

# 2017 Northeast Lakes Water Quality Report

## Northeast Glacial Lakes Watershed Improvement and Protection Project Day Conservation District

The Northeast Glacial Lakes Project sampled four area lakes during the summer of 2017. Pickerel Lake was sampled during the months of May, July, and August; Enemy Swim Lake during the months of June, July, and August; and Clear and Roy Lakes June and July. Weather, mainly persistent high winds, prevented project personnel from sampling Pickerel Lake in September, and mechanical issues with the projects boat prevented sampling Pickerel Lake in June. Project funding was not available for sampling Clear and Roy Lakes in August, however, the project has secured funds from the James River Water Development District to sample these two lakes during the months of June, July, and August in 2018 and 2019.

Composite bottom and surface samples are taken from three sites on Clear, Enemy Swim, and Pickerel Lakes, and two sites on Roy Lake, to test for Ammonia, Total Kjeldahl Nitrogen, Total Phosphorus, Total Dissolved Phosphorus, and Total Suspended Solids. A Chlorophyll a sample is taken from the composite surface sample of each lake. Other parameters taken in the field include pH of both surface and bottom samples, a Dissolved Oxygen/Temperature profile at each sampling site, and visual assessments of surface water conditions (algae blooms, suspended sediment, dead fish etc.)



### Weather

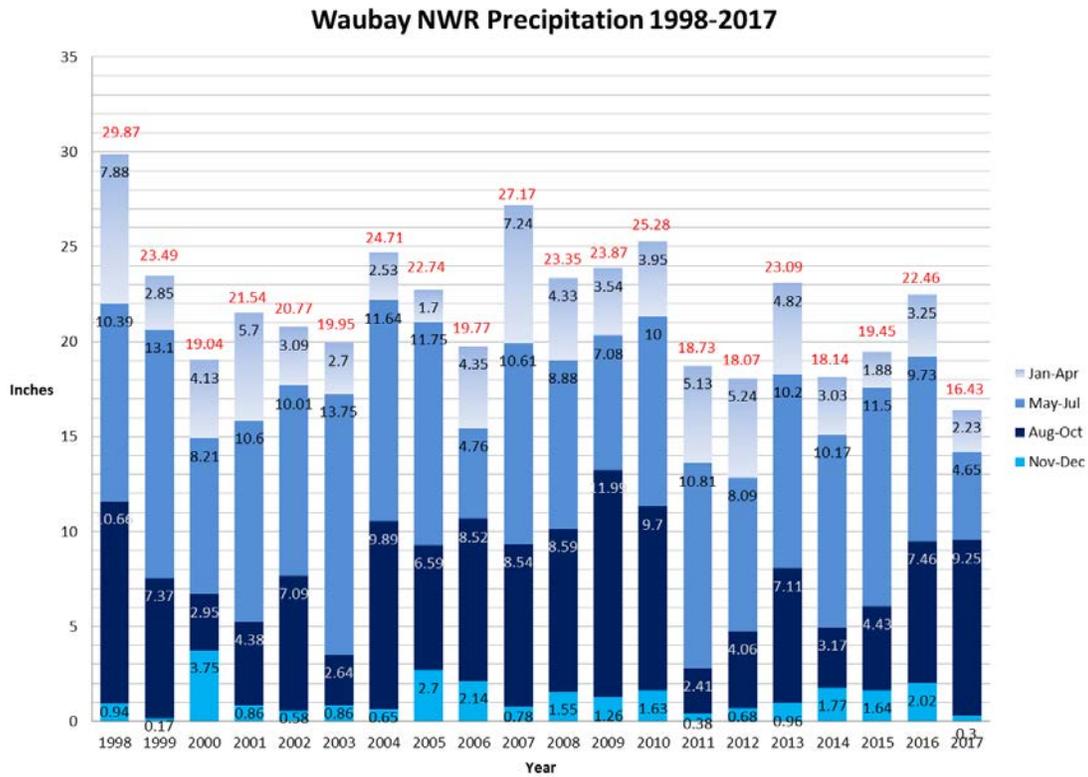
There was little snow during the 2016/2017 winter, and the area was in a moderate drought category until late summer, therefore area lakes had very little surface runoff in 2017. The Waubay National Wildlife Refuge's weather station recorded only 1.25 inches of rain for May, 2.49 inches in June, and 0.91 inches for July. August was much wetter and the 4.47 inches of rain received for this month helped to alleviate drought conditions. For the year the refuge recorded 16.43 inches making 2017 one of the driest in the last twenty years (Figure 1). June started off fairly warm with temperatures in the lower to upper 80s from June 2 through June 12. This warm period corresponded with a substantial bloom of Gleotrichia, a nuisance blue-green algae, on Pickerel Lake.

### Secchi Depth

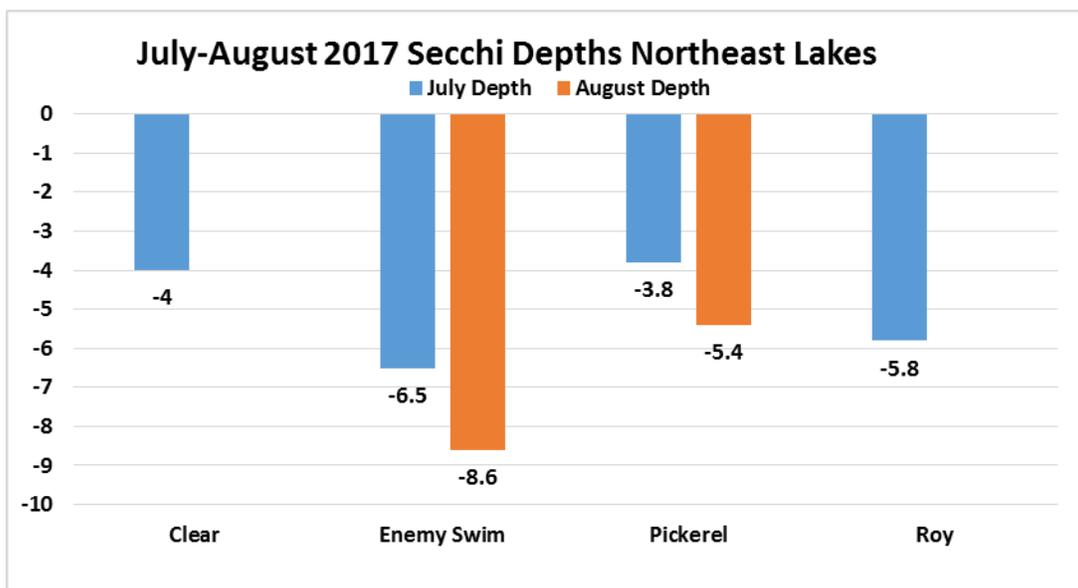
Secchi depth is a measure of lake transparency or clarity. A secchi disk, an 8 inch or larger plastic or metal disk alternately painted black and white (pictured at left), is lowered into the water until it is no

longer visible. The point where the disk disappears is called secchi depth. Low secchi depth measurements are typically due to algae blooms or suspended sediments. Enemy Swim had the best water clarity or secchi depth of lakes measured in 2017 (Figure 2).

**Figure 1.**



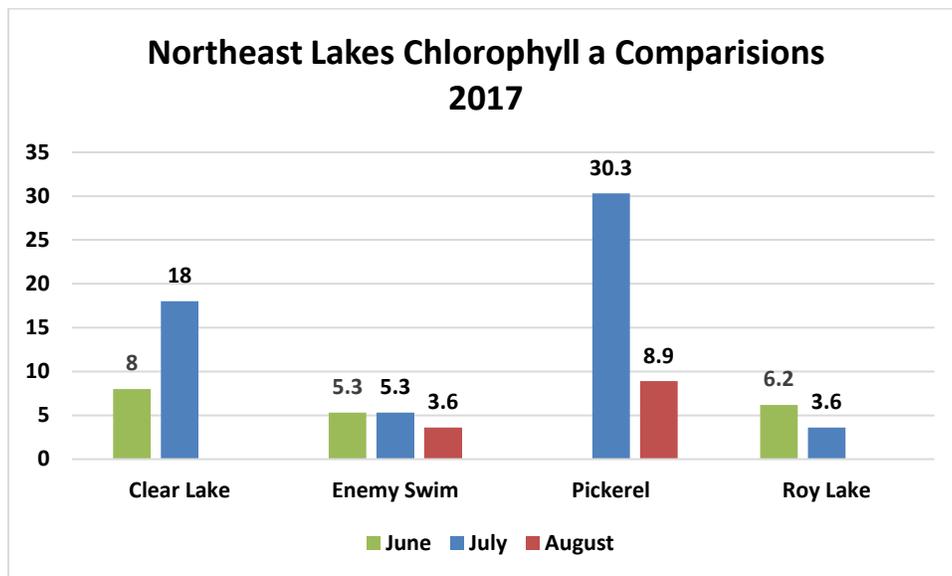
**Figure 2.**



## Chlorophyll a

Chlorophyll is the green pigment found in plants that photosynthesis, including algae. Measuring chlorophyll a levels in a lake provides a means to assess algal abundance. The production of algae is controlled by the amount of nutrients available in the water column. High levels of dissolved phosphorus in a lakes water typically translates to high algae production, low water clarity, and blooms of nuisance blue-green algae. The peak production period of algae in northern temperate lakes is during the summer months of July and August. During the summer of 2017, Pickerel Lake had the highest Chlorophyll a concentrations of the four lakes sampled in July (Figure 3). This corresponds to the low July Secchi depth reading shown above for Pickerel Lake.

Figure 3.



## Total Dissolved Phosphorus/Total Phosphorus

Total dissolved phosphorus (TDP) is the form of phosphorus readily available for use by algae and other aquatic plant growth. Figures 4 and 5, show that Enemy Swim Lake had the lowest levels of TDP of all the northeast lakes measured in 2017 which corresponds with the lakes low chlorophyll *a* levels and greater secchi depths. Pickerel Lake had very high levels of total dissolved phosphorus, especially at the bottom of the lake. These high levels of phosphorus no doubt were the reason for the persistent algal blooms on Pickerel Lake during the summer of 2017. Note that the shallower lakes; Clear, Enemy Swim, and Roy Lakes, had the same levels of TDP in both bottom and surface samples showing that these lakes were well mixed during July. Pickerel Lake because of its depth does not always mix and often stratifies during the summer months which accounts for the higher TDP at the bottom of the lake. However, when the lake does mix due to high winds or spring and fall turnover, the phosphorus located in the bottom water becomes available for algae use at the surface.

Total phosphorus, shown in Figure 6, is a measurement of the dissolved phosphorus available in the water and the phosphorus held in algae and suspended sediments in the water column. Pickerel Lake

had the highest total phosphorus levels of lakes tested in July 2017.

Figure 4.

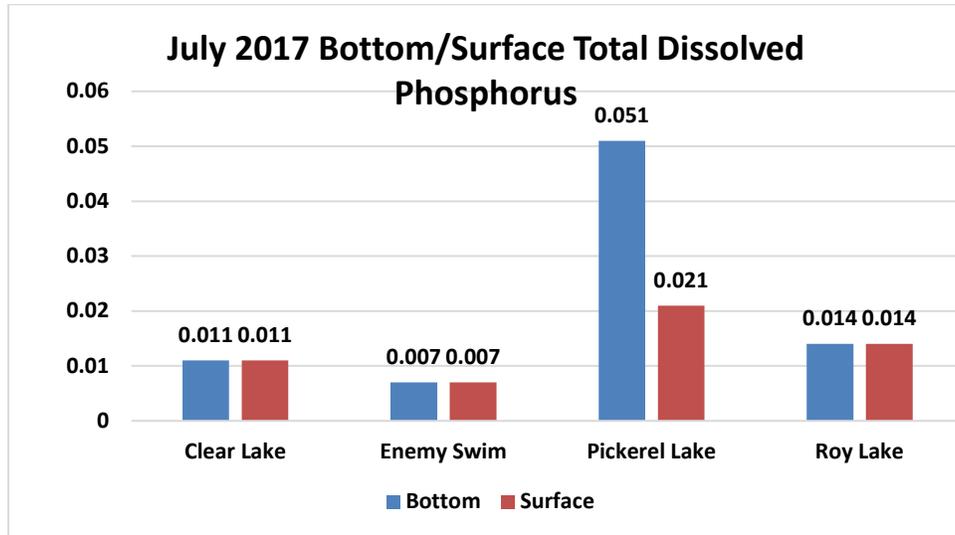


Figure 5.

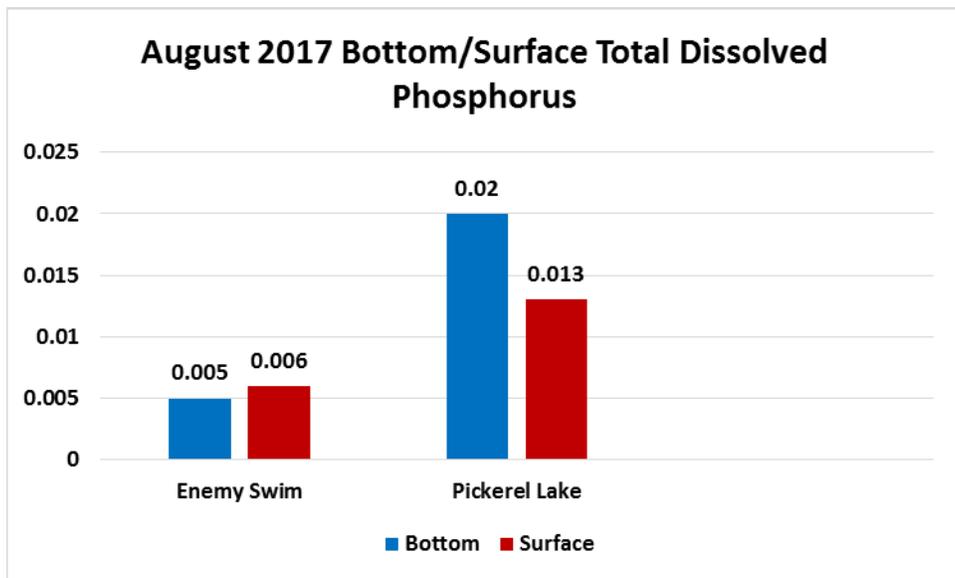
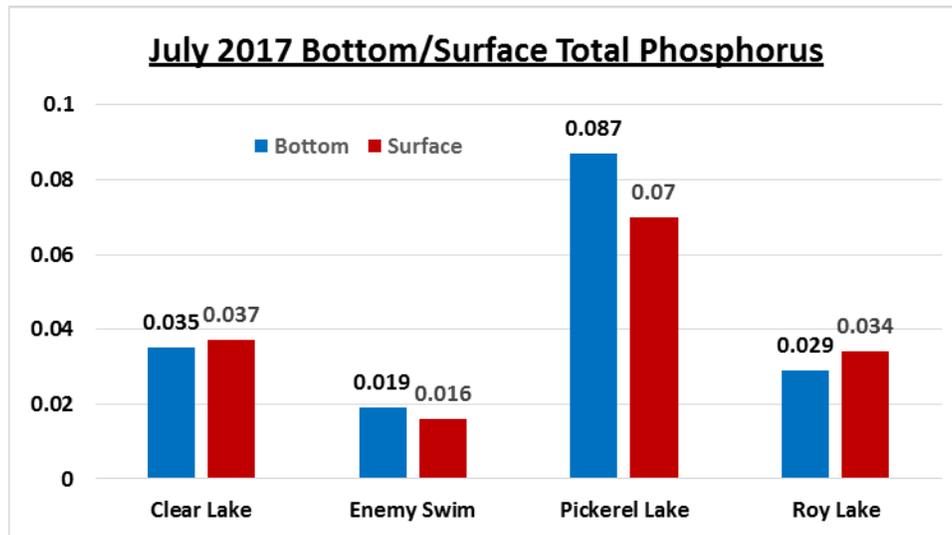


Figure 6.



### **Trophic State Index (TSI)**

Lakes can be categorized based on their “biological productivity”. An increase in productivity is called “eutrophication”. Lakes range from nutrient poor lakes categorized as “Oligotrophic” to super enriched over-productive lakes called “hyper-eutrophic”. Unfortunately, most South Dakota lakes are in the hyper-eutrophic category and typically have heavy summer long blooms of blue-green algae. Eutrophication can be measured on a numerical scale called “Carlson’s Trophic State Index” or TSI. TSI can be determined utilizing three basic water quality measurements, chlorophyll a, total phosphorus, and Secchi depth. Because the project has the most consistent and long term data for Secchi depth and Total Phosphorus we have been using these two parameters to track Pickerel and Enemy Swim Lake’s TSI.

Figure 7 shows Pickerel Lake’s TSI based on Total Phosphorus. The lake has been trending toward a higher eutrophic state for several years. Figure 8 shows Pickerel Lake’s TSI based on all three parameters measured in 2017. 2017 values are as follows, 1.4 meters for Secchi depth, 19.6 ug/l for Chlorophyll a, and 60 ug/l for Total Phosphorus. Figure 8, shows that all three parameters; Secchi depth, Chlorophyll a, and Total Phosphorus, show Pickerel Lake in the eutrophic category. Figure 9 shows the TSI of Enemy Swim Lake. Unlike Pickerel Lake, Enemy Swim Lake’s TSI is trending toward a more mesotrophic state.

Figure 7.

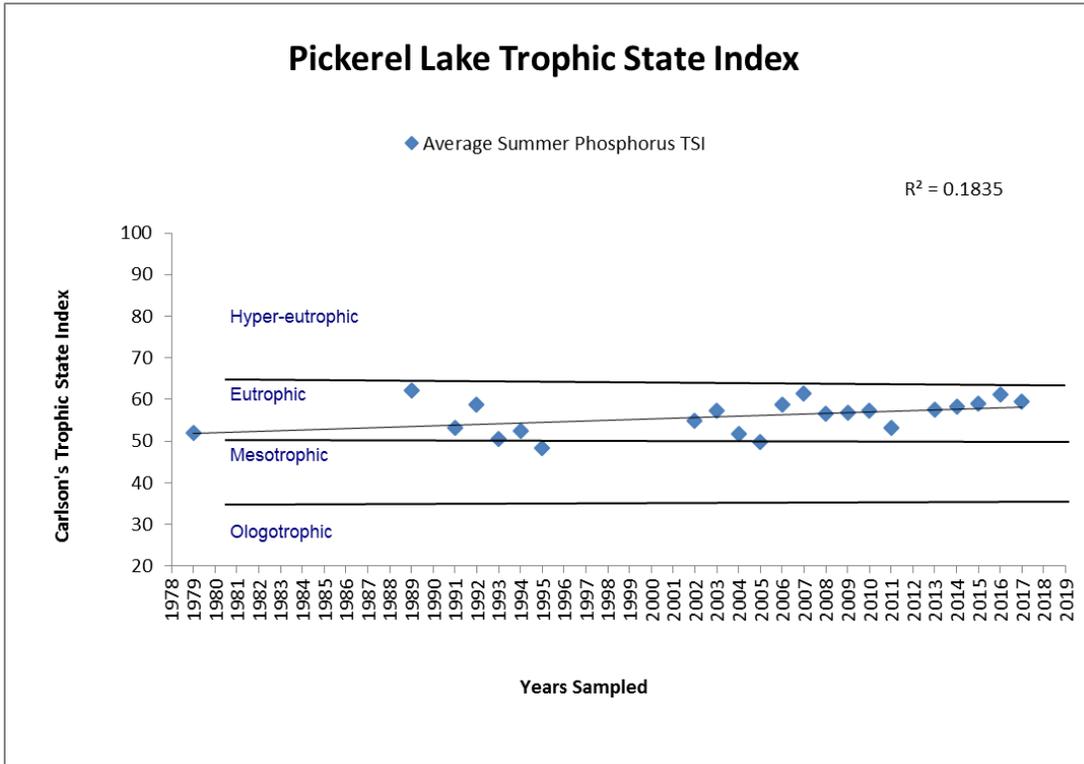
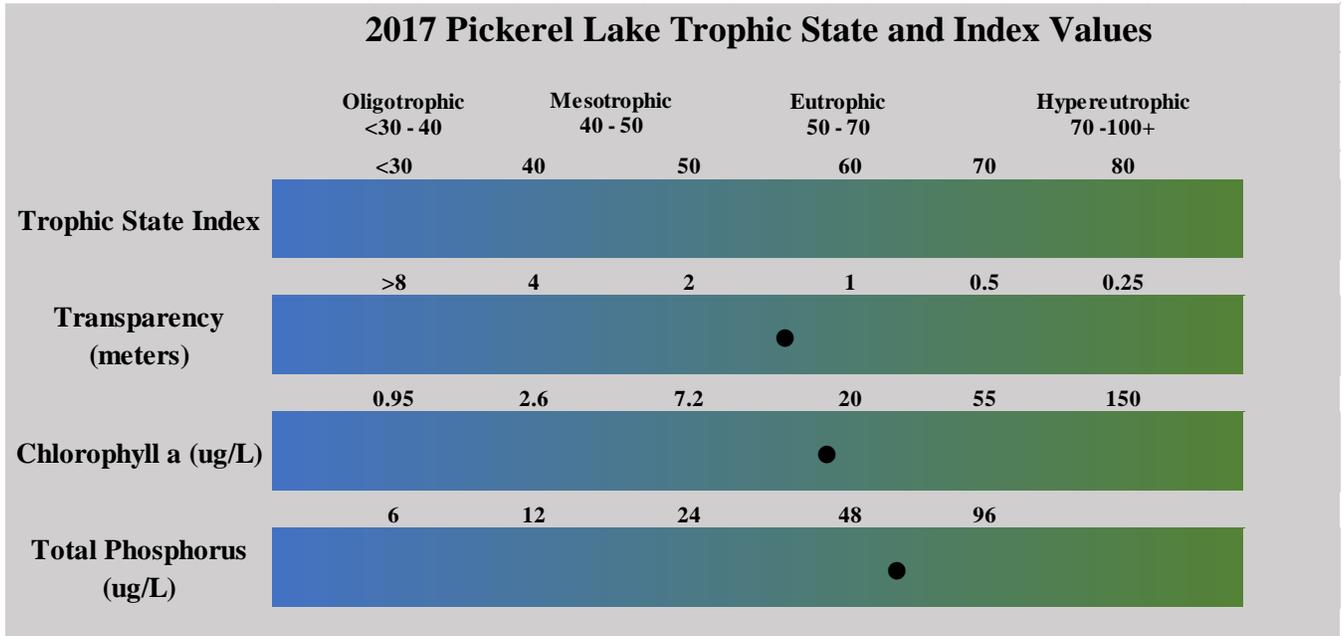
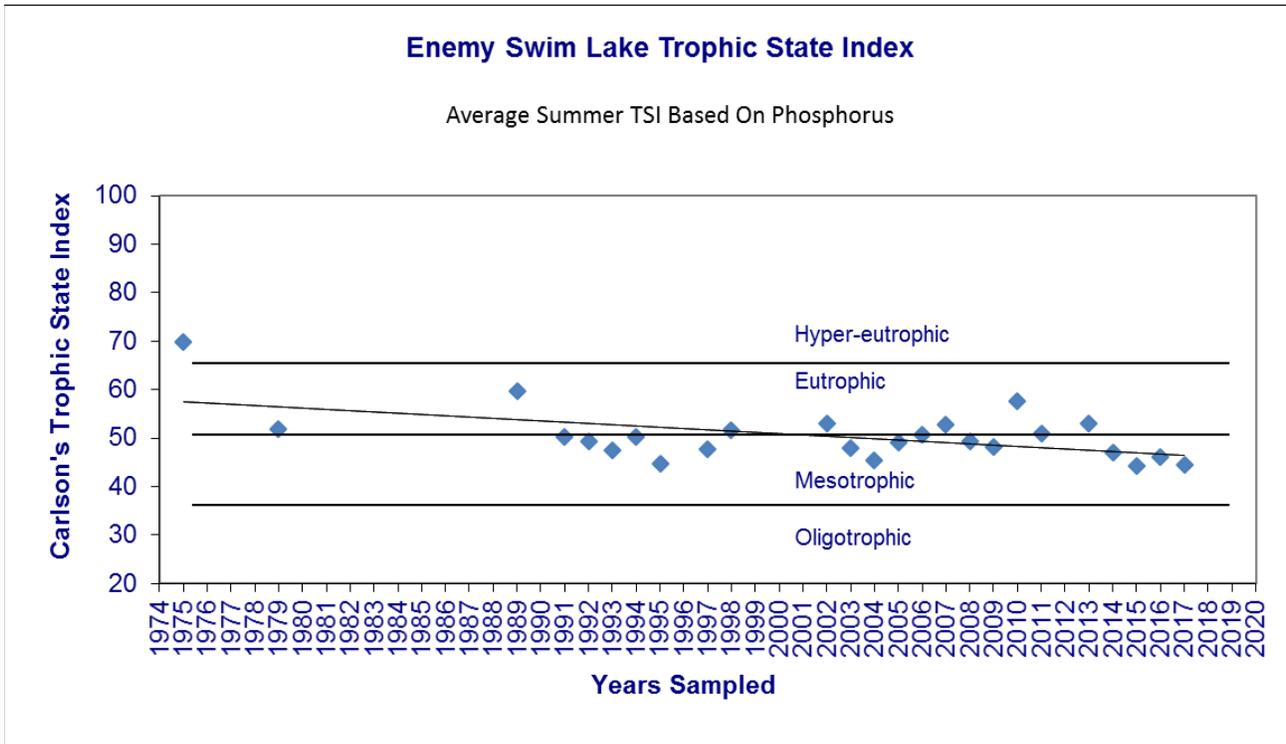


Figure 8.



**Figure 9.**



## Discussion

It's obvious during years like 2017 with little surface runoff that Pickerel Lake's water quality problems stem in large part from internal loadings of phosphorus. The lake's depth and surrounding topography lead to the lake stratifying during summer months which can cause anoxic conditions near the lake's bottom. These anoxic conditions cause phosphorus to be released from lake sediment in the dissolved form that is readily available for algae growth. Warm surface temperatures also promote algae growth which we observed in early June. We have been observing a pattern on Pickerel Lake of early blooms of *Gleotrichia* in June, then in July and August we have blooms of mostly *Microcystis* with *Anabaena* and *Aphanizomenon*, all blue-green algae. The lake's south end tends to take the brunt of these blooms. North-northwest winds push these blooms to the south end where due to topography the algae cannot be dispersed by southern winds. These blooms then stagnate and die causing a foul smell and scum that is very unpleasant and may release toxins that can be dangerous for humans and pets that come in contact with them. There has been some discussion on whether these scums could be mechanically removed from the surface on the south end and the idea should be researched.

Even though Pickerel Lake has internal loadings we still need to work on reducing external loads from shoreline development and agricultural land in the lake's watershed. The Northeast Glacial Lakes Watershed Project will continue working with the Pickerel Lake Conservancy, lakeshore property owners and watershed landowners to reduce non-point source pollutants effecting Pickerel Lake's water quality.