Turk Lake 2024 Aquatic Vegetation, Water Quality, and 2025 Management Recommendations Report

December, 2024

Turk Lake 2024 Aquatic Vegetation, Water Quality, and 2025 Management Recommendations Report (2007-2024)

Website: http://www.restorativelakesciences.com

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Section 1

Turk Lake 2024 Aquatic Vegetation, Water Quality, and 2025 Management Recommendations Report

The following information is a summary of key lake findings collected during 2024.

The overall condition of Turk Lake is ranked in the top 15% of developed lakes of similar size in the state of Michigan according to RLS scientists. The water clarity was between 7.2-8.3 feet in 2024 with higher clarity observed in the front lake. The lake did experience complete depletion of dissolved oxygen with depth during the summer sampling. However, only the very bottom of each basin showed anoxic conditions.

Continuous aquatic vegetation surveys are needed to determine the precise locations of EWM or other problematic invasives in Turk Lake. These surveys should occur in late-May to early-June and again post-treatment in 2025. RLS scientists will be present to oversee all significant aquatic herbicide treatments in 2025.

The plan for 2025 includes the use of high dose systemic aquatic herbicides (primarily ProcellaCOR®) for any new milfoil areas as well as moderate doses of contact herbicides such as diquat and/or flumioxazin (Clipper®) to reduce nuisance native pondweed growth (most commonly Thin-leaf Pondweed). Nuisance lily pads can also be treated in the late summer/early fall with Clipper® at 200 ppb if needed.

Section

2

Turk Lake Water Quality Data (2008-2024)

Water Quality Parameters Measured

There are hundreds of water quality parameters one can measure on an inland lake, but several are the most critical indicators of lake health. These parameters include water temperature (measured in °C), dissolved oxygen (measured in mg/L), pH (measured in standard units-SU), conductivity (measured in micro-siemens per centimeter-µS/cm), total alkalinity or hardness (measured in mg of calcium carbonate per liter-mg $CaCO_3$/L), total dissolved solids (mg/L), secchi transparency (feet), total phosphorus (in µg/L), chlorophyll-*a* (in µg/L), and algal species composition. Graphs that show trends for each parameter of each year are displayed below. Water quality is measured in the deep basins of Turk Lake (Front and Back) in spring and/or late summer of each year. Trend data was calculated using mean values for each parameter for each season over each sampling location. Table 1 below demonstrates how lakes are classified based on key parameters. Turk Lake would be considered mesotrophic (productive) since it does contain ample phosphorus and aquatic vegetation growth but has excellent water clarity and moderately low algal growth. 2024 water quality data for Turk Lake (front) and (back) are shown below in Tables 2-3.

Table 1. Lake trophic classification (MDNR).

Lake Trophic Status	*Total Phosphorus (µg L^{-1})*	*Chlorophyll-a (µg L^{-1})*	*Secchi Transparency (feet)*
Oligotrophic	**< 10.0**	**< 2.2**	**> 15.0**
Mesotrophic	**10.0 – 20.0**	**2.2 – 6.0**	**7.5 – 15.0**
Eutrophic	**> 20.0**	**> 6.0**	**< 7.5**

Table 2. Back Turk Lake water quality parameter data collected over the deep basin on July 30, 2024.

Depth ft.	*Water Temp ºC*	*DO mg L^{-1}*	*pH S.U.*	*Cond. µS cm^{-1}*	*Chl-a µgL^{-1}*	*Total Dissolved Solids mg L^{-1}*	*Total Kjeldahl Nitrogen mg L^{-1}*	*Total Phos. mg L^{-1}*
0	27.17	8.91	8.28	337.3	5.0	215.8	0.58	0.010
9	26.50	8.73	8.21	343.2	--	195	0.82	0.012
15	23.99	0.15	7.47	390.1	--	249.8	1.4	0.018

Table 3. Front Turk Lake water quality parameter data collected over the deep basin on July 30, 2024.

Depth ft.	*Water Temp ºC*	*DO mg L^{-1}*	*pH S.U.*	*Cond. µS cm^{-1}*	*Chl-a µgL^{-1}*	*Total Dissolved Solids mg L^{-1}*	*Total Kjeldahl Nitrogen mg L^{-1}*	*Total Phos. mg L^{-1}*
0	27.20	8.62	8.54	323.4	3.0	207	0.86	0.010
10	26.92	8.72	8.61	323.3	--	206.9	0.72	0.012
20	23.14	0.26	7.30	515.3	--	329.5	1.20	0.014

Water Clarity (Transparency) Data

Secchi transparency is a measure of water clarity and is measured with the use of a specialized Secchi disk. Elevated Secchi transparency readings allow for more aquatic plant and algae growth. The transparency throughout Turk Lake was good in July 2024 (8.3 feet in the back lake and 7.2 feet in the front lake). This is adequate to allow abundant growth of algae and aquatic plants in the majority of the littoral zone of the lake. Secchi transparency depends on the number 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. Other parameters such as Total Dissolved Solids (measured in mg/L) are correlated with water clarity and increase as clarity decreases. The total dissolved solids in Turk Lake were ≤230.1 mg/L during the 2024 sampling period.

Figures 1-10 below show the trend in mean water clarity with time. Additionally, the last graphs show the trend in mean turbidity with time.

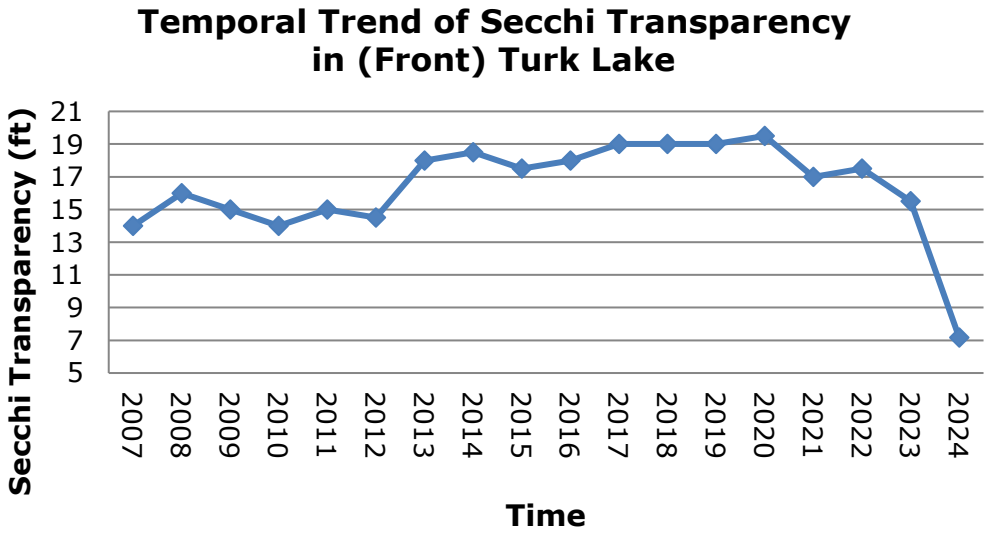

Figure 1: (Front) Changes in Secchi transparency over time in Turk Lake, Montcalm County, MI.

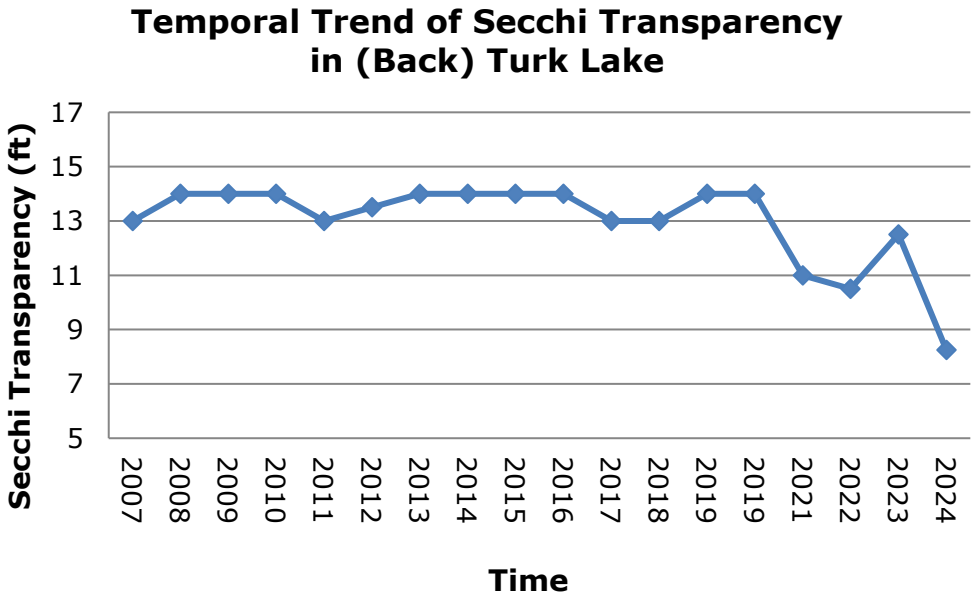

Figure 2. (Back) Changes in Secchi transparency over time in Turk Lake, Montcalm County, MI.

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. TP concentrations are usually higher at increased depths due to higher release rates of P from lake sediments under low oxygen (anoxic) conditions. Phosphorus may also be released from sediments as pH increases. Fortunately, even though the TP levels in Turk Lake are moderate, the dissolved oxygen levels are good enough at the bottom to not cause release of phosphorus from the bottom.

TP concentrations fluctuated between 0.010-0.018 mg L^{-1} in 2024 with equal concentrations recorded in both front and back lakes. The figures below show the trend in mean TP with time.

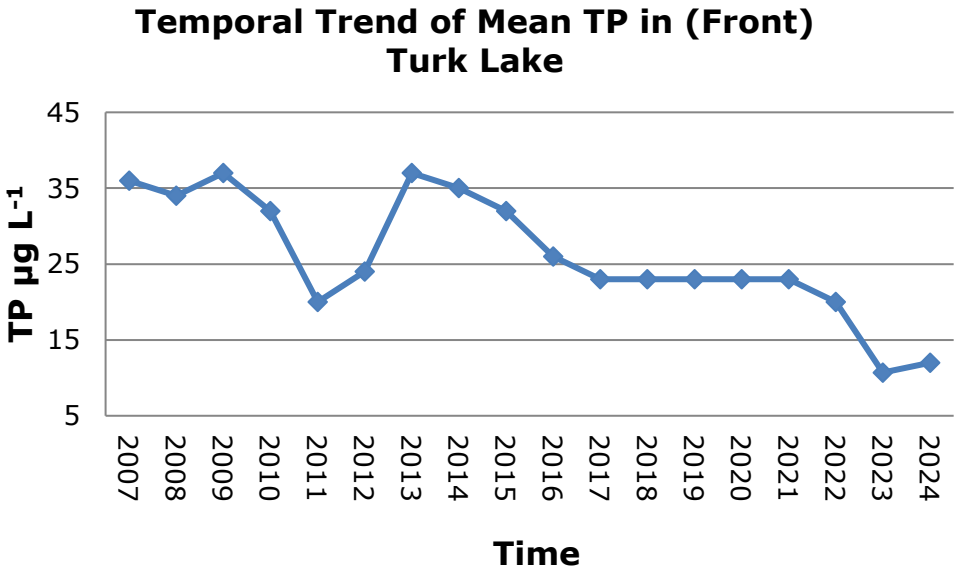

Figure 3. (Front) Changes in Total Phosphorous over time in Turk Lake, Montcalm County, MI.

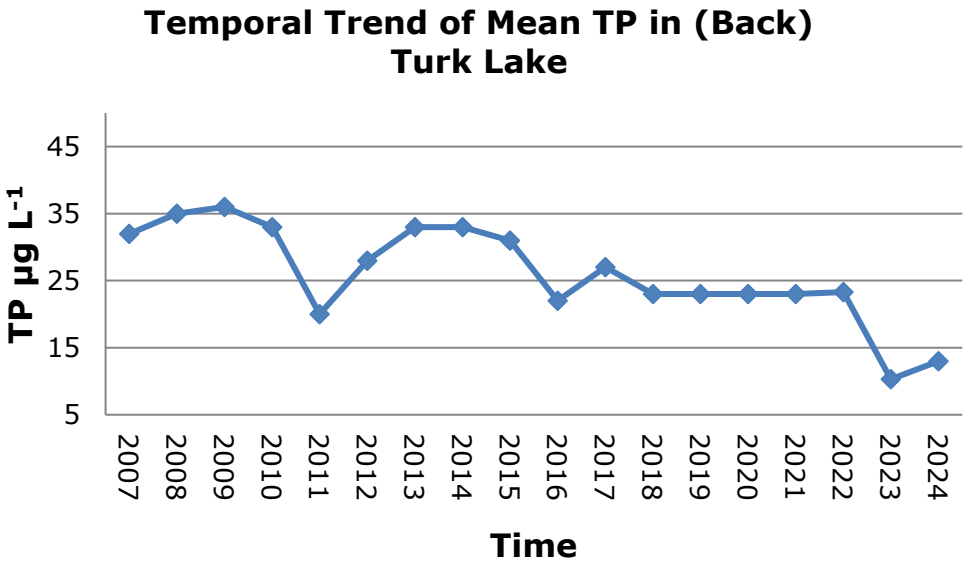

Figure 4. (Back) Changes in Total Phosphorous over time in Turk Lake, Montcalm County, MI.

pH

Most Michigan lakes have pH values that range from 6.5 to 9.5. 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). Turk Lake is considered “slightly basic” on the pH scale. The pH of Turk Lake has stabilized over the past several years to 7.3 - 8.6 S.U. which is ideal for an inland lake. The graphs below show the trend in mean pH with time.

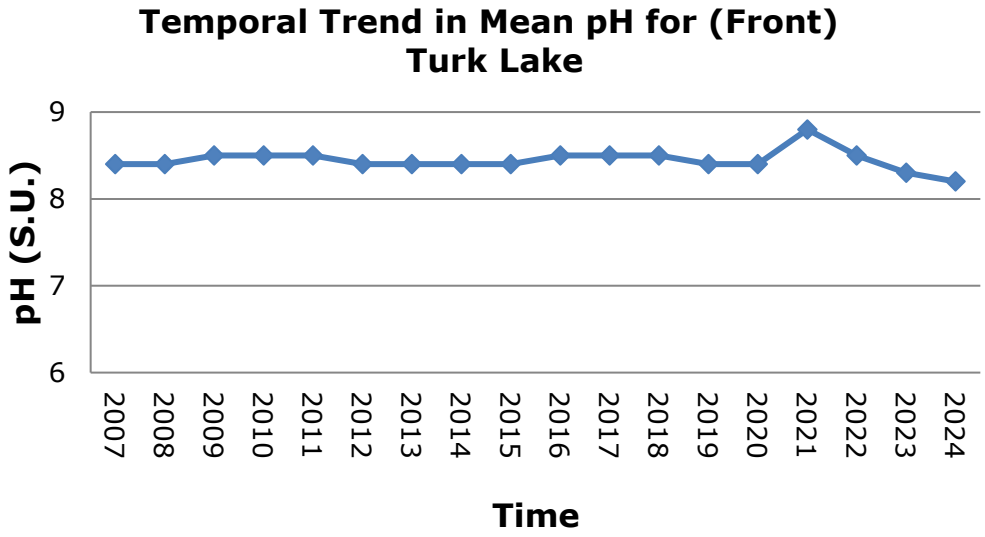

Figure 5. (Front) Changes in pH over time in Turk Lake, Montcalm County, MI.

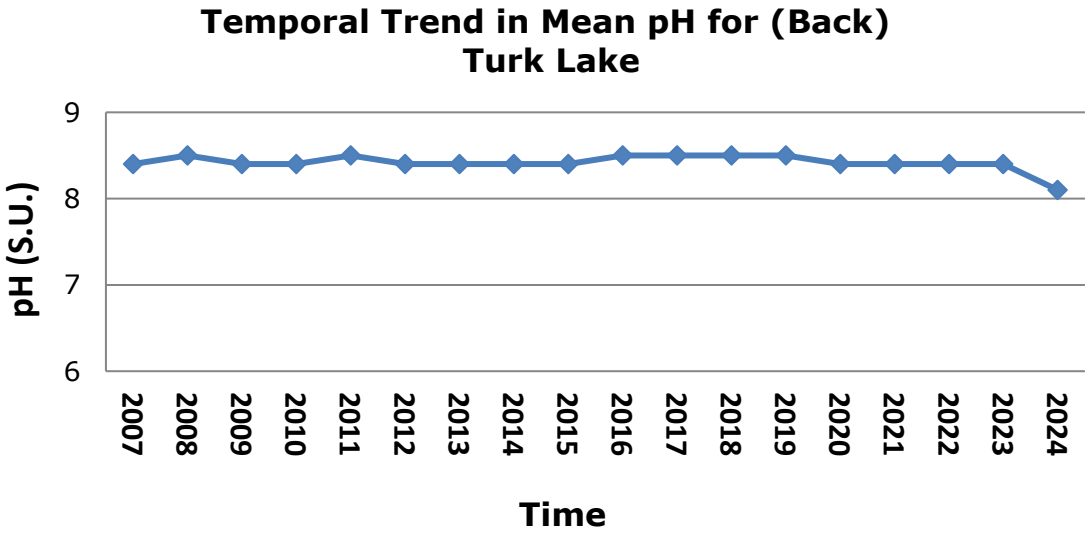

Figure 6. (Back) Changes in pH over time in Turk Lake, Montcalm County, MI.

Conductivity

Conductivity is a measure of the number of mineral ions present in the water, especially those of salts and other dissolved inorganic substances. Conductivity increases as the amount of dissolved minerals and salts in a lake increases, and also increases as water temperature increases. The conductivity values for Turk Lake were moderate in 2024 and ranged from 323.3-514.3 µS/cm. Severe water quality impairments do not occur until values exceed 800 µS/cm and are toxic to aquatic life around 1,000 µS/cm. This parameter may change annually according to road salt uses which can eventually enter the lake. The graphs below show the trend in mean conductivity with time.

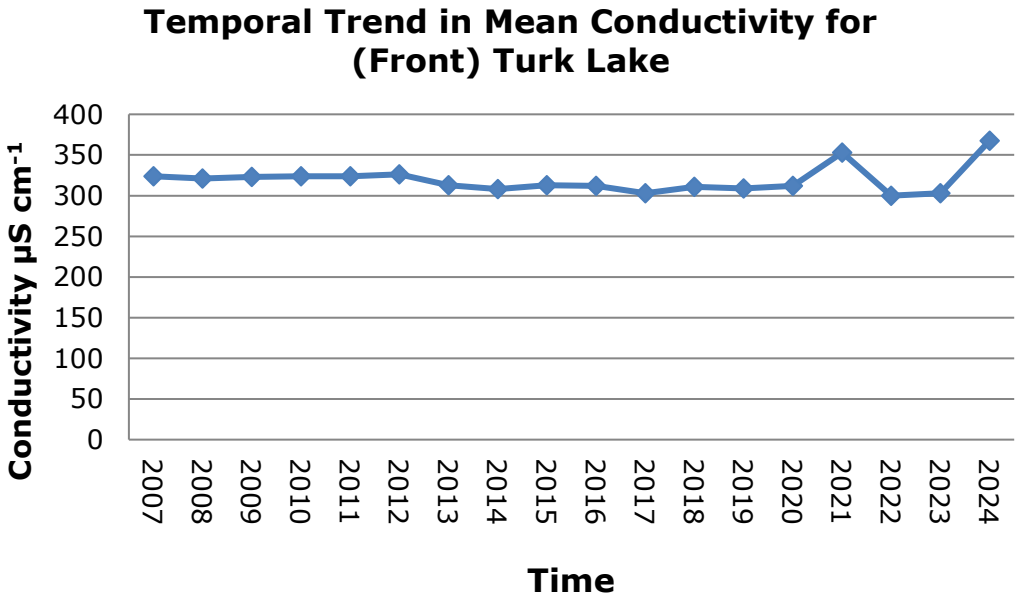

Figure 7. (Front) Changes in Conductivity over time in Turk Lake, Montcalm County, MI.

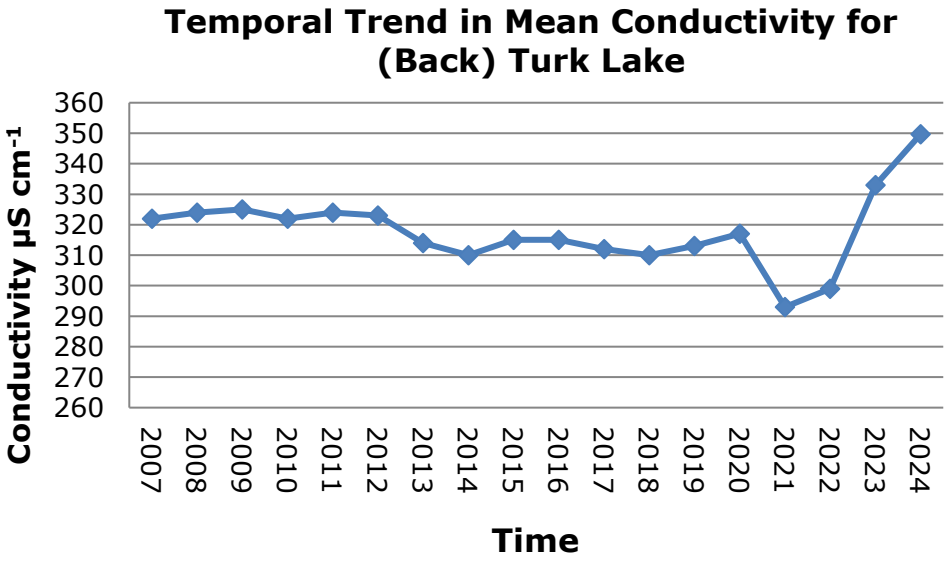

Figure 8. (Back) Changes in Conductivity over time in Turk Lake, Montcalm County, MI.

Chlorophyll-*a* and Algal Species Composition

Chlorophyll-*a* is a measure of the amount of green plant pigment present in the water, often in the form of planktonic algae. High chlorophyll-*a* concentrations are indicative of nutrient-enriched lakes. Chlorophyll-*a* concentrations greater than 6 µg L^{-1} 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. The maximum chlorophyll-*a* concentrations in July of 2024 did not exceed 5.0 µg/L which was noted in the back lake and lower concentrations in the front lake. The graphs below show the trend in chlorophyll-*a* with time.

The algal genera were determined from composite water samples collected over the deep basin of Turk Lake in 2024 were analyzed with a compound bright field microscope. The genera present included the Chlorophyta (green algae): *Chlorella* sp., *Cosmarium* sp., *Haematococcus* sp., *Pediastrum* sp., *Ulothrix* sp., *Spirogyra* sp., and *Mougeotia* sp.; The Cyanophyta (blue-green algae): *Oscillatoria* sp.; the Bascillariophyta (diatoms)*: Navicula* sp., *Tabellaria* sp., *Cymbella* sp., and *Synedra* sp. The aforementioned species indicate a diverse algal flora and represent a good diversity of alga with an abundance of diatoms that are indicative of great water quality.

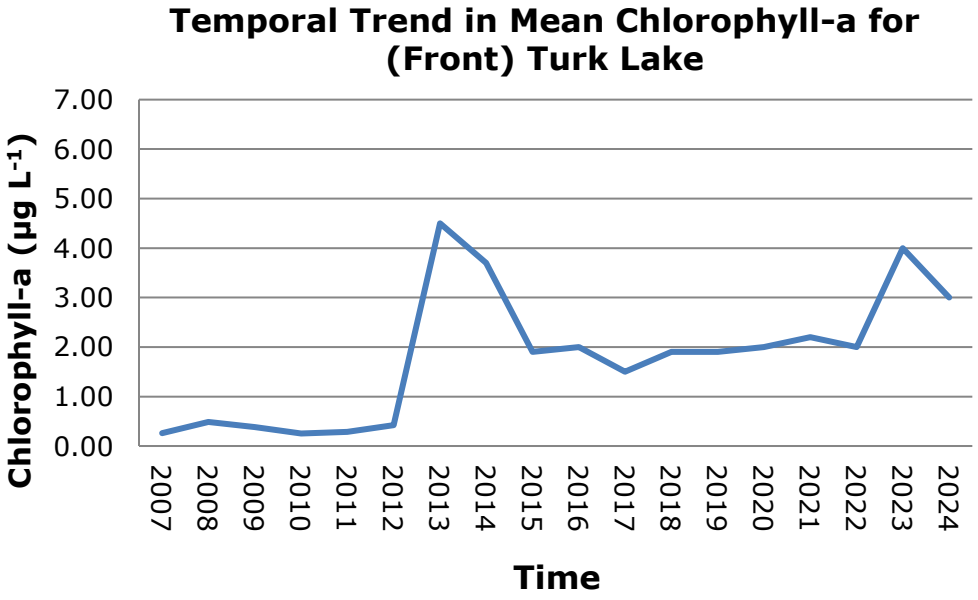

Figure 9. (Front) Changes in Chlorophyll-a over time in Turk Lake, Montcalm County, MI.

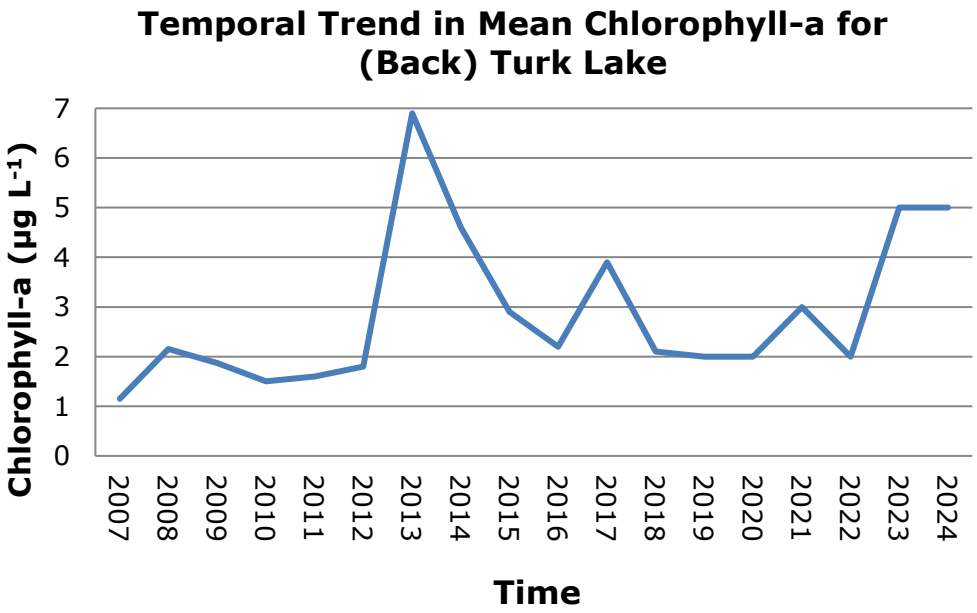

Figure 10. (Back) Changes in Chlorophyll-a over time in Turk Lake, Montcalm County, MI.

Section

3

Aquatic Vegetation Data (2024)

Status of Native Aquatic Vegetation in Turk Lake

The native aquatic vegetation present in Turk Lake is essential for the overall health of the lake and the support of the lake fishery. The July 30, 2024 survey determined that there were a total of 20 native aquatic plant species in Turk Lake. These include 14 submersed species, 2 floating-leaved and 4 emergent species. This indicates a high biodiversity of aquatic vegetation in Turk Lake. In 2007, prior to any management efforts, there was less biodiversity at a total of 12 native aquatic plant species. The removal of invasive milfoil throughout the years has allowed the low-growing native aquatic plants to thrive. The overall % cover of the lake by native aquatic plants is low relative to the lake size and thus these plants should be protected unless growing near swim areas at nuisance levels.

The most common native aquatic plants in order of abundance in 2024 included: Chara (81.0%), White waterlily (50.0%), and Illinois Pondweed (38.0%). Some of these may require treatment in shallow areas and in the back lake due to their ability to grow in dense patches and impede swimming and navigational activities.

Table 4 below shows the native aquatic plants present. Figure 11 below shows the changes since 2007 in native aquatic plants.

Table 4. Turk Lake Native Aquatic Plant Species (July 30, 2024).

Aquatic Plant Species	Common Name	Growth Form	Frequency (%)
Chara vulgaris	Muskgrass	Submersed	81.5
Nitella sp.	Nitella	Submersed	8.3
Fontinalis antipyretica	Aquatic Moss	Submersed	0.9
Potamogeton zosteriformis	Flat-stem Pondweed	Submersed	2.8
Potamogeton gramineus	Variable-leaf Pondweed	Submersed	12.0
Potamogeton pectinatus	Thin-leaf Pondweed	Submersed	2.8
Najas marina	Spiny Naiad	Submersed	6.5
Potamogeton illinoensis	Illinois Pondweed	Submersed	38.0
Potamogeton amplifolius	Large-leaf Pondweed	Submersed	24.1
Vallisneria americana	Wild Celery	Submersed	21.3
Najas flexilis	Slender Naiad	Submersed	13.9
Utricularia sp.	Bladderwort	Submersed	0.9
Najas guadalupensis	Southern Naiad	Submersed	0.9
Stuckenia pectinata	Sago Pondweed	Submersed	11.1
Nymphaea odorata	White Waterlily	Emergent	50.0
Nuphar advena	Yellow Waterlily	Emergent	14.8
Pontederia cordata	Pickereleeed	Emergent	15.7
Typha latifolia	Cattails	Emergent	15.7
Schoenoplectus sp.	Bullrushes	Emergent	13.9
Decodon verticillata	Swamp Loosestrife	Emergent	6.5

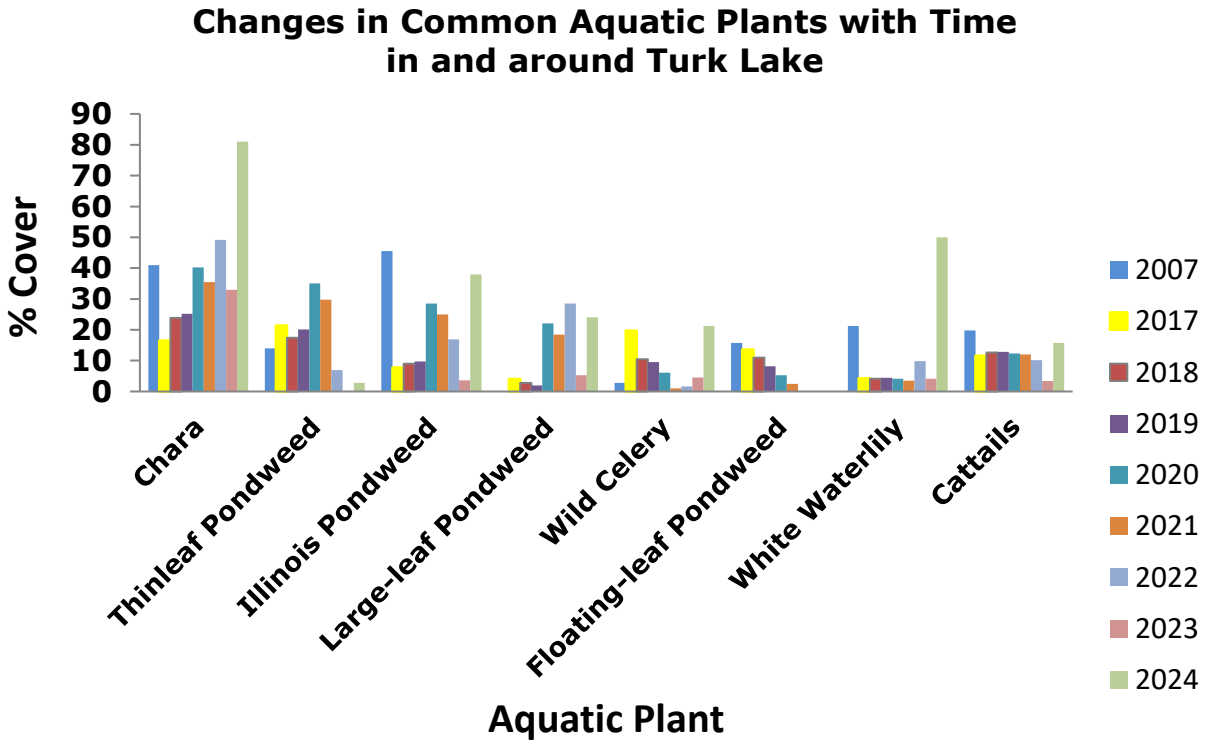

Figure 11: Changes in Native Vegetation over time in Turk Lake, Montcalm County, MI.

Invasive (Exotic) Aquatic Plant Species

The amount of Eurasian Watermilfoil (EWM) present in Turk Lake varies each year and is dependent upon climatic conditions, especially runoff-associated nutrients. The May 6, 2024 survey (Figure 12) revealed that 2 acres of EWM were present along with 0.25 acres of Starry Stonewort. Aquatic herbicide treatments were conducted on May 16, 2024 by PLM using Diquat and ProcellaCOR®. The Starry infestation will continued to be monitored.

There was another treatment on June 16th, where 10.0 acres of algae was targeted with chelated copper along with a minor nuisance native infestation that was treated with flumioxazin @100ppb.

The last treatment took place on August 8th, where a small algae bloom was treated with SeClear-G® and Lilly pads were targeted with flumioxazin to open boat paths and swim areas (Figure 13).

Figures 14-16 below show the quantity of EWM, nuisance natives, and nuisance algae treated over the years.

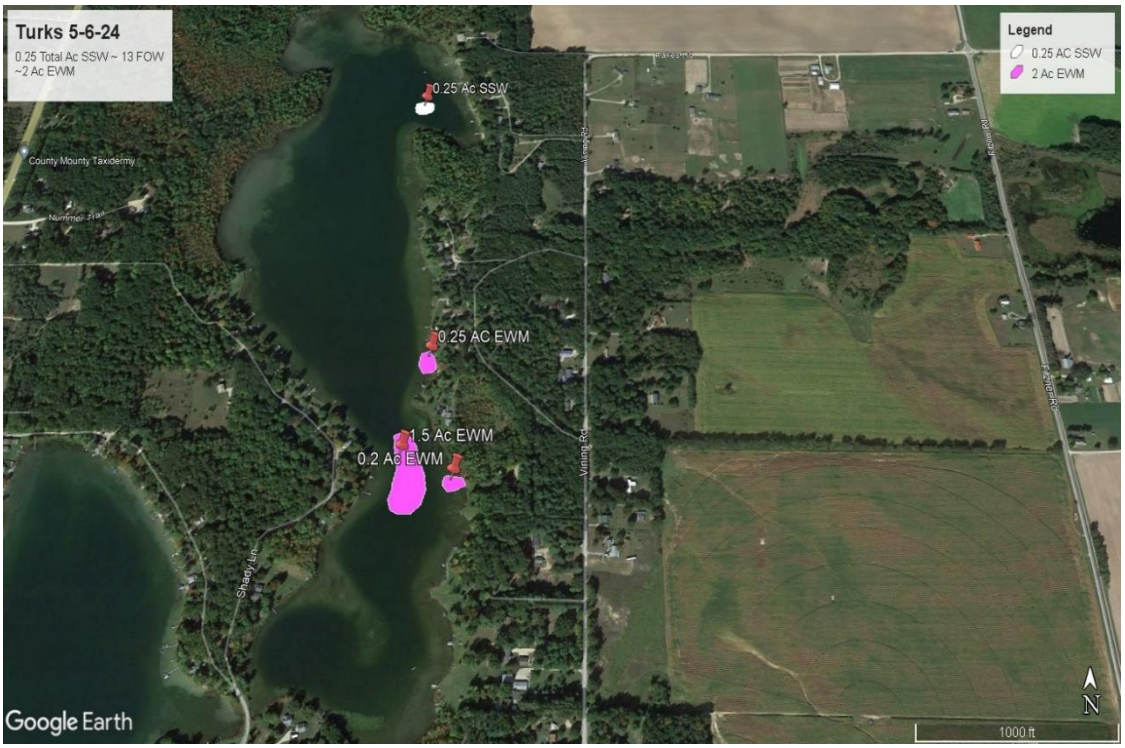

Figure 12. EWM treatment map of Turk Lake, Montcalm County, MI (May 6, 2024).

Figure 13. EWM/Algae/Nuisance Natives treatment map of Turk Lake, Montcalm County, MI (August 29th, 2024).

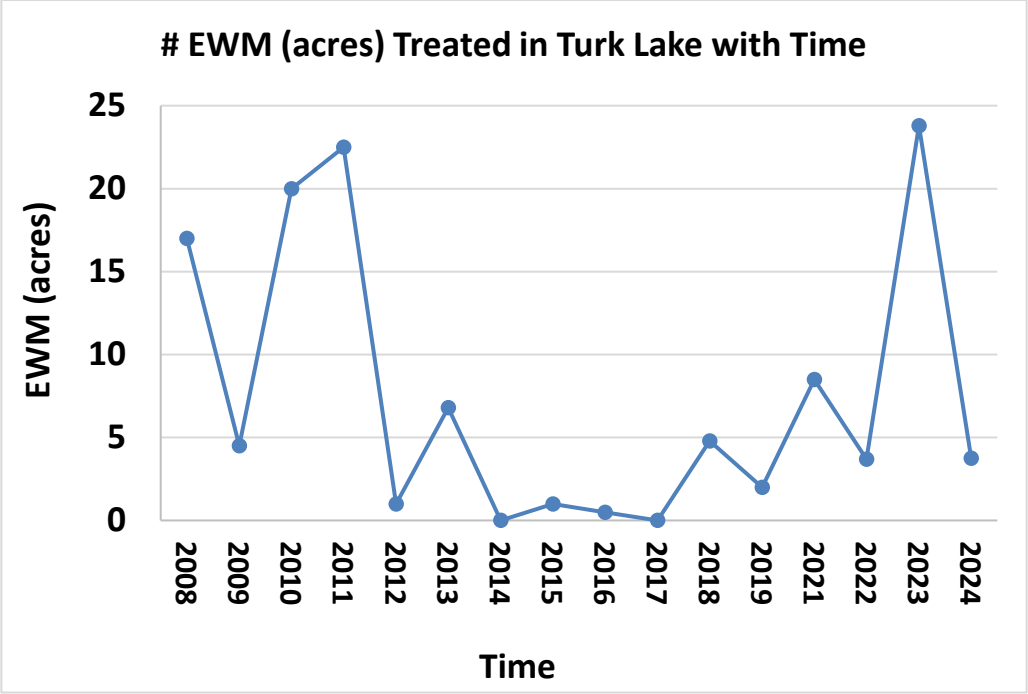

Figure 14. EWM treated over time in Turk Lake, Montcalm County, MI.

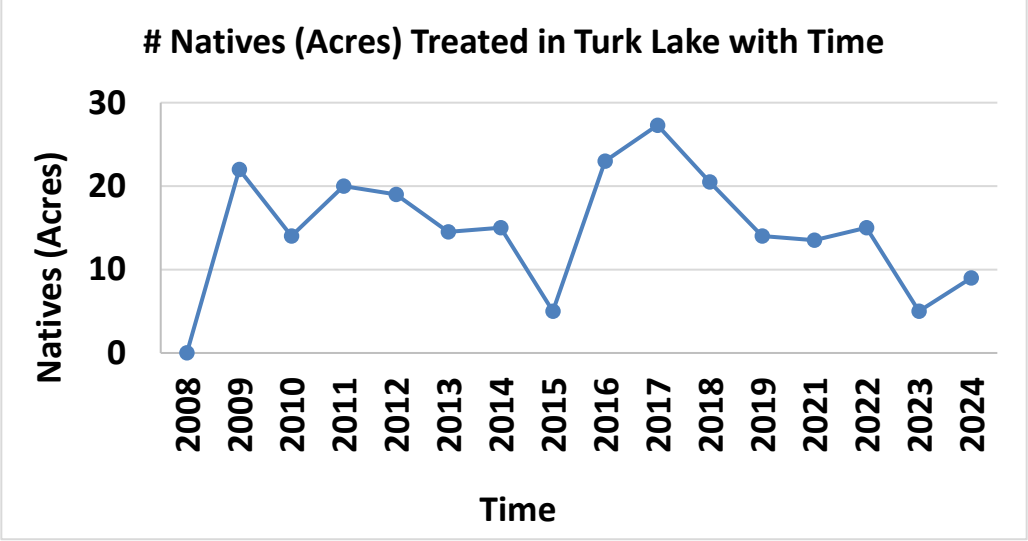

Figure 15. Natives treated over time in Turk Lake, Montcalm County, MI.

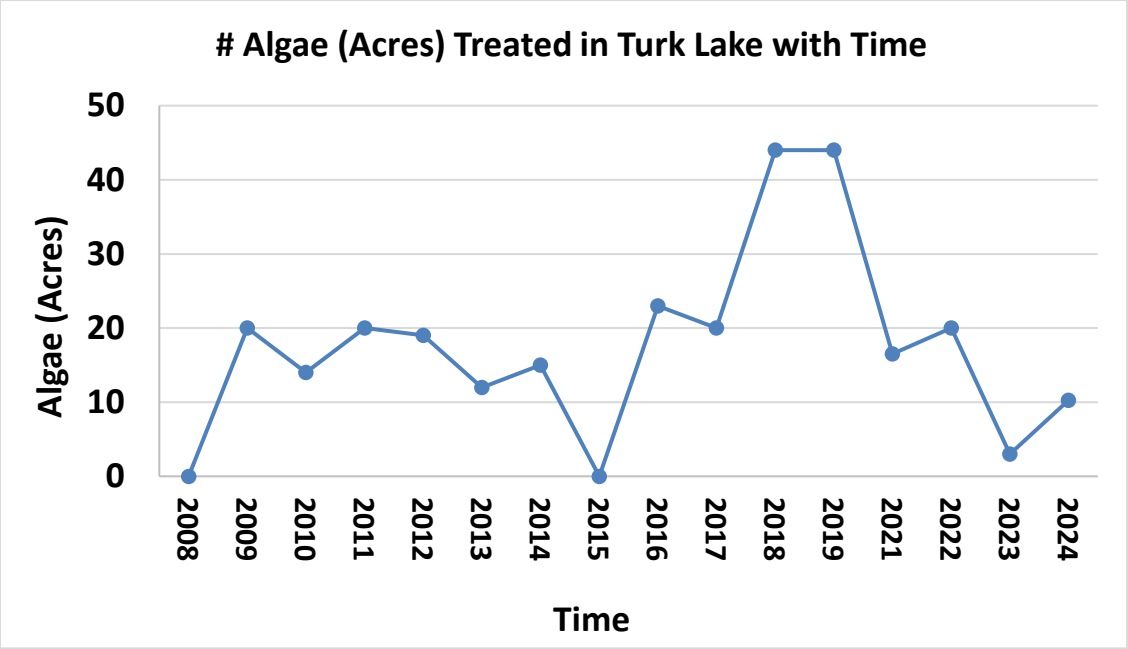

Figure 16. Algae treated over time in Turk Lake, Montcalm County, MI.

Section

4

Management Recommendations for 2025

In 2025, whole lake aquatic vegetation surveys will again be conducted in the lake to determine locations of EWM, other problematic invasive species, and any other nuisance native plants or algae. These surveys will occur in late May or early June depending on the weather and post-treatment surveys will also be scheduled as needed. RLS scientists will oversee all treatments as in previous years. Maintaining EWM at the existing low levels will be the top priority to keep a healthy aquatic plant balance.

Water quality measurements will be monitored in both the front and back lakes. Historic data will be graphed to determine any long-term trends. The current water quality of both lakes is very good. RLS encourages all riparians to follow riparian best management practices to reduce nutrients to the lake (especially maintenance of septic systems).

The treatment of nuisance natives such as Thin-leaf Pondweed will continue to be emphasized to maintain navigation on the lake. Diquat, Clipper®, and combinations of the two herbicides may be used in 2025. Any nuisance algal blooms will be addressed with chelated copper or copper products. Clipper® will be used if necessary. RLS expects the lily pad density to decline in future years due to intensive treatment efforts but cautions against too much treatment since they are favorable for the lake ecosystem. ProcellaCOR® and diquat may be used to treat EWM.

Turk Lake is a healthy lake with excellent aquatic plant diversity. Both lakes have a significant diversified fishery. Management of the EWM, Thin leaf Pondweed and protection of the water quality are essential for the long-term health of the lake.

2025 Turk Lake Improvement Board meetings will be attended by an RLS scientist as in previous years.