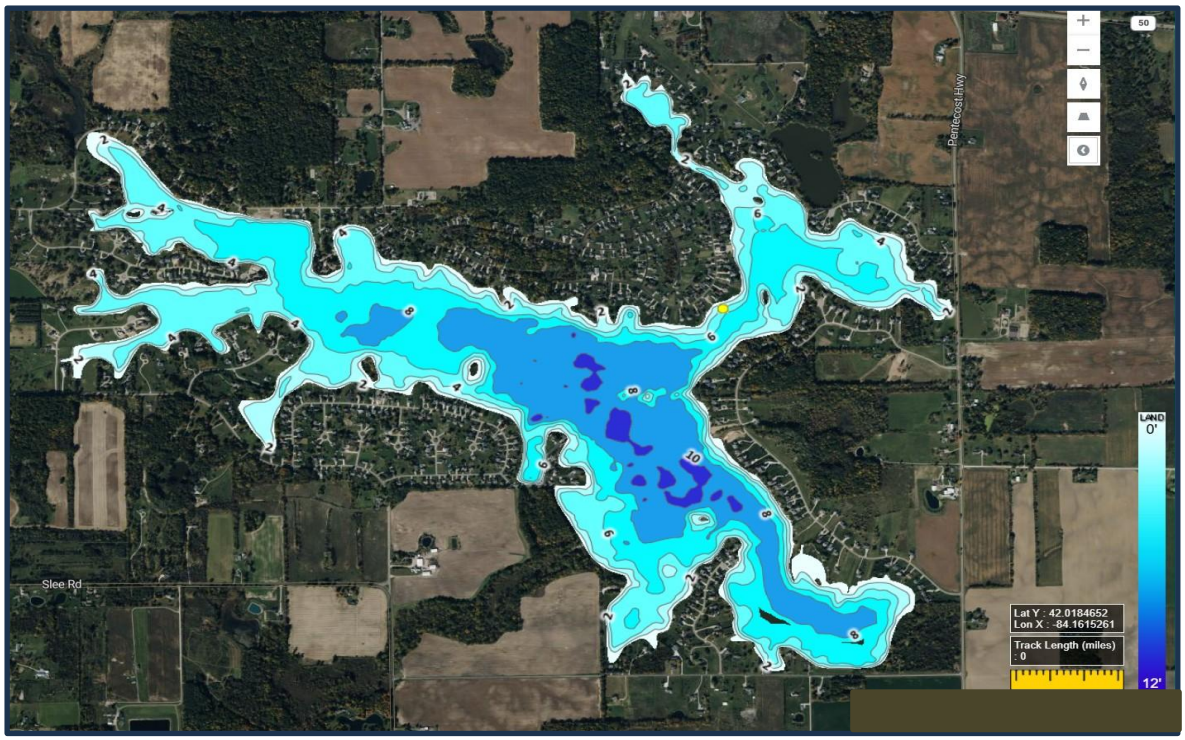
Loch Erin Lake Status Update Report
Lenawee County, Michigan



Provided for: Loch Erin Property Owners Association (LEPOA) Board

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Loch Erin Status Update Report
Lenawee County, Michigan

November 2026

1.0 EXECUTIVE SUMMARY

Loch Erin is located in Cambridge Township in Lenawee County, Michigan, and is comprised of 581.7 acres (RLS, 2019 and 2026) excluding the area to the northeast of the lake which when included allows for the lake to consist of 602 acres. The lake is a man-made impoundment with a dam located at the south region of the lake. The lake basin has nearly 15.4 miles of shoreline and is located at an altitude of 922 feet above sea level. The mean depth of the lake basin is approximately 6.5 feet. The maximum depth of the lake basin is approximately 12.1 feet (RLS, 2019 and 2026 bathymetric scan data). Additional physical and watershed characteristic data is offered below in Section 2.0

This report presents a modernized (updated) data set collected during late July of 2026 for comparison to 2019 baseline data. Such data is important to evaluate changes in lake basin, ecological, and water quality parameters over time. This data assists the LEPOA with determining possible needs and areas of focus for future management.

Based on the data comparisons, the following conclusions can be made:

In Deep Basin #1:

- The mean water temperature, pH, dissolved oxygen, specific conductivity, total Kjeldahl nitrogen, total inorganic nitrogen, and ortho-phosphorus were similar in 2019 and 2026 with favorable values for all of these parameters.

- The mean total dissolved solids, chlorophyll-a, and secchi transparency were notably higher in 2026 relative to 2019. This is interesting given that the Secchi transparency was higher but so was the chlorophyll-a concentration which usually decreases water clarity. It may be that there was less algal biovolume overall in the water column but more on the surface with the increased counts of blue-green algae that float on the surface.

- The total phosphorus and total suspended solids both decreased in 2026 which is favorable.

In Deep Basin #2:

- The mean water temperature, pH, total Kjeldahl nitrogen, total inorganic nitrogen, and ortho-phosphorus were similar in 2019 and 2026 with favorable values for all of these parameters.

- The mean total dissolved solids, dissolved oxygen, chlorophyll-a, and secchi transparency were notably higher in 2026 relative to 2019. This is interesting given that the Secchi transparency was higher but so was the chlorophyll-a concentration which usually decreases water clarity. It may be that there was less algal biovolume overall in the water column but more on the surface with the increased counts of blue-green algae that float on the surface.

- The total phosphorus and total suspended solids both decreased in 2026 which is favorable.

In Deep Basin #3:

- The mean water temperature, pH, total inorganic nitrogen, total Kjeldahl nitrogen, total phosphorus, and ortho-phosphorus were similar in 2019 and 2026 with favorable values for all of these parameters.

- The mean total dissolved solids, chlorophyll-a, and secchi transparency were notably higher in 2026 relative to 2019. This is interesting given that the Secchi transparency was higher but so was the chlorophyll-a concentration which usually decreases water clarity. It may be that there was less algal biovolume overall in the water column but more on the surface with the increased counts of blue-green algae that float on the surface.

- The total suspended solids decreased in 2026 which is favorable.

In Deep Basin #4:

- The mean water temperature, pH, total inorganic nitrogen, total Kjeldahl nitrogen, and ortho-phosphorus were similar in 2019 and 2026 with favorable values for all of these parameters.

- The mean total dissolved solids, chlorophyll-a, and secchi transparency were notably higher in 2026 relative to 2019. This is interesting given that the Secchi transparency was higher but so was the chlorophyll-a concentration which usually decreases water clarity. It may be that there was less algal biovolume overall in the water column but more on the surface with the increased counts of blue-green algae that float on the surface.

- The total phosphorus and total suspended solids decreased in 2026 which is favorable.

Sediment Hardness and Aquatic Vegetation Biovolume:

- There was a slight increase in soft bottom in 2026 relative to 2019 and a slight decline in consolidated bottom in 2026. The reason for this is unclear but could be attributed to increased submersed aquatic plant growth that contributes organic matter to the lake bottom that consequently increases the amount of softer bottom.

- There was a very slight increase in the lower-growing biovolume categories which means that lower-growing vegetation is beginning to germinate. This could be a manifestation of the measurable increase in Secchi transparency which would allow for more light penetration in this shallow lake.

Recommendations for Future Improvements:

1. The mean total phosphorus still needs to be reduced. This would result in reduced algal blooms and increased water clarity. It would also increase the amount of submersed aquatic vegetation which may then switch the lake from an algal-dominated system to a plant-dominated one which is preferred for water clarity and the fishery.
2. Algaecides should only be used on green algal blooms since many treatments can exacerbate blue-green algae blooms. The blue-green algae, *Microcystis* sp. was the most prevalent algae in the lake, which is an indicator of poor water quality.

3. Given the recent water quality data, RLS recommends collecting a similar data set in 3-5 years with trend graphs developed comparing 2019 and 2026 data to the future data. Additional scans on the lake sediment relative hardness and aquatic vegetation biovolume should also be completed at that time.

4. In addition, it is recommended that the Loch Erin community implement Best Management Practices (BMP's) discussed in the immediate watershed management report to reduce the nutrient and sediment loads being transported into the lake from areas with high erosion and drains that contribute high sediment and nutrient loads.

5. It would be beneficial to include the riparian community in the improvement program which could be initiated by holding a community-wide lake education and improvement workshop to introduce residents to the key lake impairments and garner support for continued lake protection.

2.0 LOCH ERIN PHYSICAL AND WATERSHED CHARACTERISTICS

2.1 The Loch Erin Basin

Loch Erin is located in Cambridge Township in Lenawee County, Michigan (T.5S, R.2E, Figure 1). The lake is comprised of 581.7 acres (RLS, 2019) excluding the area to the northeast of the lake which when included allows for the lake to consist of 602 acres. The lake is a man-made impoundment with a dam located at the south region of the lake. The lake basin has nearly 15.4 miles of shoreline and is located at an altitude of 922 feet above sea level. The mean depth of the lake basin is approximately 6.5 feet. The maximum depth of the lake basin is approximately 12.1 feet (RLS, 2019 bathymetric scan data; Figures 2 and 3). The lake basin also has a fetch (longest distance across the lake) of around 1.9 miles (RLS, 2019; 2026). The basin of Loch Erin has an approximate water volume of 3,539.1 acre-feet (RLS, 2019;2026 bathymetric data). The immediate watershed (which is the area directly draining into the lake) is approximately 19,850 acres (based on LiDAR data) and 11,315 acres (based on topographic modeling data). This is about 34 times the size of the lake, which is very large. Legal lake levels were established for the lake in Circuit Court on May 12, 2005, with the summer and winter levels for the elevations of 925.36' and 924.36', respectively. Court-ordered lake levels are enforced from April 1 to November 1 of each year. Wastewater from the Loch Erin community is treated at the Wastewater Treatment Plant (WWTP) via a surface water discharge permit from EGLE to discharge treated water into Wolf Creek. Wolf Creek is a sub-watershed of the larger River Raisin watershed. The River Raisin flows east to Lake Erie at Monroe and is recognized as the most crooked river in the world.

A bottom sediment hardness scan was conducted of the entire lake bottom on July 11, 2019, and again on July 24, 2026. The bottom hardness map shows (Figures 4 and 5) that most of the lake bottom consists of fairly consolidated sediment throughout the lake with a few areas with soft organic bottom. This is not surprising given the amount of sandy loams in the region which contribute to lake geology. Tables 1 and 2 below show the categories of relative bottom hardness with 0.0-0.1 referring to the softest and least consolidated bottom and >0.4 referring to the hardest, most consolidated bottom for the lake basin. There was a slight increase in soft bottom in 2026 and a decrease in hard bottom as well.

This scale does not mean that any of the lake contains a truly “hard” bottom but rather a bottom that is more cohesive and not flocculent.

Table 1. Loch Erin basin relative hardness of the lake bottom by category or hardness and percent cover of each category (relative cover) on July 11, 2019.

Lake Bottom Relative Hardness Category	# GPS Points in Each Category (Total =18,387)	% Relative Cover of Bottom by Category
0.0-0.1	3	0.02
0.1-0.2	5	0.03
0.2-0.3	721	3.80
0.3-0.4	8377	44.2
>0.4	9850	52.0

Table 2. Loch Erin basin relative hardness of the lake bottom by category or hardness and percent cover of each category (relative cover) on July 24, 2026.

Lake Bottom Relative Hardness Category	# GPS Points in Each Category (Total =11,027)	% Relative Cover of Bottom by Category
0.0-0.1	7	4.5
0.1-0.2	772	6.0
0.2-0.3	6589	4.9
0.3-0.4	3628	46.1
>0.4	31	38.5

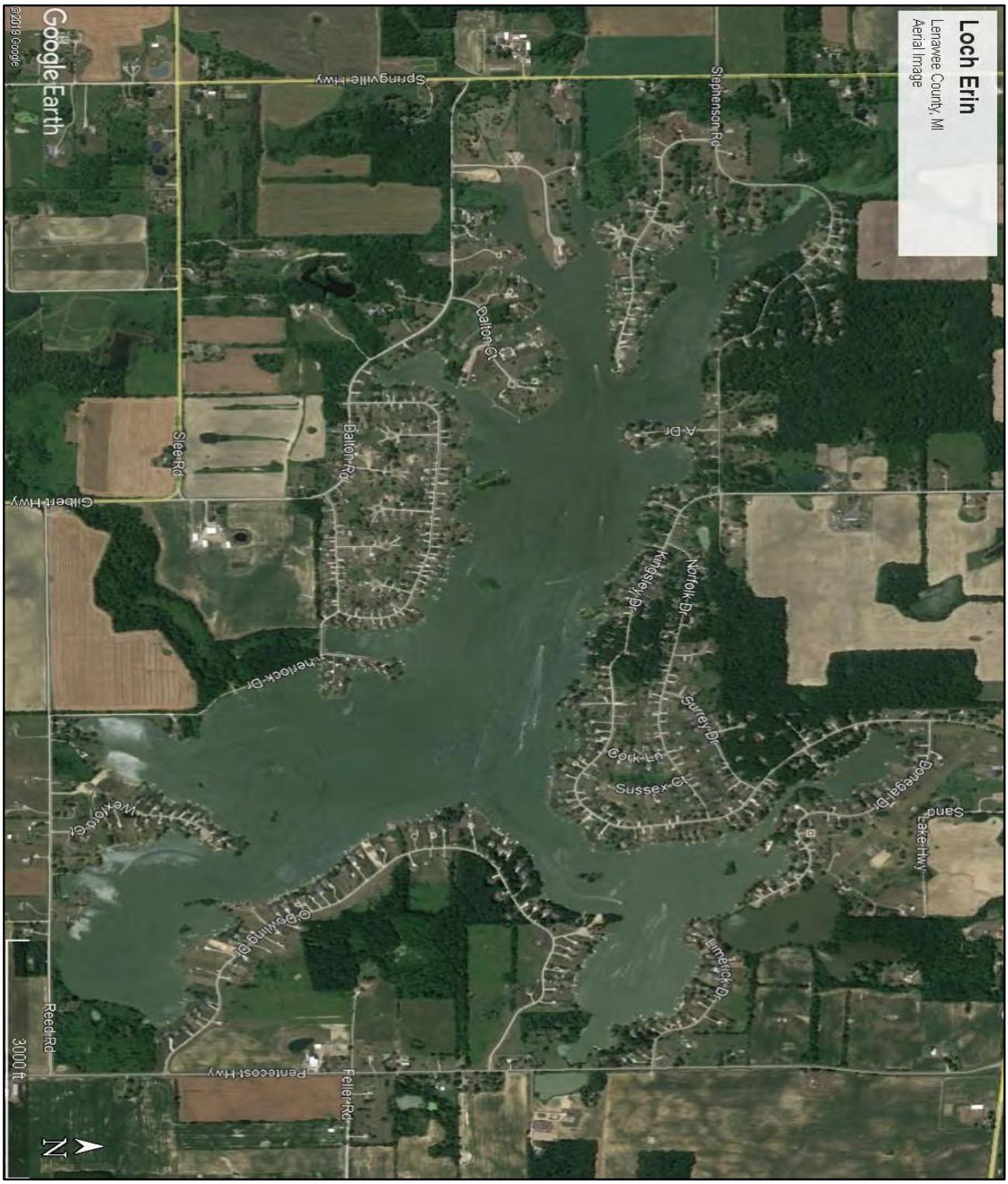


Figure 1. Loch Erin Aerial Photo, Lenawee County, Michigan.

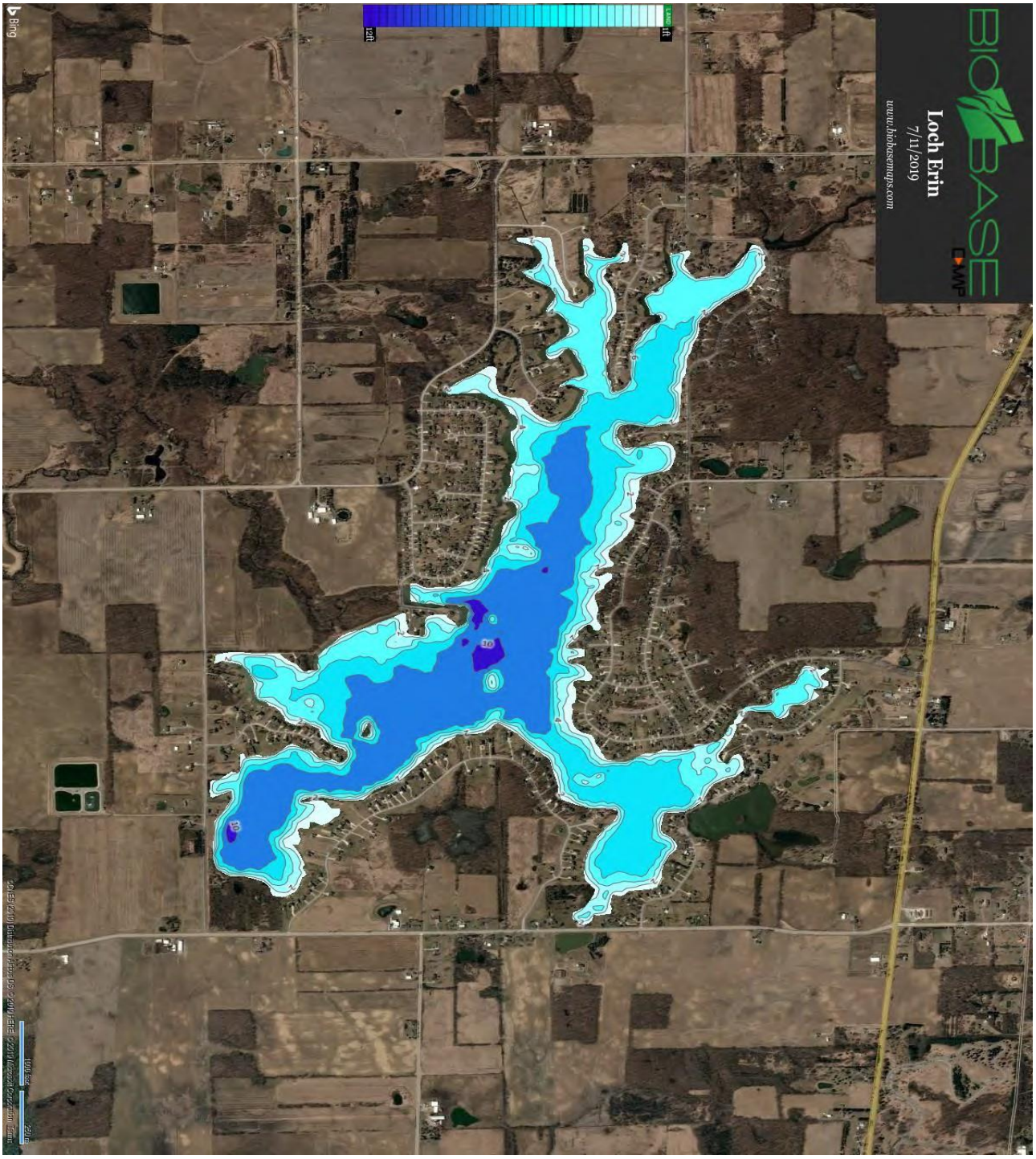


Figure 2. Loch Erin basin depth contour map (July 11, 2019).

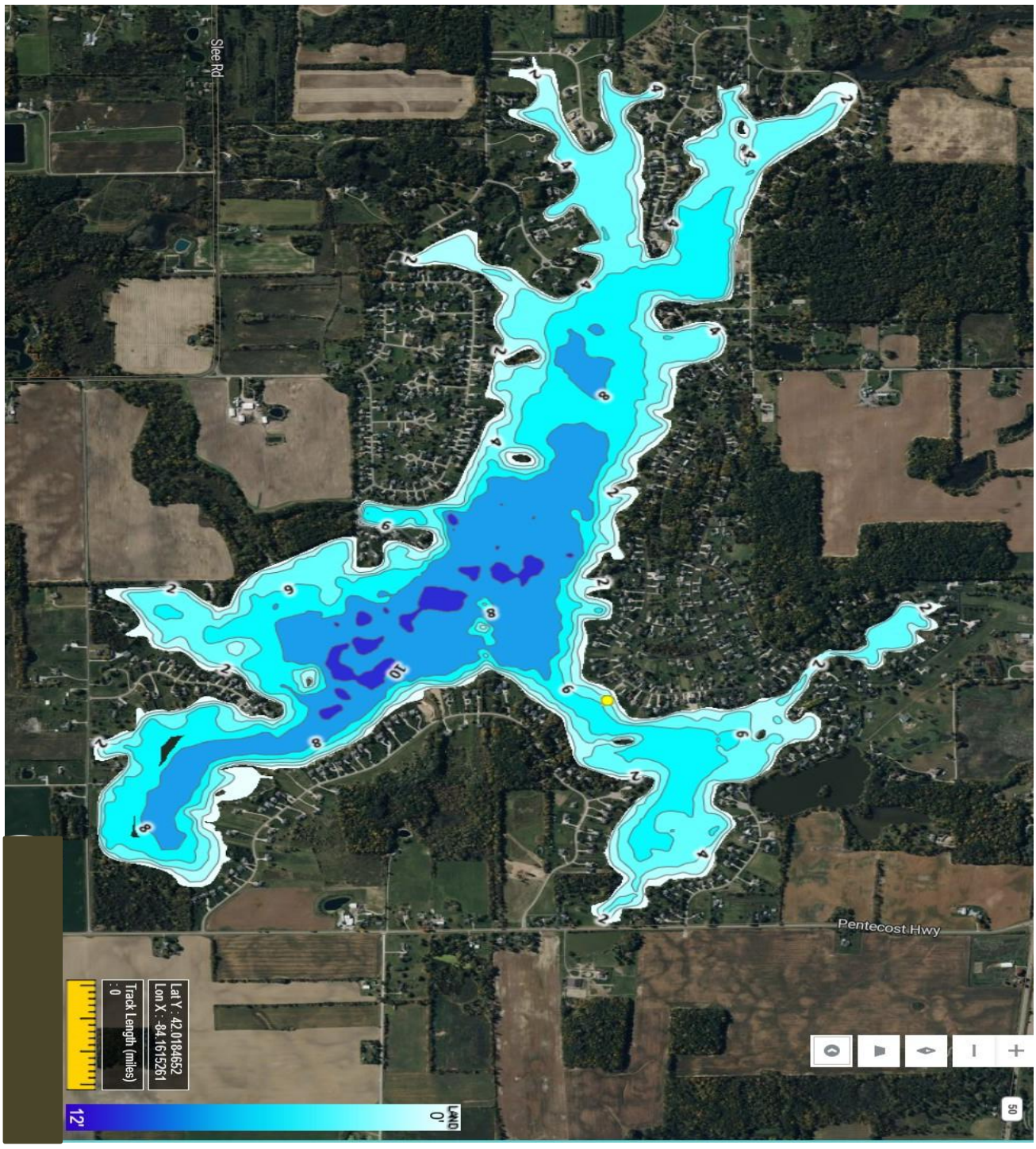


Figure 3. Loch Erin basin depth contour map (July 24, 2026).

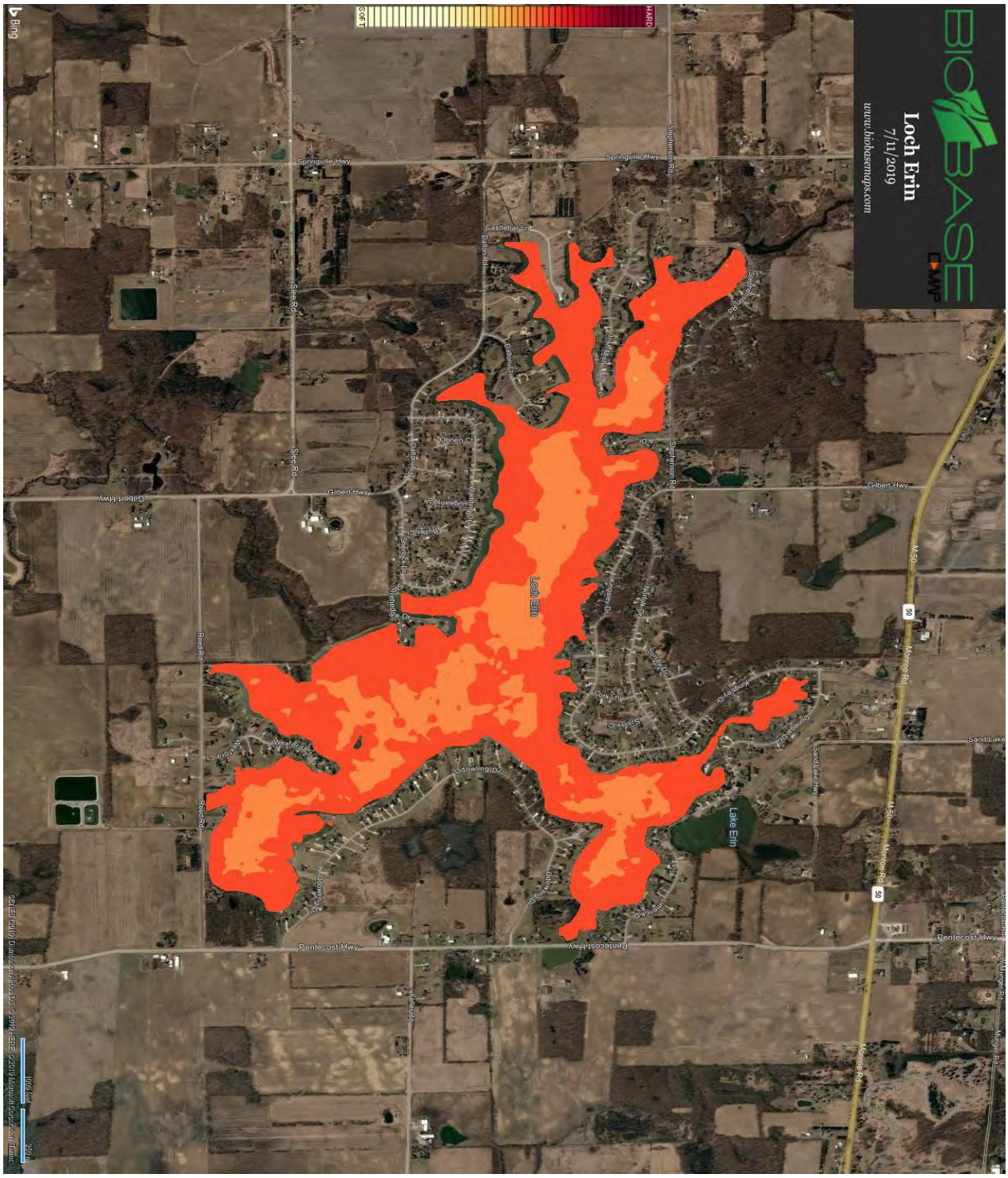


Figure 4. Loch Erin basin sediment relative hardness map (July 11, 2019).

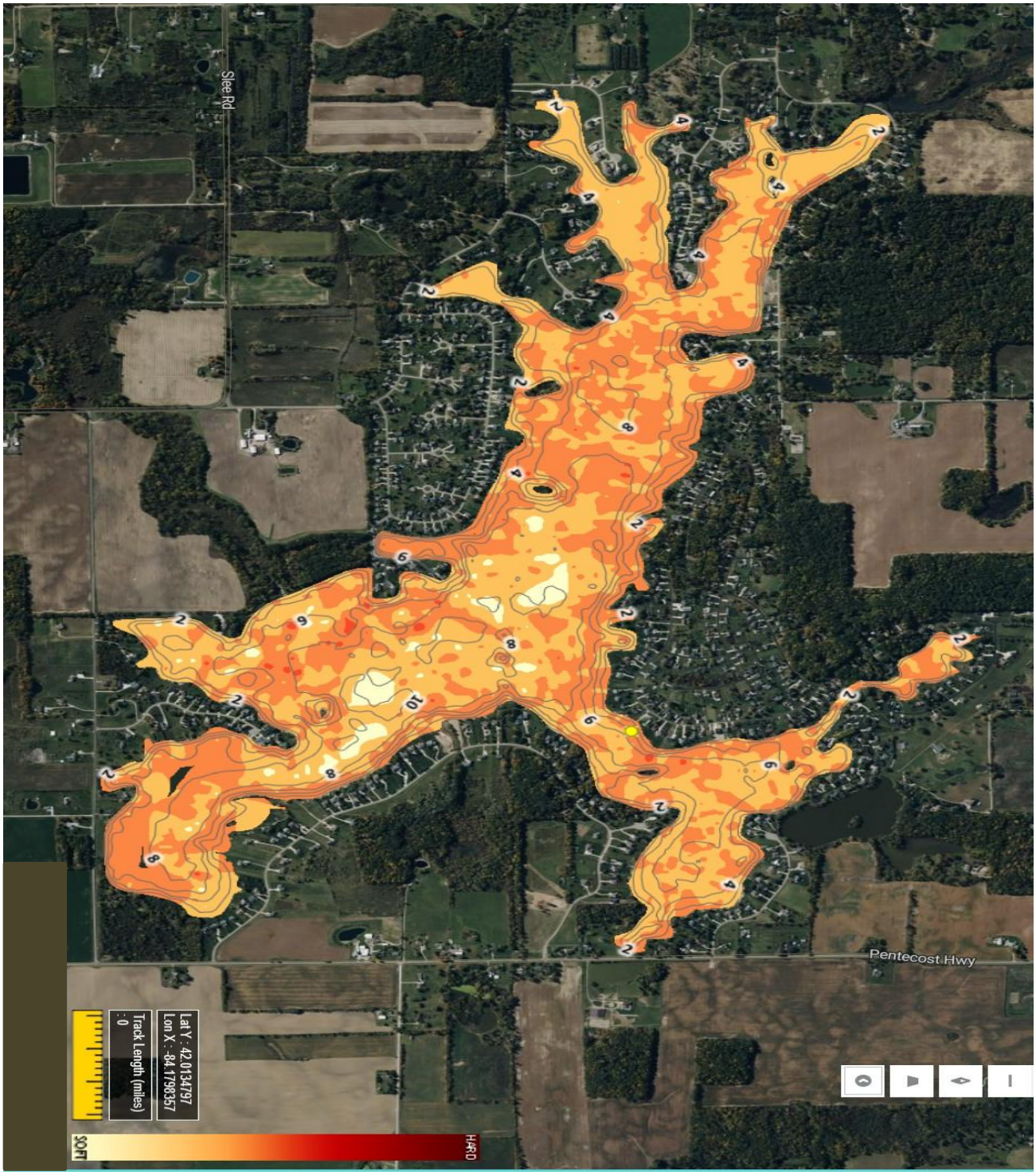


Figure 5. Loch Erin basin sediment relative hardness map (July 24, 2026).

3.0 LOCH ERIN WATER QUALITY

Water quality is highly variable among Michigan's inland lakes, although some characteristics are common among particular lake classification types. The water quality of each lake is affected by both land use practices and climatic events. Climatic factors (i.e. spring runoff, heavy rainfall) may alter water quality in the short term, whereas, anthropogenic (man-induced) factors (i.e. shoreline development, lawn fertilizer use) alter water quality over longer time periods. Since many lakes have a fairly long hydraulic residence time, the water may remain in the lake for years and is therefore sensitive to nutrient loading and pollutants. Furthermore, lake water quality helps to determine the classification of particular lakes (Table 3). Lakes that are high in nutrients (such as phosphorus and nitrogen) and chlorophyll-*a*, and low in transparency are classified as eutrophic; whereas those that are low in nutrients and chlorophyll-*a*, and high in transparency are classified as oligotrophic. Lakes that fall in between these two categories are classified as mesotrophic. The basin of Loch Erin is classified as hyper-eutrophic (nutrient-enriched) due to the high nutrients and low Secchi transparency and marked dissolved oxygen depletion with depth in some areas (Figure 6).

Table 3. General Lake Trophic Status Classification Table.

Lake Trophic Status	***Total Phosphorus (mg L^{-1})***	***Chlorophyll-a (µg L^{-1})***	***Secchi Transparency (feet)***
Oligotrophic	< 0.010	< 2.2	> 15.0
Mesotrophic	0.010-0.025	2.2 – 6.0	7.5 – 15.0
Eutrophic	> 0.025	> 6.0	< 7.5

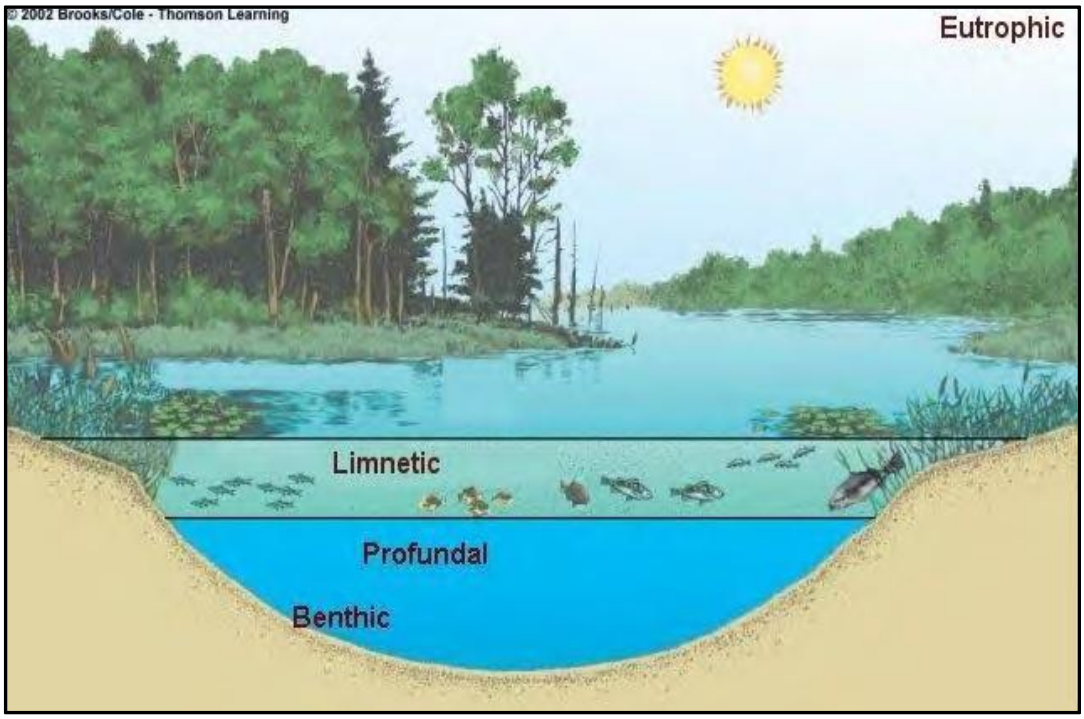


Figure 6. Diagram showing a eutrophic or nutrient-enriched lake ecosystem (photo adapted from Brooks/Cole Thomson learning online).

3.1 Water Quality Parameters

Parameters such as dissolved oxygen (in mg/L), water temperature (in °C), specific conductivity (mS/cm), total dissolved solids (mg/L), total suspended solids (mg/L), pH (S.U.), total phosphorus and ortho-phosphorus (also known as soluble reactive phosphorus or SRP measured in mg/L), total Kjeldahl nitrogen and total inorganic nitrogen (in mg/L), chlorophyll-a (in µg/L), and Secchi transparency (in feet) are parameters that respond to changes in water quality and consequently serve as indicators of change. The deep basin results for all abiotic and biotic water quality parameters from 2019 and 2026 are discussed below and are presented in Tables 6-23. A map showing the sampling locations for all water quality samples is shown below in Figure 7. All water samples and readings were collected at the 4 deepest basins on August 15, 2019, and July 24, 2026, with the use of a 3.2-Liter Van Dorn horizontal water sampler and calibrated Eureka Manta II® multi-meter probe with parameter electrodes, respectively. All samples with the exception of chlorophyll-a were taken to a NELAC-certified laboratory for analysis.

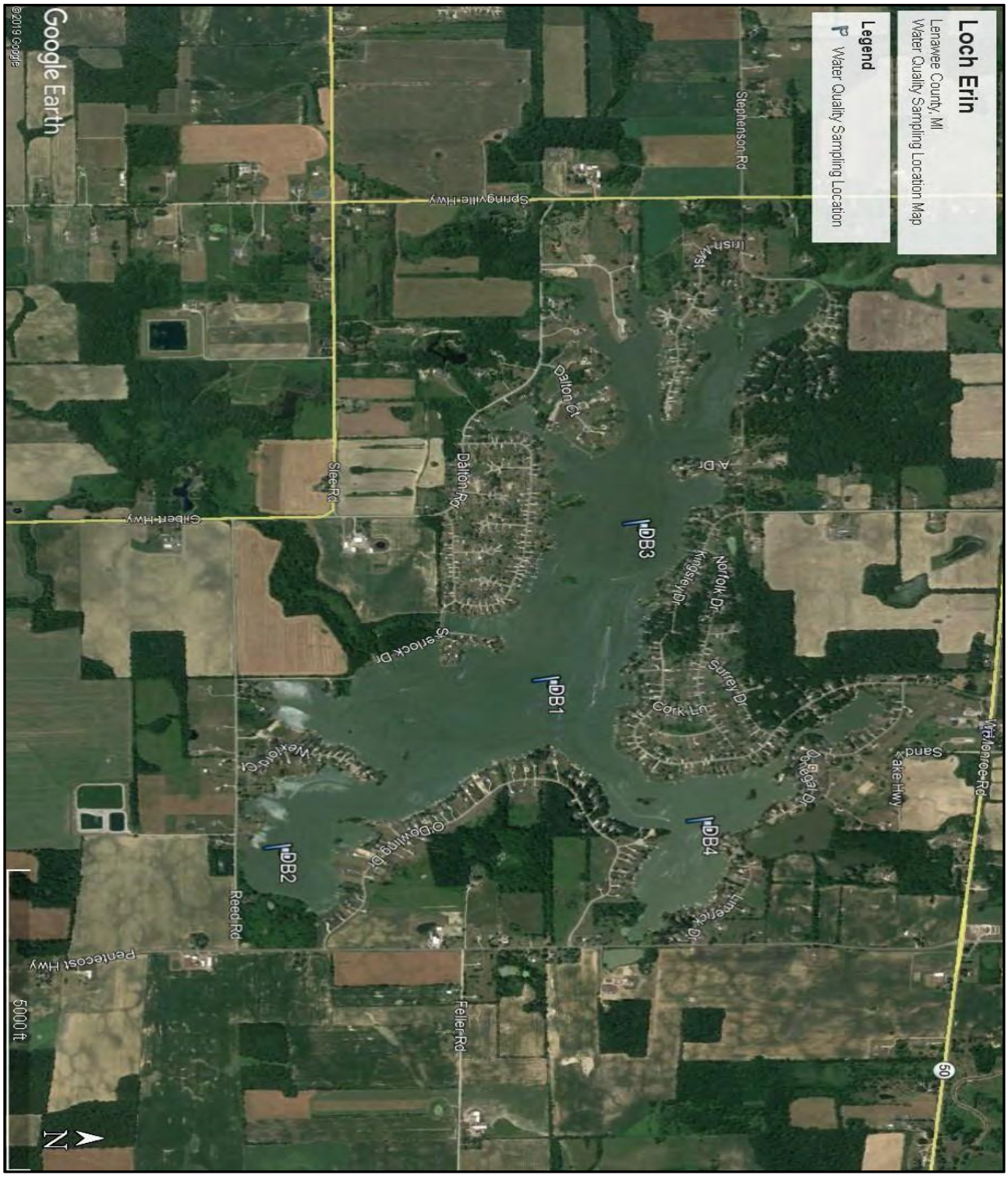
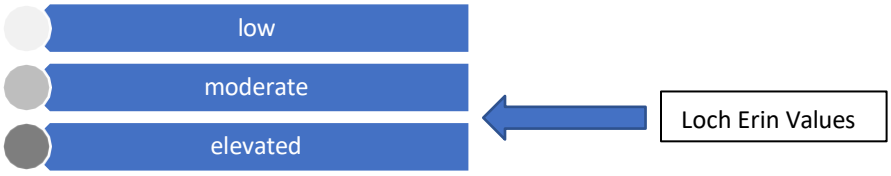


Figure 7. Locations for water quality sampling of the deep basins in Loch Erin (August 15, 2019, and July 24, 2026).

3.1.1 Dissolved Oxygen

Dissolved oxygen is a measure of the amount of oxygen that exists in the water column. In general, dissolved oxygen levels should be greater than 5 mg/L to sustain a healthy warm-water fishery. Dissolved oxygen concentrations may decline if there is a high biochemical oxygen demand (BOD) where organismal consumption of oxygen is high due to respiration. Dissolved oxygen is generally higher in colder waters. Dissolved oxygen was measured in milligrams per liter (mg/L) with the use of a calibrated Eureka Manta II® dissolved oxygen meter. The mean dissolved oxygen concentrations in the basin of Loch Erin during the August 15, 2019, sampling event ranged from 5.3-9.3 mg/L, with the lowest concentrations found in deep basins #2 and #4. The mean dissolved oxygen concentrations measured during the July 24, 2026, sampling even ranged from 7.9-8.5 mg/L, which is very good.

The bottom of the lake produces a biochemical oxygen demand (BOD) due to microbial activity attempting to break down high quantities of organic plant matter, which reduces dissolved oxygen in the water column at depth. Furthermore, the lake bottom is distant from the atmosphere where the exchange of oxygen occurs. A decline in the dissolved oxygen concentrations to near zero may result in an increase in the release rates of phosphorus (P) from lake bottom sediments.



3.1.2 Water Temperature

A lake's water temperature varies within and among seasons and is nearly uniform with depth under the winter ice cover because lake mixing is reduced when waters are not exposed to the wind. When the upper layers of water begin to warm in the spring after ice-off, the colder, dense layers remain at the bottom. This process results in a "thermocline" that acts as a transition layer between warmer and colder water layers. During the fall season, the upper layers begin to cool and become denser than the warmer layers, causing an inversion known as "fall turnover" (Figure 8). In general, shallow lakes will not stratify and deeper lakes may experience single or multiple turnover cycles. Water temperature was measured in degrees Celsius (ºC) with the use of a calibrated Eureka Manta II® submersible thermometer. The mean water temperature measurements in the basin of Loch Erin during the August 15, 2019, sampling event ranged from 24.9-25.7°C which demonstrated a lack of thermocline in all basins and nearly isothermic conditions. The mean water temperatures measured on July 24, 2026, ranged from 24.6-24.8°C. Cooler water temperatures generally also hold more dissolved oxygen.

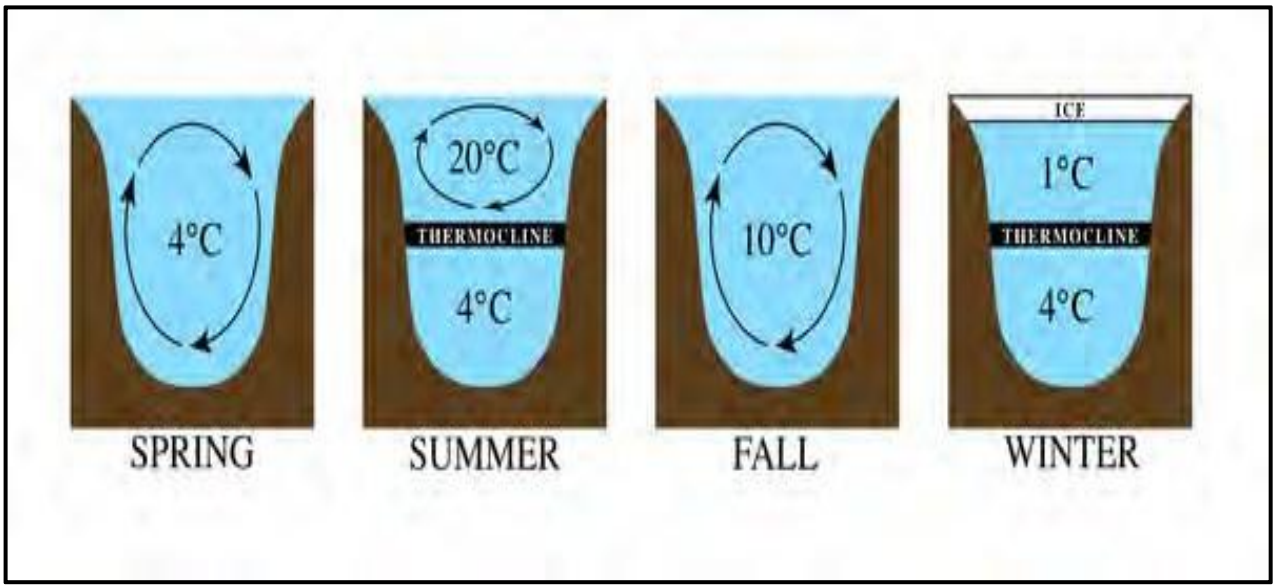
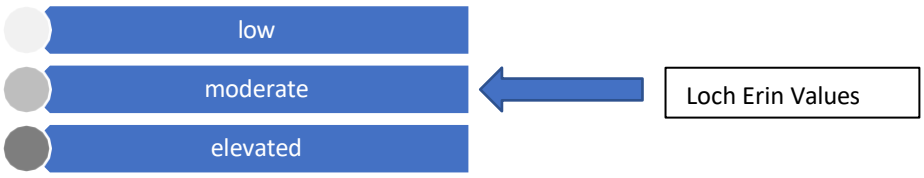


Figure 8. The lake thermal stratification process.

3.1.3 Specific Conductivity

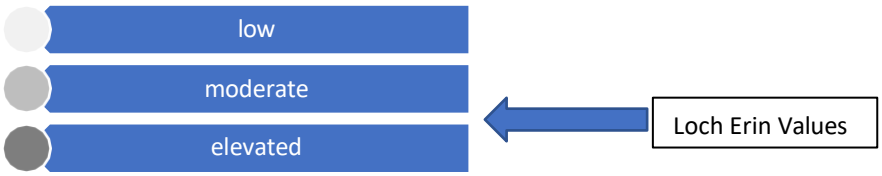
Specific conductivity is a measure of the number of mineral ions present in the water, especially those of salts and other dissolved inorganic substances. Conductivity generally increases with water temperature and the amount of dissolved minerals and salts in a lake. Specific conductivity was measured in micro-Siemens per centimeter (µS/cm) with the use of a calibrated Eureka Manta II® conductivity probe and meter. The mean conductivity values in the basin of Loch Erin during the August 15, 2019, sampling event ranged from 466-473 mS/cm, which are moderately high values. Since these values are moderately high for an inland lake, the lake water contains ample dissolved metals and ions such as calcium, potassium, sodium, chlorides, sulfates, and carbonates. Baseline parameter data such as conductivity are important to measure the possible influences of land use activities (i.e. road salt influences) on Loch Erin over a long period of time, or to trace the origin of a substance to the lake in an effort to reduce pollutant loading. Elevated conductivity values over 800 mS/cm can negatively impact aquatic life. The mean conductivity measured on July 24, 2026, ranged from 466-470 mS/cm which is favorable.



3.1.4 Total Dissolved Solids and Total Suspended Solids

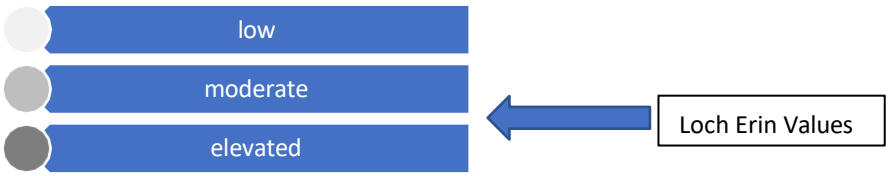
Total Dissolved Solids

Total dissolved solids (TDS) are the measure of the amount of dissolved organic and inorganic particles in the water column. Particles dissolved in the water column absorb heat from the sun and raise the water temperature and increase conductivity. Total dissolved solids were measured with the use of a calibrated Eureka Manta II® meter in mg/L. Spring values are usually higher due to increased watershed inputs from spring runoff and/or increased planktonic algal communities. The mean TDS concentrations in the basin of Loch Erin during the August 15, 2019, sampling event ranged from 210-257 mg/L. These values are moderately high for an inland lake and correlate with the moderately high conductivity measured. The mean TDS concentrations measured during the July 24, 2026, sampling event ranged from 298-301 mg/L which is moderately high.



Total Suspended Solids (TSS)

Total suspended solids are the measure of the number of suspended particles in the water column. Particles suspended in the water column absorb heat from the sun and raise the water temperature. Total suspended solids were measured in mg/L and analyzed in the laboratory with Method SM 2540 D-11. The lake bottom contains many fine sediment particles that are easily perturbed from winds and wave turbulence. Spring values would likely be higher due to increased watershed inputs from spring runoff and/or increased planktonic algal communities. The mean TSS concentrations in the basin of Loch Erin during the August 15, 2019, sampling event ranged from 27-51 mg/L, which are elevated values. Ideally values should be < 10 mg/L. The mean TSS concentrations measured during the July 24, 2026, sampling even ranged from 11-27.7 mg/L with the highest concentration found at the middle of the third deep basin.



3.1.5 pH

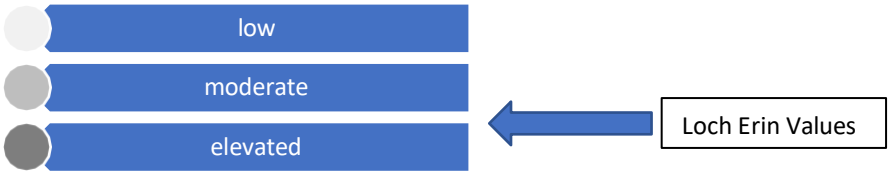
pH is the measure of acidity or basicity of water. pH was measured with a calibrated Eureka Manta II© pH electrode and pH-meter in Standard Units (S.U). The standard pH scale ranges from 0 (acidic) to 14 (alkaline), with neutral values around 7. Most Michigan lakes have pH values that range from 7.0 to 9.5 S.U. Acidic lakes (pH < 7) are rare in Michigan and are most sensitive to inputs of acidic substances due to a low acid neutralizing capacity (ANC). The mean pH values in the basin of Loch Erin during the August 15, 2019, sampling event ranged from 7.9-8.3 S.U. This range of pH is neutral to alkaline on the pH scale and is ideal for an inland lake. pH tends to rise when abundant aquatic plants are actively growing through photosynthesis or when abundant marl deposits are present. The mean pH measured during the July 24, 2026, sampling event ranged from 8.2-8.5 S.U. and are within the normal range for inland lakes.

3.1.6 Total Phosphorus and Ortho-Phosphorus (SRP)

Total Phosphorus

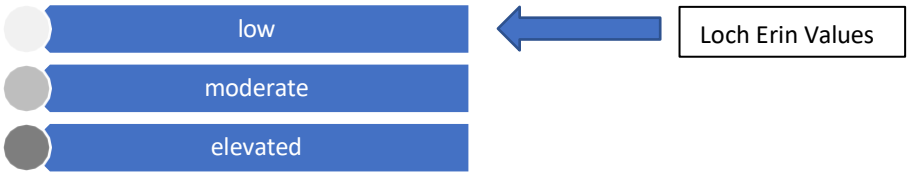
Total phosphorus (TP) is a measure of the amount of phosphorus (P) present in the water column. Phosphorus is the primary nutrient necessary for abundant algae and aquatic plant growth. Lakes which contain greater than 0.020 mg/L of TP are defined as eutrophic or nutrient enriched. TP concentrations are usually higher at increased depths due to the higher release rates of P from lake sediments under low oxygen (anoxic) conditions. Phosphorus may also be released from sediments as pH increases. Total phosphorus was measured in milligrams per liter (mg/L) with the use of Method EPA 200.7 (Rev. 4.4).

The mean TP concentrations in the basin of Loch Erin during the August 15, 2019, sampling event ranged from 0.050-0.069 mg/L which are more than twice the eutrophic threshold. These concentrations tend to be higher at the bottom depths and are indicative of internal loading of TP which means that the TP is accumulating in the lake bottom and is released when the dissolved oxygen concentrations fall below 2.0 mg/L. The mean TP concentrations during the July 2026 sampling ranged from 0.039-0.064 mg/L which is high. This elevated phosphorus can be released from sediments when the dissolved oxygen level is low. This in turn re-circulates the TP throughout the lake and makes it constantly available for algae and aquatic plants to use for growth.



Ortho-Phosphorus

Ortho-Phosphorus (also known as soluble reactive phosphorus or SRP) was measured with Method SM 4500-P (E-11). SRP refers to the most bioavailable form of P used by all aquatic life. The mean SRP concentrations in the basin of Loch Erin during August 15, 2019, sampling event ranged from <0.010-0.014 mg/L, which are low and favorable. The mean SRP concentrations in the basin of Loch Erin during July 24, 2026, sampling event were all <0.010 mg/L, which is low and below detection.

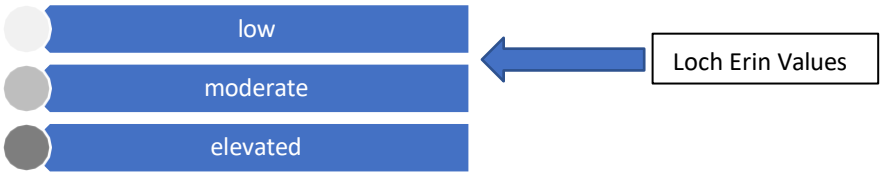


3.1.7 Total Kjeldahl Nitrogen and Total Inorganic Nitrogen

Total Kjeldahl Nitrogen (TKN) is the sum of nitrate (NO_3^-), nitrite (NO_2^-), ammonia (NH_4^+), and organic nitrogen forms in freshwater systems. TKN was measured with Method EPA 351.2 (Rev. 2.0) and Total Inorganic Nitrogen (TIN) was calculated based on the aforementioned three different forms of nitrogen at Trace Analytical Laboratories, Inc. (a NELAC-certified laboratory). Much nitrogen (amino acids and proteins) also comprises the bulk of living organisms in an aquatic ecosystem. Nitrogen originates from atmospheric inputs (i.e. burning fossil fuels), wastewater sources from developed areas (i.e. runoff from fertilized lawns), agricultural lands, septic systems, and from waterfowl droppings. It also enters lakes through groundwater or surface drainage, drainage from marshes and wetlands, or from precipitation (Wetzel, 2001). In lakes with an abundance of nitrogen (N:P > 15), phosphorus may be the limiting nutrient for phytoplankton and aquatic macrophyte growth. Alternatively, in lakes with low nitrogen concentrations (and relatively high phosphorus), the blue-green algae populations may increase due to the ability to fix nitrogen gas from atmospheric inputs. Lakes with a mean TKN value of 0.66 mg/L may be classified as oligotrophic, those with a mean TKN value of 0.75 mg /L may be classified as mesotrophic, and those with a mean TKN value greater than 1.88 mg/L may be classified as eutrophic. The mean TKN concentrations in the basin of Loch Erin during the August 15, 2019, sampling event ranged from 1.1-1.3 mg/L. The mean TKN concentrations in the basin of Loch Erin during the July 24, 2026, sampling event ranged from <0.5-1.2 mg/L which is similar to concentrations measured in 2019. These values are normal for an inland lake of similar size.

In the absence of dissolved oxygen, nitrogen is usually in the ammonia form which is the most abundant form of nitrogen in the lake.

The total inorganic nitrogen (TIN) consists of nitrate (NO3), nitrite (NO2), and ammonia (NH3) forms of nitrogen without the organic forms of nitrogen. The mean TIN concentrations in the basin of Loch Erin during the August 15, 2019, sampling event ranged from 0.010-0.051 mg/L, which are favorable values. Similarly, all samples collected during the July 24, 2026, sampling date were < 0.210 mg/L which is favorable and below detection. The 2019 and 2026 non-detection values of <0.010 and <0.210, respectively, are both synonymous but correspond to different EPA lab analysis sensitivities. Two major reasons why submersed rooted aquatic plant growth is not more prevalent given these concentrations are due to depth limitations and the lack of water clarity which is critical for higher aquatic plant growth. The nitrite and nitrate concentrations are still below detection. Overall, the nitrogen in Loch Erin is mostly in the ammonia form.



3.1.8 Chlorophyll-a and Algae

Chlorophyll-*a* is a measure of the amount of green plant pigment present in the water, often in the form of planktonic algae. Chlorophyll-a water samples were collected with an integrated tube sampler and transferred to amber bottles preserved with Lugol's solution. Chlorophyll-a samples were collected at the 4 sampling locations during the August 15, 2019, and July 24, 2026, sampling dates. High chlorophyll-a concentrations are indicative of nutrient-enriched lakes. Chlorophyll-*a* concentrations greater than 6 µg/L are found in eutrophic or nutrient-enriched aquatic systems, whereas chlorophyll-*a* concentrations less than 2.2 µg/L are found in nutrient-poor or oligotrophic lakes. Chlorophyll-*a* was measured in micrograms per liter (µg/L) with a Turner Designs® *in situ* fluorimeter. The chlorophyll-*a* concentrations in Loch Erin were determined by collecting composite (depth-integrated) samples of the algae throughout the water column (photic zone) at the deep basin sites from just above the lake bottom to the lake surface. The mean chlorophyll-*a* concentrations in the basins during the August 15, 2019, sampling event ranged from 10-11 µg/L, respectively. These concentrations are highly elevated due to the presence of abundant blue-green algae such as *Microcystis*. The July 24, 2026, concentrations ranged from 23.9-48.2 µg/L and correspond to the observed increase in microscopic blue-green algae.

The dominant algae in the lake (blue green) tends to be buoyant and float on the surface which reduces light to other favorable algae below. Cyanobacteria (blue-green algae) have the distinct advantage of using nitrate and ammonia in the water (along with N_2 gas from the atmosphere) as food and can out-compete the green algae due to their faster growth rates and ability to be buoyant at the lake surface which reduces light to underlying algae.

To determine the presence of algal genera from the composite water samples collected from the deep basins of Loch Erin, 500 ml of preserved sample were collected, and a 1-mL subsample was placed to settle onto a Sedgewick-Rafter counting chamber (Woelkerling et *al*., 1076). The ocular micrometer scale was calibrated. The samples were observed under a Zeiss® compound microscope at 400X magnification and scanned at 100X magnification to allow for the detection of a broad range of taxa present. All taxa were identified to Genus level. Phytoplankton samples were enumerated for the August 15, 2019, and July 24, 2026, sampling events and are shown below in Tables 4 and 5. In the lake basin, the blue-green algae were more dominant than both green algae and diatoms. Diatoms and green algae are the more favorable algal genera. There was a marked increase in blue-green algae in 2026 compared to 2019.



Table 4. Counts (cells per 1 mL sub-sample) for each genera of algae found at each sampling location (n=4) in the lake basin of Loch Erin (August 15, 2019).

Taxa Present	Type	DB#1	DB#2	DB#3	DB#4
Chlorella sp.	G	2	5	1	0
Scenedesmus sp.	G	7	4	2	0
Mougeotia sp.	G	11	2	6	1
Ulothrix sp.	G	5	2	0	0
Closterium sp.	G	0	0	1	1
Cladophora sp.	G	5	1	0	8
Rhizoclonium sp.	G	2	6	1	0
Gleocapsa sp.	BG	4	15	7	2
Microcystis sp.	BG	1000	3000	2000	150
Anabaena sp.	BG	26	55	10	2
Oscillatoria sp.	BG	2	10	4	1
Navicula sp.	D	1	1	0	1
Synedra sp.	D	2	1	0	1
Rhoicosphenia sp.	D	0	0	1	1

Note: G = green algae (Chlorophyta); BG = blue-green algae (Cyanophyta); D = diatoms (Bacillariophyta). Microcystis algal count data were rounded to the closest whole number.

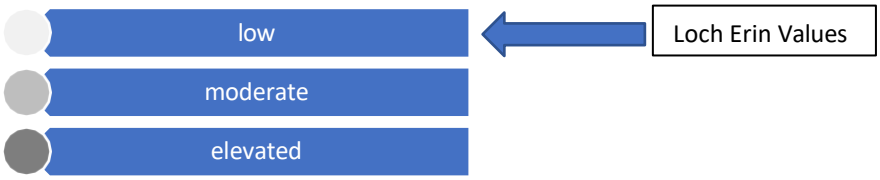
Table 5. Counts (cells per 1 mL sub-sample) for each genera of algae found at each sampling location (n=4) in the lake basin of Loch Erin (July 24, 2026).

Taxa Present	Type	DB#1	DB#2	DB#3	DB#4
Chlorella sp.	G	6	12	2	1
Haematococcus sp.	G	16	29	13	5
Mougeotia sp.	G	5	0	0	1
Ulothrix sp.	G	11	6	1	3
Pandorina sp.	G	3	4	7	2
Cladophora sp.	G	7	10	2	0
Rhizoclonium sp.	G	1	19	2	7
Microcystis sp.	BG	>12,000	>10,500	>8,000	>10,500
Anabaena sp.	BG	26	55	10	2
Oscillatoria sp.	BG	2	10	4	1
Synedra sp.	D	5	1	0	1
Navicula sp.	D	4	3	7	0
Rhoicosphenia sp.	D	9	4	1	0
Cymbella sp.	D	0	0	2	1

Note: G = green algae (Chlorophyta); BG = blue-green algae (Cyanophyta); D = diatoms (Bacillariophyta). Microcystis algal count data were rounded to the closest whole number.

3.1.9 Secchi Transparency

Secchi transparency is a measure of the clarity or transparency of lake water, and is measured with the use of an 8-inch diameter standardized Secchi disk during calm to light wind conditions. Secchi disk transparency is measured in feet (ft.) or meters (m) by lowering the disk over the shaded side of a boat around noon and taking the mean of the measurements of disappearance and reappearance of the disk (Figure 9). Elevated Secchi transparency readings allow for more aquatic plant and algae growth. Eutrophic systems generally have Secchi disk transparency measurements less than 7.5 feet due to turbidity caused by excessive planktonic algae growth. The mean Secchi transparency of the basin of Loch Erin on August 15, 2019, ranged from 1.2-1.3 feet which is very low. The mean Secchi transparency measured on July 24, 2026, was 3.0 feet which is higher than in 2019. It is clear that the Secchi transparency declined throughout the season which was largely due to the growth of blue-green algal blooms. This transparency indicates that an abundance of solids such as suspended particles and algae is present throughout the water column which increases turbidity and reduces water clarity. Secchi transparency is variable and depends on the amount of suspended particles in the water (often due to windy conditions of lake water mixing) and the amount of sunlight present at the time of measurement.



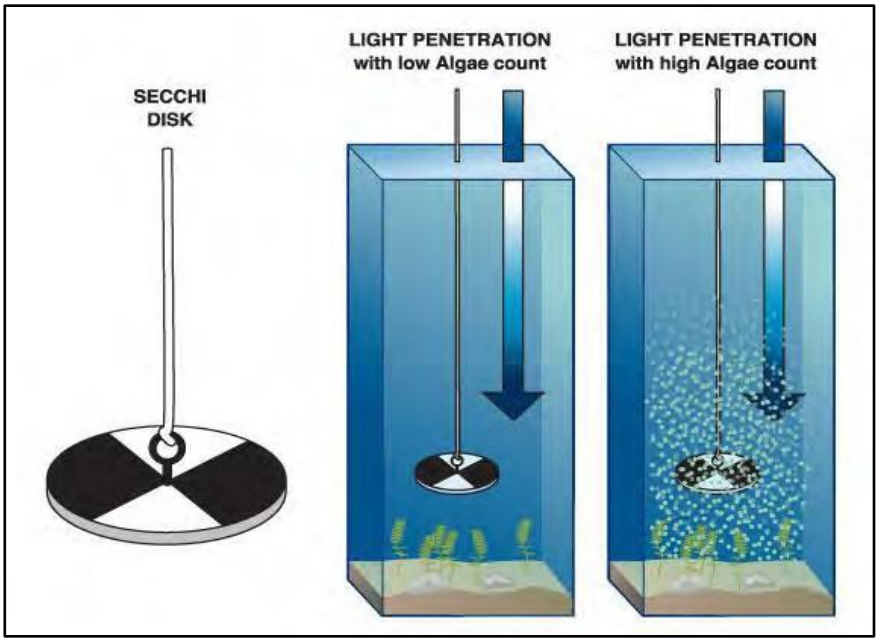


Figure 9. Measurement of water transparency with a Secchi disk.

Table 6. Loch Erin physical water quality parameter data collected at deep basin #1 (August 15, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	26.3	10.6	8.4	468	5.5	231	1.3
0.5	25.8	10.2	8.4	468	6.0	225	
1.0	25.5	8.8	8.3	470	5.0	224	
1.5	25.4	8.0	8.1	470	6.0	220	
2.0	25.3	7.8	8.1	469	5.0	218	
2.5	25.3	7.8	8.0	469	6.0	217	
3.0	25.1	7.3	8.0	470	5.5	218	

Table 7. Loch Erin chemical water quality parameter data collected at deep basin #1 (August 15, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	1.5	0.073	0.073	<0.10	<0.10	23	0.064	<0.010	10.0
1.5	1.1	0.071	0.071	<0.10	<0.10	19	0.041	<0.010	10.0
3.0	0.9	<0.010	<0.010	<0.10	<0.10	39	0.044	<0.010	11.0

Table 8. Loch Erin physical water quality parameter data collected at deep basin #2 (August 15, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	25.5	7.8	8.4	470	4.0	209	1.2
0.5	25.0	7.0	8.2	472	4.0	210	
1.0	25.0	6.0	8.2	473	4.0	210	
1.5	24.8	5.4	7.9	473	4.0	211	
2.0	24.7	4.7	7.8	473	4.0	211	
2.5	24.7	4.2	7.7	474	5.0	210	
3.0	24.7	3.9	7.4	474	4.0	209	
3.5	24.7	3.5	7.4	475	4.0	209	

Table 9. Loch Erin chemical water quality parameter data collected at deep basin #2 (August 15, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	1.3	<0.010	<0.010	<0.10	<0.10	18	0.043	<0.010	10.0
2.0	0.9	0.016	0.016	<0.10	<0.10	40	0.053	<0.010	10.0
3.5	1.2	0.110	0.110	<0.10	<0.10	96	0.110	<0.010	11.0

Table 10. Loch Erin physical water quality parameter data collected at deep basin #3 (August 15, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	26.0	9.9	8.5	464	6.0	251	1.3
0.5	25.9	10.1	8.5	464	6.0	251	
1.0	25.7	10.2	8.2	464	7.0	251	
1.5	25.6	9.6	8.2	466	6.0	252	
2.0	25.5	8.9	8.1	467	6.0	254	
2.5	25.4	6.9	8.0	468	6.0	256	

Table 11. Loch Erin chemical water quality parameter data collected at deep basin #3 (August 15, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	1.0	<0.010	<0.010	<0.10	<0.10	20	0.075	<0.010	10.0
1.5	1.4	<0.010	<0.010	<0.10	<0.10	38	0.047	0.021	10.0
2.5	1.4	<0.010	<0.010	<0.10	<0.10	82	0.066	<0.010	11.0

Table 12. Loch Erin physical water quality parameter data collected at deep basin #4 (August 15, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	26.6	7.8	8.3	472	5.0	251	1.2
0.5	26.0	7.4	8.2	472	5.0	255	
1.0	25.2	6.2	8.2	472	6.0	259	
1.5	25.2	5.5	8.1	472	6.0	259	
2.0	25.1	5.4	8.1	472	6.0	259	

Table 13. Loch Erin chemical water quality parameter data collected at deep basin #4 (August 15, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3- (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	0.9	<0.010	<0.010	<0.10	<0.10	15	0.069	<0.010	11.0
1.0	1.2	<0.010	<0.010	<0.10	<0.10	48	0.047	<0.010	11.0
2.0	1.3	<0.010	<0.010	<0.10	<0.10	54	0.049	<0.010	11.0

Table 14. Descriptive statistics of all water quality parameters in the deep basins of Loch Erin for water quality parameters collected on August 15, 2019.

Water Quality Parameter	Deep Basin #1 Means ± SD	Deep Basin #2 Means ± SD	Deep Basin #3 Means ± SD	Deep Basin #4 Means ± SD
Water temp (°C)	25.5±0.4	24.9±0.3	25.7±0.2	25.6±0.7
pH (S.U.)	8.2±0.2	7.9±0.4	8.3±0.2	8.2±0.1
Dissolved oxygen (mg/L)	8.6±1.3	5.3±1.5	9.3±1.3	6.5±1.1
Conductivity (mS/cm)	469±0.9	473±1.5	466±1.8	472±0.0
Total dissolved solids (mg/L)	222±5.1	210±0.8	253±2.1	257±3.6
Turbidity (NTU)	5.6±0.4	4.1±0.4	6.2±0.4	5.6±0.5
Secchi transparency (ft.)	1.5	1.2	1.3	1.2
Chlorophyll-a (µg/L)	10.3±0.6	10.3±0.6	10.3±0.6	11.0±0.0
Total Kjeldahl nitrogen (mg/L)	1.2±0.3	1.1±0.2	1.3±0.2	1.1±0.2
Total inorganic nitrogen (mg/L)	0.051±0.0	0.045±0.1	0.010±0.0	0.010±0.0
Ammonia nitrogen (mg/L)	0.051±0.0	0.045±0.1	0.010±0.0	0.010±0.0
Nitrate nitrogen (mg/L)	<0.10±0.0	<0.10±0.0	<0.10±0.0	<0.10±0.0
Nitrite nitrogen (mg/L)	<0.10±0.0	<0.10±0.0	<0.10±0.0	<0.10±0.0
Total phosphorus (mg/L)	0.050±0.0	0.069±0.0	0.063±0.0	0.055±0.0
Ortho-Phosphorus (mg/L)	0.010±0.0	0.010±0.0	0.014±0.0	0.010±0.0
Total suspended solids (mg/L)	27.0±10.6	51.0±40	46.7±32	39.0±21

Table 15. Loch Erin physical water quality parameter data collected at deep basin #1 (July 24, 2026).

Depth (ft)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	TDS (mg/L)	Secchi Depth (ft)
0	24.7	9.5	8.6	464	297	3.0
1.0	24.7	9.4	8.6	464	297	
2.0	24.7	9.5	8.6	464	297	
3.0	24.7	9.7	8.6	464	297	
4.0	24.7	9.6	8.6	464	297	
5.0	24.7	9.6	8.6	464	297	
6.0	24.7	9.6	8.6	464	297	
7.0	24.7	9.5	8.6	464	297	
8.0	24.4	6.8	8.6	464	302	
9.0	24.4	5.1	7.9	472	302	
10.0	24.3	5.0	7.7	473	303	

Table 16. Loch Erin chemical water quality parameter data collected at deep basin #1 (July 24, 2026).

Depth (ft)	TKN (mg/L)	TIN (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	1.0	<0.210	<10	0.032	<0.010	36.6
5.0	0.9	<0.210	12	0.052	<0.010	
10.0	1.0	<0.210	11	0.034	<0.010	

Table 17. Loch Erin physical water quality parameter data collected at deep basin #2 (July 24, 2026).

Depth (ft)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	TDS (mg/L)	Secchi Depth (ft)
0	25.1	9.9	8.6	463	296	3.0
1.0	25.0	10.0	8.6	463	297	
2.0	24.9	9.9	8.6	464	297	
3.0	24.9	9.8	8.6	464	297	
4.0	24.9	9.8	8.6	464	297	
5.0	24.9	9.7	8.6	464	297	
6.0	24.9	9.7	8.6	464	297	
7.0	24.7	9.5	8.4	466	298	
8.0	24.5	8.7	7.1	470	301	
9.0	24.5	6.6	7.1	470	301	
10.0	24.5	5.3	7.0	472	303	

Table 18. Loch Erin chemical water quality parameter data collected at deep basin #2 (July 24, 2026).

Depth (ft)	TKN (mg/L)	TIN (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	0.9	<0.210	<10	0.030	<0.010	23.9
5.0	0.8	<0.210	10	0.040	<0.010	
10.0	1.1	<0.210	13	0.058	<0.010	

Table 19. Loch Erin physical water quality parameter data collected at deep basin #3 (July 24, 2026).

Depth (ft)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	TDS (mg/L)	Secchi Depth (ft)
0	25.0	9.8	8.6	467	299	3.0
1.0	24.8	9.5	8.5	467	299	
2.0	24.8	9.3	8.5	467	299	
3.0	24.7	9.0	8.5	467	300	
4.0	24.7	8.8	8.4	468	300	
5.0	24.6	8.1	8.4	468	300	
6.0	24.6	7.9	8.3	469	302	
7.0	24.6	7.6	8.2	471	302	
8.0	24.5	4.8	7.8	475	304	
9.0	24.5	4.0	7.6	480	307	

Table 20. Loch Erin chemical water quality parameter data collected at deep basin #3 (July 24, 2026).

Depth (ft)	TKN (mg/L)	TIN (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.5	<0.210	11	0.060	<0.010	48.2
4.5	<0.5	<0.210	55	0.066	<0.010	
9.0	<0.5	<0.210	17	0.066	<0.010	

Table 21. Loch Erin physical water quality parameter data collected at deep basin #4 (July 24, 2026).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	TDS (mg/L)	Secchi Depth (ft)
0	25.0	8.6	8.7	467	299	3.0
1.0	24.7	8.7	8.5	466	298	
2.0	24.7	8.7	8.5	467	299	
3.0	24.6	8.4	8.4	467	299	
4.0	24.6	8.1	8.4	467	299	
5.0	24.6	7.8	8.4	468	299	
6.0	24.6	6.6	8.2	469	300	
7.0	24.6	6.2	8.0	472	302	

Table 22. Loch Erin chemical water quality parameter data collected at deep basin #4 (July 24, 2026).

Depth (ft)	TKN (mg/L)	TIN (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	1.1	<0.210	11	0.042	<0.010	39.2
3.5	1.3	<0.210	15	0.054	<0.010	
7.0	1.1	<0.210	14	0.044	<0.010	

Table 23. Descriptive statistics of all water quality parameters in the deep basins of Loch Erin for water quality parameters collected on July 24, 2026.

Water Quality Parameter	Deep Basin #1 Means ± SD	Deep Basin #2 Means ± SD	Deep Basin #3 Means ± SD	Deep Basin #4 Means ± SD
Water temp (°C)	24.6±0.2	24.8±0.2	24.7±0.2	24.7±0.1
pH (S.U.)	8.5±0.3	8.2±0.7	8.3±0.3	8.4±0.2
Dissolved oxygen (mg/L)	8.5±1.9	9.0±1.6	7.9±2.0	7.9±1.0
Conductivity (mS/cm)	466±3.4	466±3.0	470±4.4	468±1.9
Total dissolved solids (mg/L)	299±2.5	298±2.3	301±2.6	299±1.2
Secchi transparency (ft.)	3.0	3.0	3.0	3.0
Chlorophyll-a (µg/L)	36.6±0.0	23.9±0.0	48.2±0.0	39.2±0.0
Total Kjeldahl nitrogen (mg/L)	1.0±0.1	0.9±0.2	0.5±0.0	1.2±0.1
Total inorganic nitrogen (mg/L)	<0.210±0.0	<0.210±0.0	<0.210±0.0	<0.210±0.0
Total phosphorus (mg/L)	0.039±0.0	0.043±0.0	0.064±0.0	0.047±0.0
Ortho-Phosphorus (mg/L)	<0.010±0.0	<0.010±0.0	<0.010±0.0	<0.010±0.0
Total suspended solids (mg/L)	11.0±1.0	11.0±1.7	27.7±24	13.3±2.1

4.0 LOCH ERIN AQUATIC VEGETATION BIOVOLUME

A whole-lake scan of the aquatic vegetation in Loch Erin was conducted on July 11, 2019, and again on July 24, 2026, with a WAAS-enabled Lowrance HDS 9® GPS with variable frequency transducer. This data included tens of thousands of data sounding points in the lake basin. Points were then uploaded into a cloud software program to reveal maps that displayed depth contours, sediment hardness, and aquatic vegetation biovolume (Figures 10 and 11). On these maps, the color blue refers to areas that lack vegetation. The color green refers to low-lying vegetation. The colors red/orange refer to tall-growing vegetation. There are many areas around the littoral (shallow) zone of the lake that contain low-growing plants like Chara. In addition, any emergent canopies or lily pads will show as red or yellow color on the map. For this reason, the scans are conducted in conjunction with a whole lake GPS survey to account for individual species identification of all aquatic plants in the lake. Tables 24 and 25 show the biovolume categories by plant cover during the July 11, 2019, and July 24, 2026, scans.

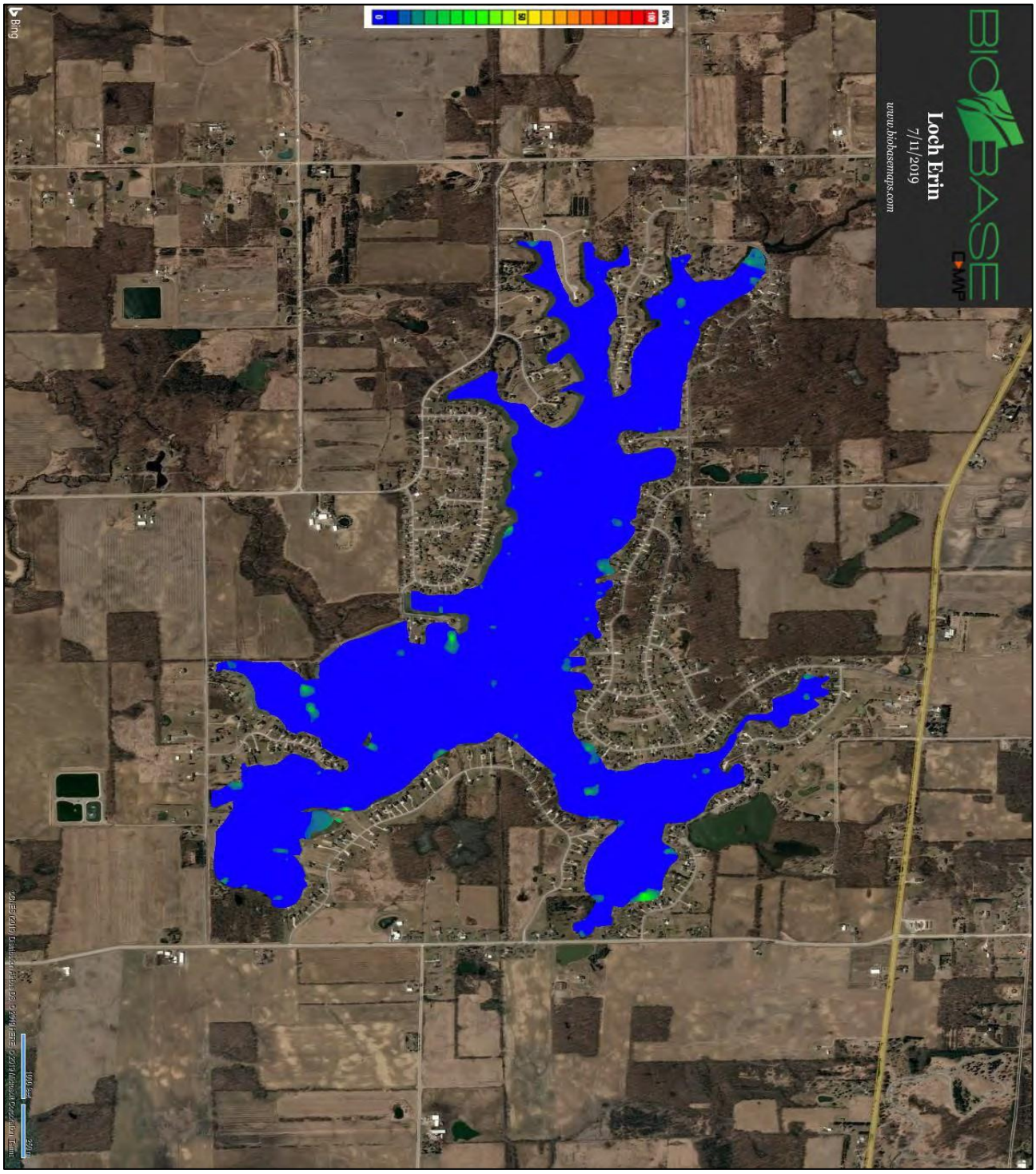


Figure 10. Aquatic plant biovolume of all aquatic plants in north Loch Erin, Lenawee County, Michigan (July 11, 2019). Note: Red color denotes high-growing aquatic plants, green color denoted low-growing aquatic plants, and blue color represents a lack of aquatic vegetation.

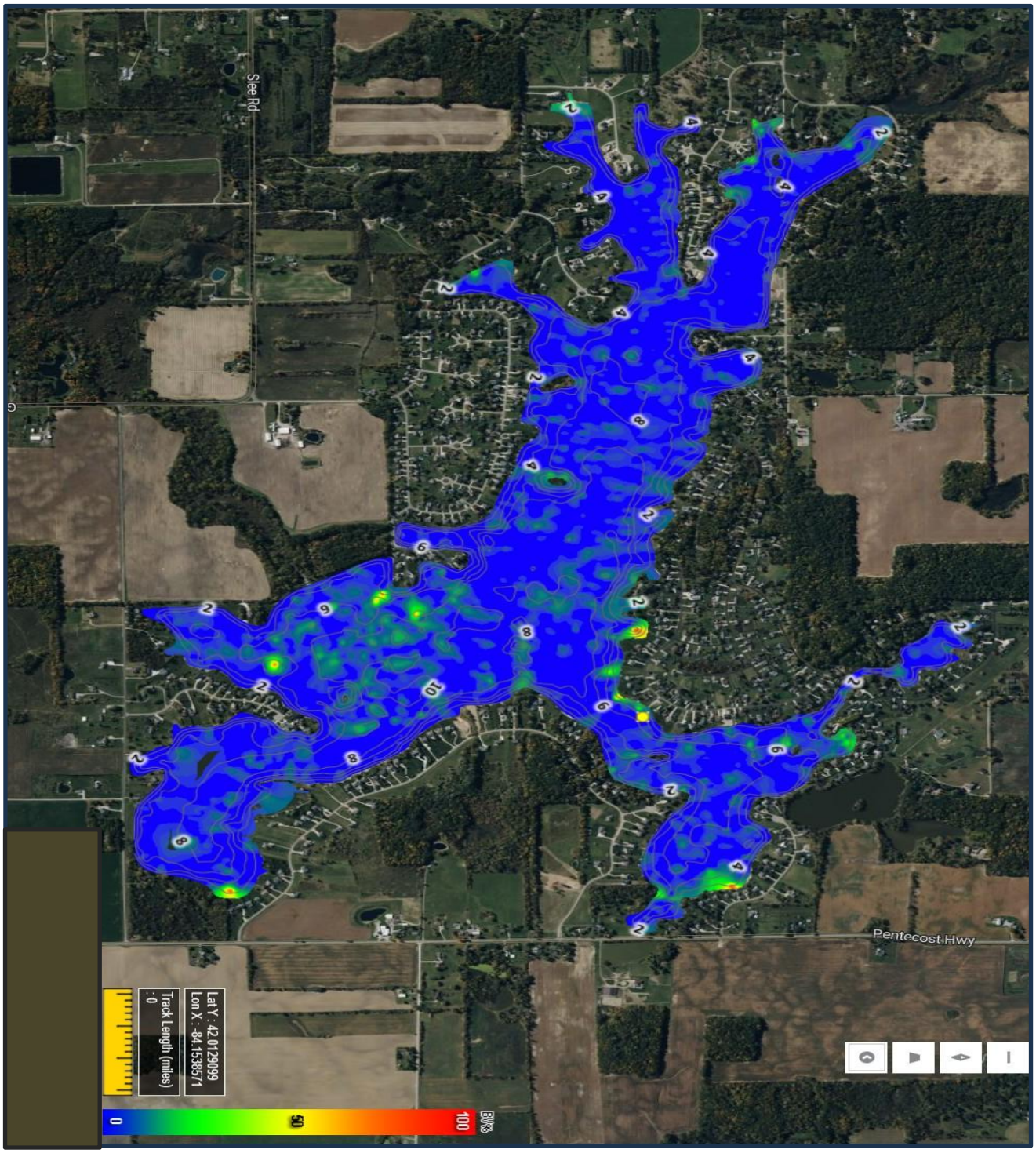


Figure 11. Aquatic plant biovolume of all aquatic plants in north Loch Erin, Lenawee County, Michigan (July 24, 2026). Note: Red color denotes high-growing aquatic plants, green color denoted low-growing aquatic plants, and blue color represent a lack of aquatic vegetation.

Table 24. Loch Erin basin aquatic vegetation biovolume by category percent cover of each category (relative cover on July 11, 2019).

Biovolume Cover Category	% Relative Cover of Bottom by Category
<5%	96.8
5-20%	2.0
20-40%	0.4
40-60%	0.3
60-80%	0.2
>80%	0.3

Table 25. Loch Erin basin aquatic vegetation biovolume by category percent cover of each category (relative cover on July 24, 2026).

Biovolume Cover Category	% Relative Cover of Bottom by Category
<5%	96.9
5-20%	2.0
20-40%	0.7
40-60%	0.1
60-80%	0.0
>80%	0.3

5.0 LOCH ERIN UPDATE CONCLUSIONS & FUTURE RECOMMENDATIONS

Loch Erin is facing significant issues that degrade water quality over time, including inputs of nutrients and solids from surrounding drains and tributaries. Fishery spawning habitat is becoming impaired by the addition of sediments to the lake and the increased BOD is resulting in a decline in dissolved oxygen with depth throughout the lake in some areas. The high nutrients have also led to increased blue-green algal blooms that may secrete toxins such as microcystins that are a public and pet health hazard and result in lake advisories. These algae also reduce light to aquatic plants and favor an algal-dominated state. The result of the overabundance of algae is higher turbidity, lower water clarity, and fewer aquatic plants (especially the native submersed types that cannot tolerate low light conditions). The quantities of nutrients and solids entering the lake are greater than the residual concentrations in the lake basins. Thus, the lake basin will continue to deteriorate unless drain/inlet improvements are made. Some noted improvements have occurred since 2019 including the reduction in some phosphorus and increase in water clarity.

Improvements would include the assurance that all areas around the lake are vegetated at all times and with proper erosion stabilization techniques. RLS has recommended intensive BMPs for all three critical source areas (CSA's) that drain to the lake. This will allow for increased recreational use and navigational use of those areas and also lead to reduced sediment and nutrient loading to the lake over time. Some of these areas may require specialized drain filters and agricultural BMPs to slow the velocity of sediment particles before entering the lake.

Furthermore, a professional limnologist/aquatic botanist should perform regular GPS-guided whole-lake surveys each spring and late summer/early fall to monitor the growth and distribution of all invasives and nuisance aquatic vegetation growth and recommend any possible treatments that may be needed. Continuous monitoring of the lake for potential influxes of other exotic aquatic plant genera (i.e. *Hydrilla*) that could also significantly disrupt the ecological stability of Loch Erin is critical. The lake manager should oversee all management activities and would be responsible for the creation of aquatic plant management survey maps, direction of the herbicide applicator to only target-specific areas of aquatic vegetation for removal, recommendations for implementation of watershed best management practices, administrative duties such as the processing of contractor invoices, and lake management education.

A complete list of recommended lake improvement options for this proposed lake management plan can be found in Table 26 below. It is important to coordinate these methods with objectives so that baseline conditions can be compared to post-treatment/management conditions once the methods have been implemented.

Table 26. List of Loch Erin proposed improvement methods with primary and secondary goals and locations for implementation.

Proposed Improvement Method	Primary Goal	Secondary Goal	Where to Implement
Systemic herbicide spot-treatments for ONLY invasives	Reduce only invasives in lake	Reduce long-term use of herbicides in lake and encourage balanced lake plant communities	Entire lake basin only where invasives present
P-reduction mitigation	Increase DO, reduce blue-green algae, increase water clarity	Reduce nutrients in the water column and sediment nutrient release	Entire lake
Water quality monitoring of lake and drains (CSA's); 3-5 years w/update	Monitor efficacy of BMP's implemented, including any aeration, drain filters, etc.	Compare baseline water quality and drain data to modern data to view trends for data-driven management	Entire Lake basin and all major drains (3 CSA's)
Annual lake surveys pre- and post-treatment	To determine efficacy of herbicide treatments on invasives (only if needed)	To determine ability of native aquatic vegetation biodiversity to recover post-management implementation	Entire lake in areas where needed
Riparian/Community Education	To raise awareness of lake/drain issues and empower all to participate in lake protection	Long-term sustainability requires ongoing awareness and action	Entire lake community and those who frequent the lake; may also include relevant stakeholders