MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY
WATER RESOURCES DIVISION
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STAFF REPORT

Inland Lake Nutrient Expression Assessment for 2020, 2022, and 2024 Integrated Reports

Introduction

Beginning with the 2020 Integrated Report, the Michigan Department of Environment, Great Lakes, and Energy (EGLE) developed an updated Assessment Methodology to document and assess the extent, severity, and frequency of nutrient-related conditions in inland lakes. This guidance advanced our designated use assessment methods related to Clean Water Act Sections 305(b) and 303(d). Michigan Water Quality Standards (WQS) currently include narrative nutrient criteria, and it was necessary to develop more detailed assessment methods providing a clearer approach to make decisions on listing inland lakes as either supporting or not supporting designated uses due to impacts of nutrient enrichment.

Many types of data are useful in a 'weight of evidence' approach to determine designated use support. Supporting information may include a combination of Carlson's trophic state index (TSI); water chemistry results for various nutrients or cyanotoxins, as discussed below; reports of nutrient expression/blooms; aerial imagery showing the extent of visible blooms; aquatic nuisance control documentation; and aquatic macrophyte surveys. All are potentially useful in demonstrating impact to designated use support, although TSI and evidence of frequent, persistent blooms are most useful in demonstrating a nutrient-enriched system.

The primary objectives of the water quality monitoring and assessment were to:

1. Assess the trophic conditions, water quality, and extent of algae and macrophyte growth in highly productive inland lakes.
2. Identify inland lakes that are not meeting WQS and/or are affected by nuisance/harmful algal blooms.

Methods and Data Sources

Lake sampling conducted by EGLE staff followed protocols described in the Inland Lake Status and Trend Field Protocols document (Walterhouse 2015). Water chemistry data and plant and algae conditions were collected in mid to late summer. The following parameters were measured:

- Transparency (Secchi depth).
- Temperature, dissolved oxygen, conductivity, pH, and phycocyanin profiles using a YSI sonde.
- Chlorophyll a sample from photic zone.
- Phosphorus, ammonia nitrogen, nitrate + nitrite, and Kjeldahl nitrogen from the surface, bottom, and middle/metalimnion.
- Macrophyte observations and density estimates.

- Lake wide description of:
  - Algae color, algae description, locations within the lake with noticeable algae
- Littoral zone estimates for:
  - Percent coverage of emergent and floating vegetation (rush, lily pads, etc.).
  - Percent coverage of submerged macrophytes (milfoil, chara, etc.)
  - Average depth of emergent and floating vegetation.
  - Percentage shoreline with algal scum.

Recent EGLE monitoring data were considered along with historic data (Trophic State Index and nutrient concentrations from the Lake Water Quality Assessment [LWQA]); algae bloom complaints, permitted herbicide treatment, remote sensing imagery, and data collected by external groups such as the MiCorps program.

Briefly, the LWQA was a collaborative effort between EGLE and the United States Geological Survey (USGS) in which the water quality of 729 public access, inland lakes, that were >25 acres were assessed from 2001-2010. Using total phosphorus, Secchi disc depth, and chlorophyll a data, TSIs were calculated, and trophic states assigned to all assessed lakes (Fuller and Taricska 2012). Remote Sensing imagery was also collected and analyzed by the USGS from 1999-2013 for all Michigan inland lakes >20 acres. The satellite imagery was used to estimate lake Secchi depth and the TSI associated with that water clarity. The satellites collected images over Michigan spanning multiple years, but the exact amount of data collected for specific lakes varied depending on cloud cover at the time of image collection (Fuller and Jodoin 2016). Finally, the MiCorps program is a collaboration between EGLE, several non-profit organizations, and citizen volunteers who collect lake data including Secchi depth, chlorophyl, and total phosphorus. If enough data have been collected for a particular lake as part of this program, TSIs can be calculated. For more information about the MiCorps program see MiCorps.net/About/.

Site Selection

Lakes were selected for monitoring and assessment based on existing information indicating the lake may be hypereutrophic; harmful algal bloom complaints and/or EGLE documentation; and external requests for monitoring based on concerns about lake productivity. Lakes assessed as not supporting the Other Indigenous Aquatic Life and Wildlife Designated Use in the 2020, 2022, and 2024 Integrated Reports using the updated nutrient assessment methodology are provided in Table 1.

Table 1. List of lakes listed as not supporting the Other Indigenous Aquatic Life and Wildlife Designated Use in the 2020, 2022, and 2024 Integrated Reports.

Lake Name	County	Year listed
Crockery Lake	Ottawa	2020
Lake Hudson	Lenawee	2020
Loch Erin	Lenawee	2020
Mona Lake	Muskegon	2020
Thornapple Lake	Barry	2020
Van Etten Lake	Iosco	2020
Pontiac Lake	Oakland	2020
Lake Ovid	Clinton	2020
Diane Lake	Hillsdale	2022
Hess Lake	Newaygo	2022
Narrow Lake	Eaton	2022
Union Lake	Branch	2022
Reeds Lake	Kent	2022
Tamarack Lake	Montcalm	2024
Swan Lake	Allegan	2024
Holloway Reservoir	Genesee	2024
Kearsley Reservoir	Genesee	2024
C.S. Mott Lake	Genesee	2024
Thread Lake	Genesee	2024
Cranberry Lake	Ottawa	2024
Matteson Lake	Branch	2024

Summary of Findings

2020 Integrated Report

Eight lakes were listed as not meeting their Other Indigenous Aquatic Life/Wildlife (OIALW) and warmwater fishery designated uses in 2020. A list of the lakes and some of their general characteristics is provided in Table 2. Land cover percentages for the lake watersheds are provided in Table 3.

Table 2. Lakes listed as not meeting OIALW and warmwater fishery designated uses in 2020 Integrated Report and some of their location and physical characteristics.

Lake Name:	Crockery Lake	Lake Hudson	Loch Erin	Mona Lake	Thornapple Lake	Van Etten Lake	Pontiac Lake	Lake Ovid
County:	Ottawa	Lenawee	Lenawee	Muskegon	Barry	Iosco	Oakland	Clinton
Location Latitude:	43.1656	41.8292	42.0100	43.1793	42.6209	44.4643	42.66604	42.9379
Location Longitude:	-85.85786	-84.26117	-84.14169	-86.25853	-85.194	-83.35627	-83.45237	-84.4107
Watershed:	Lower Grand River	River Raisin	River Raisin	Black Creek	Thornapple River	Au Sable River	Huron	Maple
Lake Type:	Natural with dam	Natural with dam	Reservoir	Natural-DRM	Natural	Reservoir	Reservoir	Reservoir
Maximum Depth (ft):	54	24	12	42	33	33	34	15
Lake size (acres):	104	473	582	655	438.6	1320	585	412
Shoreline Development Factor:	1.6	3.4	4.4	3.8	3.2	2.2	4.7	2.6
Watershed/lake size ratio:	25.2	12.8	19.2	72.3	587.0	134.8	21.4	15.1

Table 3. Watershed land cover percentages of lakes listed as not meeting OIALW and warmwater fishery designated uses in 2020 Integrated Report.

Land Cover Type	Crockery Lake	Lake Hudson	Loch Erin	Mona Lake	Thornapple Lake	Van Etten Lake	Pontiac Lake	Lake Ovid
Open Water	0.5	1.0	4.4	0.4	0.7	0.7	2.5	0.0
Barren land	0.1	0.0	0.0	0.1	0.0	0.0	0.3	0.0
Development	9.1	4.9	14.3	38.3	7.8	7.3	22.0	7.9
Forest/shrub/grassland	7.2	18.2	20.5	30.6	13.7	56.1	41.4	22.8
Wetland	6.1	15.5	17.7	11.5	15.0	23.0	26.3	23.5
Agriculture	77.0	60.4	43.1	19.1	62.6	12.8	7.6	45.8

Crockery Lake

Crockery Lake is a natural lake, with a low-head dam at its outlet, in Ottawa County. The land use in the lake's watershed is overwhelmingly agricultural (Table 3). Monitoring of Crockery Lake was done through Cooperative Lakes Monitoring Program (CLMP), LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Crockery Lake have ranged from mesotrophic to hypereutrophic (Table 4). EGLE staff have received citizen complaints about algae in the lake and have confirmed the presence of cyanobacteria blooms. Lake management companies have historically treated algae and cyanobacteria with algicides and up to 40 percent of the littoral zone plants have been treated with herbicides.

Lake Hudson

Lake Hudson is a natural lake, with a low-head dam at its outlet, in Lenawee County. The land use in the lake's watershed is primarily agricultural (Table 3). Monitoring of Lake Hudson was done through LWQA, satellite monitoring, and direct sampling by EGLE. Trophic results for Lake Hudson have been eutrophic and hypereutrophic (Table 4). EGLE staff have received citizen complaints about algae in the lake and have confirmed the presence of cyanobacteria blooms.

Loch Erin

Loch Erin is a shallow reservoir in Lenawee County. The land use in the lake's watershed is 43 percent agricultural and 14 percent developed with the remaining cover natural (Table 3). Monitoring of Loch Erin was done through satellite monitoring, and sampling by EGLE. Trophic results for Loch Erin have been eutrophic and hypereutrophic (Table 4). EGLE staff have received citizen complaints about algae in the lake and have confirmed the presence of cyanobacteria blooms. Lake management companies have historically treated algae and cyanobacteria with algicides and up to 50 percent of the littoral zone plants have been treated with herbicides.

Mona Lake

Mona Lake is a natural, drowned-river mouth lake in Muskegon County. The land use in the lake's watershed is 19 percent agricultural and 19 percent developed with the remaining cover natural (Table 3). Monitoring of Mona Lake was done through LWQA, satellite monitoring, and sampling by EGLE and Grand Valley State University (Steinman et al. 2006; 2009). Trophic results for Mona Lake have ranged from high mesotrophic to hypereutrophic (Table 4). EGLE staff have confirmed the presence of cyanobacteria blooms. Lake management companies have historically treated algae and cyanobacteria with algicides, and 8-20 percent of the littoral zone plants have been treated with herbicides.

Thornapple Lake

Thornapple Lake is a natural lake in Barry County. The land use in the lake's watershed is mostly agricultural (Table 3). Monitoring of Thornapple Lake was done through LWQA, NLA, satellite monitoring, and sampling by EGLE. Trophic results for Thornapple Lake have ranged from high mesotrophic to hypereutrophic (Table 4). EGLE staff have confirmed the presence of cyanobacteria blooms. Some sporadic herbicide and algicide treatments have been performed at this lake.

Van Etten Lake

Van Etten Lake is a reservoir in Iosco County. The land used in the lake's watershed is 7 percent developed and 13 percent agricultural (Table 3). Monitoring of Van Etten Lake was done through LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Van Etten Lake have ranged from mesotrophic to hypereutrophic (Table 4). EGLE staff have confirmed the presence of cyanobacteria blooms. Lake management companies have historically treated algae and cyanobacteria with algicides, and 8-30 percent of the littoral zone plants have been treated with herbicides.

Pontiac Lake

Pontiac Lake is a reservoir in Oakland County. The land use in the lake's watershed is 22 percent developed and 8 percent agricultural (Table 3). Monitoring of Pontiac Lake was done through LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Pontiac Lake have ranged from mesotrophic to hypereutrophic (Table 4). EGLE staff have confirmed the presence of cyanobacteria blooms. Lake management companies have historically treated algae and cyanobacteria with algicides, and 20-100 percent of the littoral zone plants have been treated with herbicides.

Lake Ovid

Lake Ovid is a reservoir in Clinton County. The land use in the lake's watershed is 8 percent developed and 46 percent agricultural (Table 3). Monitoring of Lake Ovid was done through CLMP, LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Lake Ovid have ranged from high mesotrophic to hypereutrophic (Table 4).

Table 4. Summary of sampling efforts and trophic results for each lake listed as not meeting OIALW and warmwater fishery Designated uses in 2020 Integrated Report.

Crockery Lake

Year/s Monitored:	Monitoring Project	Trophic status result	Citation
1982-2022	CLMP	Eutrophic	CLMP (2022a)
2004	LWQA	Eutrophic	Fuller and Taricska (2012)
2000, 02, 04, 07, 11	Remote Sensing	Mesotrophic-Eutrophic	Fuller and Jodoin (2016)
2015-16	EGLE Nutrient Assessment	Eutrophic-hypereutrophic	Holden (2016); Parker (2017)

Lake Hudson

Year/s Monitored:	Monitoring Project	Trophic status result	Citation
2003	LWQA	Hypereutrophic	Fuller and Taricska (2012)
1999, 2002, 04, 11	Remote Sensing	Eutrophic-Hypereutrophic	Fuller and Jodoin (2016)
2015	EGLE Nutrient Assessment	Eutrophic-hypereutrophic	Holden (2016)

Loch Erin

Year/s Monitored:	Monitoring Project	Trophic status result	Citation

1999, 2002, 04, 11, 13	Remote Sensing	Eutrophic-Hypereutrophic	Fuller and Jodoin (2016)
2018	EGLE Nutrient Assessment	Hypereutrophic	Parker (2019)

Mona Lake

Year/s Monitored:	Monitoring Project	Trophic status result	Citation
2004	LWQA	Eutrophic	Fuller and Taricska (2012)
2000, 02, 04, 07, 11, 13	Remote Sensing	Mesotrophic-Eutrophic	Fuller and Jodoin (2016)
2015-16	EGLE Nutrient Assessment	Mesotrophic-hypereutrophic	Holden (2016); Parker (2017; 2018)
2002-05	GVSU	Eutrophic-hypereutrophic	Steinman et al. (2006; 2009)

Thornapple Lake

Year/s Monitored:	Monitoring Project	Trophic status result	Citation
2003	LWQA	Eutrophic/hypereutrophic	Fuller and Taricska (2012)
1999, 2002, 04, 07, 11, 13	Remote Sensing	Mesotrophic-Eutrophic	Fuller and Jodoin (2016)
2007, 2012	NLA	Eutrophic-Hypereutrophic	USEPA (2010; 2016)
2017, 2018	Targeted	Eutrophic-Hypereutrophic	Parker (2020)

Van Etten Lake

Year/s Monitored:	Monitoring Project	Trophic status result	Citation
2002	LWQA	Hypereutrophic	Fuller and Taricska (2012)
1986-2022	CLMP	Eutrophic	CLMP (2022b)
1999, 2002, 04, 07, 11, 13	Remote Sensing	Mesotrophic-Eutrophic	Fuller and Jodoin (2016)
2018	EGLE Nutrient Assessment	Eutrophic	Parker (2020)

Pontiac Lake

Year/s Monitored:	Monitoring Project	Trophic status result	Citation
2007	LWQA	Mesotrophic	Fuller and Taricska (2012)
2000, 02, 04, 07, 11, 13	Remote Sensing	Mesotrophic-Eutrophic	Fuller and Jodoin (2016)
2017	EGLE Nutrient Assessment	Eutrophic-Hypereutrophic	Parker (2018)

Lake Ovid

Year/s Monitored:	Monitoring Project	Trophic status result	Citation
2019, 21	CLMP	Mesotrophic-Eutrophic	CLMP (2021)
2002	LWQA	Hypereutrophic	Fuller and Taricska (2012)
2000, 02, 04, 07, 11, 13	Remote Sensing	Mesotrophic-Hypereutrophic	Fuller and Jodoin (2016)
2012	EGLE Nutrient Assessment	Hypereutrophic	Holden (2013)

2022 Integrated Report

Five lakes were listed as not meeting their OIALW and warmwater fishery designated uses in 2022. A list of the lakes and some of their general characteristics is provided in Table 5. Land cover percentages for the lake watersheds are provided in Table 6.

Table 5. Lakes listed as not meeting OIALW and warmwater fishery Designated uses in 2022 Integrated Report and some of their location and physical characteristics.

Lake Name:	Lake Diane	Hess Lake	Narrow Lake	Union Lake	Reeds Lake
County:	Hillsdale	Newaygo	Eaton	Branch	Kent
Location Latitude:	41.71028	43.38866977	42.43591127	42.056818	42.946619
Location Longitude:	-84.65362	-85.76879273	-84.77954728	-85.182778	-85.595179
Watershed:	St. Joseph (Erie)	Muskegon	Kalamazoo	St. Joseph (LK Michigan)	Lower Grand
Lake Type:	Reservoir	Natural with dam	Natural with dam	Reservoir	Natural
Maximum Depth (ft):	51	25	48	16	60
Lake size (acres):	295	777	118.7	525	287.9
Shoreline Development Factor:	4.3	1.6	2.3	2.8	1.6
Watershed/lake size ratio:	6.9	11.0	74.3	647.0	4.9

Table 6. Watershed land cover percentages of lakes listed as not meeting OIALW and warmwater fishery Designated uses in 2022 Integrated Report.

Land Cover Type	Lake Diane	Hess Lake	Narrow Lake	Union Lake	Reeds Lake
Open Water	4.6	0.4	7.1	2.2	0.7
Barren land	0.1	0.0	0.0	0.1	0.1
Development	15.8	11.9	7.7	10.4	76.7
Forest/shrub/grassland	28.9	39.2	8.3	8.3	13.6
Wetland	14.0	12.2	23.2	20.1	8.5
Agriculture	36.6	36.4	53.7	58.9	0.5

Lake Diane

Lake Diane is a reservoir in Hillsdale County. The land cover in the lake's watershed is about half development/agriculture (Table 6). Monitoring of Lake Diane was done through CLMP, LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Lake Diane have ranged from eutrophic to hypereutrophic (Table 7).

Hess Lake

Hess Lake is a natural lake with a low-head dam at its outlet, in Newaygo County. The land cover in the lake's watershed is about half development/agriculture (Table 6). Monitoring of Hess Lake was done through CLMP, LWQA, satellite monitoring, consulting firms, and sampling by EGLE. Trophic results for Hess Lake have ranged from mesotrophic to hypereutrophic (Table 7). EGLE staff have received citizen complaints about algae in the lake and have confirmed the presence of cyanobacteria blooms. The lake is also regularly treated with herbicides to reduce algal growth and approximately 2-26 percent of the littoral zone is treated for excessive macrophyte growth.

Narrow Lake

Narrow Lake is a natural lake, with a low-head dam at its outlet, in Eaton County. Over half of the land cover in the lake's watershed is agricultural (Table 6). Monitoring of Narrow Lake was done through LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Narrow Lake have ranged from eutrophic to hypereutrophic (Table 7). EGLE staff have received citizen complaints about algae in the lake and have confirmed the presence of cyanobacteria blooms. A 2018 EGLE permit approved herbicide treatment for 45 percent of the littoral zone. Subsequent herbicide and algicide applications occurred in 2020 and 2021, however, reports detailing the amount of littoral zone coverage were unavailable.

Union Lake

Union Lake is a reservoir in Branch County. Over half of the land cover in the lake's watershed is agricultural (Table 6). Monitoring of Union Lake was done through LWQA, satellite monitoring,

and sampling by EGLE. Trophic results for Union Lake have ranged from mesotrophic to hypereutrophic (Table 7). Annually, EGLE issues permits to use herbicides in 15-45 percent of the littoral zone due to excessive growth of plants and algae.

Reeds Lake

Reeds Lake is a natural lake in Kent County. The land cover in the watershed draining to Reeds Lake is overwhelmingly developed (Table 6). Monitoring of Reeds Lake was done through CLMP, LWQA, satellite monitoring, and sampling by a consulting firm (Professional Lake Management [PLM]; data available at EastGRMI.gov/360/Environmental). Trophic results for Reeds Lake have ranged from mesotrophic to hypereutrophic (Table 7). EGLE staff have received citizen complaints about algae in the lake and have confirmed the presence of cyanobacteria blooms. Annually, EGLE issues permits to use herbicides in over 60 percent of the littoral zone due to excessive growth of plants and algae.

Table 7. Summary of sampling efforts and trophic results for each lake listed as not meeting OIALW and warmwater fishery designated uses in 2022 Integrated Report.

Lake Diane

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2007-2021	CLMP	Hypereutrophic	CLMP (2021)
2005	USGS	Hypereutrophic	LWQA
1999, 2002, 07, 11	USGS	Eutrophic-hypereutrophic	Satellite project
2020	EGLE	Hypereutrophic	Designated Use Assessment

Hess Lake

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2001, 02, 03, 08, 09, 10	CLMP	Mesotrophic-hypereutrophic	CLMP
2006	USGS	Hypereutrophic	LWQA
2000, 02, 04, 07, 11, 13	USGS	Eutrophic-hypereutrophic	Satellite project
2020	EGLE	Hypereutrophic	Parker (2022)
2020	EGLE	Eutrophic	Designated Use Assessment
2019	Consulting firm	Eutrophic	Jude (2020)

Narrow Lake

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2004	USGS	Hypereutrophic	LWQA
1999, 2002, 04, 07, 09, 11, 13	USGS	Eutrophic-hypereutrophic	Satellite project
2020	EGLE	Hypereutrophic	Designated Use Assessment

Union Lake

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2005	USGS	Hypereutrophic	LWQA
1999, 2002, 04, 07, 09, 11, 13	USGS	Mesotrophic-eutrophic	Satellite project
2020	EGLE	Hypereutrophic	Designated Use Assessment

Reeds Lake

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2000, 01, 02, 09	CLMP	Mesotrophic-eutrophic	CLMP
2009	USGS	Hypereutrophic	LWQA
2000, 02, 04, 07, 09, 11, 13	USGS	Eutrophic	Satellite project
2015-23	Consulting firm	Mesotrophic-hypereutrophic	PLM

2024 Integrated Report

Eight lakes were listed as not meeting their OIALW and warmwater fishery designated uses in 2024. A list of the lakes and some of their general characteristics are provided in Table 8. Land cover percentages for the lake watersheds are provided in Table 9.

Table 8. Lakes listed as not meeting OIALW and warmwater fishery designated uses in 2024 Integrated Report and some of their location and physical characteristics.

Lake Name:	Tamarack Lake	Swan Lake	Holloway Reservoir	Kearsley Reservoir	C.S. Mott Lake	Thread Lake	Cranberry Lake	Matteson Lake
County:	Montcalm	Allegan	Genesee/Lapeer	Genesee	Genesee	Genesee	Ottawa/Kent	Branch
Location Latitude:	43.44042	42.468285	43.1125	43.05555556	43.09834	43.00028	43.10576549	41.931103
Location Longitude:	-85.26112	-85.96437	-83.46278	-83.65527778	-83.63362	-83.66945	-85.7894209	-85.206696
Watershed:	Muskegon	Kalamazoo	Flint	Flint	Flint	Flint	Lower Grand	St. Joseph (LK Michigan)
Lake Type:	Natural with dam	Natural	Reservoir	Reservoir	Reservoir	Reservoir	Natural	Natural with dam
Maximum Depth (ft):	10	28	15	20	13	5	62	38
Lake size (acres):	323	214.3	954	250	1200	80	118.4	307
Shoreline Development Factor:	1.6	1.4	2.3	3.0	4.7	4.1	1.1	2.6
Watershed/lake size ratio:	3.6	68.8	352.5	293.1	325.8	516.4	7.8	35.1

Table 9. Watershed land cover percentages of lakes listed as not meeting OIALW and warmwater fishery designated uses in 2024 Integrated Report.

Land Cover Type	Tamarack Lake	Swan Lake	Holloway Reservoir	Kearsley Reservoir	C.S. Mott Lake	Thread Lake	Cranberry Lake	Matteson Lake
Open Water	0.0	3.9	1.7	1.8	1.7	1.6	0.0	0.0
Barren land	0.0	0.1	0.3	0.2	0.3	1.5	0.0	0.0
Development	36.8	8.6	10.3	27.9	11.2	38.7	9.0	5.6
Forest/shrub/grassland	12.1	21.7	24.0	27.3	24.3	25.5	0.9	6.4
Wetland	18.4	31.3	17.5	15.5	16.6	14.9	7.3	17.1
Agriculture	32.8	34.6	46.2	27.3	45.9	17.8	82.8	70.9

Tamarack Lake

Tamarack Lake is a natural lake with a low-head dam at its outlet, in Montcalm County. The majority of the land cover in the watershed draining to Tamarack Lake is a combination of agriculture and development (Table 9). Monitoring of Tamarack Lake was done through LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Tamarack Lake have ranged from mesotrophic to hypereutrophic (Table 10). EGLE staff have received citizen complaints about algae in the lake. Permits are regularly requested for herbicide treatment of 50-60 percent of the littoral zone.

Swan Lake

Swan Lake is a natural lake in Allegan County. A little over one-third of the land cover of the watershed draining into Swan Lake is agricultural and 8.6% is developed (Table 9). Monitoring of Swan Lake was done through CLMP, LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Swan Lake have ranged from mesotrophic to hypereutrophic (Table 10). EGLE staff have received citizen complaints about algae in the lake and have confirmed the presence of annual, prolonged, cyanobacteria blooms. EGLE permits have been issued for herbicide treatments of 6-11 percent of the littoral zone.

Holloway Reservoir

Holloway Reservoir is a reservoir in Genesee and Lapeer Counties. Over half of the land cover in the watershed draining to Holloway Reservoir is a combination of agriculture and development (Table 9). Monitoring of Holloway Reservoir was done through LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Holloway Reservoir have ranged from mesotrophic to hypereutrophic (Table 10). EGLE has received citizen complaints about algal blooms in Holloway Reservoir.

Kearsley Reservoir

Kearsley Reservoir is a reservoir in Genesee County. The majority of the land cover in the watershed draining to Kearsley Reservoir is a combination of agriculture and development (Table 9). Monitoring of Kearsley Reservoir was done through LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Kearsley Reservoir have ranged from mesotrophic to hypereutrophic (Table 10). Cyanobacteria were observed in Kearsley Reservoir by EGLE staff during sampling in 2021.

C.S. Mott Lake

C.S. Mott Lake is a reservoir in Genesee County. Most of the land cover in the watershed draining to C.S. Mott Lake is a combination of agriculture and development (Table 9). Monitoring of C.S. Mott Lake was done through LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Kearsley Reservoir have ranged from eutrophic to hypereutrophic (Table 10). Cyanobacteria were observed in C.S. Mott Lake by EGLE staff during sampling in 2021.

Thread Lake

Thread Lake is a reservoir in Genesee County. Most of the land cover in the watershed draining to Thread Lake is a combination of agriculture and development (Table 9). Monitoring of Thread Lake was done through CLMP, LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Thread Lake have ranged from eutrophic to hypereutrophic (Table 10). Cyanobacteria were observed by EGLE staff during sampling in 2021.

Cranberry Lake

Cranberry Lake is a natural lake in Ottawa and Kent Counties. The land use in the lake's watershed is overwhelmingly agricultural (Table 9). Monitoring of Cranberry Lake was done through CLMP, LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Cranberry Lake have ranged from eutrophic to hypereutrophic (Table 10). EGLE staff have received citizen complaints about algae in the lake and have confirmed the presence of cyanobacteria blooms. EGLE permits have been issued for herbicide treatments in 16 percent of the littoral zone.

Matteson Lake

Matteson Lake is a natural lake with a low-head dam at its outlet in Branch County. The land use in the lake's watershed is overwhelmingly agricultural (Table 9). Monitoring of Matteson Lake was done through LWQA, satellite monitoring, and sampling by EGLE. Trophic results for Matteson Lake have ranged from mesotrophic to hypereutrophic (Table 10). Cyanobacteria were observed in Matteson Lake by EGLE staff during sampling in 2020.

Table 10. Summary of sampling efforts and trophic results for each lake listed as not meeting OIALW and warmwater fishery Designated uses in 2024 Integrated Report.

Tamarack Lake

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2006	USGS	Hypereutrophic	LWQA
2000, 02, 04, 07, 09, 11, 13	USGS	Mesotrophic-eutrophic	Satellite project
2021	EGLE	Eutrophic	Designated Use Assessment

Swan Lake

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2004	USGS	Hypereutrophic	LWQA
2000, 02, 04, 07, 09, 11, 13	USGS	Mesotrophic-hypereutrophic	Satellite project
2021	EGLE	Hypereutrophic	Parker (2023)
2023	CLMP	Eutrophic-hypereutrophic	CLMP

Holloway Reservoir

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2003	USGS	Hypereutrophic	LWQA
2000, 02, 04, 07, 09, 11, 13	USGS	Mesotrophic-hypereutrophic	Satellite project
2016	EGLE	Hypereutrophic	Status and Trend monitoring
2021	EGLE	Eutrophic	Designated Use Assessment

Kearsley Reservoir

Year/s Monitored:	Monitoring organization	Trophic status result	Citation

2008	USGS	Hypereutrophic	LWQA
2000, 02, 04, 07, 11, 13	USGS	Mesotrophic-hypereutrophic	Satellite project
2021	EGLE	Eutrophic	Designated Use Assessment

C.S. Mott Lake

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2008	USGS	Hypereutrophic	LWQA
2000, 02, 04, 07, 11, 13	USGS	Eutrophic-hypereutrophic	Satellite project
2021	EGLE	Hypereutrophic	Designated Use Assessment

Thread Lake

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2003, 09	USGS	Hypereutrophic	LWQA
2000, 02, 04, 11, 13	USGS	Eutrophic-hypereutrophic	Satellite project
2021, 22	CLMP	Eutrophic-hypereutrophic	CLMP
2021	EGLE	Hypereutrophic	Designated Use Assessment

Cranberry Lake

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2002, 03	CLMP	Eutrophic-hypereutrophic	CLMP
2000, 02, 04, 07, 11	USGS	Eutrophic-hypereutrophic	Satellite project
2021	EGLE	Hypereutrophic	Parker (2023)
2023	EGLE	Hypereutrophic	Designated Use Assessment

Matteson Lake

Year/s Monitored:	Monitoring organization	Trophic status result	Citation
2005	USGS	Eutrophic	LWQA
1999, 2002, 04, 07, 09, 11, 13	USGS	Mesotrophic-eutrophic	Satellite project
2020, 21	EGLE	Eutrophic-hypereutrophic	Designated Use Assessment

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