

# PREVENTING TOXIC CYANOBACTERIA BLOOMS IN RESERVOIRS WITH SOLAR-POWERED DESTRATIFICATION

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# SOLAR POWER FOR HYDRO RESERVOIRS



Grand Lake O' the Cherokees, Oklahoma, USA



Urra Dam, Cordoba, Colombia

- Pioneer & leader in floating solar PV (FPV) project development and technology
- Founded in 2018 - based in Sausalito, CA
- Our mission is to deliver cost-effective and resilient FPV systems to customers with complex needs.

## Project Development

We specialize in designing and developing complex, first-of-a-kind, largest-of-their-kind FPV projects.



## Technology and R&D

Our R&D team develops technology and solutions that improve FPV performance, lower costs, and reduce industry barriers, driven by our customers' needs.

### Industry-Leading Financial Backing



Greenbacker™



U.S. DEPARTMENT OF  
**ENERGY**

- Oklahoma's Largest Public Electric Utility
  - Established in 1935
  - Manages over 70,000 surface acres of premier Oklahoma Lakes as well as the Oklahoma Scenic Rivers
- 5 E's
- Grand Lake O' the Cherokees
  - Pensacola Project (P-1494)



# WATER QUALITY MISSION

- Environmental Stewardship
  - “Protect the quality of the water in the Authority’s Lakes and Streams”
- Grand Lake is an extremely popular recreational destination in Oklahoma.
  - 3 Bassmaster Classics in the last 10 years
  - 4,735 Private Docks
  - 345 Commercial Docks



# FLOATING SOLAR PV (FPV)



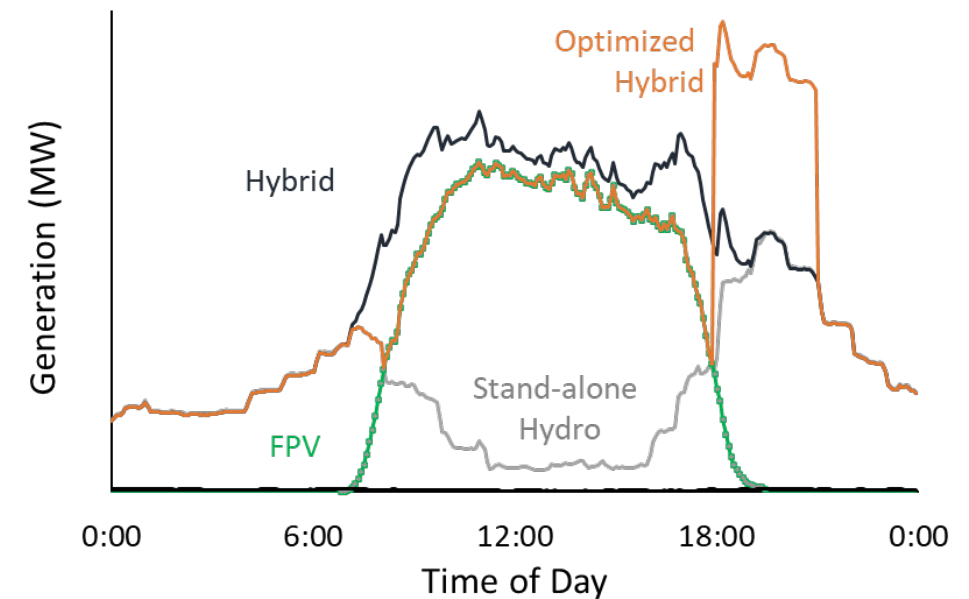
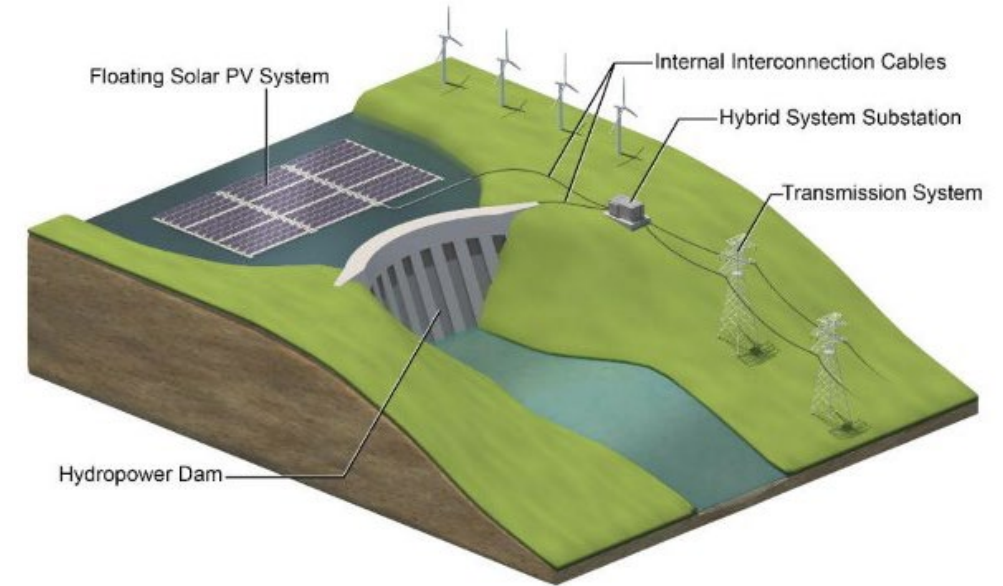
Solar arrays on inland bodies of freshwater using standard solar equipment & plastic floats

FPV is the best energy solution for customers where:

- Land is scarce and/or valuable
- Water is a critical resource for operations

# FPV & HYDRO ARE COMPLEMENTARY RESOURCES

- Shared electrical infrastructure
- Seasonal compatibility
- “Virtual” battery for dispatch optimization
- Reduced evaporation through shading



# EXAMPLES OF FPV + HYDRO AROUND THE WORLD



Santa Maria  
Brazil



Urrea  
Colombia



Alqueva  
Portugal



Sirindhorn Dam  
Thailand



Ubol Ratana Dam  
Thailand



Bui Dam  
Ghana



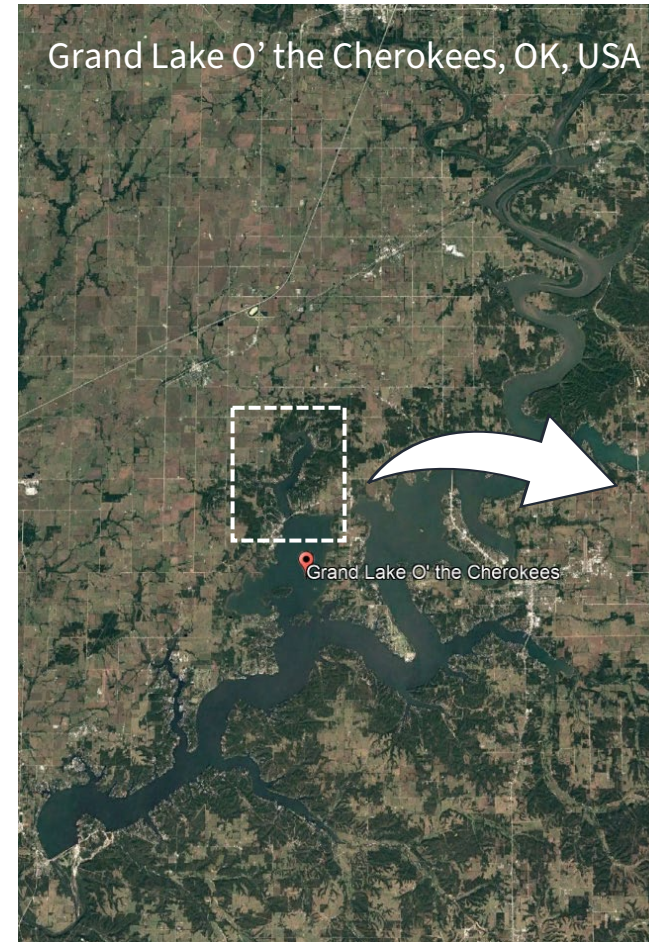
# OPPORTUNITIES TO IMPROVE WATER RESOURCES

- Power localized water treatment loads (e.g., aerators, mixers, pumps)
- Excellent for off-grid applications – can be paired with energy storage



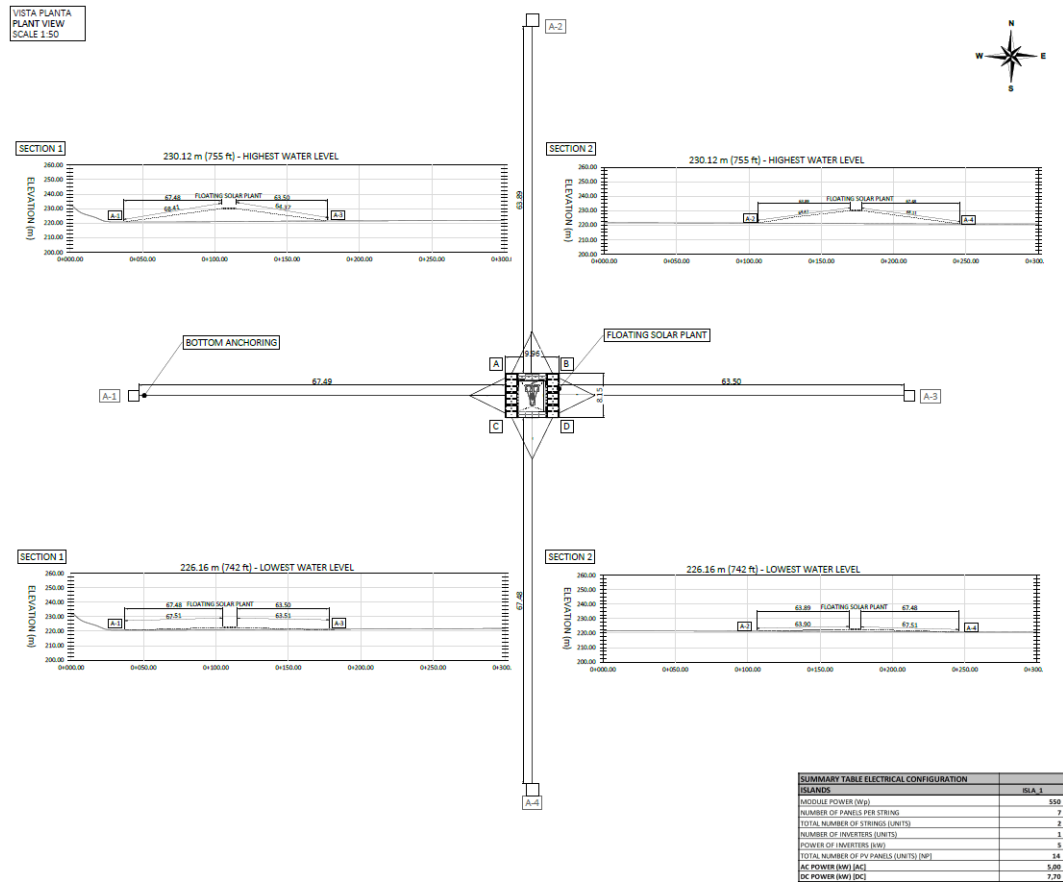
# HORSE CREEK DESTRTATIFIER

- Installed in November 2023
- 5.7kW<sub>dc</sub> floating solar array
- Integrated 3HP mixer



# DESIGN & CONSTRUCTION

- Assembled onshore & towed to final location
- Secured with 4 bottoms anchors

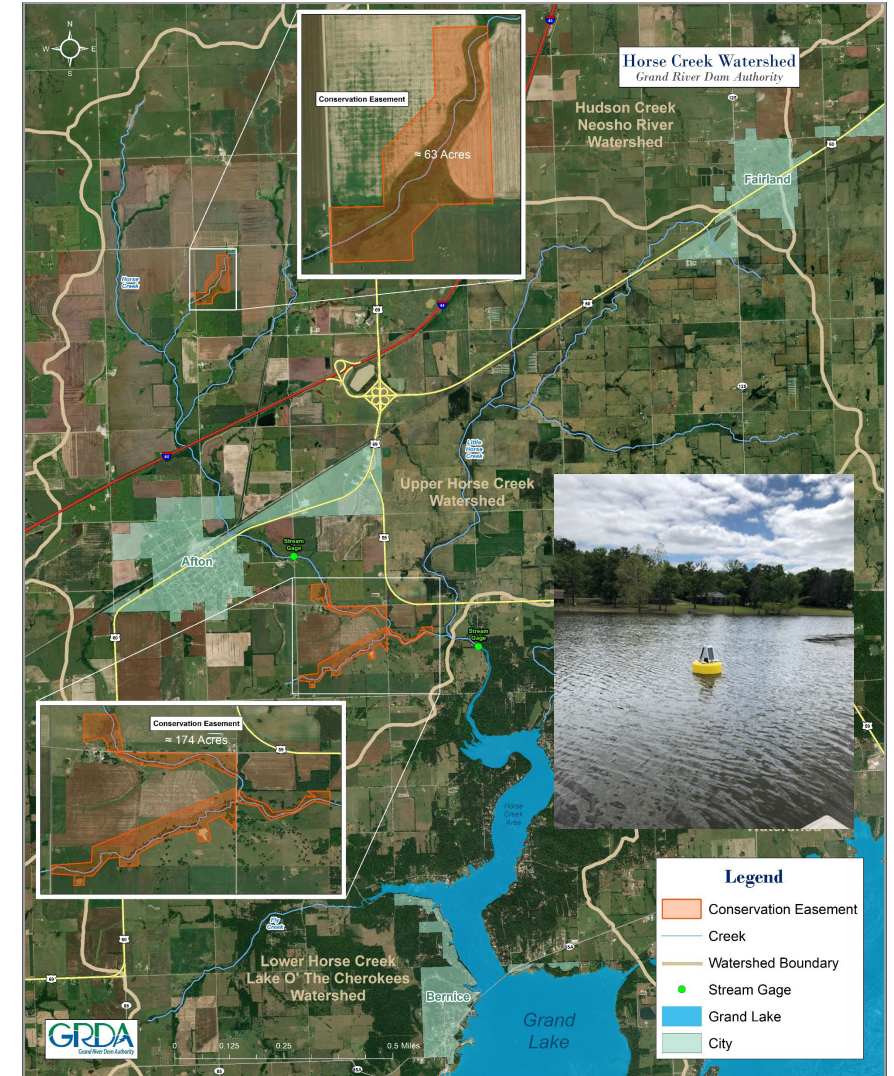


# HORSE CREEK – HARMFUL ALGAE BLOOMS

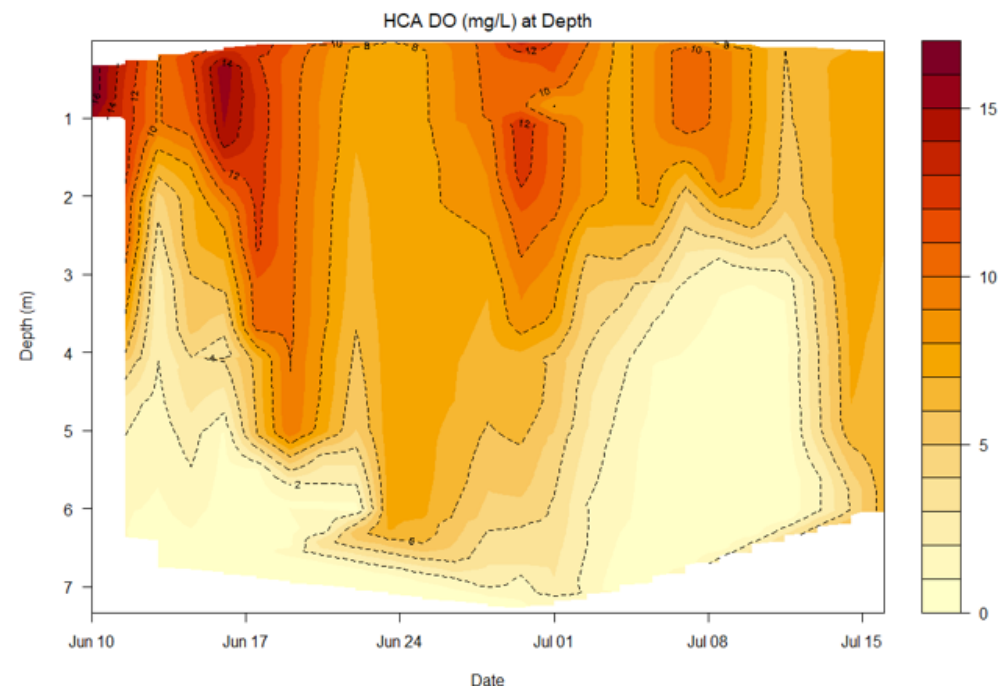
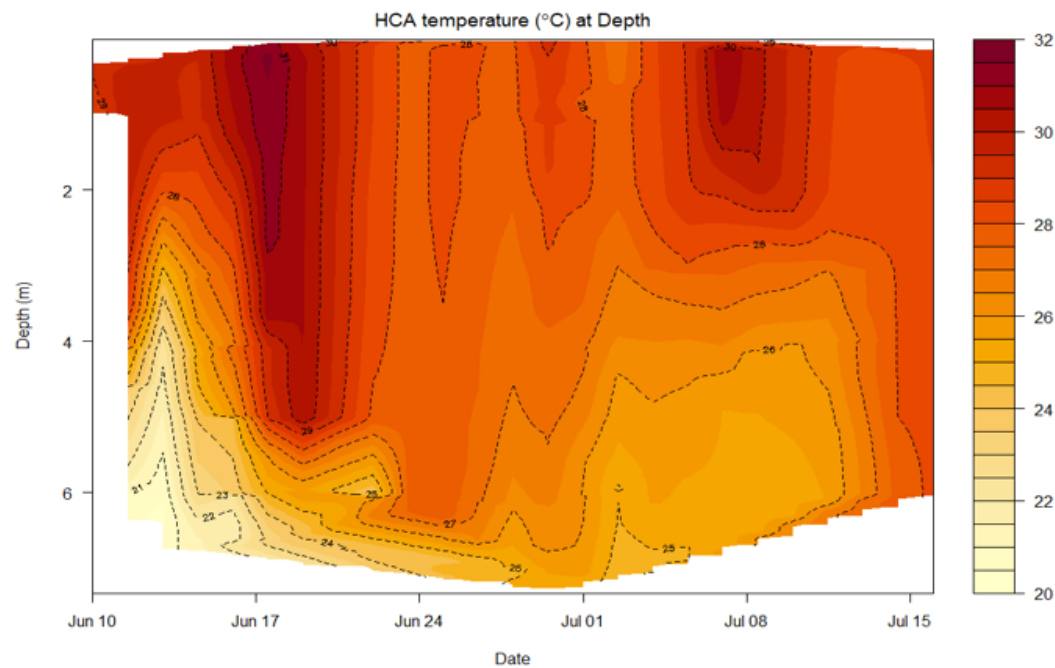
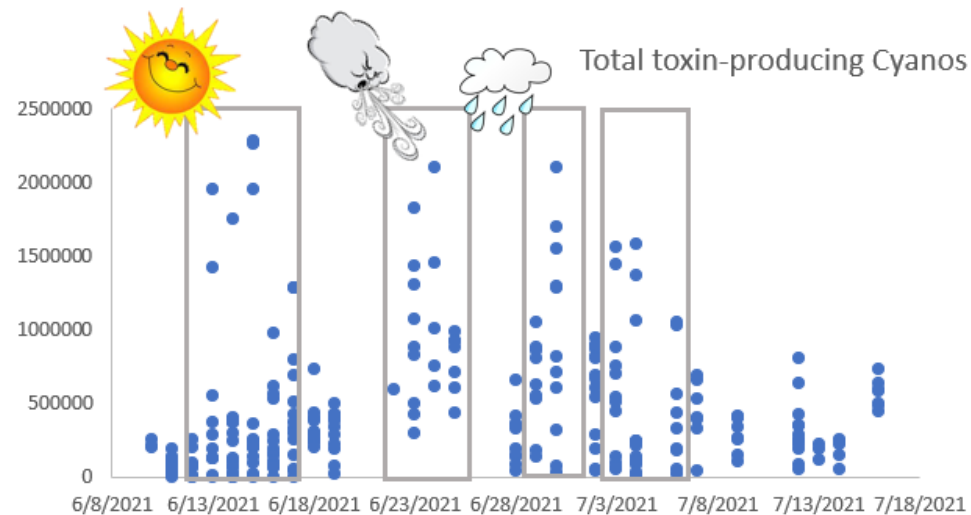
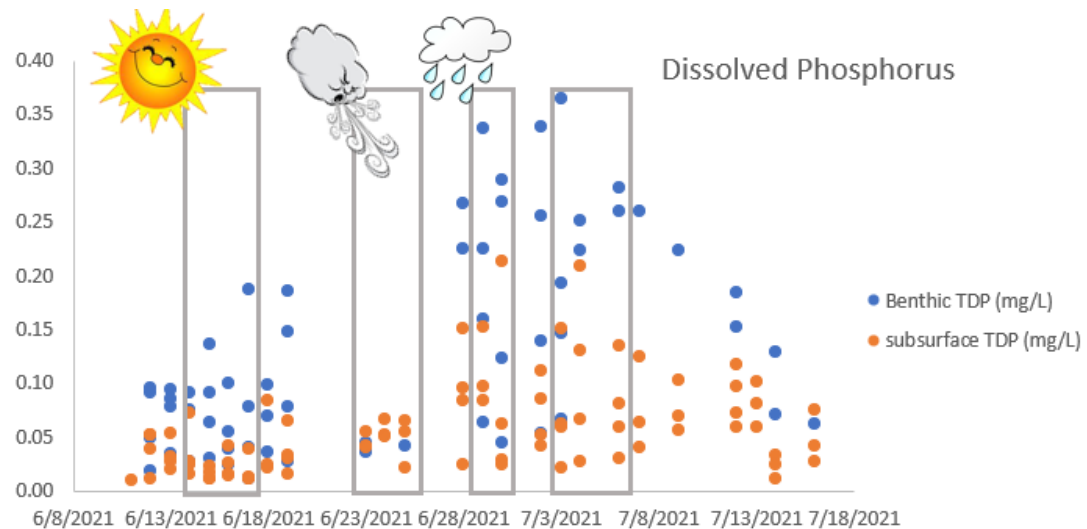


- Recurring problem since 2011
  - 2011, 2016, 2018, 2021
- Horse Creek is a microcosm of various water quality stressors
  - Row Crop & Production Ag
  - WWTPs
  - Shoreline Development
  - Unique position

- Robust monitoring and detection program
- Watershed Conservation Easements (GRDA & OCC)
  - Fence out Buffers to exclude cattle/intercept runoff
- Septic Tank Replacement Program (GRDA & ODEQ)
- In Lake Research and Development (GRDA, OSU & OU)

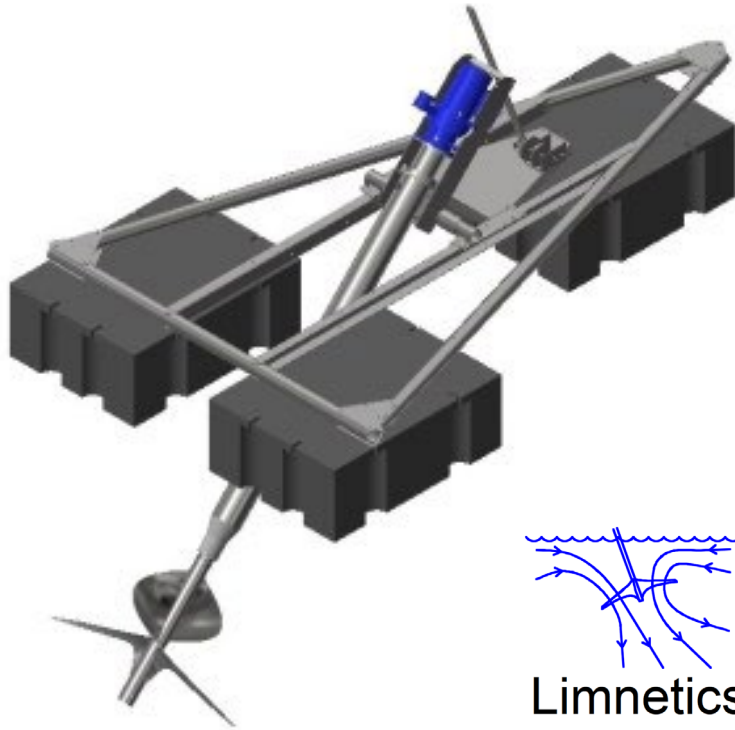


# CONCEPTUAL MODEL

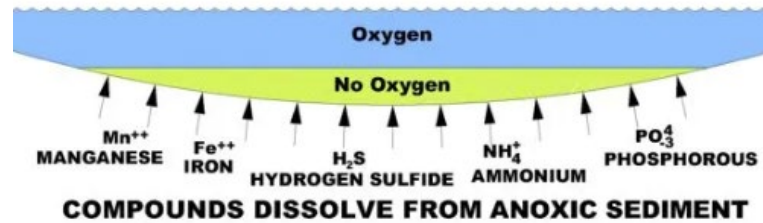


# THE LAKE DESTRATIFIER

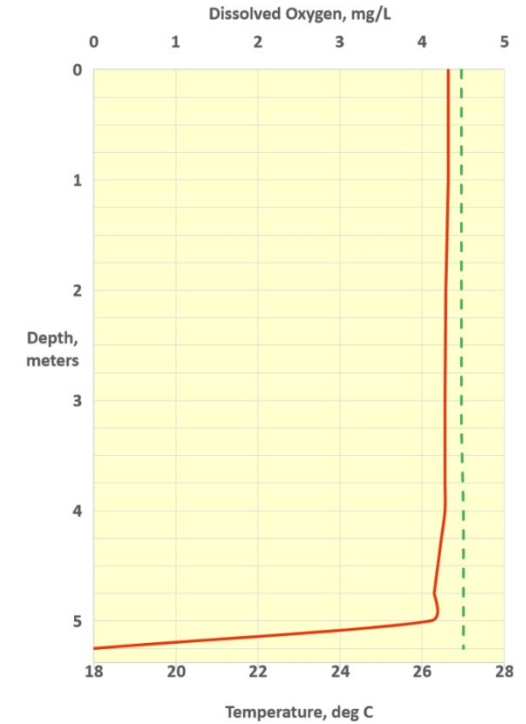
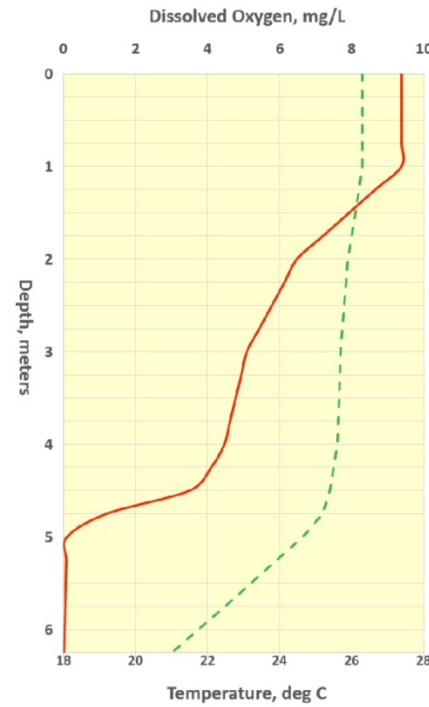
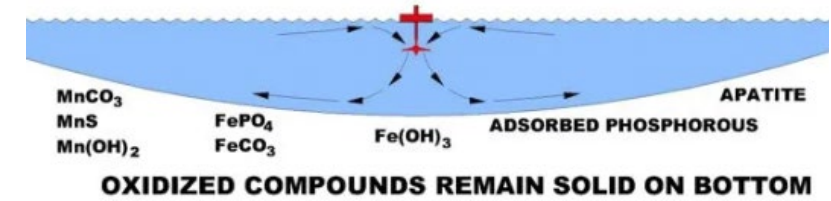
3HP Motor



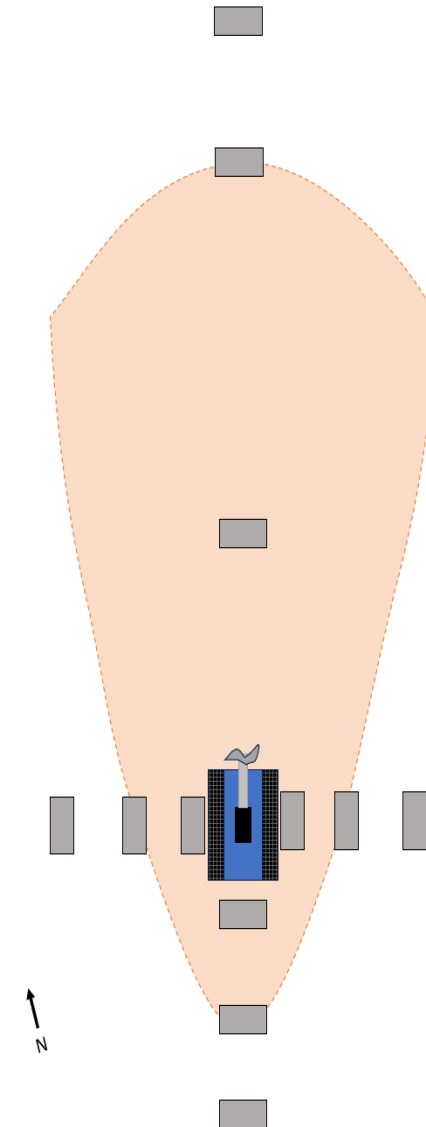
## THE PROBLEM



## THE SOLUTION

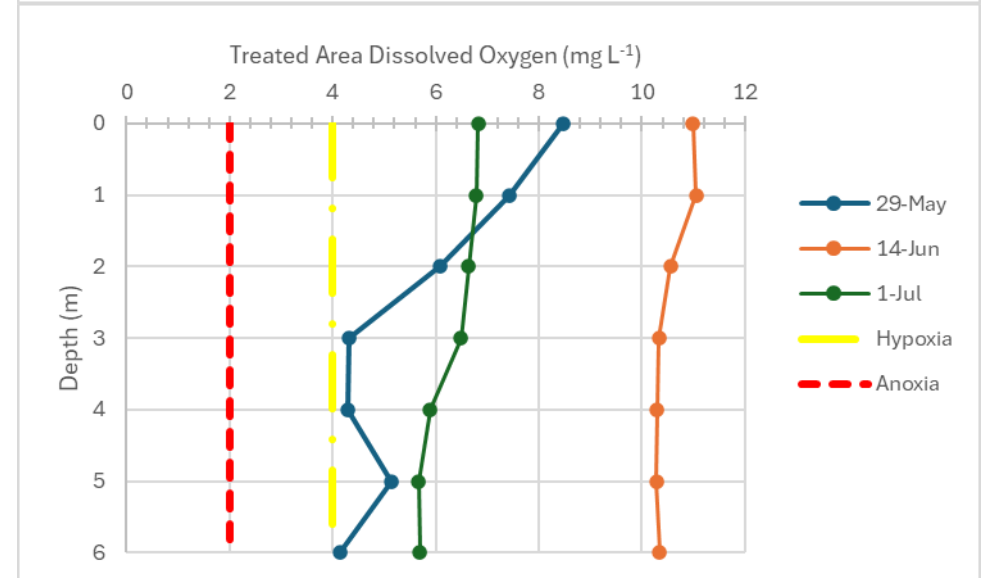
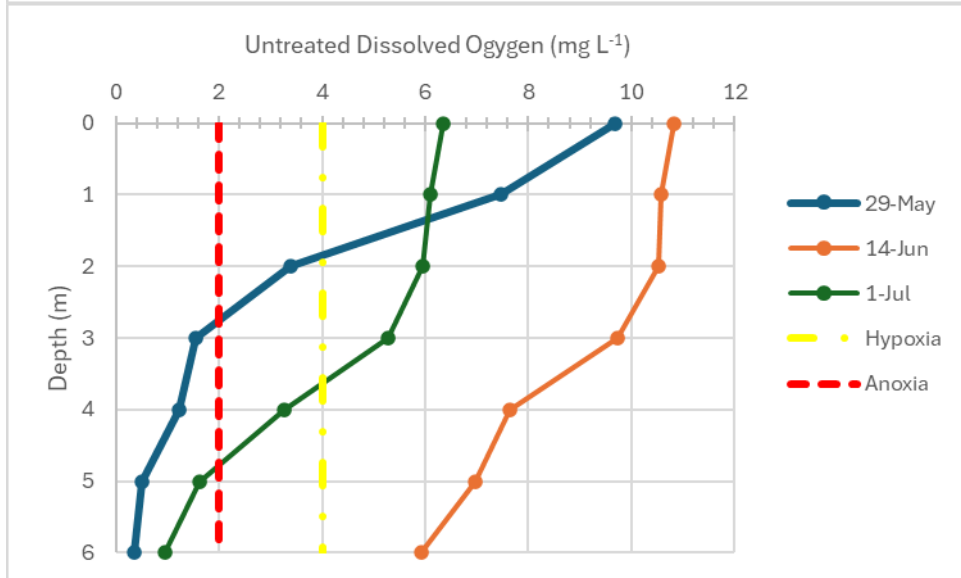
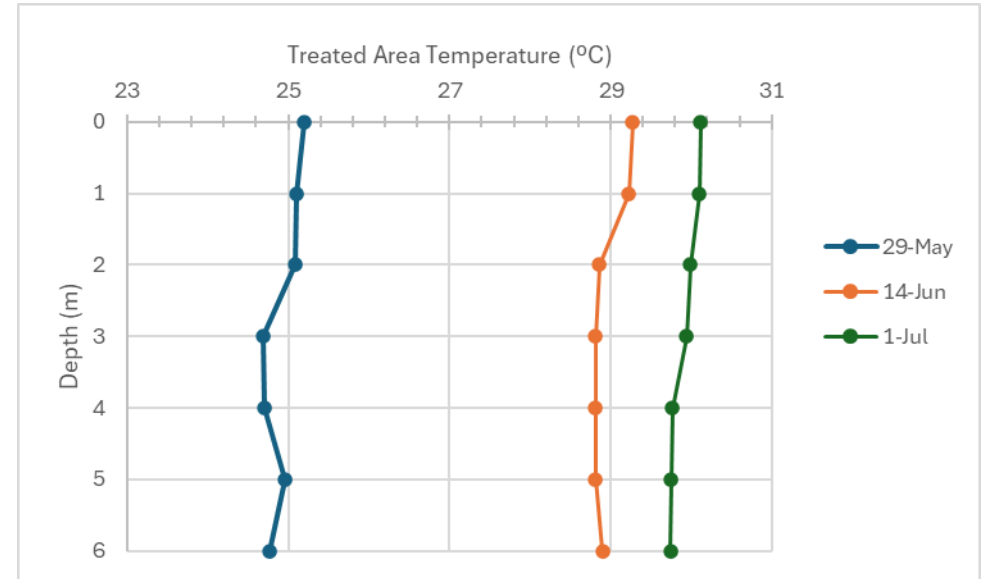
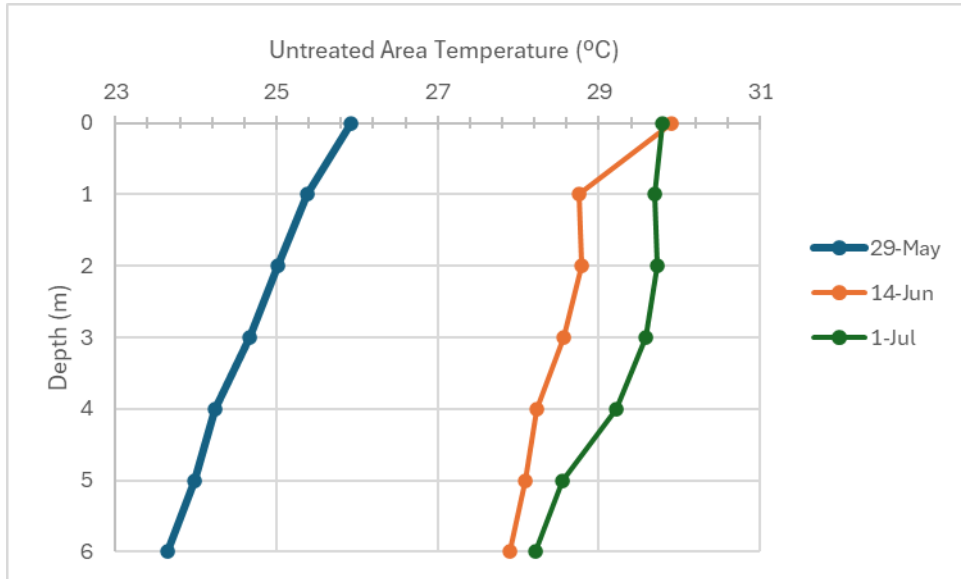


- Destratifier Positioned on large flat with silt bottom with a depth of 6m (20 ft)
- Realtime WQ buoys located in the treatment area and untreated area
- Weekly Water Quality sampling at stations (grey boxes)
  - Vertical profiles
  - Nutrients (surface and bottom)
  - Algae and Zooplankton



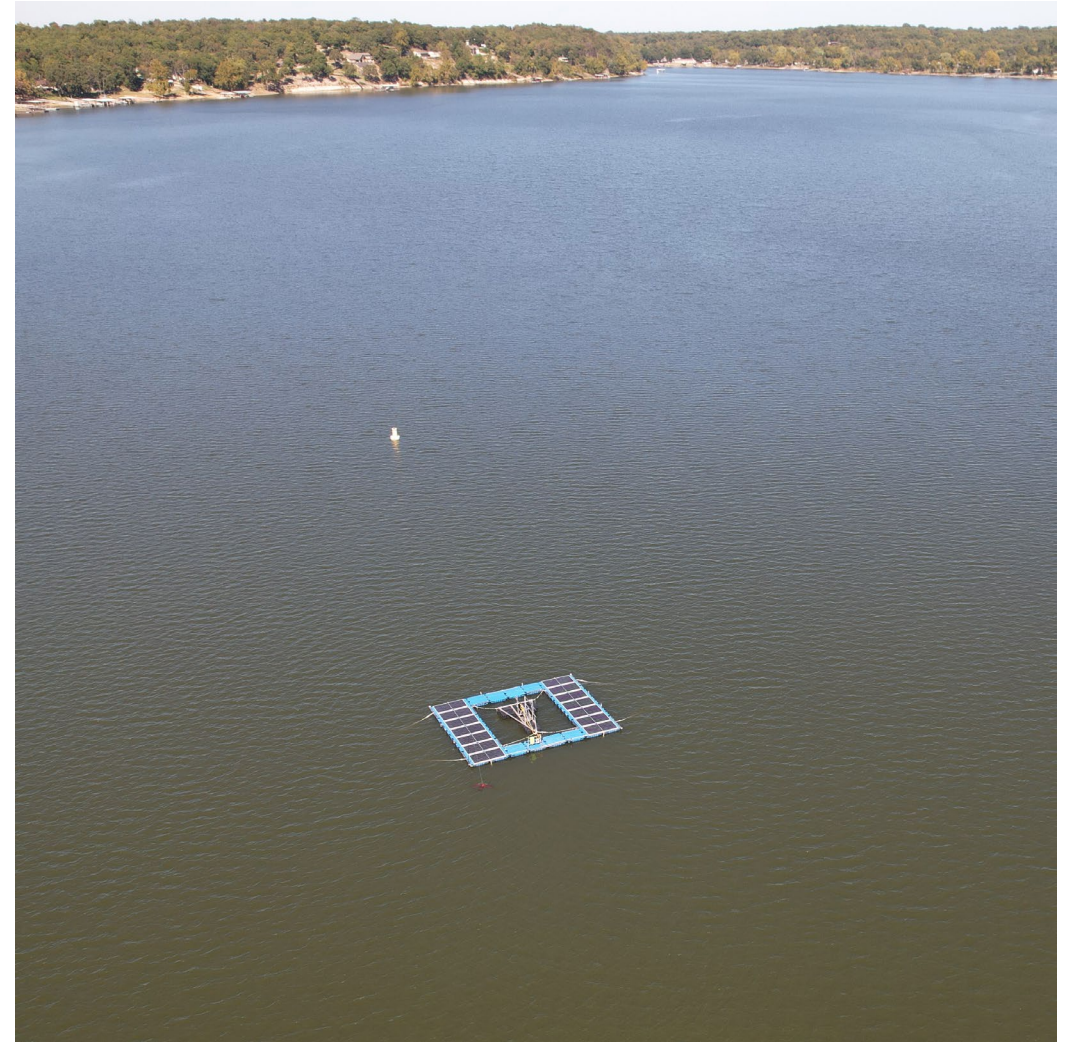


# PRELIMINARY DATA REVIEW



# FUTURE DIRECTIONS

- Continue mixer operation and water impact study through rest of summer and beyond
- Experimenting with the angle of the mixer with respect to the water surface
- Testing different orientations of the mixer relative to the shape of Horse Creek
- Considering the addition of a battery pack for 24-hour operation



- Powering other water treatment technologies
  - e.g., diffused aeration/oxygen injection, pumping
- Other types of water bodies (e.g., balancing reservoirs, wastewater ponds, etc.)
- Electric boat charging stations



## AquaPV: Regulatory and Environmental Considerations for Floating Photovoltaic Projects Located on Federally Controlled Reservoirs in the United States



## AquaPV Toolset

The **AquaPV** toolset provides foundational data and analyses for policymakers, developers, utilities, and financial firms seeking to understand floating PV (FPV) project viability on the United States (US) reservoirs and estuaries, assisting in scaling the systematic evaluation and implementation of this concept in the US.

**Techno-economic Analysis:** Tailored to FPV with standard financial metrics: Payback period, net present value, return on investment, internal rate of return, levelized cost of electricity

**Environmental Impact:** Interaction of FPV on reservoirs and estuaries: Temperature, dissolved oxygen, stability, thermocline, cold/warm water fish

**Solar Generation Data:** Generate expected PV output for any US location

**US reservoir FPV capacity:** High-fidelity geospatial resource assessment to estimate FPV technical potential on reservoirs in the US



# THANK YOU!

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