

HOW NANOBUBBLE TECHNOLOGY IS NATURALLY RESTORING A MINNESOTA COMMUNITY LAKE



Client Case Study: Tadd Lake, Atwater, MN

Treatment Dates: July 2-October 24, 2024	System: 1,000 gallons per minute trailer mounted nanobubble generator system
Problems: <ul style="list-style-type: none"> • High nutrient levels • Poor water clarity • Muck accumulation • Excessive algae blooms • Poor fishing and recreation spot 	Tadd Lake Results Compared to Upper Lake: <ul style="list-style-type: none"> • Better water quality: Over 300 mV ORP & Dissolved oxygen over 3 mg/L 99% of the time • Less muck: 90% reduction in soft organic sediments • Improved clarity: 2 times clearer • Reduced algae: 4 times lower algae count • Reduced nutrients: 4 times less dissolved phosphorus • Restored fishing spot for locals

Tadd Lake, a 10-acre freshwater lake in Atwater, MN, once thrived as a popular spot for recreational fishing. However, excess algae and aquatic weeds covering the surface have made it hard to get a hook into the lake depths. As a terminal lake, or a lake that has no natural outlet, Tadd Lake is connected to the 25-acre Upper Lake, and receives inputs from Upper Lake via a small canal. Historically, Tadd Lake has been plagued by issues typical in nutrient-laden water bodies: muck accumulation, low clarity, and frequent algae blooms. In response, the Middle Fork Crow River Watershed District (MFCRWD), the agency dedicated to protecting and preserving water quality throughout the entire watershed, launched a restoration program. The results of this initiative will serve as a model for natural lake restoration, in both the local watershed and beyond.

In search of a chemical-free, foundational solution, MFCRWD partnered with Moleaer to use their innovative nanobubble technology, offering a sustainable solution to effectively address water challenges. This partnership aimed to help kickstart the natural recovery of the lake and boost its resilience against long-standing challenges like excessive algae growth. Moleaer deployed its trailer-mounted nanobubble system on July 2-3, 2024, introducing oxygen throughout the lake's water column, including the lake bottom, helping mitigate nutrient loading and support aerobic (oxygen-loving) microbial activity. To track impacts of the nanobubble treatment, MFCRWD monitored water quality in both Tadd Lake and neighboring Upper Lake, which served as a comparison site that didn't receive any treatment.



Figure 1. An aerial view of Tadd and Upper Lakes, showing the locations of the Moleaer nanobubble treatment unit and buoy-mounted water quality sensors.

Results of Nanobubble Treatment Show Significant Improvements in Water Quality

Throughout Tadd Lake, Moleaer's system successfully increased and stabilized dissolved oxygen (DO) and oxidation-reduction potential (ORP) levels. ORP reflects how well water can naturally break down contaminants and maintain good water quality. During the four-month monitoring period from July 2 to October 24, 2024, significant improvements were documented:

- **Oxygenation and Water Quality:** DO levels in Tadd Lake consistently remained above critical thresholds for aquatic life. Surface DO stayed above 3 mg/L for 99% of the treatment period, preventing hypoxic (low oxygen) conditions, and never fell to zero. In contrast, Upper Lake's DO levels dropped to zero at times, particularly during warmer periods. At the lake bottom, the average DO at the bottom (benthic DO) of Tadd Lake was twice that of Upper Lake, staying above 3 mg/L for 65% of the time, compared to only 25% in Upper Lake (Figure 2).

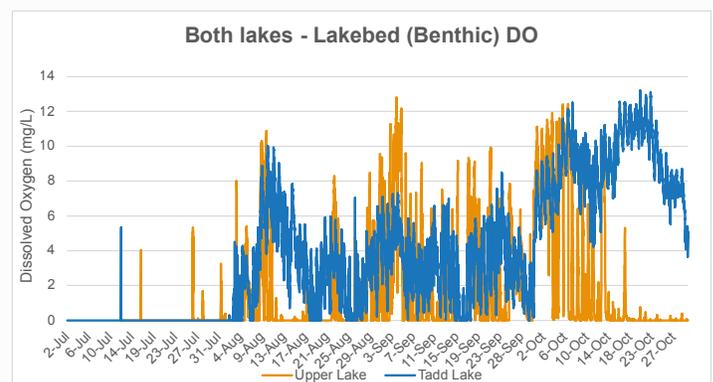


Figure 2. Dissolved oxygen measurements from the RDO Blue sensor in the benthic zone (i.e. 1-2 ft above the lake bottom) in Tadd and Upper Lakes after nanobubble treatment in Tadd Lake began.

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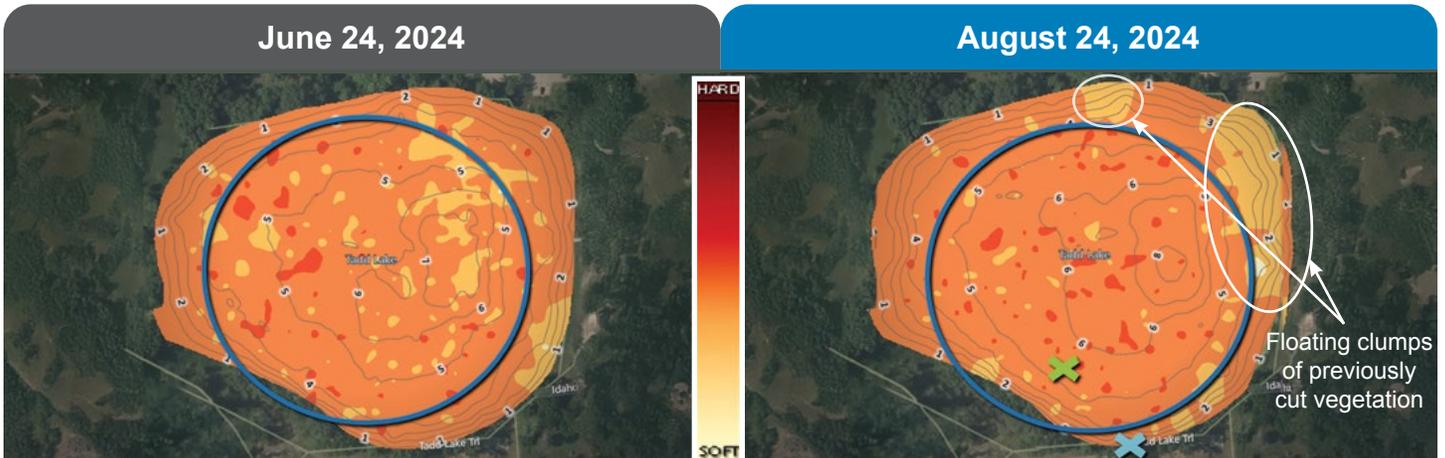


Figure 3. Sediment hardness mapping results from Tadd Lake before treatment (June 24, 2024) and 30 days after treatment began (August 24, 2024). Green X indicates location of discharge point from Moleaer nanobubble generator. Light blue X indicates location of Moleaer system on land. Area circled in blue shows greatest reduction in softer, organic matter (“i.e. muck”) between the two dates.

- **Reduced Muck:** By the end of summer, the bottom of Tadd Lake saw a 90% reduction in soft organic muck in central areas and a 30-40% increase in harder sediment (Figure 3).
- **Nutrient Levels:** Tadd Lake displayed lower nutrient loads compared to Upper Lake, with 4 times less dissolved phosphorus (Figure 4). This stability potentially results from reduced internal and external nutrient loading due to the nanobubble treatment.
- **Reduced Blue-Green Algae Levels:** Tadd Lake had four times fewer blue-green algae cells than Upper Lake and maintained a more diverse algae community (Figure 5).
- **Enhanced Clarity and Ecological Resilience:** Water clarity in Tadd Lake improved significantly. By the treatment’s end, it was more than twice as clear as Upper Lake. The enhanced clarity allowed sunlight to reach greater depths, fostering more photosynthesis and encouraging a healthier and more diverse phytoplankton community essential for a resilient ecosystem. Daily imagery of both lakes confirmed that Tadd Lake remained clear while Upper Lake experienced a severe algae bloom that lasted over a month, creating a stark visual contrast (Figure 6).

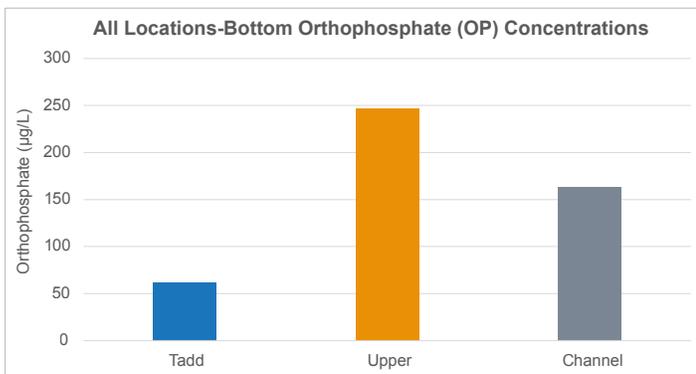


Figure 4. Orthophosphate concentrations in Tadd and Upper Lake, and within the channel.

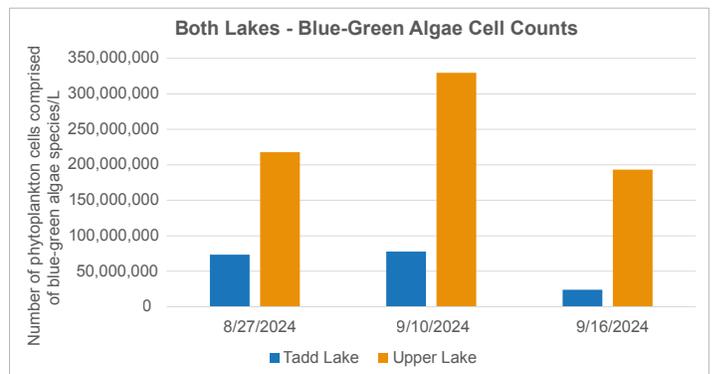


Figure 5. Total blue-green algae cell counts (per liter) from Tadd and Upper Lakes over the three sampling dates.



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▼ Tadd Lake ▼



Before July 2, 2024



September 29, 2024

▼ Upper Lake ▼



Figure 6. Aerial photos of Tadd and Upper Lakes taken before July 2, on July 28, and September 29, 2024. Pictures courtesy of Tony Vruwink.

From Challenges to Solutions: Natural Restoration for Minnesota Lakes and Beyond

The Tadd Lake restoration project showcases the effectiveness of Moleaer’s nanobubble technology in naturally restoring lake health. The results are compelling: higher DO and ORP levels, reduced muck, greater water clarity, reduced total and blue-green algae, and a more diverse algae ecosystem – despite the challenges posed by summer heat, exceptionally heavy and frequent rainfall, and associated nutrient influx events. Nanobubble technology has proven to be a powerful, chemical-free solution for lake restoration, achieving results that pave the way for sustainable water quality management for MFCRWD and other communities facing similar issues.

