Bone Lake Management District
Polk County, Wisconsin

Bone Lake Water Quality

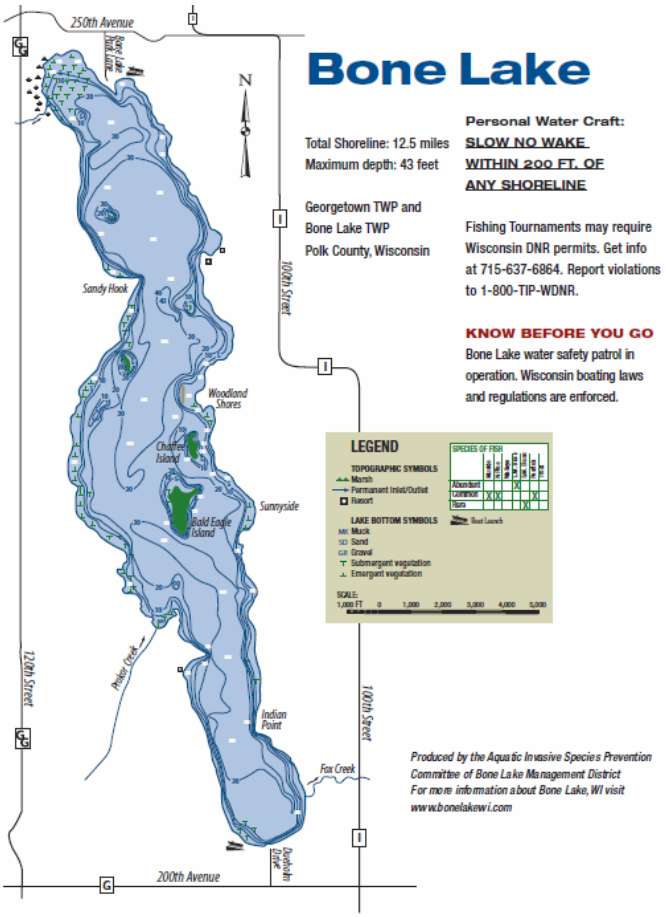
Fact Sheet

CONTENTS

The Lake 1
Bone Lake Water Quality 2
  Lakes Classification 2
  Trophic State 2
Bone Lake Water Quality Modeling 3
  Reducing Phosphorus Load to Bone Lake 4
  Predicted Water Quality Changes with Phosphorus Reduction 4
Sources 5

THE LAKE

Bone Lake is a 1,667-acre lake located in Polk County, Wisconsin, in the town of Georgetown (T35N, R16W) and the town of Bone Lake (T36N, R16W); WBIC: 2628100. It is a drainage lake. Prokor Creek and three intermittent streams flow into the lake while Fox Creek flows out of the lake. Fox Creek eventually reaches the Apple River which flows to the St. Croix River. The maximum depth is 43 feet, and the mean depth is almost 22 feet.



Bone Lake Water Quality

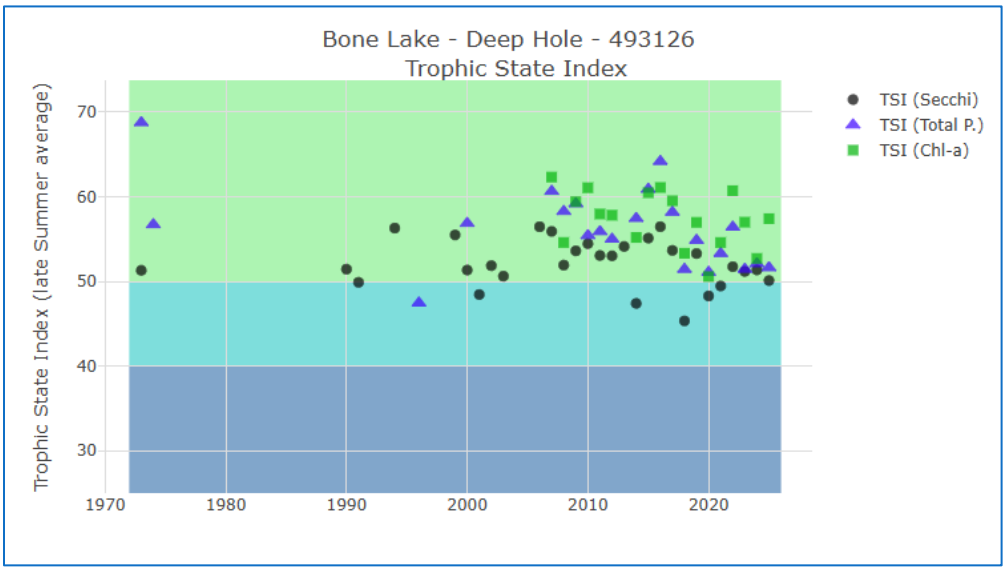
Lakes Classification

Bone Lake is on the WDNR 2024 Impaired Waters List for total phosphorus levels that lead to excessive algae growth. Bone Lake is classified as a Deep Lowland Lake by the WDNR. It is assumed that a Deep Lowland Lake remains stratified in temperature layers in the summer. Placing Bone Lake in this classification is likely in error because in many years Bone Lake mixes periodically during the summer bringing water and phosphorus up from the deepest portions of the lake.

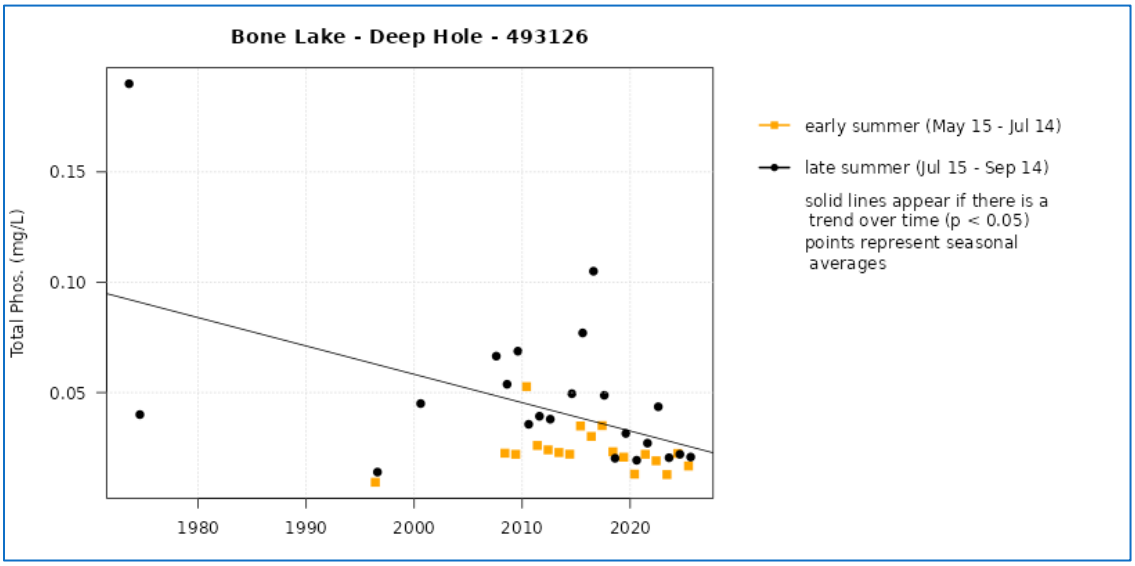
The phosphorus standard for a deep lowland lake is 30 *ug*/L. This is equivalent to the phosphorus goal in the 2015 Bone Lake Management Plan. Bone Lake remains on the impaired waters list because in-lake phosphorus concentrations (June 1 through September 15) are above that standard when averaged over many years. However, in years when the lake mixes later, such as from 2023 to 2025, phosphorus concentrations remain below the Deep Lowland Lake impaired waters standard with a mean of 19.5 *ug*/L. In 2015 to 2017 when the lake stratified then mixed early, the growing season mean was 54 *ug*/L.

Trophic State

Trophic State is a classification system of nutrient levels in lakes calculated based on Secchi depth, total phosphorus, and/or chlorophyll. Oligotrophic lakes have low nutrients and clear water. Eutrophic lakes are high in nutrients and support abundant algae growth. Mesotrophic lakes have conditions in between these classifications. Bone Lake is a mesotrophic to eutrophic lake with clear water in early summer that, in some years, deteriorates with frequent algae blooms in mid to late summer. The south basin generally has greater water clarity than the north basin. Phosphorus concentrations control the level of water clarity in Bone Lake because increased phosphorus levels increase algae growth. Lake sediments release phosphorus when the lake water stratifies in temperature layers in the summer and oxygen levels decrease at the lake bottom. When the lake loses temperature stratification and mixes, phosphorus-rich bottom waters are brought to the surface and increase algae growth. Phosphorus input to Bone Lake also comes from the watershed, atmospheric deposition, groundwater, and septic systems.

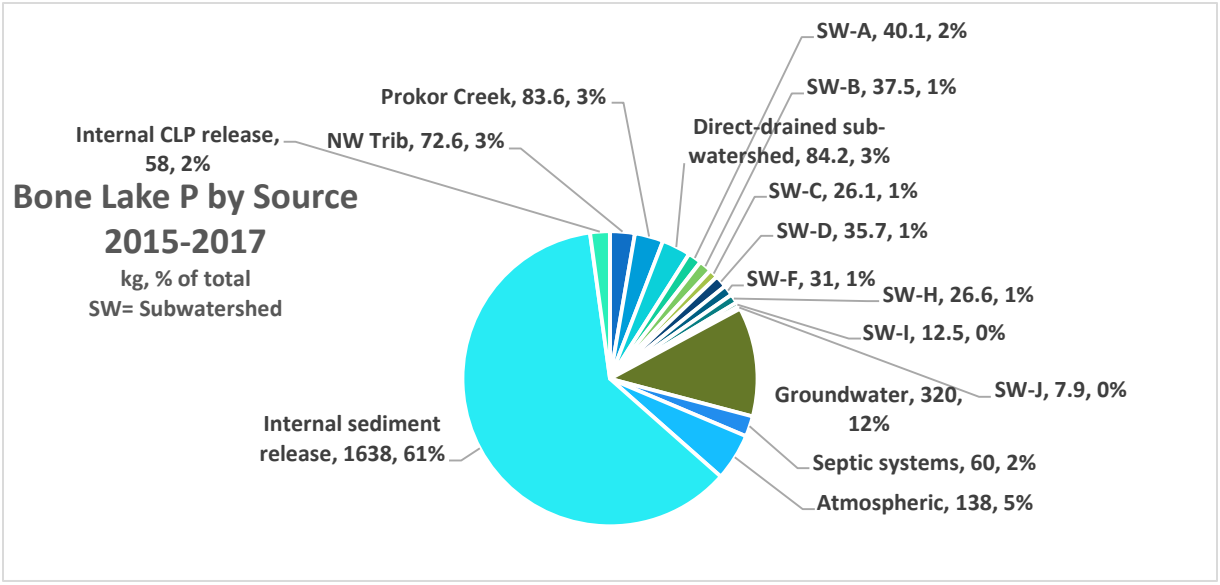


Volunteers have collected Bone Lake water quality data (Secchi depth, total phosphorus, and chlorophyll-a, a measure of algae growth) through the WDNR Citizen Lake Monitoring Network (CLMN) for decades. Volunteers also measure lake temperature and oxygen profiles which indicate if the lake is stratified in layers based on temperature and water density. CLMN results provide an overview of the trophic state and water quality over the years. Of the parameters measured, only late summer phosphorus shows any trend as shown in the graph below. This trend shows improving late-summer water quality.

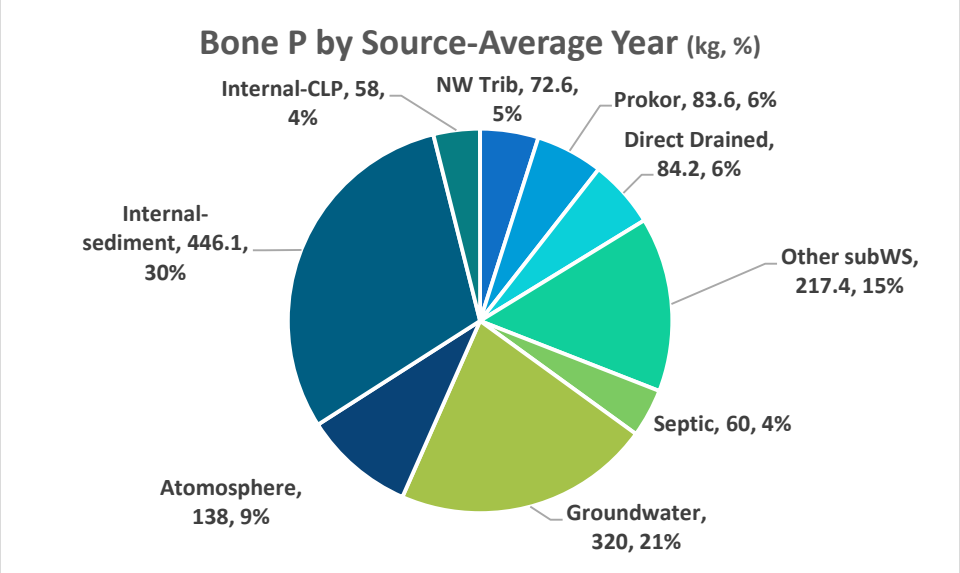


Bone Lake Water Quality Modeling

Bone Lake water quality can vary from year to year, especially in late summer. A recent update to a lake model, first created in 2018, explained why this occurs (Schieffer, 2025). Lake models are used to estimate sources of phosphorus to the lake then to predict impacts of changing phosphorus loading from various sources. The updated lake model resulted in the phosphorus budget shown below. Nutrient inputs for the model came from a variety of sources, including updated watershed boundaries and land cover in each sub watershed.



This figure is striking because it shows a high load from lake sediments during these years (2015-2017) when the lake lost stratification and mixed during the growing season. In years when the lake mixes later, the phosphorus budget looks different. The loads from other sources increase in significance when there is little or no phosphorus released from lake sediments. Because the overall phosphorus load is lower with little or no internal loading, there is less phosphorus and algae growth in these years. It is important to note that phosphorus loads from the watersheds vary from year to year, largely depending on precipitation and runoff amounts. The estimated phosphorus inputs for an average year are shown in the figure below.



Reducing Phosphorus Load to Bone Lake

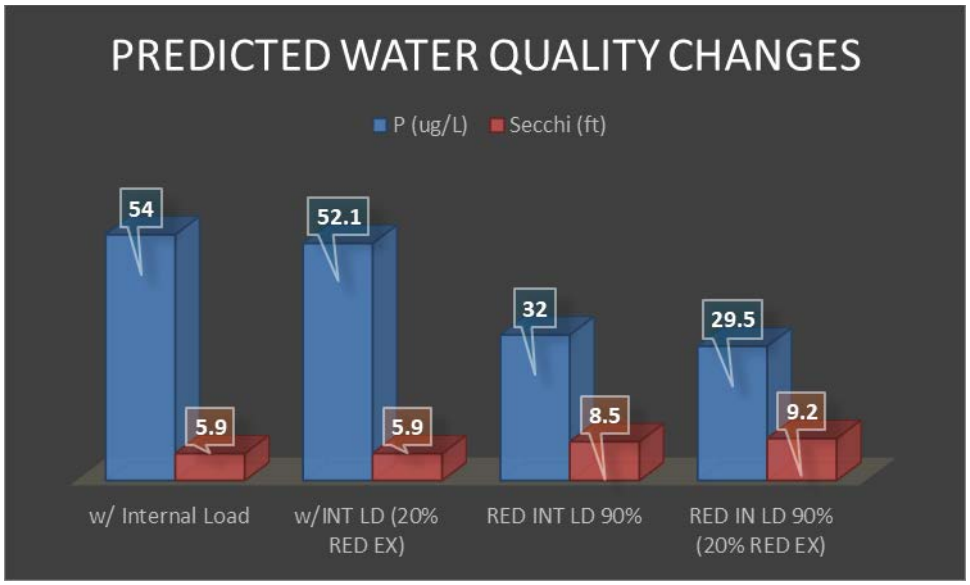
As mentioned above, internal load is naturally low in some years when the lake remains stratified into late summer. Removal of curly leaf pondweed with harvesting can reduce the internal load of the lake. An alum treatment is another means to reduce internal load. Alum treatments bind phosphorus in lake sediments devoid of oxygen.

The potential to apply alum to Bone Lake was investigated in detail by the Bone Lake Management District in 2019 and 2020. The estimated cost for an alum treatment at that time was $2.6 million. After considerable deliberation by a committee, presentation and discussion at the 2020 annual meeting, and following a survey of lake residents, the board dismissed the alum treatment proposal, and it was not brought to the members for a vote.

Phosphorus load to the lake from external sources (creeks and watersheds) can be reduced by installing practices that reduce runoff of nutrients and sediment from impervious surfaces such as roofs, driveways, and sidewalks. Because lawns can shed considerable runoff to the lake, especially on steep slopes, converting lawn to natural growth is also beneficial. Crop field practices can also reduce runoff of nutrients to the lake.

Predicted Water Quality Changes with Phosphorus Reduction

The model predicts that reductions in external loading as high as 80 percent would result in increased water clarity of only 0.66 feet. In contrast, reducing the internal load by 90 percent predicts increased water clarity of 2.6 feet – from 5.9 feet to 8.5 feet. When coupled with even a 20 percent reduction in external loading, water clarity is predicted to increase to 9.2 feet. These values reflect averages over the growing season.



Actual monitoring results, from years when the lake remains stratified, mimic model predictions for high internal load reduction. For example, from 2023-2025 when the lake mixed late, the mean Secchi depth was 8.5 feet. In years when internal loading is low, external/watershed loading reductions would visibly improve Bone Lake water quality. External load reductions also reduce the potential for sediment/internal phosphorus loading in future years.

Sources

James, William. Examination of sediment phosphorus fluxes and aluminum sulfate dosage considerations for Bone Lake, Wisconsin. December 2017.

Rose, Shelley. *Bone Lake Management District Alum Survey Report*. October 2020.

Steve Schieffer Ecological Integrity Services. *Bone Lake 2025 Lake Model Update*.

Wisconsin Department of Natural Resources. *2024 Impaired Waters List*.

Wisconsin Department of Natural Resources. Water Explorer Web Application. Accessed January 16, 2026. https://dnr-wisconsin.shinyapps.io/WaterExplorer/?stationid=493126