Little Green Lake Protection and Rehabilitation District
Attn: Mr. James B. Clark
RE: Little Green Lake, Wisconsin

Dear: Mr. Clark, February 10, 2023

Thank you for contacting Restorative Lake Sciences (RLS) to provide a professional opinion relative to the existing studies conducted on Little Green Lake and their findings and recommendations. RLS reviewed two reports including: "Little Green Lake Alum Treatment Feasibility Study" issued March of 2022, and "Little Green Comprehensive Management Plan" issued December 2018. Both of these evaluations provide important data relative to the lake health and current impairments. The purpose of this professional opinion is not to critique these evaluations or perform a detailed analysis, but to offer recommendations for the optimum outcomes relative to the recommendations made upon an unbiased and objective perspective from RLS.

Key Points on Little Green Lake:

1. Little Green Lake is a eutrophic and shallow 479-acre lake with a mean depth of approximately 11 feet and maximum depth of 27 feet and has a predominately agricultural watershed (~75%).
2. The lake is on the Wisconsin DNR (WDNR) 303d list for impaired water bodies.
3. The lake has excessive phosphorus concentrations, elevated chlorophyll, low dissolved oxygen, and degraded habitat (Onterra LLC March 2022 report).
4. The lake experiences large infestations of dense Curly Leaf Pondweed (CLP).
5. Nutrients in the lake were estimated to be 69% from internal loading (from release of phosphorus from anoxic deepwater and littoral sediments and CLP biomass).
6. External loading is estimated at 31%.
7. The watershed is four times larger than the lake with a watershed to lake ratio of 4:1.
8. There is currently an aeration system in use.
9. There are three sediment basins which trap approximately 75% of the phosphorus entering them. It is unknown whether they reduce nitrogen or if that is a problem for the lake.
10. Release of phosphorus from the lake bottom still occurred despite the existing aeration system (WDNR, 2013-2014). This system appears to not adequately destraify the water column.
11. A proposed alum treatment would reduce deepwater phosphorus release by anoxic sediments approximately 90% and is estimated to cost $540,000.

Needs for Little Green Lake:

1. Reduction of internal loads (by reducing all external loads and CLP biomass). Reduction of CLP biomass (estimated 80%) would be needed to result in increased water clarity. Reduction of deepwater phosphorus would require an alum treatment or a much more efficient aeration system.
2. A more thorough understanding of the phosphorus concentrations throughout the water column, not just nearshore. Bottom phosphorus is critical for understanding the reservoir available for release and also availability for sediment pore water.
3. Conduct an immediate watershed Critical Source Area (CSA) analysis to determine ACTUAL, not modeled loads (using WiLMS) of nutrients and source origins.
4. Additional reduction of nutrients that exit the sedimentation basins to reduce nutrient loads to the lake.

Professional Recommendations:

If the existing aeration is removed, it would be imperative to replace it with a system that creates strong thermal destratification from the surface to the bottom and also oxygenates the bottom sediments. This would result in reduction of phosphorus in the sediment pore water and reduce the release into the upper waters. It is critical to increase dissolved oxygen at the lake bottom to reduce P-release that results in increased submersed aquatic vegetation and algae growth. This method is also costly for a proper retrofitted system but has demonstrated measurable declines in phosphorus, nitrogen, and algae in inland lakes.

If alum is applied to the lake hypolimnion, it would reduce the phosphorus release at the bottom but likely not address the phosphorus in the littoral zone. Additionally, it may have negative impacts on the microbes and macroinvertebrates in lake sediments that are critical for lake metabolism and fishery food chain. It was determined that alum alone would not result in significantly improved water clarity, which is a primary goal of riparians. This method is also very costly for low return of desired outcomes.

As mentioned above, there is a strong need for determination of all possible Critical Source Areas (CSA's) around the lake to assure that all runoff is effectively managed to reduce nutrient loads to the lake. The existing sedimentation basins are effective, but there are still outputs and possibly other unknown areas that are contributing nutrients and solids to the lake. Reduction of external loads is critical if any within-basin methods are utilized for internal load reductions.

Furthermore, the removal of CLP is critical for reducing the internal loading and accumulation of phosphorus in the littoral zone where it is also released. Regardless of whether another aeration system or alum treatment is implemented, it is important to reduce the CLP and it may take substantial harvests during the July-August period. It is recommended that the Association create a matrix of desired goals in order of importance or priority. Then, each goal should be paired with the improvement technology most likely to accomplish that goal.

If you have any questions regarding this professional scientific opinion, please feel free to contact me at the information below.

Sincerely,

RESTORATIVE LAKE SCIENCES

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