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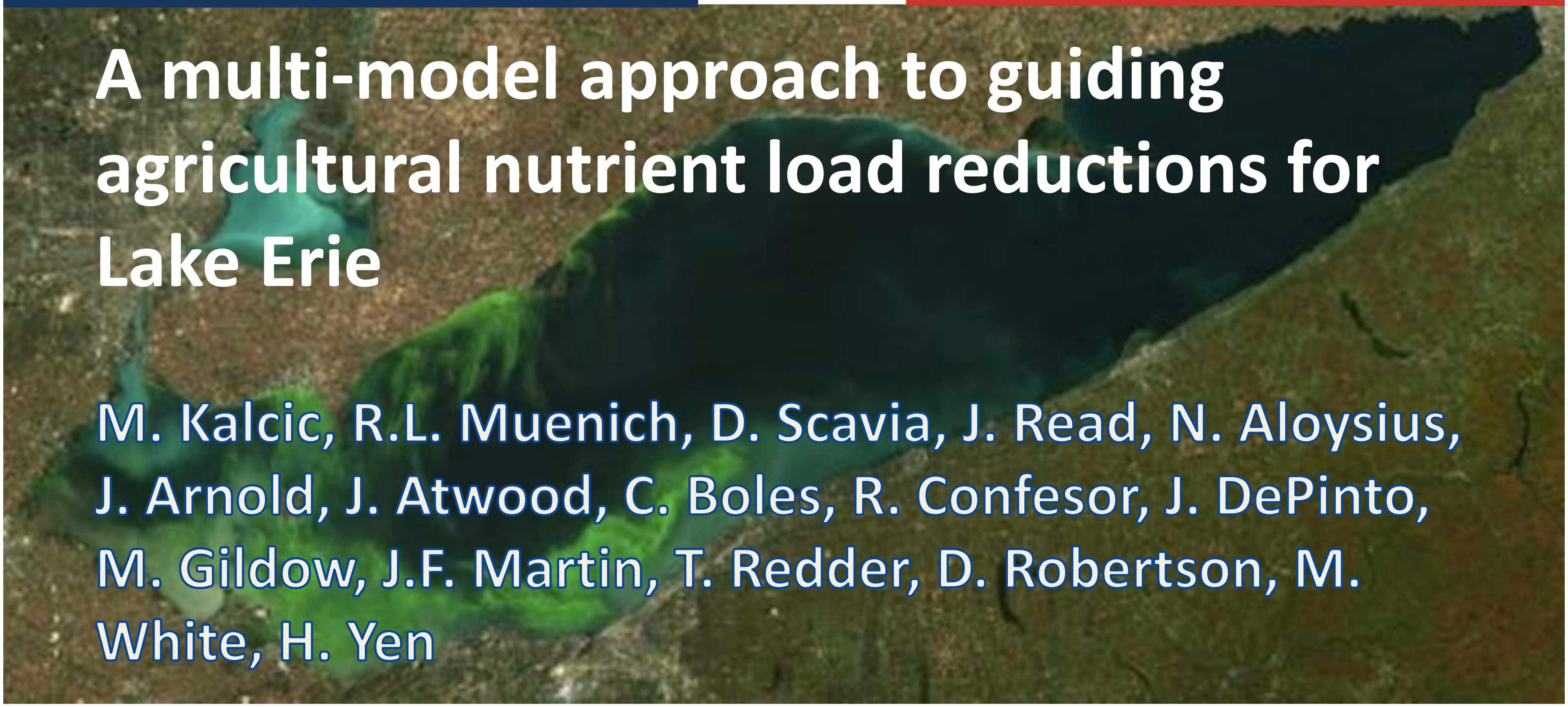
THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES



A multi-model approach to guiding agricultural nutrient load reductions for Lake Erie

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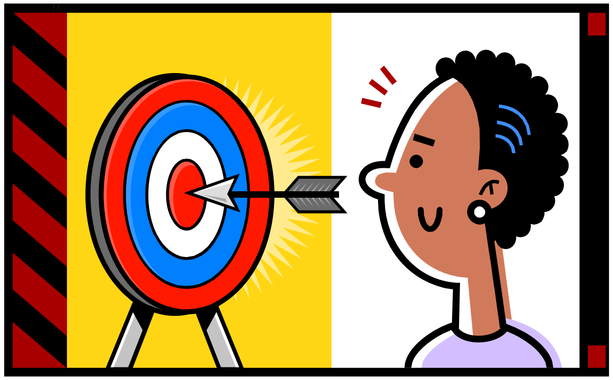
http://graham.umich.edu/water/project/erie-western-basin

This is a project supported by NSF and the Erb Family Foundation and led by Don Scavia at the University of Michigan.

NSF

Fred A. and Barbara M. Erb Family Foundation

Project Goal

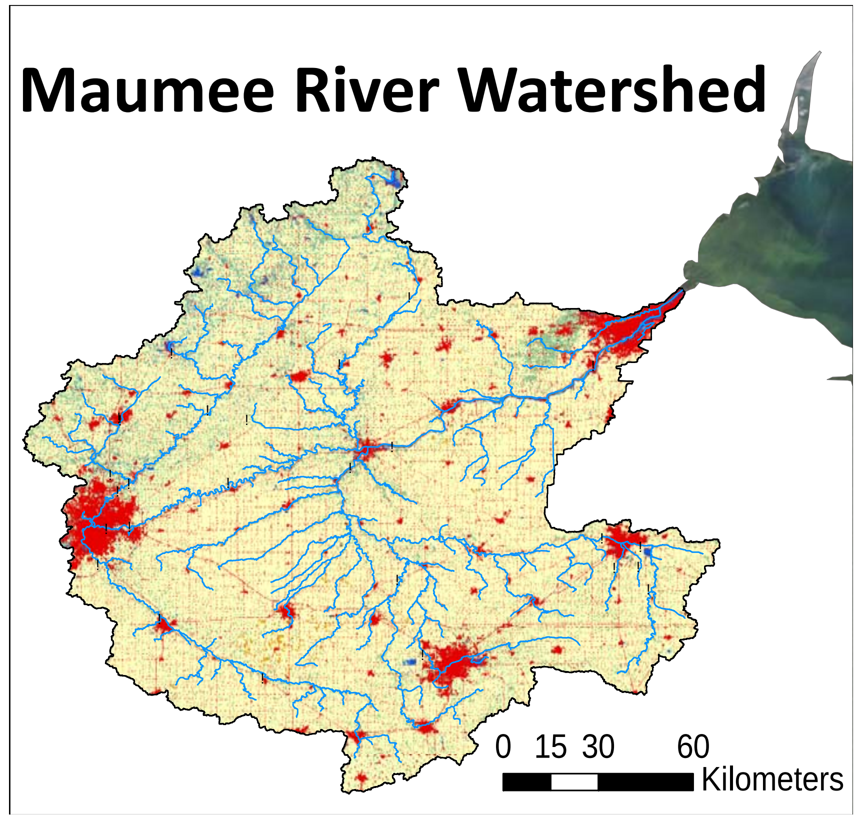


Can these targets be achieved?

What practices, how many?

2015 Great Lakes Water Quality Agreement Protocol, Annex 4 **Spring** (March-July) Targets

	Maumee Watershed	Western Lake Erie
Dissolved Reactive P (**DRP**)	186 MT	40% of 2008
Total P (**TP**)	860 MT	40% of 2008



Project Approach

Assemble six modeling groups with <u>Maumee River Watershed</u> models

SWAT models (Soil and Water Assessment Tool)

University of Michigan	Don Scavia, Jen Read Margaret Kalcic Rebecca Muenich
LimnoTech — Water Environment | Scientists Engineers	Joe DePinto Todd Redder Chelsie Boles
Ohio State	Jay Martin Noel Aloysius Marie Gildow
USDA ARS — United States Department of Agriculture, Agricultural Research Service; BLACKLAND Texas A&M AgriLife Research & Extension Center — LEADING IN LAND & WATER SOLUTIONS - SERVING TEXAS OVER 100 YEARS	Jeff Arnold, Mike White, Haw Yen
Heidelberg University	Rem Confesor

SPARROW model (SPAtially Referenced Regressions On Watershed attributes)

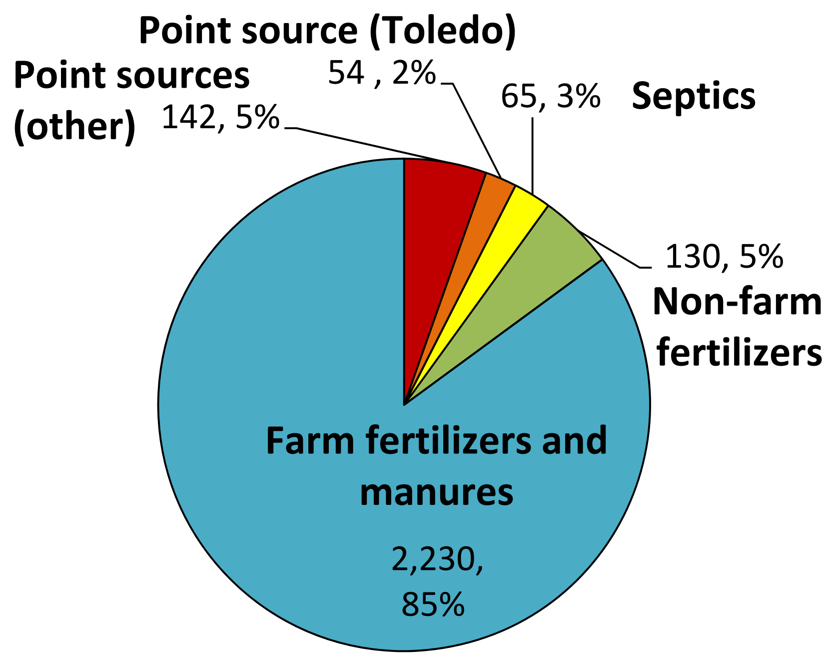
USGS — science for a changing world	Dale Robertson

Consult with representatives of conservation organizations, NGOs, and the agricultural community to identify potential scenarios.

Project Approach

- **Models successfully validated with historical data: 2005-2014**
- **Analyzed impact of bundled scenarios on P discharge: 2005-2014**
- **Estimated 85% of Maumee P from agriculture, so focused on agricultural management options**

Estimated P **Delivery** from the Maumee River to Lake Erie (*t/y*)

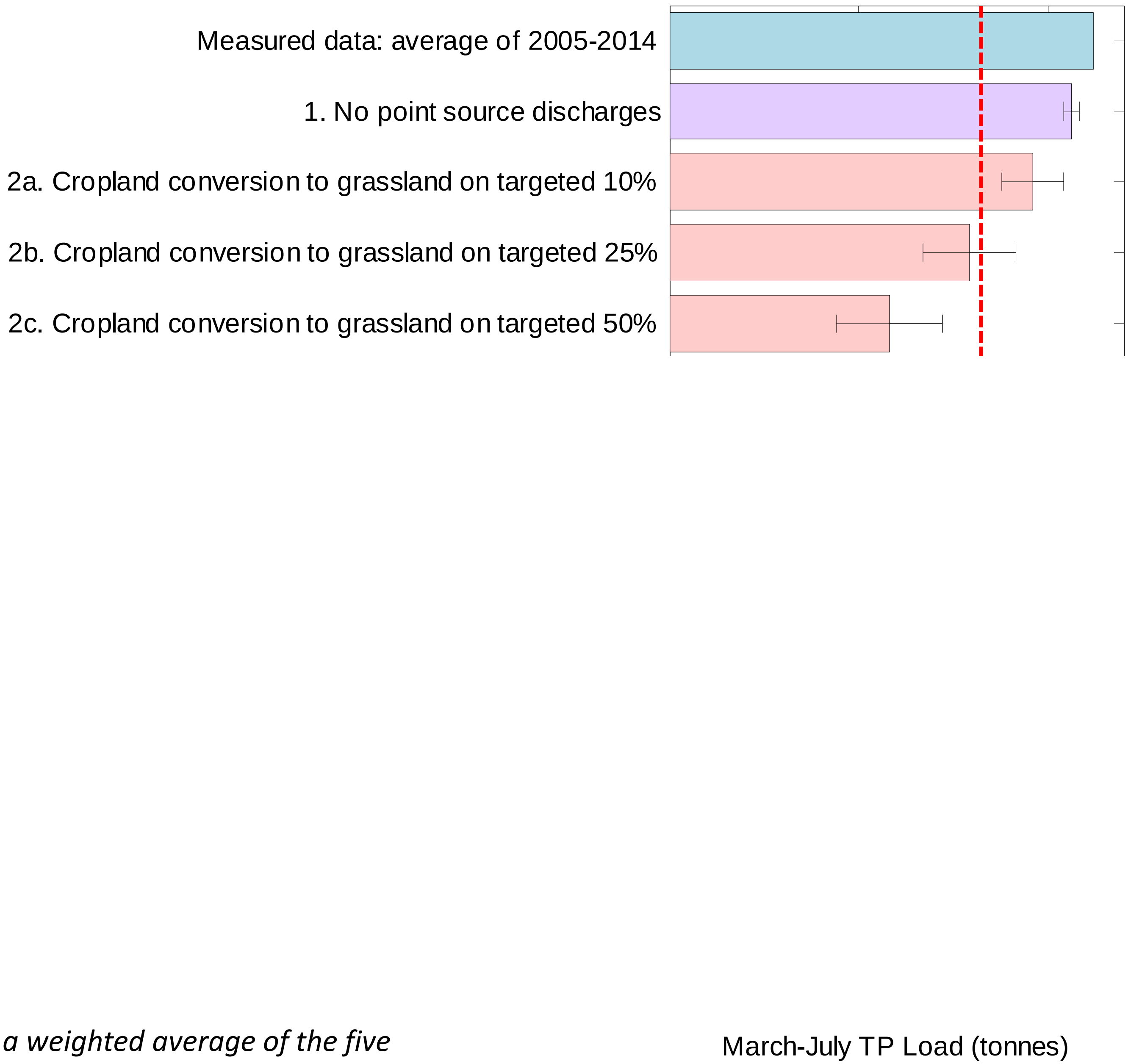


Delivery of Farm Fertilizers & Manures =
Average Load to Lake Erie (2620 t/y) –
Toledo WWTP (54 t/y) –
Other Point Sources (142 t/y) –
Non-farm Fertilizers (130 t/y) –
0.39 * Septics (65 t/y)
= ~ ***2230 t/y***

Bundled Scenarios

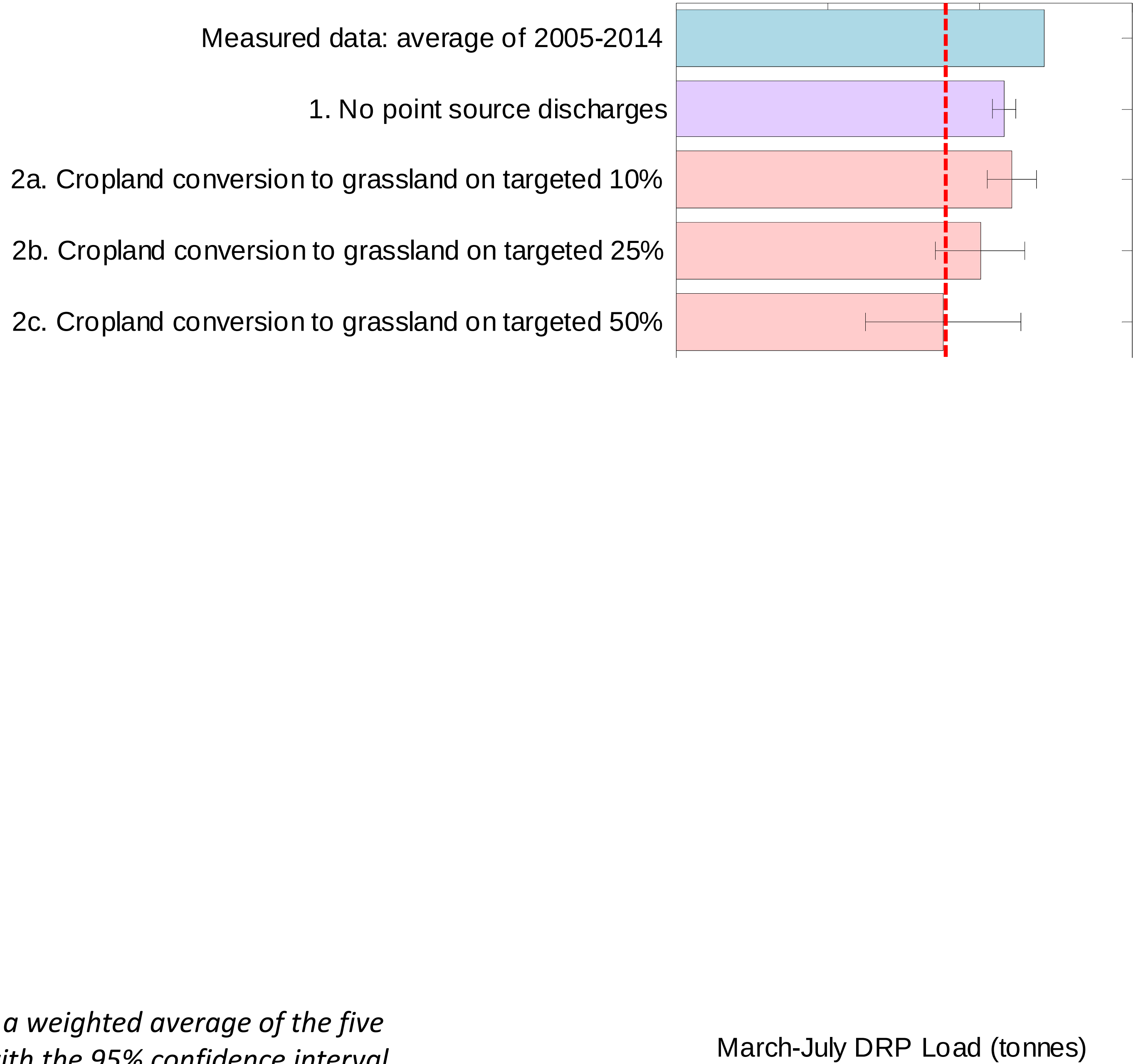
No.	Name	Description
1	**No Point Source Discharges**	All PS discharges were removed (i.e., set to zero).
2a-c	**Cropland conversion to grassland** at 10% (5a), 25% (5b), and 50% (5c) targeted adoption	In these three scenarios designed to test how much land would need to be removed from production if farms adopted no additional conservation practices, 10%, 25%, and 50% of the row croplands with the lowest crop yields and greatest TP losses were converted to switchgrass and managed for wildlife habitat with limited harvesting for forage and no P fertilization.
3	**In-field practices** at 25% random adoption	The following practices were applied together on a random 25% of row cropland: 50% reduction in P fertilizer application, fall timing of P applications, subsurface placement of P fertilizers, and a cereal rye cover crop.
4	**Nutrient management** at 25% random adoption	The following practices were applied to a randomly selected 25% of row crop acreage: a 50% reduction in P fertilizer application, fall timing of P applications, and subsurface placement of P into the soil.
5	**Nutrient management** at 100% adoption	The following practices were applied to 100% of row crop fields: a 50% reduction in P fertilizer application, fall timing of P applications, and subsurface placement of P into the soil.
6	**Commonly recommended practices** at 100% random adoption	The following 4 practices were each applied to separate 25% of the crop acres: a 50% reduction in P fertilizer application, subsurface application of P fertilizers, continuous no-tillage, and medium-quality buffer strips.
7	**Continuous no-tillage and subsurface placement of P fertilizer** at 50% random adoption	A combination of continuous no-tillage and subsurface application of P fertilizers were applied together on a randomly selected 50% of row crop acres.
8	**Series of practices** at 50% targeted adoption	The following practices were targeted to the 50% of row cropland with the highest TP loss in the watershed: subsurface application of P fertilizers, cereal rye cover crop in the winters without wheat, and application of medium-quality buffer strips.
9	**Series of practices** at 50% random adoption	The following practices were applied to a random 50% of row cropland: subsurface application of P fertilizers, cereal rye cover crop in the winters without wheat, and application of medium-quality buffer strips.
10	**Diversified rotation** at 50% random adoption	An alternative corn-soybean-wheat rotation with a cereal rye cover crop all winters without wheat was applied over a randomly chosen 50% of row cropland.
11	**Wetlands and buffer strips** at 25% targeted adoption	Wetlands treating half of overland flow in a sub-watershed were targeted to 25% of sub-watersheds with the greatest TP loading rates and medium-quality buffer strips were targeted to 25% of row cropland with greatest TP loss rates.

TP Results: March-July loading*



**Plotting a weighted average of the five models with the 95% confidence interval*

DRP Results: March-July loading*



**Plotting a weighted average of the five models with the 95% confidence interval*

Most Effective Scenarios

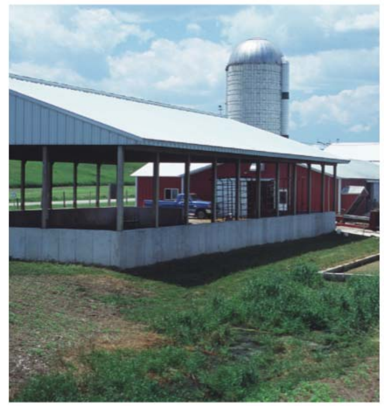
	No.	Name	Description
DRP	5	**Nutrient management on 100% cropland**	50% reduction in P application, with fall **subsurface application**
Both	8	**Series of targeted practices at 50% adoption**	**50% Subsurface application, additional 50%** of cereal rye cover crop in the winters and medium-quality buffers on **high P-loss cropland.**
TP	9	**Series of random practices at 50% adoption**	**Subsurface application**, cereal rye cover crop in the winters without wheat, medium-quality buffers **applied together on random 50% of cropland**.
TP	11	**Targeted wetlands and buffers on 50% of cropland**	Wetlands and buffers on 25% **of highest P-loss cropland** (intercepting half of overland and tile flow

Management Plan Adoption and Future Needs

	% Cropped Acres			
	NRCS	**NRCS**	**Wilson et al.**	**Wilson et al.**
Survey Year	**2006**	**2012**	**2012**	**2014**
Region	**WLEB**	**WLEB**	**Maumee**	**Maumee**
Practice				
Cover crops	**2**	**6**	**8**	**16**
P placement	**-**	**-**	**26**	**25**
Buffer Strips	**18**	**31**	**35**	**-**

*Continued and **Accelerated** Adoption Needed*

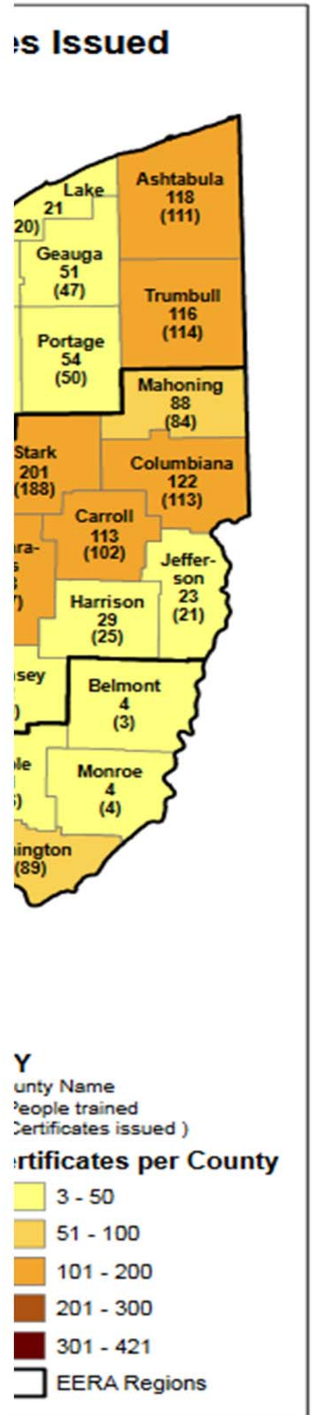
The Tri-State Western Lake Erie Basin Phosphorus Reduction Initiative



The Tri-State Western Lake Erie Basin Phosphorus Reduction Initiative is a multi-state project to protect the western basin of Lake Erie by reducing phosphorus (P) and sediment loading to decrease Harmful Algal Blooms (HABs). Project partners have identified Natural Resources Conservation Service (NRCS) conservation practices and innovative demonstration practices that farmers can implement using Environmental Quality Incentive Program (EQIP) and Agricultural Conservation Easement (ACEP) funds to protect soil health, water quality, and prevent fish and wildlife degradation. The Western Lake Erie Basin Regional Conservation Partnership Program (RCPP) project was awarded $17.5 million. Ohio will receive about $12.25 million, which is split between EQIP, ACEP and technical assistance.

OHIO'S PRIORITY PRACTICE LIST

Animal Waste Storage Structure	Install animal waste storage structures to allow producers longer storage and allow for appropriate waste application.
Nutrient Placement	Place all phosphorus under the soil surface using variable rate technology; incorporation is not included in this practice.
Cover Crops	Plant an over-wintering cover crop single species or multiple species mix with at least one over-wintering species.
Crop rotation including a small grain followed by a multi-species mix cover crop	Add wheat or small grain to the rotation that has not been part of the rotation for the past 5 years or more.
Water Control Structures and Drainage Water Management	Install a controlled drainage structure and manage it for water quality.
Water Quality Inlets/Blind Inlets	Replace open inlets/risers with underground outlets supporting water quality.



Summary of Findings

- Multiple pathways to 40% appear possible
- But, widespread, accelerated adoption needed
- Targeting is better than random placement
- Subsurface P application is very effective

Broader Conclusions

- Also reductions of nitrogen and sediment, but may not be optimal for them.
- Possible to maintain agriculture and improve water quality

Questions?

http://graham.umich.edu/water/project/erie-western-basin

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