

Evaluation of Sorbent Application Methods for Mercury Control in a Contaminated Reservoir in San Jose, CA

Marc Beutel, PhD, PE

Environmental Systems Graduate Group

University of California, Merced



ASRS 2025

Butte MT



Acknowledgements



Shelby Defeo, PhD

Naivy Rodal, PhD, Stillwater Sciences

James Downing, Senior Water
Resources Specialist

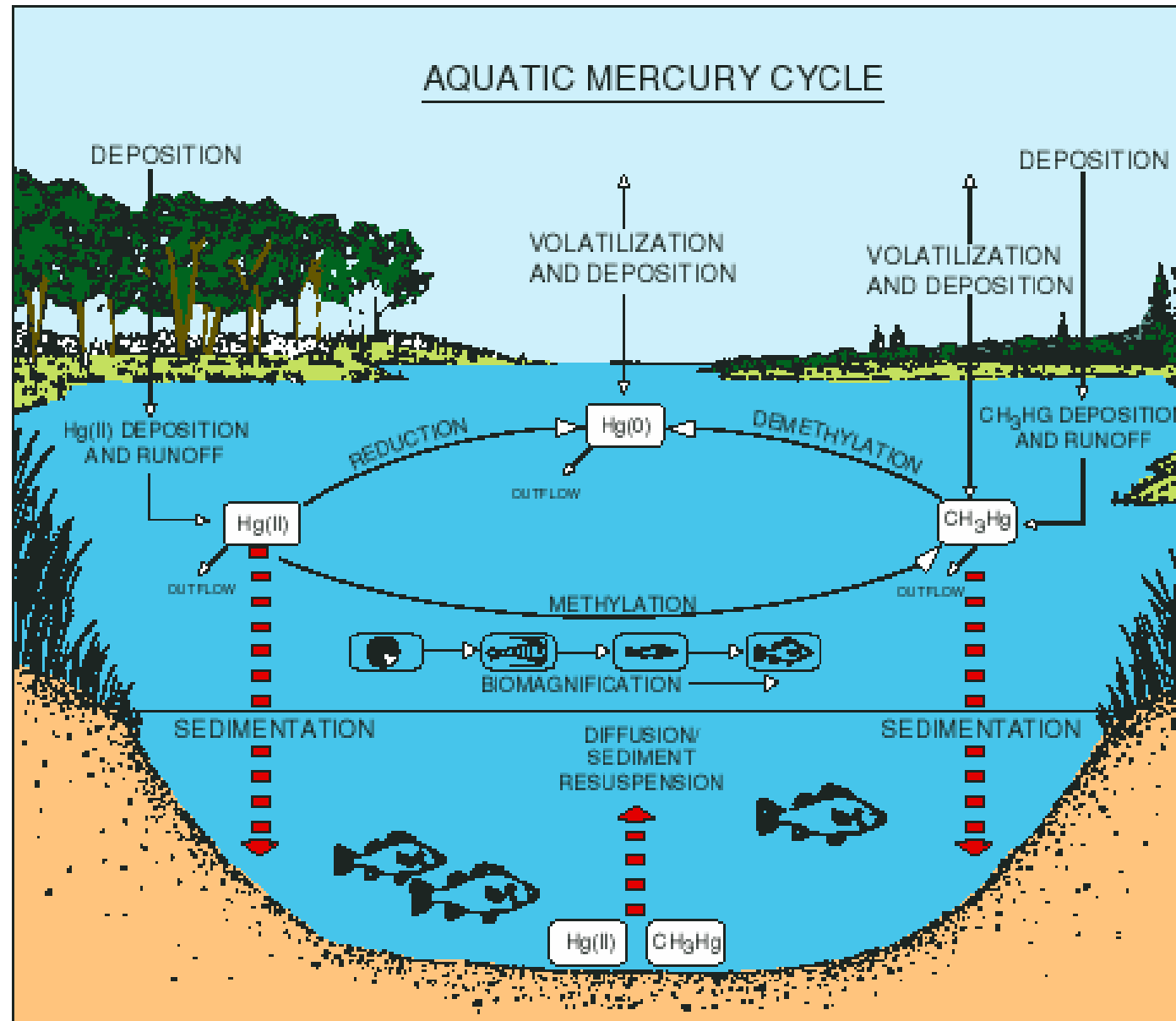
Karie Holterman, Associate Water
Resources Specialist



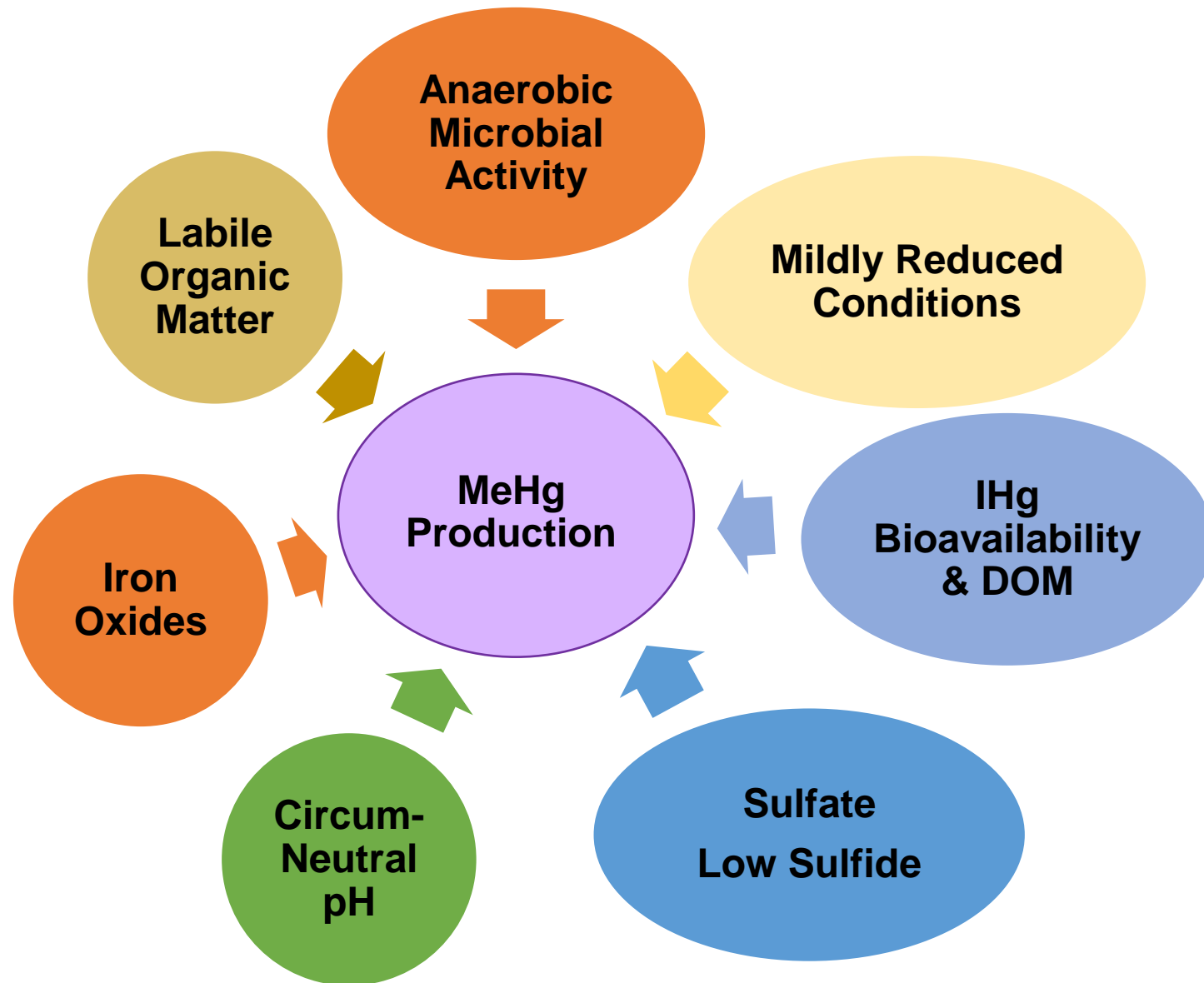
Background

An aerial photograph showing a large concrete dam across a river valley. The reservoir behind the dam is filled with greenish water. The surrounding landscape is a mix of green hills, dense forests, and a town visible in the distance under a clear blue sky. The word "Background" is overlaid in large black text on the left side of the image.

Mercury Cycling in Aquatic Ecosystems

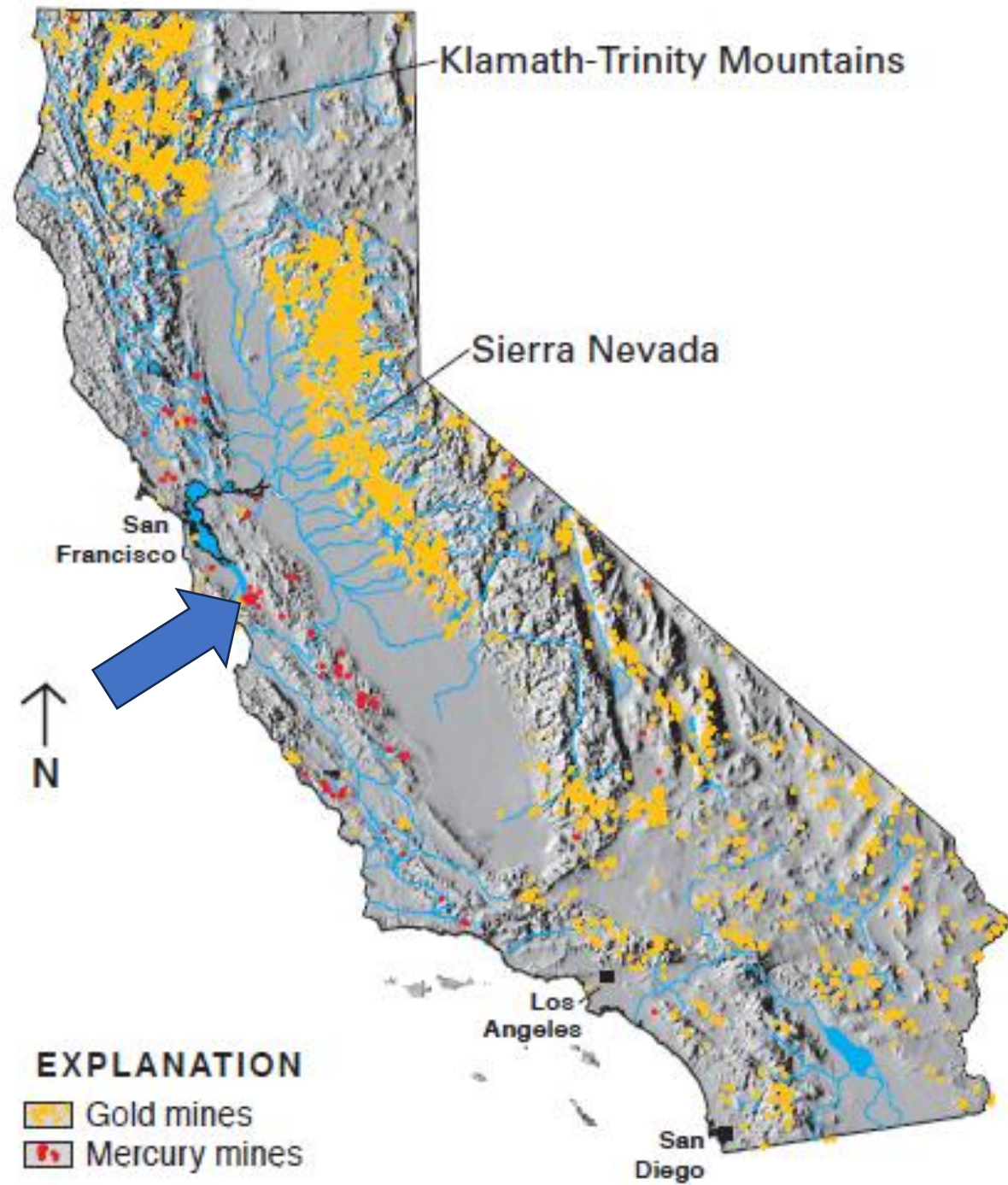


Mercury Cycling in Aquatic Ecosystems



Study Site

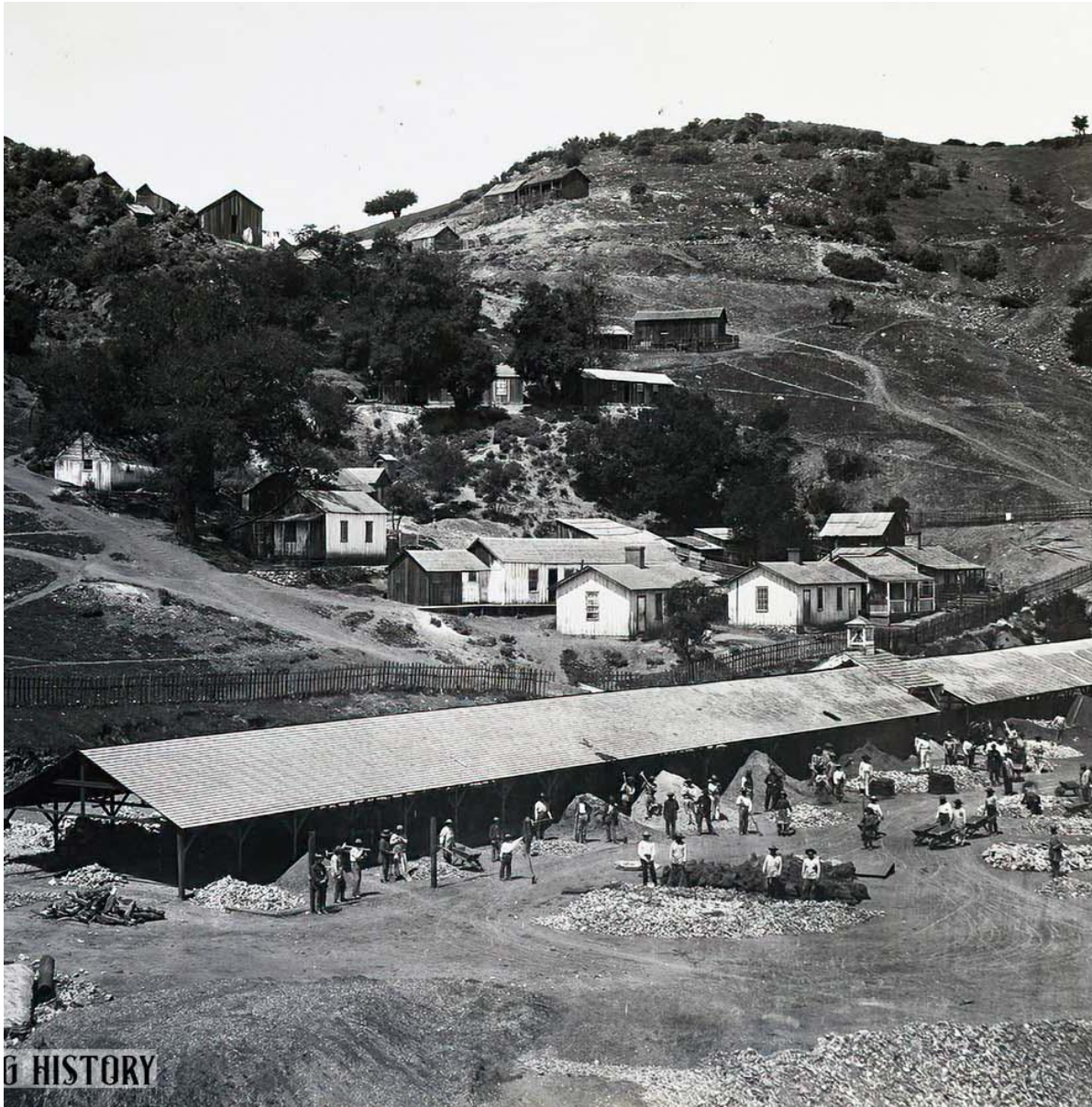




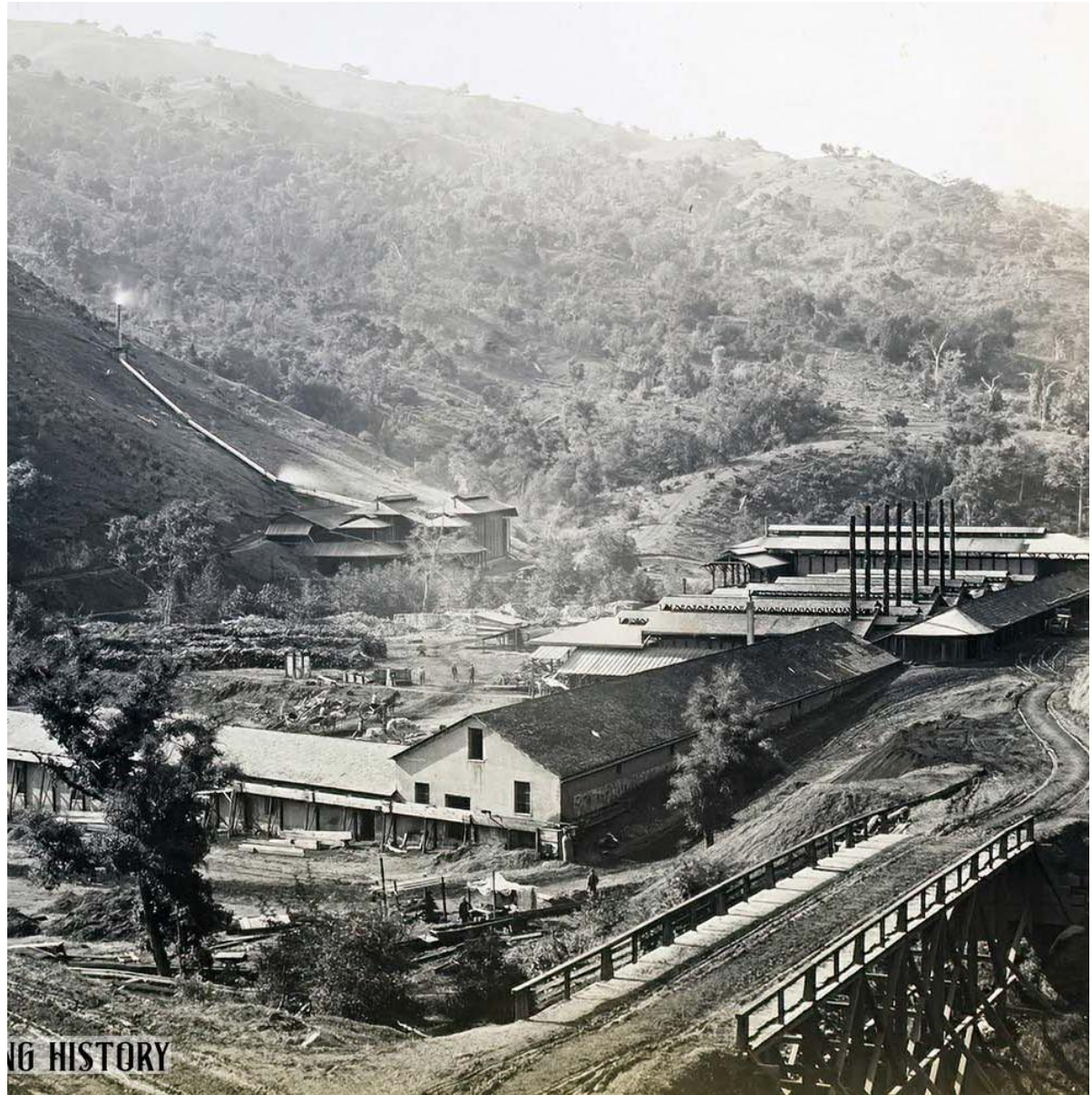
Hunerlach & Alpers , 2003

New Almaden Mine

- **Mercury discovered in 1845 in South San Jose**
- **Largest mercury mine in North America**
- **Over 83 million pounds of mercury produced**
- **Site now under ongoing remediation and management**
- **Removal and capping of mine-waste piles and roasted oar or “calcine”**
- **Creek restoration and lake improvement projects**
- **Gudalupe River Mercury Total Maximum Daily Load implemented in 2007**



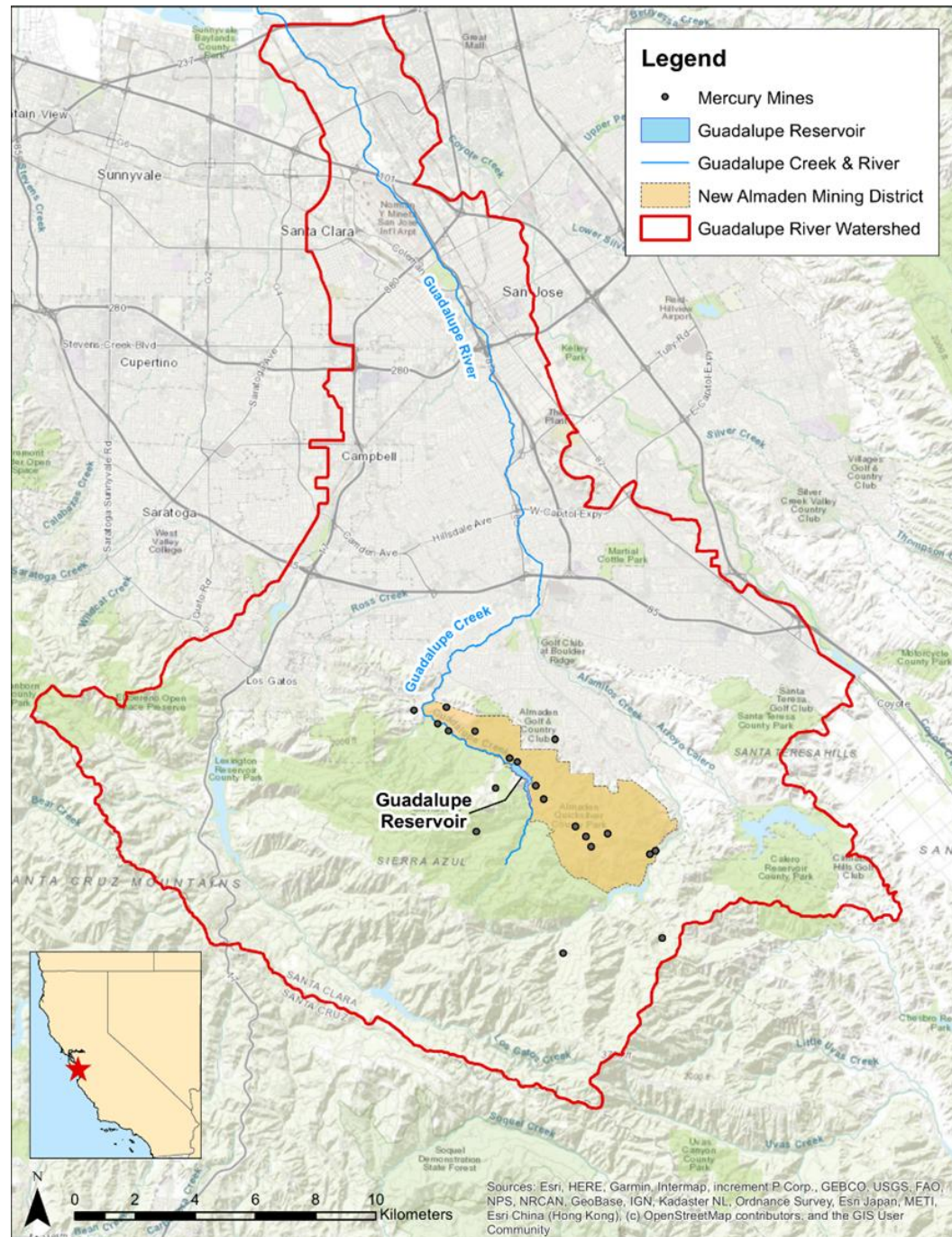
6 HISTORY



6 HISTORY

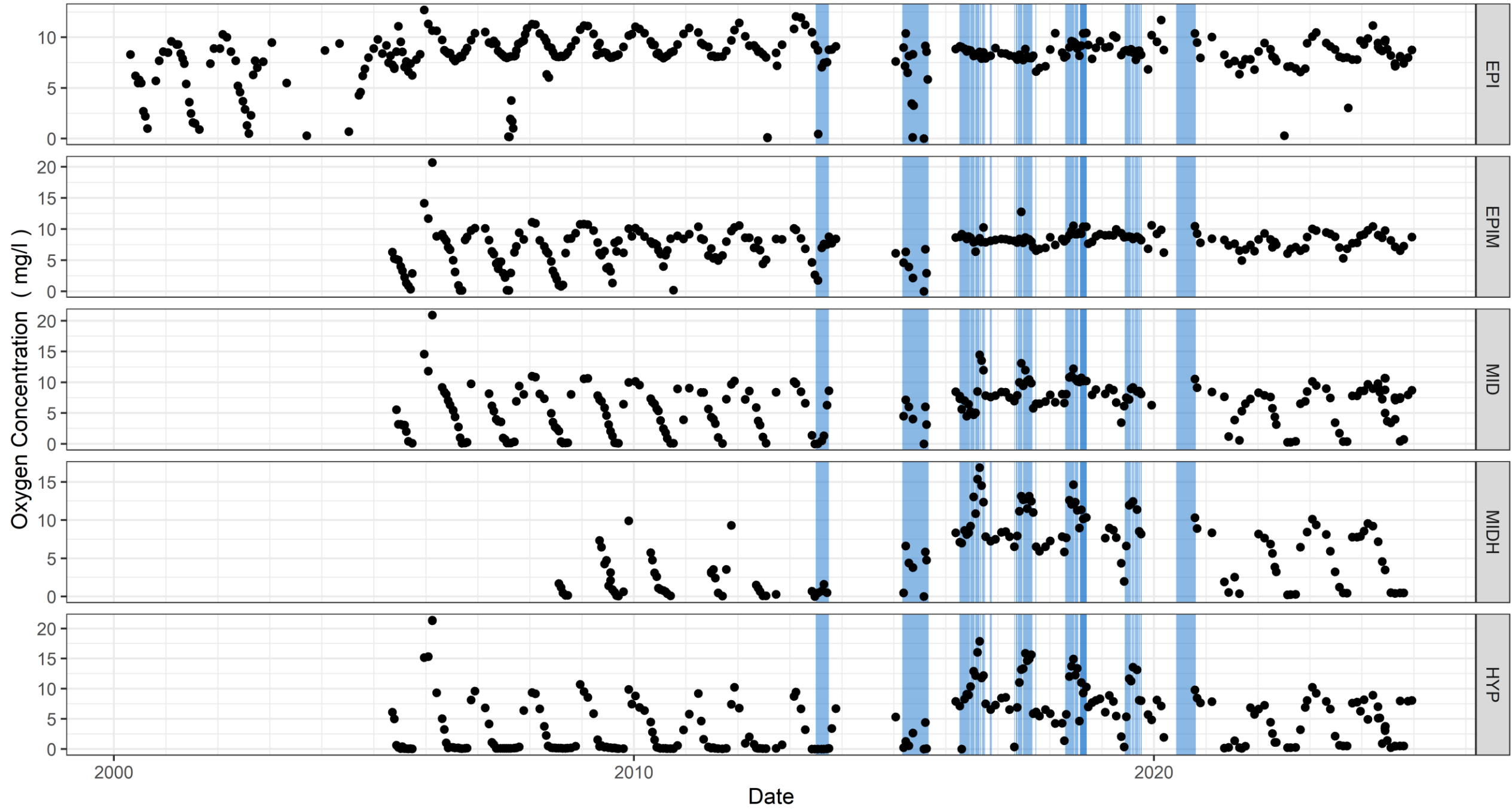
Guadalupe Reservoir

- **Build in 1935**
- **Flood control and groundwater recharge**
- **Area = 75 acres**
- **Mean depth = 18 m**
- **Sediments = ~2 ppm THg**
- **Bottom waters = ~20 ng/L MeHg**
- **Large mouth bass = ~3-8 ppm**
- **TMDL target of < 1.5 ng/L methylmercury in bottom waters of Guadalupe Reservoir**

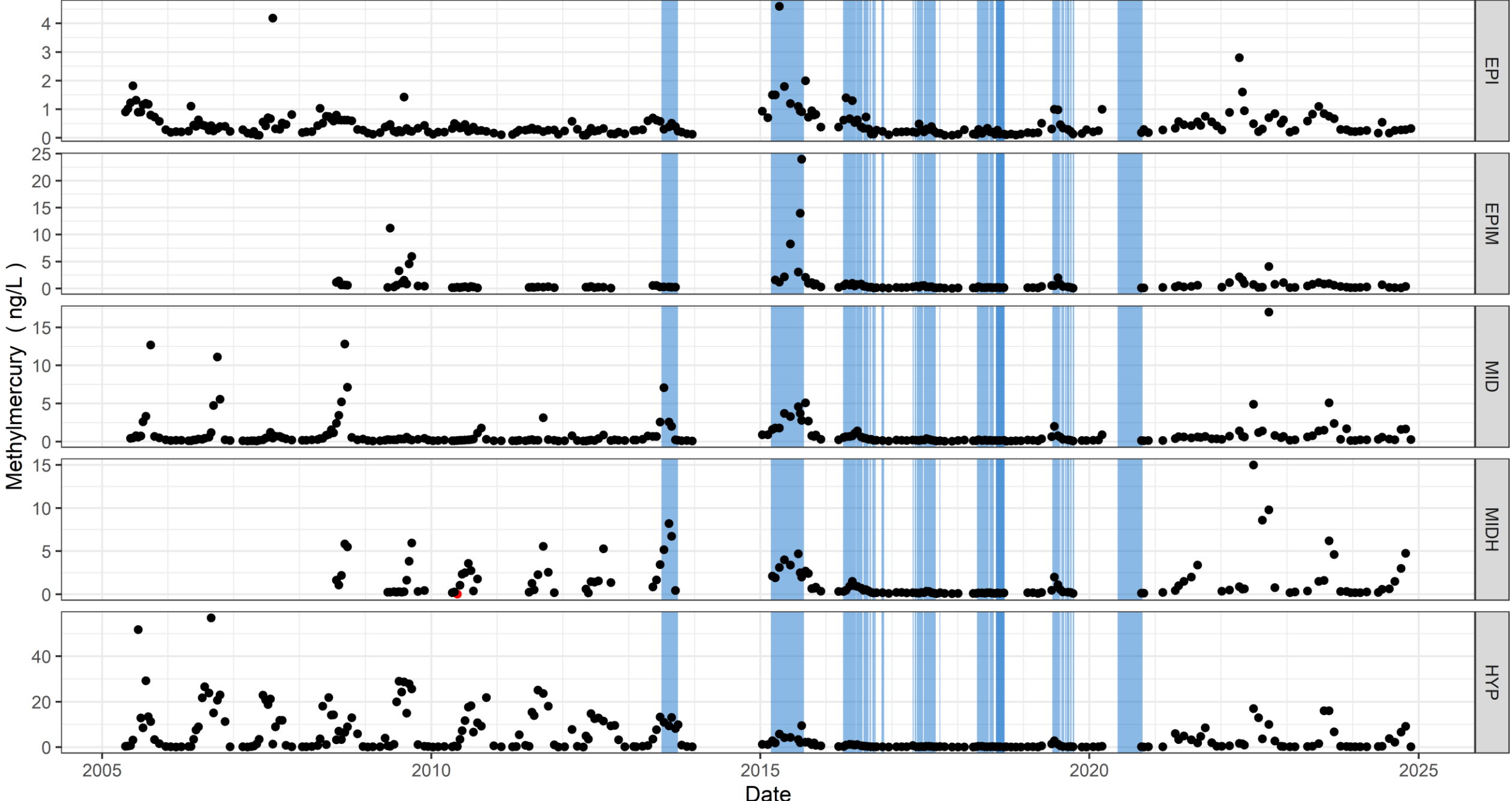




GUADALUPE RESERVOIR: Oxygen Concentration



GUADALUPE RESERVOIR: Methylmercury



An aerial photograph showing a large concrete dam across a river valley. The reservoir is filled with greenish water. The surrounding landscape is a mix of green hills, dense forests, and a town visible in the distance under a clear blue sky.

Study Aims & Approach

Study Aims

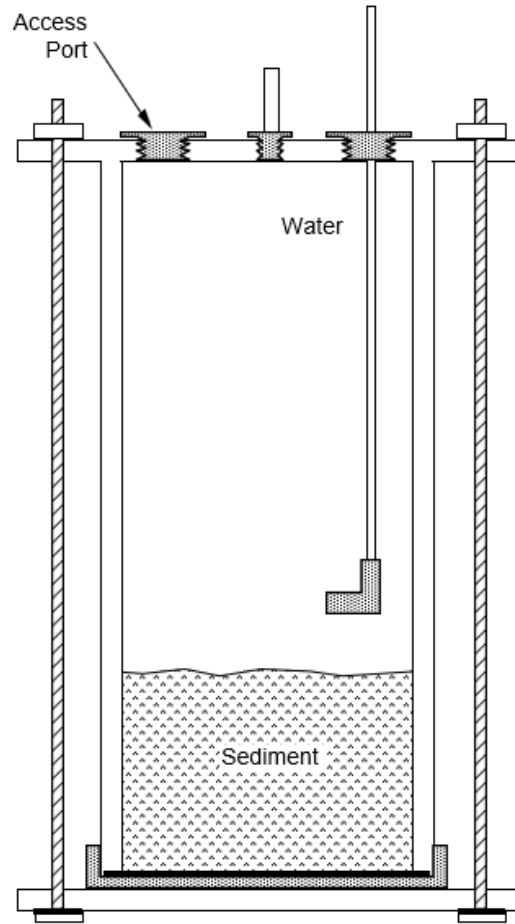
Proof-of-concept, bench-scale experiment to assess ability of sulfur-functionalized activated carbon sorbent to lower mercury levels at the sediment-water interface.

- Assess three different sorbent application methods
- Assess oxic versus anoxic conditions
- Monitor water quality in chambers over time

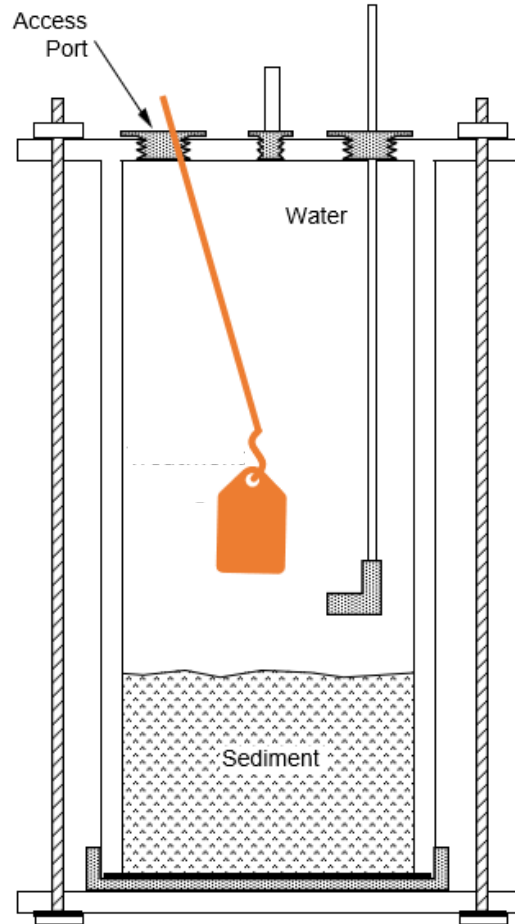
MERSORB® is a trademark of Nucon International, Inc. It is a sulfur-impregnated activated carbon that binds ionic mercury from gases and liquids.



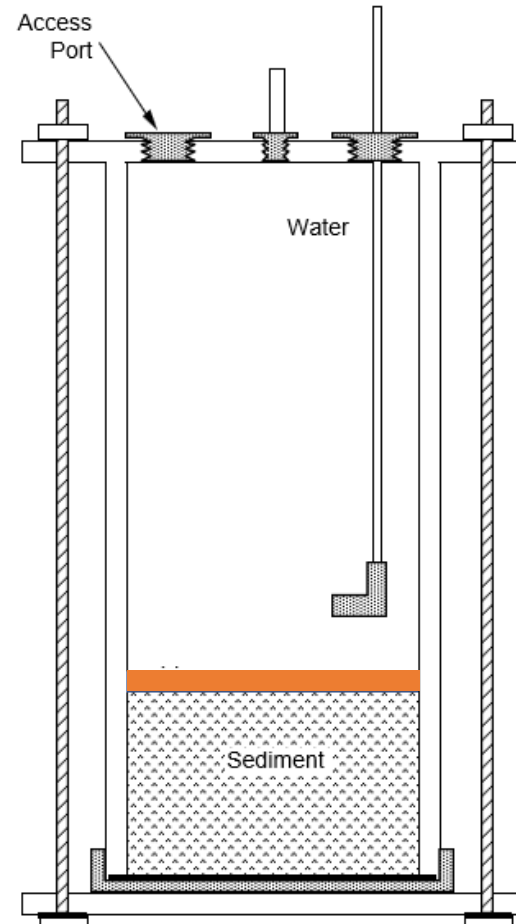
Application Methods



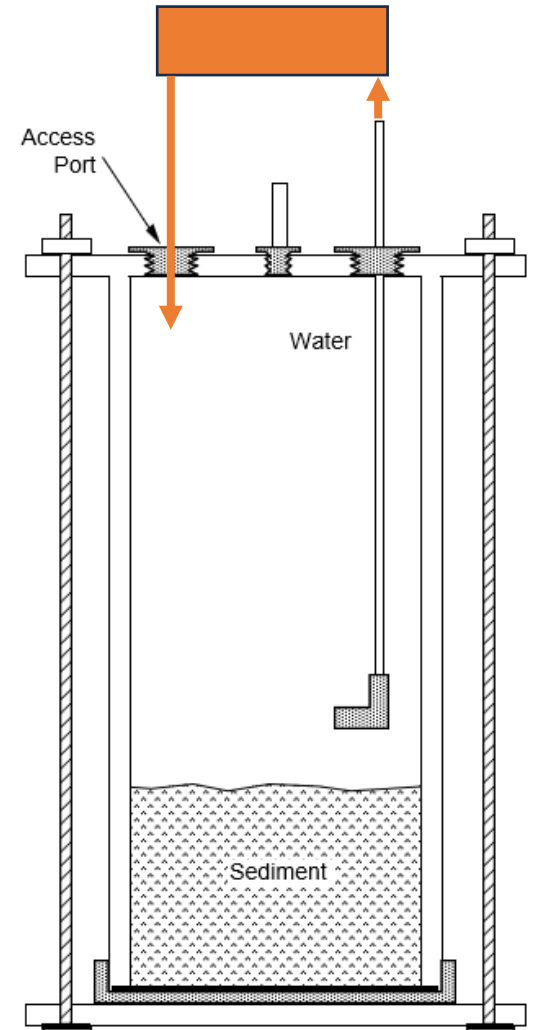
Control



Treatment
Bag (TB)



Sediment
Application (SA)



Flow
Through (FT)

Field Sampling



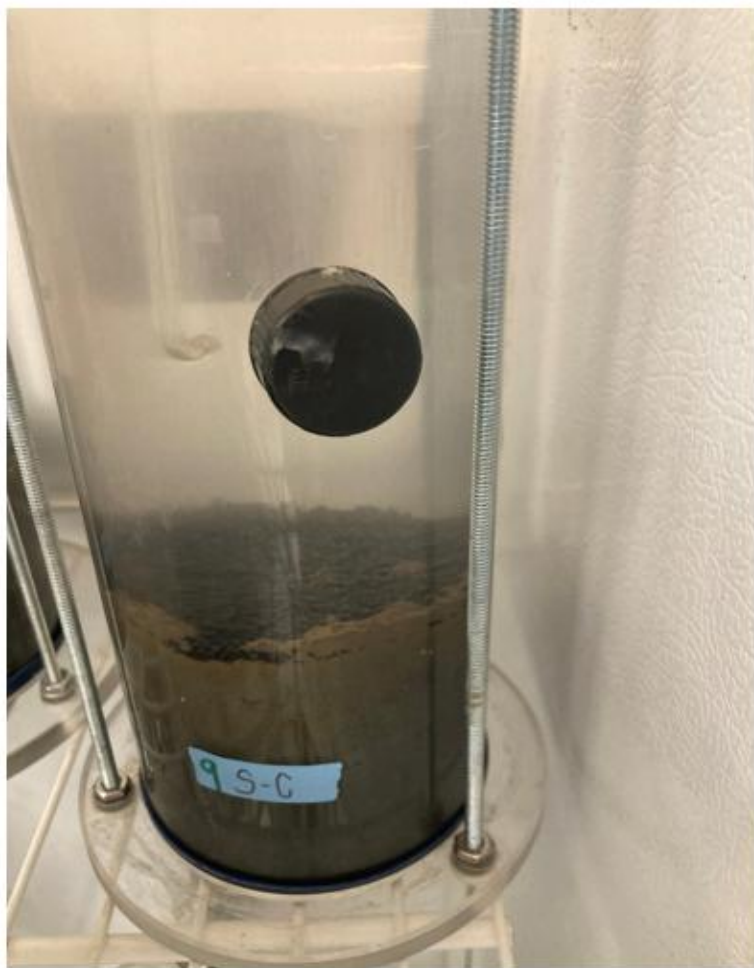
Application Methods

Mimic “typical” areal
treatment rate of 3.5 kg/m^2

Flow Through system had
treatment HRT ~ 2 hours
and chamber HRT ~ 5 days



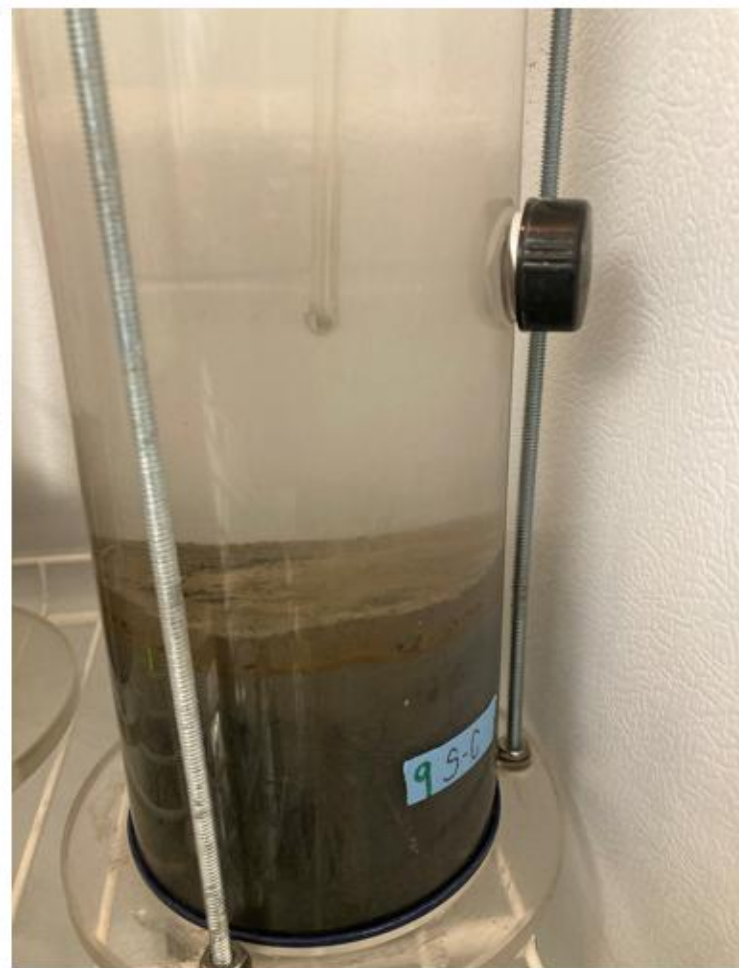
Burial of Sorbent



May 12th



May 15th



June 7th

Biofilm Growth in Flow Through Chambers



May 25th



June 17th

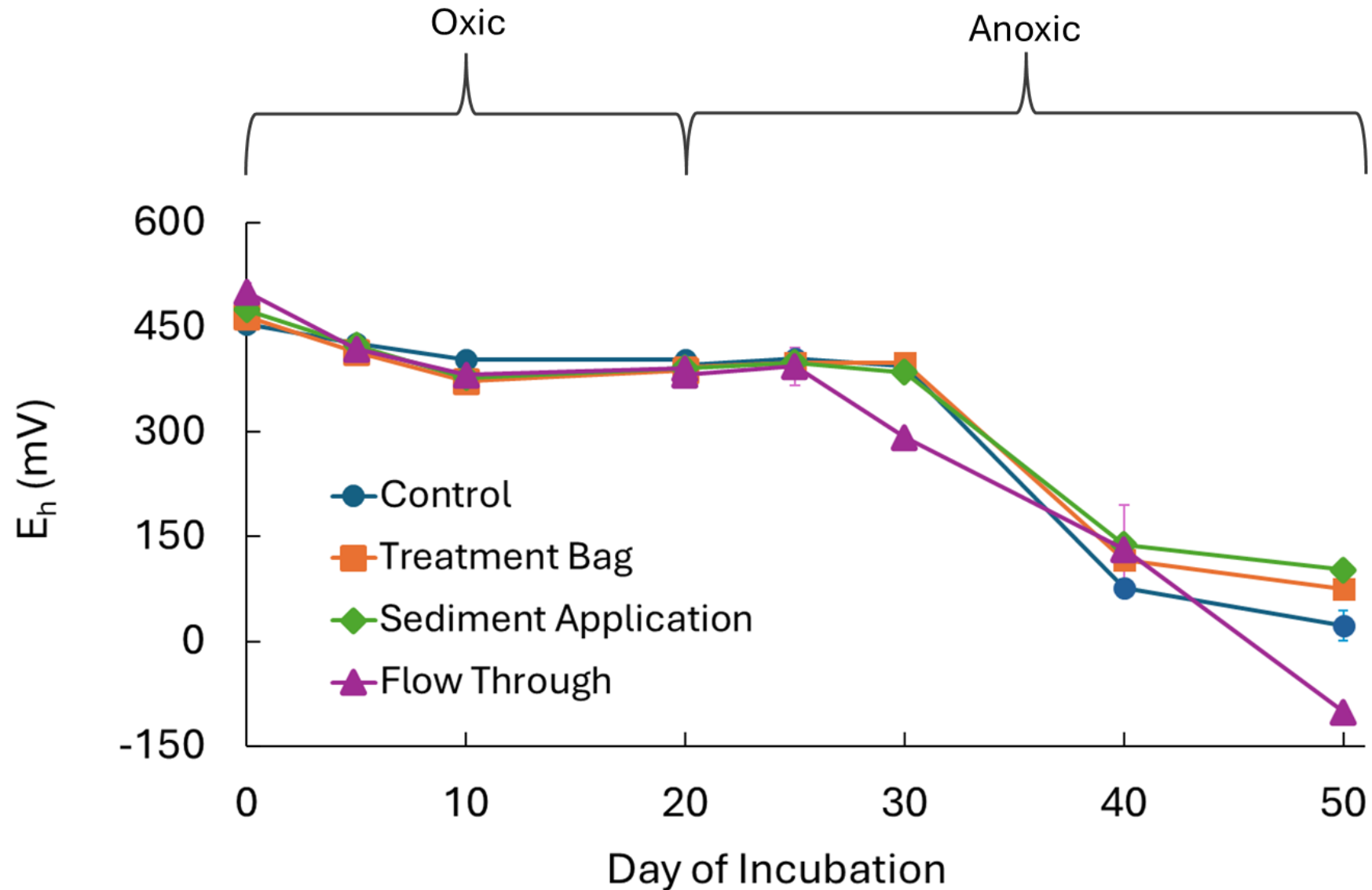


June 27th

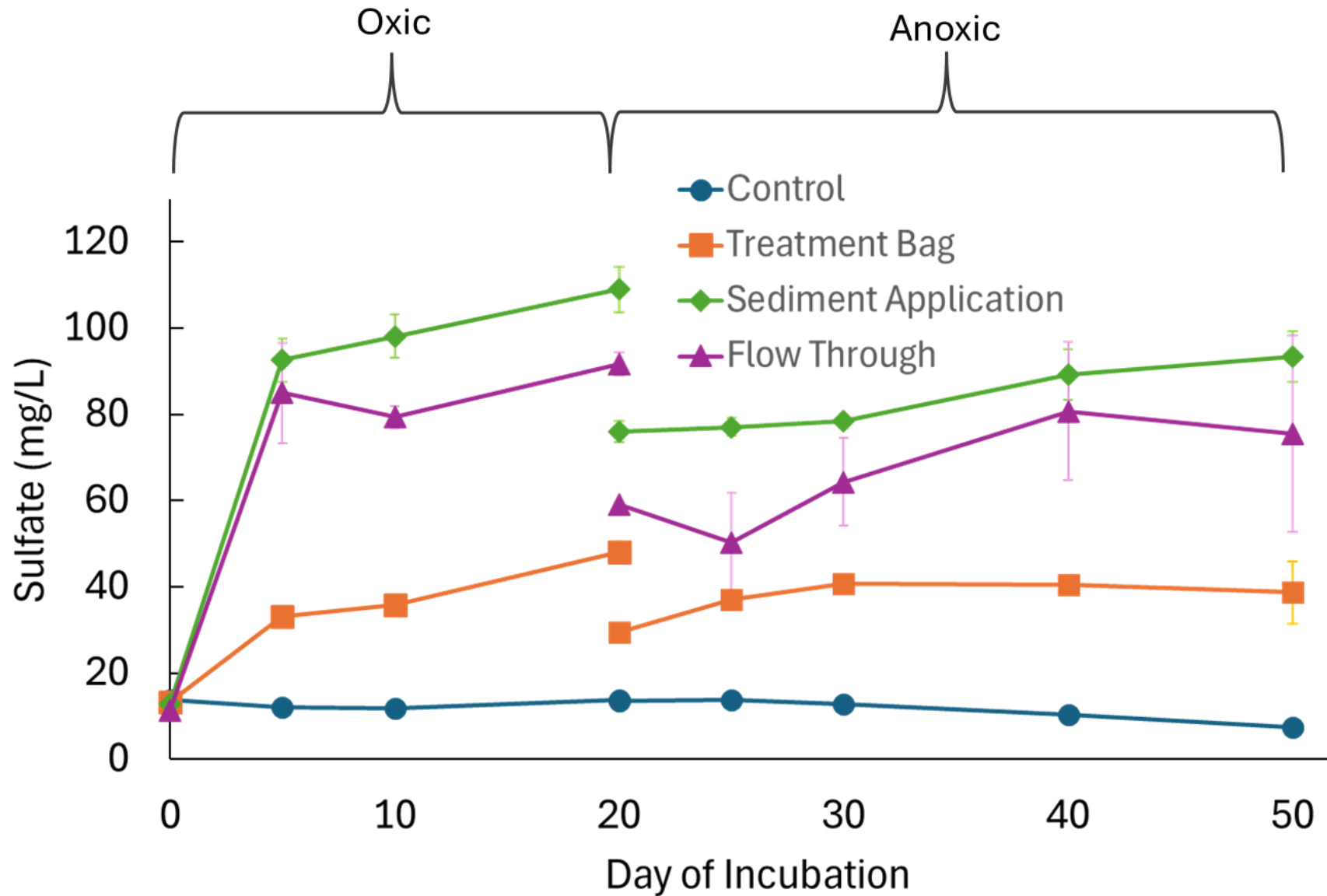
Study Results

An aerial photograph showing a large concrete dam across a river valley. The reservoir is filled with greenish water. The surrounding landscape is a mix of green hills, dense forests, and a town visible in the distance. The sky is clear and blue.

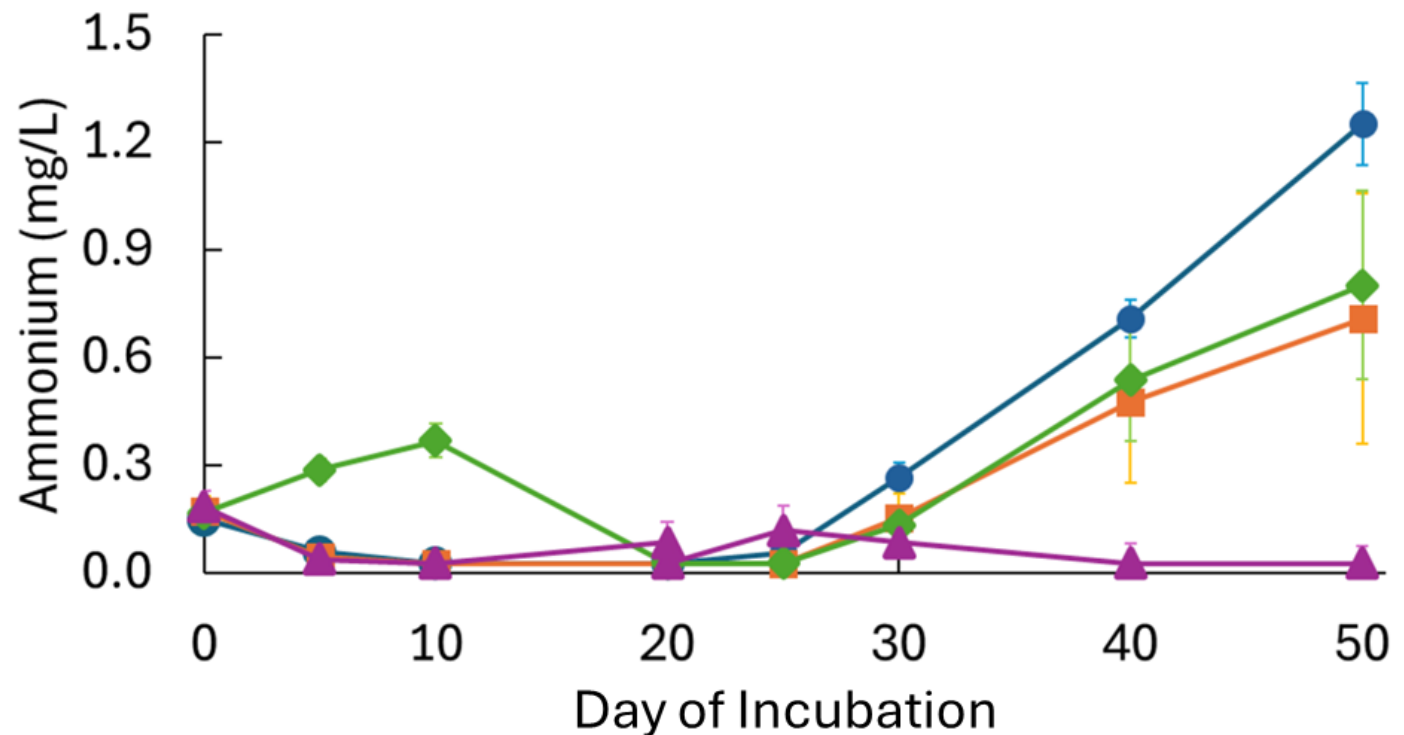
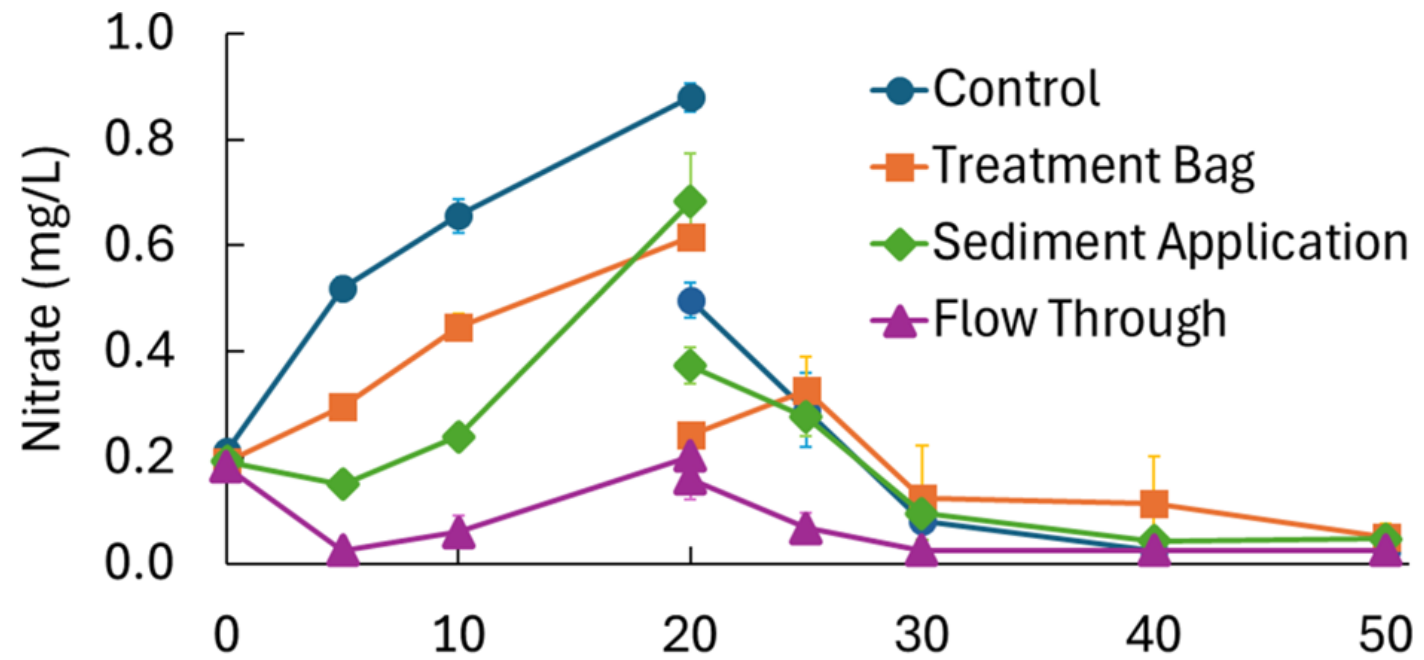
Oxidation-Reduction Potential



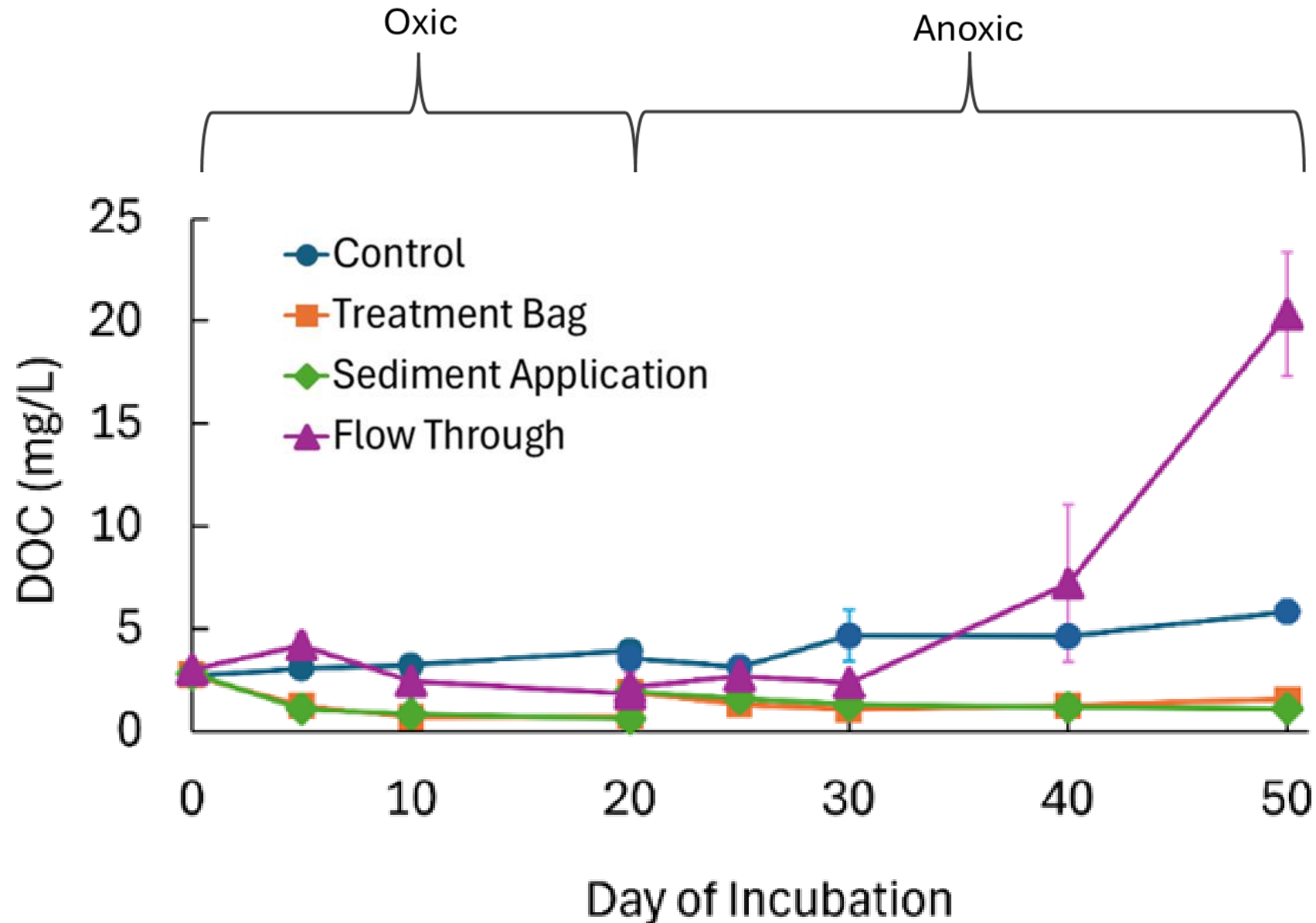
Sulfate



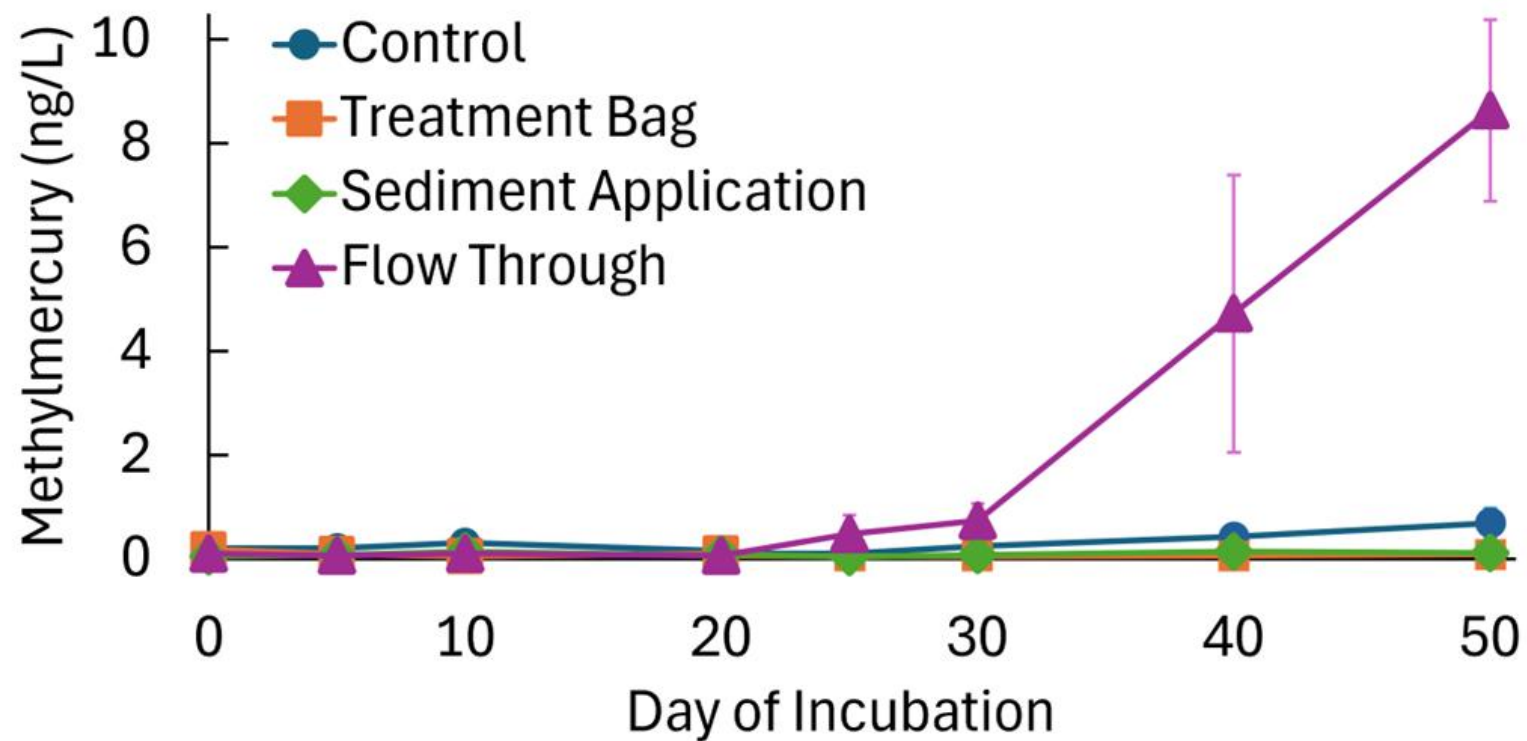
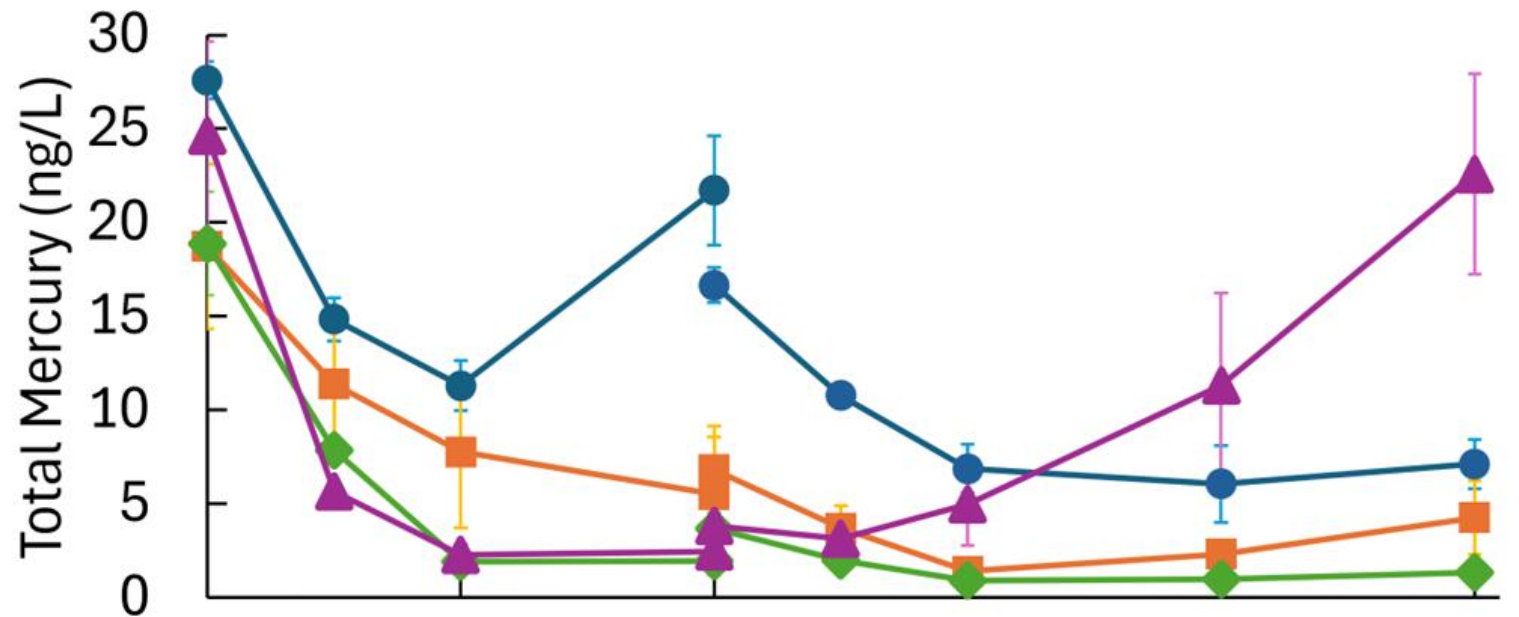
Nitrate & Ammonia



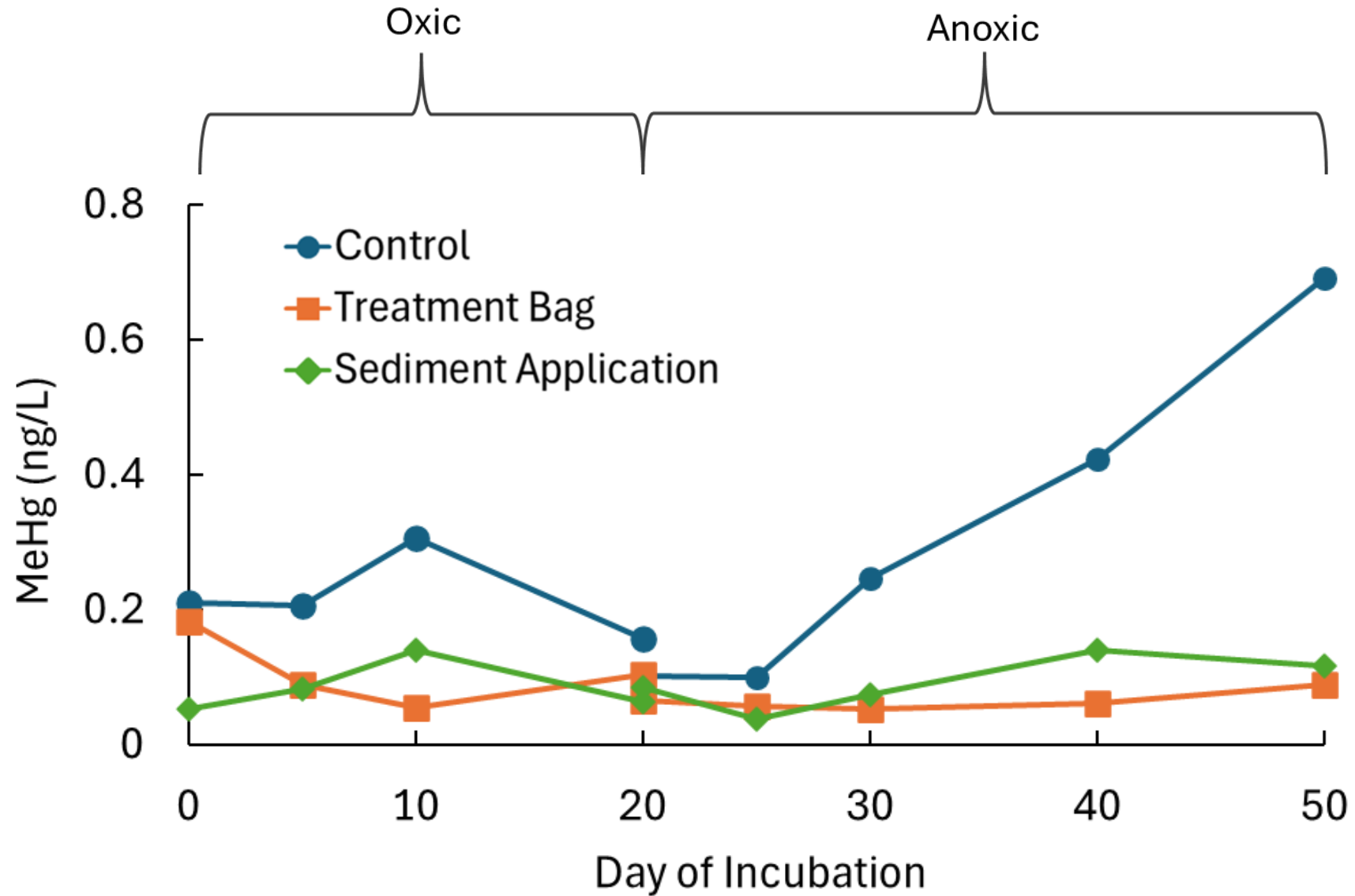
Dissolved Organic Carbon



Mercury



Methylmercury



Summary

- All treatment approaches were effective at lowering mercury and DOC in water
- MerSorb added substantial levels of sulfate to water
- Flow Through chambers inadvertently stimulated biofilm growth, reduced conditions, and sediment release of mercury
- Results highlight the role organic carbon plays in promoting mercury cycling at the sediment-water interface
- Follow-up study of sorbent effectiveness under reduced conditions – results pending!
- Follow-up study on varying application dose – do this summer!

Thank You for Your Attention!

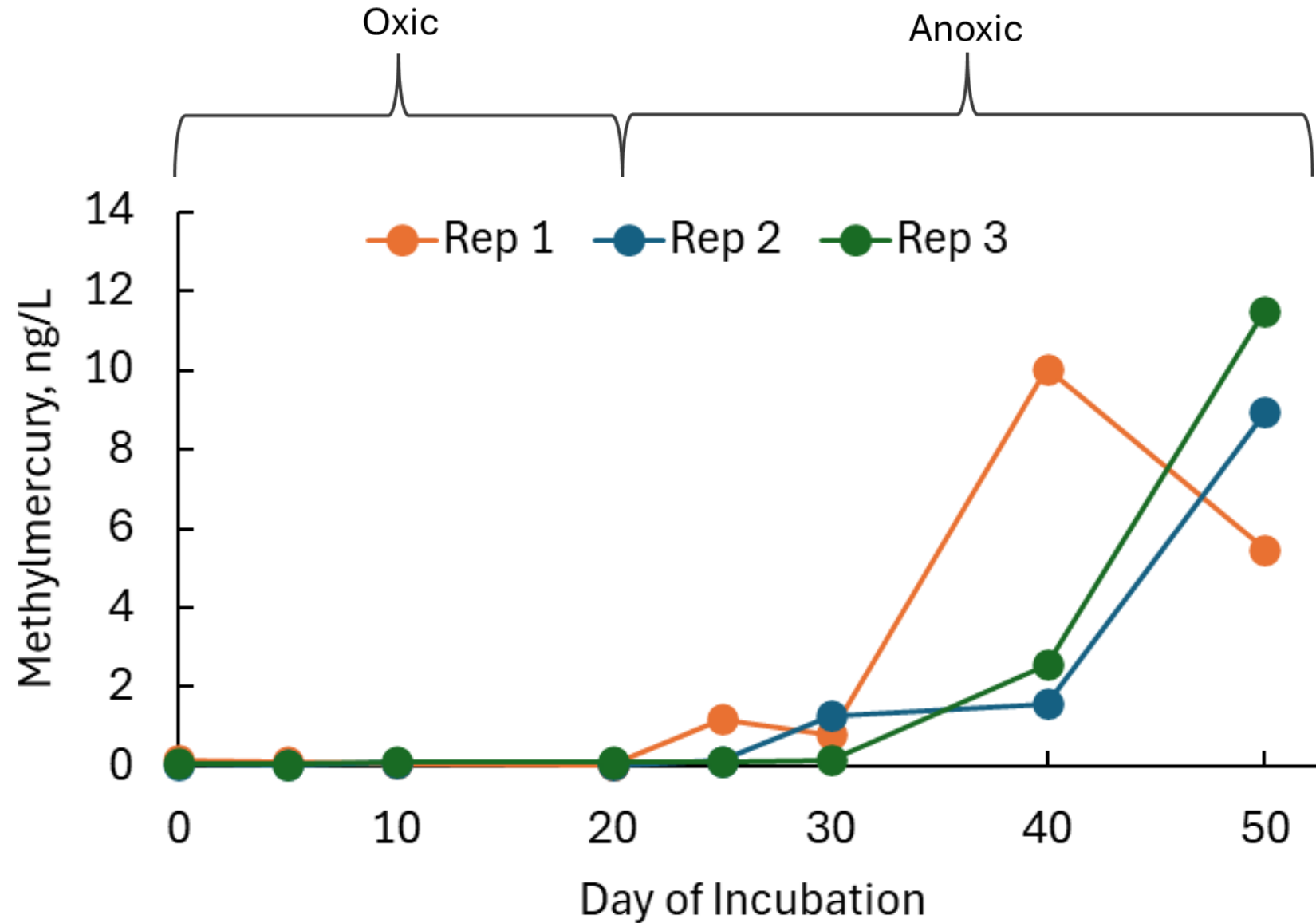


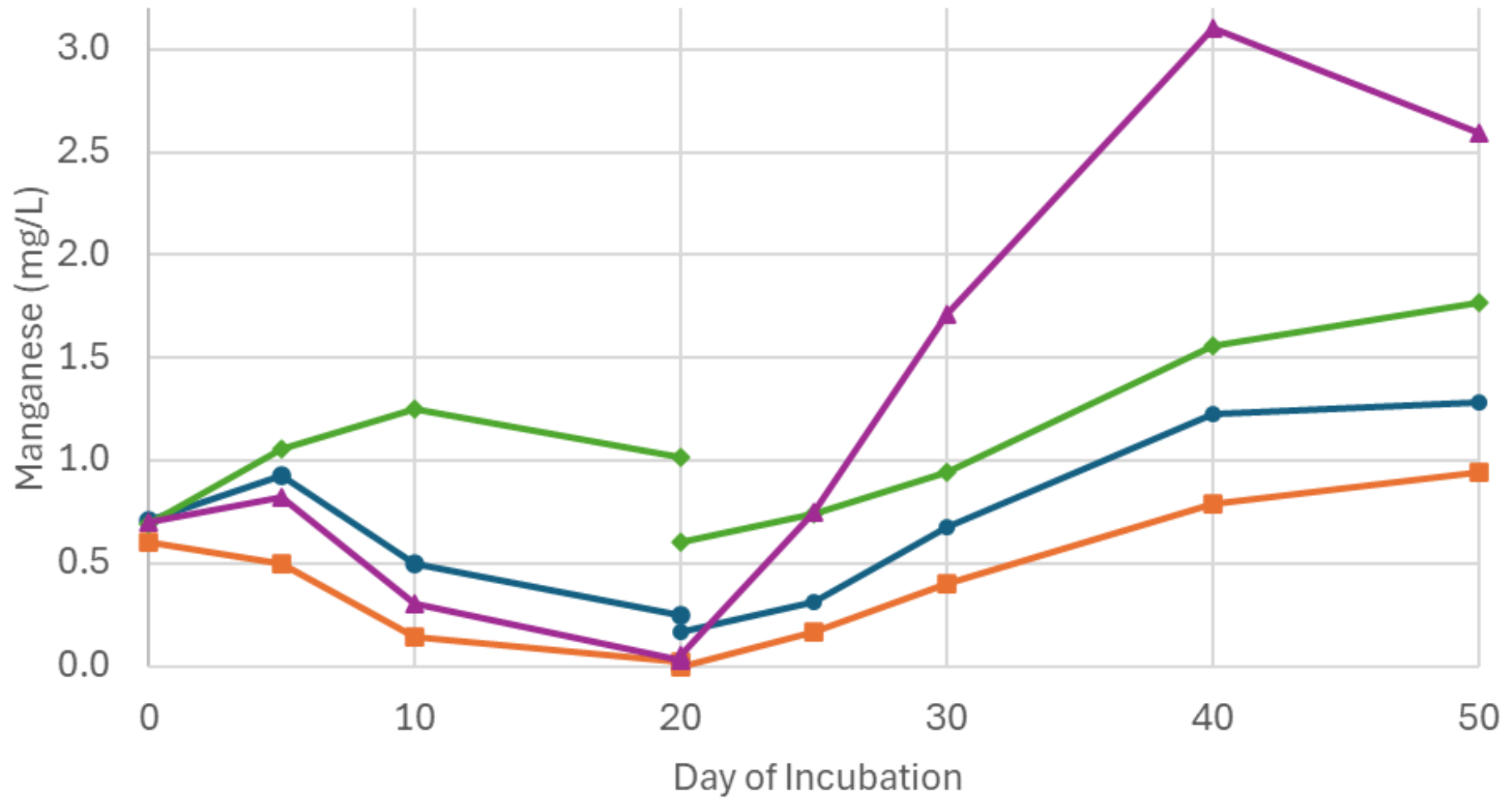
Assistant Prof Marc and
PhD student Stephen in
2009 sampling mercury
at Twin Lakes, WA!?

Tap'er Light!

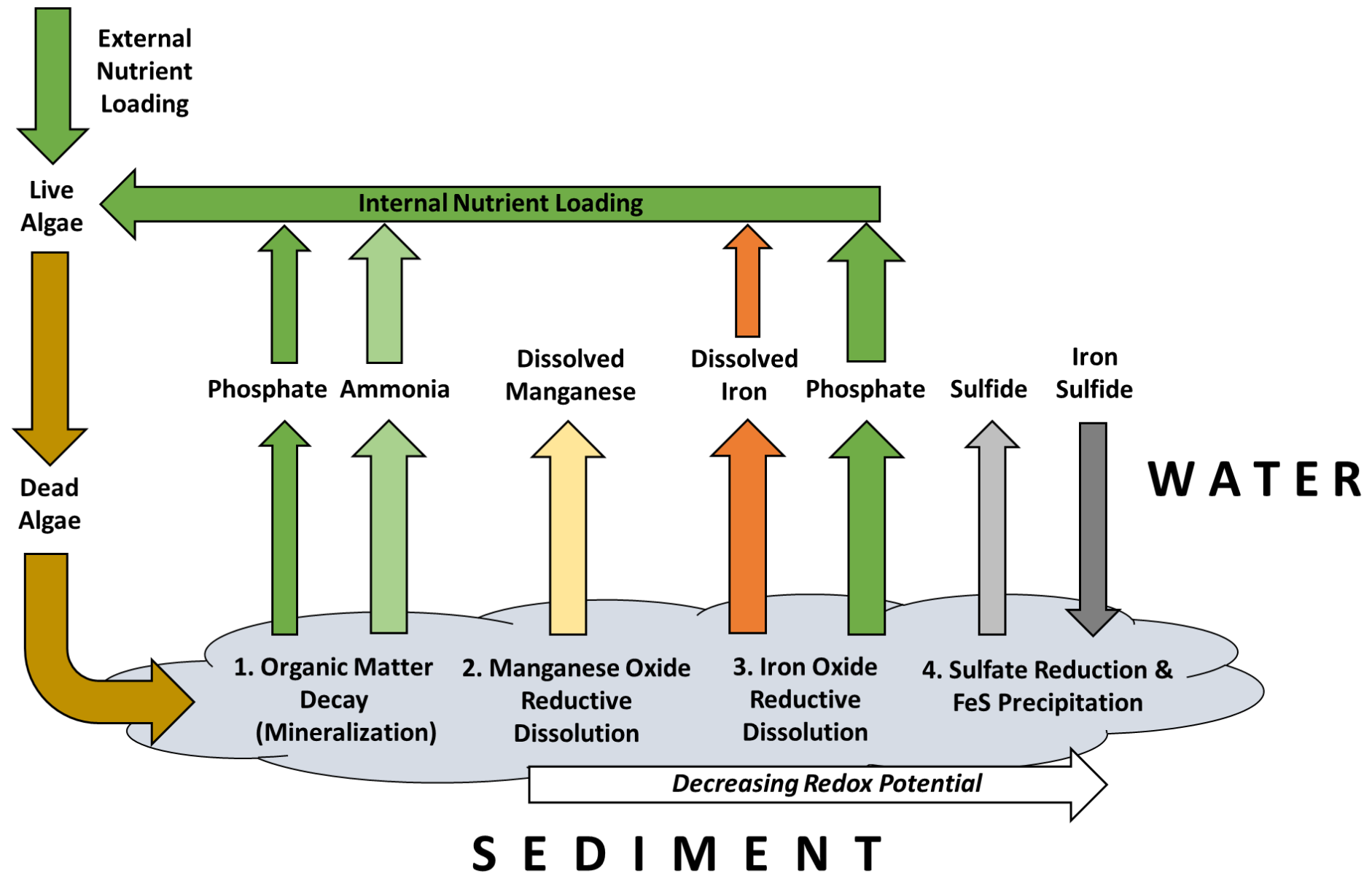


MeHg in Flow Through Chambers





Internal Nutrient Loading Conceptual Model



Internal Nutrient Loading Conceptual Model

