

To: Don Trygstad, Chairman
Mona Lake Watershed Council

Date: October 26, 2021

From: John Jacobson, PE, Senior Engineer
Mark S. Kieser, Senior Scientist
Kieser & Associates, LLC

cc: Project Files

RE: Preliminary Summary of Mona Lake 2021 Alum Treatment Response

Kieser & Associates, LLC (K&A) is providing herein a preliminary summary of 2021 alum treatment outcomes in Mona Lake based on pre- and post-monitoring of water quality conditions. This was the first of three years of recommended treatments.

Summary of 2021 Alum Treatment:

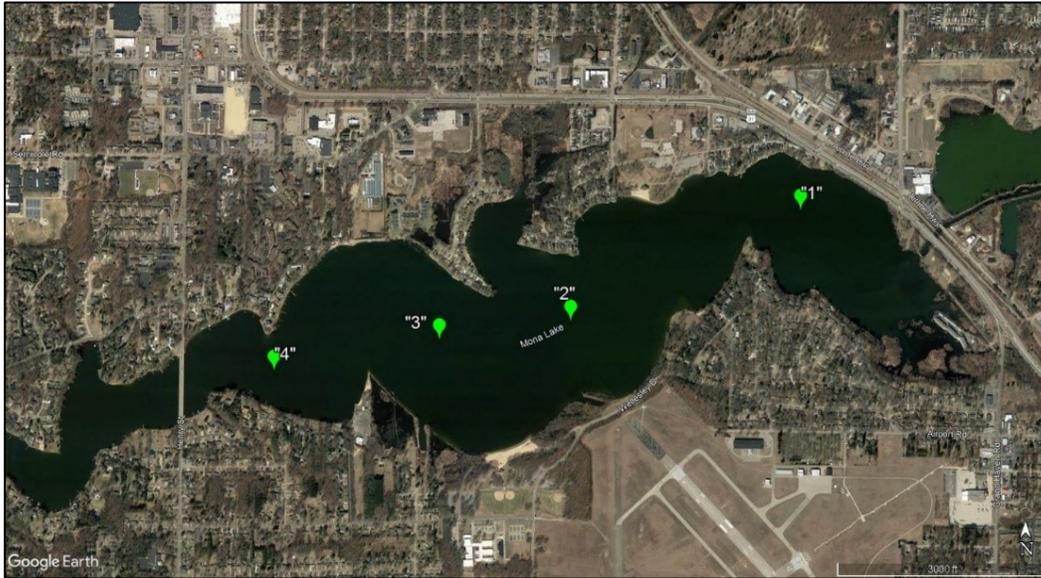
- HAB Aquatic Solutions of Lincoln, Nebraska was contracted by the Mona Lake Watershed Council to perform alum treatment on 150 acres of Mona Lake. This occurred from May 18-19, 2021. A map of the treatment areas covered is as follows.



- The original HAB bid was to treat 73 acres of Mona Lake beginning at the 18-foot depth contour in the central portion of the lake and proceeding west. Because of competitive bid pricing and timeframe of application, the Mona Lake Watershed Council was able to contract for additional acreage moving west and thus, 150 acres of Mona Lake was treated in 2021.

Water Quality Monitoring:

- K&A conducted five water quality sampling events to monitor pre- and post-treatment conditions. These included one pre-treatment sampling event (May 18, 2021), and four post-treatment sampling events (May 20, June 18, July 20, and September 8, 2021). The map below shows K&A sampling stations for each event.



Findings:

- The treatment immediately stripped phosphorus from the water column and reduced Total Phosphorus (TP) levels by 44% over concentrations measured the day before treatment.
- Soluble Reactive Phosphorus (SRP) remained low (averaging 5.5 ug/l) in the lower (hypolimnetic) water depths during the four post-treatment sampling events in 2021.
- Alum treatment proved effective based on water quality monitoring data compared to prior years.
- The percent reduction of phosphorus in hypolimnetic waters of the two treatment areas (S2 and S3) and downstream of treatment area (S4) over 2018 and 2017 historic levels was as follows:

Sampling Area #	TP Reduction over 2018 Levels	TP Reduction over 2017 Levels	SRP Reduction over 2018 Levels	SRP Reduction over 2017 Levels
S2	77%	74%	90%	92%
S3	91%	92%	98%	97%
S4	95%	94%	94%	87%

- TP in bottom waters of Mona Lake in July and August of 2018 increased 10 times over prior months of the year (40 ug/l average to 400 ug/l average). In 2017, the July and August average TP increased 20 times over prior months (50 ug/l average to 1,000 ug/l average).
- Late August and early September 2021 saw sustained winds from the southwest mixing nearly the entirety of the eastern part of the lake. Alum treatment kept available phosphorus in the lake east of Henry Street Bridge low, ranging from 2.8 - 22 ug/l; drastically lower than seen in previous years.
- With the late season 2021 water column mixing event following treatment, no algal blooms were reported in the eastern lake areas; a radical difference than seen in previous years prior to alum treatment.
- An ancillary benefit of the alum treatment of the 150 acres was the suppression of bottom water phosphorus levels in untreated downstream areas above the Henry Street Bridge. Bottom water SRP concentrations at sampling station S4 in areas downstream of treatment were nearly identical throughout the summer to those treated at S3.
- A notable result of treatment was improved water clarity in Mona Lake. Historic Secchi Disk readings from 2017 and 2018 ranged from 3.5 to 5 feet, while for 2021, comparable June and July Secchi Disk readings were between 5 and 7.6 feet.
- A secondary benefit of alum treatment was the reduction of the sediment oxygen demand. A review of the dissolved oxygen (DO) levels in the water column between historical 2017/2018 and 2021 was telling. Historical DO readings were zero (0) at approximately 15 feet of depth to the lake bottom, while in 2021 the DO declined to only 3 mg/l at 18 feet, then went to a minimum of 1 mg/l at the bottom of the lake. None of the 2021 sampling events revealed any DO readings below 1 mg/l.

Recommendations:

- As to future treatments, K&A is recommending for 2022, the completion of the next 25% alum dosage as designed in the 150 acres treated in 2021, along with water quality monitoring consistent with 2021 efforts.
- Because alum treatment over the 150 acres in the central and upper portions of the lake had a significant beneficial impact on the untreated downstream 50-acre area immediately above of the Henry Street Bridge, K&A would characterize any consideration of extending alum treatment to this area as a low priority for 2022.
- Alum treatment in the Ellis Drain area of the lower lake could be considered, however, this is not currently covered by permit and there are insufficient monitoring data to otherwise guide treatment recommendations.
- No alum treatment of channel areas below the Henry Street Bridge is recommended. These are deep with minimal fetch (available length for wind mixing) such that sediment phosphorus release does not appear to be creating

much of a risk to upstream areas. Importantly, P released from sediments in the channel will be washed out of the lake if left untreated. This is the preferred outcome versus locking this up with alum when it otherwise does not push upstream even during severe wind conditions. Thus, the return on investment for alum treatment in the channel is questionable.