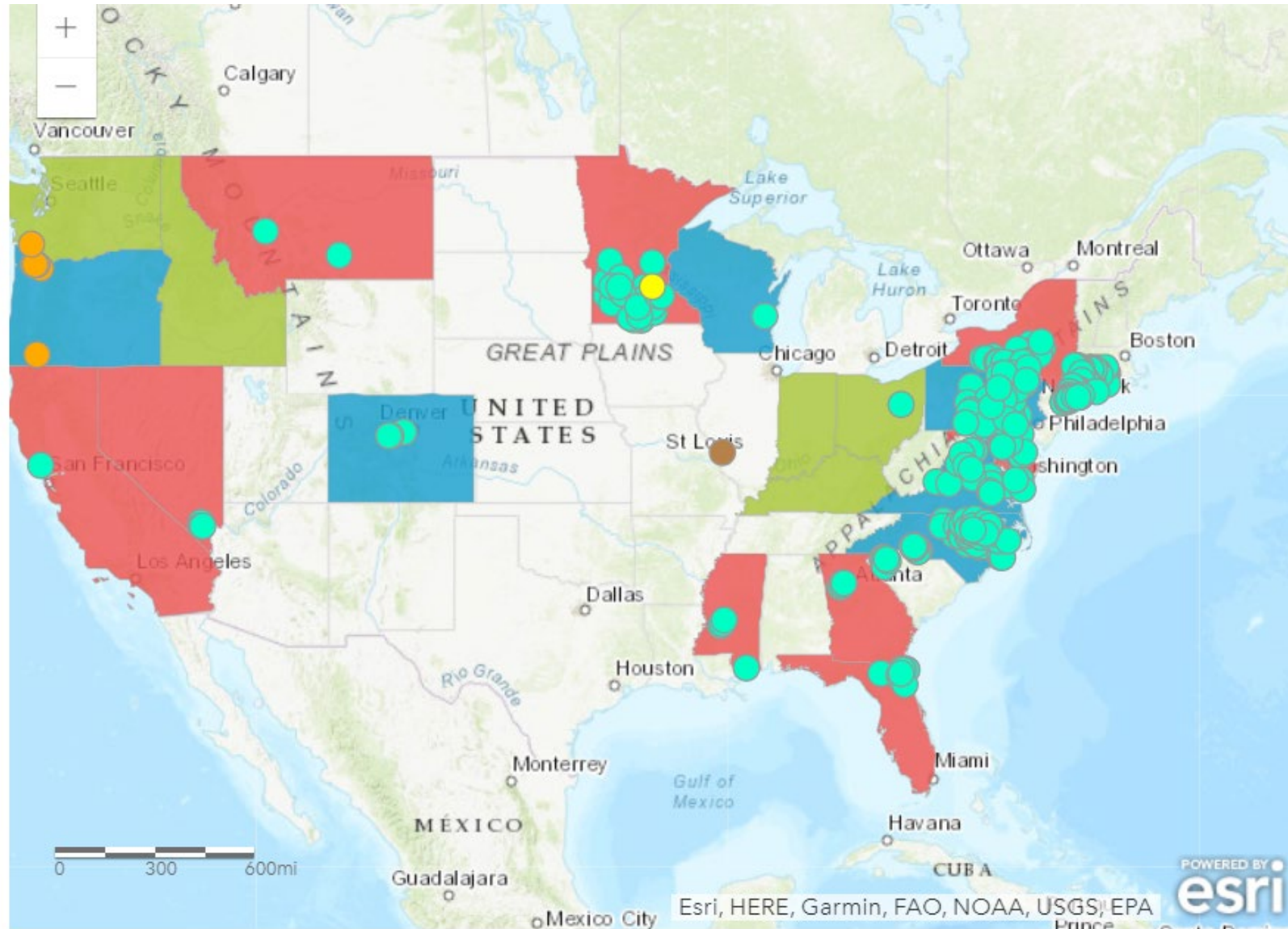


# ***Water Quality Trading to Meet Local and Regional Goals***

Jessica Fox, Sr. Technical Executive  
Electric Power Research Institute  
[jfox@epri.com](mailto:jfox@epri.com)



# WQT Programs





# OHIO RIVER BASIN WATER QUALITY TRADING PROJECT



Environmental  
Finance  
Voluntary Carbon  
Markets Rankings  
**WINNER**



**WaterWorld.**



# Ohio River Basin WQT Overview

- Ohio, Indiana, Kentucky
- Full decade of experience
- 60 Landowners
- Contracts run between 5 to 40 years
- Agricultural and Forestry Practices
- 200,000 TN/TP Credits Verified



## Heartbroken dog owners mourn the loss of their pets from deadly algae

August 14, 2019

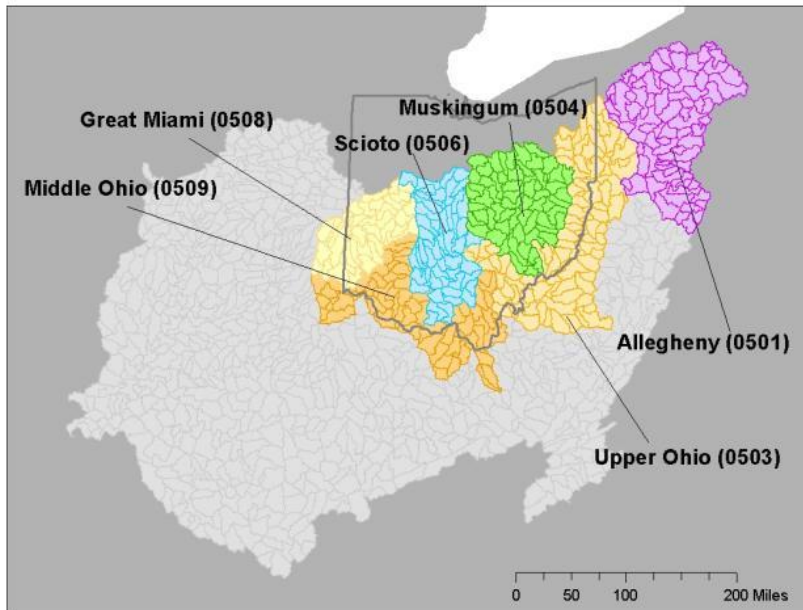


ACROSS THE SOUTH DOGS ARE DYING FROM TOXIC ALGAE EXPOSURE AFTER SWIMMING IN LAKES, PONDS

The Daily BRIEFING \* w/ DANA PERINO \*



# Models – Edge of Farm (NTT) and Watershed Model (WARMF)



U.S. ENVIRONMENTAL PROTECTION AGENCY  
Ecosystems Research Division

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You are here: EPA Home » athens » wwqtcs » html » Watershed Analysis Risk Management Framework (WARMF)

## Watershed Analysis Risk Management Framework (WARMF)

To facilitate TMDL analysis and watershed planning, WARMF was developed under sponsorship from the Electric Power Research Institute (EPRI) as a decision support system for watershed management. The system provides a road map to calculate TMDLs for most conventional pollutants (coliform, TSS, BOD, nutrients). It also provides a road map to guide stakeholders to reach consensus on an implementation plan. The scientific basis of the model and the consensus process have undergone several peer reviews by independent experts under EPA guidelines. WARMF is now compatible with the data extraction and watershed delineation tools of EPA BASINS. WARMF is organized into five (5) linked modules under one, GIS-based graphical user interface (GUI). It is a very user friendly tool suitable for expert modelers as well as general stakeholders.

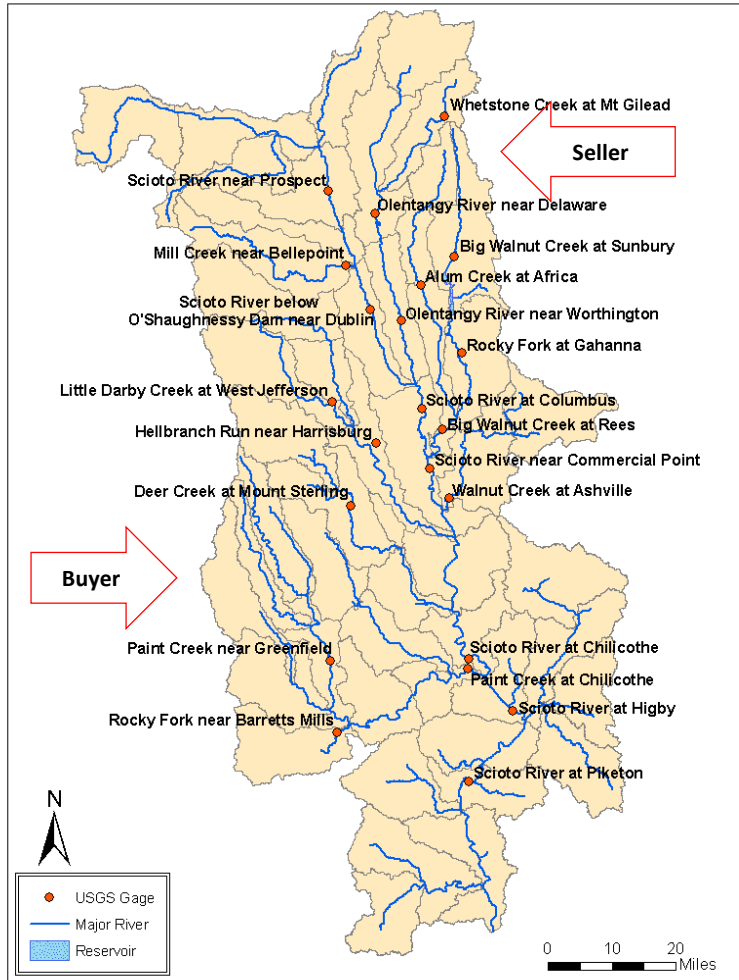
### WARMF Components

The Engineering Module is a GIS-based watershed model that calculates daily runoff, shallow ground water flow, hydrology and water quality of a river basin. A river basin is divided into a network of land catchments (including canopy and soil layers), stream segments, and lake layers for hydrologic and water quality simulations. Land surface is characterized by land use / land cover and precipitation is deposited on the land catchments to calculate snow and soil hydrology, and resulting surface runoff and ground water seepage to river segments. Water is

#### WWQTCS Info

- WWQTCS Home
- Technical Support
- Tools
  - Watershed Models
    - Basins
    - LSPC
    - WAMView
    - SWMM
    - WARMF
  - Water Quality Models
    - WASP
    - QUAL2K
    - Aquatox
    - EPD-RIV1
  - Hydrodynamic Models
    - EFDC
    - EPD-RIV1

# Specific Nutrient Numbers Depend on Location



# First Journal paper on Credit Calculation Methods

Published June 2014

## Attenuation Coefficients for Water Quality Trading

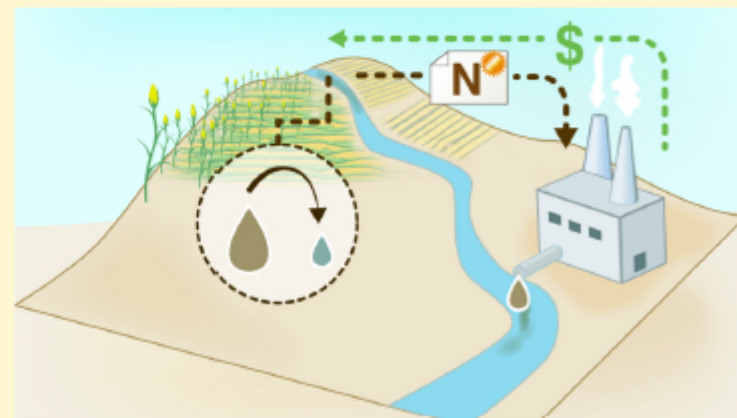
Arturo A. Keller,<sup>\*,†</sup> Xiaoli Chen,<sup>†</sup> Jessica Fox,<sup>‡</sup> Matt Fulda,<sup>†</sup> Rebecca Dorsey,<sup>†</sup> Briana Seapy,<sup>†</sup> Julia Glenday,<sup>†</sup> and Erin Bray<sup>†</sup>

<sup>†</sup>Bren School of Environmental Science and Management, University of California, Santa Barbara, California 93106-5131, United States

<sup>‡</sup>Electric Power Research Institute, Palo Alto, California 94304, United States

### Supporting Information


**ABSTRACT:** Water quality trading has been proposed as a cost-effective approach for reducing nutrient loads through credit generation from agricultural or point source reductions sold to buyers facing costly options. We present a systematic approach to determine attenuation coefficients and their uncertainty. Using a process-based model, we determine attenuation with safety margins at many watersheds for total nitrogen (TN) and total phosphorus (TP) loads as they transport from point of load reduction to the credit buyer. TN and TP in-stream attenuation generally increases with decreasing mean river flow; smaller rivers in the modeled region of the Ohio River Basin had TN attenuation factors per km, including safety margins, of 0.19–1.6%, medium rivers of





# Targeting Conservation with Tree Planting



 PLOS ONE

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RESEARCH ARTICLE

## Giving credit to reforestation for water quality benefits


Arturo A. Keller<sup>1\*</sup>, Jessica Fox<sup>2</sup>

<sup>1</sup> Bren School of Environmental Science & Management, University of California Santa Barbara, Santa Barbara, CA, United States of America, <sup>2</sup> Electric Power Research Institute, Palo Alto, CA, United States of America

\* [keller@bren.ucsb.edu](mailto:keller@bren.ucsb.edu)

 Check for updates

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 OPEN ACCESS

**Citation:** Keller AA, Fox J (2019) Giving credit to reforestation for water quality benefits. PLoS ONE 14(6): e0217756. <https://doi.org/10.1371/journal.pone.0217756>

**Editor:** Rodolfo Nájera, Imperial College London

### Abstract

While there is a general belief that reforesting marginal, often unprofitable, croplands can result in water quality benefits, to date there have been very few studies that have attempted to quantify the magnitude of the reductions in nutrient (N and P) and sediment export. In order to determine the magnitude of a credit for water quality trading, there is a need to develop quantitative approaches to estimate the benefits from forest planting in terms of load reductions. Here we first evaluate the availability of marginal croplands (i.e. those with low infiltration capacity and high slopes) within a large section of the Ohio River Basin (ORB) to assess the magnitude of the land that could be reforested. Next, we employ the Nutrient Tracking Tool (NTT) to study the reduction in N, P and sediment losses from con-

Overall, there is the potential for avoiding 60 million kg N and 2 million kg P from reaching the streams and rivers of the northern ORB as a result of conversion of marginal farmland to tree planting. This represents a significant fraction of the goal of the USEPA Gulf of Mexico Hypoxia Task Force to reduce TN and TP reaching the dead zone in the Gulf of Mexico.

Keller AA & Fox J (2019) **Giving credit to reforestation for water quality benefits.** PLoS ONE 14(6):e0217756.

# How to improve the quality of water? By planting (many) trees

American researchers have made the link between reforestation and improved water quality. They call today polluting facilities to reforest their lands.



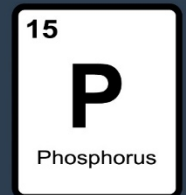
= 250 million



= 60 million kg




= 2 million kg



= 1.54 million



# Credits are Registered



**Ohio River Basin Trading Project** **EPRI** | ELECTRIC POWER RESEARCH INSTITUTE

Ohio River Basin - Water Quality Trading Project

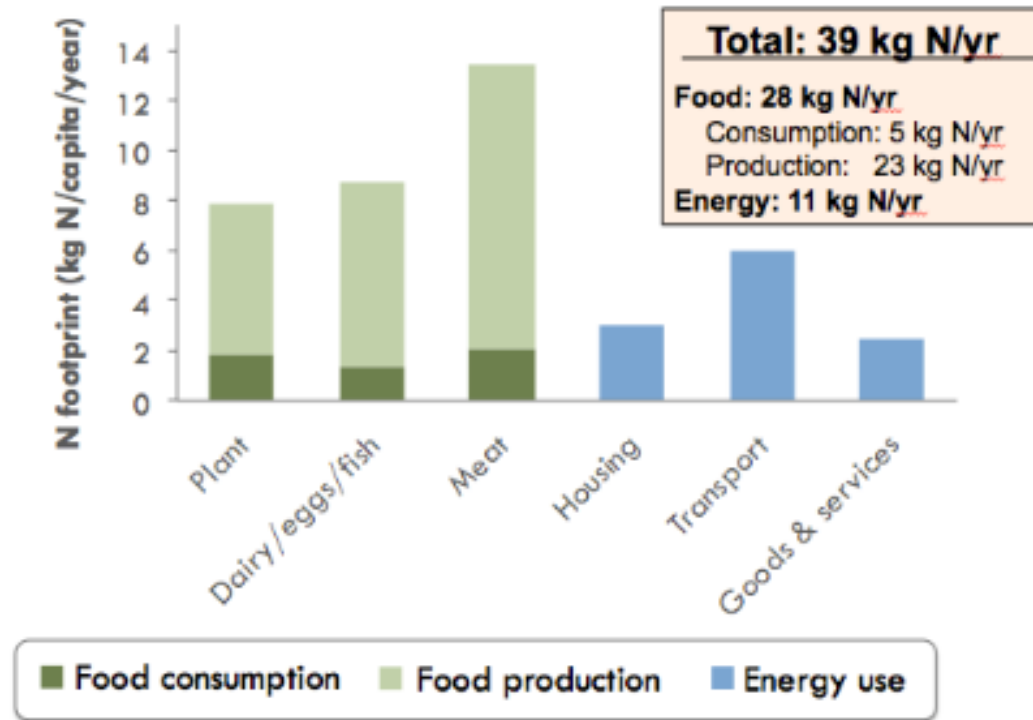
Clear Search:

Account Holders	Projects	Issuances / Listings	Holdings	Retired Credits	Cancelled Units				
△ Project Name	Account Name	Project Type	Installation Date	State / Province	Watershed (HUC 4)	Sub-Watershed (HUC 10)	BMP	Details	
IN-029-2013-106	Dearborn County SWCD	Nitrogen Reduction	04 Sep 2013	IN	Middle Ohio	South Hogan Creek-North Hogan Creek	Feedlot: Waste Management System	View	
IN-029-2013-106	Dearborn County SWCD	Phosphorus Reduction	04 Sep 2013	IN	Middle Ohio	South Hogan Creek-North Hogan Creek	Feedlot: Waste Management System	View	
IN-115-2013-108	Ohio County SWCD	Nitrogen Reduction	26 Aug 2013	IN	Middle Ohio	South Fork Laughery Creek-Laughery Creek	Feedlot: Waste Management System	View	
IN-115-2013-108	Ohio County SWCD	Phosphorus Reduction	26 Aug 2013	IN	Middle Ohio	South Fork Laughery Creek-Laughery Creek	Feedlot: Waste Management System	View	
IN-115-2013-109	Ohio County SWCD	Phosphorus Reduction	20 Nov 2013	IN	Middle Ohio	Gunpowder Creek-Ohio River	Feedlot: Waste Management System	View	

# Personal Footprints



## Personal N footprint in the US



<http://n-print.org/>

James Galloway, University of Virginia

Allison Leach, University of New Hampshire

# Scenarios

## SRF/WIFIA Projects

- \$50M Funding
- 1% allocated to WQT = \$500,000
- Benefits achieved quickly while traditional infrastructure installed.

## 319 Funds

- States can purchase and retire credits.

Funding cycles back into more BMPs and more TN/TP reductions.

# Future . . .

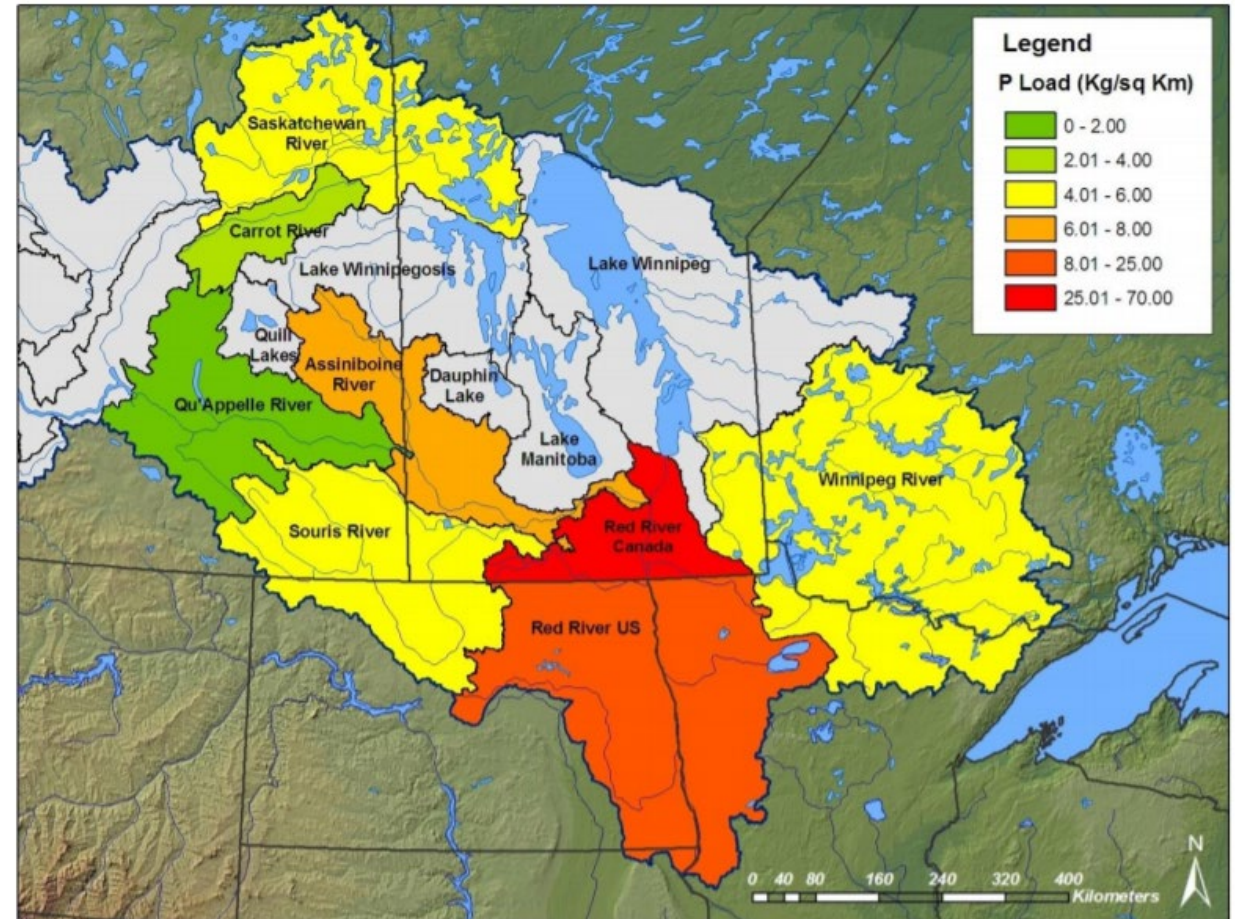
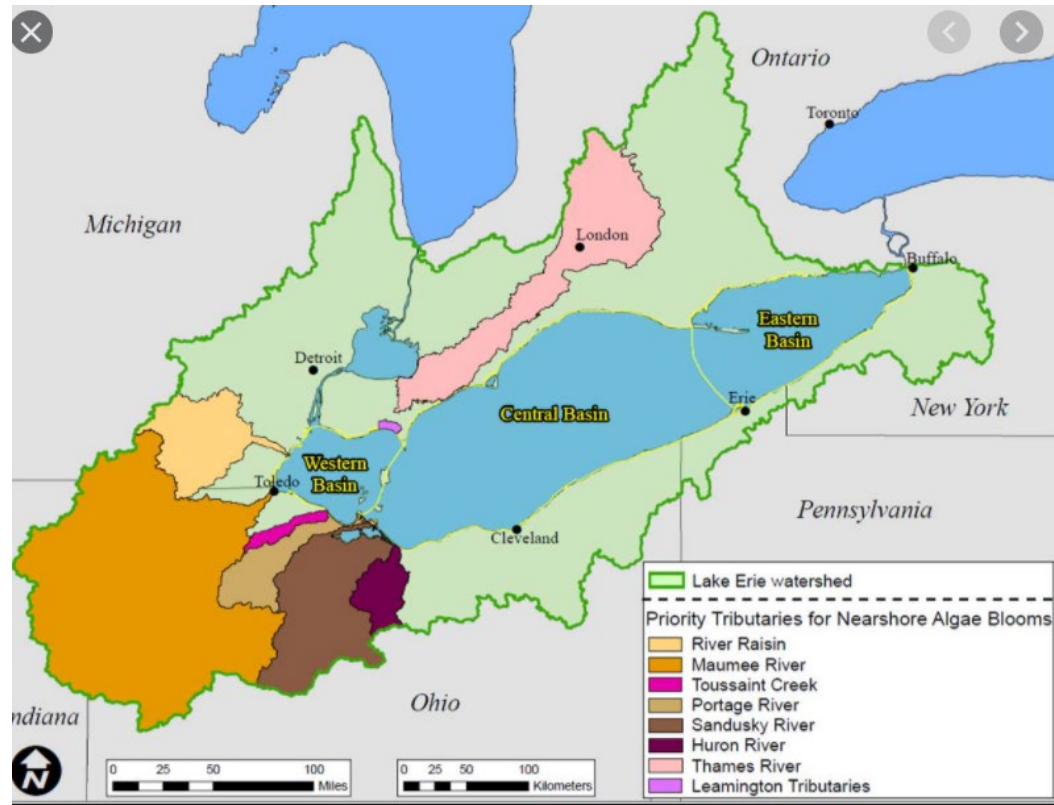


Figure 2: Phosphorus load ranges in tonnes/year flowing into Lake Winnipeg based on averaged total annual phosphorus loads measured from 1994 to 2001 at long-term monitoring stations in Manitoba and interpreted by Bourne et al. (2002)

# Let's Give This a Go!

- Inventory of verified credits & ready to produce more.
- A decade of agency and stakeholder support.
- Science to calculate value based on specific point of concern.
- We need State's help to identify teaming opportunities for grants, loans, purchases.



**OHIO RIVER BASIN  
WATER QUALITY TRADING PROJECT**



***Do Your Part!***

[wqt.epri.com](http://wqt.epri.com)