

Monitoring Michigan Lakes



**WATER RESOURCES DIVISION
MICHIGAN DEPT OF ENVIRONMENTAL
QUALITY**

Mike Walterhouse



Inland Lakes

- Water Chemistry
- Pathogens
- Fish Contaminants
- Wildlife Contaminants
- Sediment Chemistry
- AIS
- Biological Condition



TMDL Lake Monitoring



Where

- Lake Allegan
- Lake Macatawa
- Ford & Belleville Lakes
- Upper Huron Lakes

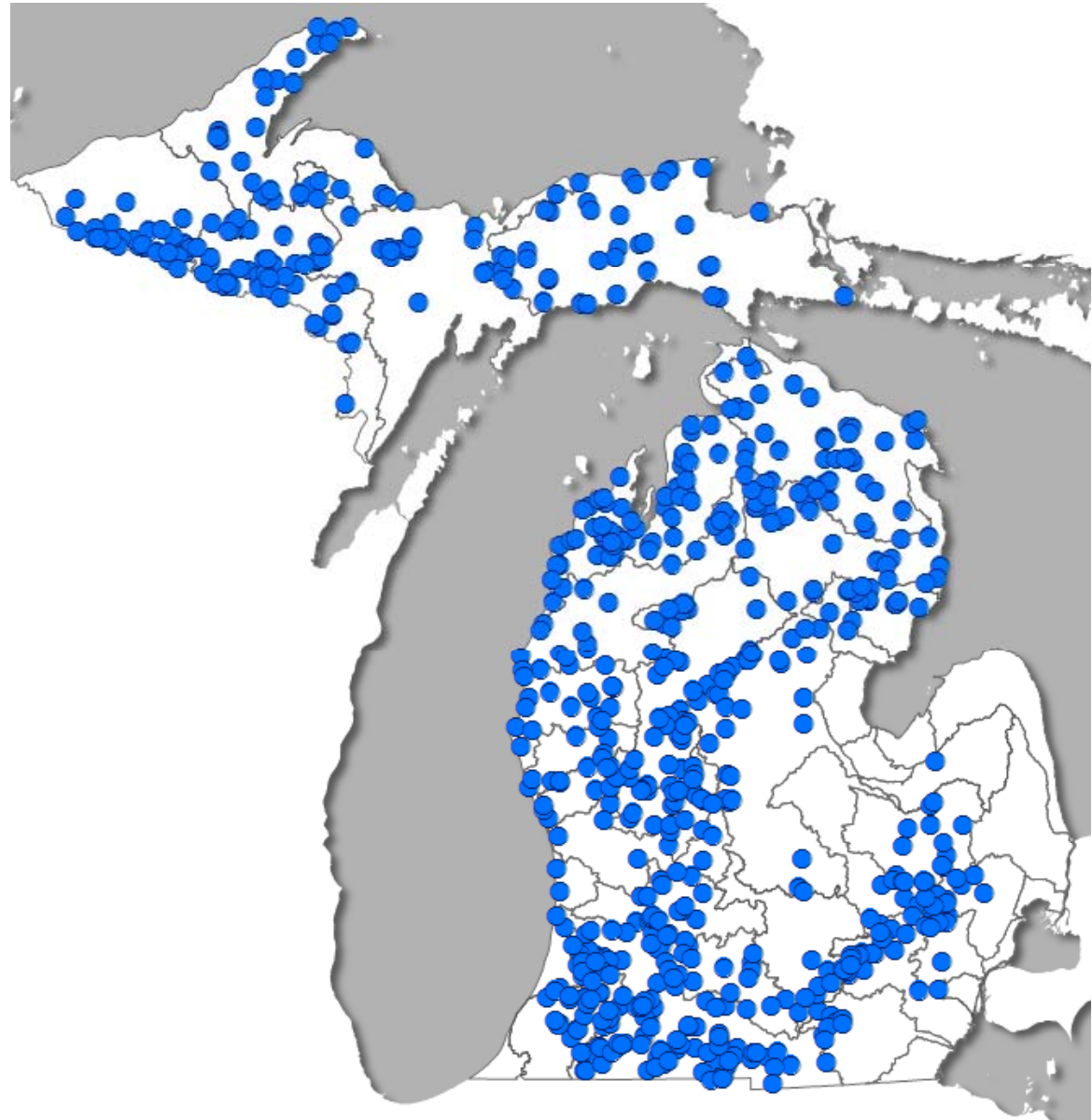
What & When

- Nutrients
- Conventional Pollutants
- Temperature/Dissolved Oxygen Profiles
- Microcystin (emerging issue)
- Typically monthly April – September
- Every other year



Lake Water Quality Assessment

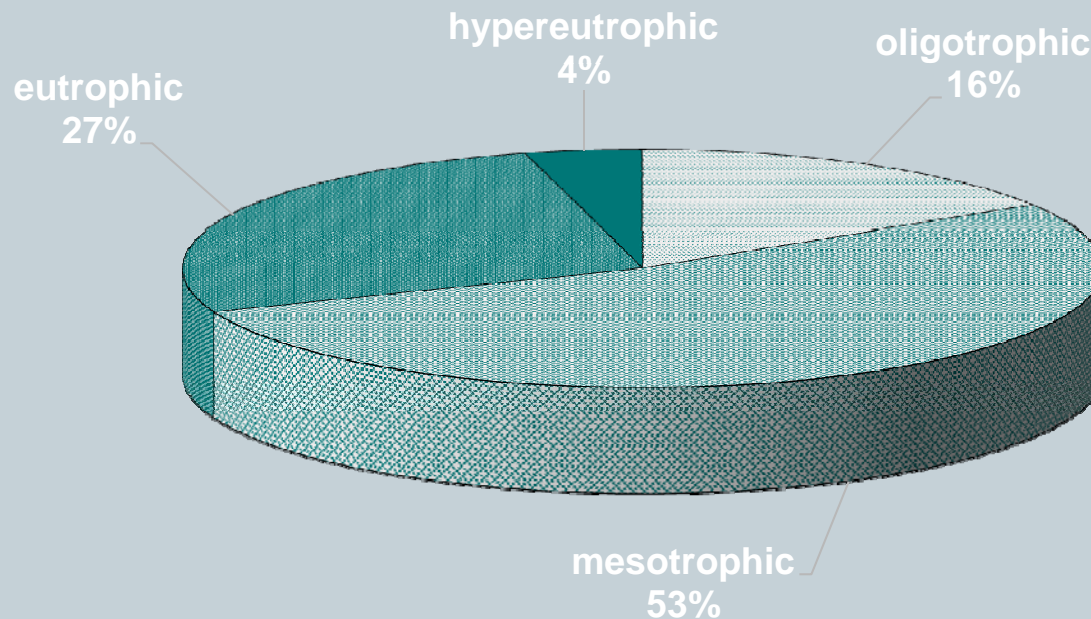
- Trophic Status
 - Sampling
 - Satellite imagery



... more on Lake Water Quality Assessment

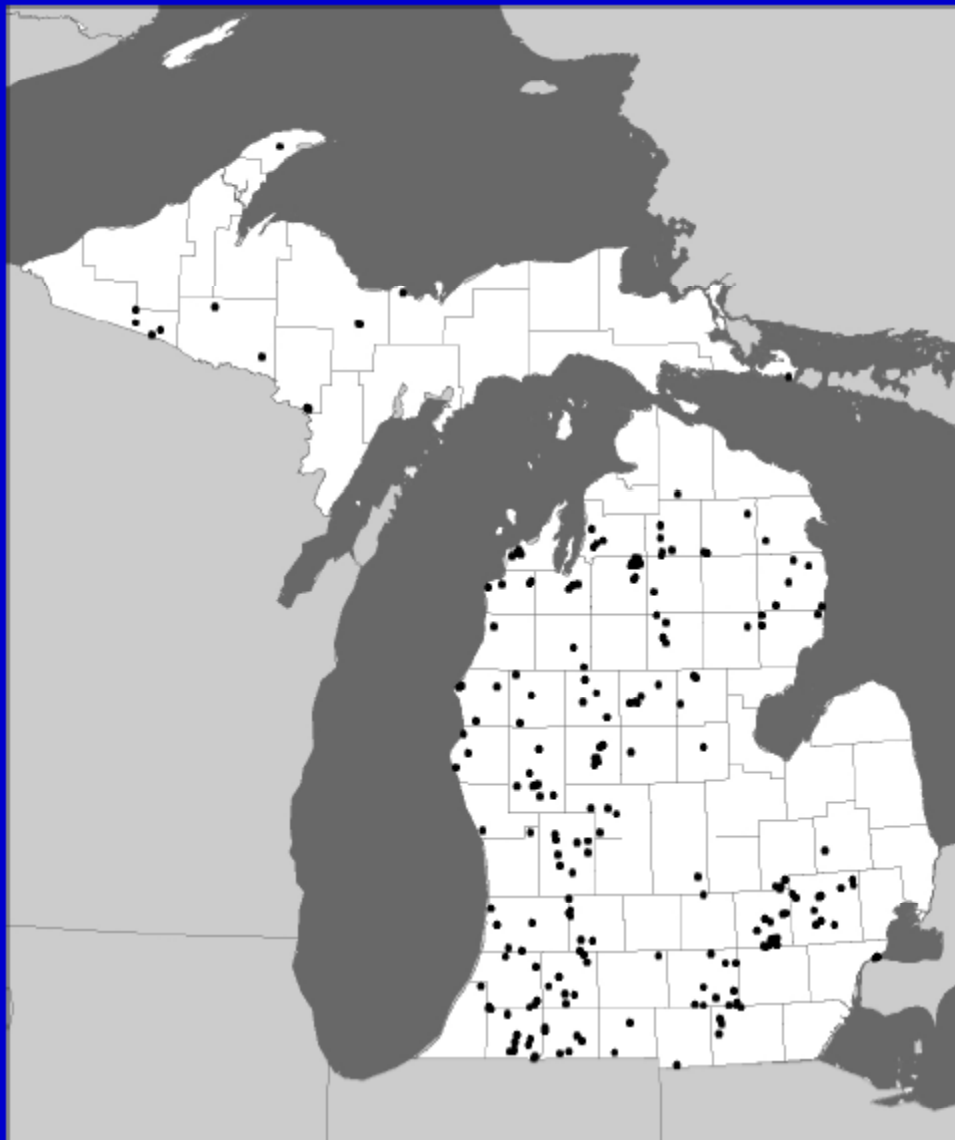


- Inland Lake Quality – Trophic condition in 729 public access lakes



Cooperative Lakes Monitoring Program (CLMP)

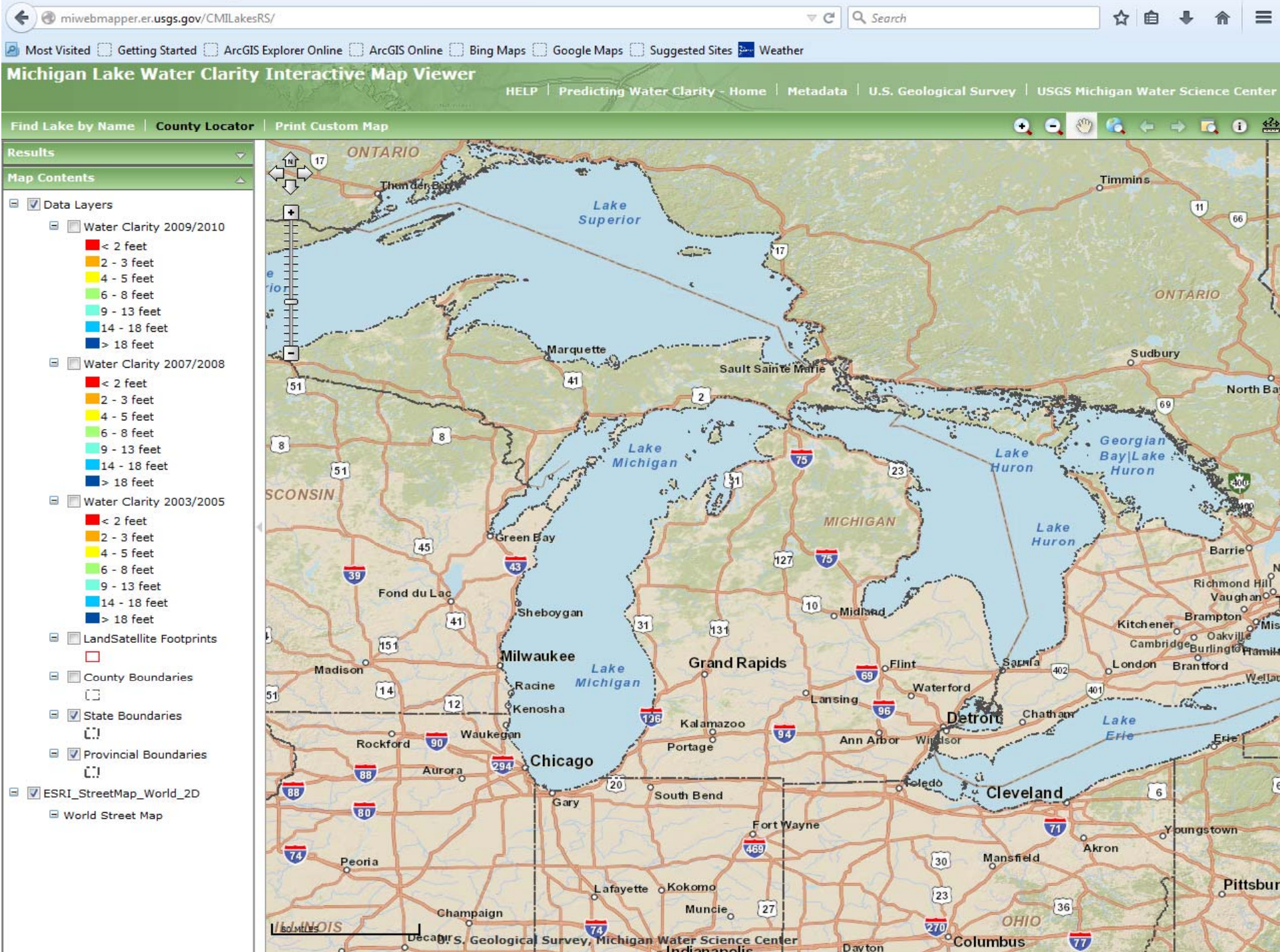




CLMP Membership

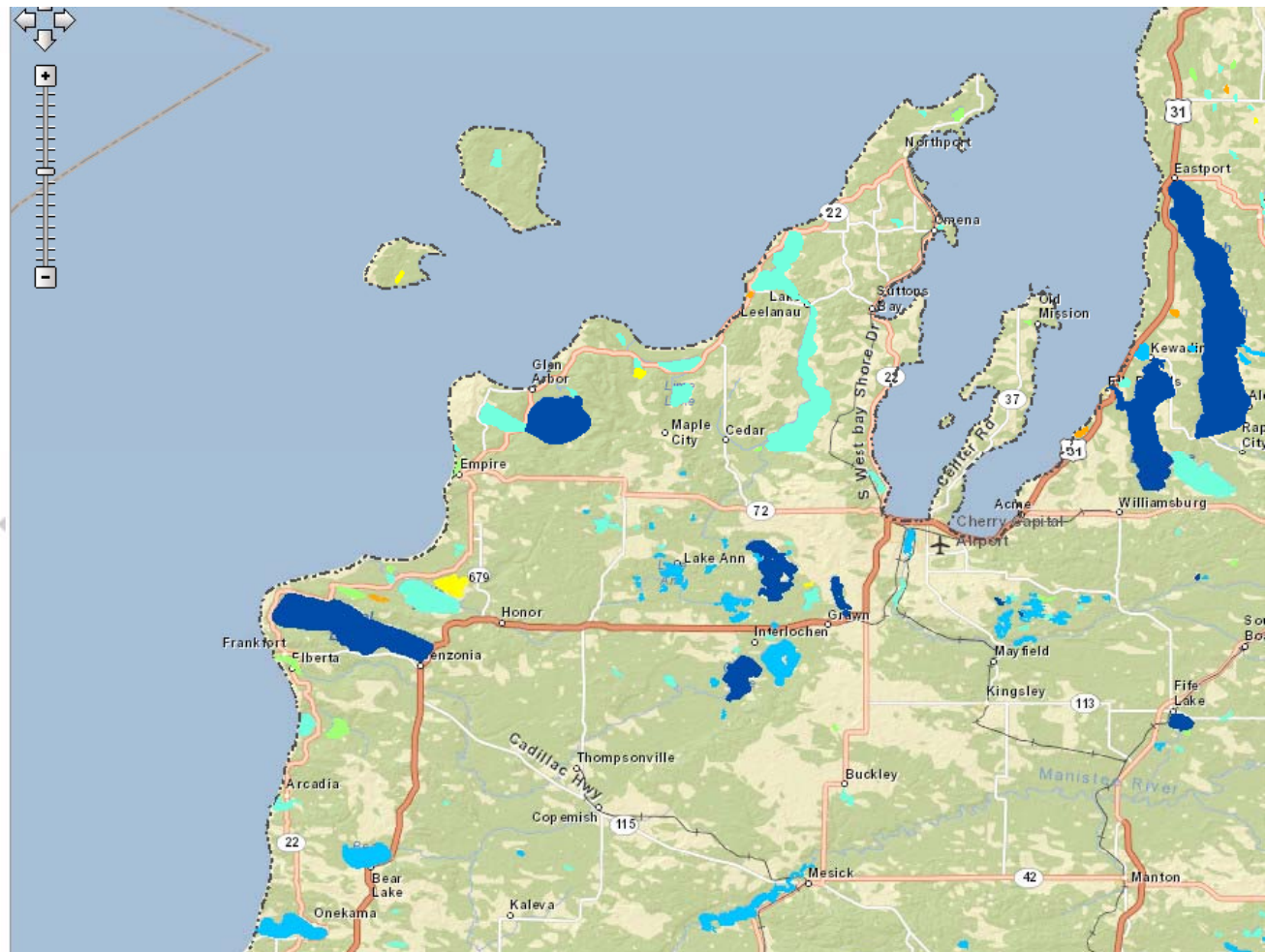
2013 number:
~225 Lakes
monitored by
lake
associations or
individuals





Map Contents

- ☒ Data Layers
 - ☒ Water Clarity 2009/2010
 - < 2 feet
 - 2 - 3 feet
 - 4 - 5 feet
 - 6 - 8 feet
 - 9 - 13 feet
 - 14 - 18 feet
 - > 18 feet
 - ☐ Water Clarity 2007/2008
 - < 2 feet
 - 2 - 3 feet
 - 4 - 5 feet
 - 6 - 8 feet
 - 9 - 13 feet
 - 14 - 18 feet
 - > 18 feet
 - ☐ Water Clarity 2003/2005
 - < 2 feet
 - 2 - 3 feet
 - 4 - 5 feet
 - 6 - 8 feet
 - 9 - 13 feet
 - 14 - 18 feet
 - > 18 feet
 - ☐ LandSatellite Footprints
 - ☐ County Boundaries
 - ☒ State Boundaries
 - ☒ Provincial Boundaries
 - ☒ ESRI_StreetMap_World_2D
 - World Street Map



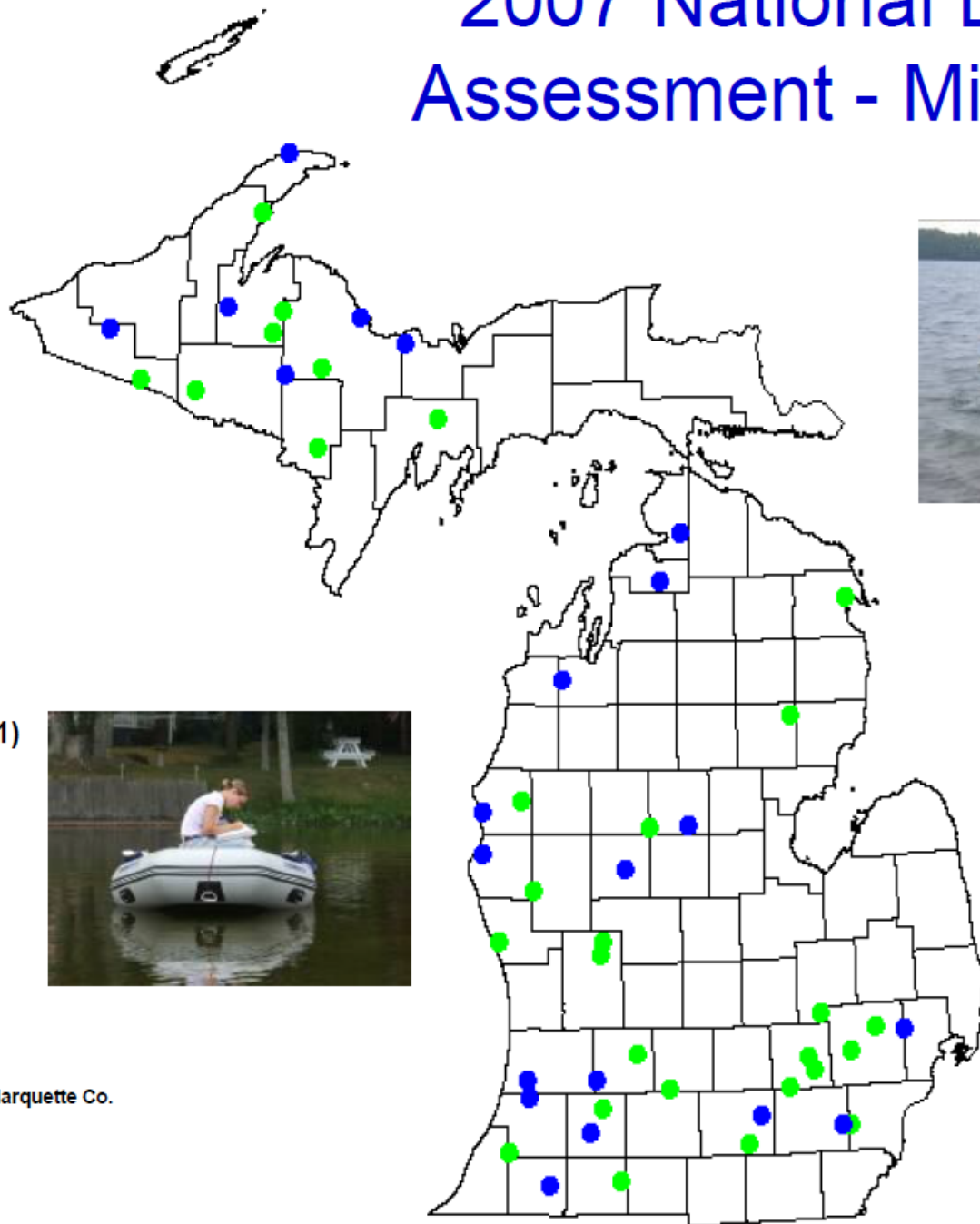
● EPA NLA Survey Lakes (MI = 29)

Lake Besser, Alpena Co.
 Fence Lake, Baraga Co.
 Thornapple Lake, Barry Co.
 Eight Point Lake, Clare Co.
 McDonald Lake, Delta Co.
 Bloomgreen Marsh, Dickinson Co.
 Pine Lake, Eaton Co.
 Squaw Lake, Genesee Co.
 Loon Lake, Gogebic Co.
 Mud Lake, Houghton Co.
 Silver Lake, Iron Co.
 Clark Lake, Jackson Co.
 Campbell Lake, Kalamazoo Co.
 Pine Lake, Kent Co.
 Stoner Lake, Kent Co.
 Brighton Lake, Livingston Co.
 Hi-Land Lake, Livingston Co.
 Lake Chemung, Livingston Co.
 Dewey Lake, Marquette Co.
 Keewaydin Lake, Marquette Co.
 Tallman Lake, Mason Co.
 Muskegon Lake, Muskegon Co.
 Martin Lake, Newaygo Co.
 Bogie Lake, Oakland Co.
 Mill Lake, Oakland Co.
 Au Sable Lake, Ogemaw Co.
 Palmer Lake, St. Joseph Co.
 Round Lake, Van Buren Co.
 Belleville Lake, Wayne Co.

● MI State-scale Lakes (+21)

Howe Lake, Alger Co.
 Upper Scott Lake, Allegan Co.
 Big Lake, Baraga Co.
 Warner Lake, Barry Co.
 Donnell Lake, Cass Co.
 Deer Lake, Charlevoix Co.
 No Name Lake, Clare Co.
 Crooked Lake, Emmet Co.
 Lake Gogebic, Gogebic Co.
 Bridge Lake, Grand Traverse Co.
 Tims Lake, Jackson Co.
 West Lake, Kalamazoo Co.
 Lake Bailey, Keweenaw Co.
 Stony Creek Lake, Macomb Co.
 Forestville Impoundment, Dead River, Marquette Co.
 Lotto Lake, Marquette Co.
 Pere Marquette Lake, Mason Co.
 Blue Lake, Mecosta Co.
 Wyckoff Lake, Oceana Co.
 Lake Saddle, Van Buren Co.
 Ford Lake, Washtenaw Co.

2007 National Lakes Assessment - Michigan



The NLA and MI Lakes Management

- Support for Low Impact Development
 - habitat alteration is a major stressor for MI lakes
 - supports the need to address mitigation of lakeshore habitat impacts



● EPA NLA07RVT Lakes (MI = 18)

Pine Lake, Kent Co.
Pere Marquette Lake, Mason Co.
Au Sable Lake, Ogemaw Co.
Saddle Lake, Van Buren Co.
Muskegon Lake, Muskegon Co.
Deer Lake, Charlevoix Co.
Crooked Lake, Emmet Co.
Round Lake, Van Buren Co.
Thornapple Lake, Barry Co.
Mill Lake, Oakland Co.
Ford Lake, Washtenaw
Palmer Lake, St. Joseph Co.
Blue Lake, Mecosta Co.
Brighton Lake, Livingston Co.
West Lake, Kalamazoo Co.
Mud Lake, Houghton Co.
Bogle Lake, Oakland Co.
Silver Lake, Iron Co.

● EPA NLA12NAT (MI = 20)

Garwood Lake, Berrien Co.
Clear Lake, Montmorency Co.
Fourth Lake, Hillsdale Co.
Crocker Lake, Muskegon Co.
Bella Lake, Baraga Co.
Seventh Speotaale Lake, Otsego Co.
Crooked Lake, Kalamazoo Co.
Windover Lake, Clare Co.
Patriola Lake, Charlevoix Co.
Lake Mary, Menominee Co.
Middle Black Lake, Kalkaska Co.
Little Portage Lake, Washtenaw Co.
Coady Lake, Montcalm Co.
No Name Lake, Marquette Co.
Thompson Lake, Mackinac Co.
School Lake, Calhoun Co.
Lake Alloe, Baraga Co.
Mud Lake, Isabella Co.
No Name Lake, Cass Co.
Pogy Lake, Mecosta Co.

● State-scale NLA12ST (MI = 15)

South Pond, Dickinson Co.
Ionia Lake, Alger Co.
Hawk Island Park Lake, Ingham Co.
Huckleberry Lake, Allegan Co.
Jones Lake, Ingham Co.
Lake Mitchell, Wexford Co.
Bass Lake, Luon Co.
Powell Lake, Marquette Co.
Clear Lake, Muskegon Co.
Forrest Lake, Shiawassee Co.
Tupper Lake, Ionia Co.
Gasley Lake, Iron Co.
Stewart Lake, Barry Co.
Little Glen Lake, Leelanau Co.
Suoker Lake, Schoolcraft Co.



FACT SHEET

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Image: DEQ



National Lake Assessment (NLA)

In the summer of 2012, Michigan participated in the U.S. Environmental Protection Agency's nationwide survey of the condition of inland lakes to help measure the health of our waters, take actions to prevent pollution, and evaluate restoration activities. Mill Lake was one of 53 Michigan inland lakes that were sampled as part of the National Lake Assessment. This fact sheet contains data collected from that study as well as the 2007 NLA Study in Table 1.

MI Lake Water Quality Assessment

From 2001 - 2010, 729 public access lakes were monitored for baseline lake condition. Water quality parameters include nutrients (nitrogen and phosphorus), chlorophyll *a*, water clarity (Secchi depth), color, dissolved oxygen, water temperature, specific conductance, pH, alkalinity, hardness, and major ions such as calcium, magnesium, sodium and chloride. Statewide averages of this data are also presented in Table 1 for comparison purposes with the NLA data.

What is a lake watershed?

It is all of the land and water area that drains to the lake. Land use in the watershed impacts the water quality of the lake.

Watershed Land Use Type	Percentage
Agriculture	3%
Developed	37%
Forest	21%
Water	11%
Wetland	24%
Other	4%

Mill Lake Facts

- **Location**– central Oakland County
Lat: 42.74529, Long: -83.311
- **Lake Area**– 27.7 acres
- **Watershed Area**– 9.3 square miles
- **Maximum Depth**– 33 feet
- **Inlet**–Channel from Voorheis Lake
- **Outlet**–Sashabaw Creek
- **Lake level control structure?** –No
- **Shoreline**– Residential and forest
- **No public boat launch**
- **Trophic Status**–*oligotrophic*
- **Microcystin**– present, but low risk
- **Invasive Species Observed (NLA)**
 - Curly-leaf pondweed
 - Eurasian watermilfoil
 - *Phragmites*
 - Purple Loosestrife
 - Reed canary grass
 - Zebra mussels

www.mi.gov/deqaquaticinvasives

Land Use in Mill Lake Watershed

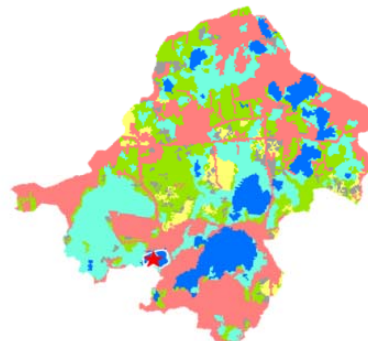




Image: DEQ

Trophic Status Index (TSI)

- A way to classify a lake. It describes the amount of nutrients and plant growth. The classification is based on three measurements:

Chlorophyll a concentration

- a measure of the amount of algae in the water

Total Phosphorus concentration

- a measure of a critical nutrient that allows algal and plant growth

Secchi Depth Transparency

- a measure of water clarity and the depth at which algae and plants can grow.

Lakes are often put into three classifications:

Oligotrophic-has low nutrient concentrations and low plant growth.

Mesotrophic- has moderate nutrient concentrations and plant growth.

Eutrophic-has high nutrients and high plant growth

The **water temperature** and **dissolved oxygen levels** at different water depths are also important for plants, fish, and other organisms in the lake. The dissolved oxygen and temperature stratification of this lake is typical for a mesotrophic lake. See Figure 1 and www.micorps.net for more information.

What is toxic algae, and is it in this lake?

- Green algae and bluegreen algae are natural and present in most lakes.
- A **harmful algal bloom** is when large amounts of blue-green algae have released algal toxins.
- We test the water for **microcystins**, which is a type of blue-green algae toxin. If levels are 20 micrograms per liter or larger, it is advised by the World Health Organization that no swimming or other recreation take place in the water

For More Information:



www.deq.state.mi.us/beach/



MiCorps www.micorps.net
Monitoring Michigan's Water Quality



DEQ Lake Water Quality
Monitoring Information:
www.mi.gov/deqinlandlakes



<http://ifr.snre.umich.edu/MiFISH>



<http://water.epa.gov/type/lakes/>

Figure 1. Dissolved Oxygen and Temperature Profile for Mill Lake

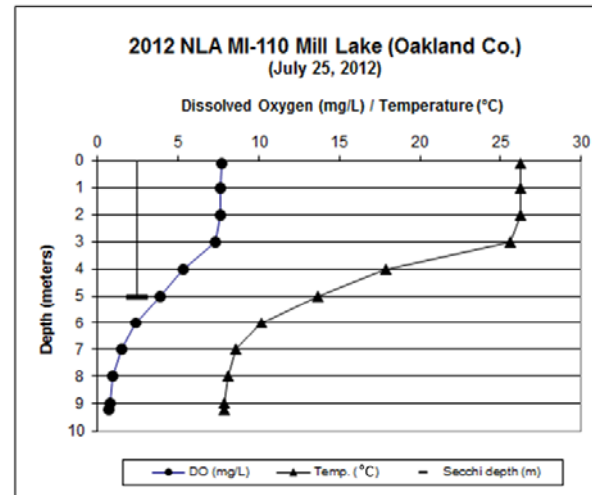


Table 1. Water quality parameters collected as part of National Lake Assessment (NLA) 2007, 2012, or compared with statewide averages from Michigan's Lake Water Quality Assessment (LWQA) 2001-2010.

Parameter	NLA (8/16/2007)	NLA (7/25/2012)	Statewide Average LWQA 2001-2010 (± Standard Deviation)
Surface temperature (°C)	25.0	26.2	23.9 (2.2)
Surface dissolved oxygen (mg/l)	8.0	7.6	8.1 (1.0)
Total phosphorus (µg/l)	5.0	10.0	16 (16)
Total Nitrogen (mg/l)	0.6	0.6	0.6 (0.4)
Chlorophyll-a (µg/l)	2.0	1.5	6.1 (10.0)
Secchi depth transparency (m)	4.5	5.1	3.1 (1.5)
pH	8.2	8.4	8.2 (0.5)
Conductivity (µS/cm)	631.2	620.0	271.1 (157.8)
Calcium (mg/l)	60.0	55.1	34.2 (19.0)
Magnesium (mg/l)	19.2	18.4	11.1 (6.6)
Sodium (mg/l)	37.7	42.3	8.3 (13.0)
Potassium (mg/l)	2.0	1.9	1.2 (0.8)
Sulfate (mg/l)	16.3	17.6	10.5 (12.6)
Chloride (mg/l)	81.3	79.8	16.7 (25.1)
Acid Neutralizing capacity (mg/l CaCO ₃)	364.6	348.8	109.5 (58.2)
Dissolved Organic Carbon (mg/l)	8.9	8.7	.
Turbidity (NTU)	1.1	0.3	.
Trophic State Index	34	36	45
Trophic State	oligotrophic	oligotrophic	mesotrophic
Atrazine (µg/l)	.	0.0	.
Microcystin (µg/l; algae toxin)	.	.	.
World Health Organization Risk Category: <10 Low risk, 10-20 Moderate risk, >20 High risk	0.1	0.1	.

Inland Lake Beaches

- Voluntary & conducted by local health departments, paid for with MDEQ grant dollars
- 153-269/yr out of 571 public beaches



Michigan Department of Environmental Quality

BeachGuard Home | Michigan.gov Home | Search/Export | RSS | About | Log In | Beach Search:

Welcome to the Michigan BeachGuard System, a public resource provided by Michigan DEQ for information on Michigan beach water quality sampling results and beach advisories and closures.

Michigan Beaches

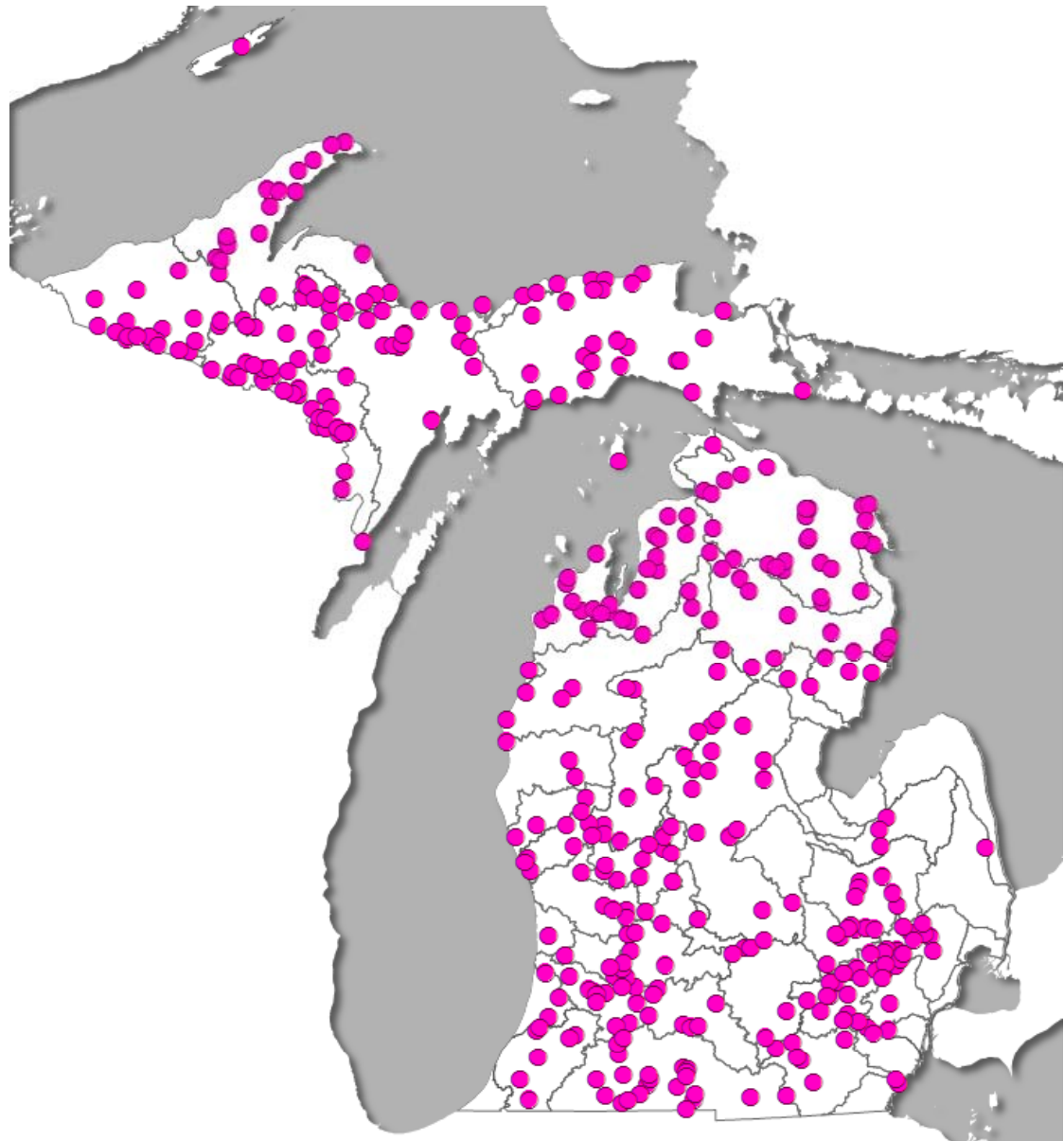
- [1222 Public Beaches](#)
- [509 Private Beaches](#)
- [Closures and Advisories](#)**
- No Current Closures or Advisories





Fish Contaminants in Inland Lakes

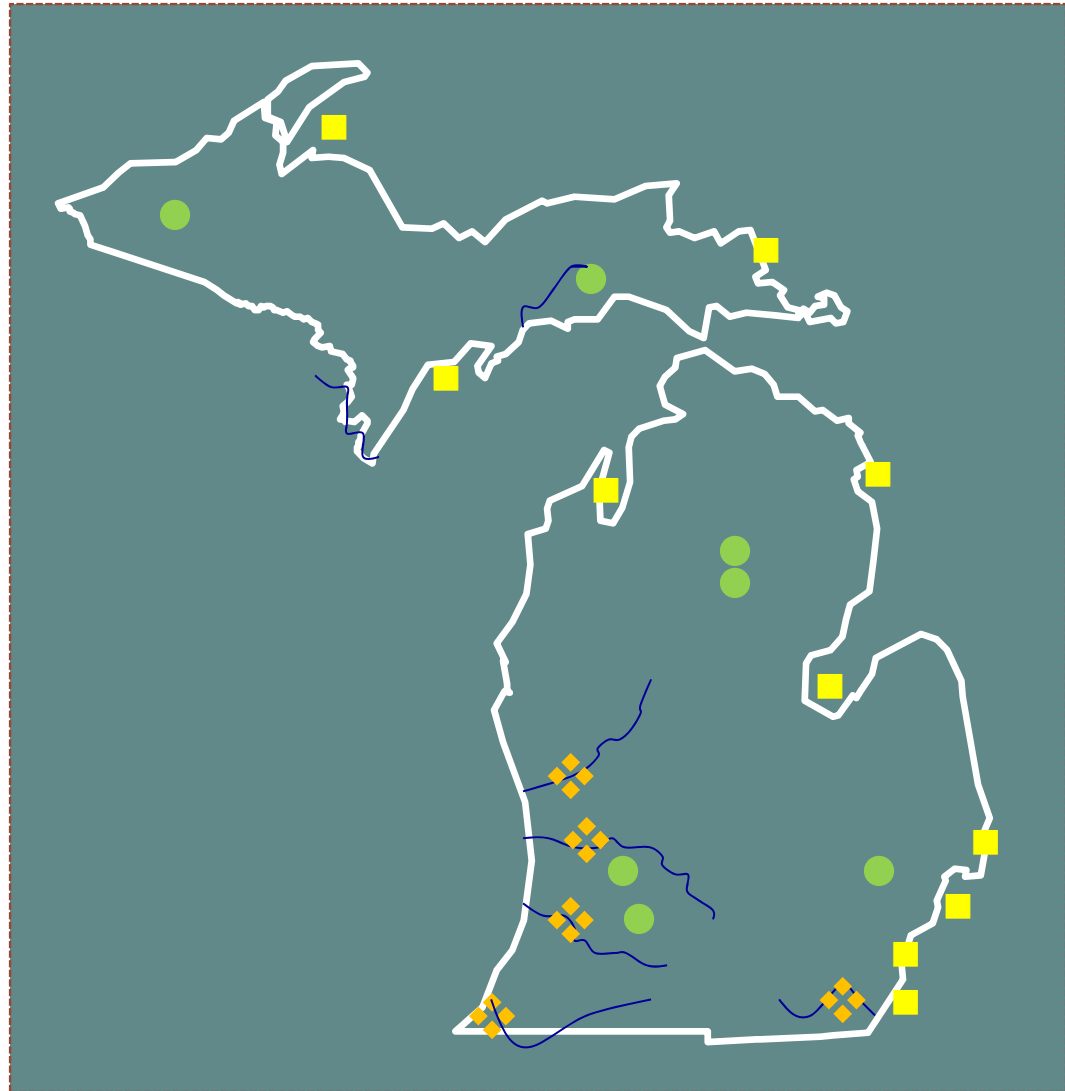
- Inland Lakes
- Drowned River Mouths
- Impoundments
- Since 1981-399 sites-30 species
- Current effort ~30 lakes/yr





Fish Contaminant Trends in Inland Lakes & Great Lakes

- 22 Fixed Stations
- 7 Inland Lakes
- 10 Great Lake/
Connecting
Channels
- 5 River
Impoundments



Wildlife Contaminants



- **Bald Eagle Nestling Plasma/Feathers**
 - 1999 to present
 - Persistent and toxic contaminants
 - Evaluate spatial and temporal trends
 - Comparing these data to historic data in literature
 - About 30 inland sites per year

Sediment Chemistry in Inland Lakes

- Sediment Chemistry Trend Monitoring
- 58 Lakes sampled from 1999-2010
- Collection and analysis of high-quality sediment cores



In the Collaborative Hopper

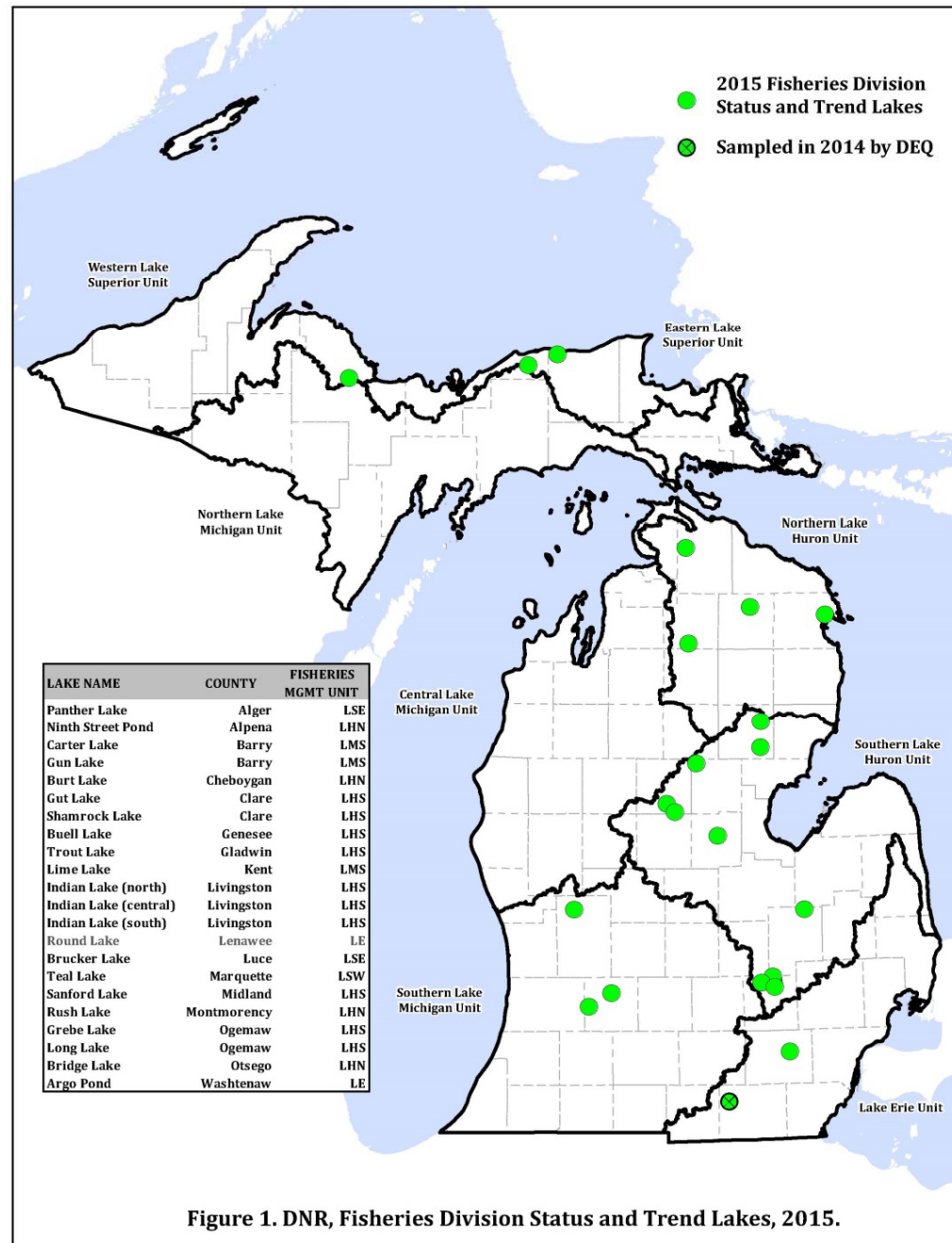


Fish Division Status and Trend Lakes

- Since 2001, > 500 lakes, > 10 acres, broader definition of public access

Current Data- 25-30 Lakes/Yr

- Fish Community
- Temp/DO profiles Secchi
- Nutrients Chlorophyll *a* Color Alkalinity
- # of Houses # of Docks Large Woody Debris
- % Armored Shoreline Zooplankton AIS



DEQ Additions

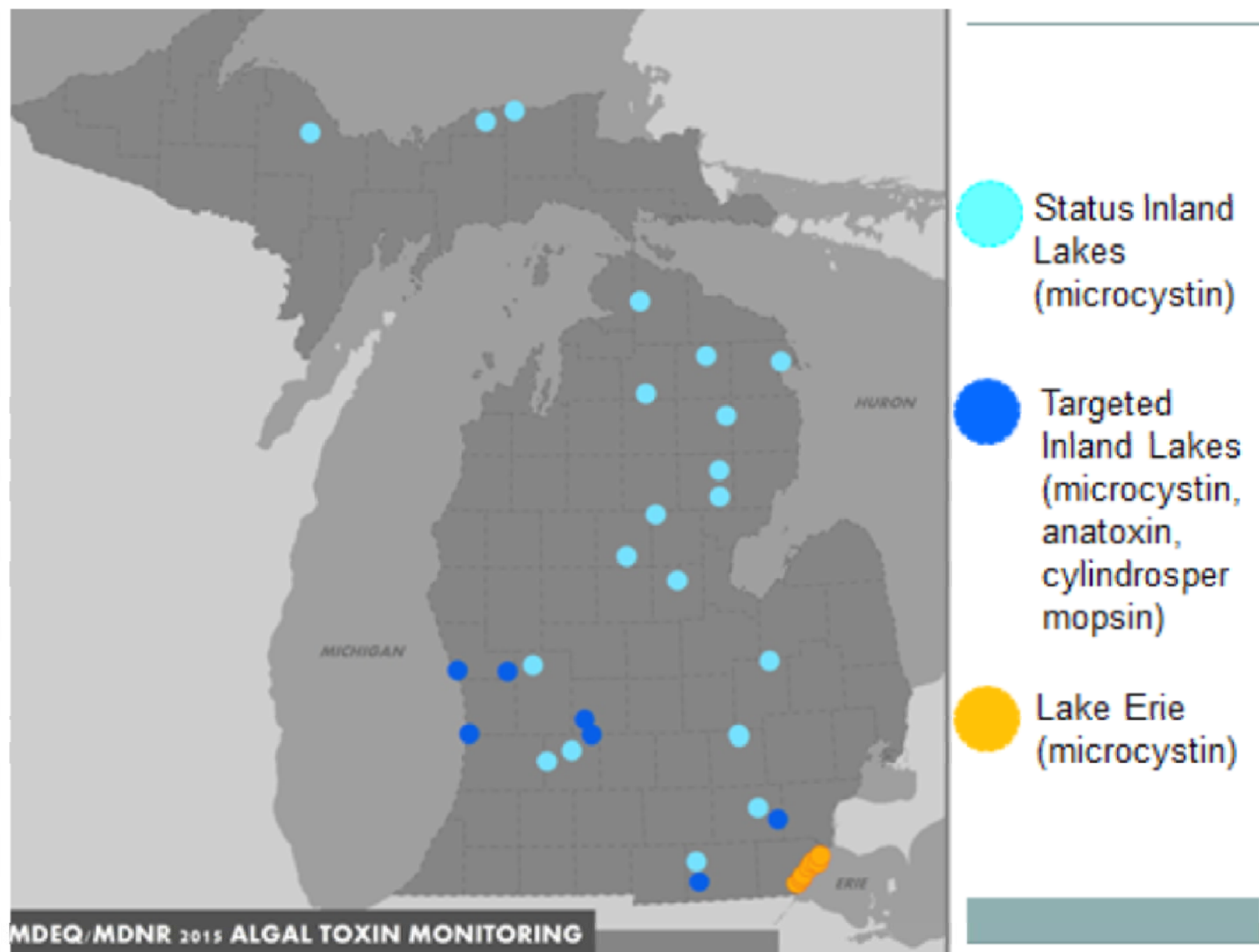


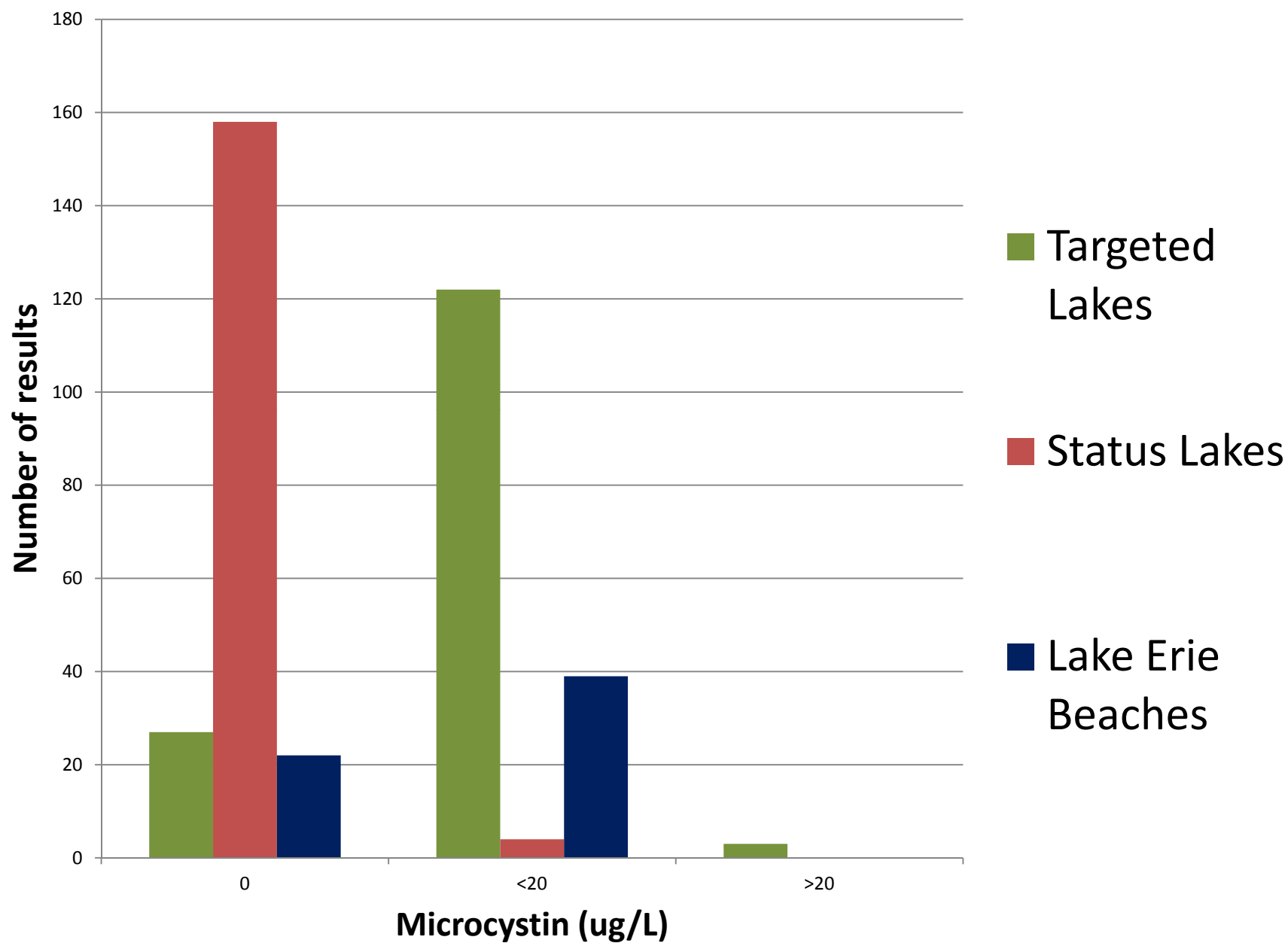
Spring Turnover

- Temp/DO Profiles
- T. Phos & Nitrogen Compounds
- Chlorophyll *a*
- Secchi
- Cl, SO₄, Ca, Mg, Na, K, Alk, color, hardness

Summer

- Temp/DO Profiles
- T. Phos & Nitrogen Compounds, Alk
- Chlorophyll *a*, Color
- Secchi
- % Emergent Vegetation
- % Lawn/Beach
- Natural riparian width, density & structure
- Submerged Aquatic vegetation surveys
- HABs
- AIS





August Fun in da UP

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