Enemy Swim Lake Water Quality Update 2024

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Composite surface and bottom water samples were collected during June, July, and August 2024 from three sites on Enemy Swim 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.

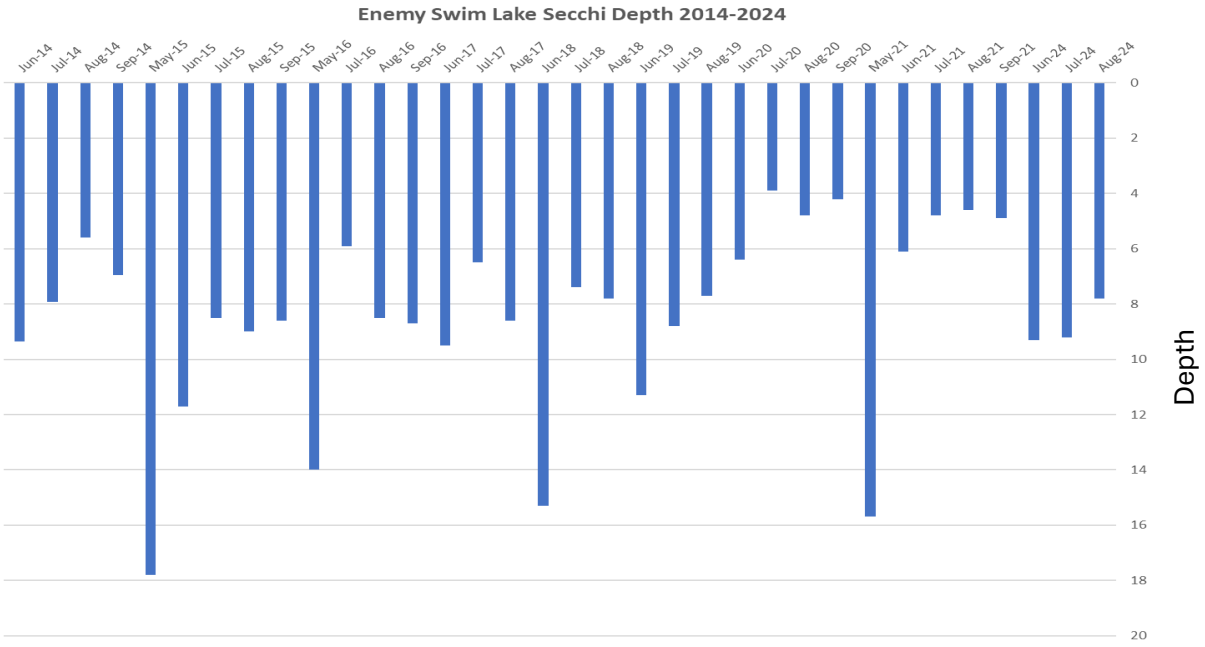
Secchi Depth

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 as the summer season progresses due to increases in algae growth.

In 2024, Secchi disk measurements trended overall average compared to past data. Figure 1 shows Secchi measurements recorded since 2014. As you can see in the past, Secchi readings were greater in the months of May and June, and then gradually diminishing in the summer months, although Enemy Swim historically has overall increased water clarity due to being a mesotrophic or "medium rich" lake. In Enemy Swim Lake, decreased summer Secchi depth readings is almost always due to the presence of algae and very rarely suspended sediment for watershed or shoreline erosion.

One factor that may affect Enemy Swim Lake's water clarity in the future is the presence of zebra mussels. Enemy Swim was considered infested with zebra mussels in 2022. This year, there was a larger influx of zebra mussel populations found, especially along the northern shorelines of the lake. Due to zebra population in Enemy Swim being relatively new, data cannot be correlated yet to show if zebra mussels are changing the clarity parameter of the lake. Looking to the future, it will be crucial to continue monitoring water quality, as these aquatic invasive species have been changing lake ecosystems of nearby infested lakes, like Pickerel and Blue Dog.

Figure 1

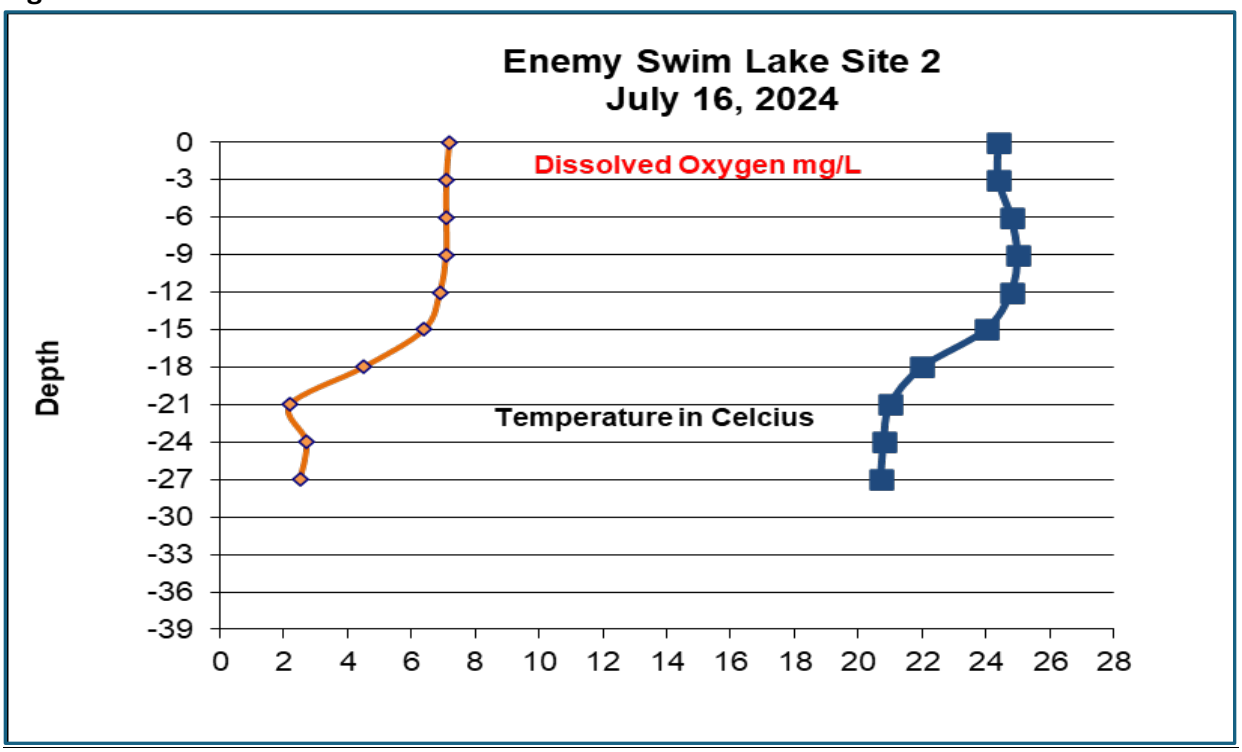


<u>Dissolved Oxygen (DO)</u>

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.

Enemy Swim was slightly stratified at Site 2 and 3 on July 16, 2024, with oxygen levels below 3 mg/l at 21 to 26 feet (Figure 2.) The August sampling did not show signs of stratification and overall, the lake was well mixed. Before sampling took place on July 16th, the temperatures ranged in the mid 80's for temperature and calm winds for 4 days, allowing the conditions to develop for slight stratification to occur. On July 17th, a cold front moved through, causing winds and drop in temperature and mixing of the lake. Enemy Swim has had history of stratification events. Due to more lake surface area and not as great depths compared to Pickerel, these events are often short lived.

Figure 2.

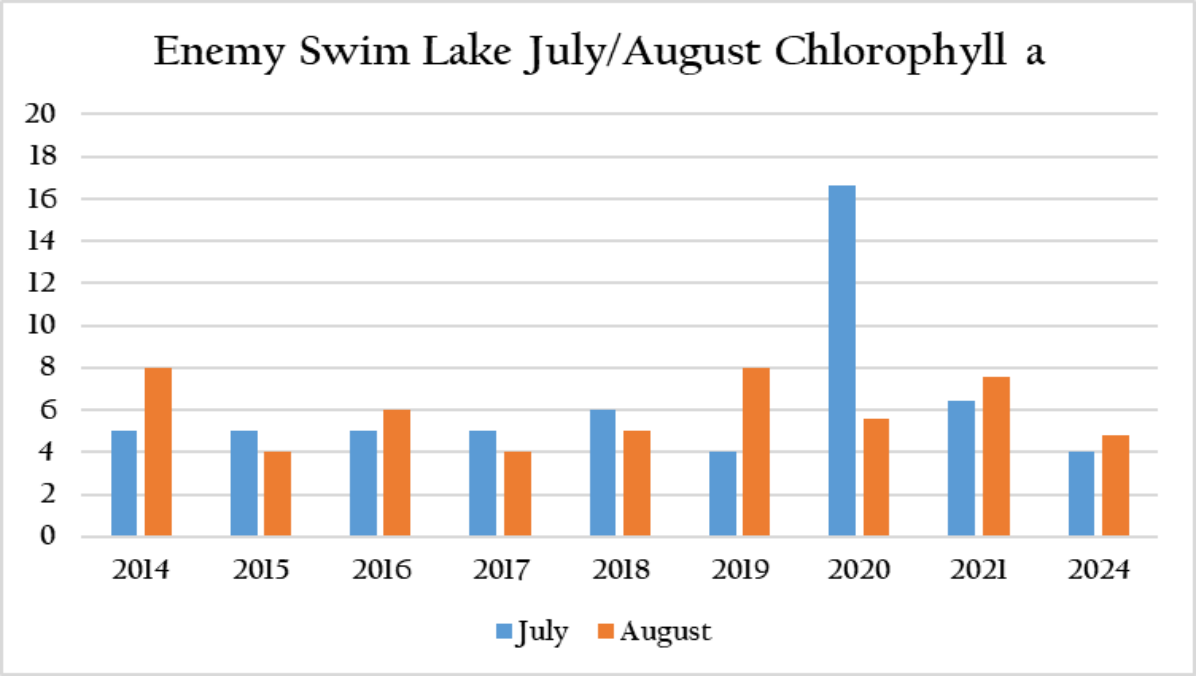


Chlorophyll *a*

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. Due to Enemy Swim being a mesotrophic or "medium rich" lake, the chlorophyll measurements have never been over the 20 ug/l threshold in the project's history. Figure 3 shows the history of Chlorophyll *a* data since 2014.

What has been seen on local lakes with history of higher chlorophyll *a* levels, is the ability of zebra mussels to filter large amounts of water. Chlorophyll *a* level 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* will continue to be a parameter monitored on Enemy Swim Lake for future water quality data collection.

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. Mesotrophic lakes, like Enemy Swim, tend to trend with medium amounts of phosphorus available for algae growth. The lake at times may experience higher phosphorus counts 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 Enemy Swim Lake are tested for total phosphorus. Both surface (Figure 4) and bottom (Figure 5) total phosphorus levels continue to stay level overall. This indicates external sources of phosphorus from the lake's watershed have been minimized, and internal loadings from the lake's sediments have not been released during stratification events.

Figure 4.

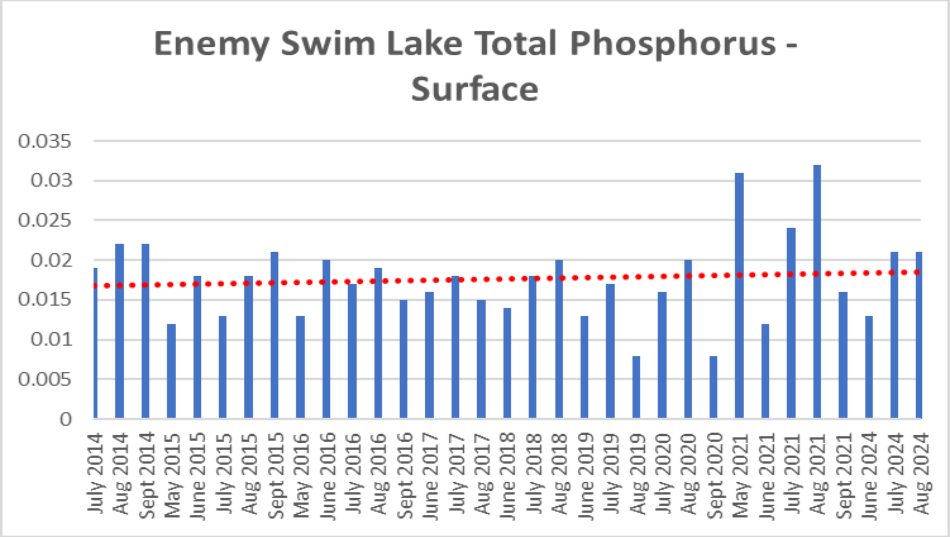
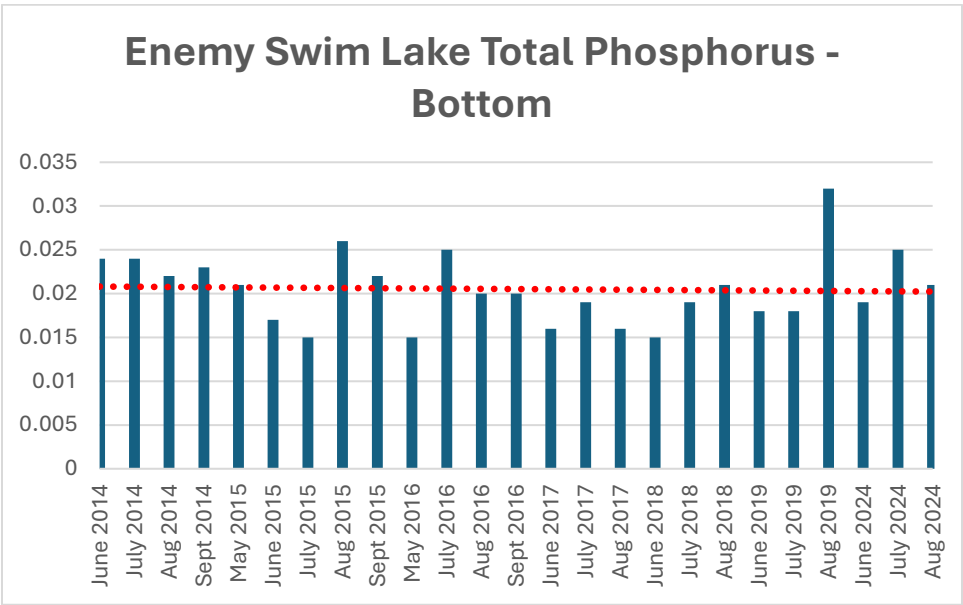


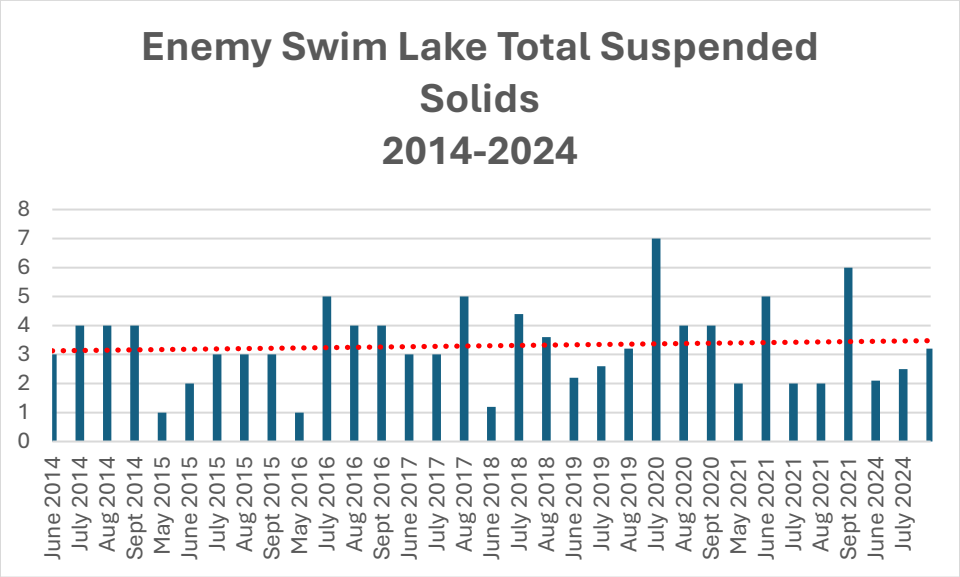
Figure 5.



<u>Total Suspended Solids (TSS)</u>

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 Enemy Swim Lake, higher TSS measurements typically are due to algae blooms. Total suspended solids levels for the lake are shown in Figure 6. Overall, the analysis of 2024 shows the total suspended solids maintaining with averages over the last 10 years.

Figure 6.



Conclusion

The summer of 2024 saw overall average of what Enemy Swim has typically shown in characteristics over the last 10 years, based on the chemical property parameters. Some physical changes have been noticed and most likely is due to the introduction of zebra mussels. With the introduction and relatively new population of zebra mussels, the lake may experience changes in water quality in clarity, and transportation and concentration of nutrients within the littoral zone of the lake. This has already been a factor with the increased Cladophora, or "green slime" algae was found along the shorelines, coating the rocks, native macrophytes or aquatic plants and other substrate. There is a misconception that zebra mussels "clean" lakes. This is probably because water clarity often improves after a lake is infested with zebra mussels, and the clearer water looks cleaner due to the decrease in algae and other suspended solids. However, zebra mussels do not remove pollutants like phosphorus which is the major nutrient responsible for the eutrophication or aging of a lake. The project will continue to work with the Enemy Swim Sanitation District on further lake monitoring into the future to collect data and work on further on ways to protect and improve the water quality of Enemy Swim Lake.

It is important for lake shore owners and users to continue to practice AIS prevention strategies, such as drying of boat live wells, bilges, jet skis and other water recreation equipment, and not transporting water from other water bodies. Practice of removing aquatic vegetation from boat and jet ski trailers, bait buckets, and other equipment is another way to prevent transportation of AIS species. Curly leaf pondweed is currently found in Pickerel and Blue Dog Lakes, both of which are located within 10 miles of Enemy Swim. If lake shore owners and lake users may have found curly leaf pondweed, please contact either project personnel or the SD Game Fish and Parks office in Webster to report a potential find.