

Development of a Fine-scale Ecosystem Model for the Western Basin of Lake Erie (WLEEM)

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LimnoTech Projects in the Maumee Basin & Western Lake Erie

- “Blanchard Watershed Modeling” (2010) - AnnAGNPS
- “Tiffin River Watershed Modeling” (2012) – SWAT
 - Funding source: USACE – Buffalo District
- “Development of Lower Maumee River/Bay Model” (2010)
 - Funding source: USACE – Buffalo District
- “Great Lakes Ecological Sustainability Strategy” (2014)
 - Funding source: Great Lakes Protection Fund
- “Extreme Event Impacts on WQ in the Great Lakes” (2015)
 - Funding source: National Science Foundation
- “Evaluation of Toledo Harbor Deposition” (2013)
 - Funding source: GLRI via USACE – Buffalo District
- “Influence of Open-Lake Placement of Dredged Material on Western Lake Erie Harmful Algal Blooms” (2014)
 - Funding source: USACE – Buffalo District

**“Western Lake
Erie Ecosystem
Model”
(WLEEM)**

Western Lake Erie Ecosystem Model (WLEEM) Objectives

- Model ecological response of Western Basin of Lake Erie to external (e.g., Maumee Watershed) and internal (e.g., wind-driven resuspension) sources:
 - Sediment $\Rightarrow$ sedimentation and turbidity
 - Nutrients $\Rightarrow$ nuisance & harmful algal blooms
- Support **Management** and **Research** in WLEB:
 - Link with Maumee watershed model to quantify response to current sediment and nutrient loads and to specific changes in watershed land use and management actions (e.g., BMPs)
 - Simulate in-lake responses to climate change driven extreme event scenarios
 - Support the quantification and analysis of GLRI metrics for sedimentation and harmful algal blooms in the Maumee River/Bay and Western Basin



Western Lake Erie Ecosystem Model (WLEEM)

“Simulating Waves
Nearshore” (SWAN)

EFDC Model

Wind-Wave
Sub-Model

Hydrodynamics

- Water level
- Current velocity

Hydrodynamic
Sub-Model

- Current
velocity

Wind-Waves

- Significant height
- Direction
- Frequency

Shear
Stress

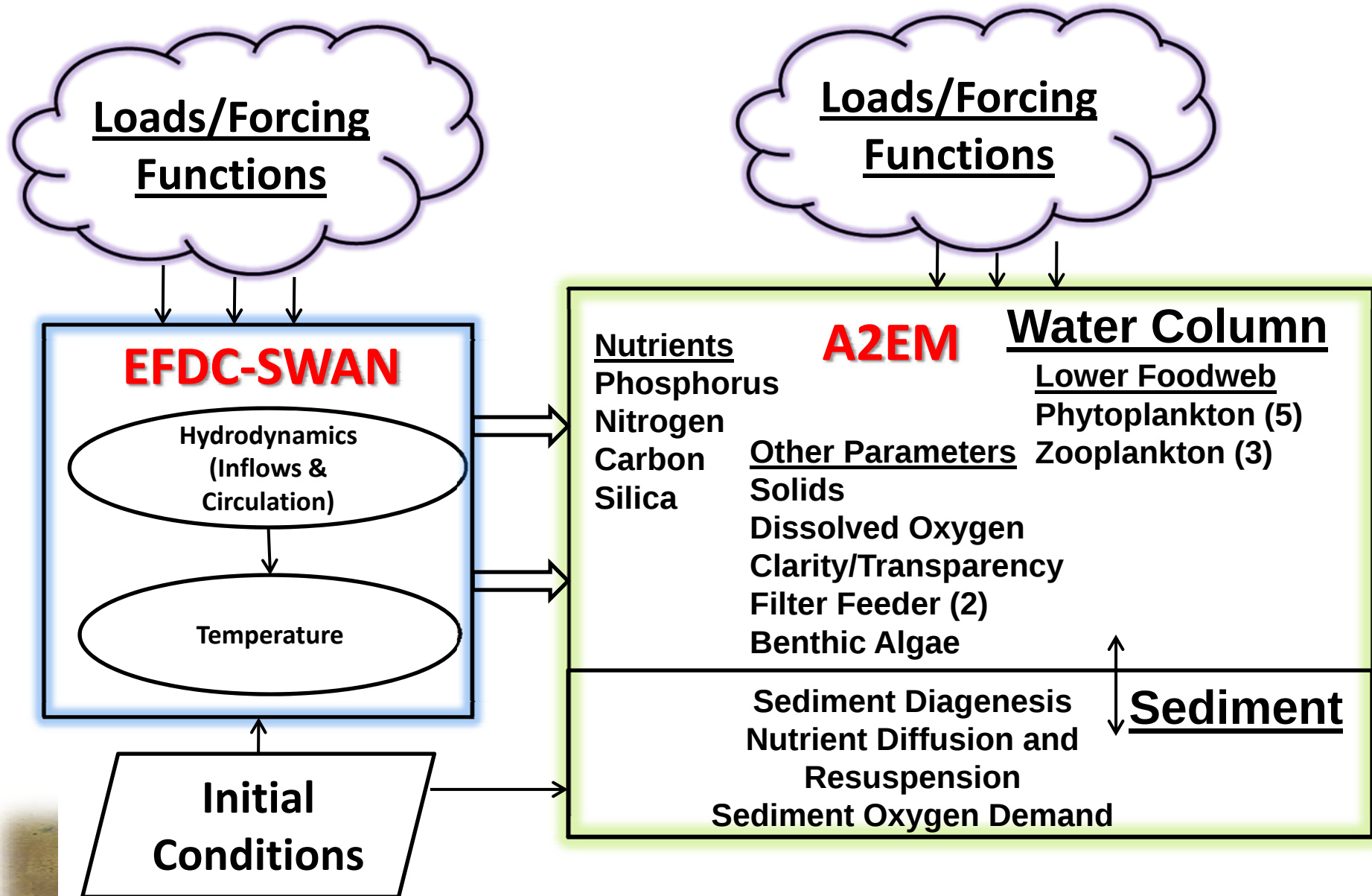
Sediment Transport
Sub-Model

Nutrient &
Eutrophication
Sub-Model (A2EM)

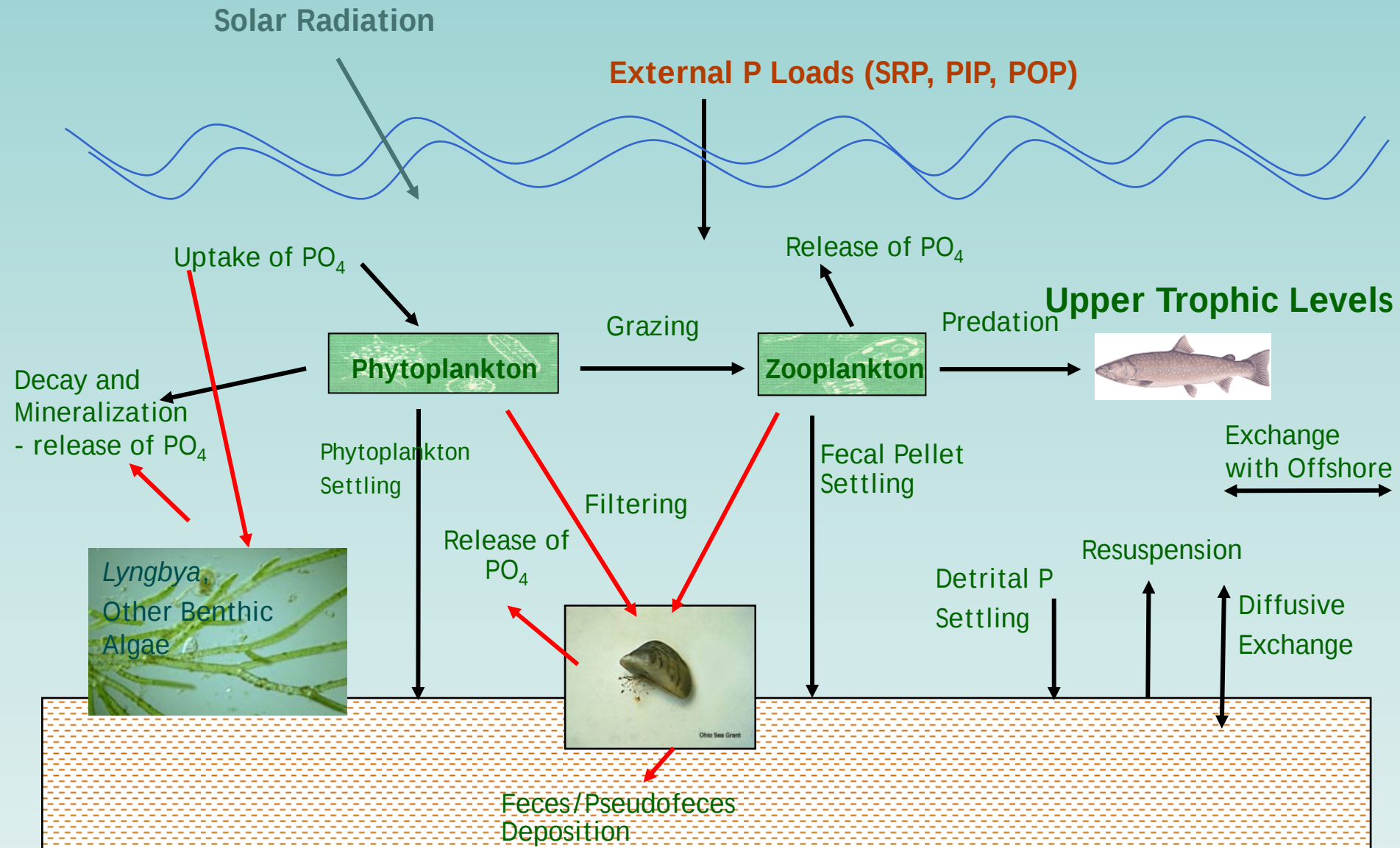
Water Quality Linkage

- Flows
- Suspended solids
- Settling/resuspension rates

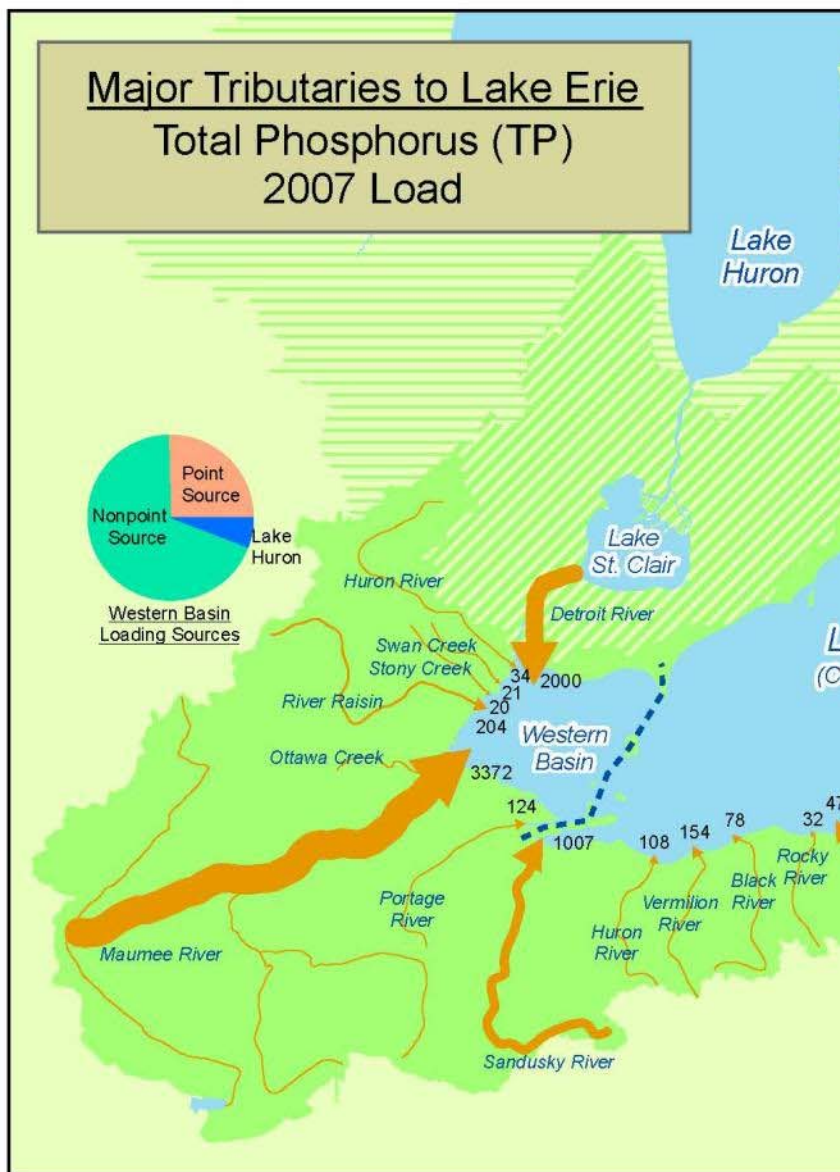
WLEEM (EFDC-A2EM)



Phosphorus Cycling in WLEEM



Major Tributaries to Lake Erie Total Phosphorus (TP) 2007 Load



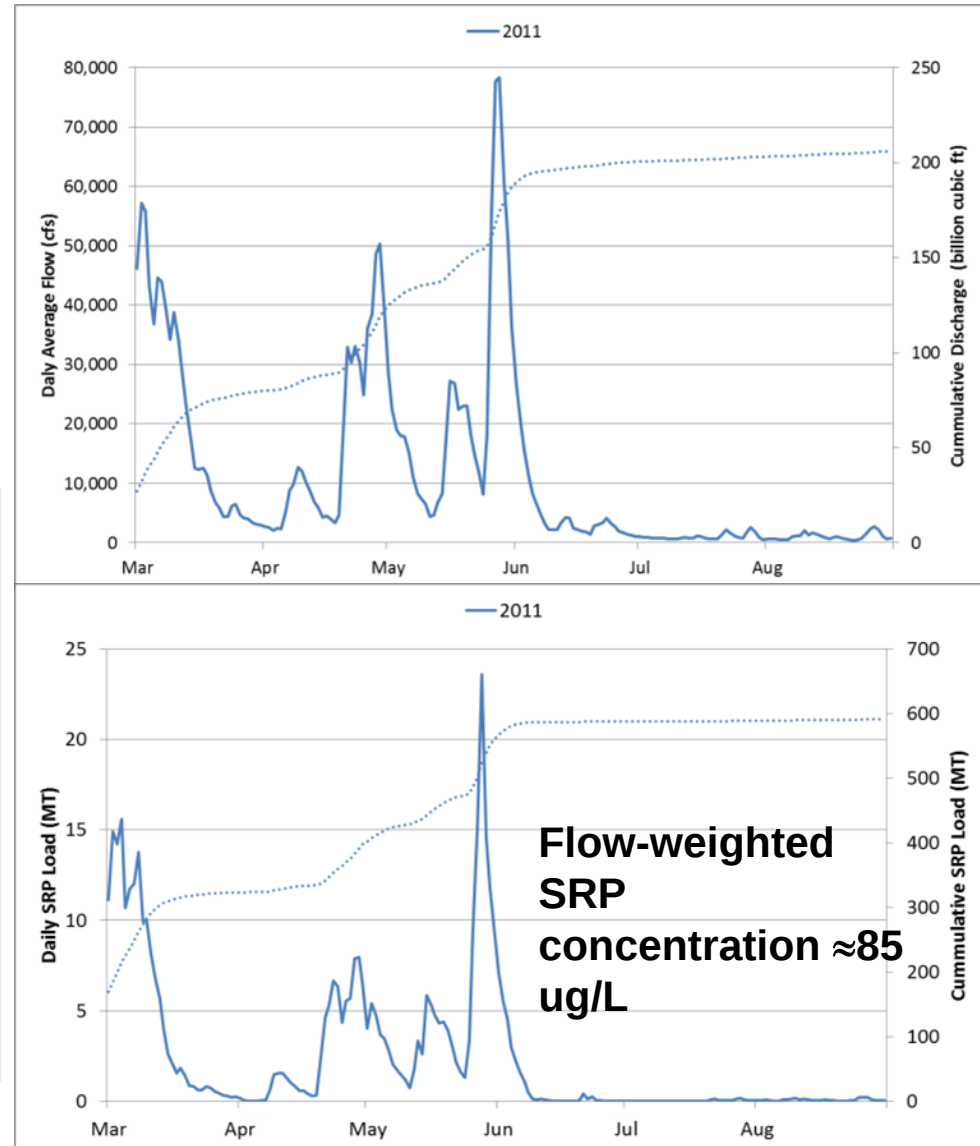
Major Tributaries to Lake Erie Soluble Reactive Phosphorus (SRP), 2007 Load



Maumee phosphorus load fueled 2011 bloom

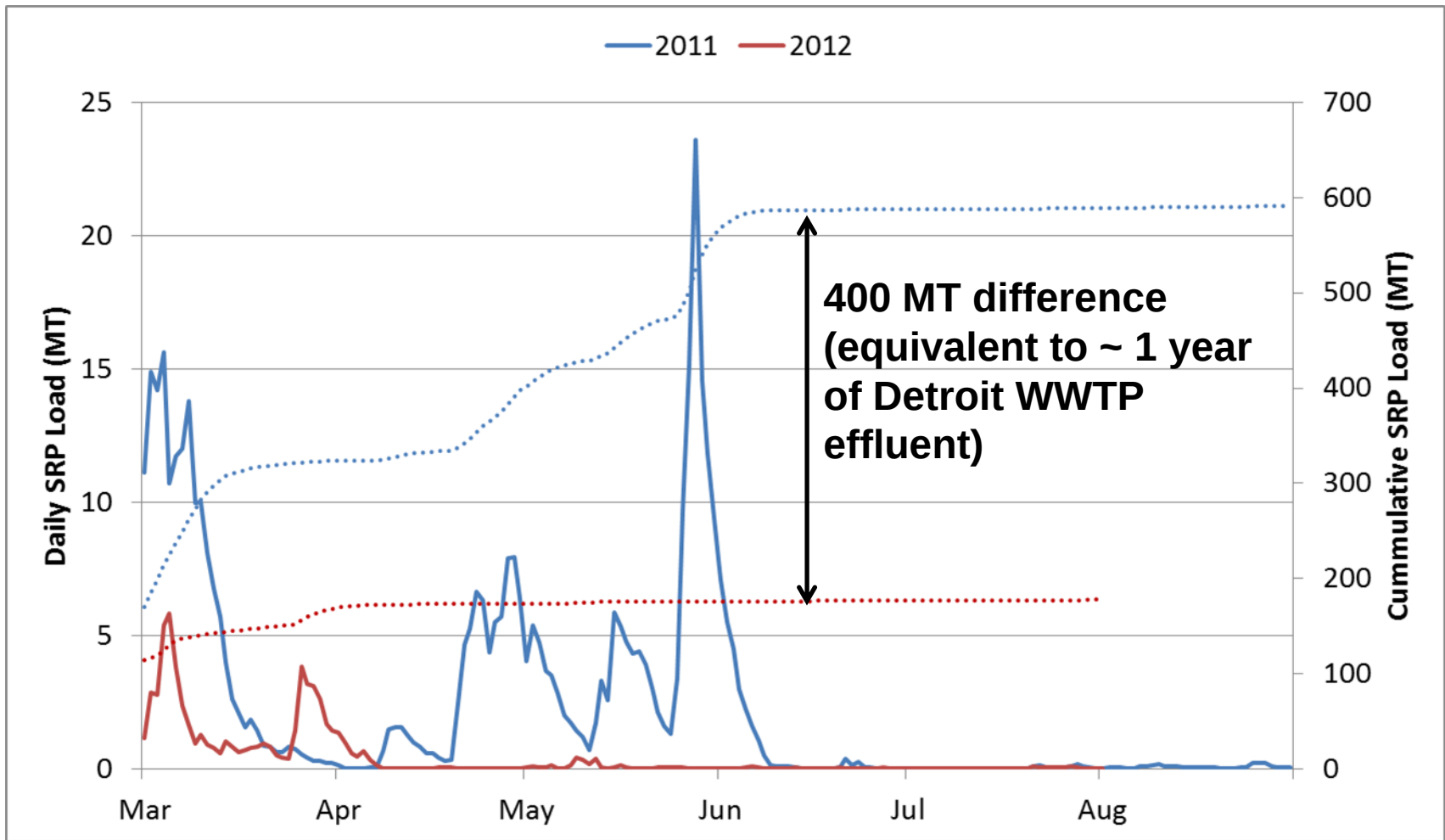
Several large events from March – mid-June, followed by very low flows for rest of the summer.

Plume of Detroit River (SRP ≈ 10 ug/L) moved to Central Basin north of Pelee Island.



Data obtain from Heidelberg University

Maumee River SRP Load





09/03/2011 (DOY=246)

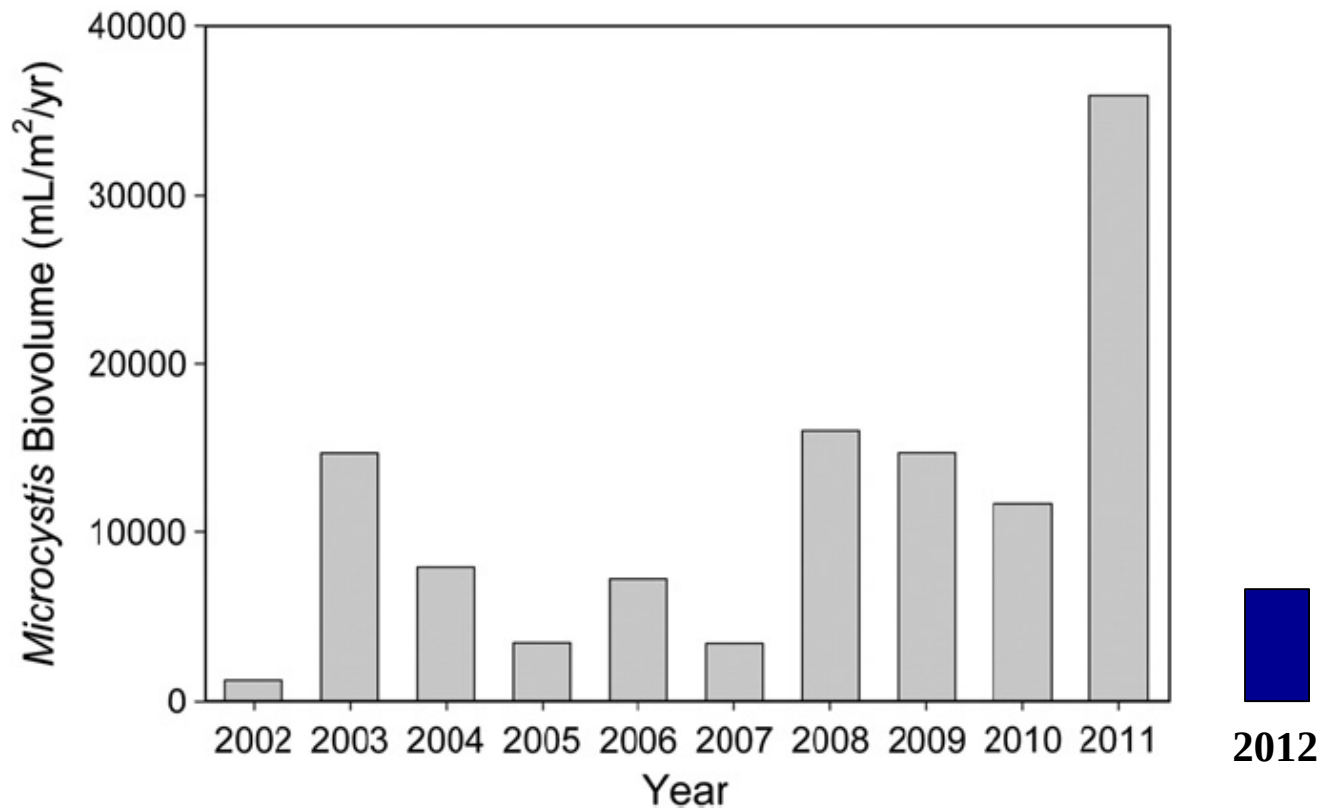


08/30/2012 (DOY=243)

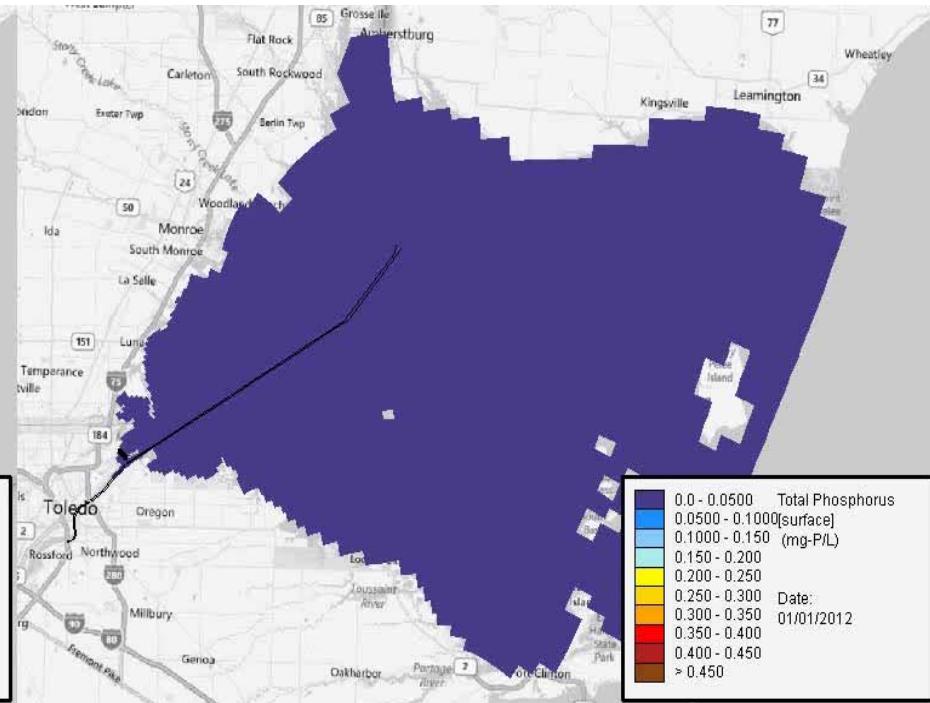
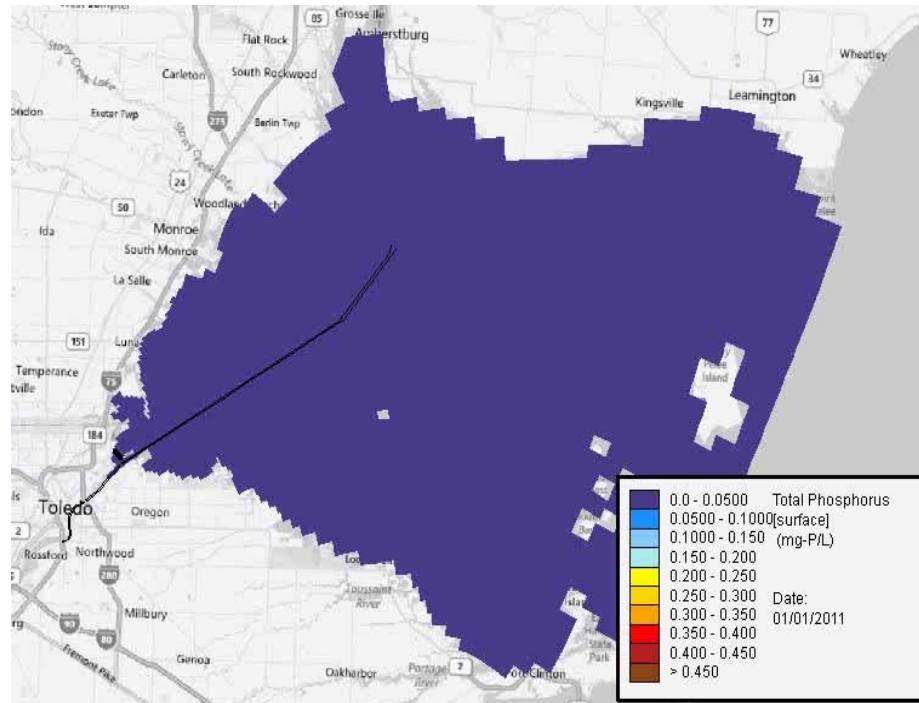
***Microcystis* in Western Basin**

(from Bridgeman, University of Toledo)

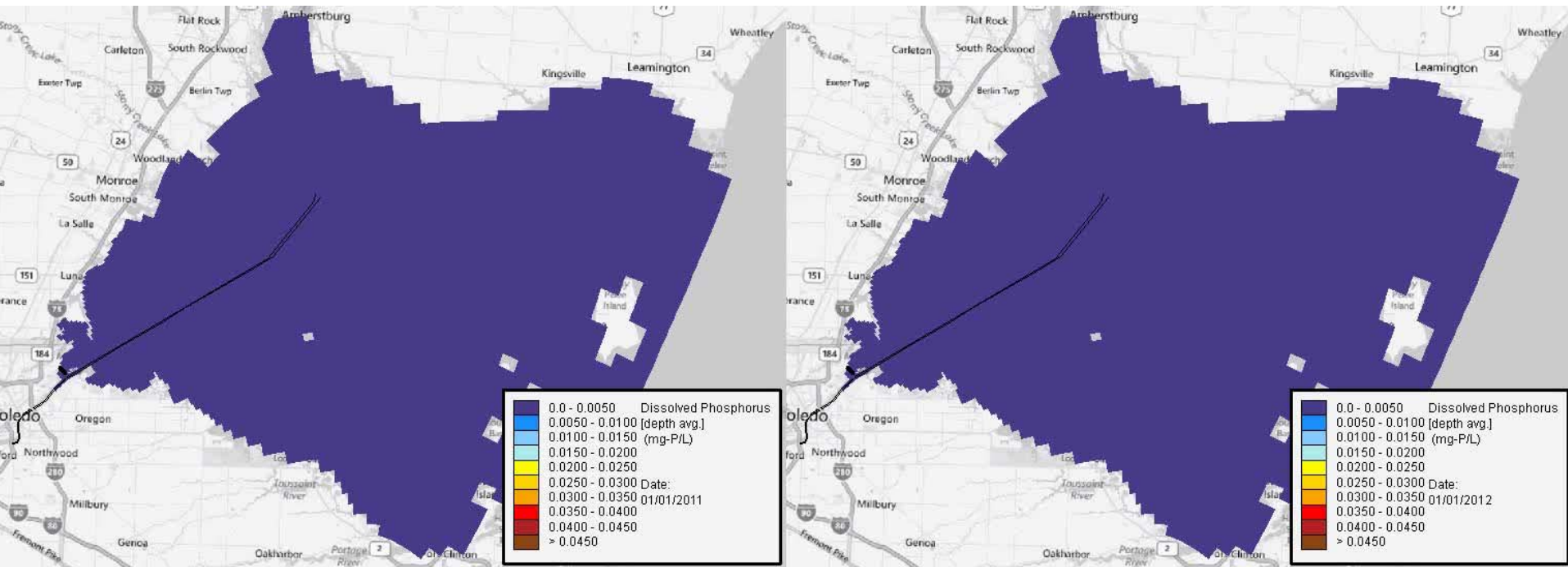
- 2011 *Microcystis* bloom largest on record. 2012 bloom was much smaller than 2011.
- No significant difference in Detroit River load between 2011 and 2012



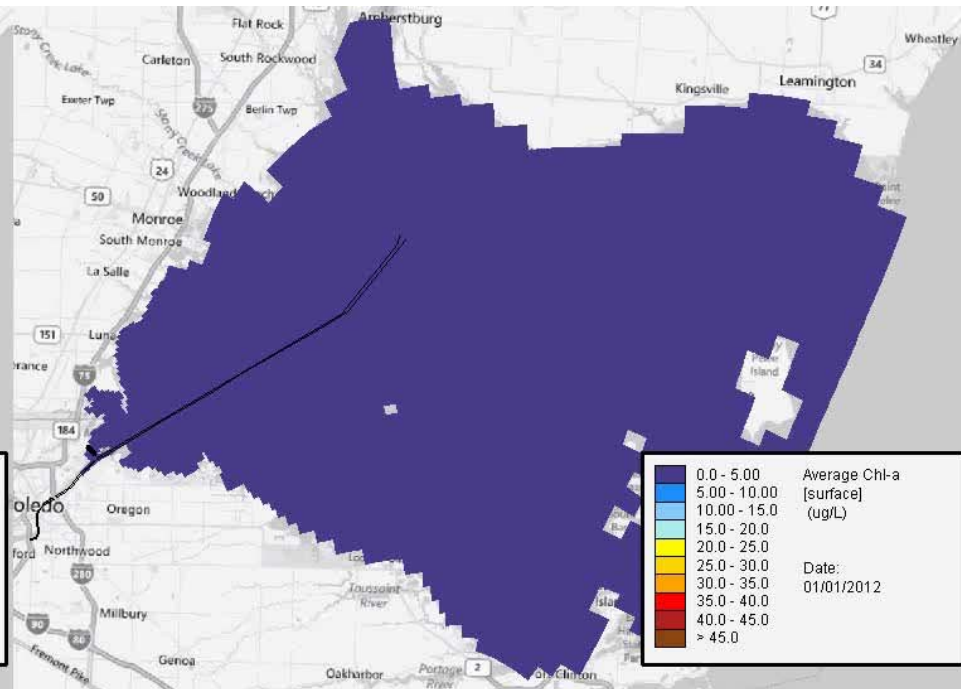
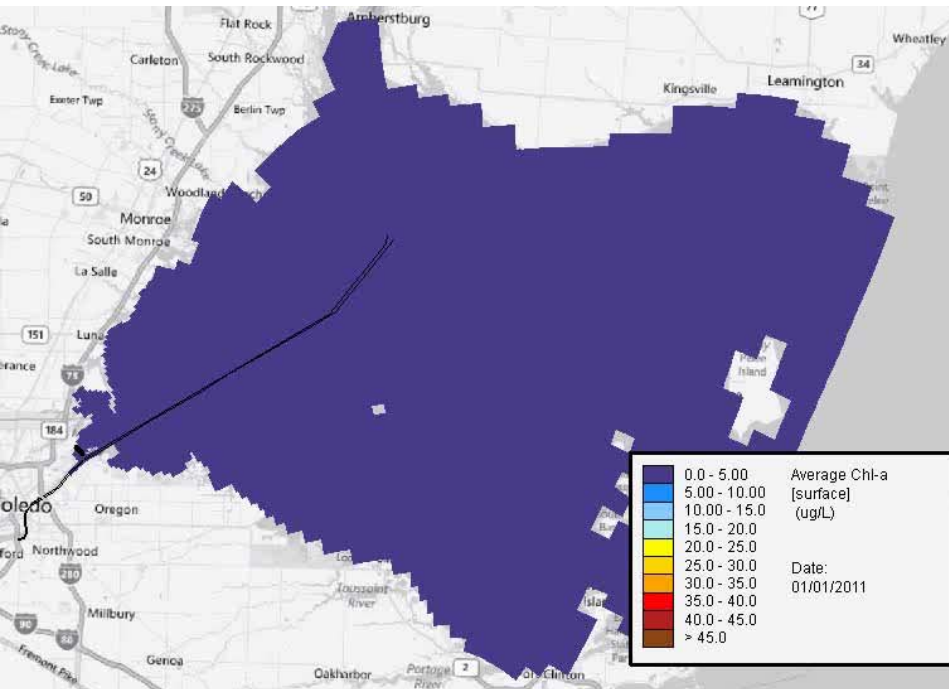
WLEEM TP Simulations (2011-12)



WLEEM Dissolved Phosphorus Simulations (2011-12)



WLEEM Chlorophyll a Simulations (2011-12)

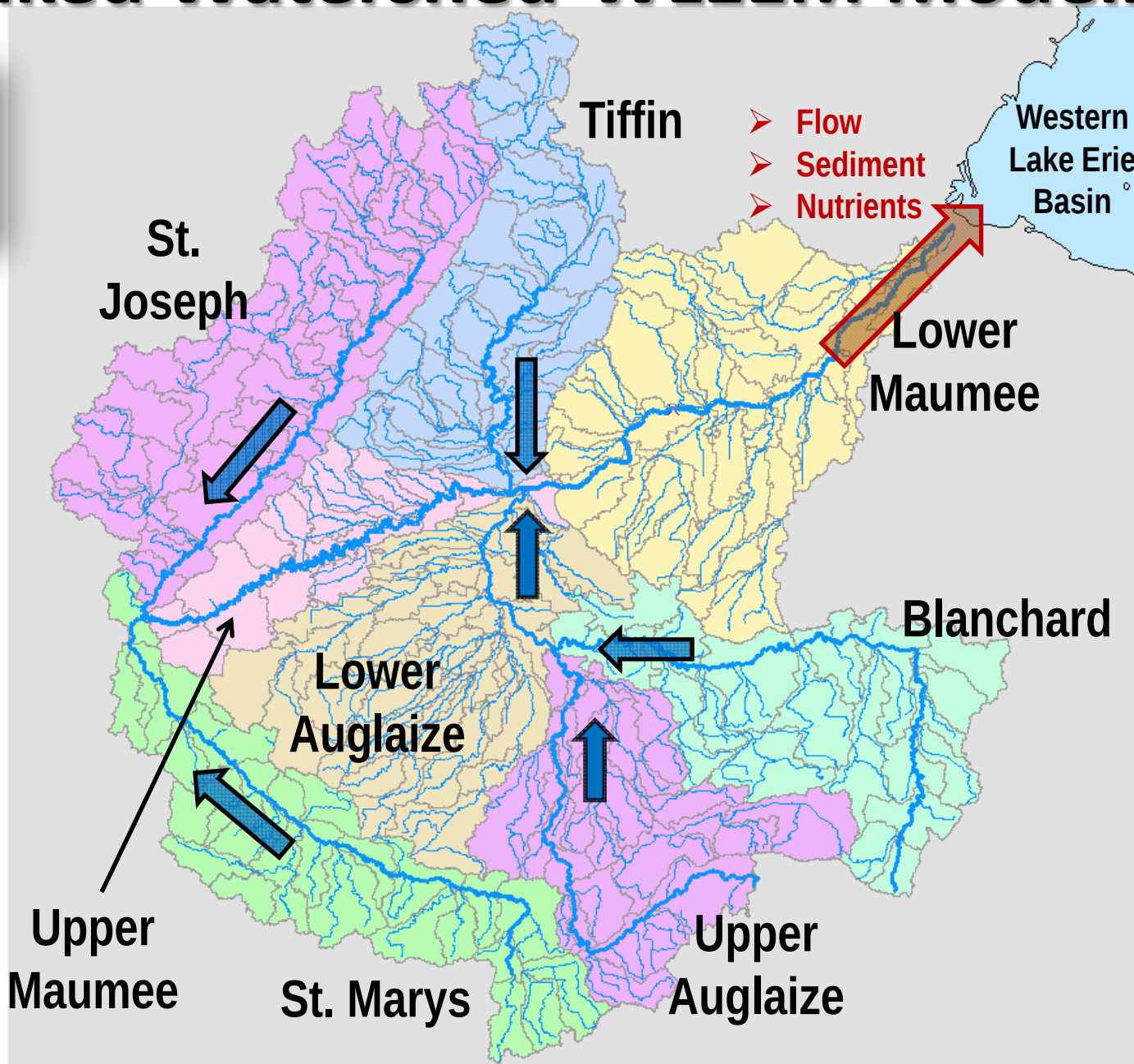


Linked Watershed-WLEEM Modeling



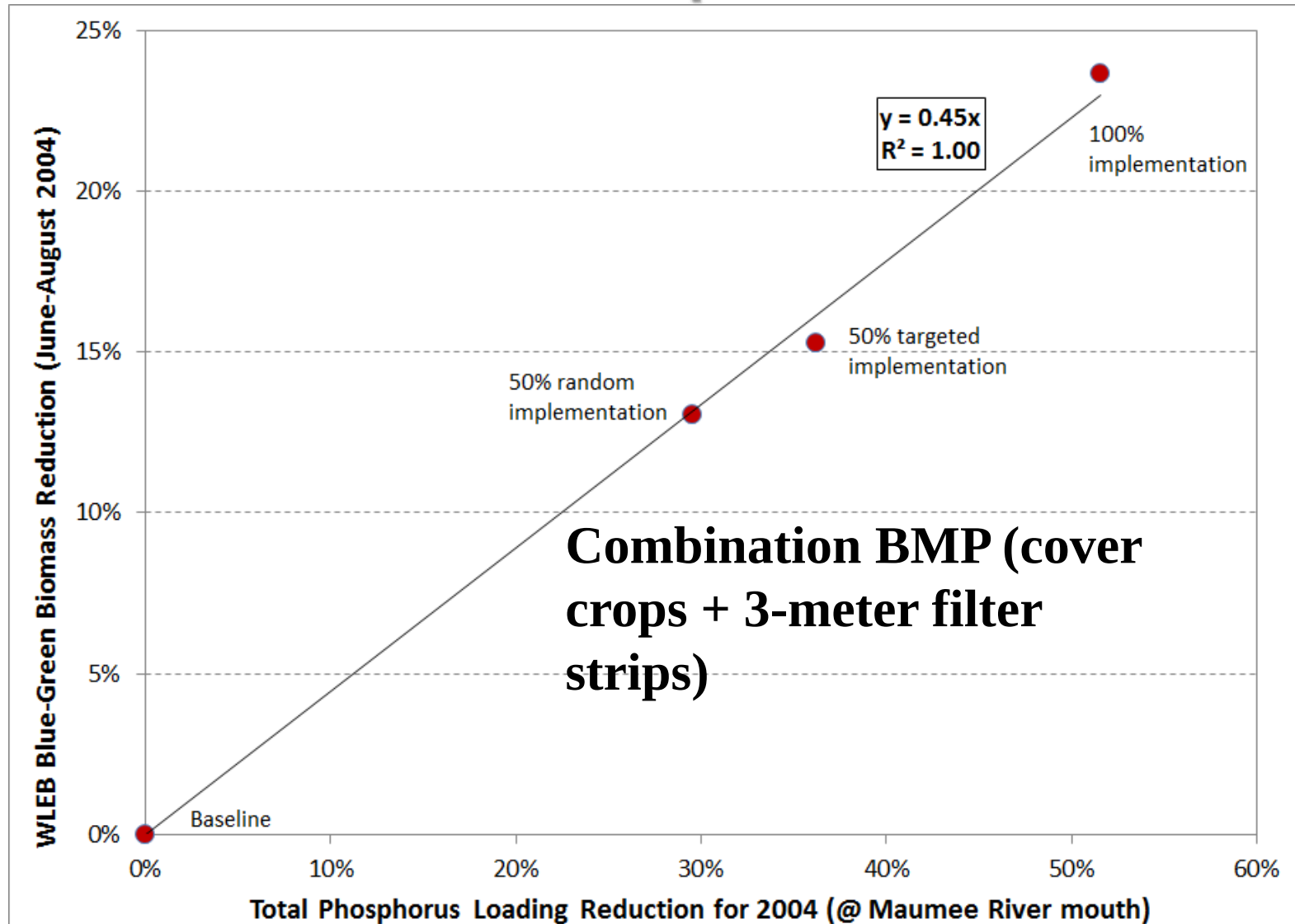
SWAT Model

Bosch et al. 2011

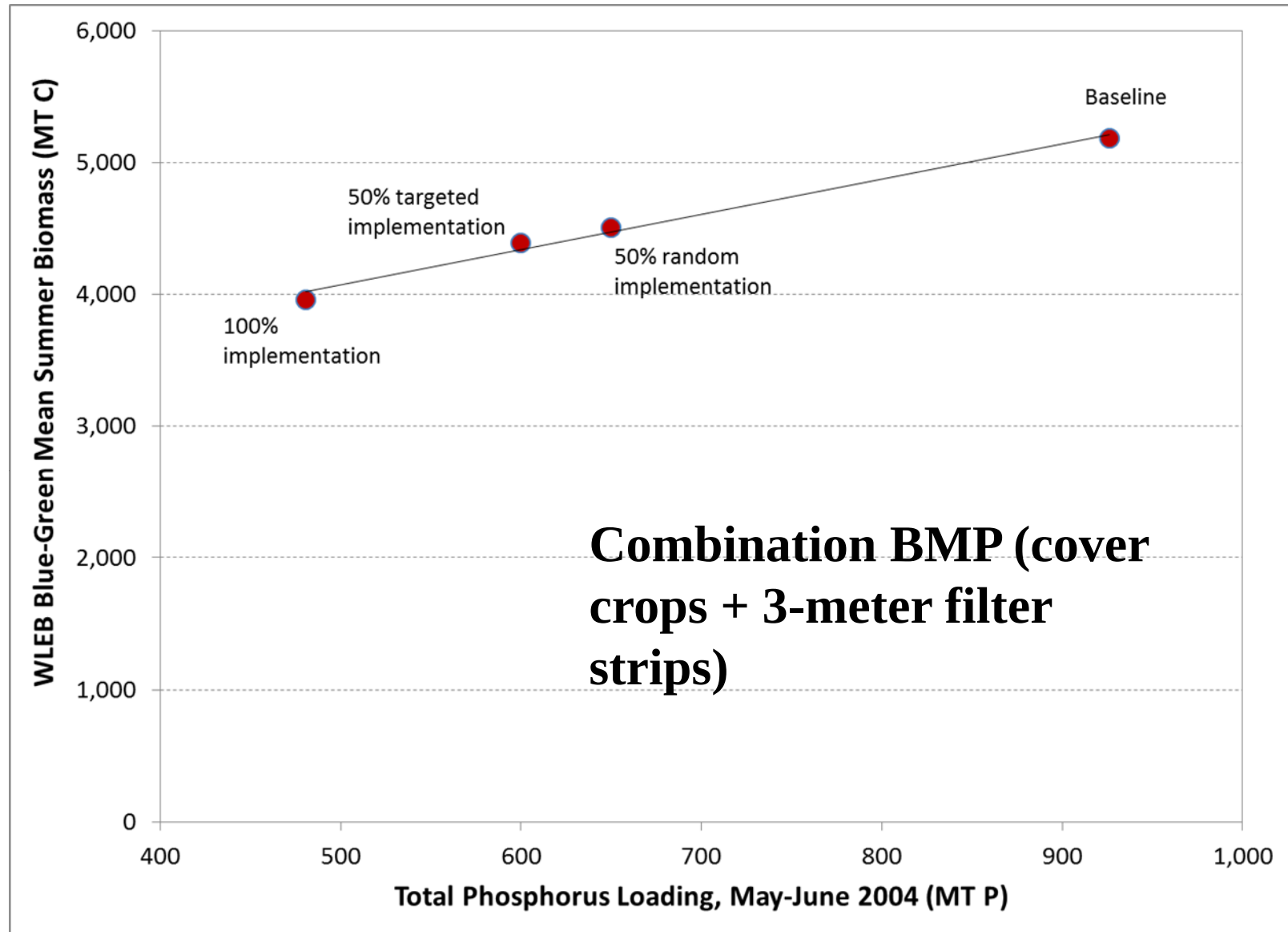


WLEEM
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Linked Watershed-WLEEM Allows Connection between actions in Maumee watershed and In-lake Response



Same scenarios related to spring P loading from Maumee



A background image of a sunset over the ocean. The sun is a bright yellow circle on the horizon, casting a long, shimmering reflection across the dark, choppy water. The sky is a gradient of orange and yellow.

Questions?

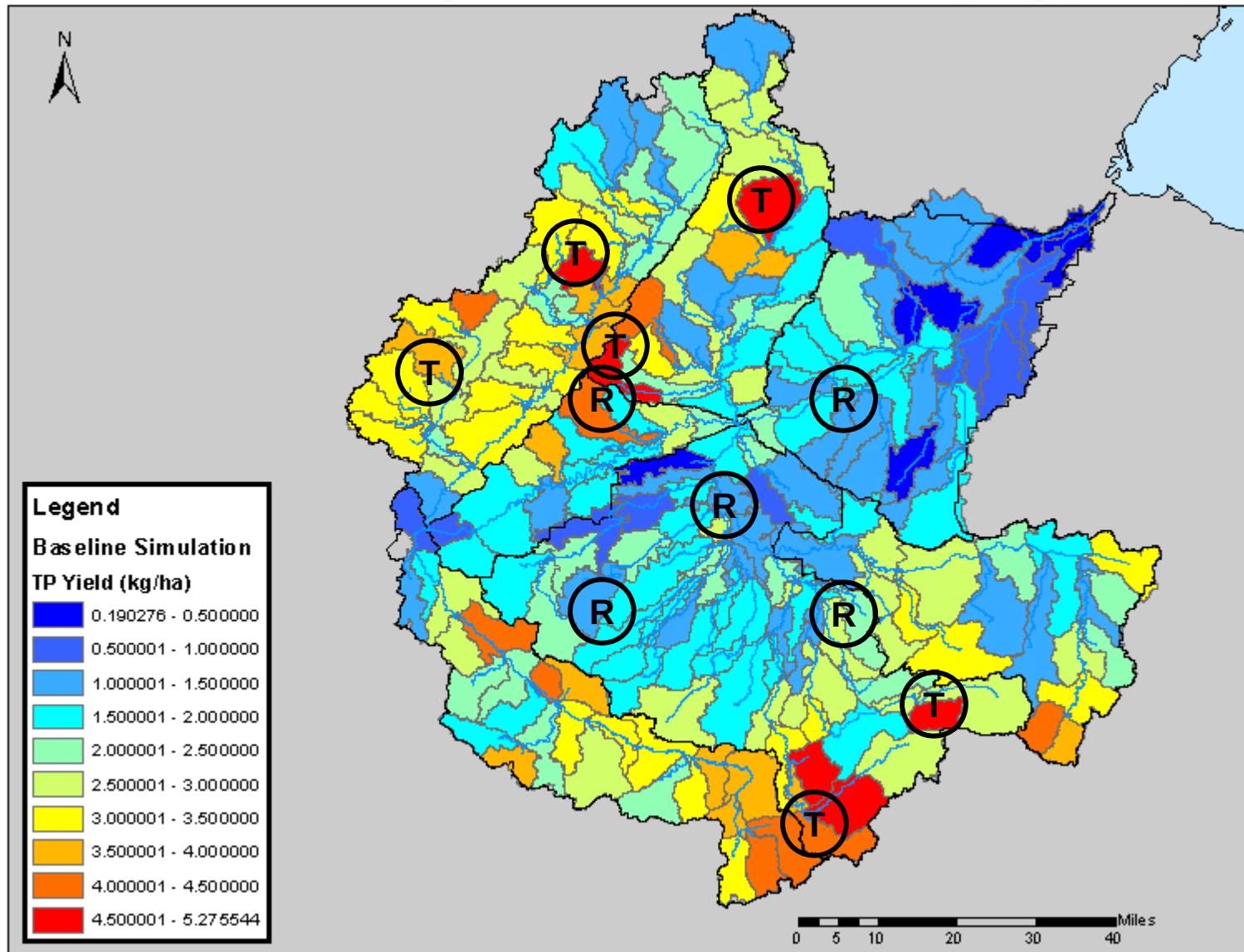
Keep 'Em Great

Joseph DePinto

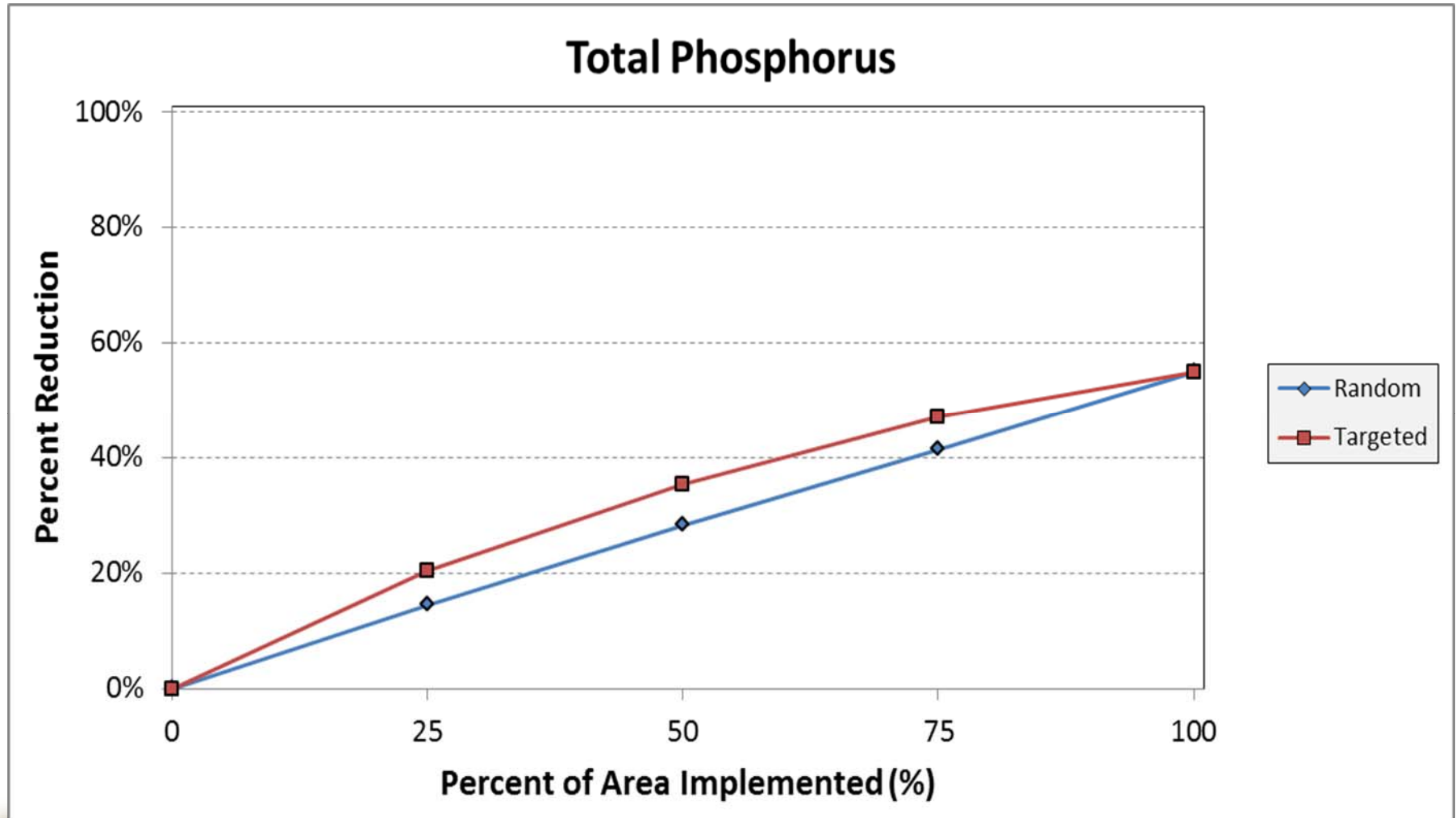
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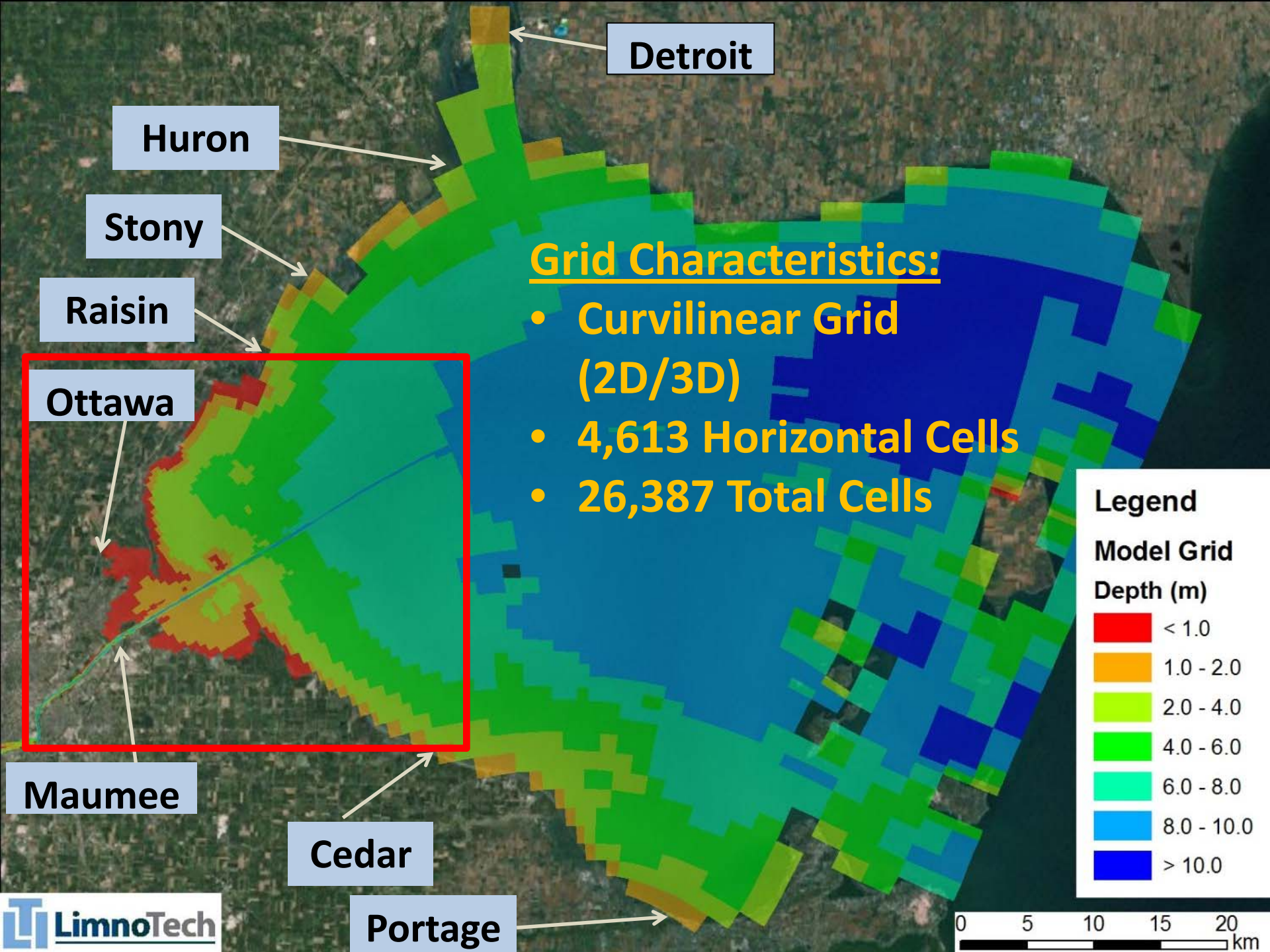
jdepinto@Limno.com

Total Phosphorus Yields (kg/ha)



Targeted vs. Random BMP Implementation (cover crops + 3 meter filter strips)





Navigation Channel



Navigation Channel

Ottawa

Maumee

Legend

Model Grid

Depth (m)

	< 1.0
	1.0 - 2.0
	2.0 - 4.0
	4.0 - 6.0
	6.0 - 8.0
	8.0 - 10.0
	> 10.0