



**Multi-Faceted Approach  
to  
Harmful Algal Blooms**

**Presentation By:  
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Mohegan Lake Improvement District**

# To Be Covered . . . .

**Historical Background**

**Lake Challenges (Phosphorus & HABs)**

**Managing the Symptoms**

**Attempts to Find a Longer-Term Solution**

**Natural Lake**

**Located in Northern Westchester**

**Town of Yorktown**

**103 Acres, 1 mile long**

**Average depth 12'**

**Eutrophic Lake**

**Limited Inflow and Outflow**

**Highly Developed Watershed**

## Lake Mohegan Associations



# MOHEGAN LAKE IMPROVEMENT DISTRICT



**Caring for our lake and building community**

- **Special Tax District formed in 1975 by lake residents**
- **Approx. 1,800 tax parcels in Yorktown and Cortlandt**
- **Volunteer board, part-time summer staff (4)**
- **Approx. \$90,000 annual budget**



# Historical Origins of Phosphorus

- **Lake Mohegan became the “playground” for New York City residents**
- **Latter part of 19<sup>th</sup> Century, significant development around the lake**

## The St. Nicholas Hotel



**324 feet long, accommodating 500 guests**

**Destroyed in 1908 fire**

**One of many hotels, “casinos,” and bungalow colonies**

## Dairy Building at the Mohegan Farm



**300 acre farm occupying ½ mile of the east shore of the lake  
There was also a 600-hen poultry house**

# Historical Origins of Phosphorus

- **This lakeshore development occurred long before modern septic systems or lake friendly agricultural practices.**
- **Blue green algae blooms began to impact water quality as early as the 1930s.**
- **“Old-timers” remember beaches dumping blue crystals of copper sulfate into the lake back then.**

# Historical Origins of Phosphorus

- **Mid 1900s onward saw growth of all-year round homes around the lake.**
- **The last straw: a proposed development of hundreds of condo units on septic systems on the north shore in the early 1970s.**
- **Lake residents, fed up by deteriorating lake conditions, gathered together and successfully sued to stop the development unless it was sewerred.**

# Historical Origins of Phosphorus

- **Building upon the successful lawsuit (court conditioned construction of the condos upon installation of a sewer system) residents petitioned the Towns (Yorktown and Cortlandt) to create a tax district to fund efforts to improve the lake.**

# Historical Origins of Phosphorus

- **In the meantime, the local highway department, to make roads safer, installed stormwater infrastructure speedily carrying stormwater from the watershed neighborhoods directly into the lake.**

- **Municipal storm water systems dump directly into lake**

**Stormwater testing showed high concentrations of phosphorus in stormwater**



# Lake Problems

- **Over-development resulted in the rapid filling in of the lake:**
  - **Maximum depth of 60 feet in the 1930s**
  - **Maximum depth of 22 feet in the 1990s**
  - **Over 20 feet of unconsolidated “muck” on the lake bottom**

# Lake Problems

- **Recreational use of the lake was impacted**
  - **Lake became choked with aquatic weeds**
  - **Harmful Algal Blooms became a regular summer occurrence**
    - **Odor events**
    - **Health Department Beach Closures**
- **HABs impacted not just aesthetics, but health and potentially property values**

# Challenges Faced by MLID

- **Invasive Species**



- **Blue Green Algae (cyanobacteria)**
- **Maintaining suitability of lake for recreational uses (swimming, fishing, boating, picnicking)**

# Challenges Faced by MLID

## Invasive Species

- Water Chestnut(*trapa natans*)
- Eurasian Watermilfoil (*myriophyllum*)
- Curly-Leaved Pondweed (*potamogeton crispus*)



**We are now in Year 16 of  
Water chestnut eradication**

# Challenges Faced by MLID

Maintaining suitability of lake for recreational uses (swimming, fishing, boating, picnicking)

- **Weed harvesting with mechanical harvester**
  - to clear beach areas
  - to help clear invasives
  - To remove some mass of nutrients from lake ecosystem

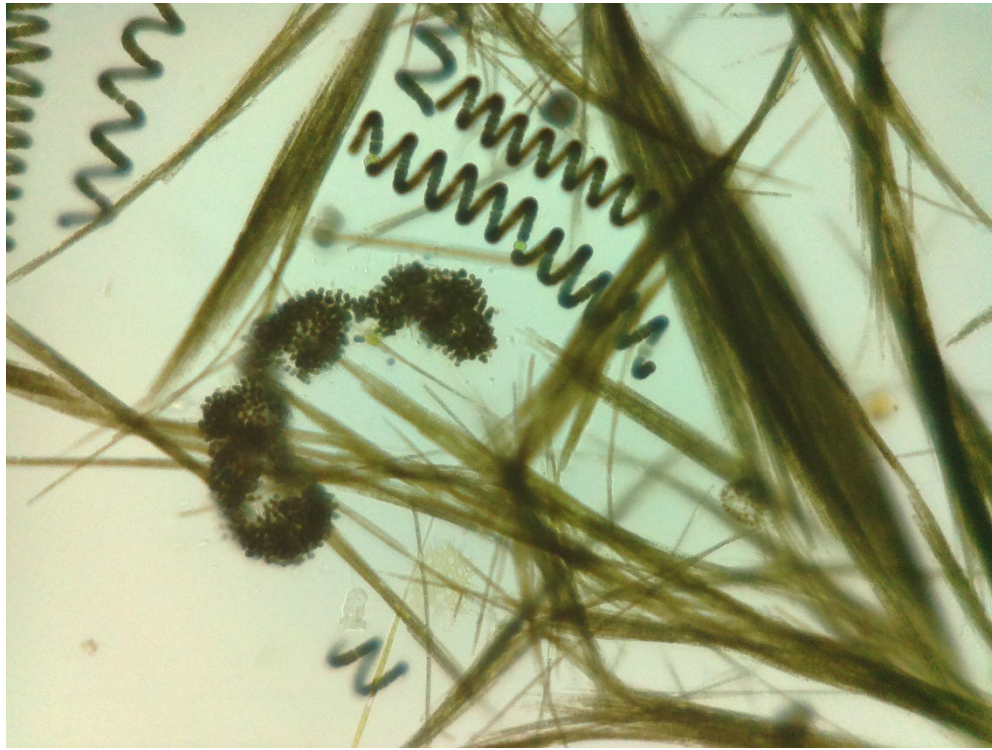


# **Our Unsolved Problems:**

**High Phosphorus Levels and  
Blue Green Algae (cyanobacteria) blooms**



# Not a pretty picture . . . .



**High phosphorus levels are one of the known causes of Harmful Algal Blooms**

# Over-population of Canada geese



**May contribute 8% of summer phosphorus load**

# Dubious Distinctions:

**Average seasonal TP (Total Phosphorus):  
88 ug/L**

**One test showed phosphorus levels in the lake of 172 ug/l, when NYS guidance value for recreational lakes is 20 ug/l.**

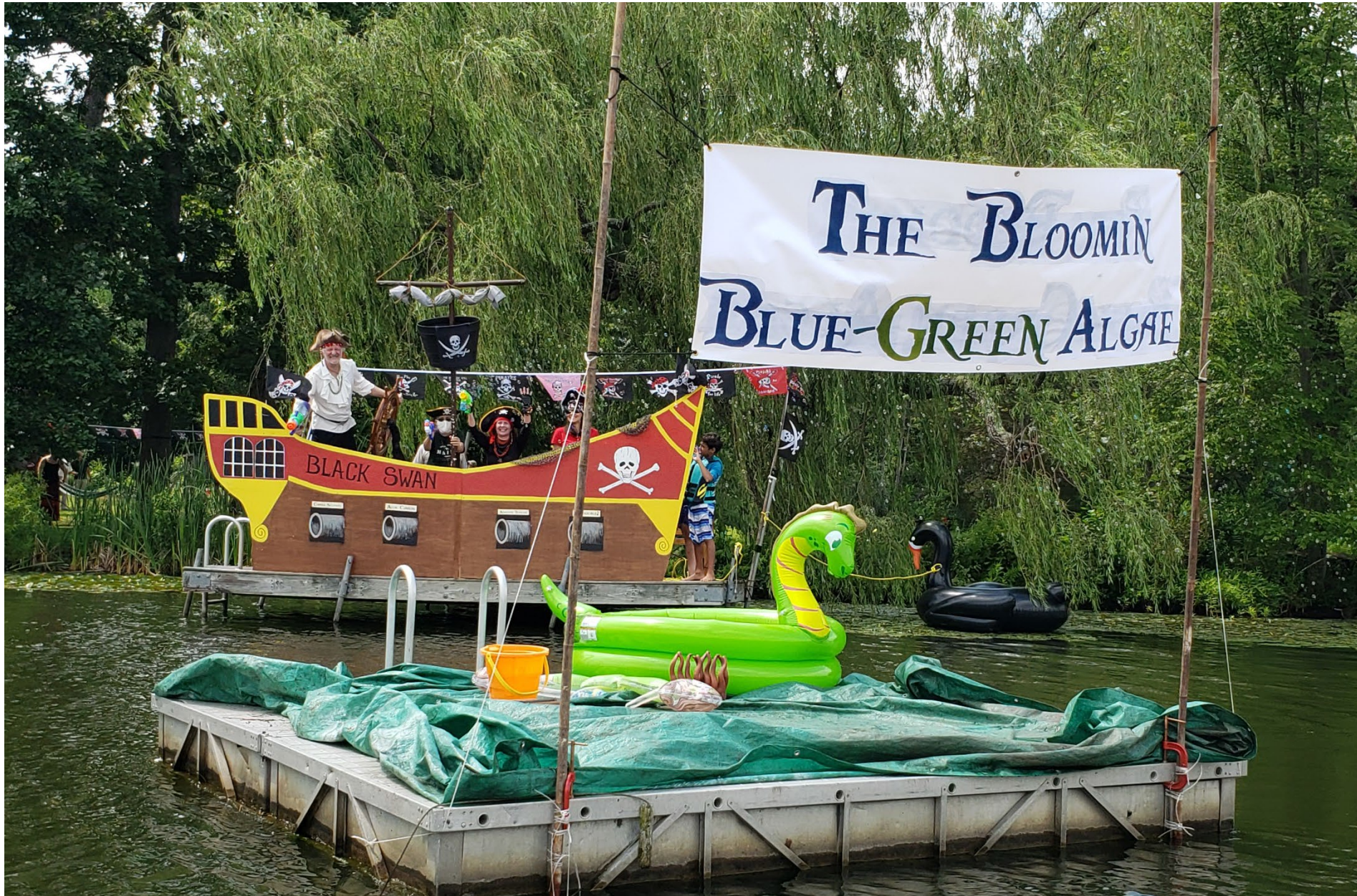
**In one study period in 2014, we had the highest bga counts in New York State**

# **Attempts to Address the Problems**

## **I. Keeping the Community Engaged**

- Newsletters**
- Meetings around the lake**
- Meetings with Town Boards and Elected Officials**
- Annual “Lake Day” Festival**

# Lake Day Beach Decorating Contest



# **Attempts to Address the Problems**

## **II. Treating the “Symptoms”**

- Mowing the lawn with the weed harvester since late 1970s**
- Tried bales of barley straw in 1990s**
- Tried shoreline well to increase flushing rate**
- Copper algaecide treatments since 1930s**
- Possible experiment with ultrasonic treatments in 2026?**

# Traditional Copper Treatments



**Annually get permits for copper sulfate, Cutrine Ultra, and EarthTec – only way to keep beaches open**

# Ultrasonic Treatment Trial



**Will it suppress  
surface blooms?**

**(Hydro BioScience  
Ultrasonic Algae  
Control Unit)**

# Attempts to Address the Problems

## III. Getting at the Causes

- Improved aeration system to reduce “internal loading” in 2023
- Possible lake bottom injection system of natural bacteria to speed “digestion” of organic lake-bottom muck in 2026?

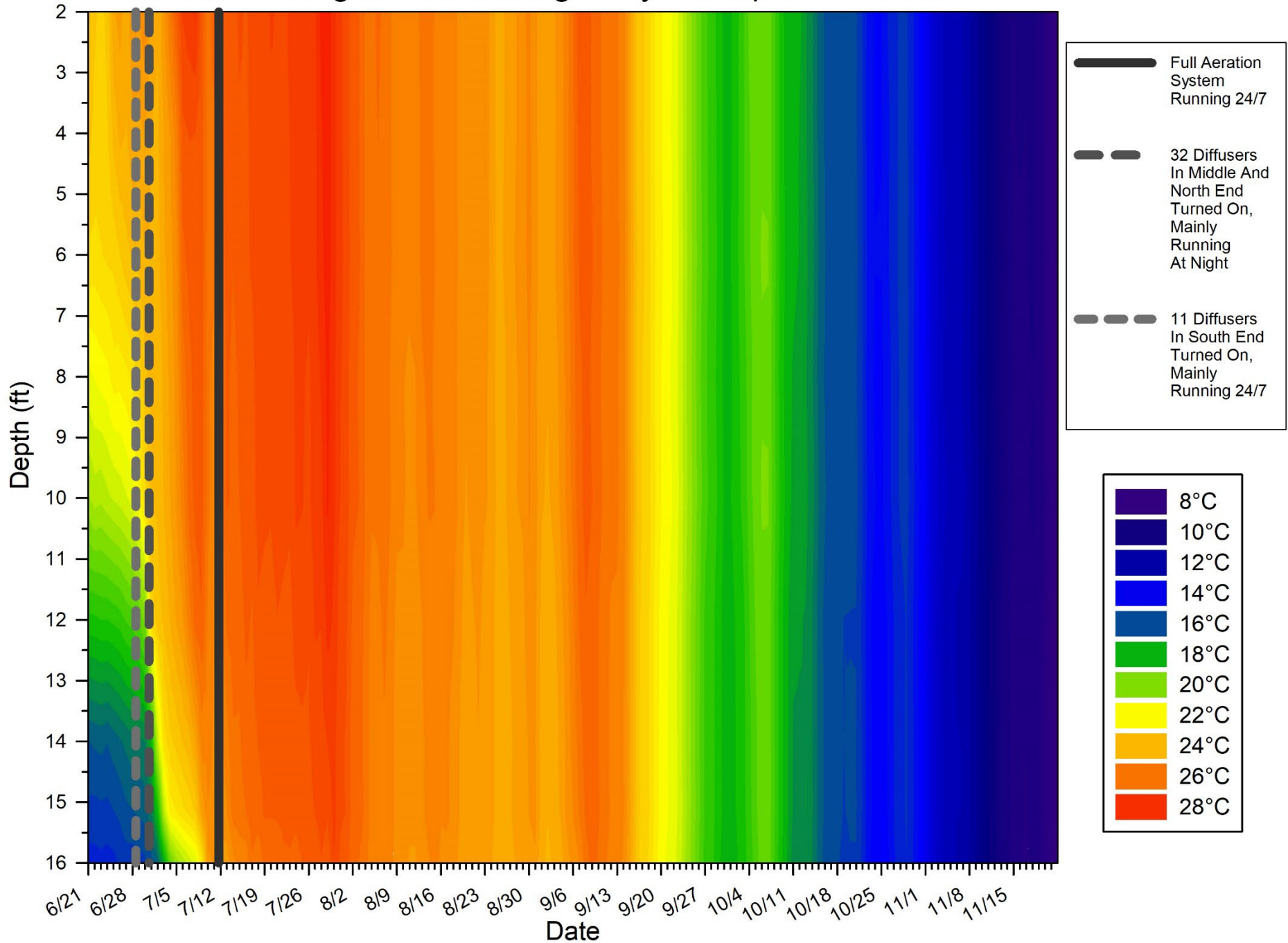
### Longer Term Initiatives

- Alum treatment ???
- Stormwater phosphorus mitigation
- Installing Sewer in balance of watershed

# **What has aeration accomplished?**

- **Eliminated thermal stratification**
- **Eliminated anoxic lake bottom conditions**
  
- **No evidence of decrease in total phosphorus**
- **No evidence of decrease in chlorophyll-a**

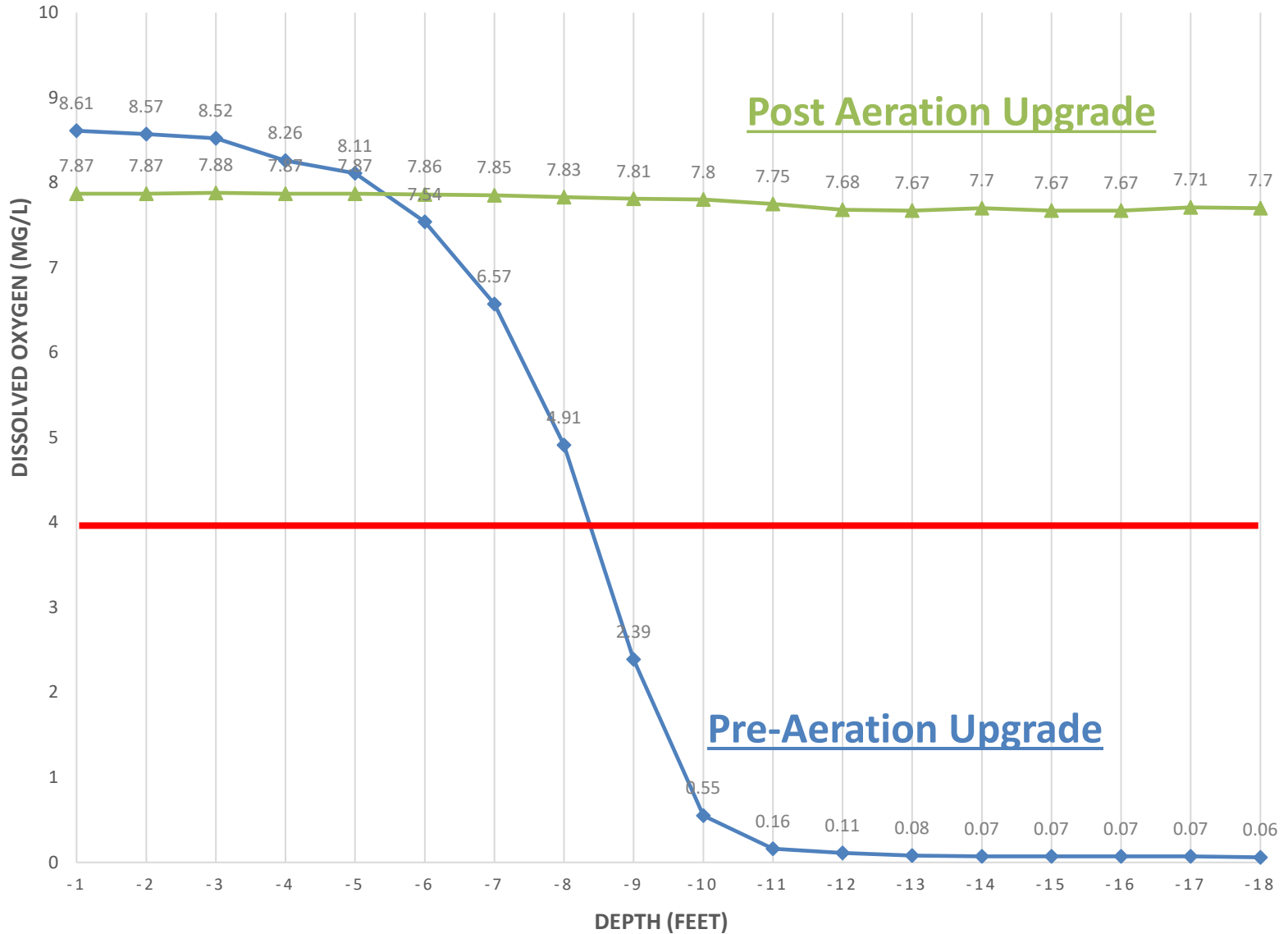
# Lake Mohegan - Monitoring Buoy - Temperature Profile



# DISSOLVED OXYGEN - BUOY 2

## PRE AND POST AERATION (AERATION STARTED 6/30/23)

◆ Dissolved Oxygen 6/28/23      ▲ Dissolved Oxygen 8/2/2023



# **What has aeration accomplished?**

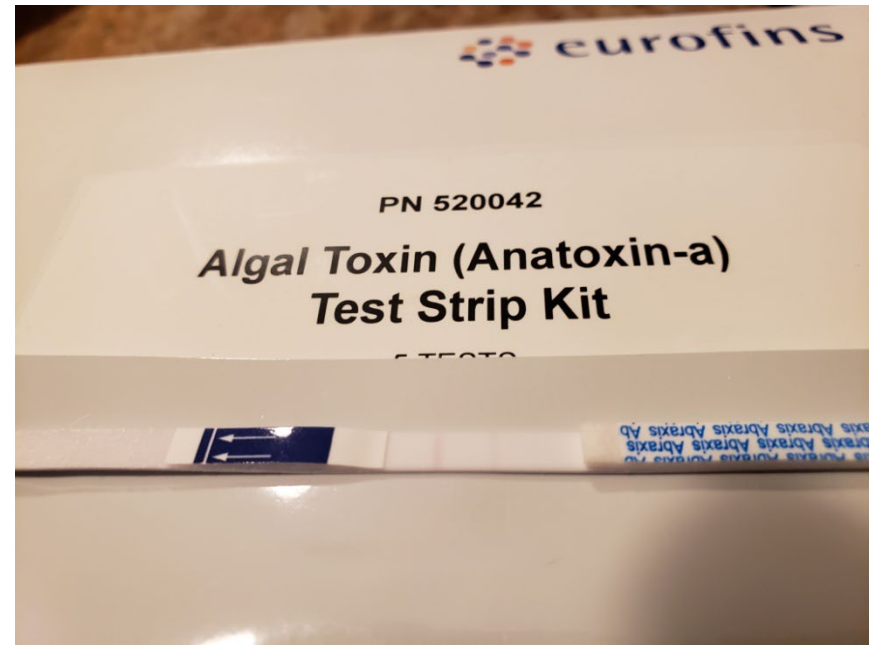
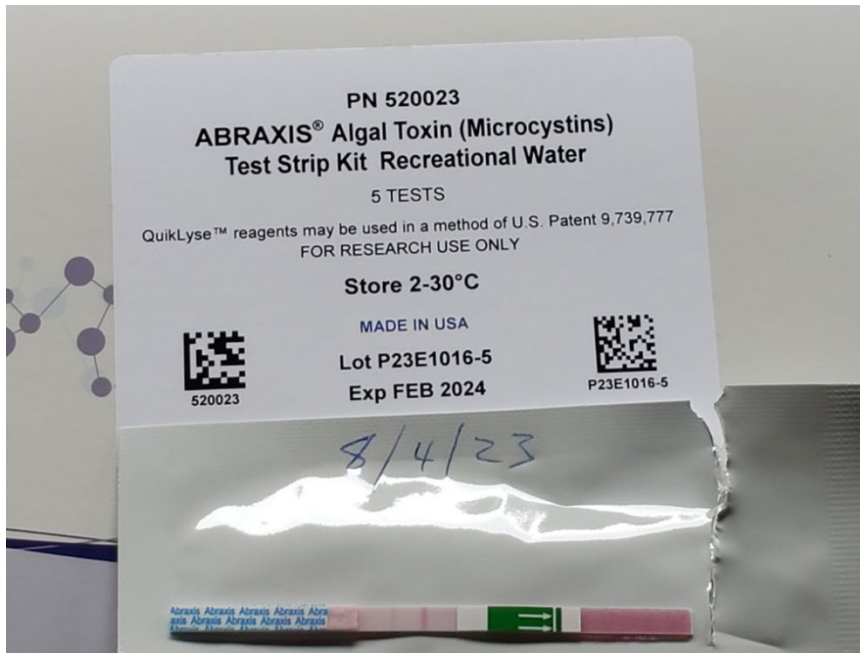
- **May have resulted in a healthier balance of blue green algae and green algae/diatoms**
- **May have resulted in a decrease in Microcystin toxin levels**

# 2024 Toxin Tests

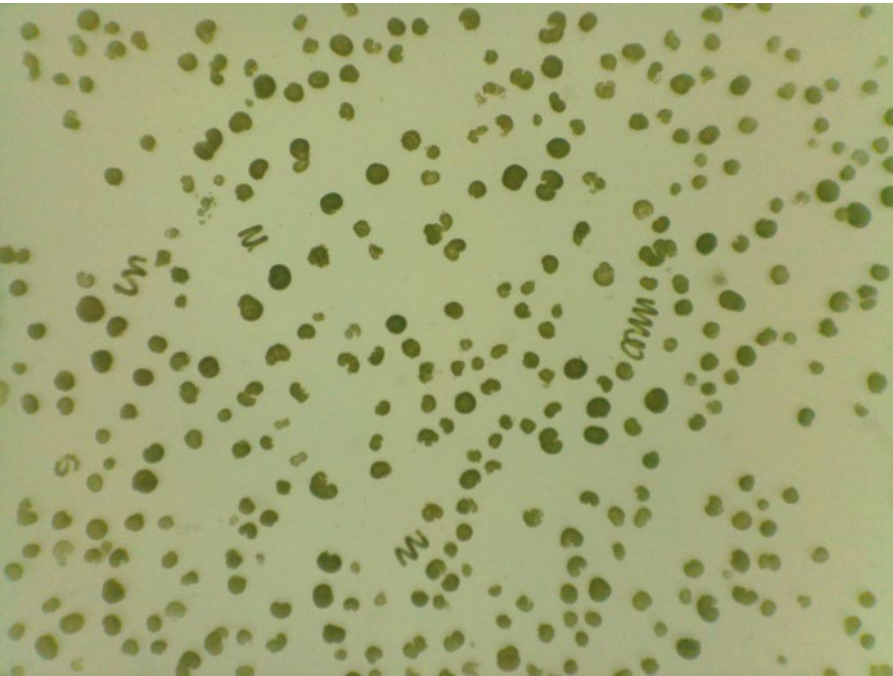
## Dates

## Toxin Results

7/5	Anatoxin-a Undetectable
7/20	Microcystin Undetectable
8/4	Microcystin & Anatoxin-a Undetectable

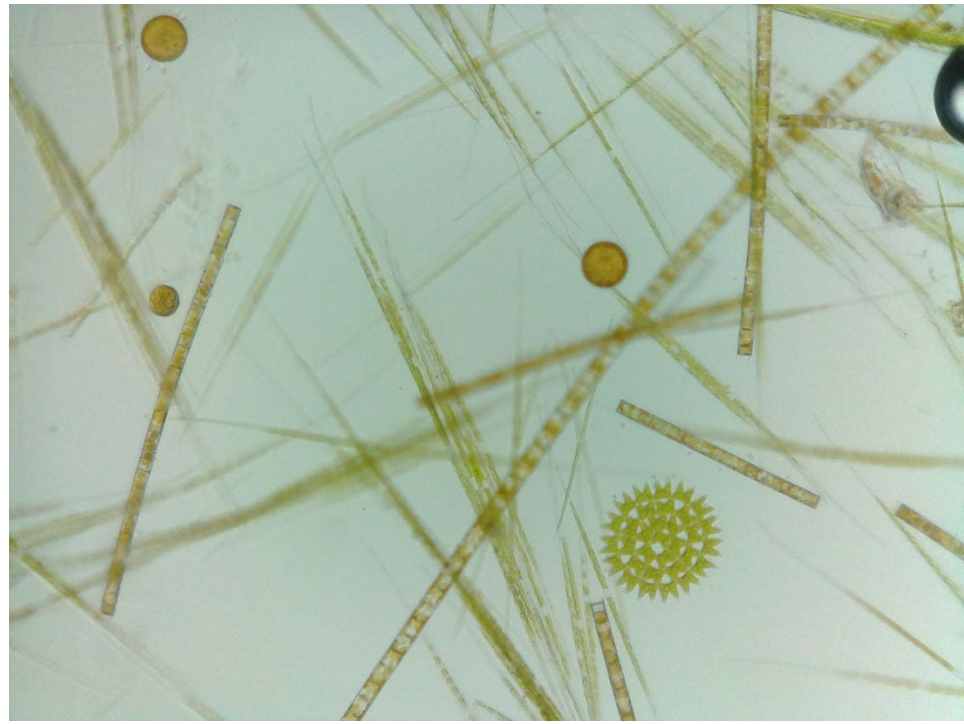


# Monitored Species Variations



**October 6, 2022**

**October 17, 2023**



# Biological Treatment System

- **Automated brewing system in 1,000 gallon tanks**
- **16 hour brewing cycles**
- **Lake bottom injection via 10,000 feet of self-weighted tubing**
- **Natural bacteria that ideally will eat away at nutrient rich organic muck and deepen lake**
- **We will do an in depth study to measure impact**
- **If we get DEC permits (pending), EverBlue Lakes will be the installer**

# Mohegan Lake Proposed Biological Treatment System

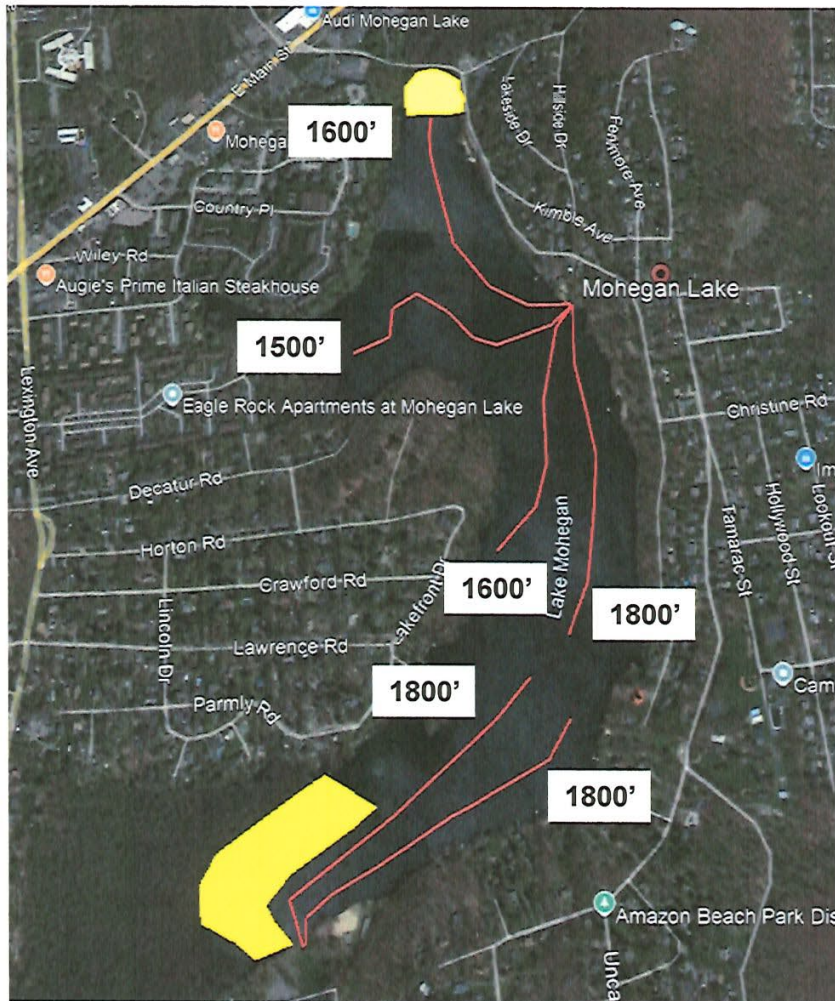
## Section View



## Field Installation Example



## Treatment Distribution & Application



Two systems will deliver treatment through six distribution lines. Each distribution line will have a series of pressure regulated emitters that will distribute the treatment evenly along that line with an emitter located an average of 125 to 150 feet apart depending on individual line length.

A total of 10,100 linear feet of airline and 75 emitters will be installed as indicated in the drawing.

# Longer Term Initiatives

## Nutrient Inactivants to Bind Phosphorus

### 2002 Alum Treatment

Reduced Phosphorus Levels in Lake

Significant increase in water clarity

Positive affect began to fade by 2003

Followup studies indicated dose was insufficient

### 2019 Alum Pilot by DEC

Minimal positive impact

Dose used was approximately 16% of the 2002 treatment

We believe the dose was less than 10% of an effective dose

**DEC still studying Nutrient Inactivants and  
not providing permits for its use**

# **Longer Term Initiatives**

## **Stormwater Phosphorus Mitigation**

**Hundreds of Catch Basins Around Lake**

**Catch Basin Inserts with Phosphorus Filtration**

**Cartridges Installed in Ten Catch Basins Thus Far - It's a Start!**

## **Sewering the Watershed**

**About 65% of the Watershed has been Sewered**

**Balance will be very challenging!**

**High Phosphorus Levels May Remain in Groundwater for a Long Time!**

# Citizen Science Assessments

CSLAP (of course!) and other efforts

We continue to monitor impacts and conditions



A scenic photograph of a sunset over a body of water. The sky is filled with soft, horizontal bands of orange, pink, and light blue. In the foreground, the dark silhouettes of trees and bushes frame the scene from the top and sides. The water in the lower third of the image reflects the colors of the sky.

# Questions?

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