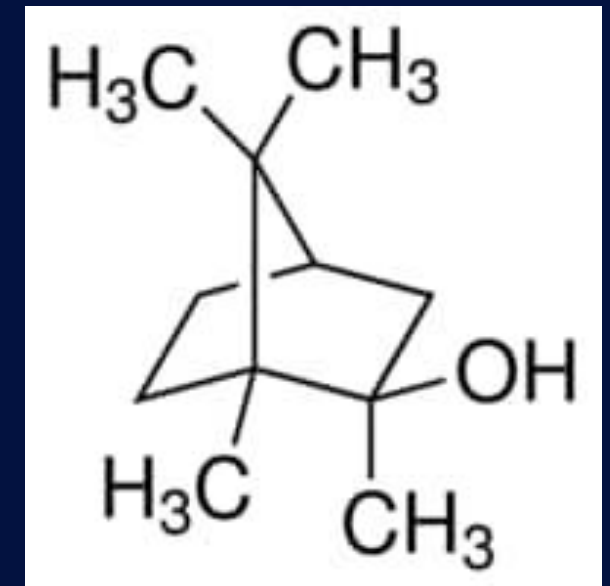
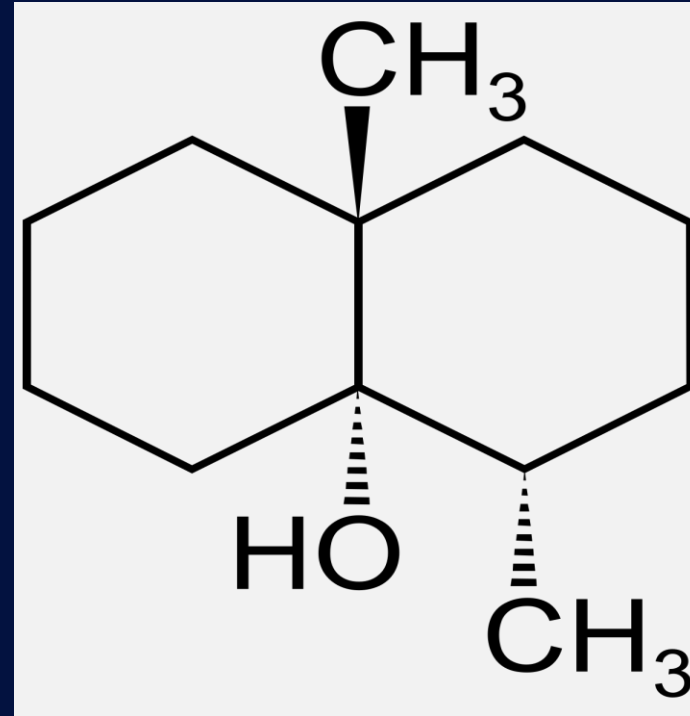


Using Actionable Data to Achieve Successful HAB Control



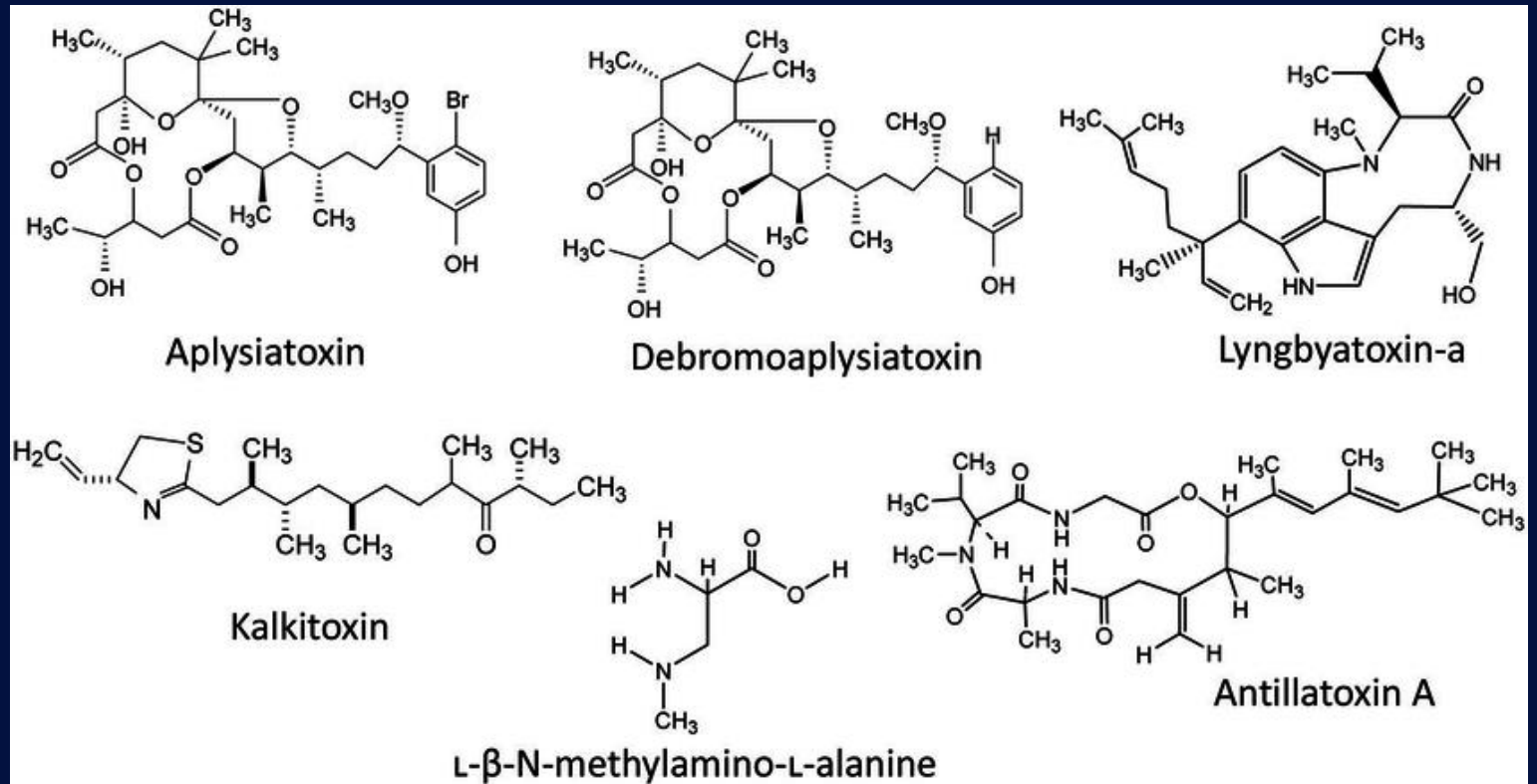
Algae Causes Foul Taste & Odor

- More than 200 taste and odor compounds associated with each type of algae!
- Methylisoborneol (MIB) & geosmin are common
- Descriptions: fishy, earthy, muddy, rotten, bitter, swampy, musty, septic, vile, sewage...
- Adsorption media (GAC) to remove



Algae May Contain Toxins

- Cyanobacteria (blue-green algae) contain cyanotoxins, most commonly microcystins, cylindrospermopsin, anatoxins and saxitoxins
- Hazardous to humans and animals
- Effects may include skin irritation, stomach cramps, vomiting, nausea, diarrhea, fever, sore throat, headache, muscle and joint pain, blisters of the mouth and liver damage



Algae Affects Water Chemistry

- Algae affects pH (both alive and dead)
- Algae affects dissolved oxygen (both alive and dead)
- Algae increases total suspended solids (regardless whether alive or dead)
- All these issues, plus taste, odor, and toxins, present problems whether a reservoir is only used for drinking water supply, or is also used for recreation



Fouling and Adsorption Issues

- Treatment process: pumps → filter(s) → granular activated carbon (GAC)
- Algae as TSS foul pumps, filters, & media = downtime, backwash, possible damage, & replacement/recharge
- Taste, odor, and toxin compounds adsorb onto media = shorter media life, possible breakthrough
- Water chemistry (esp. dramatic change) affects operation of adsorption media = possibly reduce efficiency, cause breakthrough, shorten media life, or even *large-scale desorption*
- All of these issues = increased cost & risk, unhappy stakeholders

Traditional Algae “Control”

Chemical Methods:

- Unintended impacts on chemistry, processes, and environment
- Handling/environmental hazards
- May cause pollutant accumulation
- Require re-application
- May contribute to sludge buildup, requiring future dredging
- May require third party to be on-site (potential issues re: site access and liability)

Mechanical Methods:

- Mixing/aeration have limited efficacy (may provide no improvement at all)
- High power & maintenance requirements
- May release additional nutrients



Ultrasonic Algae Control

Monitor – Predict - Control



Monitoring Parameters:

- pH
- Turbidity
- Dissolved Oxygen
- Temperature
- Chlorophyll-a
- Phycocyanin
- Others as customer desires

Why Monitor in Real-Time?

- Shifting from reactive to proactive water management
- Tackle problems before they occur
- Know the concentration and distribution of algae in a water body
- Apply the most cost-efficient and effective treatment
- Insights into algae & water trends



Academic Research Focused on Key Bloom Variables

- Understand the reactions in the benthic zone
- Dissolved oxygen levels

New Water Quality Monitoring Products

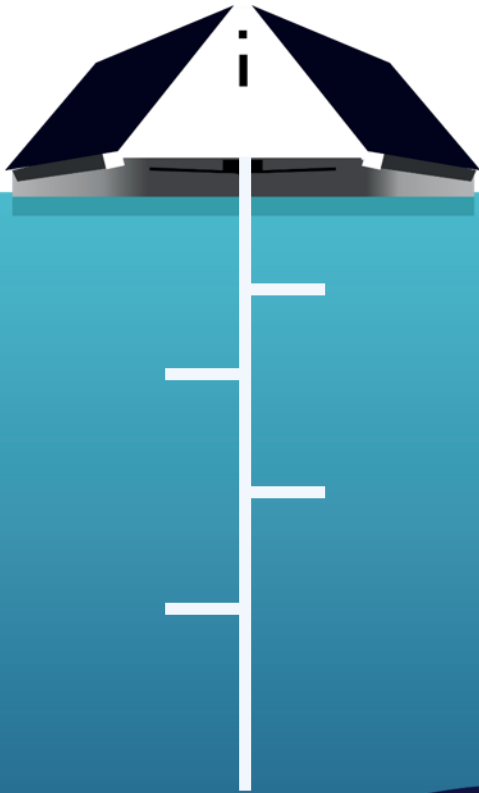
- **Phosphate Sensor**
- **Vertical Profiler**
- **Weather Station**
- **Prediction Models**

Phosphate Sensor

- Measures PO_4 at different depths for a detailed vertical profile of phosphate concentrations
- Measure the seasonal phosphate release from the sediments
- Winch allows configuration of different depths, which enables flexibility and custom utilization of the vertical profiling as per customer requirement
- Reagents and waste are contained within the system and replaced at regular intervals



Vertical Profiler



- Measures in high resolution
- Collects data at different depths
- 50% more affordable than other profilers on the market
- Data is transmitted through 4G or satellite to the MPC-View online software
- Maintenance can easily be done from a boat - No need to step onto the buoy or bring it back to shore

Vertical Profiling Specs

- Minimum profile depth 300 mm [1']
- Maximum profile depth 100 m [330']
- Weight: 11 kg [25 lbs.]
- Operating temperature: 0 to 50 °C [32 to 122 °F]
- Operating humidity: 0 to 95% RH
- Ingress protection: IP65



Weather Station

- Wind speed
- Wind direction
- Air temperature
- Humidity
- Pressure
- Dew point
- Wet bulb temp
- Precipitation
- Solar radiation

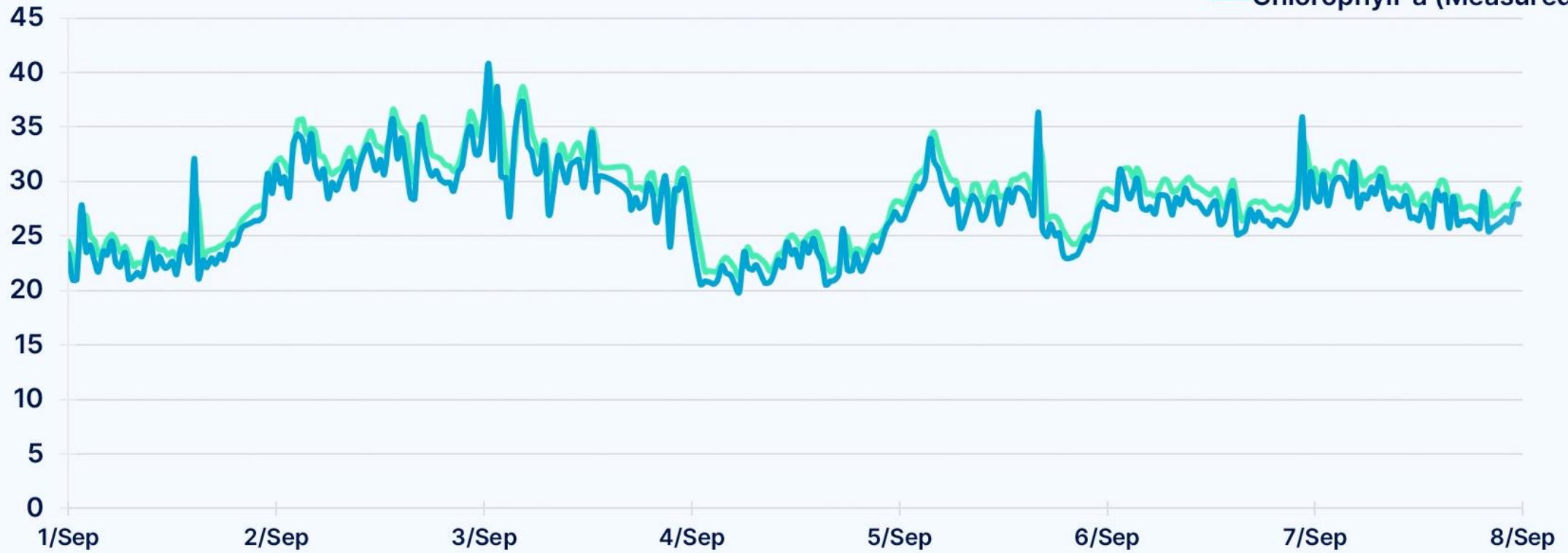


Prediction Models

- Effective algae control starts with prediction
- Data from MPC-Buoys all over the world
- Data collected for 10+ years

aLG-ai

— Chlorophyll-a (Predicted)
— Chlorophyll-a (Measured)

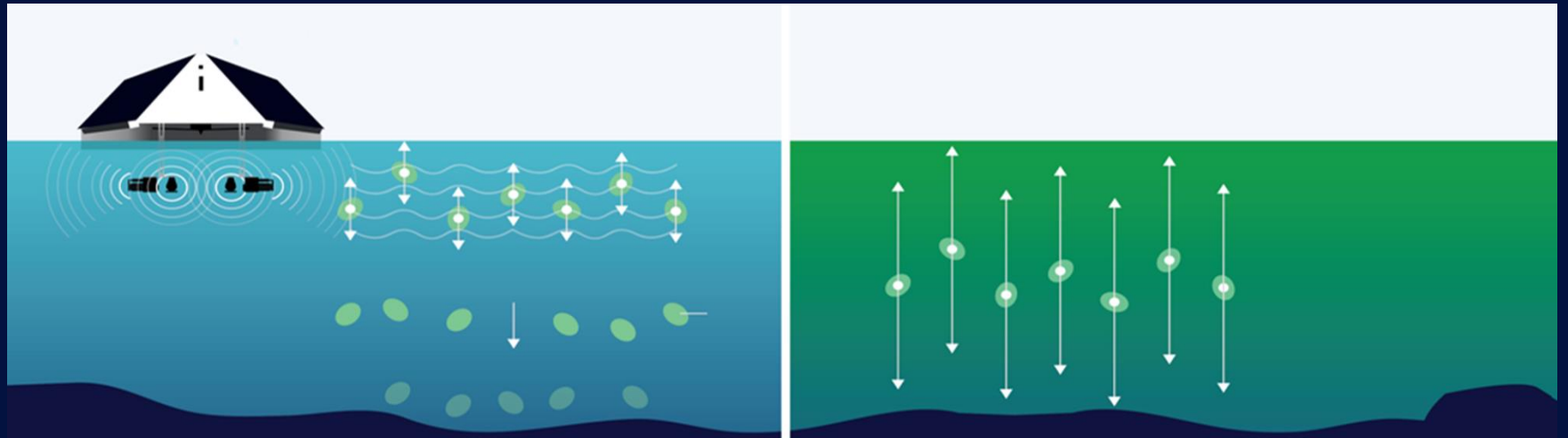


Value of Data-Driven Water Management

- Dramatically improve efficacy of algae control (and therefore, cost-savings) by targeting and predicting
- Valuable data provides powerful insights, both real-time data and historical trends
- Powerful tools for decision-making (example: PO₄ coming from sediment or non-point source, answer may determine approach to nutrient reduction efforts)

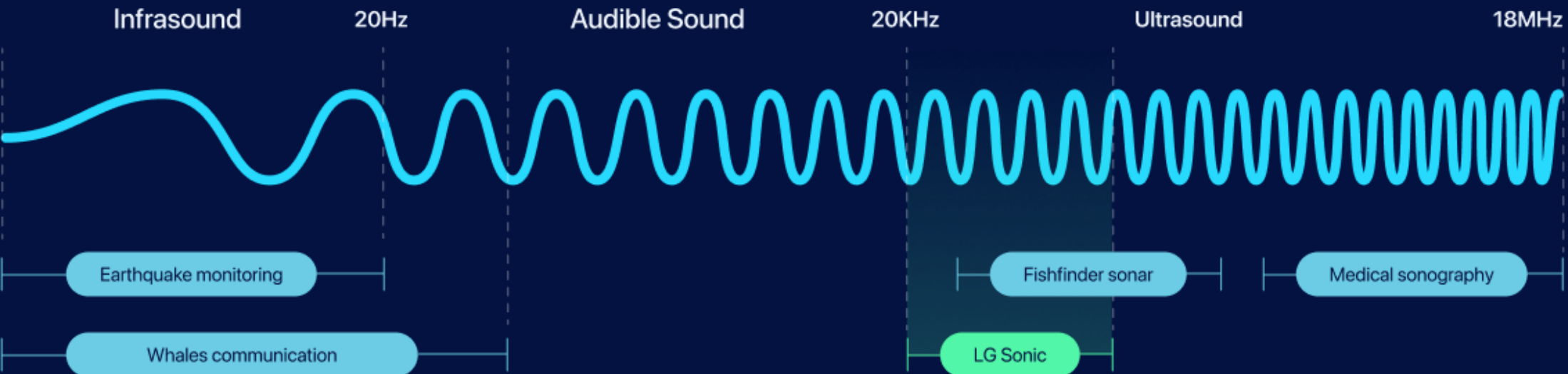
Ultrasonic Algae Control

- Ultrasound works by preventing algae from rising up in the water column, starving them of sunlight & photosynthesis
- The ultrasonic waveforms used for treatment should be varied periodically in order to target the algal species present (thereby optimizing treatment results) & to avoid any potential treatment resistance later
- Ultrasonic treatment is best used when informed by water quality monitoring



LG Sonic Ultrasound

- Ultrasound has been used in a wide array of industries for decades
- At specific frequencies, it can be used to control algae growth
- Our low-power ultrasound does not cause cavitation
- Safe for people, pets, aquatic life, and the environment



Case Study: Town of Superior, Colorado

- Problem: Algae causing major taste & odor issues, negatively impacting ops



- Results: Within 2 weeks of install, turbidity & pH both decreased
- Chlorophyll-a reduced 90%
- Influent turbidity remained < 1 NTU
- Geosmin remained < 9 ng/L
- Eliminated PAC usage = **\$27,000 annual savings**
- ZERO taste and odor complaints

Case Study: City of Johnstown, Colorado

- Problem: Algae causing major taste & odor issues, negatively impacting ops
- Historically, water was poor-tasting, known to become very “fishy” near the end of summer each year

Johnstown, CO



- Results: Within 2 weeks of install, turbidity decreased, remained < 1 NTU
- Chlorophyll-a reduced 90%
- Geosmin reduced from 1000-1300 ng/L to 5-6 ng/L (**99.5% reduction**)
- Eliminated one GAC media change per year (**\$120,000 annual savings**)
- ROI < 1 year
- ZERO taste and odor complaints (citizens took to social media to question why/how the water wasn't “disgusting”)

Case Study: City of Archie, Missouri

- Problem: Algae was negatively impacting operations, causing DBPs due to treatment, potential for taste & odor, an eyesore that caused public concern
- Algae caused post-treatment turbidity to exceed allowable limits
- Needed to reduce chemical usage: copper was accumulating, potassium permanganate ineffective
- Concerned authority having jurisdiction (AHJ)

- Result: Within 1 month, algae concentrations dramatically reduced
- Operations improved
- Public “amazed” at condition of lake
- Satisfied AHJ, increase public water usage

Issue/Parameter	Before using LG Sonic's	After using LG Sonic's	Comments
	MPC-Buoy	MPC-Buoy	
Influent Turbidity (To Plant)	0.9 - 1.2 NTU	0.3 - 0.4 NTU	65.3% reduction
Effluent Turbidity (Post-Treatment)	0.1 - 0.2 NTU	0.05 - 0.09 NTU	53.3% reduction
Filter Runtime	12 h	36 h	300% increase
Backwash Water Volume over 3 days (Waste, Requiring Makeup Treatment)	39.7 m ³ [10,500 gal]	13 m ³ [3,500 gal]	66.7% reduction
Avg. Daily Water Usage	280-400 m ³ /day [75-100 kgal/day]	320-420 m ³ /day [85-110 kgal/day]	10-13.3% increase

Q&A Session

Or send us an email:
info@lgsonic.com

Thank you for your time!