Pickerel Lake Water Quality Update -2022

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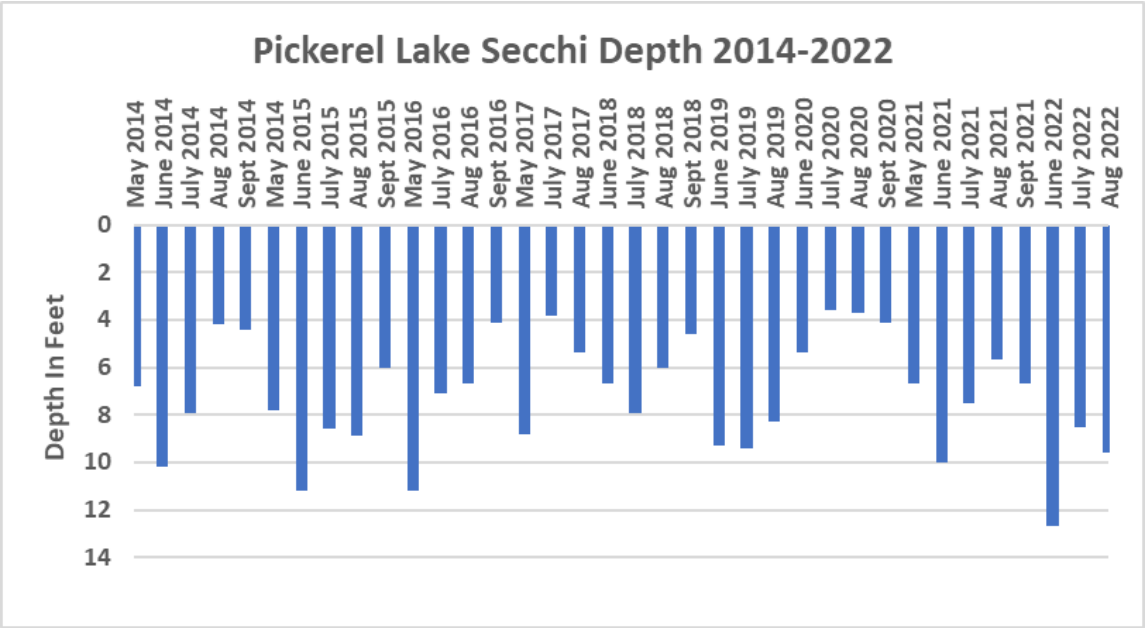
Composite surface and bottom water samples were collected during June, July, and May 2022 from three sites on Pickerel Lake for the following parameters: total phosphorus, nitrate-nitrogen, total kjeldahl nitrogen, ammonia-nitrogen, total suspended solids, and chlorophyll *a*. Field parameters taken by Prairie Coteau personnel include pH, dissolved oxygen, and Secchi depth. RMB Laboratories located in Detroit Lakes, Minnesota conducted analysis of the water samples collected.

Secchi Depth

Secchi depth is a measure of lake transparency or clarity. A Secchi disk is an 8 inch or larger plastic, or metal disk alternately painted black and white. The disk, attached to a measuring tape, is lowered into the water until it is no longer visible from the surface. The depth measured where the disk is no longer visible is called the Secchi depth. Low Secchi depth measurements are typically due to algae blooms or suspended sediments from a lake's bottom or watershed and shoreline soil erosion. Secchi depth usually decreases in eutrophic lakes like Pickerel as the summer season progresses due to increases in algae growth. Water transparency is one water quality parameter many people believe improves with heavy infestations of zebra mussels due to their ability to filter large amounts of lake water in a single day, thus removing algae and suspended solids.

Secchi depth has improved from 2020, the last year with significant algal blooms as indicated by the chlorophyll a measurements from that year as shown in Figure 3. On June 22 of this year, the lowest average reading of the last eight years of 12.7 feet (average of three sites) was measured (Figure 1). On this date the Secchi depth at Site 2 located just west of Chekapa Bay was 14 feet. Overall, though, no significant improvement in Secchi depth can be seen since 2014 as the lake continues to vary greatly from year to year in water clarity as shown in Figure 1.

Figure 1

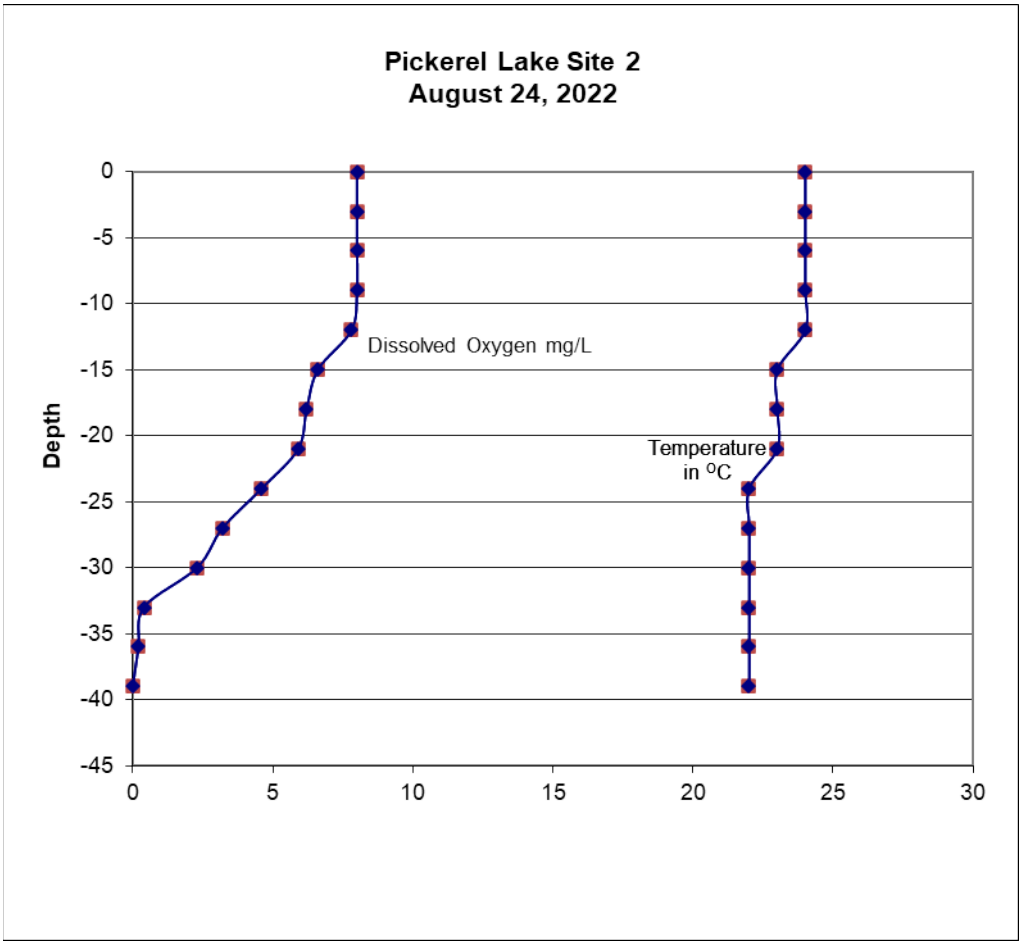


Dissolved Oxygen (DO)

Oxygen is essential for the survival of aquatic life. The diffusion of atmospheric oxygen into lakes occurs naturally and is enhanced by the agitation of the lakes surface by wind. Wind will mix oxygen vertically within the lake. Oxygen is also produced by algae and rooted aquatic plants called macrophytes where sunlight is available for photosynthesis. In the deeper areas of the lake where sunlight does not reach (called the profundal zone) oxygen levels depend on mixing by the wind. During periods of calm winds and high temperatures during the summer months the lake may stratify with lighter warmer water at the surface and heavier colder water near the bottom. The difference in density of the lighter and heavier water prevents mixing, and the bottom water may become depleted of oxygen (hypoxic) which then causes a chemical reaction that releases phosphorus from the lake's sediment. High winds and cooler surface temperatures weaken the stratification allowing the lake to mix. This in turns mixes the dissolved phosphorus from the bottom to the surface where it is available for algae to use.

Pickerel was partially stratified at Site 2 on August 24, with oxygen levels below 1 mg/l at 33 to 39 feet deep (Figure 2). However, only a small portion of the lake was affected, and probably little phosphorus was released. It is not known how long the lake was stratified since no water quality tests were taken in September.

Figure 2



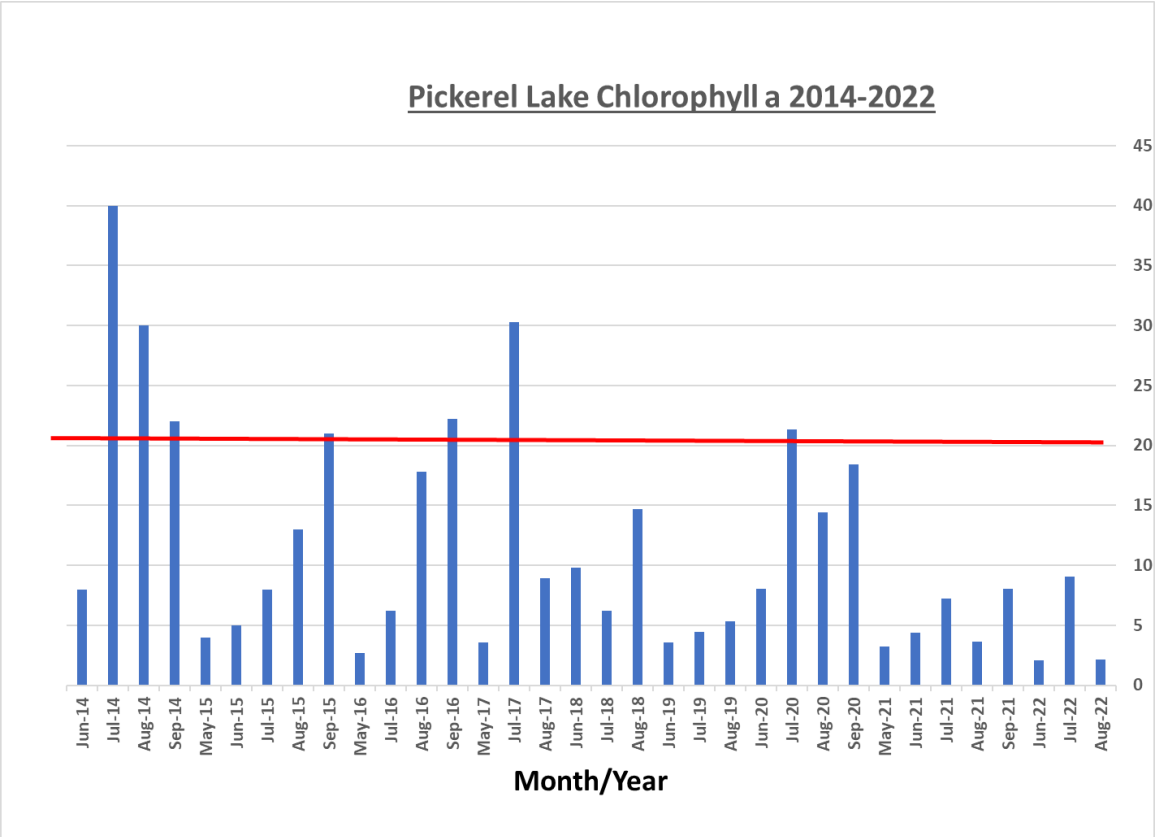
Chlorophyll *a*

Chlorophyll is the green pigment in algae that can be extracted and measured giving a year-to-year comparison of algal biomass in a lake. Higher chlorophyll measurements indicate higher algal biomass. Chlorophyll measurements over 20 ug/l (micrograms per liter) usually indicate a nuisance bloom of blue-green algae (above the red line shown in Figure 3). Due to the ability of zebra mussels to filter large amounts of water, chlorophyll *a* levels in the lake may decrease as green algae and diatoms are consumed by these mussels. This however is not necessarily a good thing as these phytoplankton are an important part of the food chain, unlike blue-green algae which cannot be eaten by zooplankton and are disliked by zebra mussels.

Chlorophyll *a* levels in 2022 did decrease from those measured in 2021 for June and August. but were slightly higher for July. Zebra mussels may be reducing green algae levels in the lake, and the lack of any large stratification events releasing phosphorus from bottom sediments that would produce noxious blue-green algae blooms did not occur in 2021 and 2022. It is interesting

to note when Chlorophyll levels are taken in September, they are often higher than the summer months indicating that fall turnover of the lake occurs in September and the increase of phosphorus due to turnover sparks an early fall algae bloom as observed in September 2015, 2016, 2020, and 2021 (Figure 3). Chlorophyll *a* levels observed from Pickerel Lake have not exceeded the State water quality standard of 20 ug/L (red line) since July 2020.

Figure 3



Total Phosphorus (TP)

Total phosphorus is the total amount of phosphorus found in plant and animal fragments (mainly plankton) suspended in the water column, and ortho-phosphate or dissolved phosphorus available for plant growth. Eutrophic lakes, like Pickerel, have an overabundance of phosphorus available for algae growth, especially from internal loadings from sediments that periodically are released when the lake's bottom becomes anoxic (depleted of oxygen) when the lake stratifies. Both surface and bottom samples from Pickerel Lake are tested for total phosphorus.

Surface total phosphorus levels have been trending downward since 2014 (Figure 4). This could be from improved agricultural practices in the watershed and implementation of shoreline buffers along the lake's shoreline, and a lack of stratification events releasing phosphorus from the

lake's bottom sediment. Note the total phosphorus measurement from the bottom sample from July 2019 (Figure 5). The lake was stratified on this date with dissolved oxygen readings very similar to August 2022 (Figure 2). However, there was no algae bloom observed with this stratification event (Figure 3) showing that the lake doesn't always mix after stratification. Now however, with the infestation of zebra mussels, the phosphorus released by a stratification event may be transferred to the near shore area due to the filtering capacity of zebra mussels who will take up the phosphorus and deposit it in feces along the shoreline where populations are the highest. In 2022, we did observe an increase of Cladophora, a slimy filamentous algae growing on rocks and other substrate along the lake's shoreline (Figure 6). So, for the next few years we may not see nuisance algae blooms on the lake but will see an increase in shoreline filamentous algae and macrophytes in the shallow areas of the lake.

Figure 4

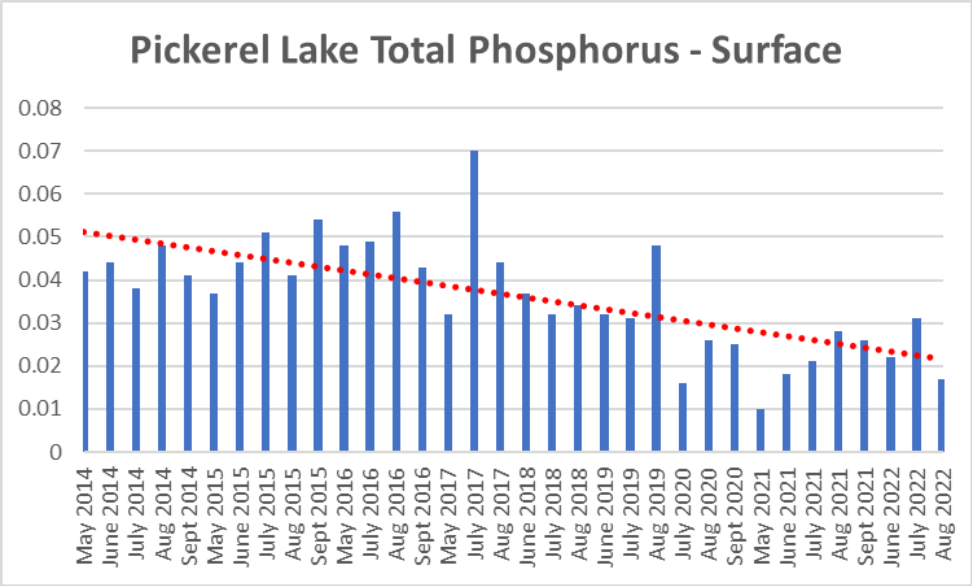


Figure 5

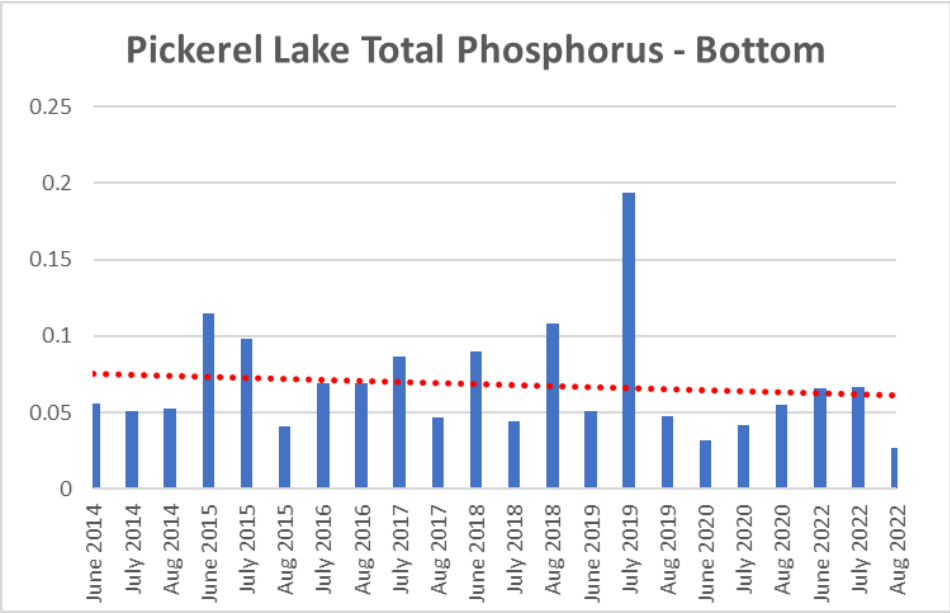


Figure 6

Total Suspended Solids (TSS)

Total Suspended Solids (TSS) include a wide variety of material; algae, silt, decaying plant and animal matter. These solids are suspended in the water column and captured by filtering a sample of lake water. While many suspended solids occur naturally in a lake like plankton, soil and organic material from shoreline and cropland erosion in a lake's watershed can increase suspended solids. In shallow lakes like Blue Dog, wave action from wind and boats can stir up bottom sediments

making the lake very turbid. In Pickerel Lake, higher TSS measurements typically are due to algae blooms. Note the higher TSS levels in 2020 (Figure 7) coincide with higher chlorophyll a levels in 2020 (Figure 3).

The TSS of Pickerel Lake decreased in 2021 and 2022 (Figure 7), but is comparable with other years pre-infestation. However, the lower TSS and Chlorophyll levels coupled with increased Secchi Depths in 2021 and 2022 may be the first signs Pickerel Lake's water quality is being changed by Zebra mussel infestation.

Figure 7