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# WESTERN LAKE ERIE BASIN

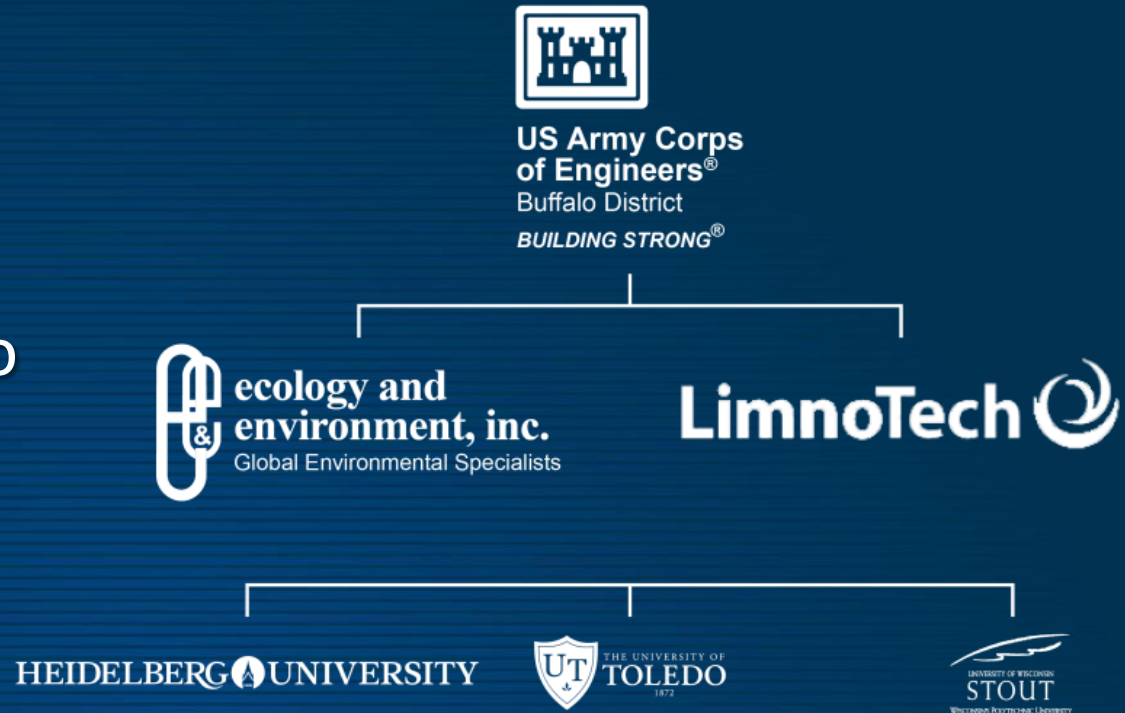
## Influence of Open-Lake Placement of Dredged Material on Harmful Algal Blooms

Presenters: Joe DePinto, Ph.D. and Ed Verhamme  
LimnoTech

October 27, 2014

# Project Team

- Ecology and Environment, Inc.
- LimnoTech
- University of Toledo
- University of Wisconsin -Stout
- Heidelberg University
- Other Data Providers:  
NOAA, USGS, and EPA



# Problem Statement

- Is open-lake placement of dredged material from Toledo Harbor a significant factor contributing to harmful algal bloom (HAB) events that have occurred in the Western Lake Erie Basin (WLEB)?
- Use field sampling and modeling analyses to assess short term and long term effects



Photo: 2014 Toledo Water Intake



# Study Area

**Open Lake Placement Area:**  
1 sq. mi. versus 1,150 sq. mi.  
for Western Basin

Open Lake  
Placement Area

Lake Mile 18

Lake Mile 11

### Toledo Intake

Oregon Intake

Maumee Bay

Maumee

Harbor View Bay

Mile 0

Cedar Point Rd

Oregon

Navarre Ave

Brown Rd

Area




Geographic Society, 2010; N

## Lake Erie

## Study Area

Toledo Harbor

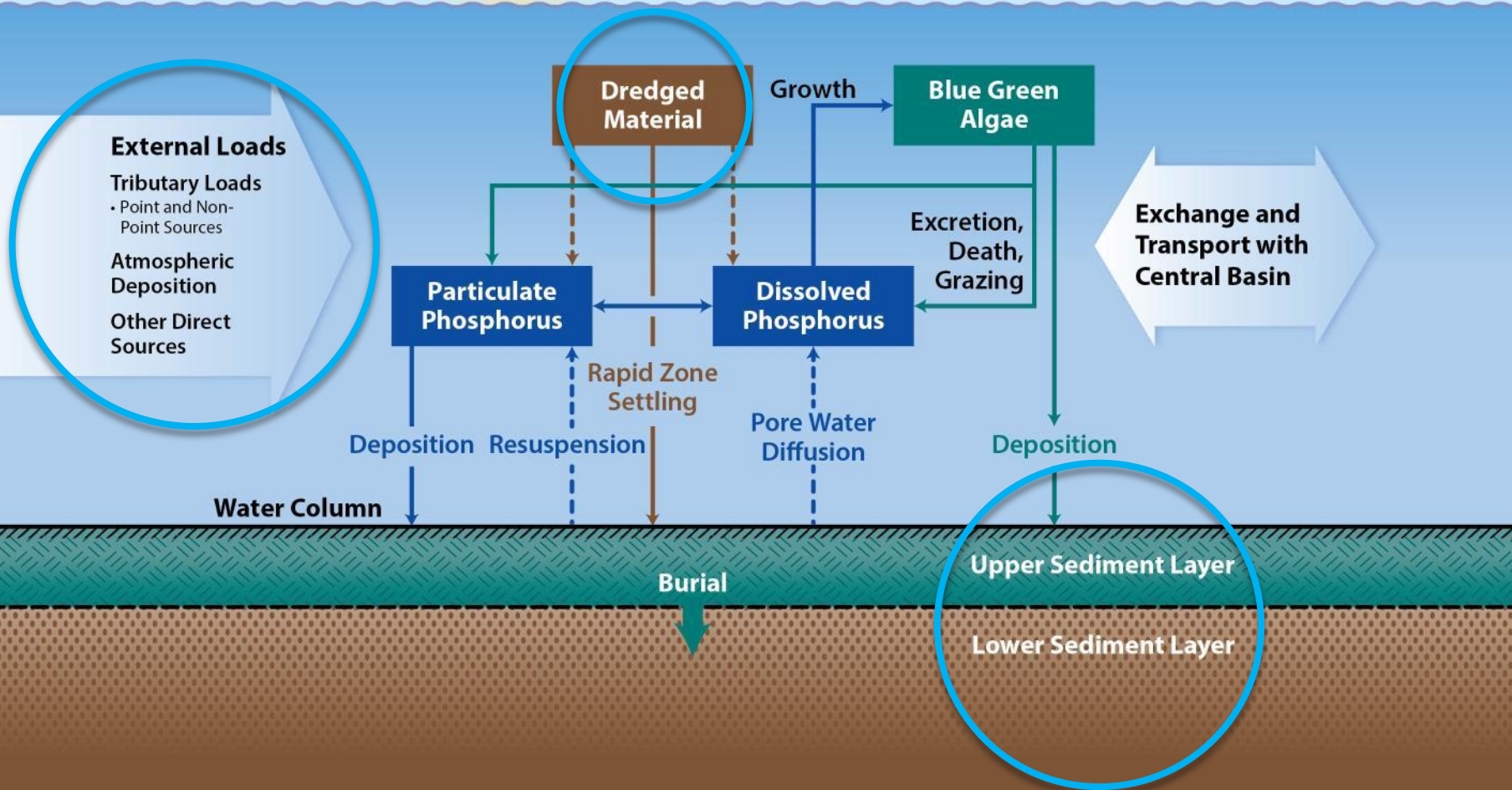
Toledo, Ohio

 Water Intake  
 Navigation Channel  
 Open Lake Placement Area

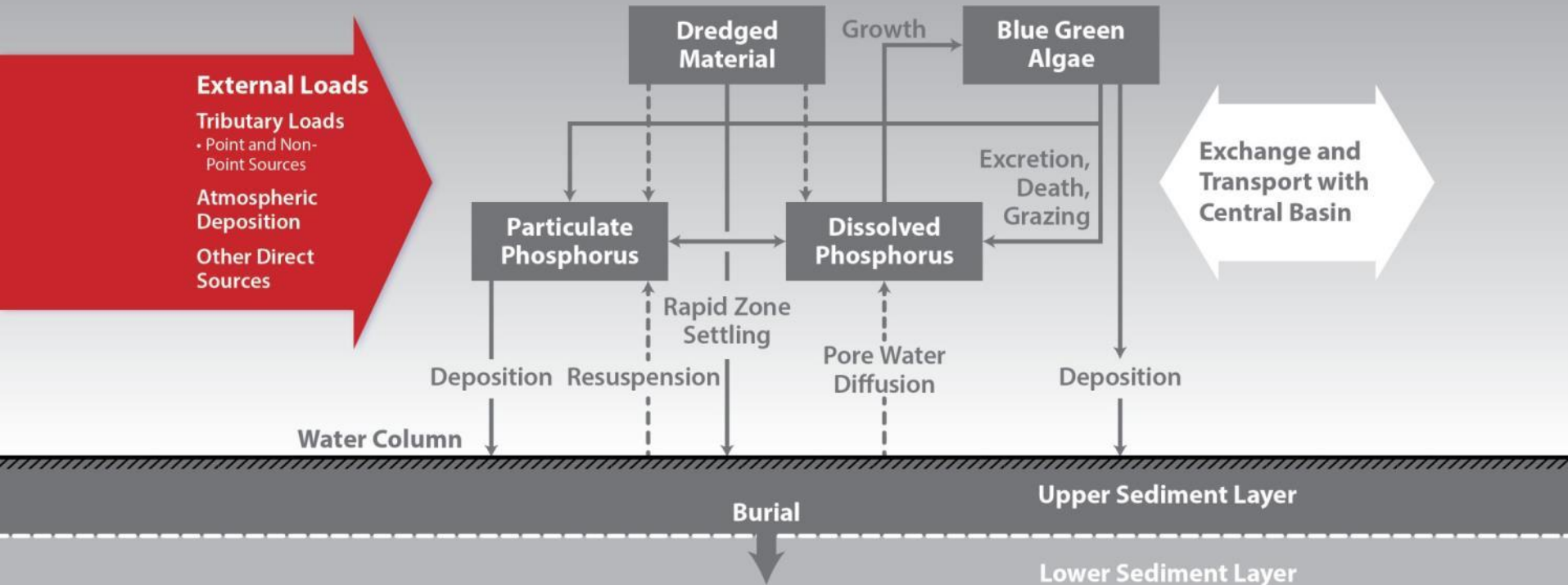
Source: ESRI 2012; Limnotech 2014; National Geographic Society, 2010; NOAA 2014.



# Conceptual Model



# External Loads



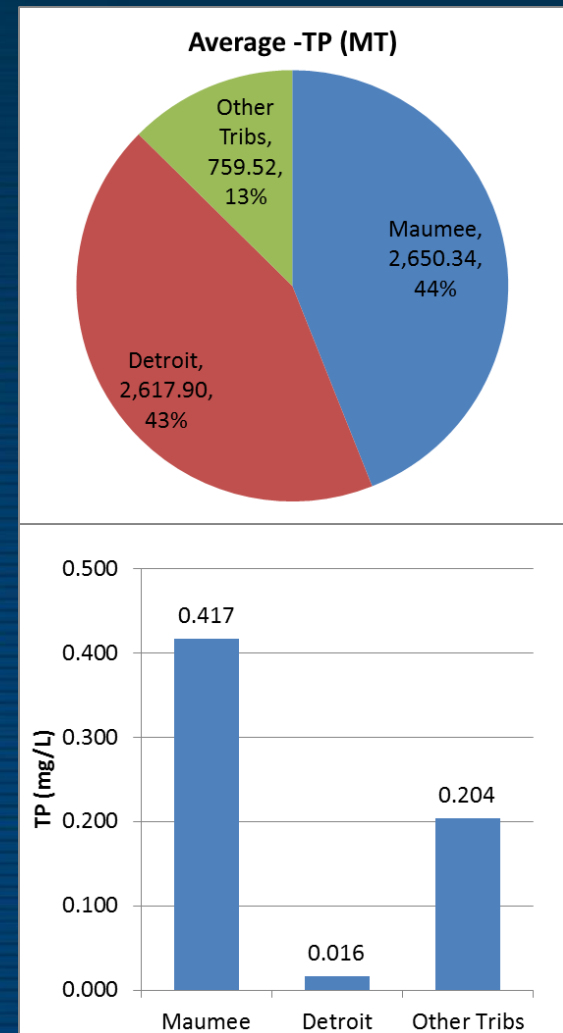
## Conceptual Model



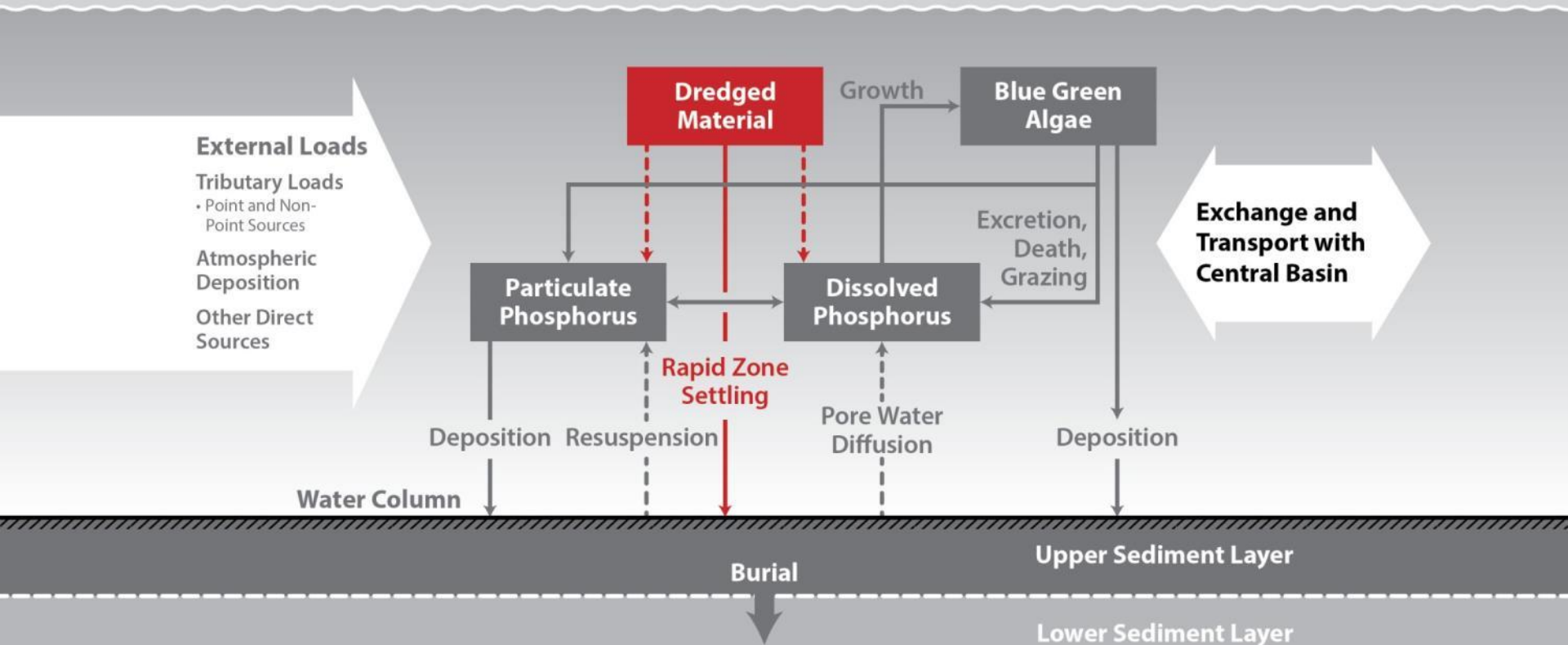
## External TP Load

*The Maumee River higher mean TP concentration is just what cyanobacteria need to form HABs*

- Maumee River TP Load delivers very high TP concentration ( $>0.4$  mg TP/L) to Western Basin during high flow events in spring.
- The Detroit River has a large load, but very low TP concentration.
- Other tributaries/sources have a relatively small TP load.



# Dredged Material



## Conceptual Model



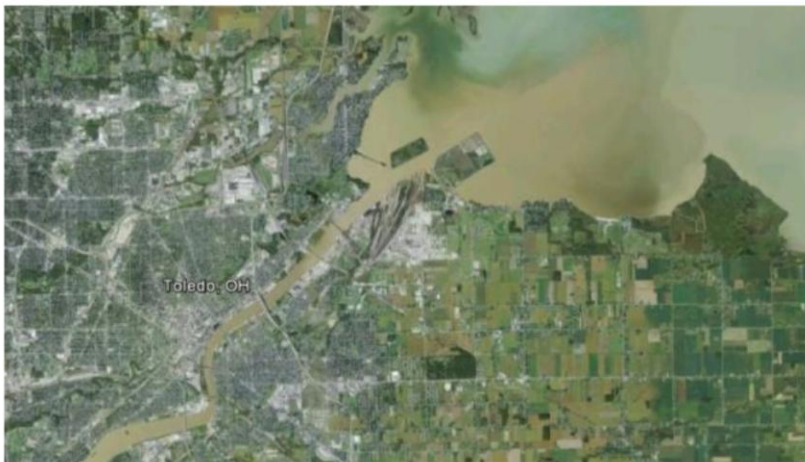
# Toledo Harbor Dredging

## ■ Toledo Harbor

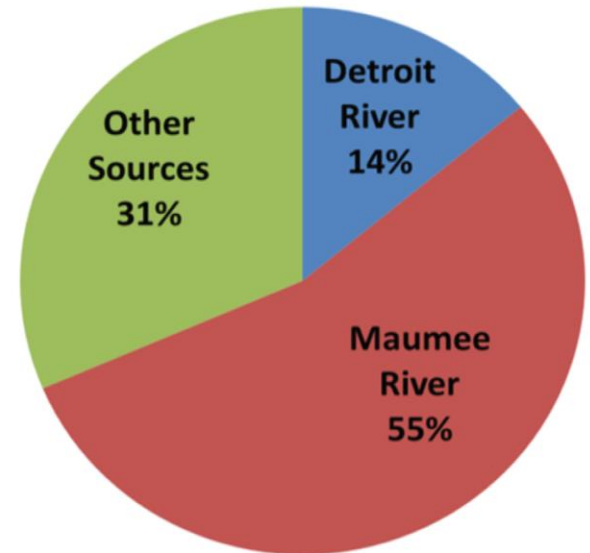
- ~1/4 of total Great Lakes maintenance dredging cost (highest in Great Lakes)
- Designated a “critical” dredged material management area
- 760,000 CY (20 yr. avg.)  
85% from Bay Channel

## ■ Sediment sources to Federal navigation channels

- Maumee River is dominant loading source
- Wind-wave resuspension focuses Maumee-delivered and other sediments into navigation channel

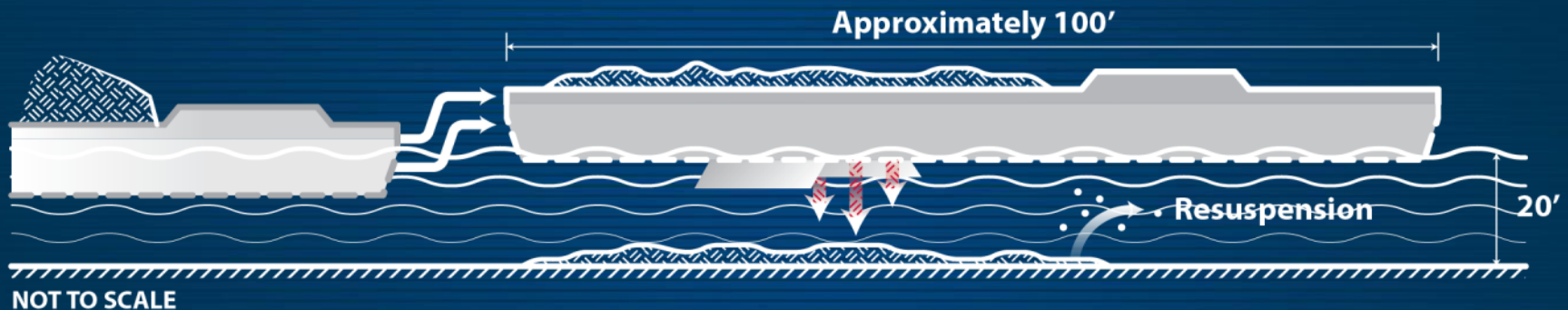


Western Lake Erie  
Basin: 2006-12  
Sediment Load  
Distribution



# 2013 Open Lake Placement

- Mechanical dredging with placement into 1,500 CY scow
- Placement events occur ~6x per day between July and October (675 total)
- Scows have a draft of 10 feet and placement occurs in 15-20 feet of water. Placement takes <1min



# Field Sampling Overview

- Short-term event sampling
  - Monitored placement events on six different days
  - Collected vertical profiles
  - Grab samples of nutrients & solids
  - Dredged material sampling
- Long-term monitoring
  - Continuous water quality sondes
  - Grab samples
  - Sediment (June & October)
    - Cores
    - Surface grabs
    - Phosphorus flux
    - Sediment traps

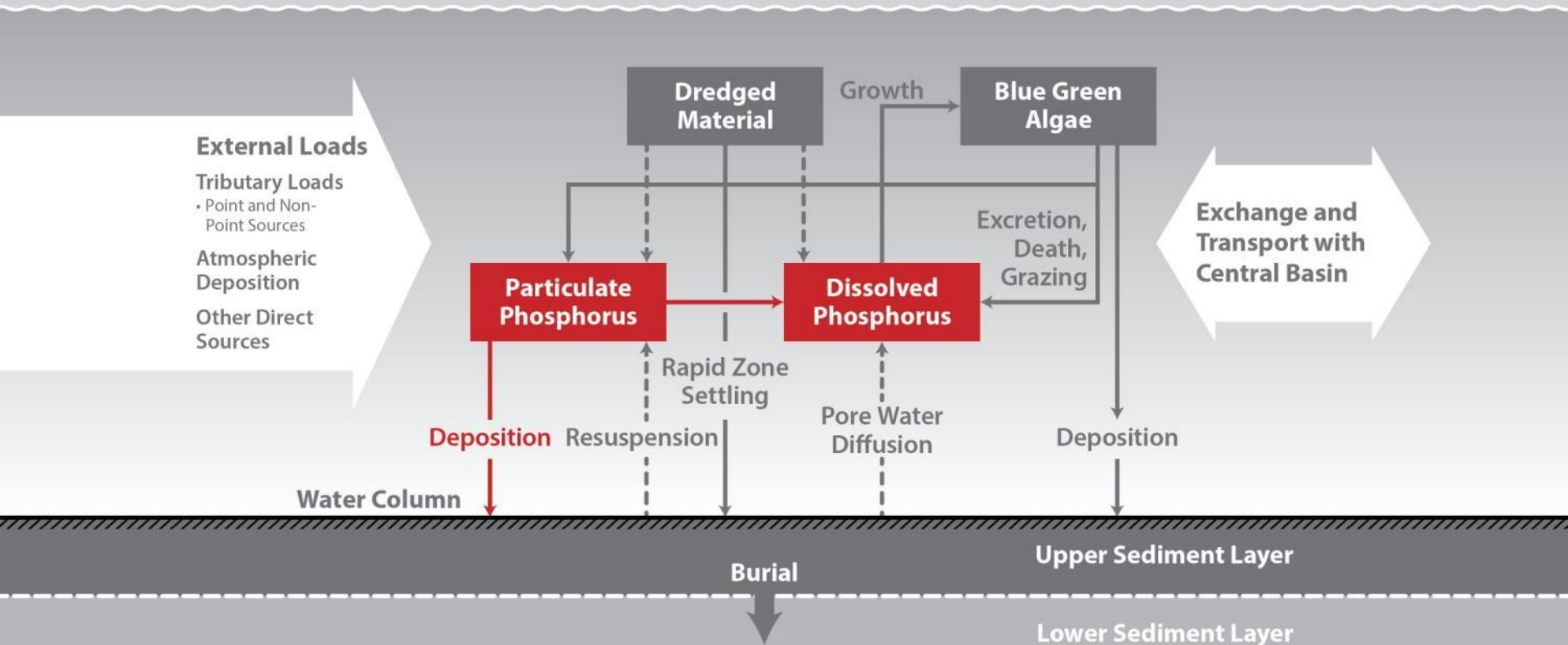








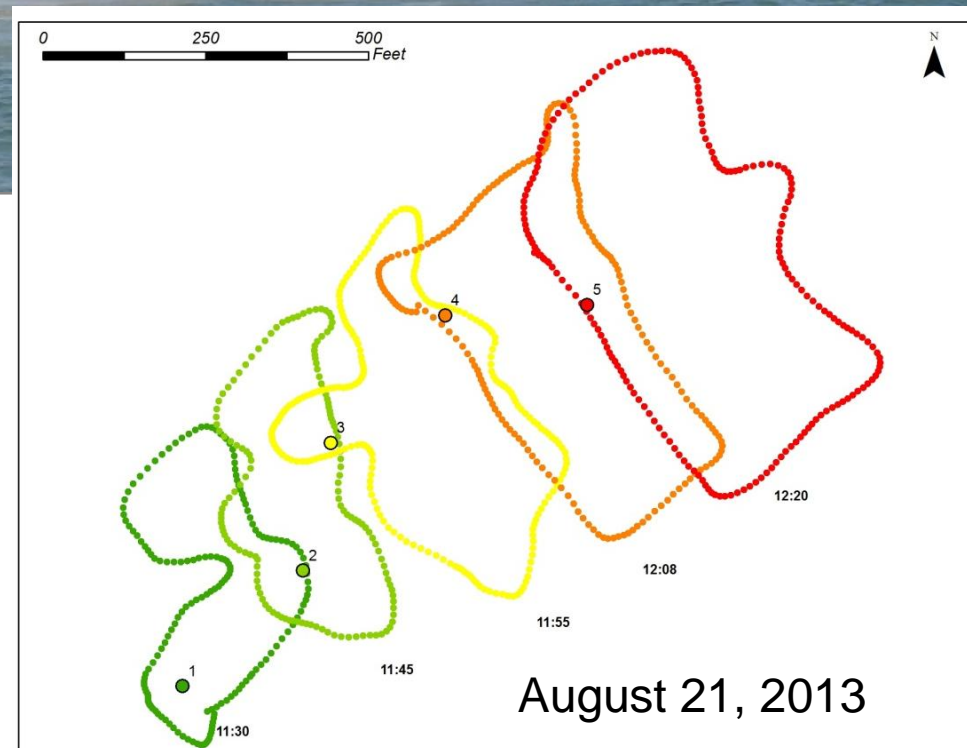
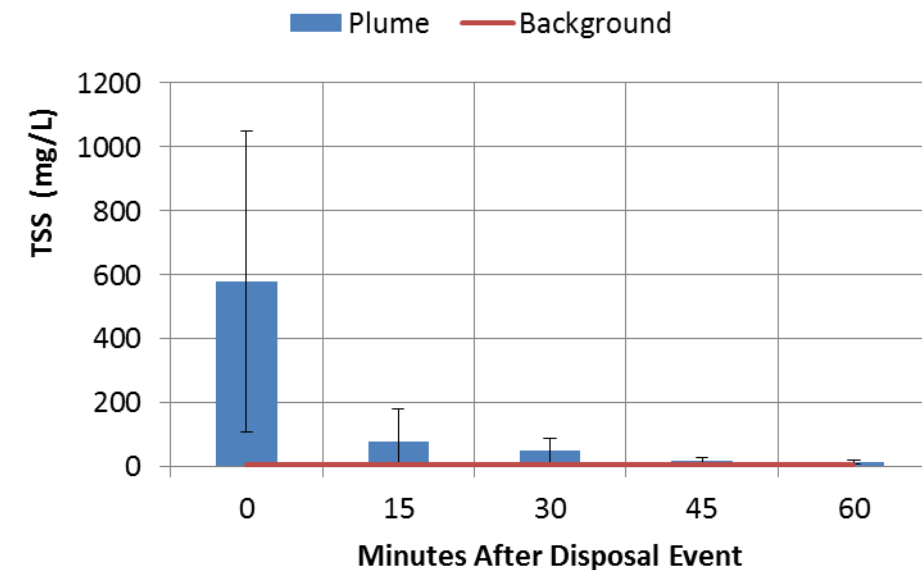
# Water Quality



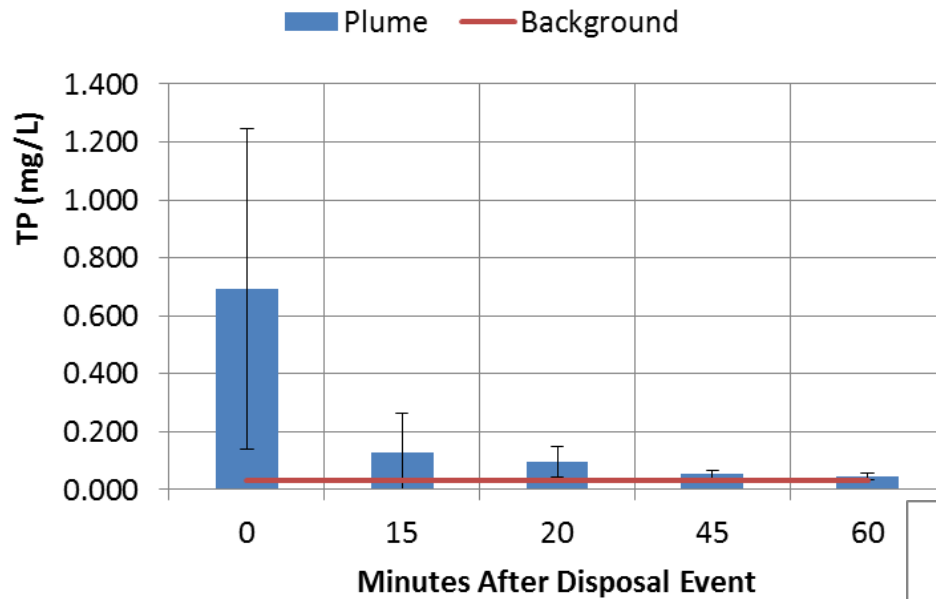
## Conceptual Model

# Short Term - Plume Tracking

*97.5% of placed material settles immediately  
remaining 2.5% within an hour*

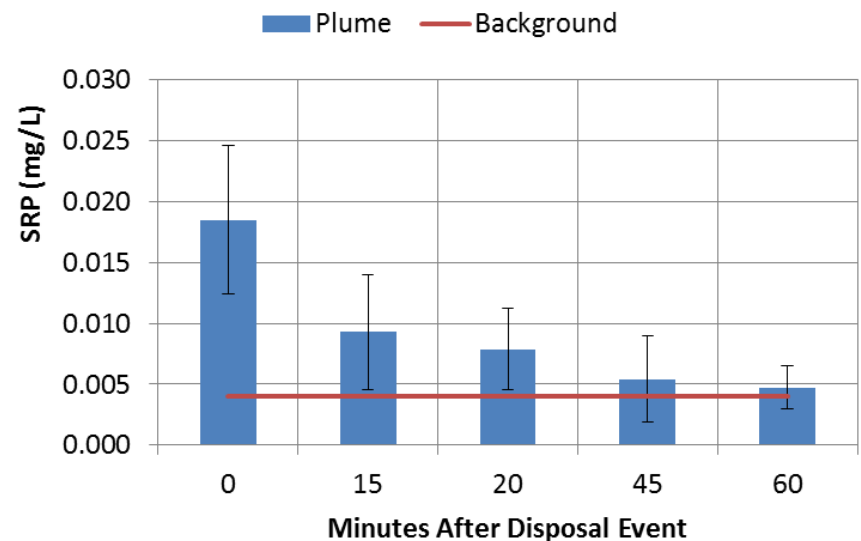


# Plume Tracking

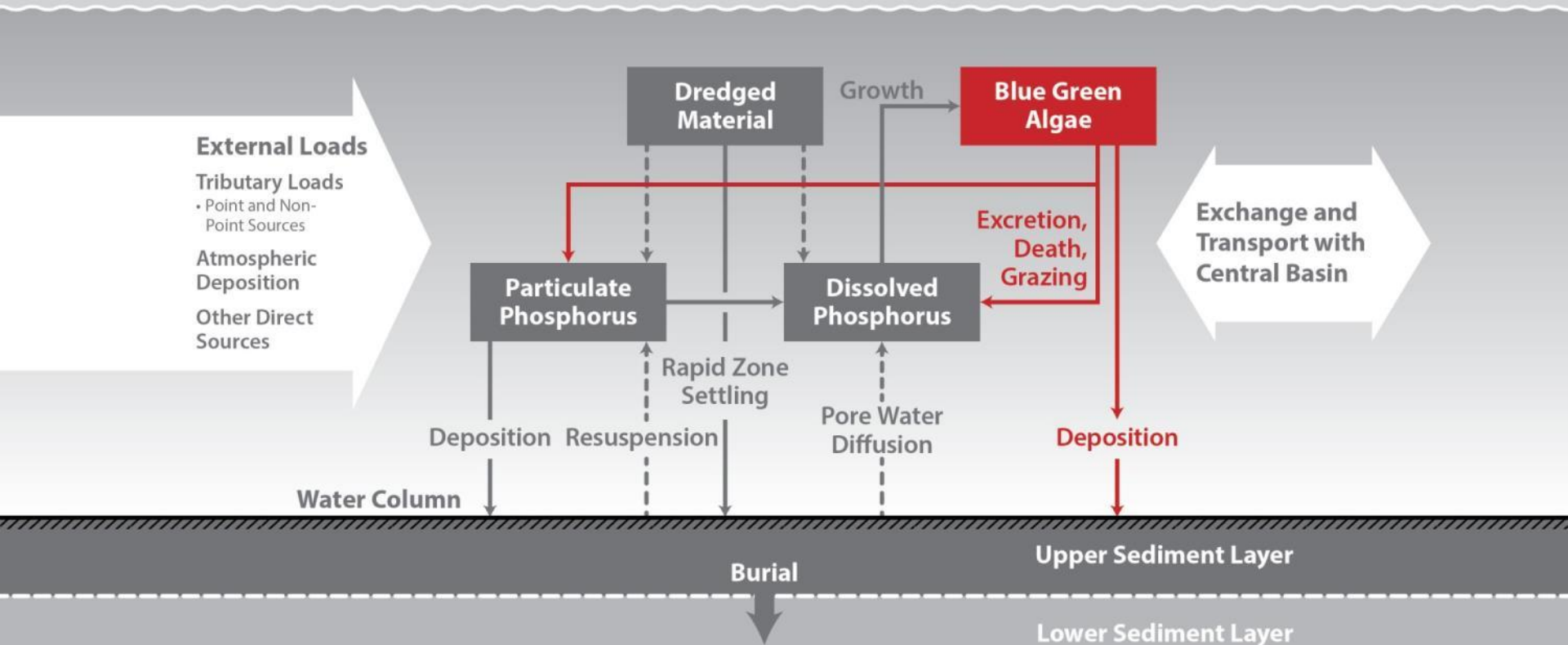


*TP in water column reaches background levels within an hour (through settling and dispersion).*

*SRP in water column reaches background levels within an hour (through dispersion).*



# Biological

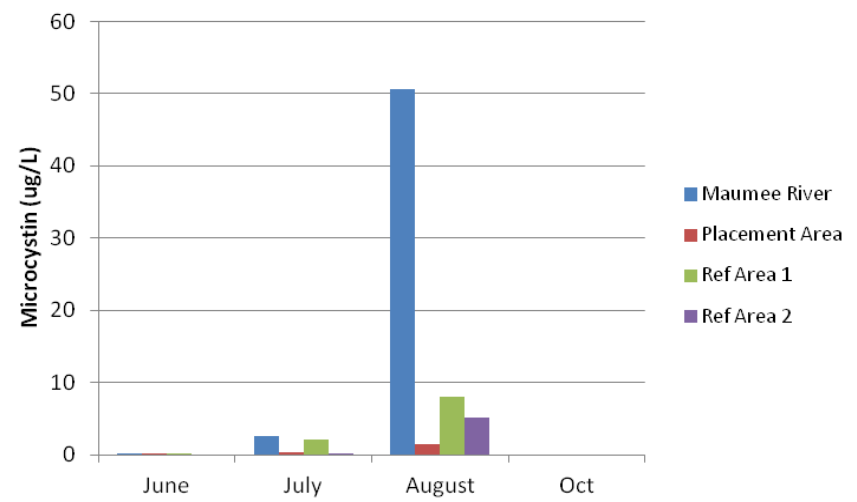
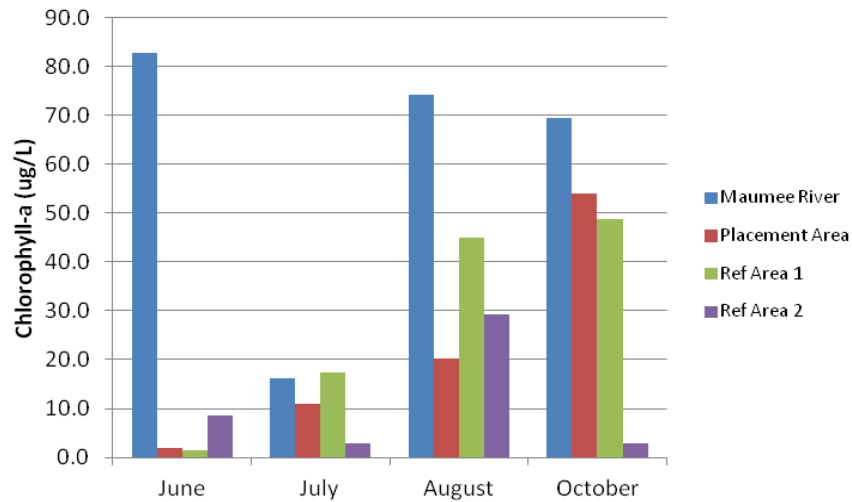


## Conceptual Model

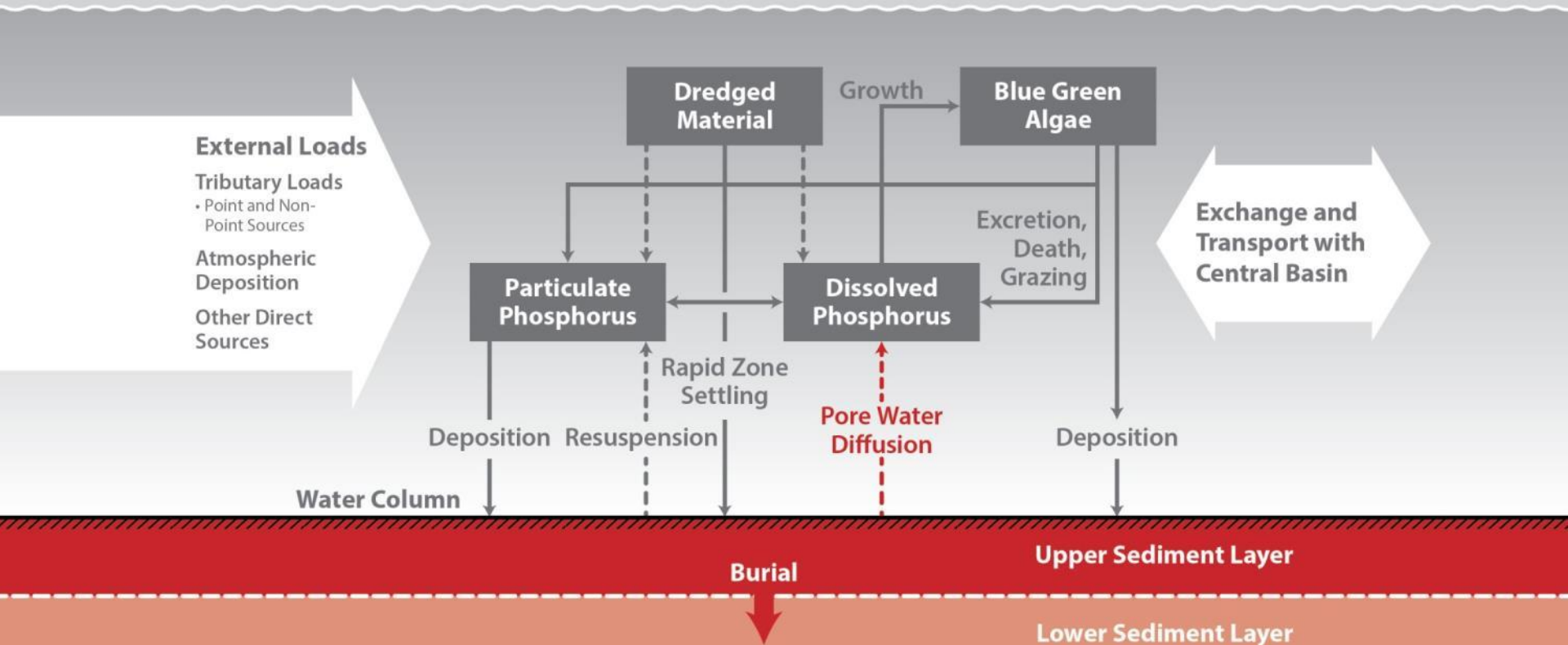


# Biological Results

*Concentrations of Phytoplankton are highest at the Maumee River Mouth*



# Sediment

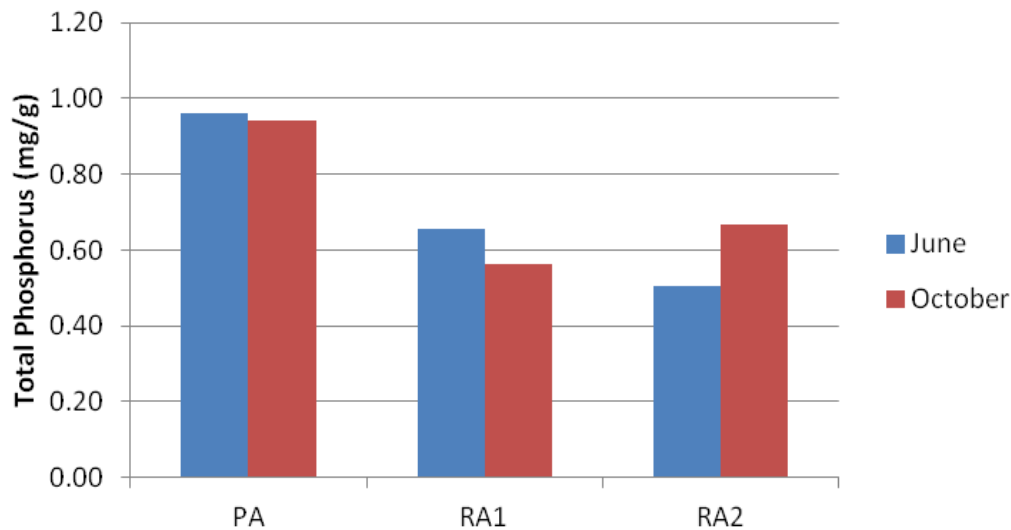


## Conceptual Model

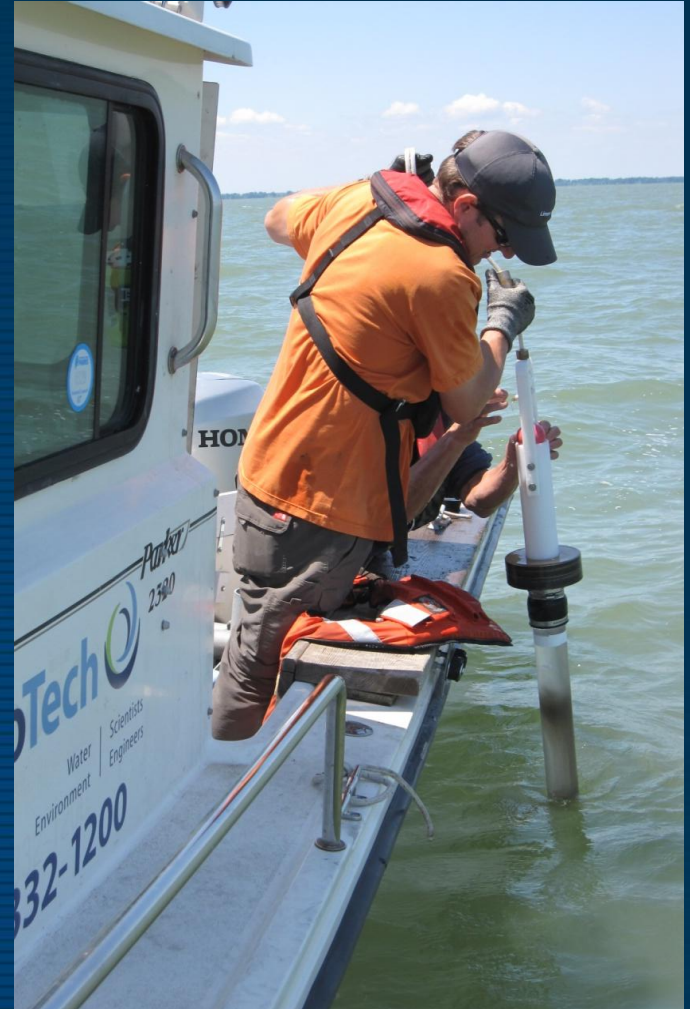
# Sediment Results

*Sediment concentrations of TP at the placement site and reference areas are similar, but lower than Maumee River suspended sediment.*

Sediment Total P

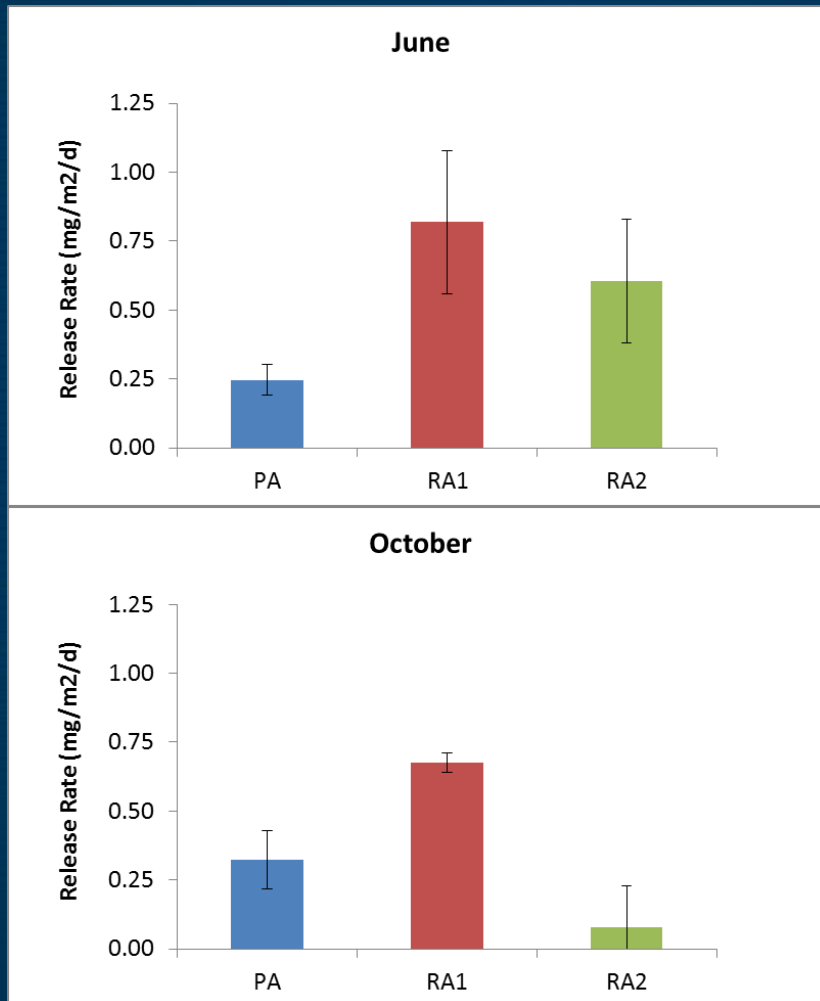


Maumee River Suspended  
Sediment: 3.5 mg/g



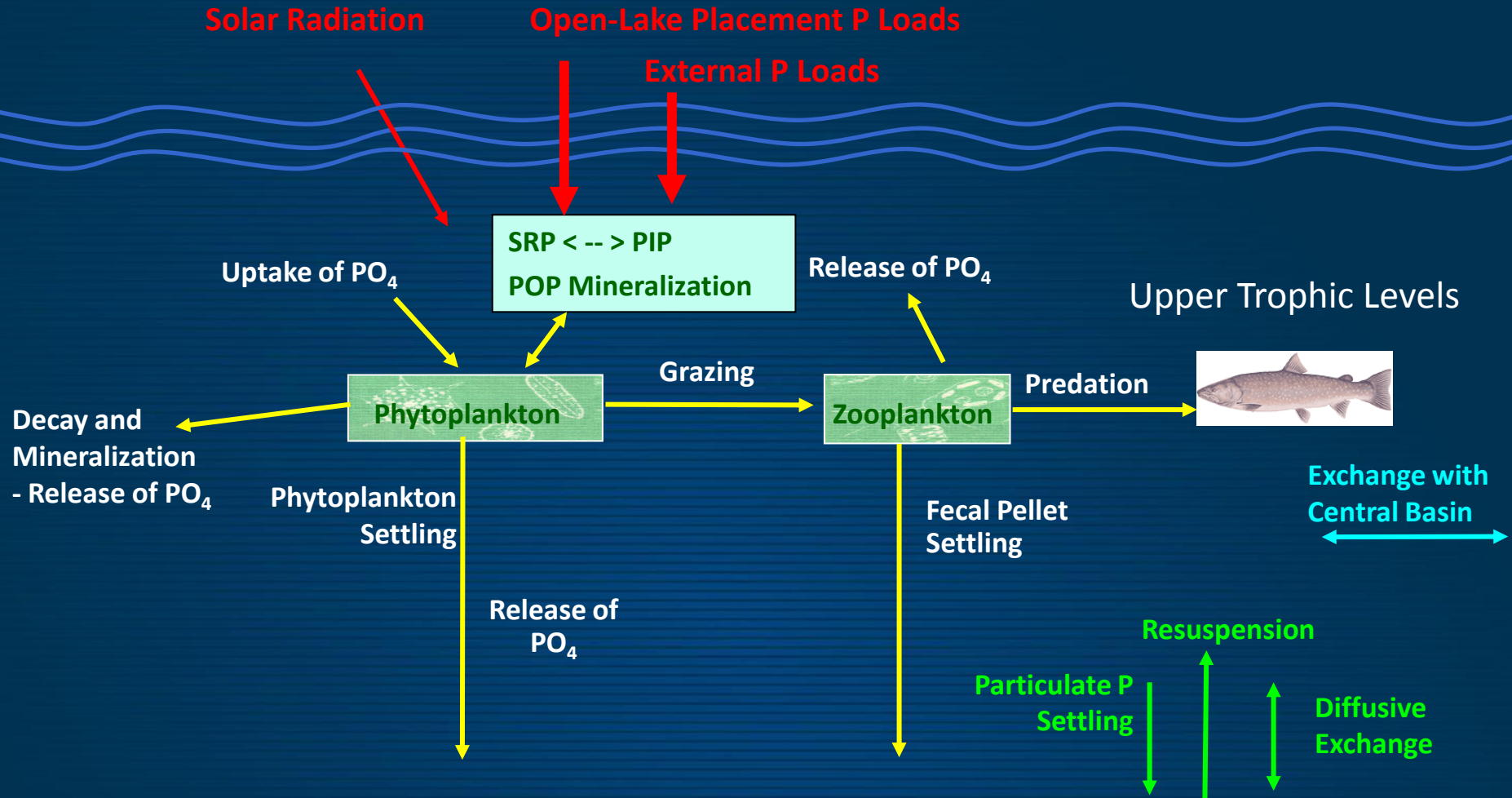
# Sediment P Aerobic Release Rates

*Phosphorus diffusion from the sediment in the placement area is lower than the rest of WLEB and <0.04 % of total diffusive load.*





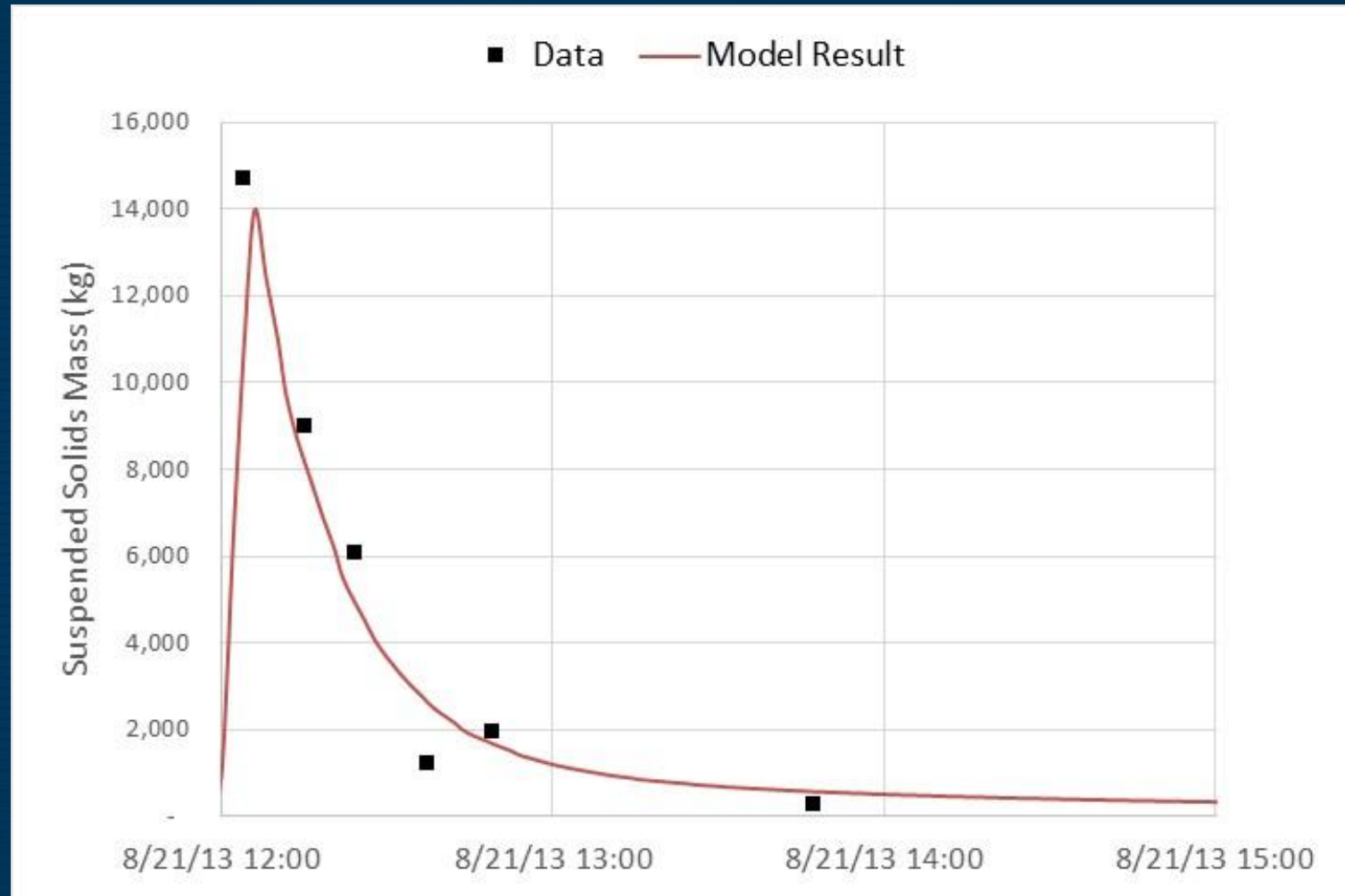
# Western Lake Erie Ecosystem Model (WLEEM) - Phosphorus Cycling



PIP: Particulate Inorganic Phosphorus  
POP: Particulate Organic Phosphorus

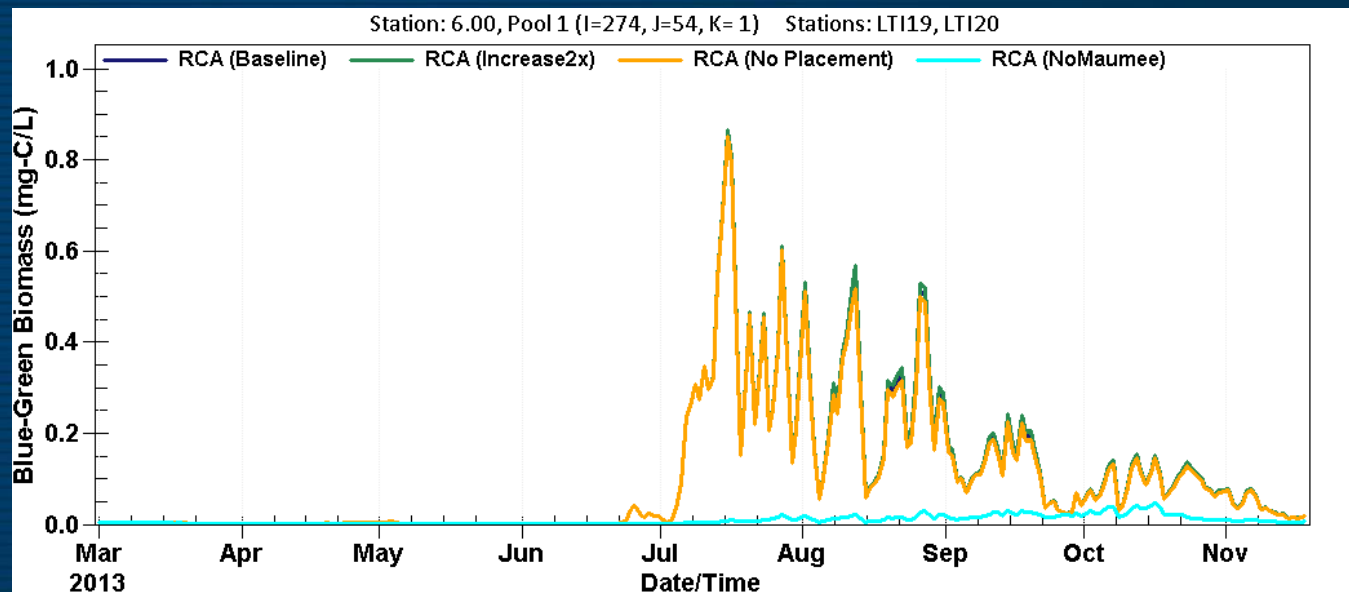
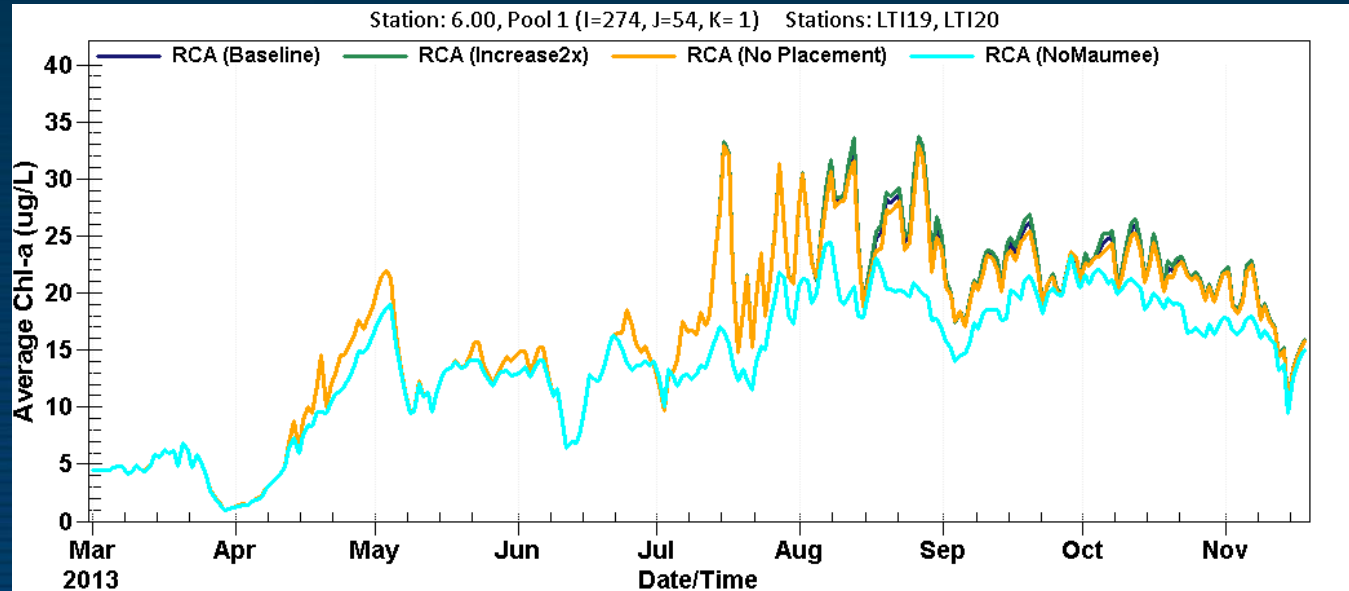
# Model Calibration

*Model captures deposition of open lake placed material very well.*



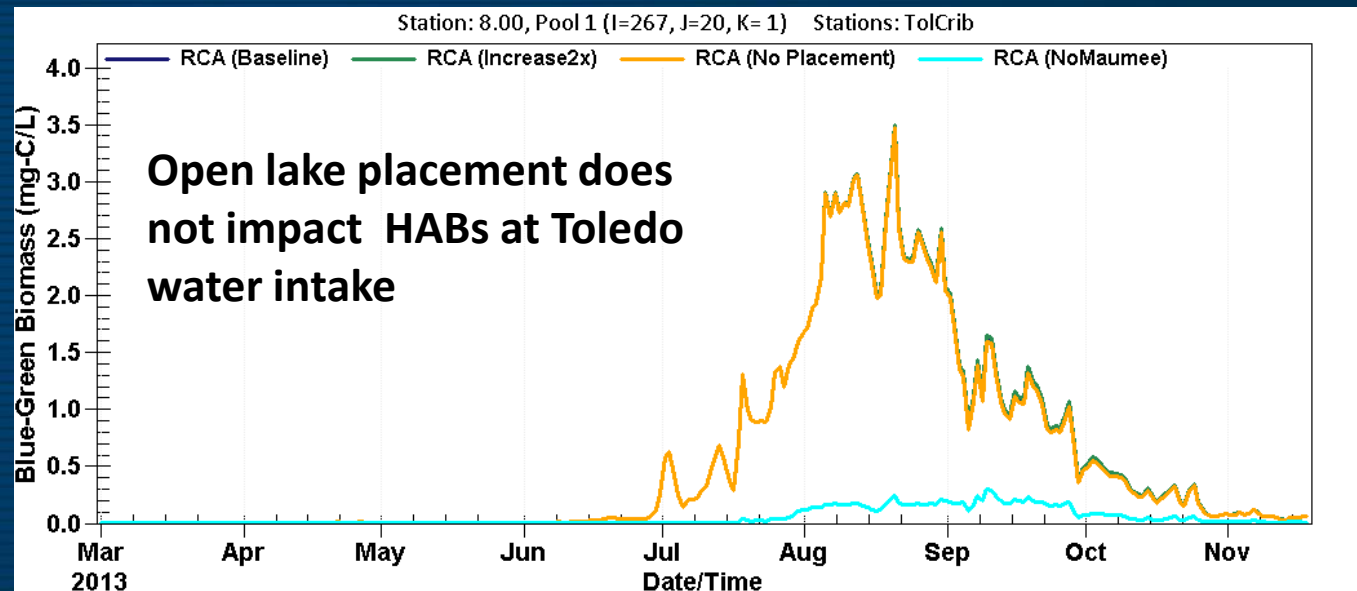
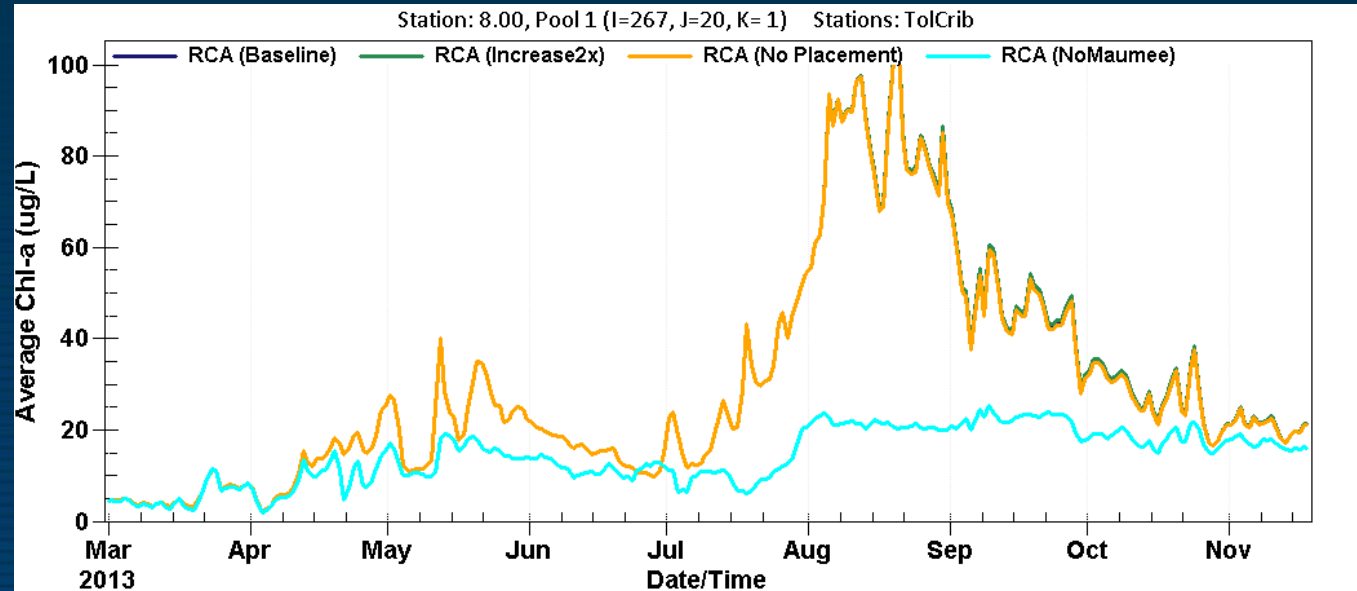
# Model Results - Placement Site

Baseline  
Increase  
Placement  
No  
Placement  
No Maumee



# Model Results - Toledo Water Intake

Baseline  
Increase  
Placement  
No  
Placement  
No Maumee





# Summary

- > 95% of barge-released dredged material deposits very quickly as a single mass to the sediments at the open-lake placement site.
- Residual water column suspended sediment and phosphorus concentrations following placement return to near-background levels within an hour through settling and dispersion.
- Cyanobacteria measurements at placement and reference areas match current scientific understanding of bloom development and movement in WLEB.

# Summary

- Sediment and associated phosphorus from the placement area resuspend and deposit at the same rate as other areas of similar depth in WLEB.
- TP concentrations are 4x higher in Maumee River suspended sediment than placement and reference area sediment.
- Placement area bathymetry measurements show deposited material has not been spread throughout the Western Basin.
- Sediment pore water from the placement area is not a significant source (<0.04% of total diffusive P budget) of bioavailable phosphorus.

# Conclusions

- Open-lake placement of dredged material does not contribute to the development of HABs in the Western Basin of Lake Erie.
- Removing dredged material from the basin would not reduce HABs.
- Our study conclusions are in agreement with the scientific consensus that reducing HABs should focus on Maumee River phosphorus loading.

## Questions?

The HAB report is available at the following link:

<http://www.lrb.usace.army.mil/Portals/45/docs/PublicReview/R-WLEB-Final-Report.pdf>