



LARGE-SCALE NANOBUBBLE TREATMENT REDUCES HABS, RESTORES RECREATION, AND SUPPORTS LOCAL ECONOMY

Client: City of Lake Elsinnore

Surface Area:
3,000 acres

Volume:
9.8 billion gallons of water

Maximum Depth:
42 ft

Lake Trophic Status:
Hypereutrophic

Challenges:

- **High Nutrient Loading:**
Internal loading: >75% of nutrient budget
External loading: 6.5 million gallons of treated wastewater per day during spring-fall each year
- **History of Algal Toxins:** Danger algae toxin advisory levels and/or lake closures for 4 out of last 7 years, prior to 2024
- **Lake Closures:** Closed to recreation for 8 months in 2022 due to algal toxin levels

Results to Date:

- **8x reduction in algal toxins**
- **Zero lake closures since October 2024**
- **\$900 million in private investment attracted to the community**

Lake Elsinnore, located at the base of the San Jacinto River watershed, is the largest lake in Southern California. For years, the lake experienced severe water quality challenges driven by excessive nutrient loading, persistent harmful algal blooms (HABs), and dangerously low dissolved oxygen levels. These conditions resulted in multiple toxin advisories and lake closures significantly impacting recreation and the local economy.

Nanobubble Treatment Solution:

The City of Lake Elsinnore worked with Moleaer to deploy nanobubble treatment systems in a phased approach. These systems address the challenges plaguing the lake by increasing oxygen levels, even at depth, to mitigate internal nutrient release, increase muck digestion and improve water quality.

Phase 1: Demonstration (February 2024)

- ✓ Total Treatment: 3.5 million gallons of water per day
- ✓ Oxygen: 1,320 lbs of oxygen per day

Phase 2: Expansion (October 2024)

- ✓ Total Treatment: 6.5 million gallons of water per day
- ✓ Total Oxygen: 5,500 lbs of oxygen per day

Phase 3: Treatment Expansion (October 2026)

- ✓ Total Treatment: 39 million gallons of water per day
- ✓ Total Oxygen: 15,000 lbs of oxygen per day

Today, Lake Elsinnore represents the largest publicly regulated water body in the United States with a permanent nanobubble technology installation, establishing a data-backed model for large-scale surface water restoration.

Comprehensive Monitoring Program

A rigorous monitoring program was established through collaboration between the Elsinnore Valley Municipal Water District (EVMWD), the City of Lake Elsinnore, Moleaer, and GEI Consultants.



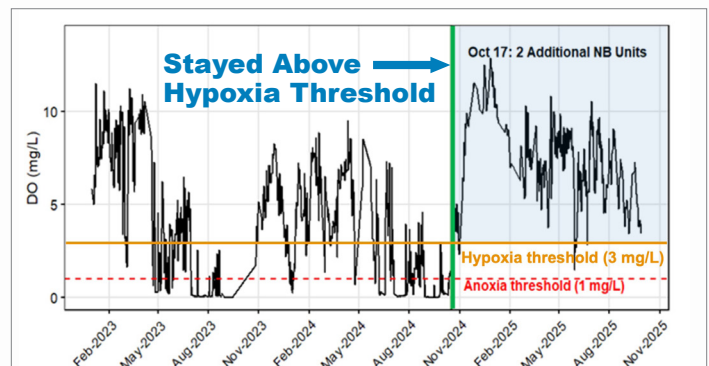
Moleaer nanobubble system installation locations.

Results

✓ Dissolved Oxygen Improvements:

Sustained oxygenation is critical to prevent the release of phosphorus from sediments that fuel algal growth. Nanobubble technology increased and stabilized dissolved oxygen levels throughout the water column:

- **DO levels remained above oxygen-depleted thresholds (>1 mg/L) at 3-6 meters deep, even during summer months.**
- Frequency of low oxygen events (<3 mg/L DO) at all monitored depths significantly decreased after November 2024

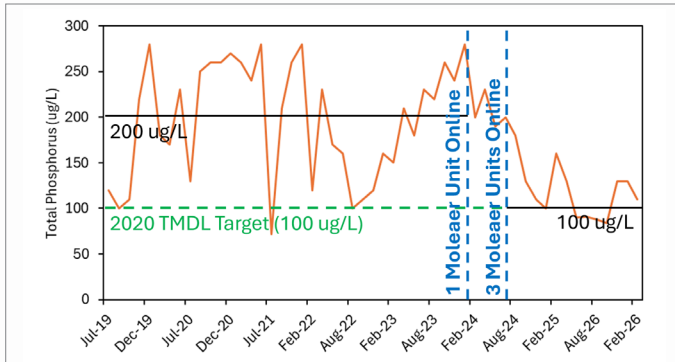


Data from EVMWD. Sensors at 3-6 m below the water surface at the Lakeshore Buoy, near the center of Lake Elsinnore.



✔ Nutrient Reduction

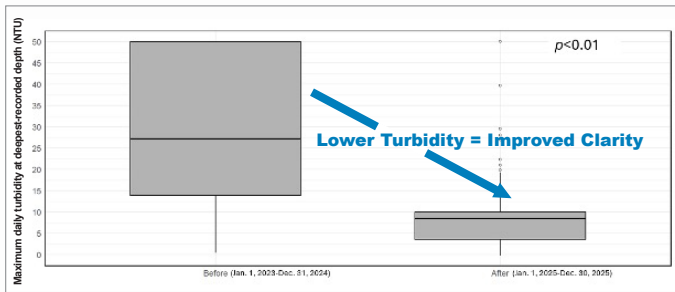
- **Increased DO and ORP** led to a decrease in nutrients
- **TMDL compliance** for total Phosphorus
- **Total nitrogen was reduced by 50%**, from 5.0 mg/L to 2.5 mg/L



Lake Elsinore TMDL monitoring conducted by GEI Consultants on behalf of EVWMD.

✔ Water Clarity Improvements

Turbidity measurements at all monitored depths significantly decreased following deployment of additional nanobubble treatment units in October 2024, indicating improved water clarity throughout the lake.



Daily maximum turbidity (NTU) prior to and after extended nanobubble treatment.



Landsat imagery of Lake Elsinore in December from 2015 to 2025, showing significant water clarity improvements and reduced algal blooms.

✔ Harmful Algal Blooms and Toxin Reductions

The most significant improvements were observed in measures of harmful algal blooms and associated toxins:

- **8x reduction in algal toxins**
- **75% reduction in cyanobacteria biomass**, as shown in modified cyano index (satellite image-derived)

These improvements represent a substantial change in lake conditions. The reduction in microcystin concentrations from levels associated with elevated health risks to levels below EPA recreational advisory thresholds, enabled the lake to remain open throughout the critical summer recreation season.

Economic & Community Impact

The success of nanobubble treatment has catalyzed significant economic investment in Lake Elsinore, reinforcing the connection between environmental restoration and community prosperity. The City reports approximately \$900 million in new private investment across housing, commercial development, and tourism-related infrastructure.

Adam Gufarotti, the City's Assistant Director of Lake & Community Operations, noted:

"Restoring Lake Elsinore has done more than improve water quality, it's restored confidence in our community's future. We're now seeing \$900 million in new investment flowing into housing, businesses, and attractions. For our residents, that means more local jobs, better amenities, and a community that's truly thriving. It's proof that when you prioritize your natural resources, everyone benefits."

A Future for Lake Elsinore

Lake Elsinore serves as a model for how innovative technology, adaptive management, and community commitment can restore severely impaired water bodies. The City has made Moleaer nanobubble technology a foundational component of its long-term lake management plan, with continued expansion planned for 2026 and beyond.

Acknowledgments

This project represents a collaborative effort by the City of Lake Elsinore, Elsinore Valley Municipal Water District, GEI Consultants, and Moleaer's dedicated team. Their commitment to innovation and adaptive management is setting a new standard for restoring and protecting valuable freshwater resources.



Discover the power of nanobubble lake restoration. Visit:
www.moleaer.com/en-us/industries/lakes-ponds

The information and data contained herein are deemed to be accurate and reliable and are offered in good faith, but without guarantee of performance. Moleaer assumes no liability for results obtained or damages incurred through the application of the information contained herein. Customer is responsible for determining whether the products and information presented herein are appropriate for the customer's use and for ensuring that customer's workplace and disposal practices are in compliance with applicable laws and other governmental enactments. Specifications subject to change without notice. Copyright © 2026 Moleaer. All trademarks stated herein are the property of their respective company. All rights reserved. This document is confidential and contains proprietary information of Moleaer Inc. Neither this document nor any of the information contained herein may be reproduced, redistributed or disclosed under any circumstances without the express written permission of Moleaer Inc. Rev. 09-10-26 R5 EN