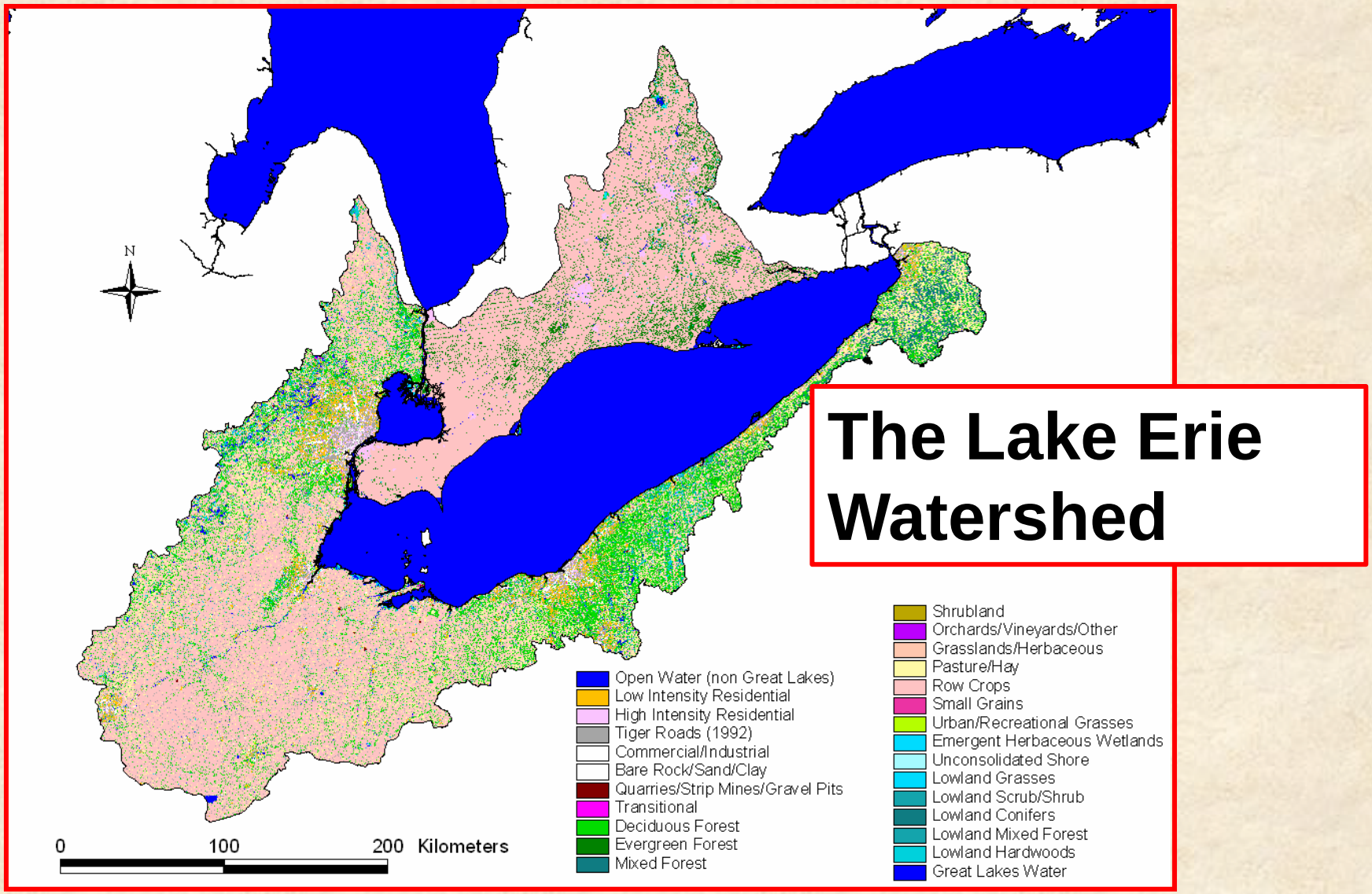
*From Soils to the Maumee River to the Western Basin: Connecting the (Phosphorus) **Dots***

Lake Erie Waterkeeper Conference
North Cape Yacht Club
April 8, 2011

Dr. David Baker
National Center for Water Quality Research
Heidelberg University

We are involved in long-term, large-scale research in a “working watershed.”



The Lake Erie Watershed

One of the research questions --

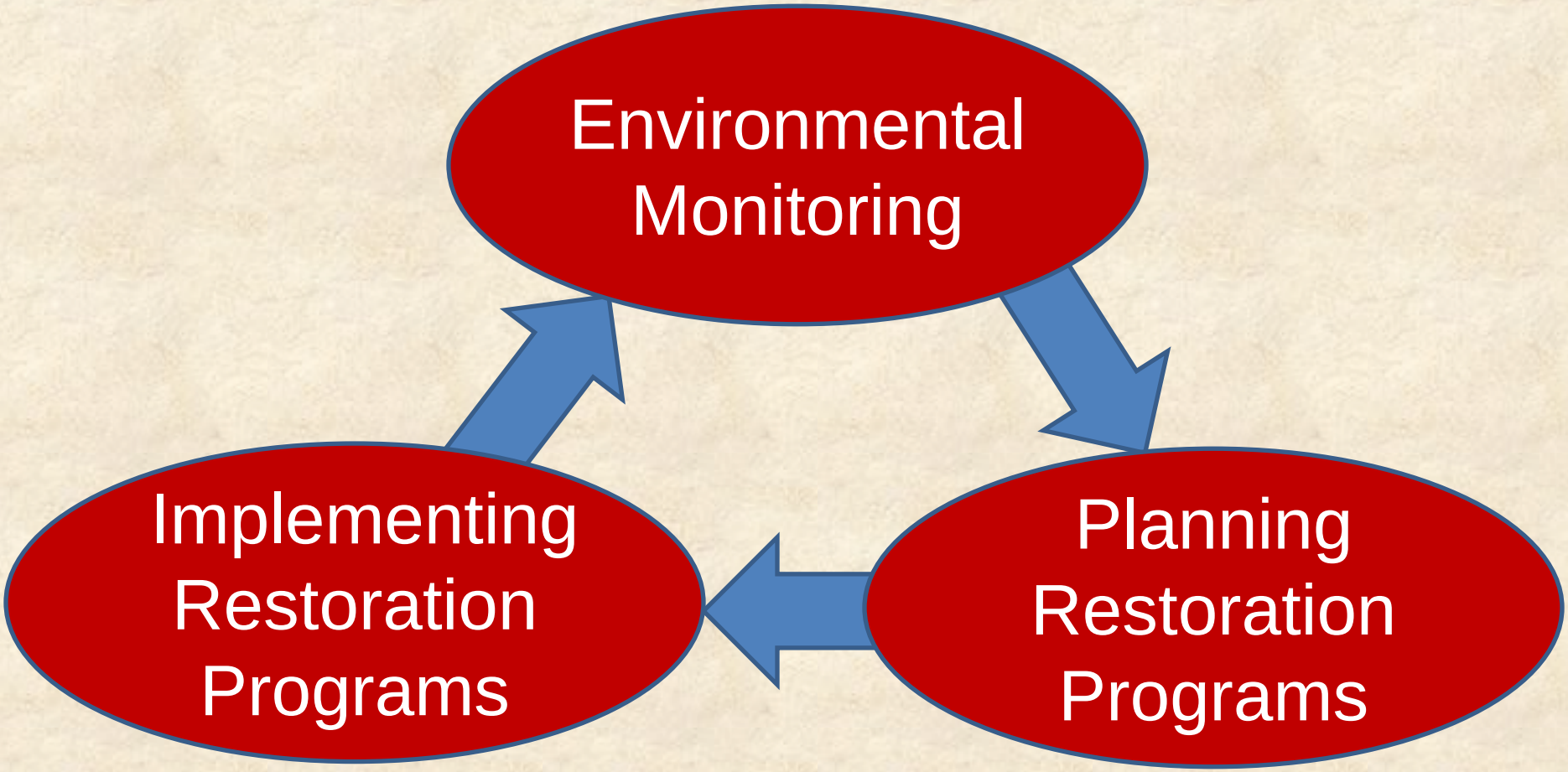
Can we maintain and increase agricultural productivity in the Lake Erie Watershed and, at the same time, reduce adverse impacts of agriculture on water quality in Lake Erie?

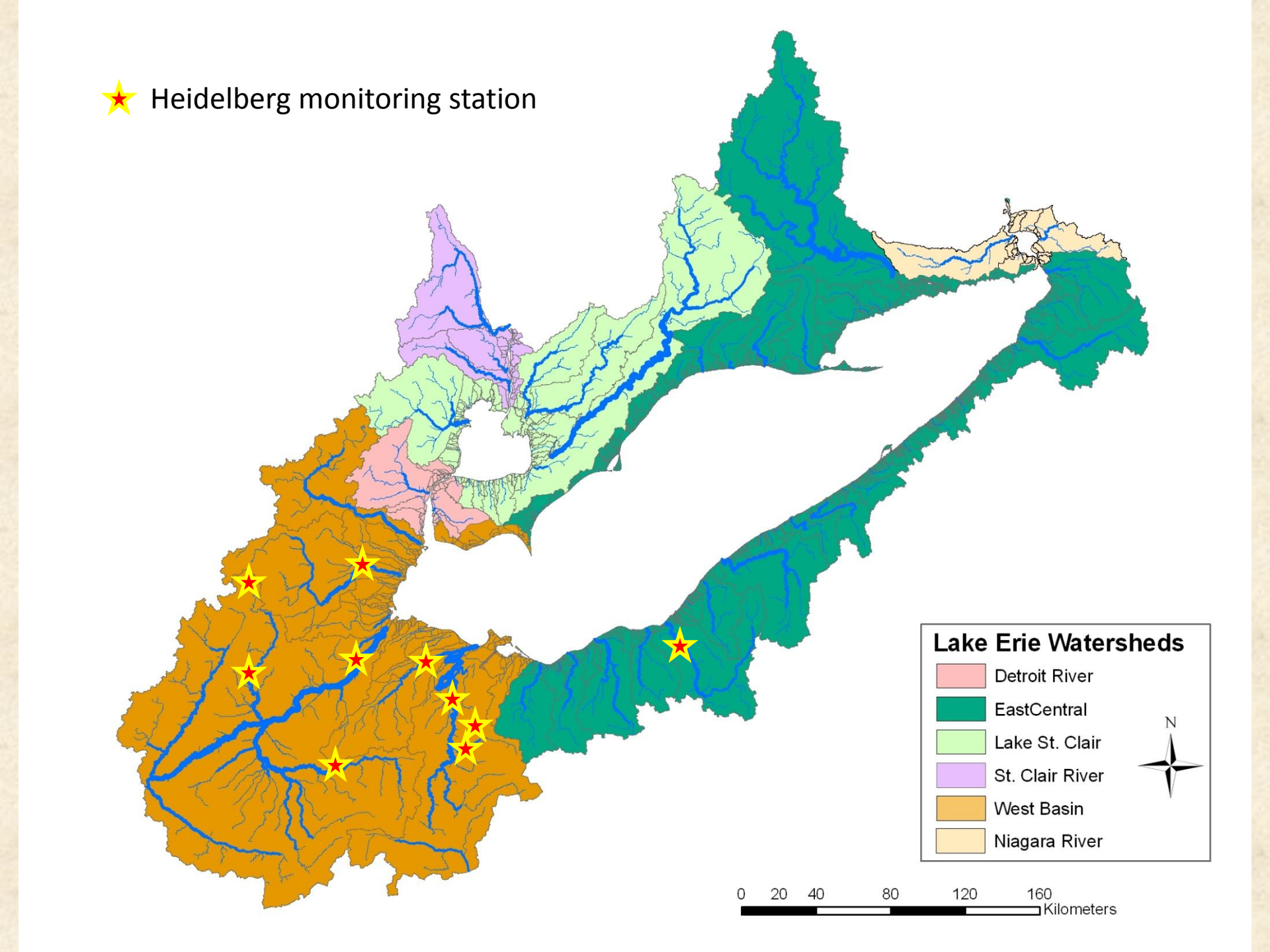
or

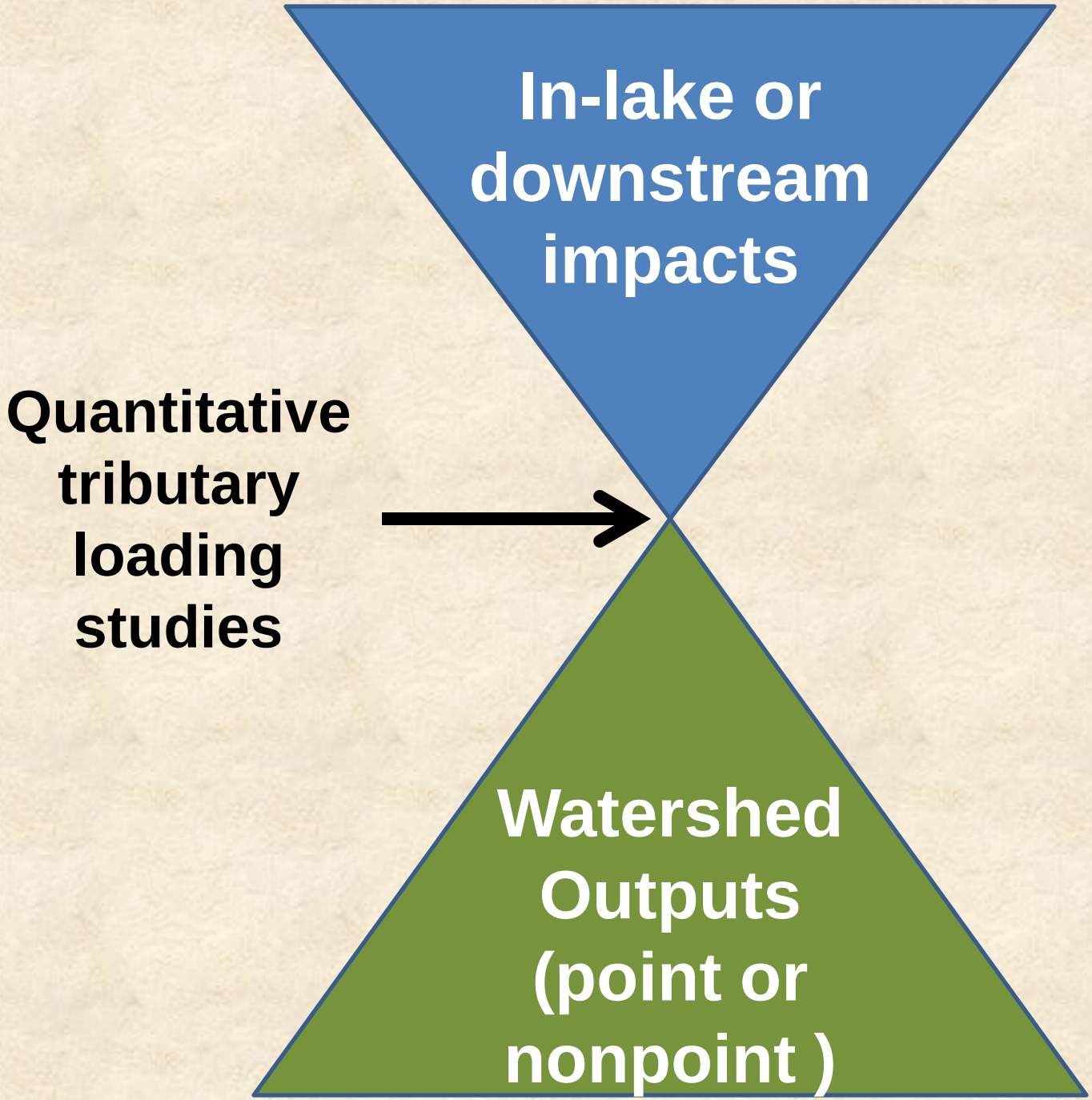
How can we minimize adverse impacts of food production on water resources?

How do you do "research" in large, "working" watersheds?

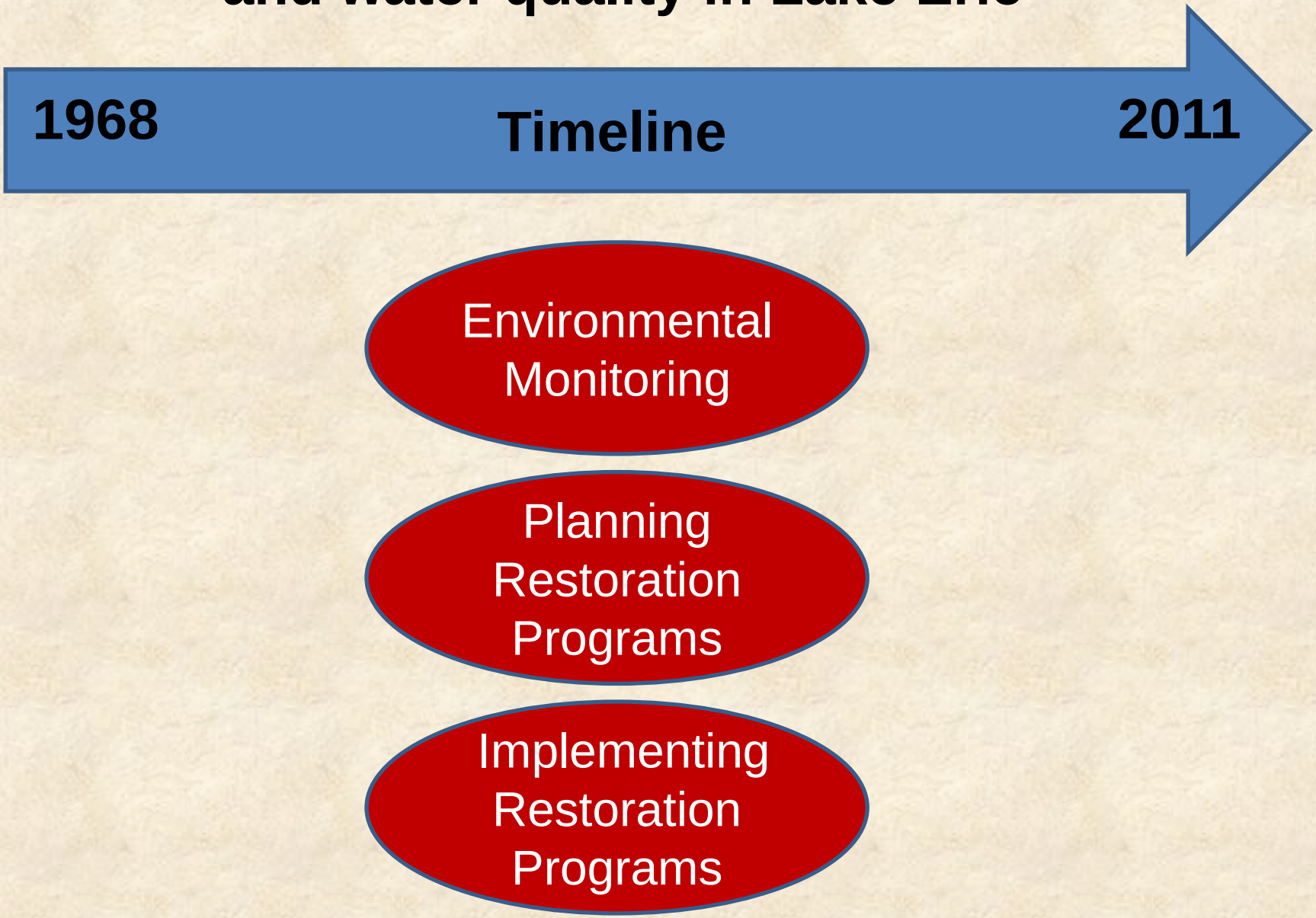
Research through adaptive management…

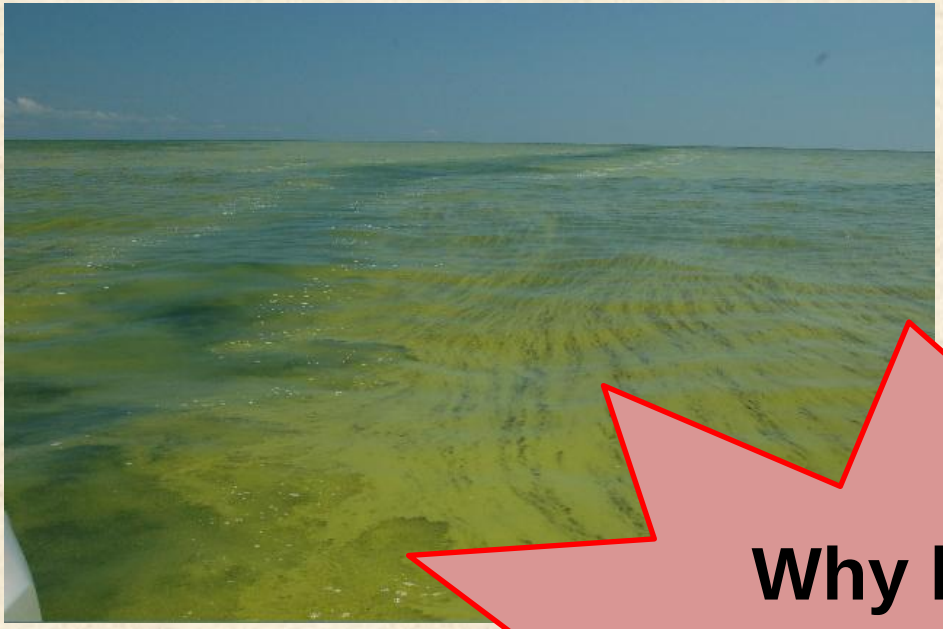



Heidelberg monitoring station
Lake Erie Watersheds
Detroit River
EastCentral
Lake St. Clair
St. Clair River
West Basin
Niagara River
N
0 20 40 80 120 160
Kilometers


In-lake or downstream impacts
Quantitative tributary loading studies
Watershed Outputs (point or nonpoint)

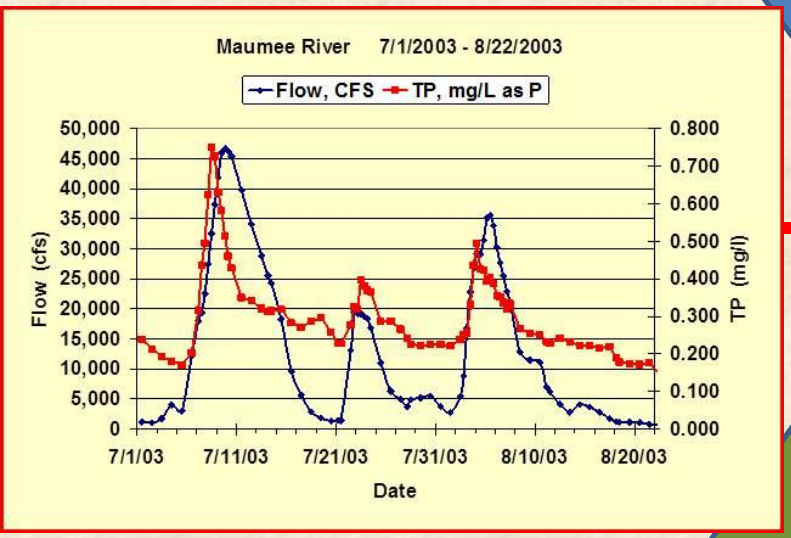
Phosphorus loading, load reduction programs and water quality in Lake Erie

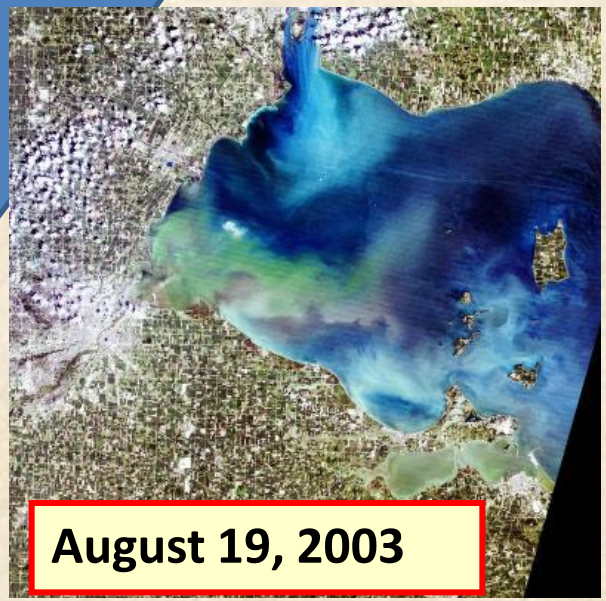




Why have conditions deteriorated?

In-lake or downstream impacts

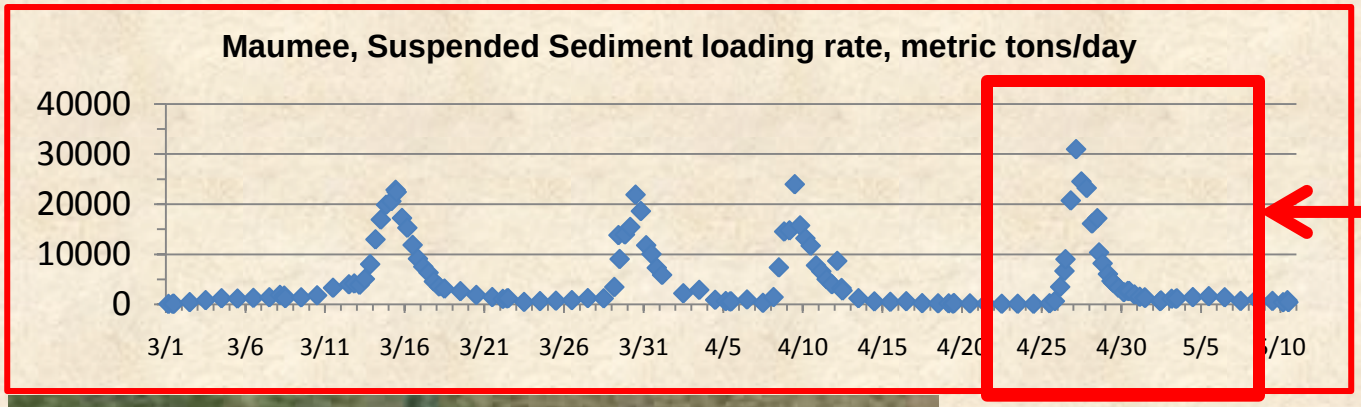




Connecting the dots

Watershed Outputs (point or nonpoint)

2. What is the fate and effect of nutrients entering the Western Basin during storm runoff events?



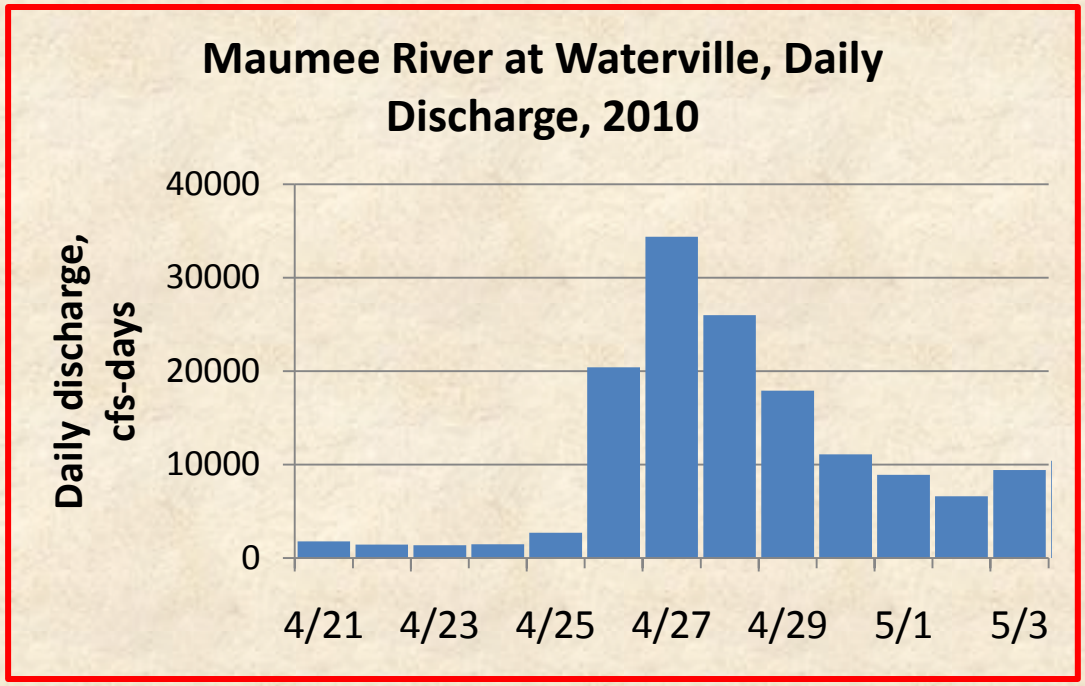
To address these questions we conducted a Lagrangian study of this runoff event

What is the relationship between the sediment loading events beginning March 1, 2010 and the satellite image of April 30, 2010?

Where has most of the sediment been deposited?

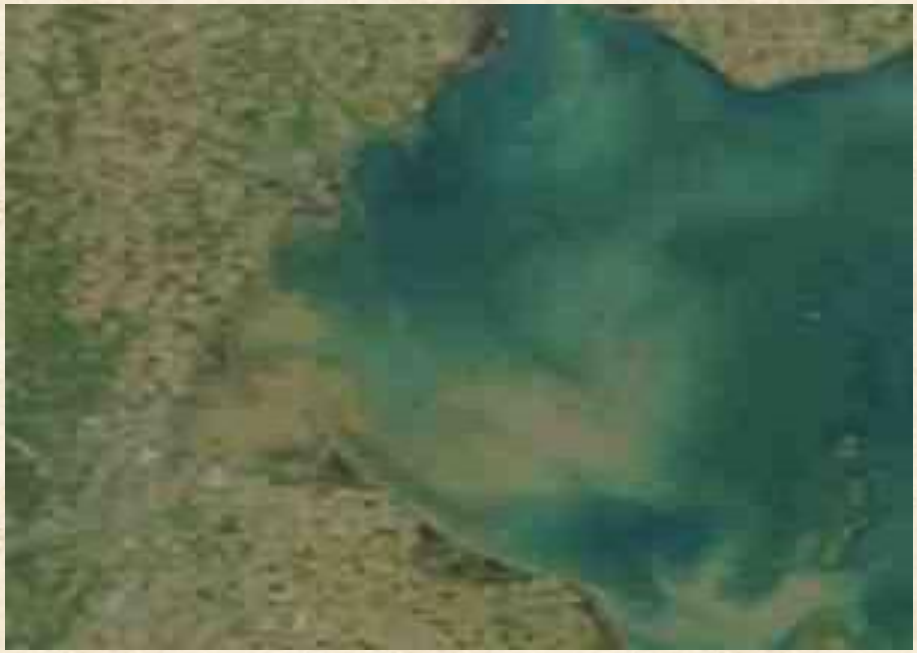
What has happened to the dissolved nutrients that accompanied the pulsed sediment loads?

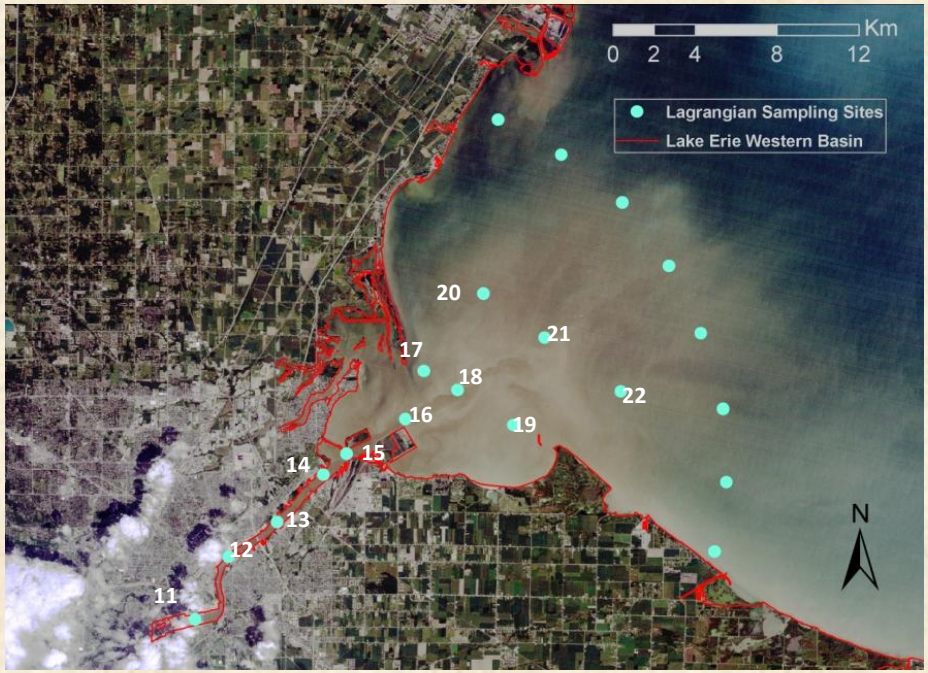
Where and how much mixing has occurred between Maumee storm event water and Detroit River inputs?



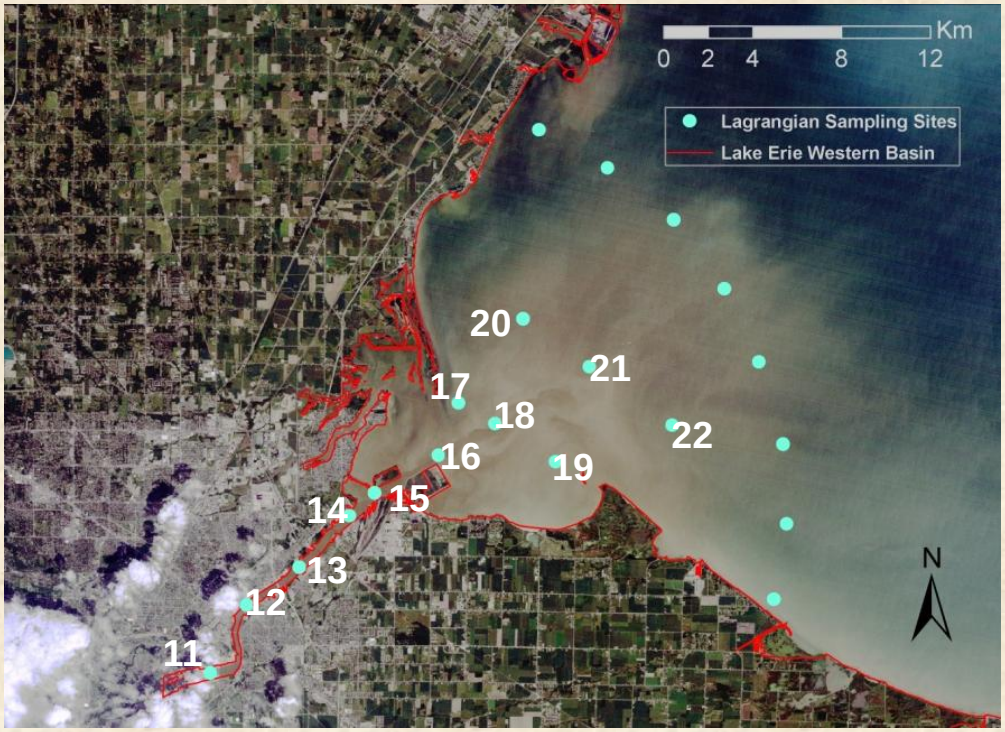
Lagrangian Sampling - follow and sample water mass as it flows downstream and into the lake.

Lagrangian Interpretation - use frequent sampling at a grid of stations coupled with <u>chemical markers of discrete water masses.</u>





Lagrangian Sampling



12 Stations

Sampling depth
1 meter below surface
1 meter above bottom

Collection Dates:

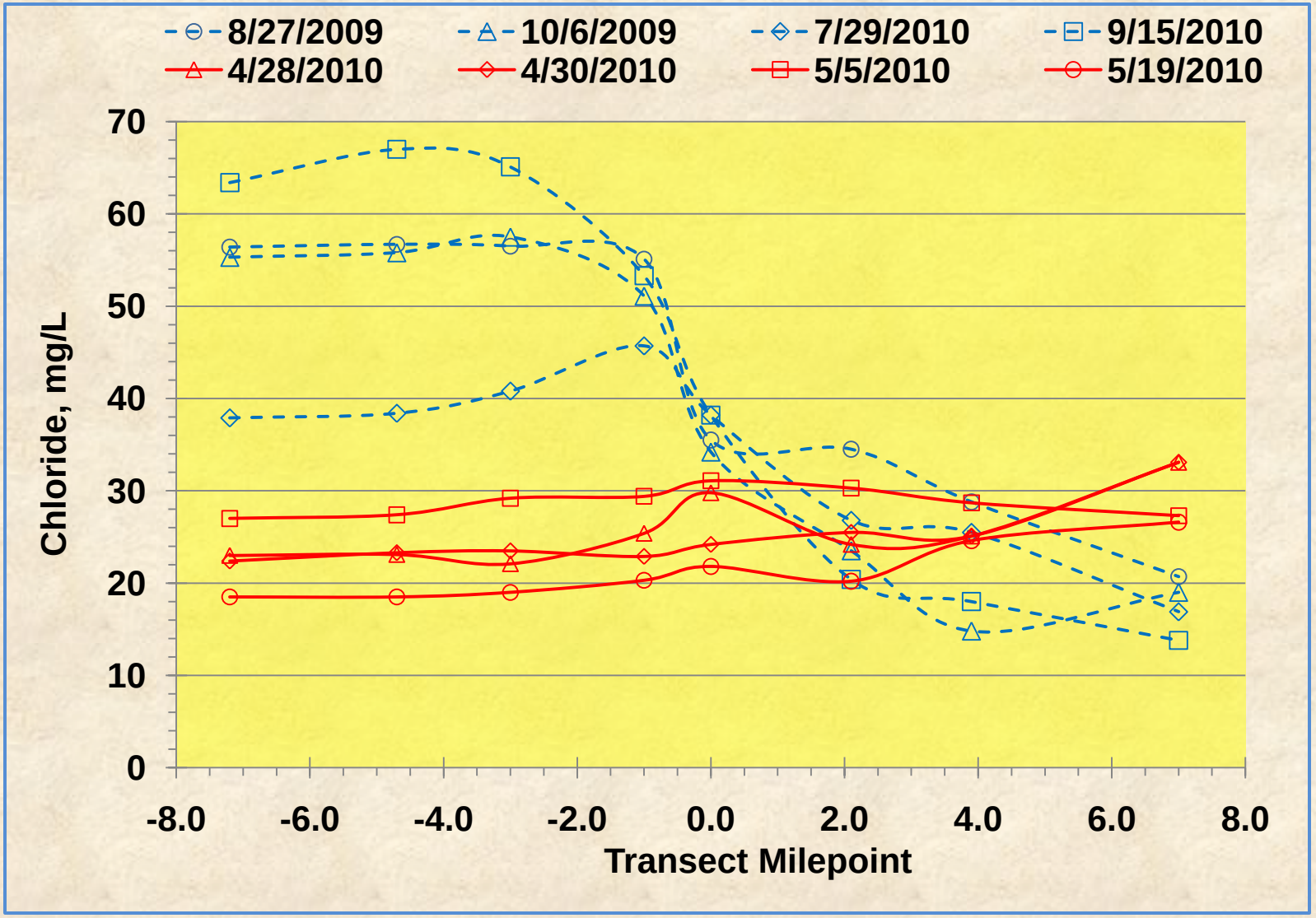
4/21/2010	← Algal Sampling
4/27/2010	
4/28/2010	← Algal Sampling
4/29/2010	
4/30/2010	
5/1/2010	
5/3/2010	
5/5/2010	← Algal Sampling
5/12/2010	← Algal Sampling
5/19/2010	← Algal Sampling

This sampling program was initiated in cooperation with the following charter boat captains and crew:

Paul Pacholski and Raul Salinas

Kim Salinas and Jason Gostiaux

Blue, dashed line reflect base flow conditions, top samples
Red, solid lines reflect storm runoff conditions, top samples



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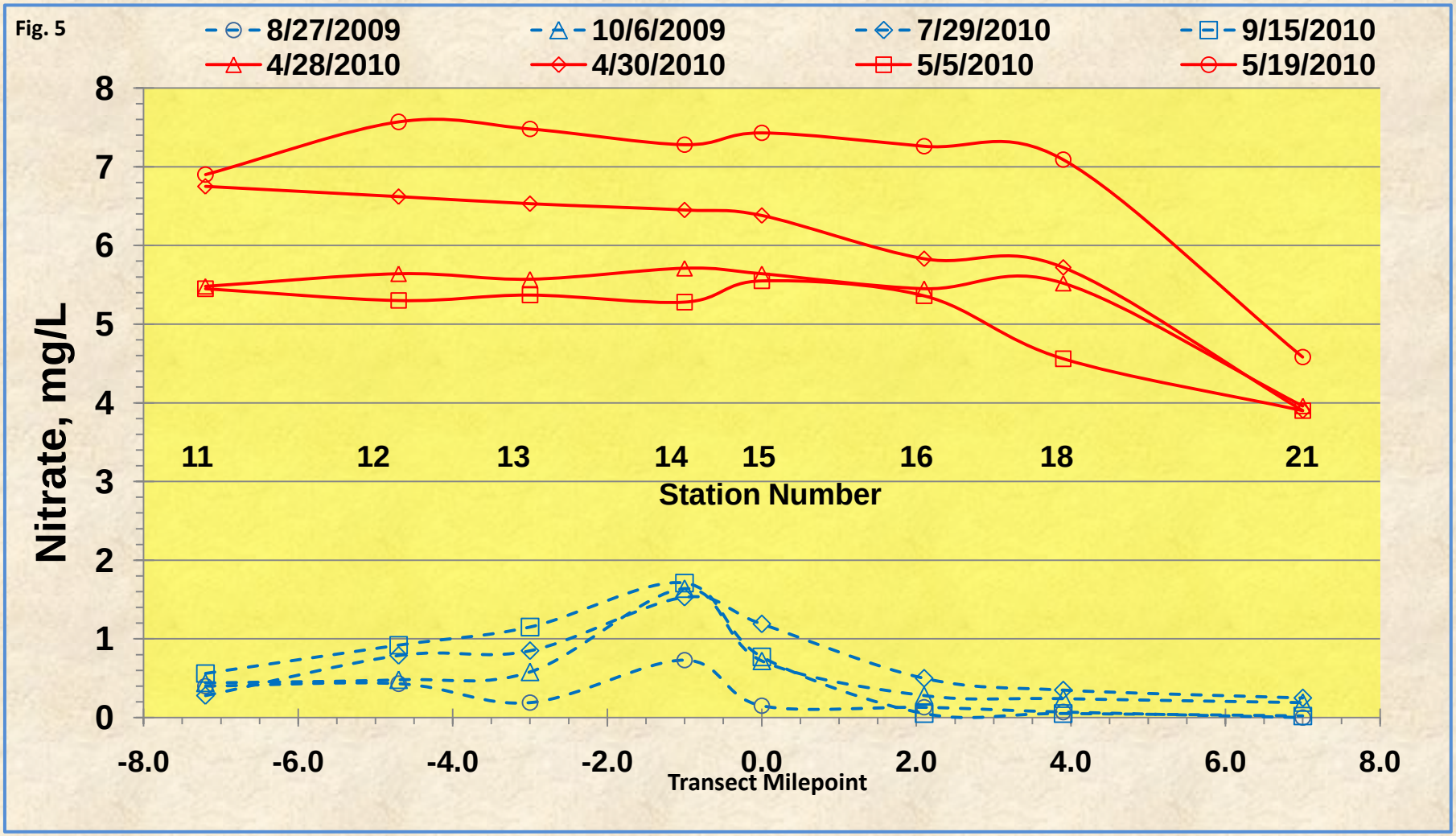
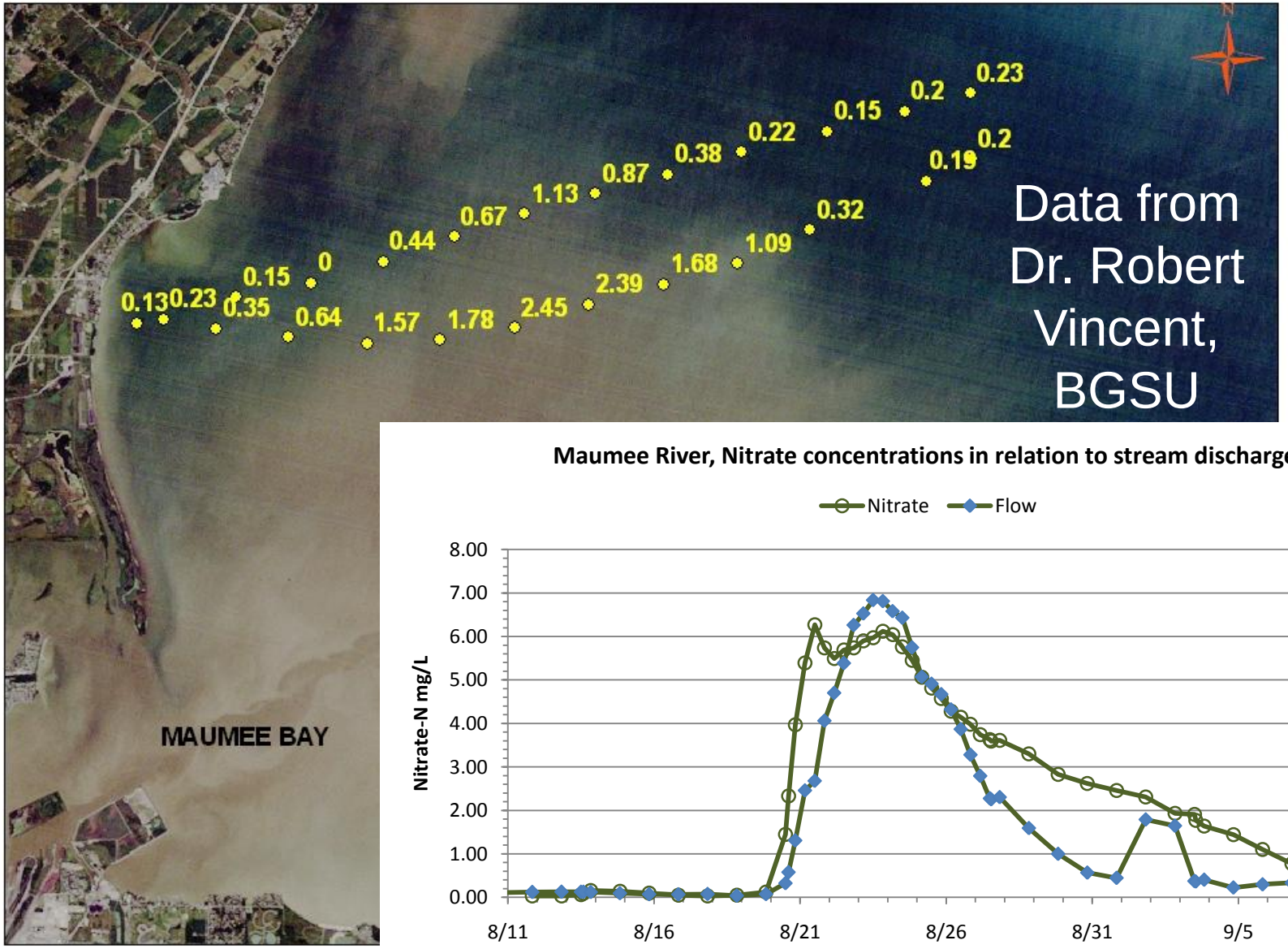


Figure 5. Nitrate-N concentrations during low flows (dashed lines) and high flows (solid lines) along transect stations.

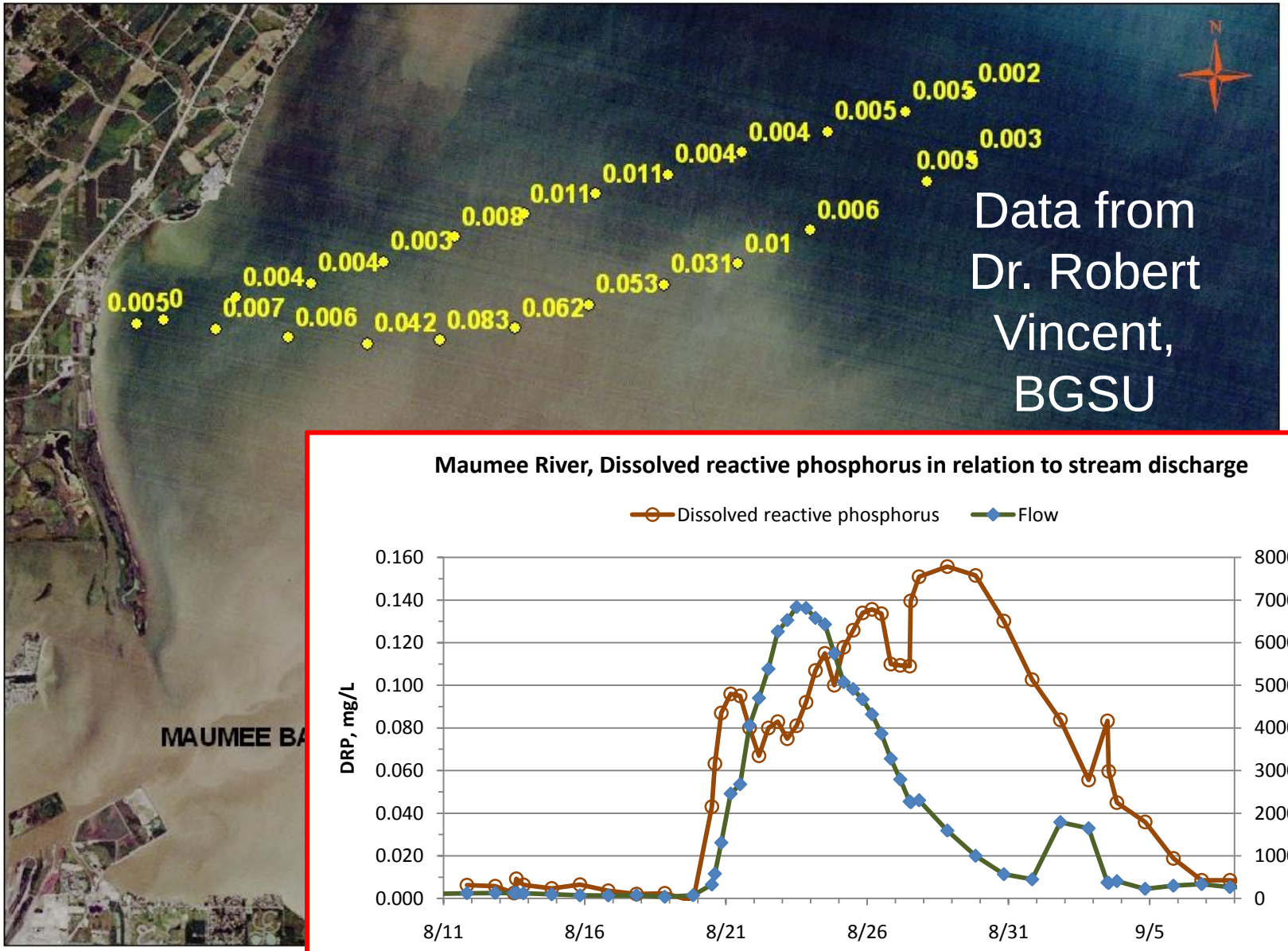
Lake Erie Western Basin (August, 30th 2007)
Nitrate



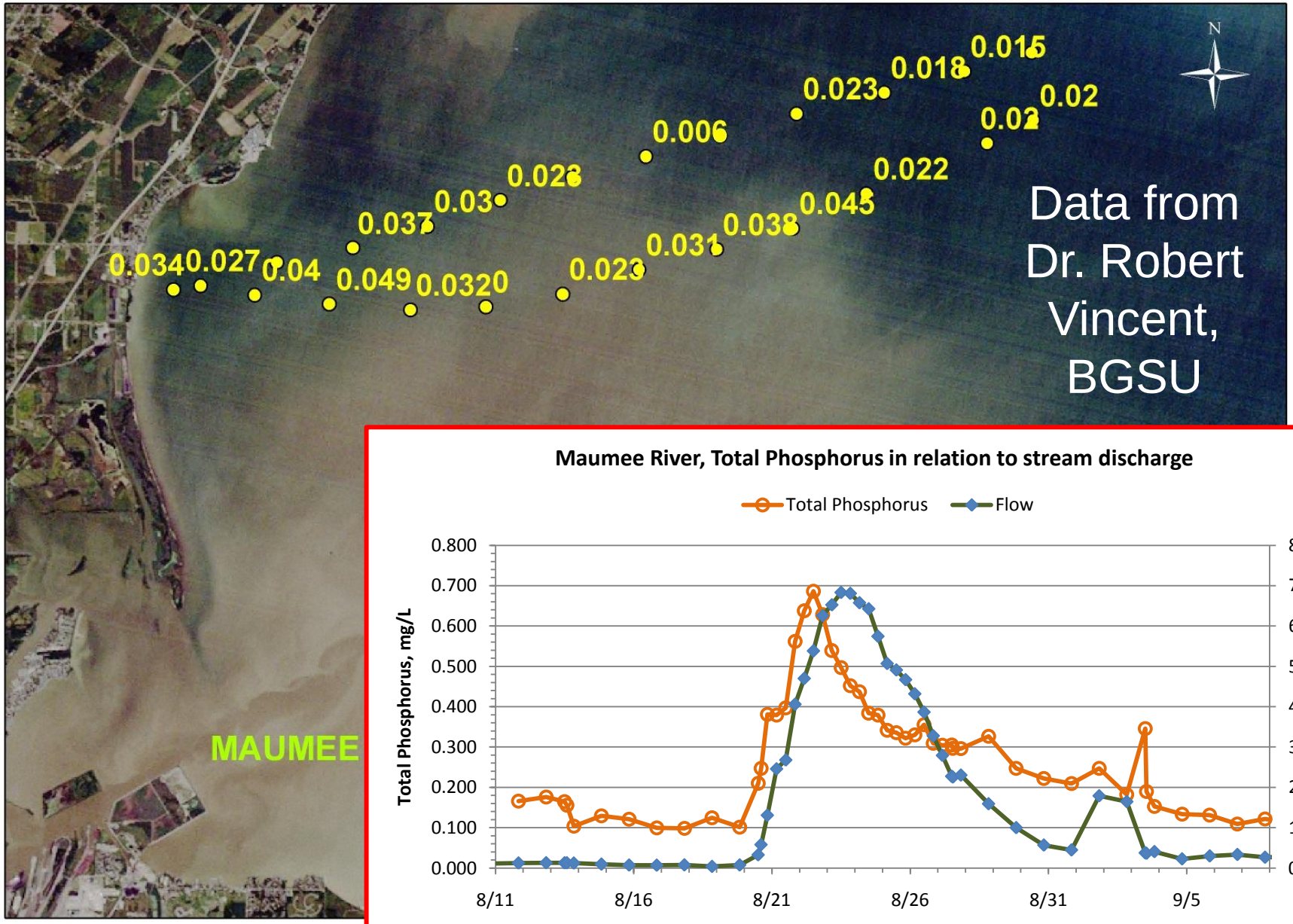
Data from Dr. Robert Vincent, BGSU

Maumee River, Nitrate concentrations in relation to stream discharge

Lake Erie Western Basin (August, 30th 2007)
Dissolved Reactive Phosphourous



Lake Erie Western Basin (August 30, 2007)
Particulate Phosphorus (PartP)



MODIS Terra – True Color – 250m – March 20, 2009

Maumee Peak Flow:
~90,000 cfs

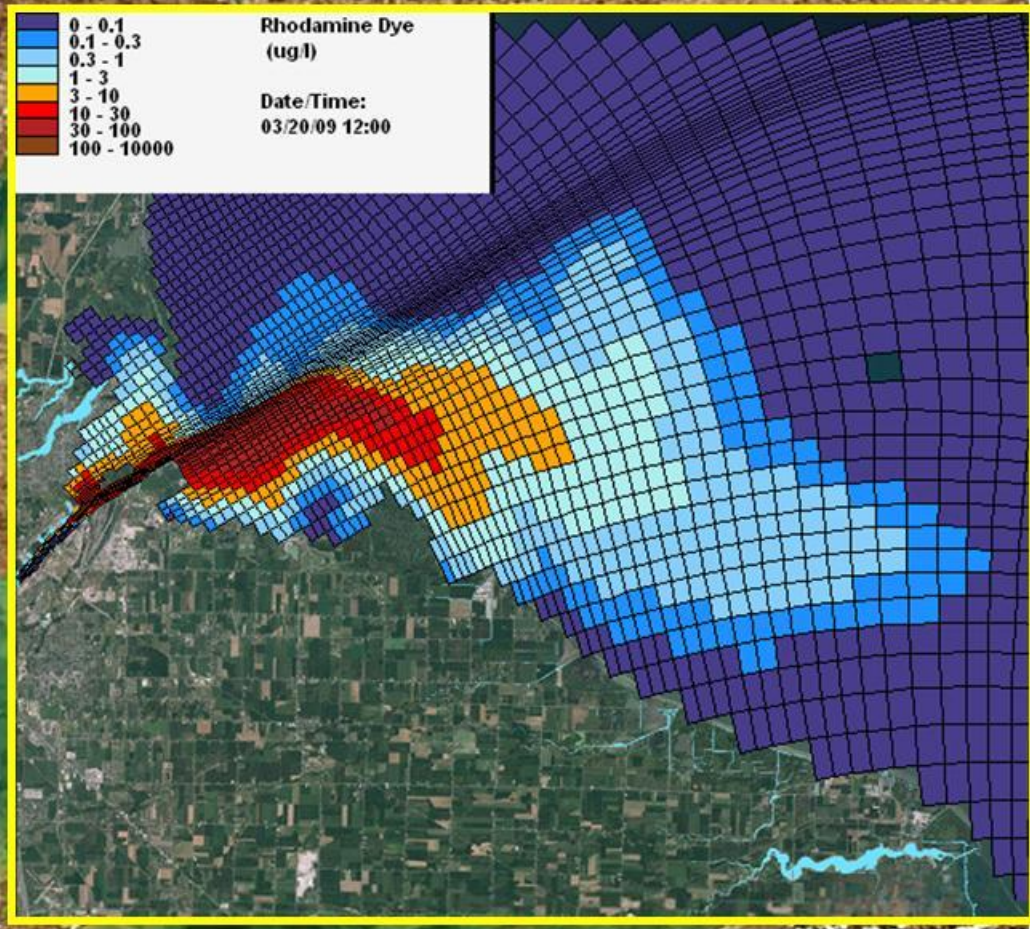
Huron River

River Raisin

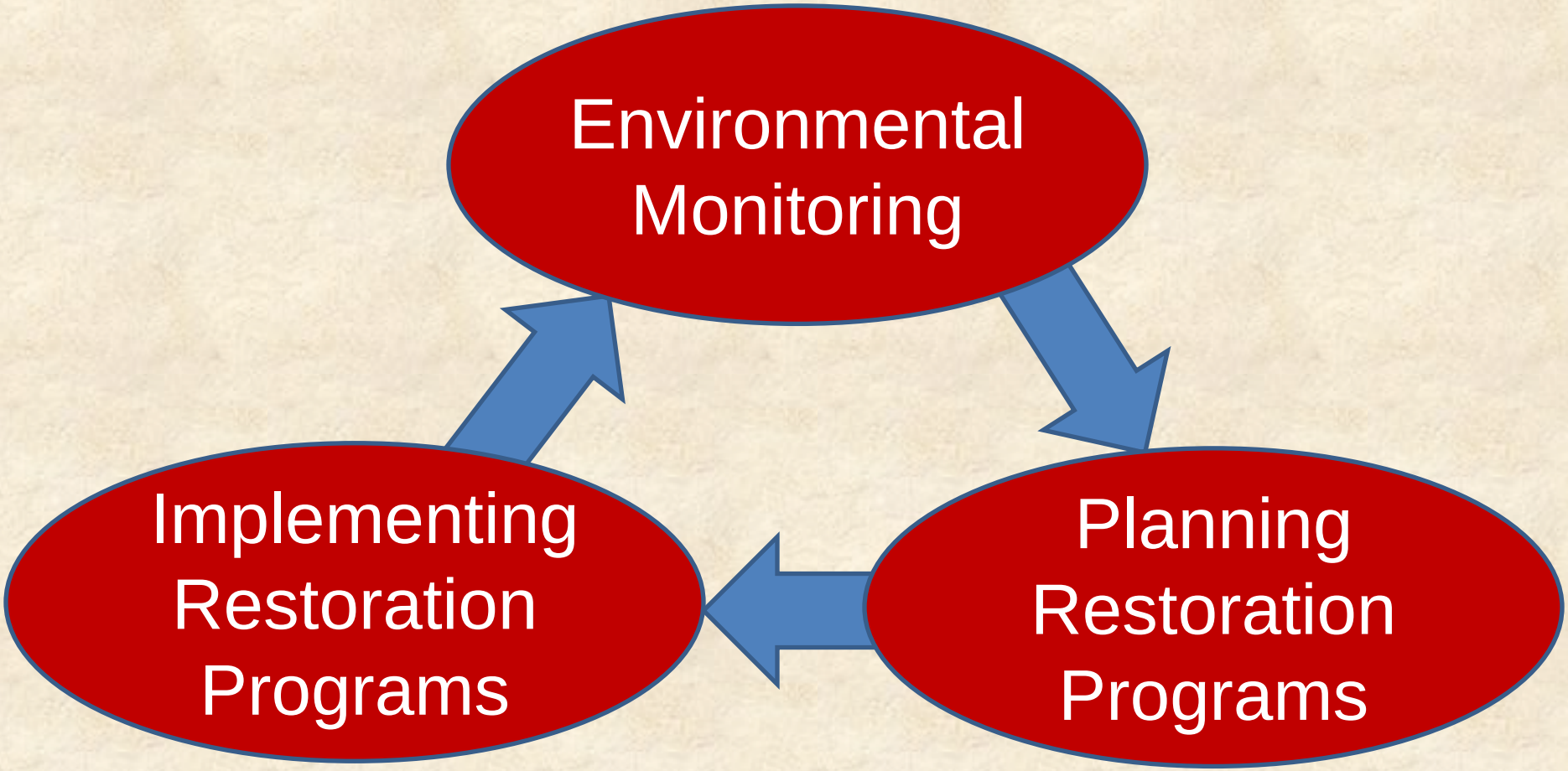
Maumee River

Portage River

Sandusky River



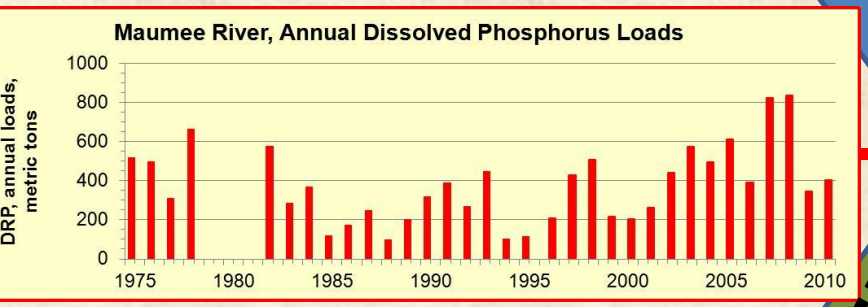
A calibrated model



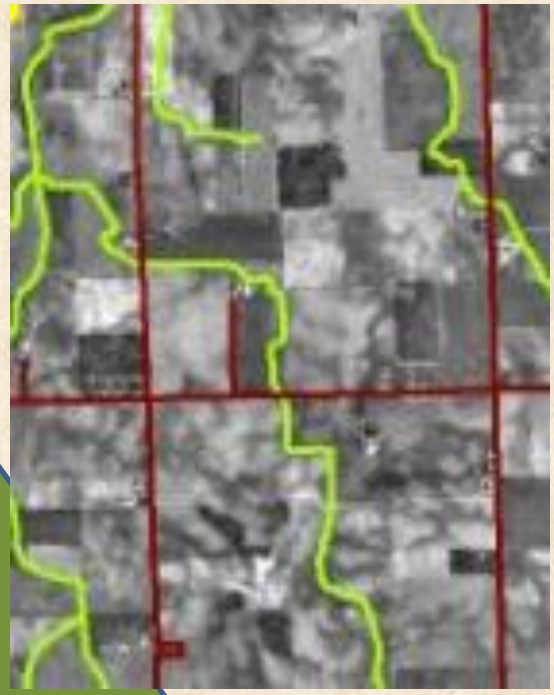
LaMP, Maumee AOC, Western LE Basin program

Connecting the dots

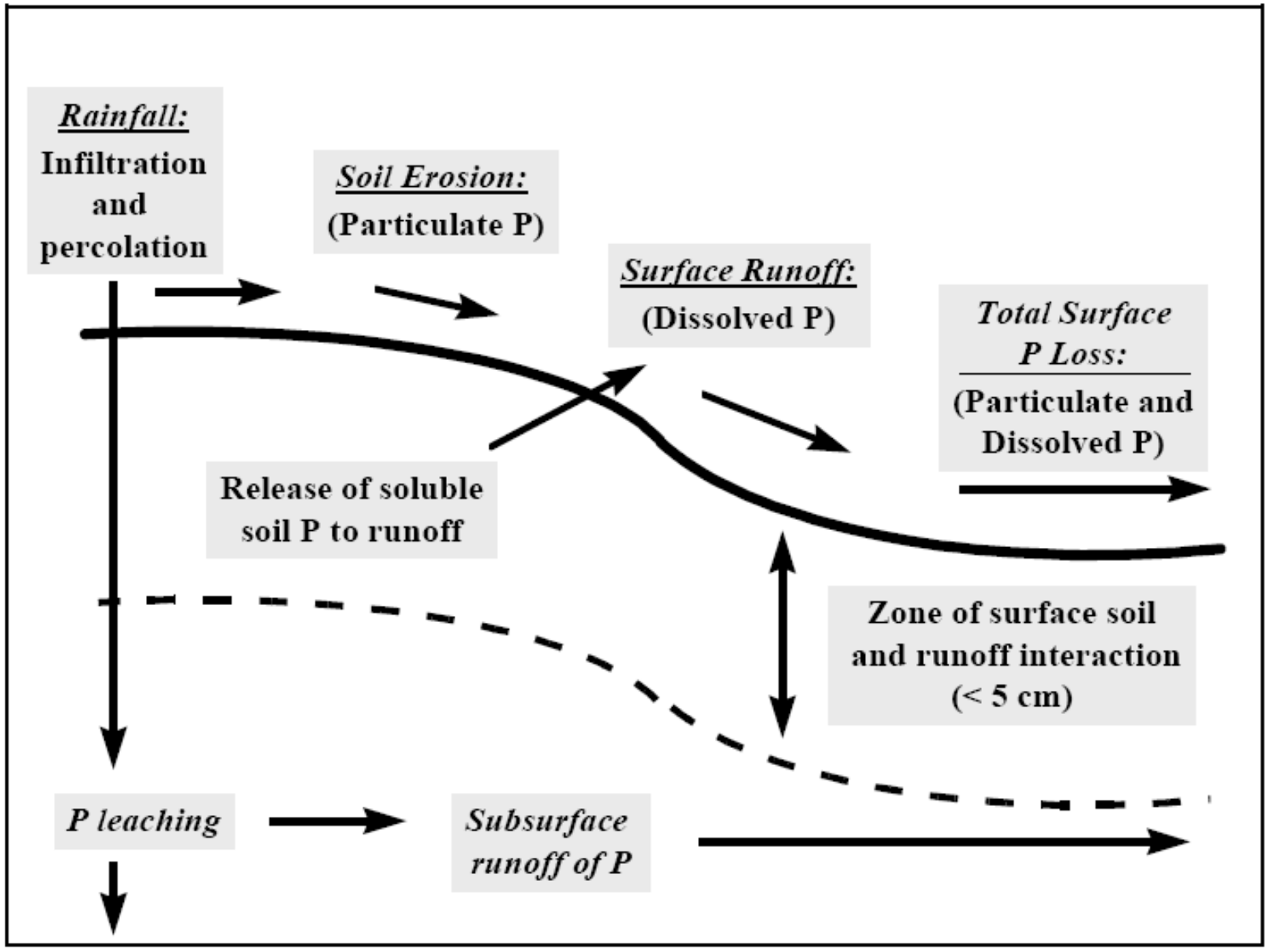
In-lake or downstream impacts



Watershed Outputs (point or nonpoint)



How does phosphorus move from cropland to streams?



Soil Testing

For Crop Production

Agronomic Soil Testing

0- 8 inch cores

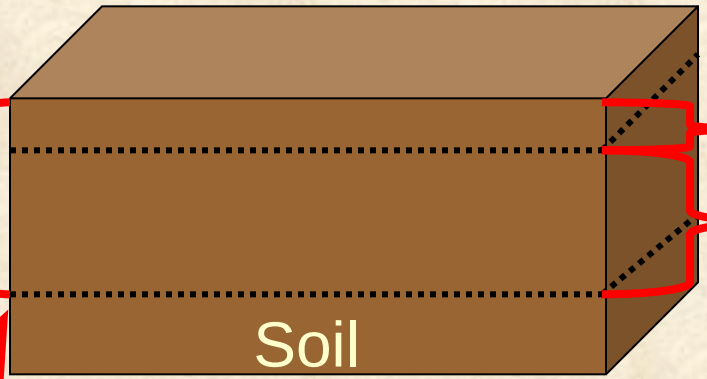
Plants can generally access nutrients within the top 8 inches of soil

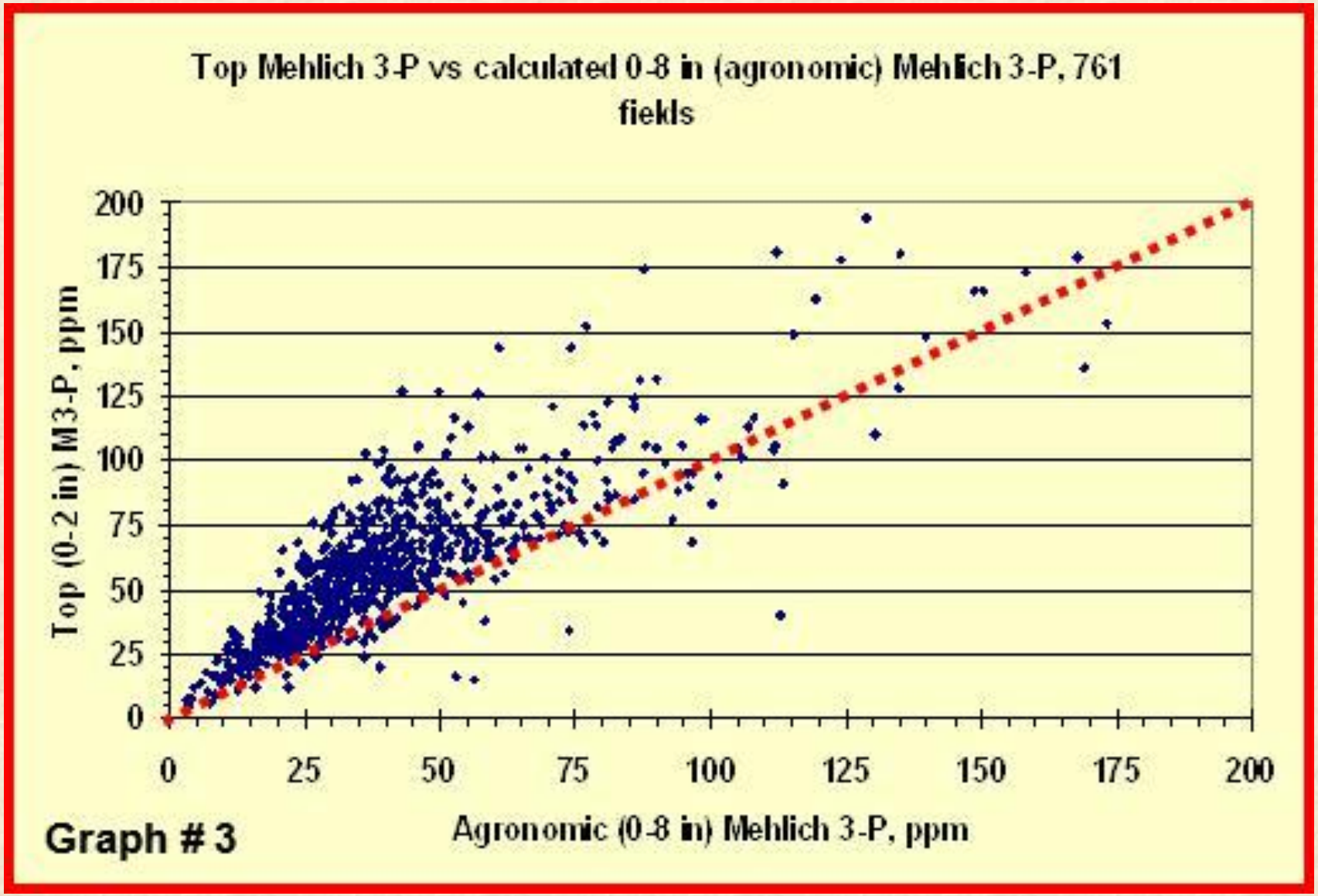
For Environmental Runoff

Environmental Soil Testing 0-2 inches

Soil Testing to Evaluate Stratification 2- 8 inch

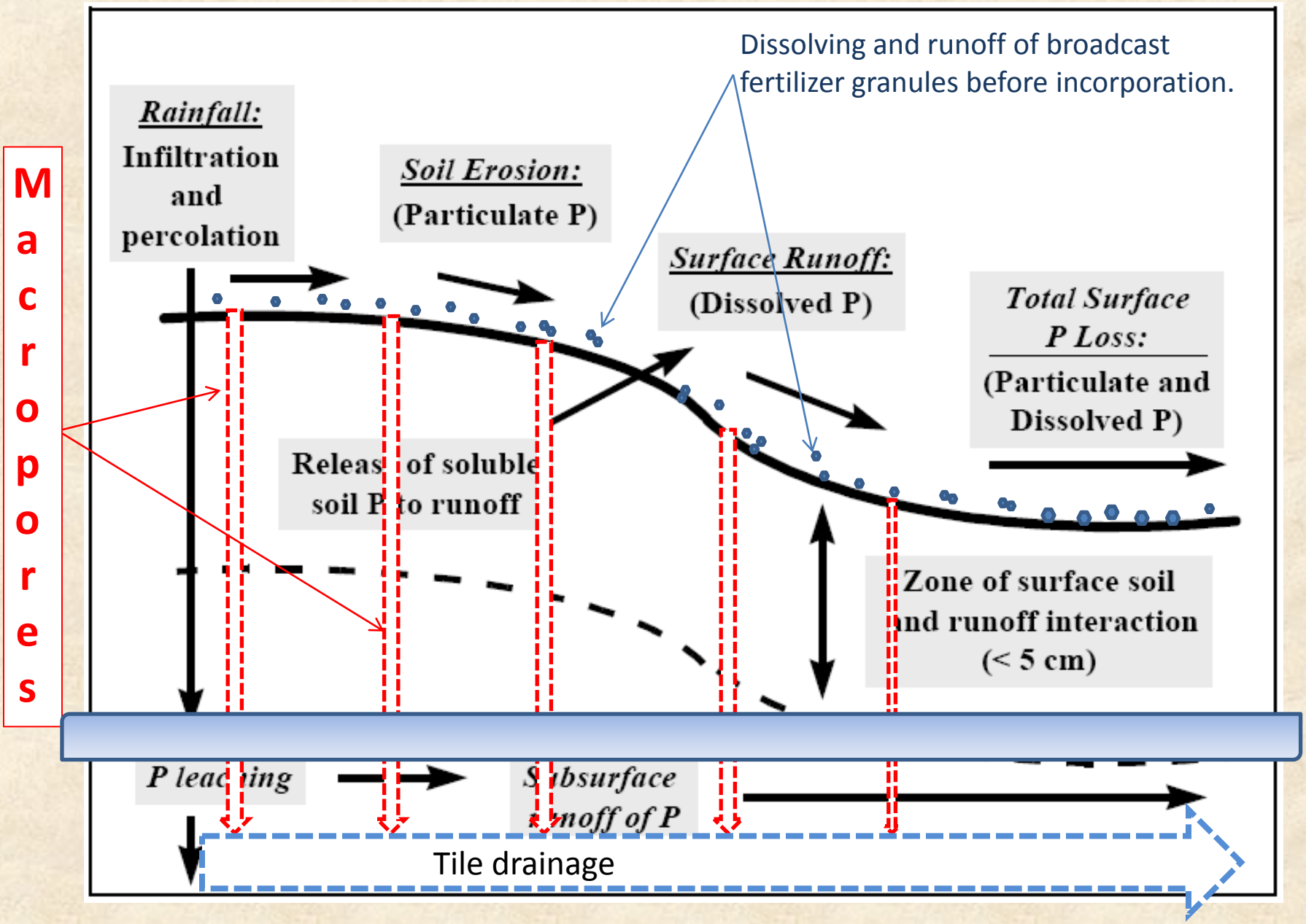
Dissolved phosphorus concentrations are generally proportional to soil test P in top 2 inches




Top Mehlich 3-P vs calculated 0-8 in (agronomic) Mehlich 3-P, 761 fields
Top (0-2 in) M3-P, ppm
0
25
50
75
100
125
150
175
200
Agronomic (0-8 in) Mehlich 3-P, ppm
Graph # 3

Mehlich 3 P Soil Test values, ppm (2010 data)							
Field #	**0-1 in**	**1-2 in**	**2-5 in**	**5-8 in**		**Calc 0-2**	**Calc. 0-8**
1	141	96	46	20		119	54
2	44	59	30	22		52	32
3	95	49	17	23		72	33
4	93	68	68	17		81	52
5	90	64	34	9		77	35
6	62	52	27	9		57	28
7	69	76	51	22		73	46
Ave	**85**	**66**	**39**	**17**		**76**	**40**

Revised diagram for pathways of dissolved phosphorus runoff.



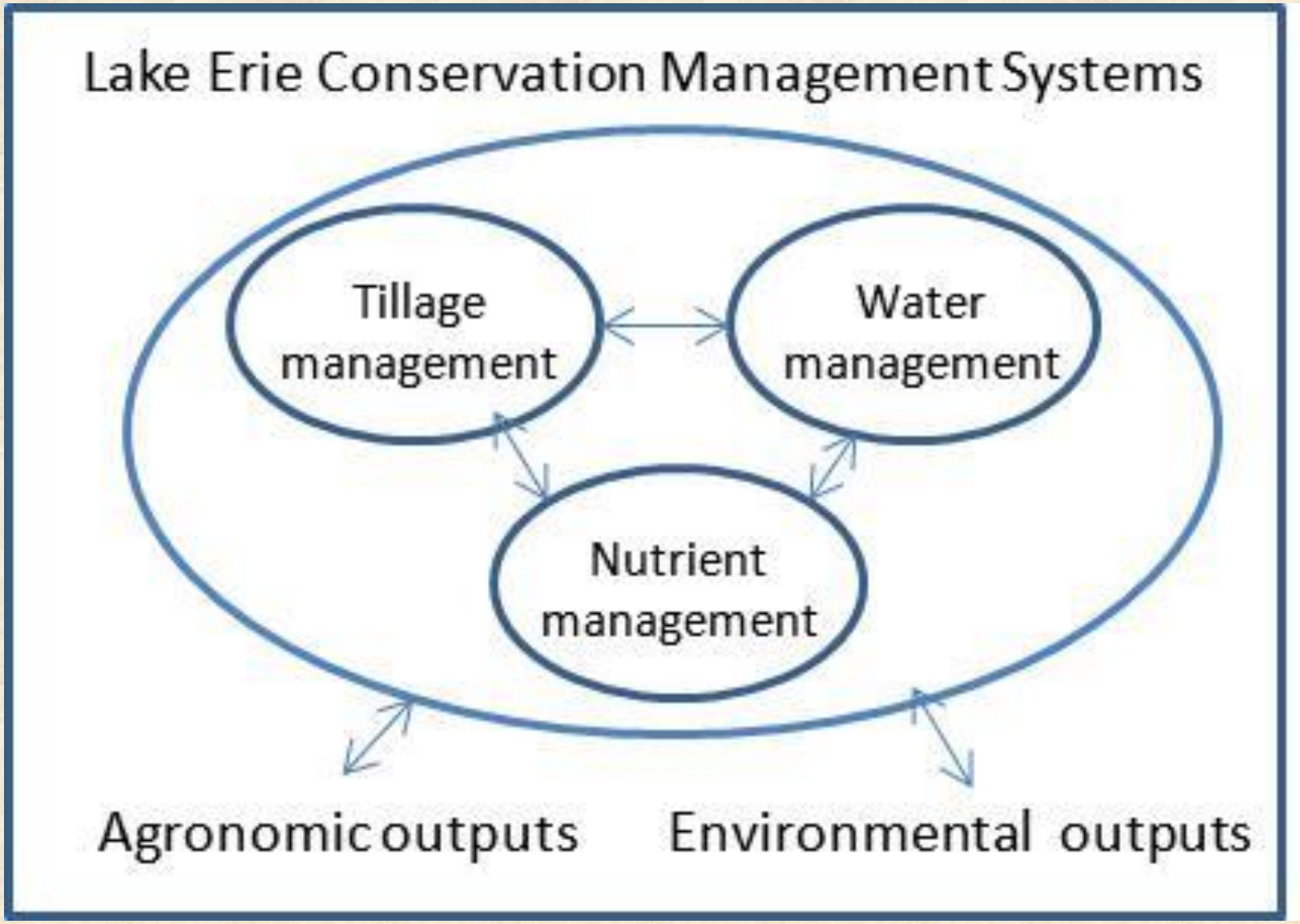
A Quick Summary

1. There is considerable uncertainty within the research and agricultural community regarding the relative importance of various causes of increased DRP runoff.

2. This uncertainty translates into uncertainty about the packages of BMPs that need to be implemented to reduce DRP runoff.

3. Some of this uncertainty could be resolved if we could get all of those with relevant information to meet together, evaluate what we do know, make our best judgment recommendations, and identify research needs.

   (This is “doable” – will it get done?)


Lake Erie Conservation Management Systems
Tillage management
Water management
Nutrient management
Agronomic outputs
Environmental outputs