

LAKE LEMON MONITORING PROGRAM
2025 Results Summary



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Lake Lemon 2025 Water Monitoring Overview

The Lake Lemon Conservancy District (LLCD) began contracting Indiana University in 1998 to monitor water quality of the lake and incoming tributaries. Figure 1 shows the sampling locations for Lake Lemon and the tributaries in 2025. IU has provided full sampling methods to the LLCD. Figure 2 displays precipitation during the sampling season with individual sampling events indicated.

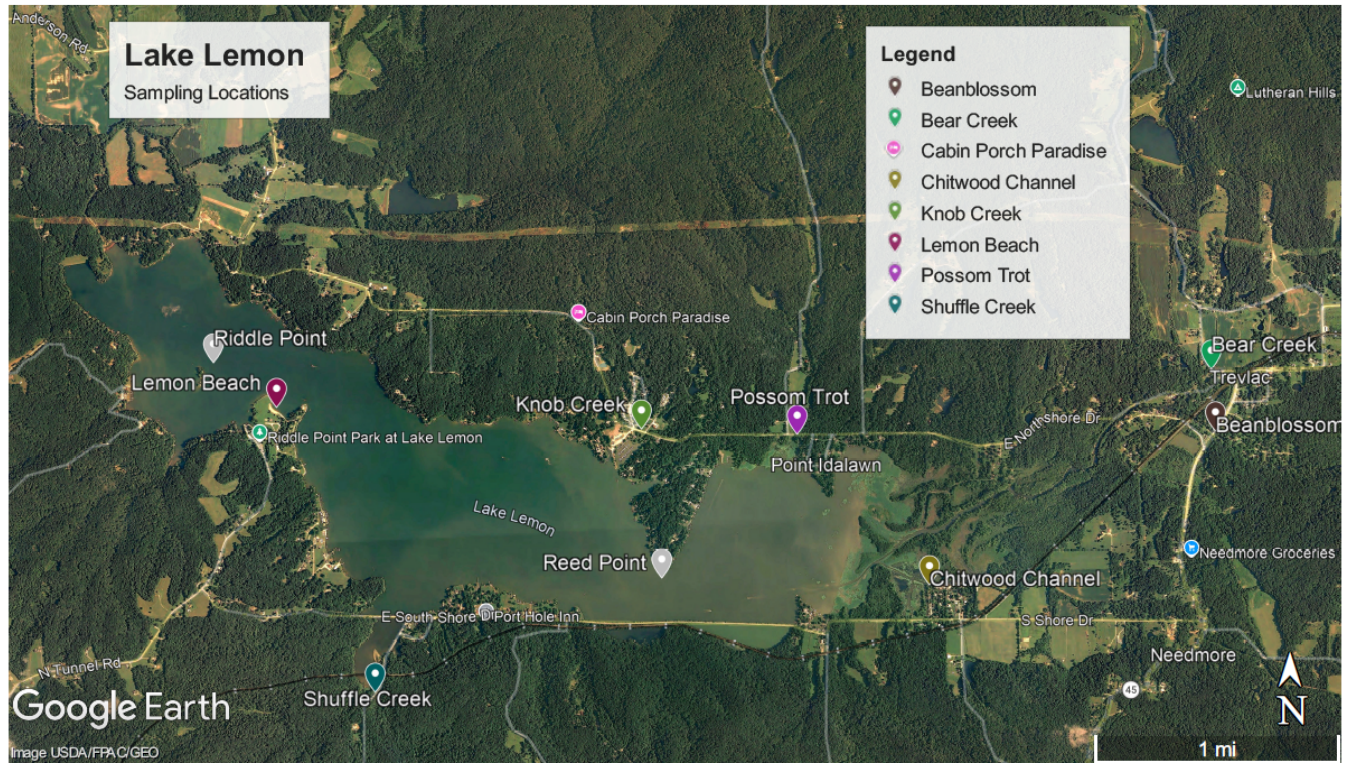


Figure 1 Sampling locations for the Lake Lemon Water Monitoring Program.

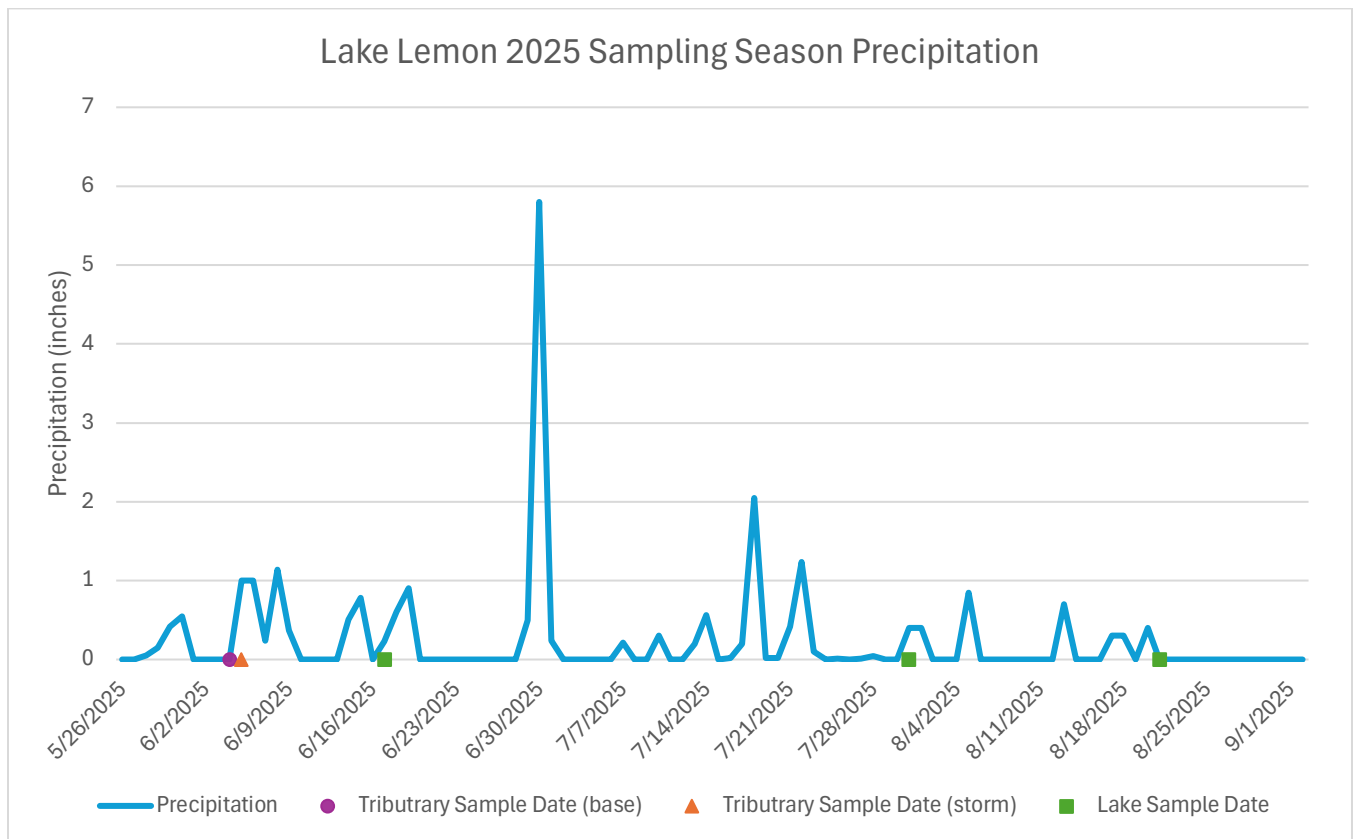


Figure 2 Precipitation amounts during the 2025 sampling season.

Lake Lemon 2025 Summary Results

Temperature and Dissolved Oxygen

IU collected a full profile of temperature and dissolved oxygen from one-meter depth increments through the water column at Riddle and Reed Point in Lake Lemon (Figures 3 and 4). The temperature profile illustrates the seasonal variation in water temperature and thermal stratification that occurs as the surface water warms. This year, June had the least amount of oxygen at Riddle point, decreasing to less than 1 mg/L by 3 meters below the surface. The August dissolved oxygen concentration averaged 8.0 mg/L in the epilimnion. This is a substantial decrease from the abnormally high value seen last year. Last year's (2024) August average dissolved oxygen was almost 14 mg/L compared to 2023's August average dissolved oxygen that was 9.6 mg/L. The value from 2024 was abnormal. Anoxic conditions develop below 4 meters mid-summer as organic matter on the lake bottom creates biochemical oxygen demand (BOD) that breaks down the organic matter consuming available oxygen. Stratification of the surface water reduces mixing of oxygen in the deeper water. The shallow depth of Reed Point and lake turbulence usually keep this area of the lake well mixed and oxygenated, however anoxic conditions happened in June and July but not in August (Figure 3). In past years, usually the July and August sampling events are when anoxic conditions occur.

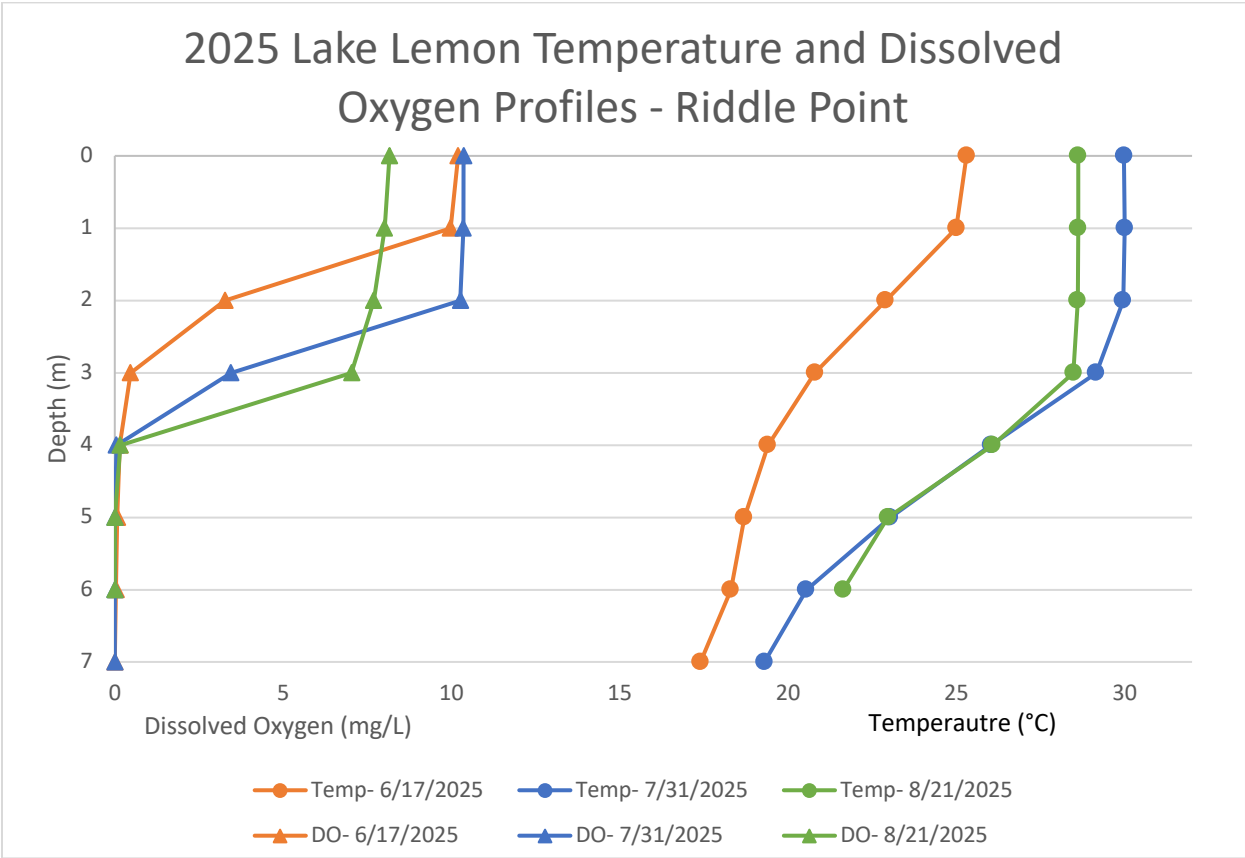


Figure 3 Temperature and dissolved oxygen profiles from all sample dates from Indiana University at Riddle Point in 2025.

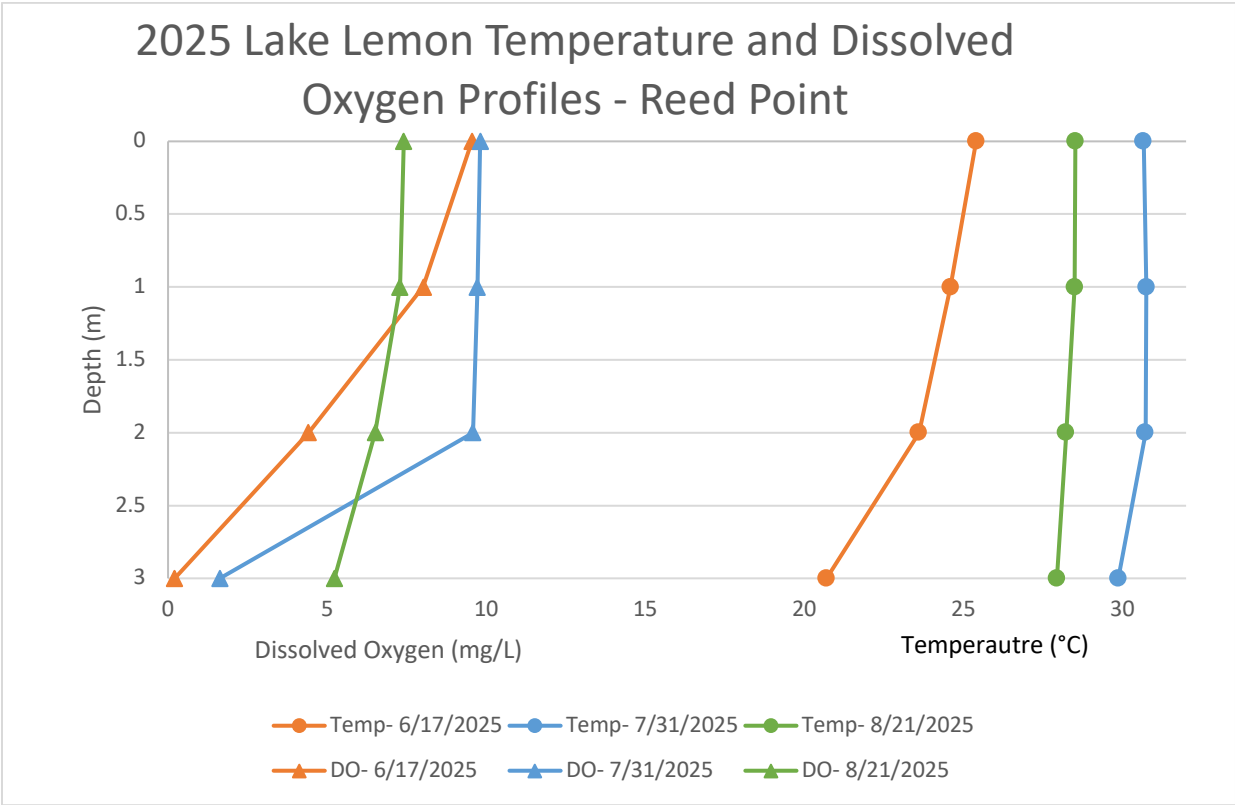


Figure 4 Temperature and dissolved oxygen profiles from all sample dates from Indiana University at Reed Point in 2025.

Water Quality Summary

IU collected epilimnion samples from the top 2 meters of the water column and hypolimnion at 3 meters depth (9.8 ft) at Reed Point and 6 meters depth (19.7 ft) at Riddle Point. Reed point was not stratified in August, thus only an integrated epilimnion sample was collected during this month.

Table 1 Water Quality Characteristics of Lake Lemon – Riddle Point and Reed Point, 6/17/2025.

Parameter	Riddle		Reed	
	Epilimnion	Hypolimnion	Epilimnion	Hypolimnion
Secchi (m)	1.15	--	0.93	--
Light trans @ 1m (%)	18.85	--	25.41	--
1% Light Level (ft)	8.9	--	6.6	--
% Water Column Oxic	37.5	--	87.5	--
pH	8.59	6.92	7.8	7.15
Conductivity (uS/cm))	146.8	195.2	160.2	168.3
Acid Neutralizing Capacity (mg/L)	54.9	65.8	59.7	68.1
Nitrate (mg/L)	0.0070	0.0070	0.0070	0.0563
Ammonia (mg/L)	0.0405	0.2766	0.1349	0.1275
Total Nitrogen (mg/L)	0.5279	0.5062	0.4983	0.5224
Orthophosphate (mg/L)	0.0074	0.0238	0.0085	0.0087
Total Phosphorus (mg/L)	0.0392	0.0585	0.0463	0.0574
Chlorophyll- <i>a</i> (ug/L)	28.165	--	14.777	--
Plankton (Cells/mL)	12,961	--	7,714	--
Blue-green (Cells/mL)	676	--	1,861	--
HAB (Cells/mL)	336	--	263	--
HAB %	3	--	3	--
<i>E. coli</i> (#/100 mls)	10	--	4	--

Table 2 Water Quality Characteristics of Lake Lemon – Riddle Point and Reed Point, 7/31/2025.

Parameter	Riddle		Reed
	Epilimnion	Hypolimnion	Epilimnion
Secchi (m)	0.5	--	0.4
Light trans @ 1m (%)	--	--	--
1% Light Level (ft)**	3.3	--	2.6
% Water Column Oxic	50	--	87.5
pH	9.17	6.94	9.06
Conductivity (uS/cm)	164.39	217.06	169.86
Acid Neutralizing Capacity (mg/L)	69.9	99.3	72.3
Nitrate (mg/L)	0.0070	0.0700	0.0070
Ammonia (mg/L)	0.1639	1.0254	0.2551
Total Nitrogen (mg/L)	0.7162	1.367	0.7543
Orthophosphate (mg/L)	0.0050	0.2827	0.0066
Total Phosphorus (mg/L)	0.0446	0.2733	0.0561
Chlorophyll-a (ug/L)	45.75	--	58.68
Plankton (Cells/ml)	354,733	--	314,695
Blue-green (Cells/mL)	6,373	--	14,198
HAB (Cells/mL)	343,390	--	289,560
HAB %	97	--	92

**Estimated from Secchi depth for July.

Table 3 Water Quality Characteristics of Lake Lemon – Riddle Point and Reed Point, 8/21/2025.

Parameter	Riddle		Reed
	Epilimnion	Hypolimnion	Epilimnion
Secchi (m)	0.7	--	0.45
Light trans @ 1m (%)	34	--	21.61
1% Light Level (ft)	5.9	--	4.3
% Water Column Oxic	62.5	--	100
pH	8.69	7.33	8.42
Conductivity (uS/cm)	162.38	233.47	162.65
Acid Neutralizing Capacity (mg/L)	76.1	101.9	77.1
Nitrate (mg/L)	0.007	0.1749	0.0191
Ammonia (mg/L)	0.0753	1.0219	0.1240
Total Nitrogen (mg/L)	0.7211	1.3724	0.7777
Orthophosphate (mg/L)	0.0083	0.1633	0.0081
Total Phosphorus (mg/L)	0.0663	0.1603	0.0777
Chlorophyll-a (ug/L)	54.105	--	43.302
Plankton (Cells/ml)	171,353	--	170,420
Blue-green (Cells/mL)	39,813	--	61,853
HAB (Cells/mL)	105,194	--	64,826
HAB %	61	--	38

Primary Productivity

Chlorophyll-a, which is a measure of the primary pigment in algae, is a direct measure of algal productivity. In the integrated epilimnion samples from the surface to the 2-meter depth, the chlorophyll-*a* concentrations ranged from 14.8 µg/L in June to the mid-50s µg/L in July and August. Chlorophyll-*a* concentrations >7 µg/L are indicative of eutrophic lake conditions. Overall, we see a seasonal pattern of nutrient increase by late summer as total phosphorous concentrations increase, which is characteristic of Lake Lemon as seen in Figures 5 and 6. The pattern is mirrored by increases in chlorophyll-*a* concentrations. The data suggests that conditions exist for increased growth of algae during the growing season (Figures 5 and 6).

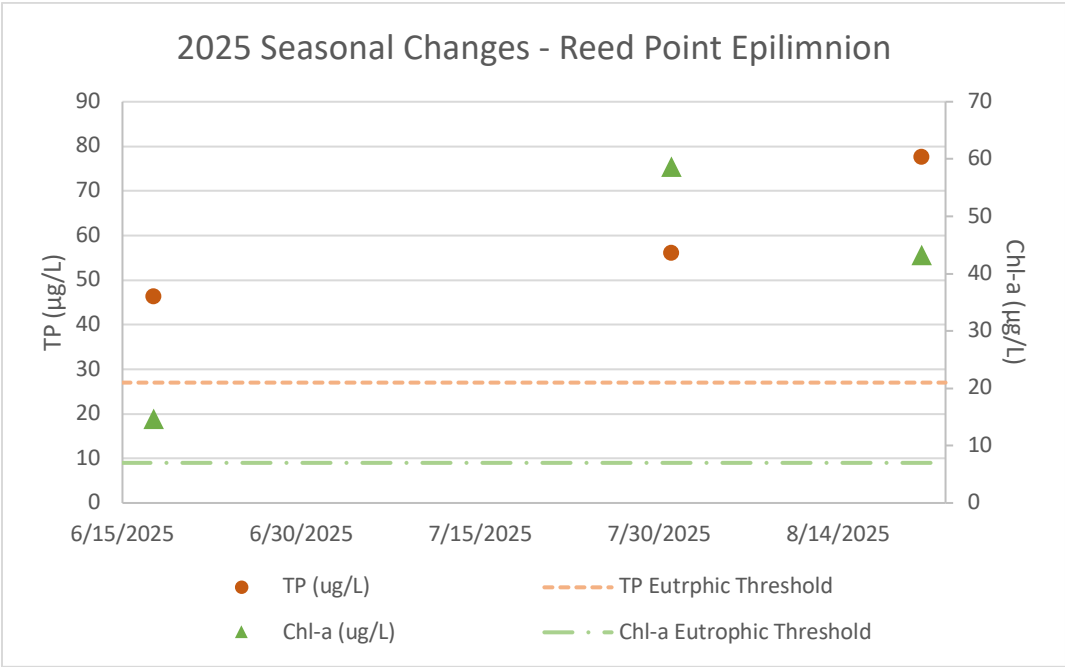


Figure 5 Seasonal changes in total phosphorus and chlorophyll-a in the surface waters (epilimnion) at Reed Point in Lake Lemon in 2025.

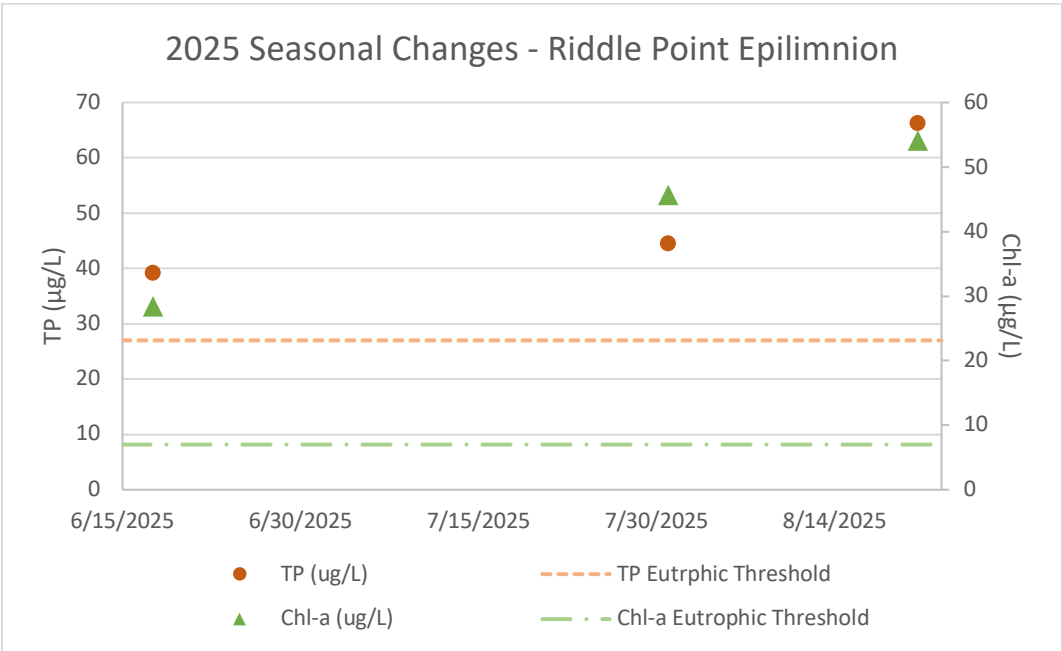


Figure 6 Seasonal changes in total phosphorus and chlorophyll-a in the surface waters (epilimnion) at Riddle Point in Lake Lemon in 2025.

Bacteria at Beach and Tributaries

IU collected *E. coli* samples in tributaries leading into Lake Lemon 2025 (Figures 7 and 8). The state standard for full body contact and recreation is 235 colonies per 100 mLs. This year was wetter than last, and thus we experienced some exceedances of this standard throughout the watershed, especially during the tributary storm sampling (Figure 7). The sample container for the Possom Trot site during the base sampling event on 6/4/2025 leaked during transport and there was not enough sample for analysis, so only the storm result on 6/5/2025 was reported. The only time *E. coli* exceeded the state standard at the Beach was before the official opening date (Table 4, Figure 8). Weekly monitoring of the beach—and its lower level of *E. coli* compared to the rest of the watershed—continues to bring down the historical EPA *E. coli* standard exceedances for recreation at Lake Lemon and its tributaries from 32% to 31%.

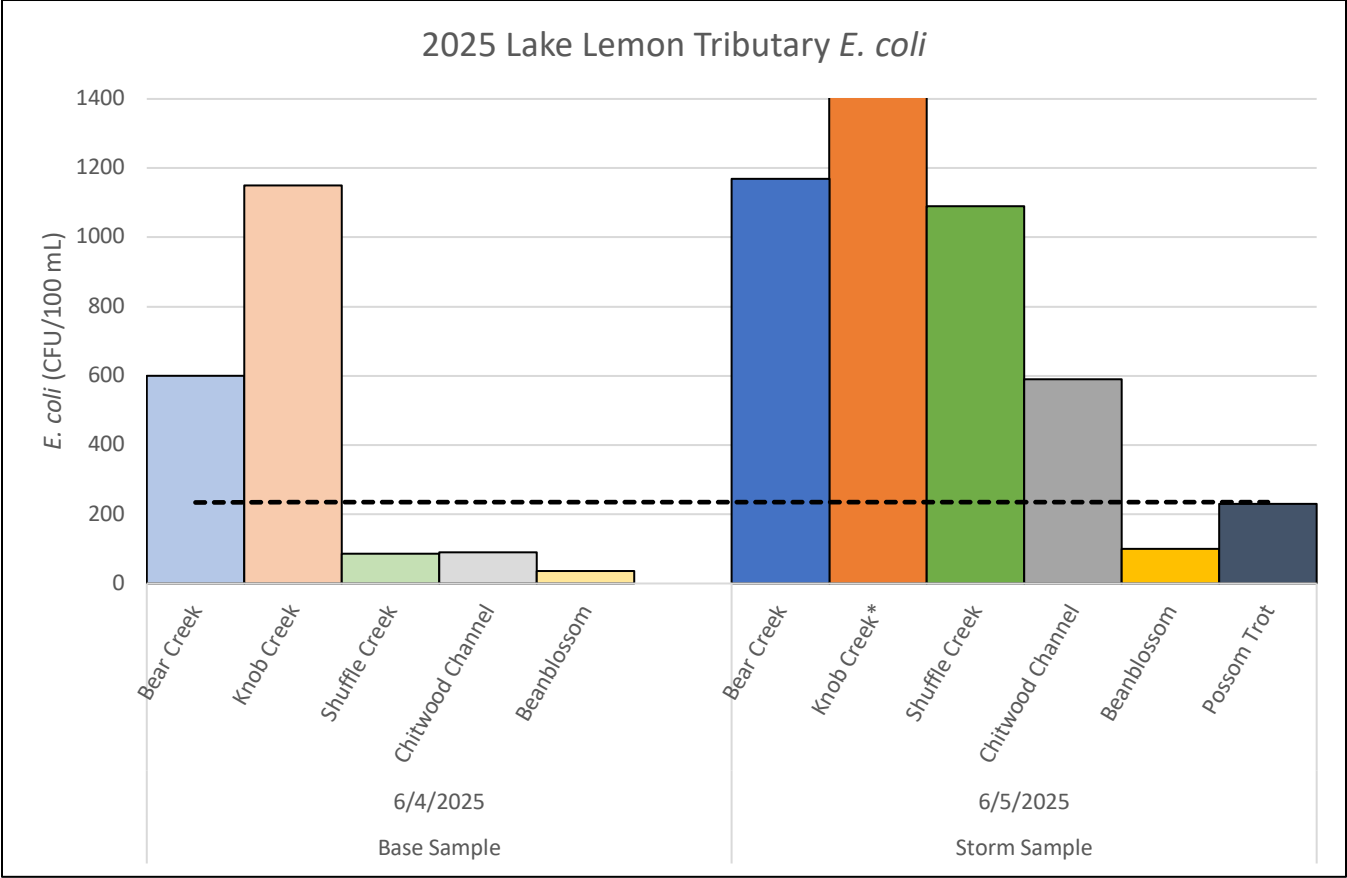


Figure 7 Lake Lemon base and storm tributary sampling on 6/4/25 and 6/5/5, respectively. There is no result for Possom Trot on 6/4/25. *Knob Creek on 6/5/25 *E. coli* result was over 8,000 CFU/100mL so chart was adjusted to see detail of remaining sites.

Table 4 Lake Lemon Beach *E. coli* for the 2025 sampling season.

Lake Lemon Beach	<i>E. coli</i> (#/100 mL)
5/20/2025	1140
5/22/2025	390
5/27/2025	4
6/3/2025	4
6/4/2025	66
6/5/2025	80
6/12/2025	36
6/17/2025	24
6/24/2025	10
7/2/2025	56
7/7/2025	8
7/14/2025	12
7/21/2025	9
7/28/2025	136
8/4/2025	8
8/11/2025	52
8/18/2025	13
8/25/2025	15

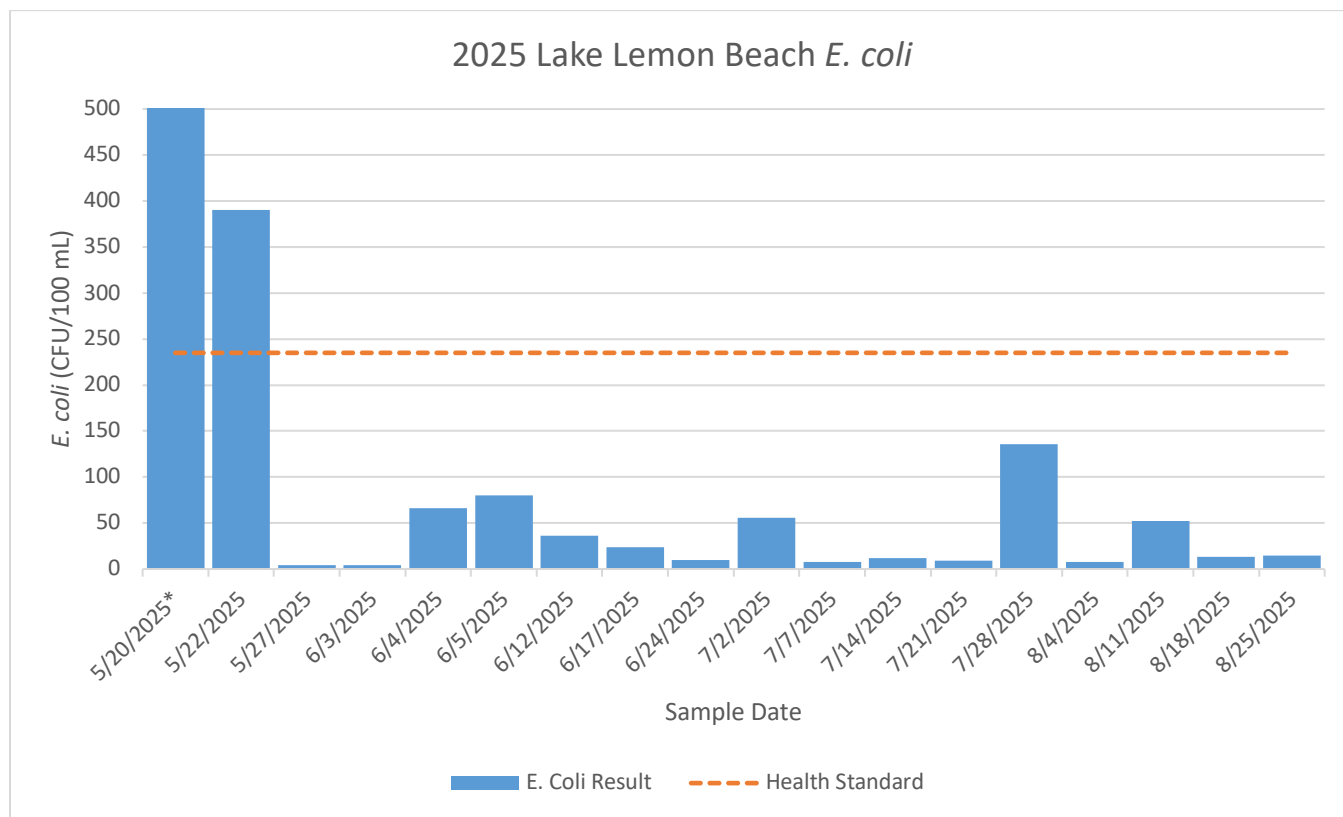


Figure 8 Lake Lemon Beach *E. coli* results for summer 2025. The sample collected on 5/20/2025 was over 1,100 CFU/100mL so chart was adjusted for scale.

Phytoplankton at Lake Lemon Beach

Cylindrospermopsin toxin testing was added to the beach monitoring in 2025. Cylindrospermopsin is a toxin produced by one of the most prevalent cyanobacteria genera found in Lake Lemon during the summer, *Raphidiopsis*. The first week of cylindrospermopsin monitoring resulted in a non-detect (Table 5). The remainder of the summer resulted in a faint positive, or a concentration of 10 ng/L cylindrospermopsin or less each week. The EPA’sz recommended recreational criteria for cylindrospermopsin exposure is 15 ng/L. No samples were shipped out for phytoplankton taxa analysis due to the lack of measurable toxin at the beach the beach in 2025.

Table 5 Cylindrospermopsin Toxin Results at Lake Lemon Beach in 2025.

Lake Lemon Beach	Result (ppb)
6/17/2025	Below detection limit
6/24/2025	Under 10 ng/L
7/2/2025	Under 10 ng/L
7/7/2025	Under 10 ng/L
7/14/2025	Under 10 ng/L
7/21/2025	Under 10 ng/L
7/28/2025	Under 10 ng/L
8/4/2025	Under 10 ng/L
8/11/2025	Under 10 ng/L
8/18/2025	Under 10 ng/L
8/25/2025	Under 10 ng/L

Trophic State

The trophic state of a lake helps characterize the level of productivity and the expected life that may exist in a lake. The overall classifications of lakes can help with comparison across lakes as well as from year to year. We use Carlson’s Trophic State as it was developed based on lakes similar to those in Indiana.

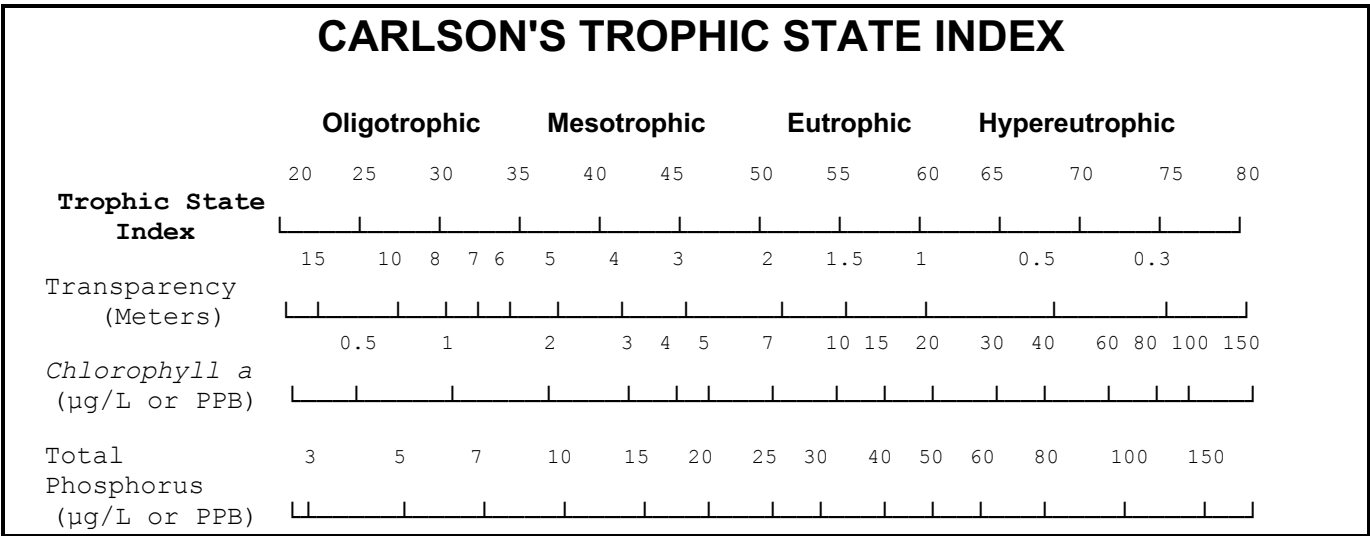


Figure 9 Carlson's trophic state index.

Table 6 Characteristics of trophic state categories.

Classification	Transparency	Nutrients	Algae	D.O.	Fish
Oligotrophic	clear	Low TP < 6 µg/L	few algae	Hypo has D.O.	can support salmonids (trout and salmon)
Mesotrophic	Less clear	Moderate TP 10-30 µg/L	healthy populations of algae	Less D.O. in hypo	lack of salmonids
Eutrophic	transparency <2 meters	High TP > 35 µg/L	abundant algae and weeds	No D.O. in the hypo during the summer	Warmwater fisheries only. Bass may dominate.
Hypereutrophic	transparency <1 meter	extremely high TP > 80 µg/L	thick algal scum Dense weeds	No D.O. in the hypo during the summer	Rough dominate. Summer fish kills possible.

We use Riddle Point Carlson TSI scores to look at the historic trend for Lake Lemon demonstrating that the lake is generally characterized as eutrophic. Figures 10-12 illustrate the Carlson TSI historic trends for Secchi disk, chlorophyll-*a*, and total phosphorus, respectively. Blue dots represent May, June, and early July samples while the orange dots represent the last summer samples, usually late July or August. The eutrophic status for Carlson TSI across the three parameters is 50 and represented in each figure by a purple dotted line. The 27-year mean for each reading: Secchi disk, chlorophyll-*a*, and total phosphorus is above this Carlson TSI eutrophic status score represented in each figure by a green dotted line. Overall, a pattern of seasonal variation of lower scores (less eutrophic) in the spring and increasing trophic state to eutrophic/hypereutrophic status by late summer exists during the monitoring of Lake Lemon. Late summer samples rarely fall below the eutrophic categorization. This only happened once in 2006 for chlorophyll-*a* and once in 2018 for total phosphorus. All Secchi disk TSI values in late summer are above eutrophic status.

Carlson Secchi Disk TSI Historic Trend

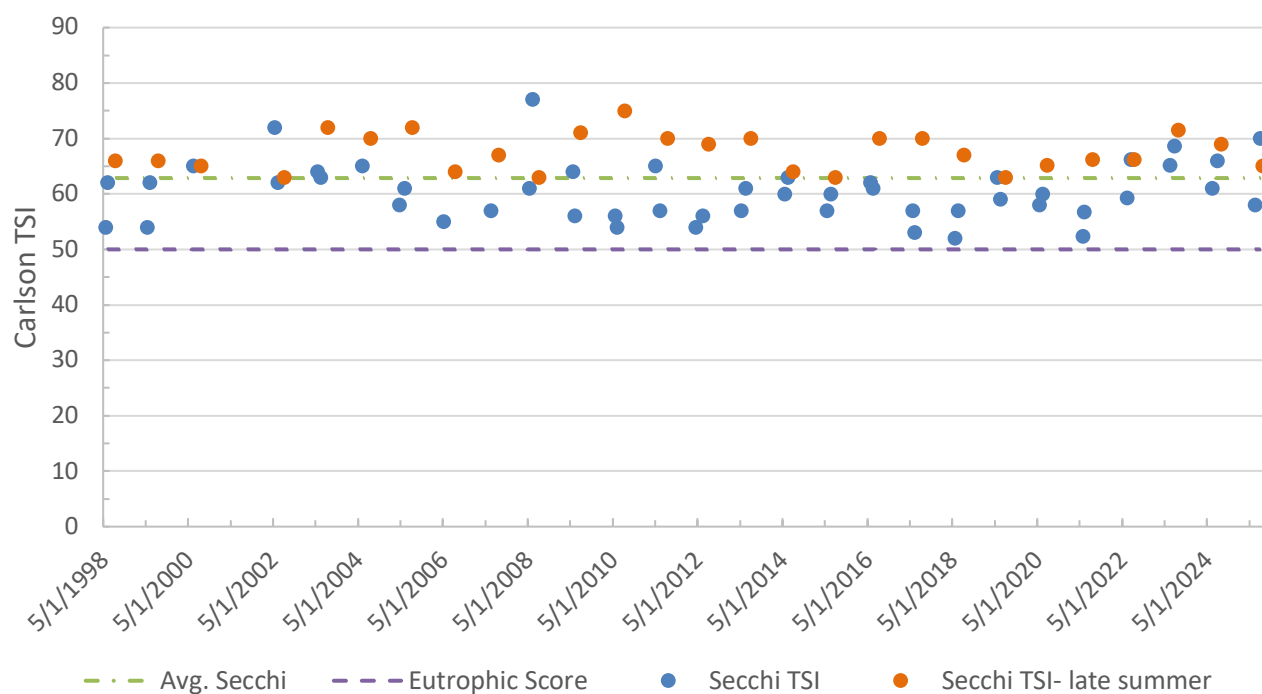


Figure 10 The 27-year historic trend for Carlson Secchi disk TSI scores in blue and orange with the average Secchi across this timeframe as the green dashed line.

Carlson Chl-a TSI Historic Trend

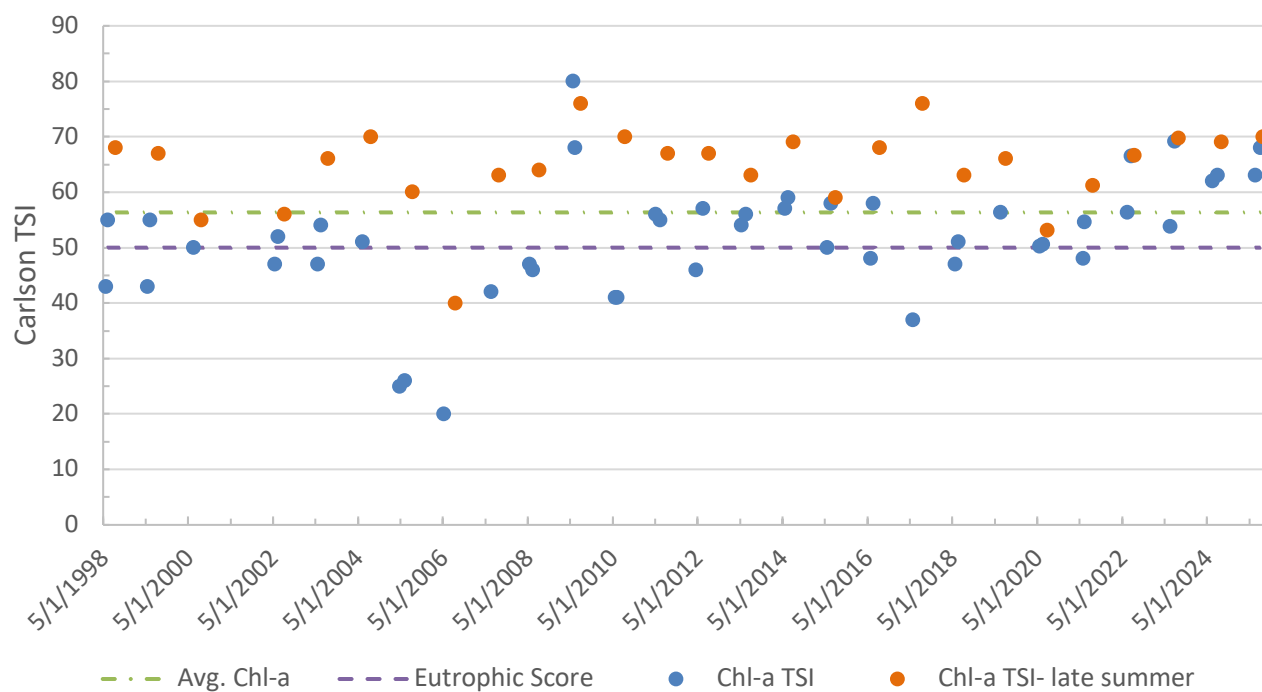


Figure 9 The 27-year historic trend for Carlson chlorophyll-a TSI scores in blue and orange with the average chlorophyll-a across this timeframe as the green dashed line.

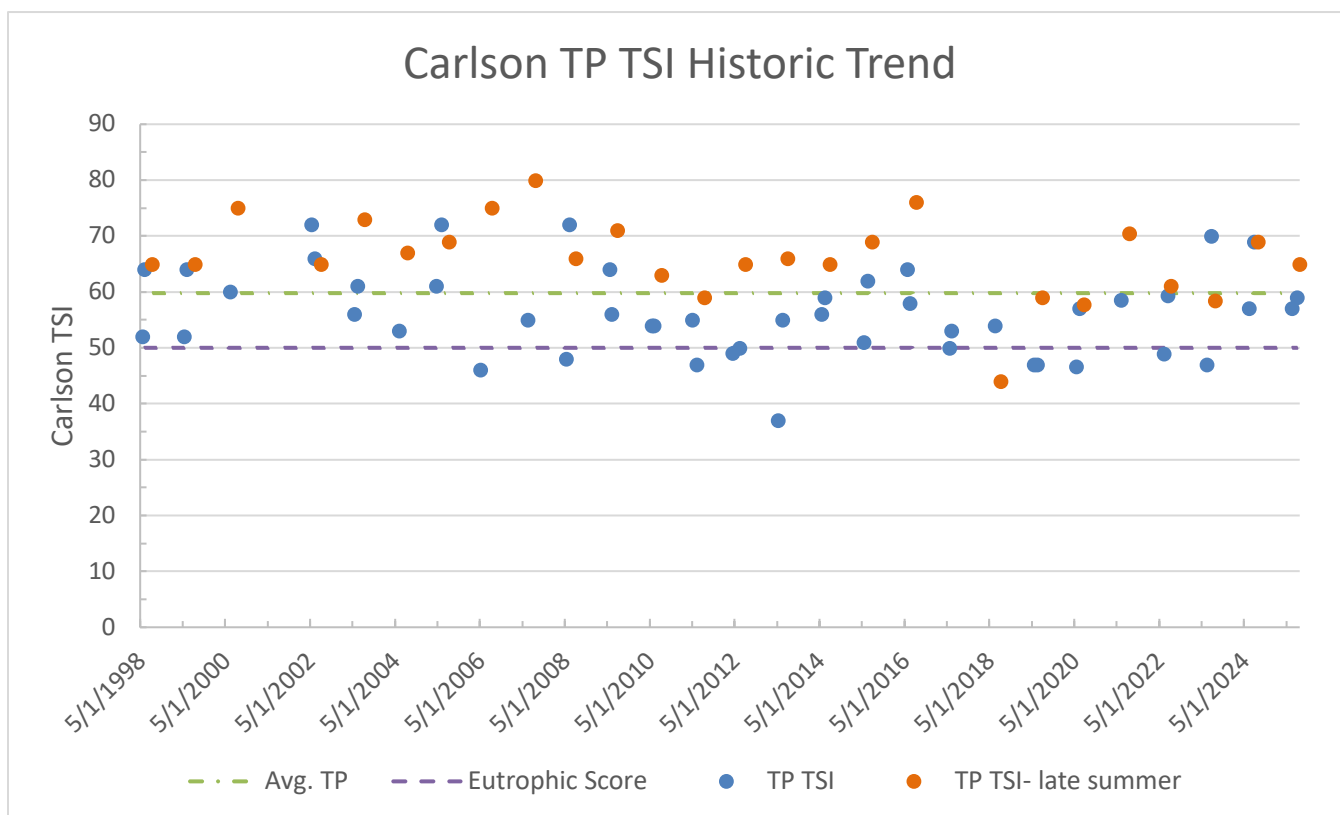


Figure 12 The 27-year historic trend for Carlson total phosphorus TSI scores in blue and orange with the average TP across this timeframe as the green dashed line.

Lake Lemon Water Monitoring Conclusions and Recommendations

HABs continue to be persistent during the height of the summer in Lake Lemon. In the summer of 2025, they peaked during the late July sampling event and appeared to die back during August. We recommend regular beach monitoring for HABs and will continue to monitor Reed and Riddle Point during normal sampling events in June, July, and August. We also recommend continuing to monitor algal blooms in 2026 and using the contract lab Phycotech for speed and consistency of results.

Cylindrospermopsin testing kits are a viable cost effective, real-time monitoring strategy for human health hazards at Lake Lemon Beach. Even with majority cylindrospermopsin producing algae present, toxins remained low. Algal concentration does not necessarily correlate to toxin presence. Based on current understanding of algal toxin production it is recommended to begin testing for toxins earlier in the season, i.e. when *E. coli* monitoring begins in May. For any results above 15 ng/L, the Lake Manager will be contacted for next steps. Contracting with Phycotech for algal analysis can confirm changes to species composition if adjustments are needed as to specific toxins to screen.

Bacteria issues are still a challenge in the incoming tributaries to the lake, especially after storm events. We recommend continuing to monitor the same six stream inlets as past years with a corresponding beach sample for comparison.

IU will continue to work with the Lake Manager to seek effective strategies to monitor water quality for changes overtime and protect human health of those using the lake.

Helpful Resources

- IDEM's E. coli Recreational Exposure Criteria: <https://www.in.gov/idem/lakemichigan/lake-michigan-beach-monitoring-and-notification-program/beach-water-contamination-and-your-health/>
- EPA Recreational Health Advisories for Cyanotoxins: <https://www.epa.gov/habs/protecting-human-health-cyanotoxin-exposure-during-recreation>
- Carlson's Trophic State Index Information: <https://www.nalms.org/secchidipin/monitoring-methods/trophic-state-equations/>