

**wood.**



# Testing Performance Efficiency of Innovative Nutrient Reduction Technologies with In-Situ Mesocosms

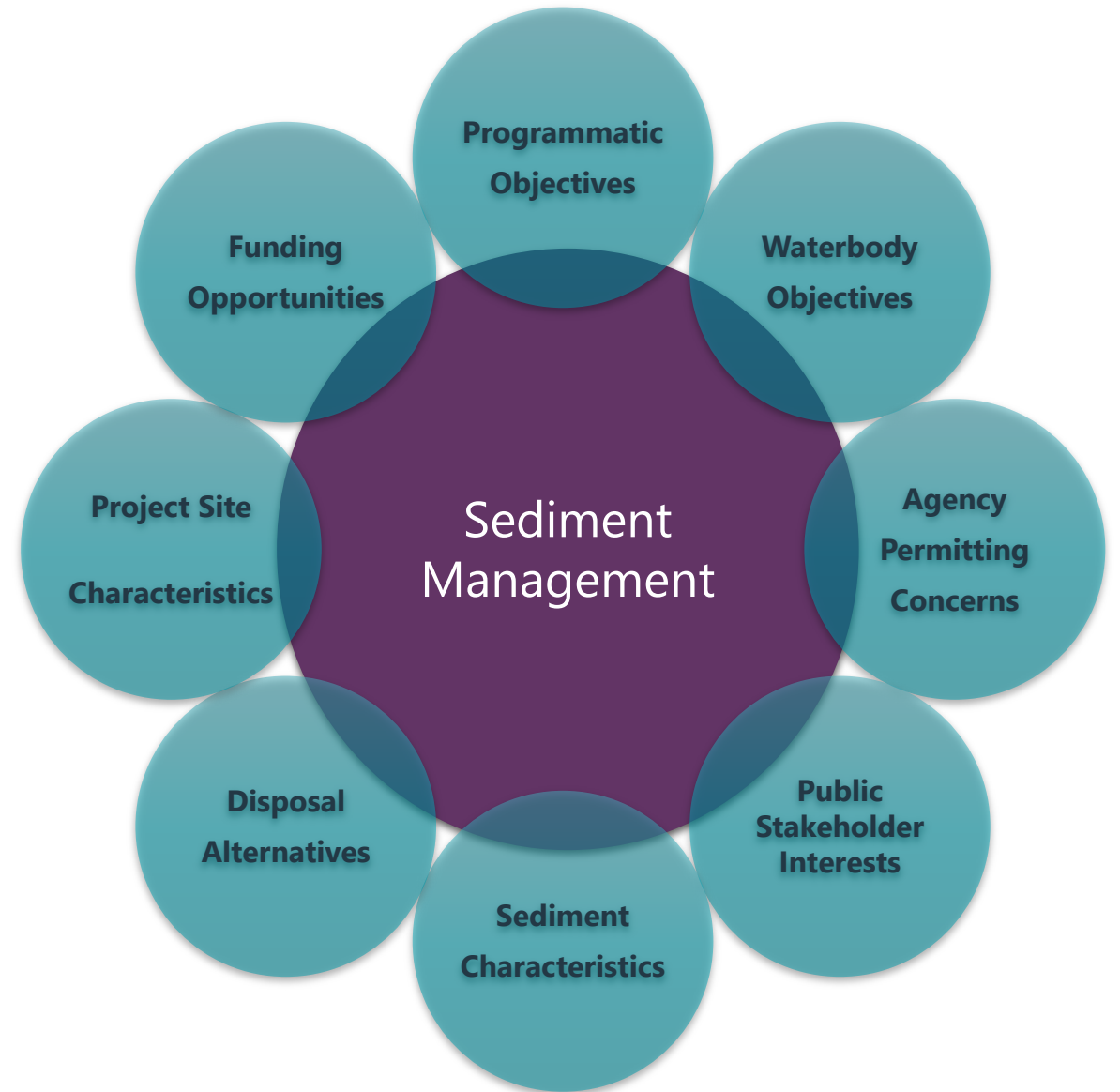
Mary Szafraniec, Laurie Smith, Sara Phelps, Francesca  
Lauterman

8<sup>th</sup> Biennial UF Water Institute Symposium  
February 22, 2022



# Outline

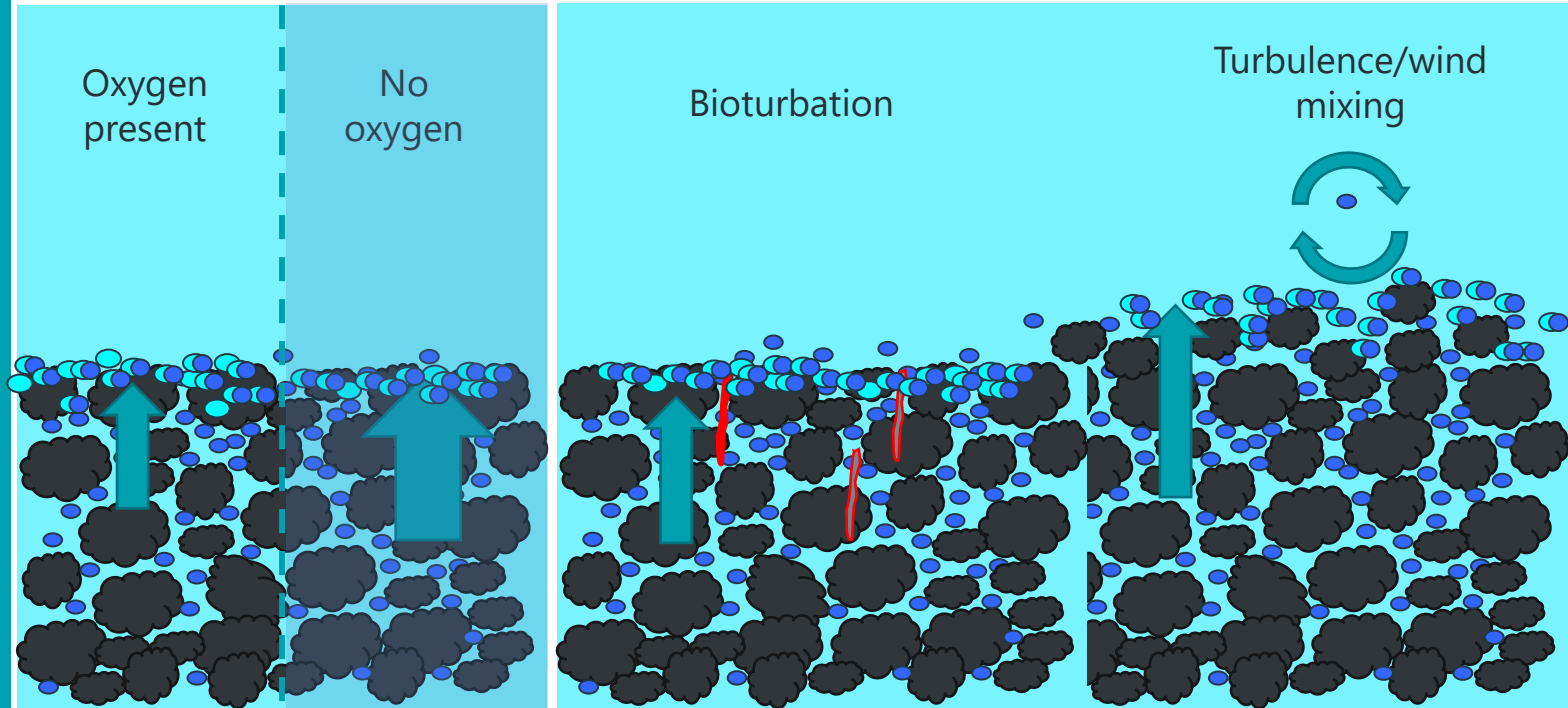
- Overview of Sediment Management Approach and Benefits
- Case Study
- Summary



# Sediment Management Approach and Benefits

# How does sediment quality impact water quality?

- + Stabilize sediments for aquatic vegetation establishment and growth
- + Reduce algal blooms
- Resuspension
- Diffusion
  - Release nutrients and other pollutants to water column
  - Source or sink for pollutants – internal cycling



# Approaches to Sediment Management

## No Action

- Natural Attenuation

## Cap/Inactivate

- "Clean" fill
- Biological
- **Chemical Inactivation**
  - **Alum**
  - **Phoslock**
  - **Flock & Lock**
  - **Virophos**
  - **Nclear TPX**
  - **Coated sand**

## Dredge/Dewater

- Mechanical
- Hydraulic

DMMAAs

Geotextile tubes

Subaqueous

Wastewater plant

Islands

Relocation



Is Permitting  
Feasible?



A presentation by Wood.

## How and When to Pursue a Sediment-Focused Waterbody Management Project

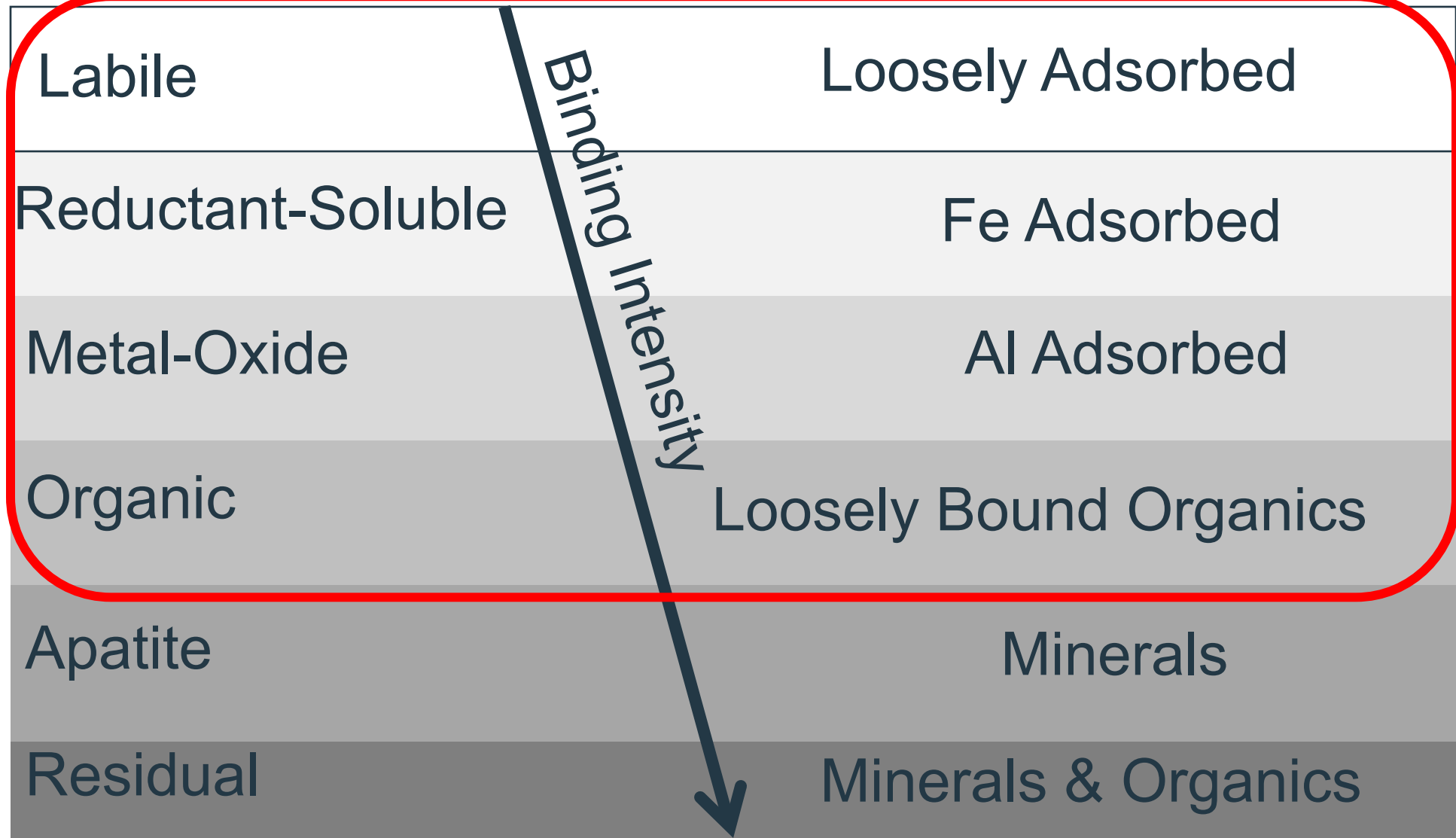
- Waterbody or alternatives analysis studies indicate that sediment cycling generates a significant portion of the pollutant loading
- Untreated stormwater inputs are limited or being addressed
- Upstream sediment transport is limited or has been addressed
- Treatment alternatives analysis has been conducted
- Funding source has been identified

# Sediment Phosphorus Fractionation

Nuisance algae most readily utilize biologically available phosphorus - BAP

MUCK  
HIGH  
BAP

SAND  
LOW  
BAP



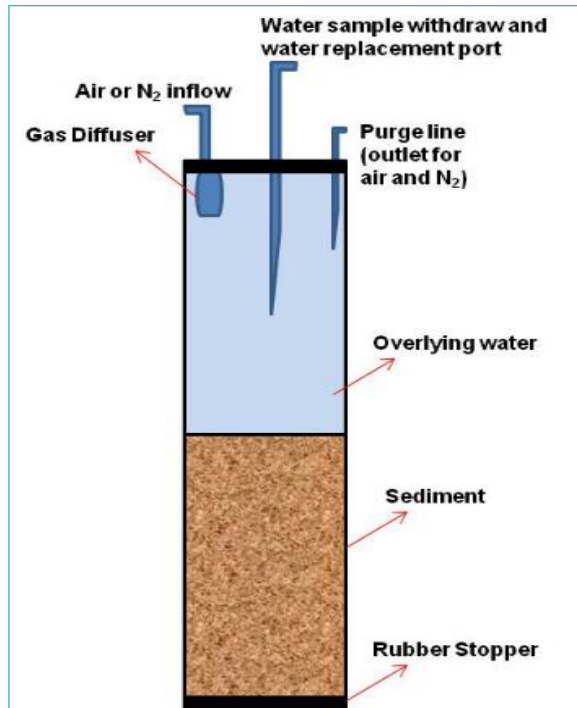
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# Treatment Alternative Analysis

## Bench Scale Sediment Flux

Intact sediment core incubations to measure flux (release) of nutrients or other pollutants





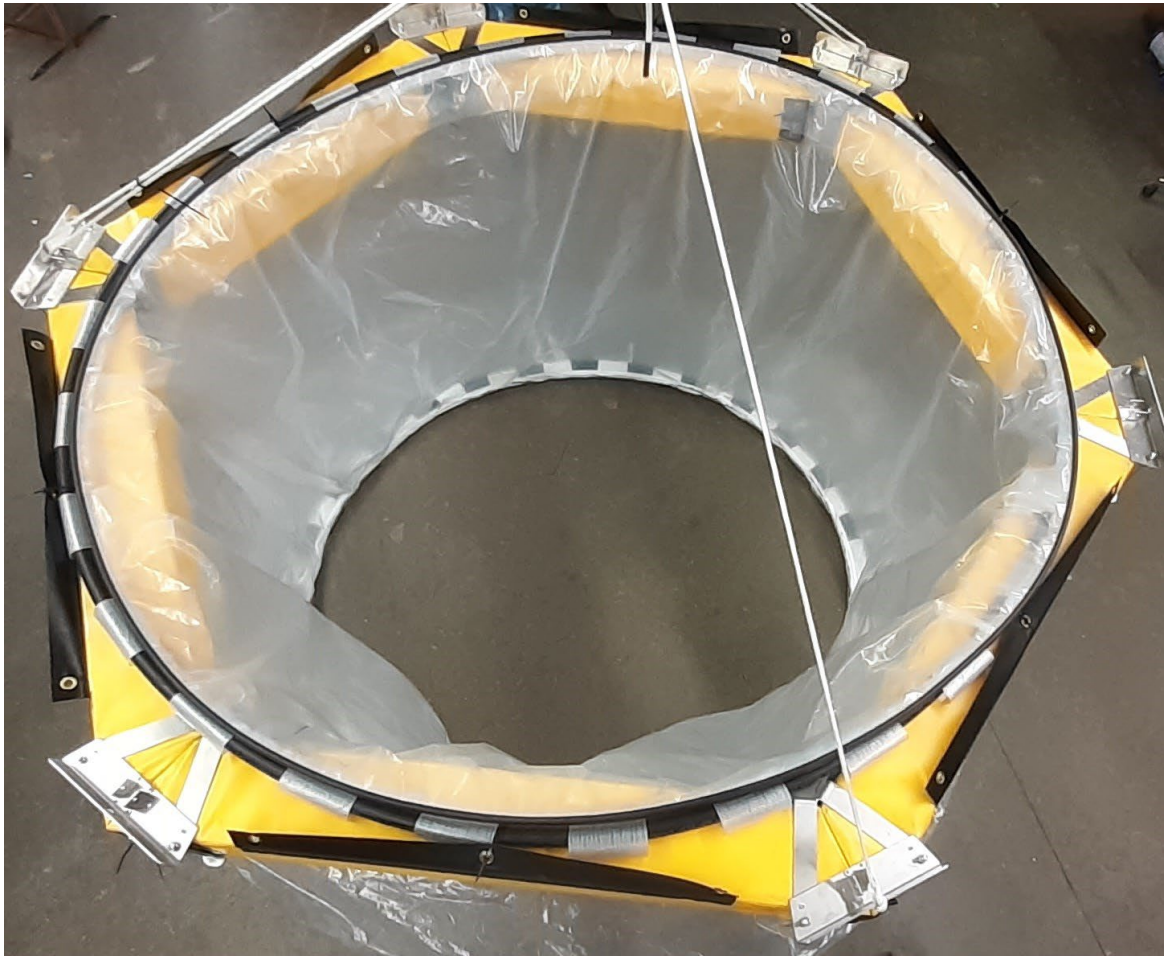
# Case Study

# City of Lakeland Crystal Lake Mesocosm Study

- Crystal Lake is verified impaired (per FDEP 3030(d) list) for total phosphorus (TP), total nitrogen (TN) and chlorophyll-a, and has regularly documented harmful algal blooms (HABs).
- Phased project – Phase I: Nutrient and hydrologic budget
  - Sediment = primary source
- Deferred TMDL with a 4e Pollutant Reduction Plan (PRP)
  - Developed restoration alternatives
  - Sediment management is top priority - Phase II
- Cooperative funding obtained from SWFWMD



# Mesocosm Study



Evaluate  
effectiveness of  
various treatment  
alternatives



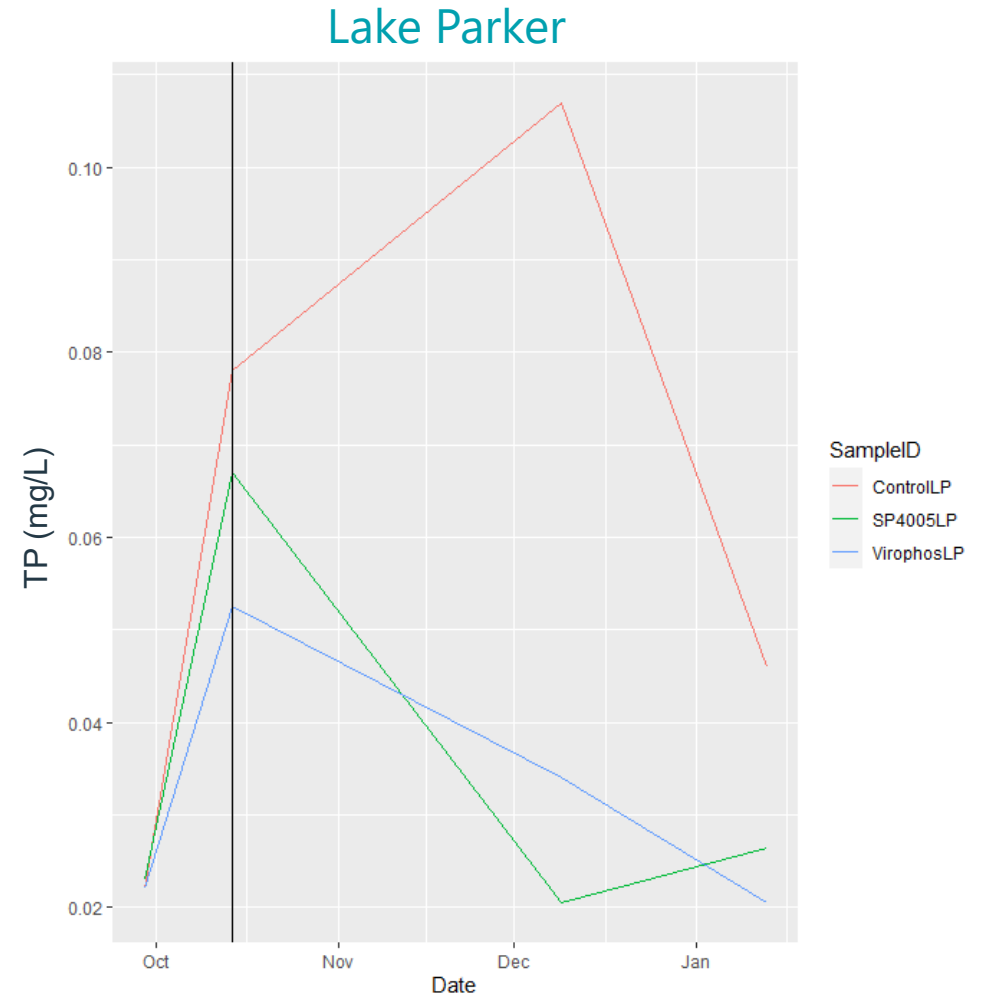
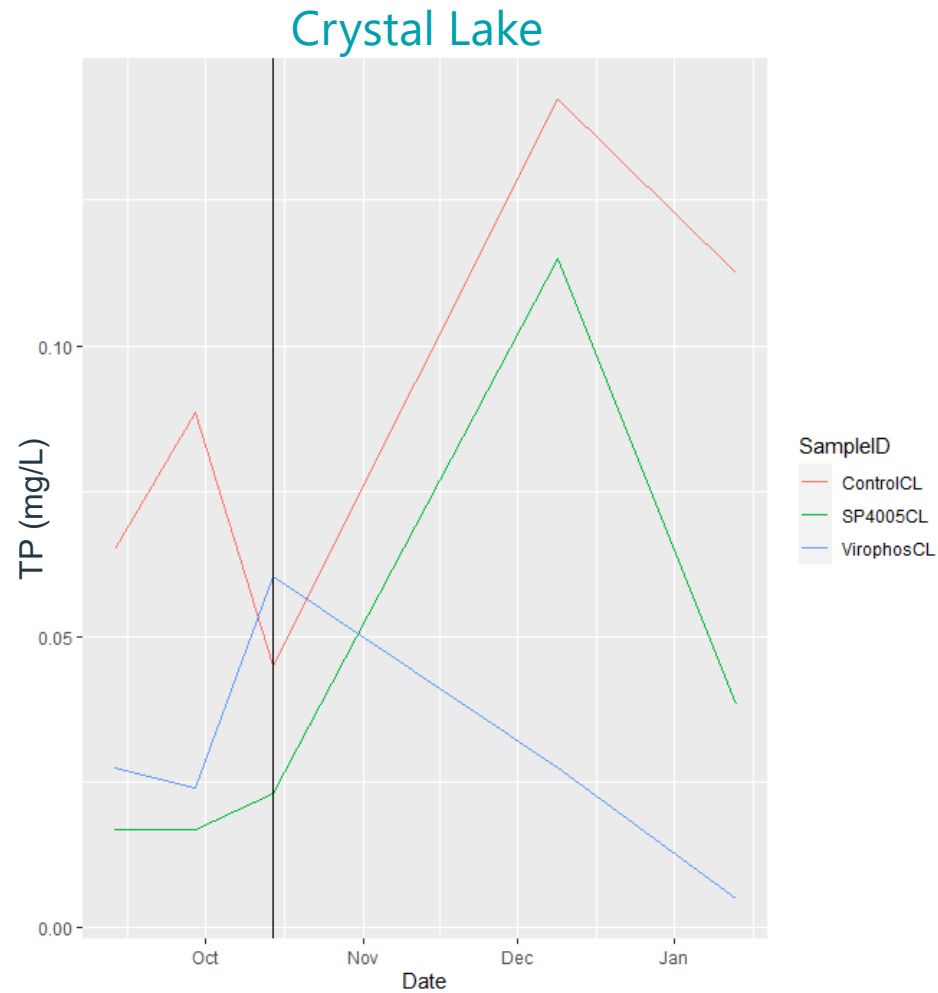
# Mesocosm Study Design

- 6 limnocorrals each in Crystal Lake and Lake Parker (2m D x 4m h)
  - 2 Virophos replicates
  - 2 Phoslock replicates
  - 2 Control replicates (bare sediment)
- Product application in October 2021
- Test period includes wet and dry seasons



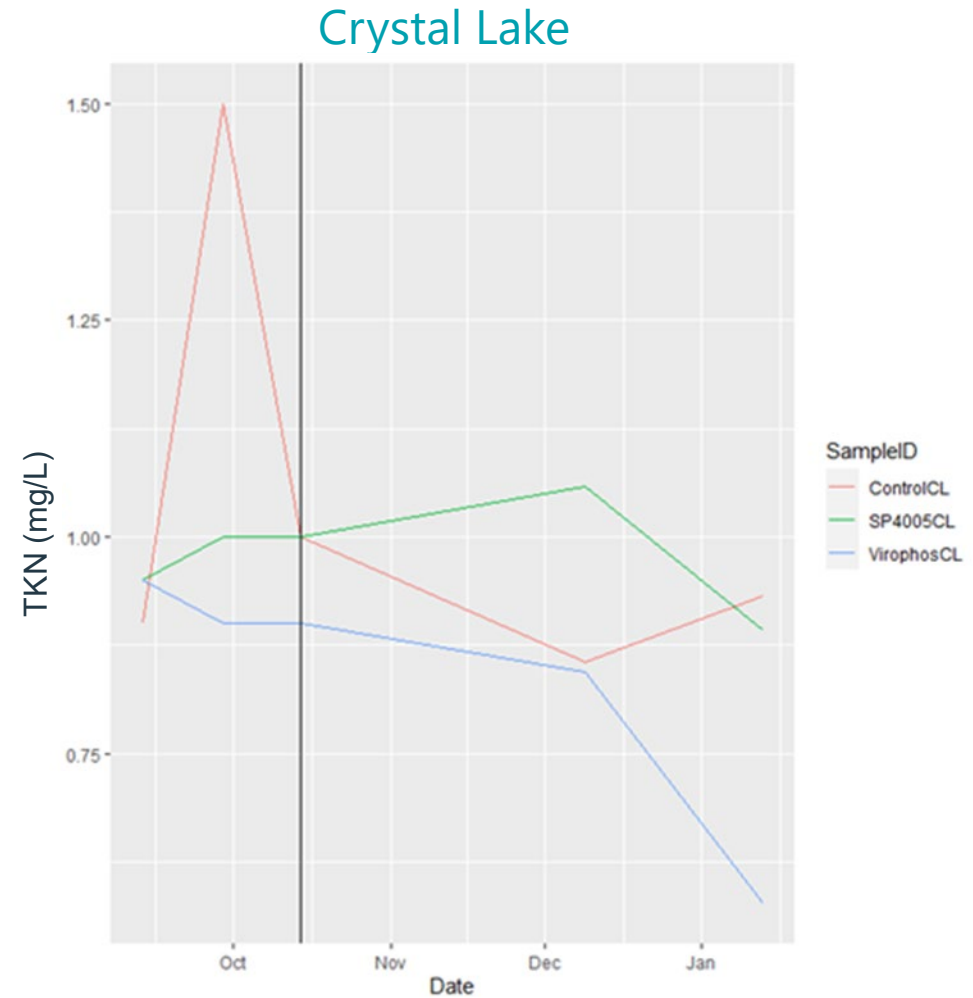
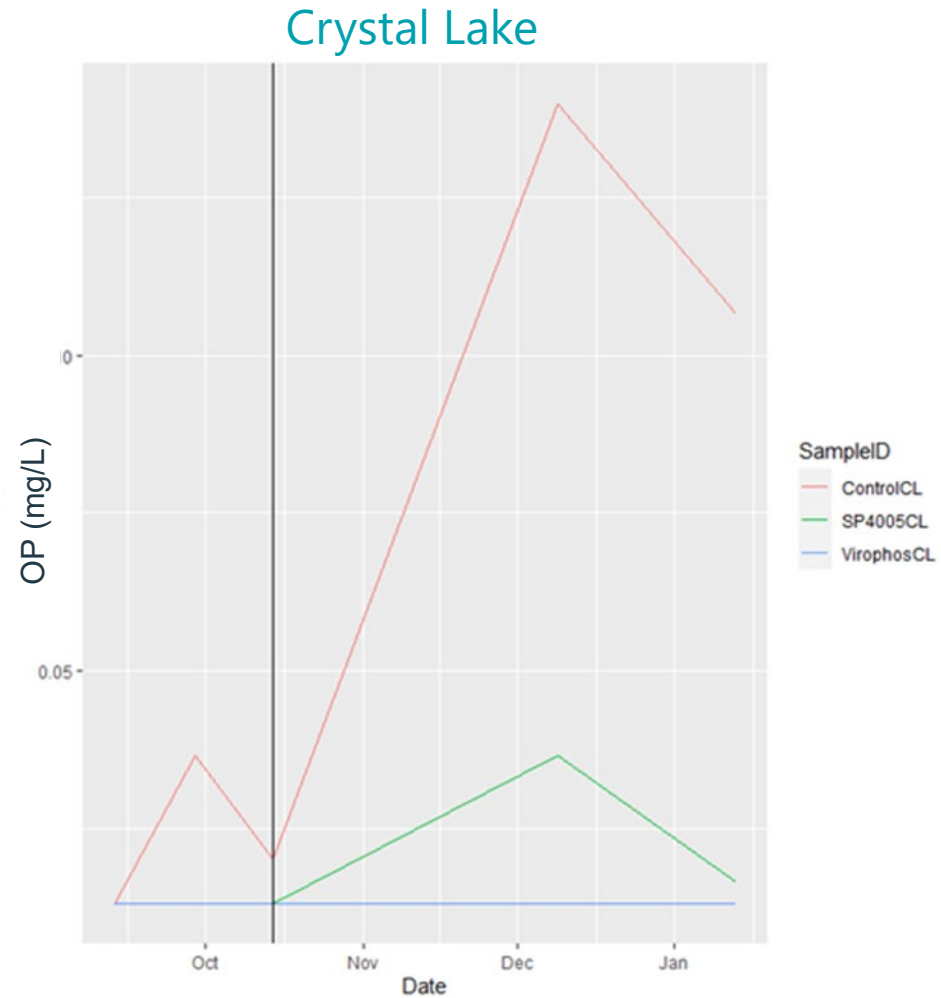
# Mesocosm Study Preliminary Results

## In-mesocosm Water Quality



# Mesocosm Study Preliminary Results

## In-mesocosm Water Quality

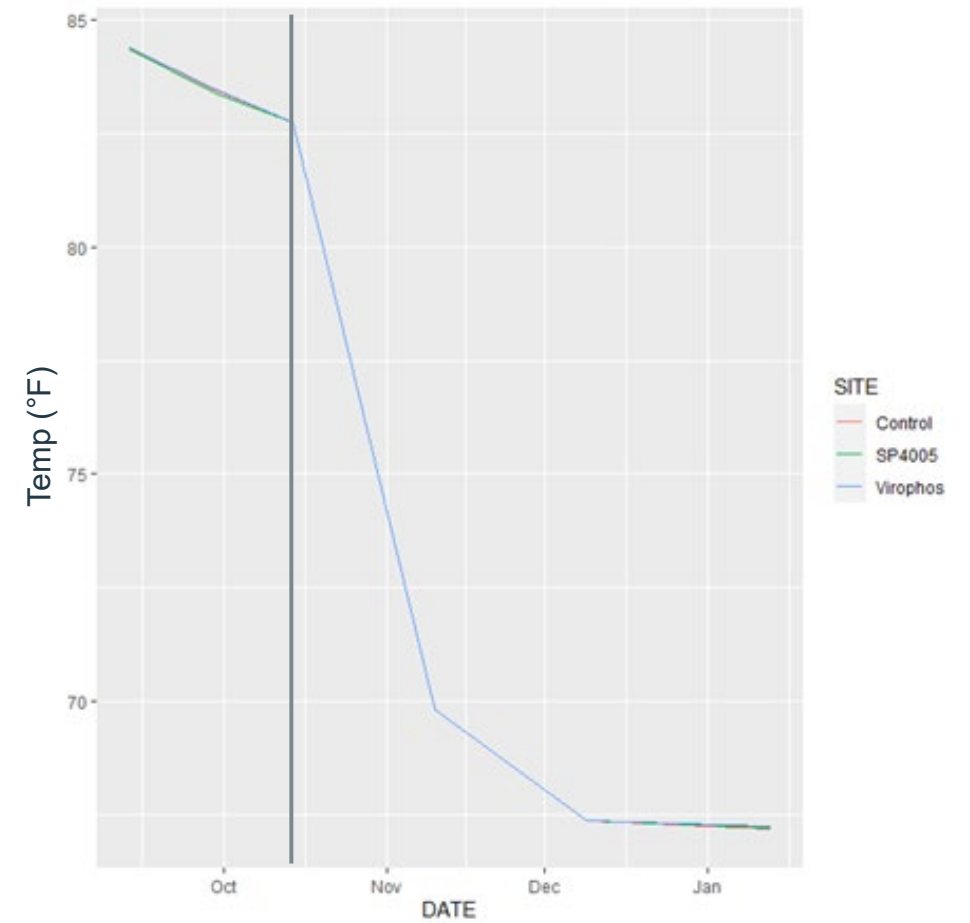
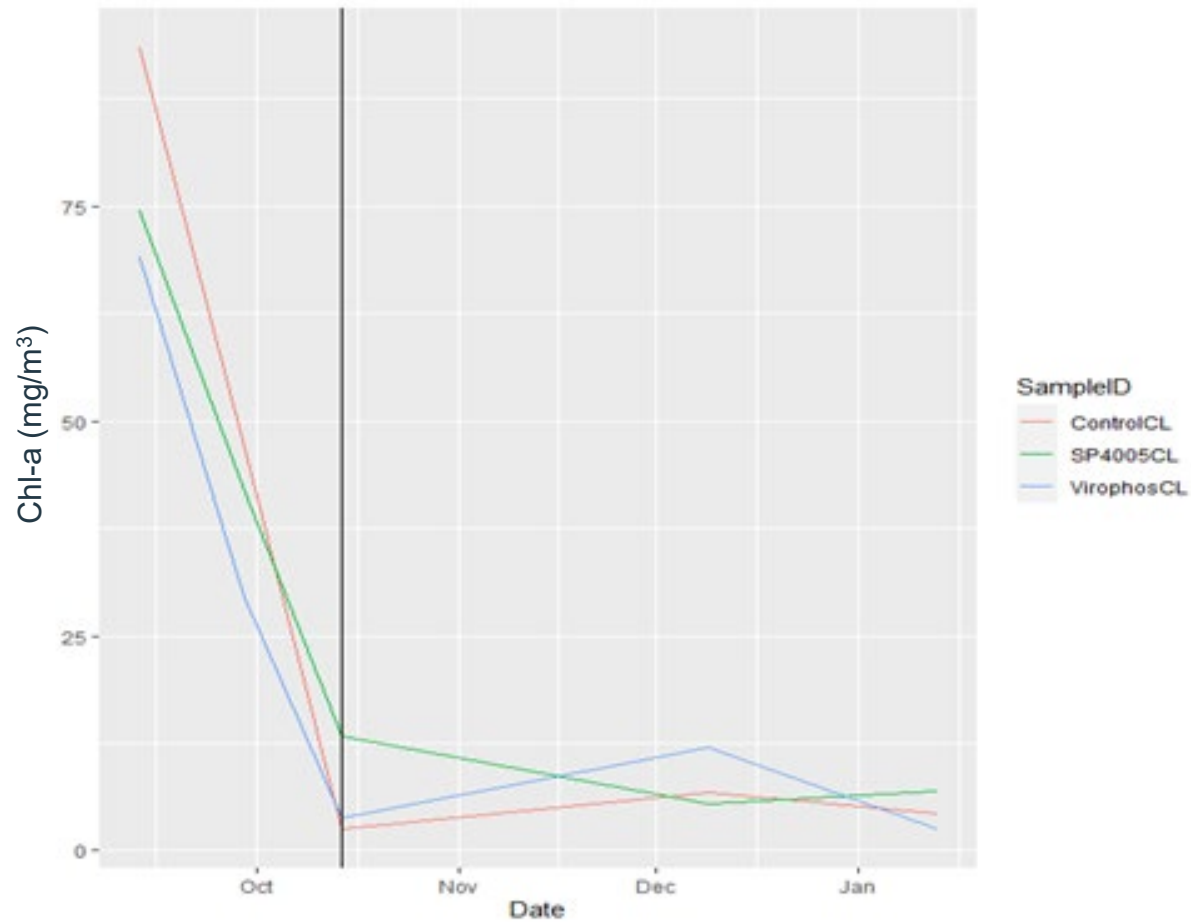




# Mesocosm Study Preliminary Results

## In-mesocosm Water Quality

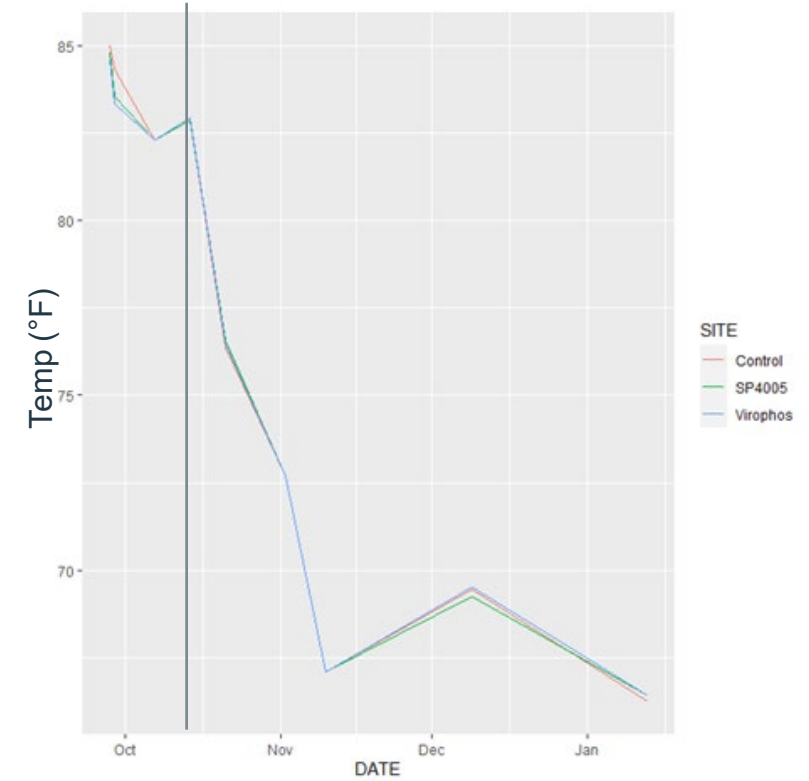
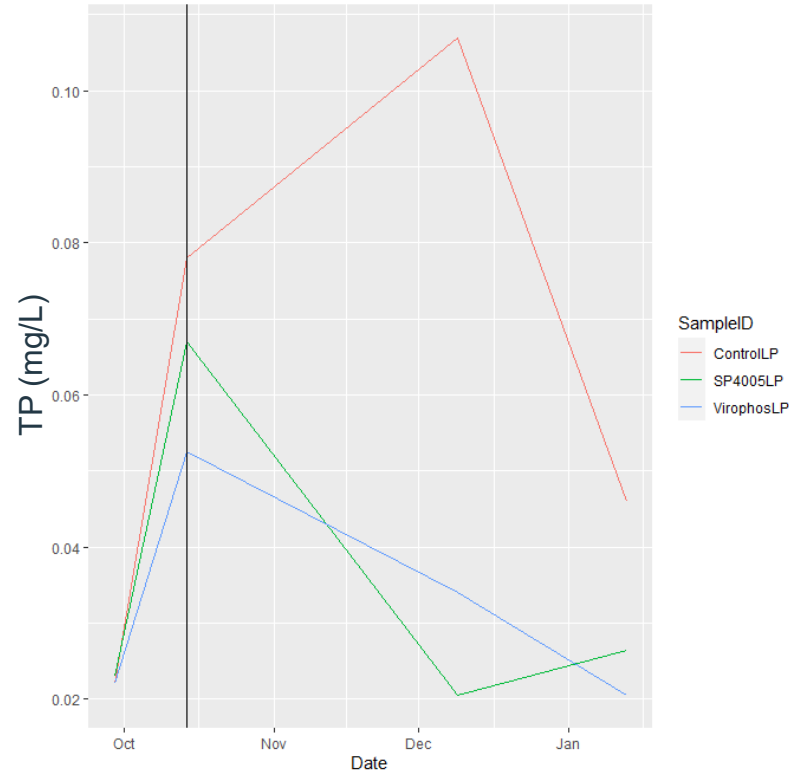
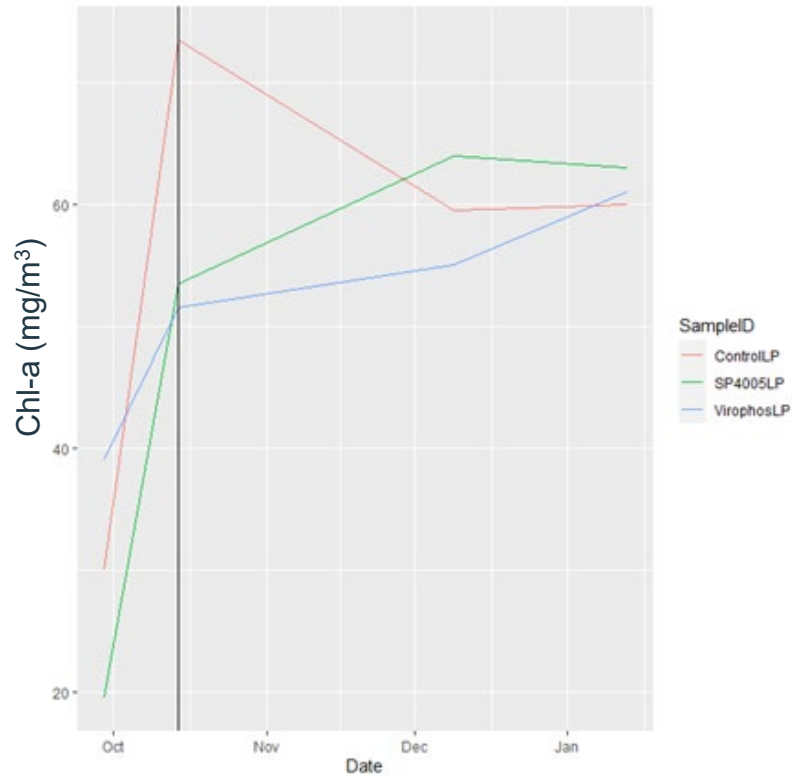
### Crystal Lake



# Mesocosm Study Preliminary Results

## In-mesocosm Water Quality

### Lake Parker



# Mesocosm Study Preliminary Results

## Sediment P Fractionation (Pre-application)

Location	% Solids	Biologically Available P (BAP)				Not Available	Total P
		Labile P	Reductant-Soluble P	Metal-Oxide P	Organic P	Apatite and Residual P	
Control	71	1	2	17	9	60	89
SP-4005	15	2	7	78	64	2,027	2,178
Virophos	65	1	2	27	24	120	140



# Summary

- Internal loading from nutrient-laden organic sediments can be a significant source of water quality impairments
- Understanding and quantifying internal loading potential is critical
- Sediment capping and chemical inactivation may result in significant load reduction that is highly cost-effective and direly needed in many lakes in FL
- Reduced internal loading can reduce HAB abundance and improve water quality
- Additional evaluation of benefits from sediment capping are needed
  - Specifically measuring the offset of additional organic sediment accumulation from internal cycling and algal proliferation
- Need to better understand how effective products are *in-situ*



\*Sediment capping projects are not **currently** permissible in Sovereign Submerged Lands

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