FAQs about Alum

The Bone Lake Management District is considering alum treatments to improve water clarity in Bone Lake. Bone Lake typically experiences algae blooms in the mid- to late-summer that can affect the safety and enjoyment of the water. Alum treatments can reduce these blooms; however, they are costly. The funding would primarily come from a special assessment on Bone Lake properties which would need to be approved by majority vote of Bone Lake property owners at an annual District meeting. We know you have questions. The following are frequently asked questions about alum.

What is alum?

Alum (aluminum sulfate) is a nontoxic liquid that is commonly used in water treatment plants to clarify drinking water. Alum is a common food additive.

How does alum work?

The use of alum in lakes began in the early 1970's to reduce the amount of phosphorus in the water. Lower amounts of phosphorus lead to lower amounts of algae and the symptoms associated with poor water quality. Alum is most often used to control phosphorus release from the lake bottom sediments (internal loading.) Research has shown that even when external sources of phosphorus from the surrounding watershed are lowered, the internal cycling can continue to support significant nuisance algal blooms.[1]

Is alum safe?

Alum has been repeatedly shown to be safe for humans. Alum is a common food additive and has also been used for decades to clean our drinking water before consumption. The exact same drinking-water-certified alum would be used when performing a lake improvement application.

Aluminum is a main ingredient of alum, is the third most abundant element in the earth's crust and naturally occurs in lake sediments. Virtually all food, water, air and soil contain aluminum and the average adult consumes 7 -9 milligrams of aluminum every day. The FDA supports the safe use of alum as a food additive and a single dose of Maalox contains 400 milligrams of aluminum.

Alum use in lakes results in an especially low exposure to aluminum as very low amounts of aluminum are added during an application and the alum remains undissolved in the lake sediments.

What is the impact of alum on fish?

Aluminum is considered a non-essential metal because fish and other aquatic life do not need it to function. There is a large body of scientific literature documenting the safe use of alum in lake environment conditions, which has allowed the North American Lake Management Society to endorse its use (NALMS, 2017).[2] The EPA is also recognizing an increased level of safety with aluminum in lake systems. Based on research that occurred since the criteria were set in 1988, EPA is suggesting new lake criteria that is four times higher (EPA, 2017).[3]

We consulted with Aaron Cole, Fisheries Biologist for the Wisconsin DNR. His research indicated that there are no known impacts to fish from alum treatments are far as toxicity goes. In his research, he found the potential for aluminum toxicity to invertebrates, zooplankton, and fish is negligible if the lake pH stays above 6. Specifically, when aluminum is highly soluble (at low pH) it can interfere with fish respiratory function. Therefore, as long as lake pH remains above 6 during an alum treatment, fish mortality is not expected to occur. He went on to say that long-term significant improvement in water clarity could decrease panfish growth rates as clear water supports less fish biomass and increases aquatic plants used by prey fish for hiding cover. Usually lakes with clear water and dense vegetation have abundant

panfish populations with low size structure, and low-density largemouth bass populations with high size structure.

How does alum impact plants (aquatic vegetation)?

Alum is harmless to plants. The improved water clarity after an alum application typically results in an increase of aquatic plants in the lake.

This is a benefit to the lake as the plants allow the lake to function naturally, provide important habitat for fish and other aquatic organisms, increase lake oxygen concentrations, stabilize the lakebed and reduce sediment resuspension, reduce shoreline erosion, and help prevent the lake from returning to an algae-dominated state.

However, some may consider aquatic plants a nuisance around docks, beaches, and in boating corridors. It is recommended that all lakes have an active plant management plan. This is especially true for lakes that have been cleaned by an alum application. Bone Lake has had an active aquatic plant management plan for over 10 years.

Where has alum been used effectively?

The alum committee looked at several lakes where alum has been used effectively including Bald Eagle Lake (in Minnesota)[4], Cedar Lake (north of New Richmond)[5], and Long Lake (west of Balsam Lake)[6].

Where has alum been used unsuccessfully?

Alum was deemed to be unsuccessful in Lake Wapogasset in Amery, Wisconsin.[7] Projections were that the alum would hold the sediment for 8-10 years. In fact, water quality was only improved for 2-3 years. It was determined that, although DNR recommendations were followed, the amount of alum applied was not sufficient to bind the phosphorous. Bone Lake's proposal calls for a higher alum dosage.

What is the long-term outlook with alum?

Using alum can produce a five- to fifteen-year reduction in the frequency and intensity of nuisance algal bloom, rather than the total elimination of all algae. Additional alum treatments are required to maintain results as (a) alum loses its binding effectiveness over time, and (b) phosphorus is continually added to the water through run-off and decaying organic material.

A long-term commitment to treating Bone Lake with alum is required to maintain any gains in binding the internal phosphorus load and increasing water clarity.

What is the alum treatment plan for Bone Lake?

A sediment core from Bone Lake was used to determine the initial dose of alum required to react with mobile phosphorus in the sediment. Bone Lake's recommended dose is 100 g Al/m2 applied to depths greater than 30 feet which is about 563 acres. Our initial dose will be applied in four applications over an eight-year period.

Bone Lake Proposed Alum Treatment Plan

	Target Year	Dosage in Grams per Square Meter	Gallons
First Application	2023	40 g/m2	411,524
Second Application	2026	20 g/m2	205,762
Third Application	2028	20 g/m2	205,762
Fourth Application	2031	20 g/m2	205,762
		Total from Four Applications	1,028,810
Next round of treatments: Starting 2039 to 2041 at 50% to 60% of total initial dosage.			

In order to maintain results from alum, maintenance applications should be planned for ten years after the last phase initial dose is applied.

How would alum be applied to Bone Lake?

Alum is applied to lakes using specialized equipment and barges that ensure the precise placement of the material in the lake. On contact with the water, the liquid alum forms a fluffy aluminum hydroxide precipitate called floc. Aluminum hydroxide (the principle ingredient of common antacids) binds with the phosphorus to form an aluminum phosphate compound. The compound is insoluble in water and the bound phosphorus can no longer be used to fuel the algae.

As the floc settles, phosphorus and particles are removed from the water column leaving the lake noticeably clearer. The floc then forms a thin layer on the bottom that binds the phosphorus as it leaches out of the bottom sediments during internal loading events. The floc layer keeps the phosphorus from entering the overlying water and makes it unavailable to the algae.

The result is a reduction in the frequency and intensity of nuisance algal bloom, rather than the total elimination of all algae.

Will boats disturb the alum floc at the bottom?

Alum would be applied to Bone Lake at water depths of 30 feet and deeper. Boats should not disturb the floc once it settles to the bottom of the lake.

What are the key disadvantages of alum?

The key disadvantages of alum are

- high cost of application for Bone Lake's 1,781 acres; and
- decreasing effectiveness over time, warranting additional applications

What are the key benefits from Alum?

The key benefits we are hoping to achieve are

- a 2.5- to 3-foot improvement in water clarity in late summer;
- reduce the occurrence of algae blooms including blue-green algae blooms (floating "green paint" looking water); and
- potentially small increase in property valuation

[1] HAB Aquatic Solutions Handout at http://www.bonelakewi.com/docs/ALUM/Alum%20information.pdf

[2] https://www.nalms.org/nalms-position-papers/the-use-of-alum-for-lake-management/

[3] https://www.epa.gov/wqc/2018-final-aquatic-life-criteria-aluminum-freshwater

[4] http://habaquatics.com/bald-eagle-lake/

[5] https://cedarlakealum.wordpress.com/

[6] "Long Lake, Wisconsin - Limnological Response to Alum Treatment: 2019 Interim Report"; February 3, 2020; University of Wisconsin-Stout and Harmony Environmental.

[7] https://wapobear.com/wp-content/uploads/2016/04/WapoBearTrapPlanFinal3.pdf

This is one in a series of four handouts answering frequently asked questions about Bone Lake's water quality, alum treatments, costs and funding of alum treatments, and voting in a lake management district.