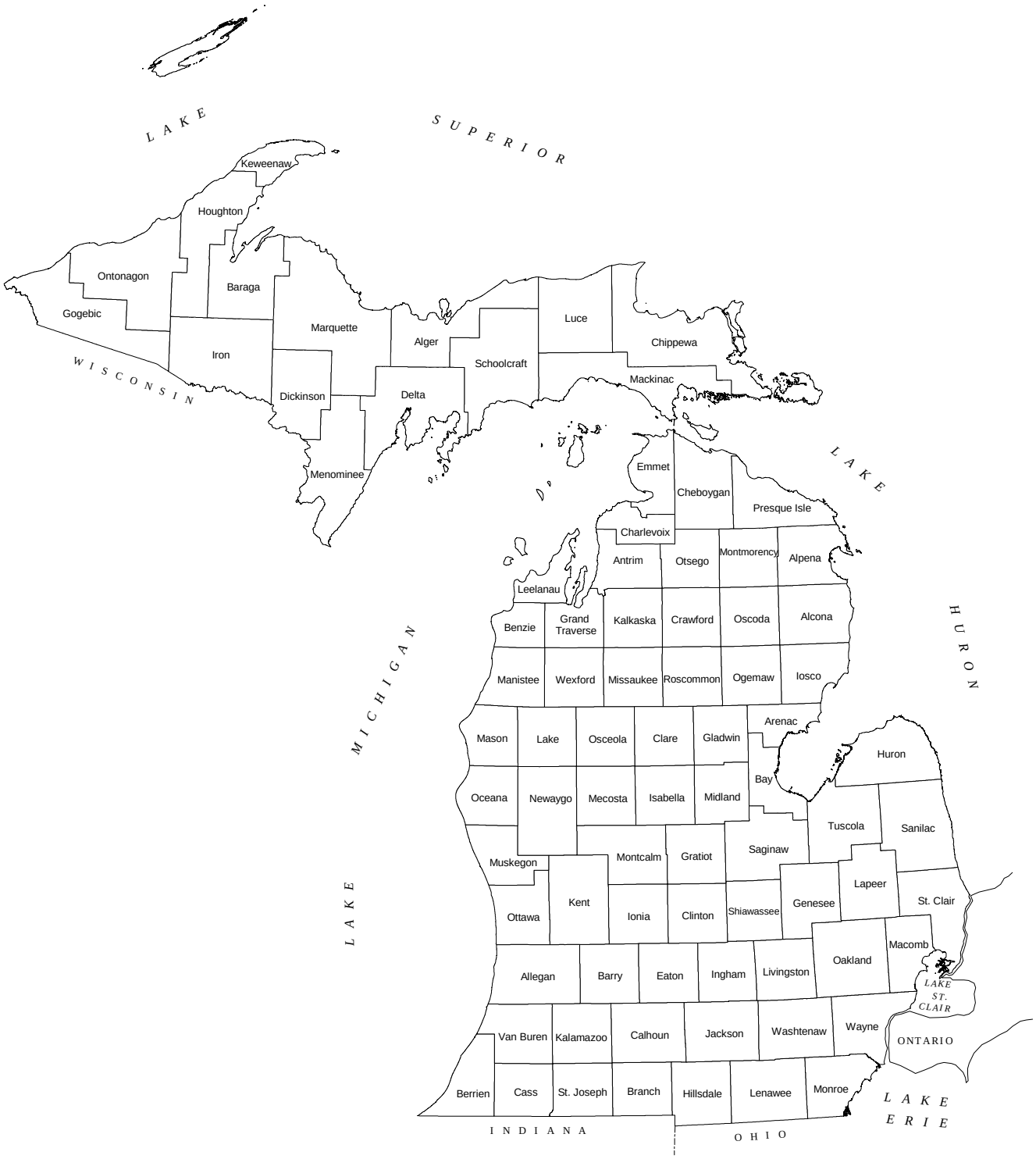


Table 2: 2001 Estimated Water Withdrawals for Agricultural Irrigation in Michigan, by Hydrologic Basin*

Hydrologic Basin Code	1997 Irrigated Farms ≥ 14 Acres: Number of Farms	1997 Irrigated Farms ≥ 14 Acres: Irrigated Acres	2001 Estimated Water Withdrawn (MGD): Great Lakes	Surface Water	Ground Water	Total
04010302	0	0	0.00	0.00	0.00	0.00
04020101	0	0	0.00	0.00	0.00	0.00
04020102	0	0	0.00	0.00	0.00	0.00
04020103	0	0	0.00	0.00	0.00	0.00
04020104	(D)	(D)	(D)	(D)	(D)	(D)
04020105	0	0	0.00	0.00	0.00	0.00
04020201	(D)	(D)	(D)	(D)	(D)	(D)
04020202	(D)	(D)	(D)	(D)	(D)	(D)
04020203	0	0	0.00	0.00	0.00	0.00
04030106	0	0	0.00	0.00	0.00	0.00
04030107	4	435	0.00	0.43	0.08	0.51
04030108	7	452	0.00	0.26	0.14	0.39
04030109	(D)	(D)	(D)	(D)	(D)	(D)
04030110	4	760	0.00	0.45	0.11	0.56
04030111	(D)	(D)	(D)	(D)	(D)	(D)
04030112	0	0	0.00	0.00	0.00	0.00
04040001	4	139	0.00	0.03	0.04	0.07
04050001	574	184,225	0.00	26.88	53.43	80.31
04050002	124	12,983	0.00	2.62	4.83	7.45
04050003	137	23,253	0.00	5.72	5.46	11.18
04050004	37	6,814	0.00	1.97	2.33	4.31
04050005	40	6,111	0.00	1.02	2.49	3.50
04050006	173	46,233	0.24	5.51	23.91	29.66
04050007	17	2,747	0.00	0.60	0.74	1.34
04060101	60	7,620	0.32	1.20	2.52	4.05
04060102	70	26,056	1.24	2.19	10.95	14.39
04060103	29	6,209	0.00	0.89	4.01	4.90
04060104	30	1,911	0.00	0.12	1.06	1.19
04060105	60	5,797	0.06	0.24	4.89	5.19
04060106	(D)	(D)	(D)	(D)	(D)	(D)
04060107	0	0	0.00	0.00	0.00	0.00
04070001	(D)	(D)	(D)	(D)	(D)	(D)

Hydrologic Basin Code	1997 Irrigated Farms ≥ 14 Acres: Number of Farms	1997 Irrigated Farms ≥ 14 Acres: Irrigated Acres	2001 Estimated Water Withdrawn (MGD): Great Lakes	Surface Water	Ground Water	Total
04070002	0	0	0.00	0.00	0.00	0.00
04070003	14	2,227	0.00	1.11	1.68	2.78
04070004	4	350	0.00	0.03	0.40	0.43
04070005	(D)	(D)	(D)	(D)	(D)	(D)
04070006	8	1,495	0.00	0.35	0.99	1.34
04070007	(D)	(D)	(D)	(D)	(D)	(D)
04080101	4	1,021	0.03	0.16	0.53	0.72
04080102	10	1,458	0.13	0.59	0.06	0.78
04080103	54	11,072	3.82	2.26	2.37	8.46
04080104	6	537	0.15	0.07	0.15	0.37
04080201	6	233	0.00	0.02	0.08	0.11
04080202	25	4,295	0.00	0.45	1.77	2.22
04080203	17	1,310	0.00	0.60	0.47	1.08
04080204	23	4,398	0.00	1.61	2.42	4.03
04080205	16	2,729	0.47	0.28	1.67	2.42
04080206	9	1,805	0.06	0.53	0.60	1.19
04090001	27	4,078	0.00	1.20	1.44	2.64
04090002	0	0	0.00	0.00	0.00	0.00
04090003	25	1,992	0.06	0.87	0.34	1.27
04090004	7	362	0.06	0.03	0.14	0.23
04090005	27	3,649	0.17	0.68	1.19	2.04
04100001	15	3,009	0.02	1.63	0.70	2.34
04100002	32	6,006	0.00	1.91	0.84	2.75
04100003	(D)	(D)	(D)	(D)	(D)	(D)
04100006	(D)	(D)	(D)	(D)	(D)	(D)
Other Basins	13	1,057	0.00	0.32	0.48	0.80
Total	1,712	384,828	6.83	64.83	135.31	206.96

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Note: (D) represents data withheld to avoid disclosing information for individual farms.

Index Map of Michigan Hydrologic Basins

Table 3: 2001 Estimated Water Withdrawals for Irrigated Crops in Michigan, by Crop Type*

Crop Name	1997 Irrigated Farms ≥ 14 Acres	Irrigated Acres	2001 Estimated Water Withdrawn (MGD)
Corn for Grain or Seed	716	164,036	70.44
Corn for Silage or Green Chop	87	6,130	2.68
Popcorn	13	2,836	0.78
Soybeans	360	47,460	26.93
Dry Edible Beans (Navy, Black, etc.)	77	11,363	7.08
Snap Beans (Bush and Pole)	113	13,045	7.77
Wheat	61	7,727	3.33
Oats	15	703	0.32
Rye	10	384	0.15
Barley	5	148	0.06
Sorghum	7	326	0.23
Alfalfa/Hay/Silage	173	10,109	3.88
Potatoes	134	33,425	39.41
Sugar Beets	36	2,430	1.33
Vegetables - Group 1	94	3,693	1.68
Vegetables - Group 2	314	23,214	5.48
Vegetables - Group 3	381	14,148	4.14
Sweet Corn	93	2,319	1.09
Asparagus	5	231	0.14
Fruit Trees & Grapevines	168	11,261	6.41
Blackberries	5	5	0.00
Blueberries	162	8,794	3.95
Cranberries	3	14	0.01
Raspberries	41	152	0.07
Strawberries	79	652	0.30
Nursery & Greenhouse Crops (includes sod)	160	19,679	19.15
Mint	6	544	0.13
Total		384,828	206.96

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Vegetables - Group 1: turnips and tomatoes

Vegetables - Group 2: lettuce and romaine, cucumbers and pickles, radishes, cantaloups and muskmelons, honeydew melons, broccoli, cabbage, cauliflower, collards, mustard greens, spinach, and watermelons

Vegetables - Group 3: sweet peppers, hot peppers, green peas, eggplant, pumpkins, dry onions, green onions, carrots, celery, squash, rhubarb, beets, and lima beans