Assessing the Sources and Management Options for Detroit River Nutrient Loads to Lake Erie

Lake Erie Millennium Network Meeting
February 23, 2017

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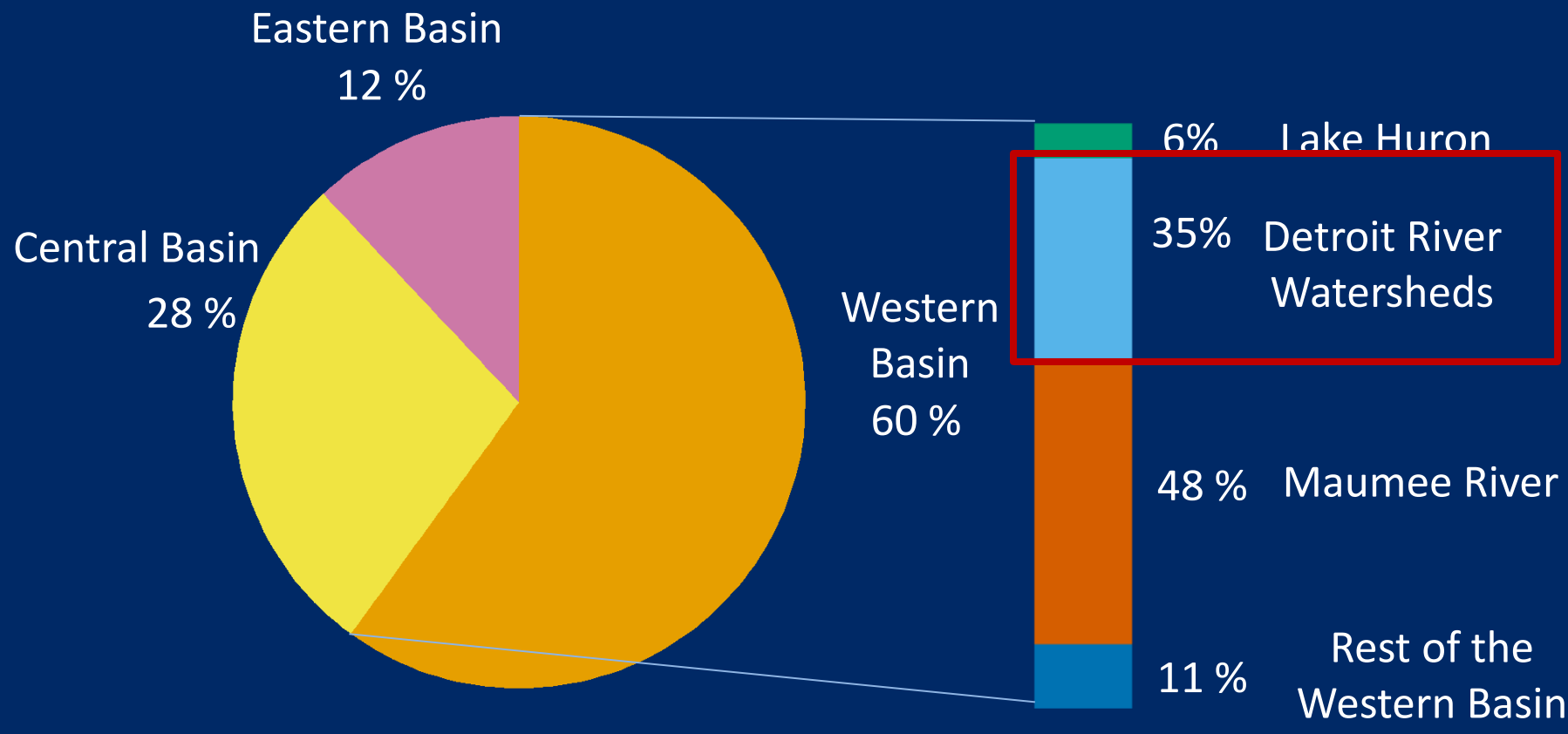
WATER CENTER
UNIVERSITY OF MICHIGAN

Fred A. and Barbara M. Erb Family Foundation

TP loads to Lake Erie



(Maccoux et al. 2016)

ntext


ENVIRONMENT

The New York Times

Behind Toledo's Water Crisis, a Long-Troubled Lake Erie

By MICHAEL WINES AUG. 4, 2014

August 2014

Algae-infested water from
Toledo. Joshua Lott for The N

Email

Share

TO
drin
and
years


GLWQA:

Reduce P loads by 40%

Water

September 7, 2012. Canadian Embassy; Washington, DC. Credit:

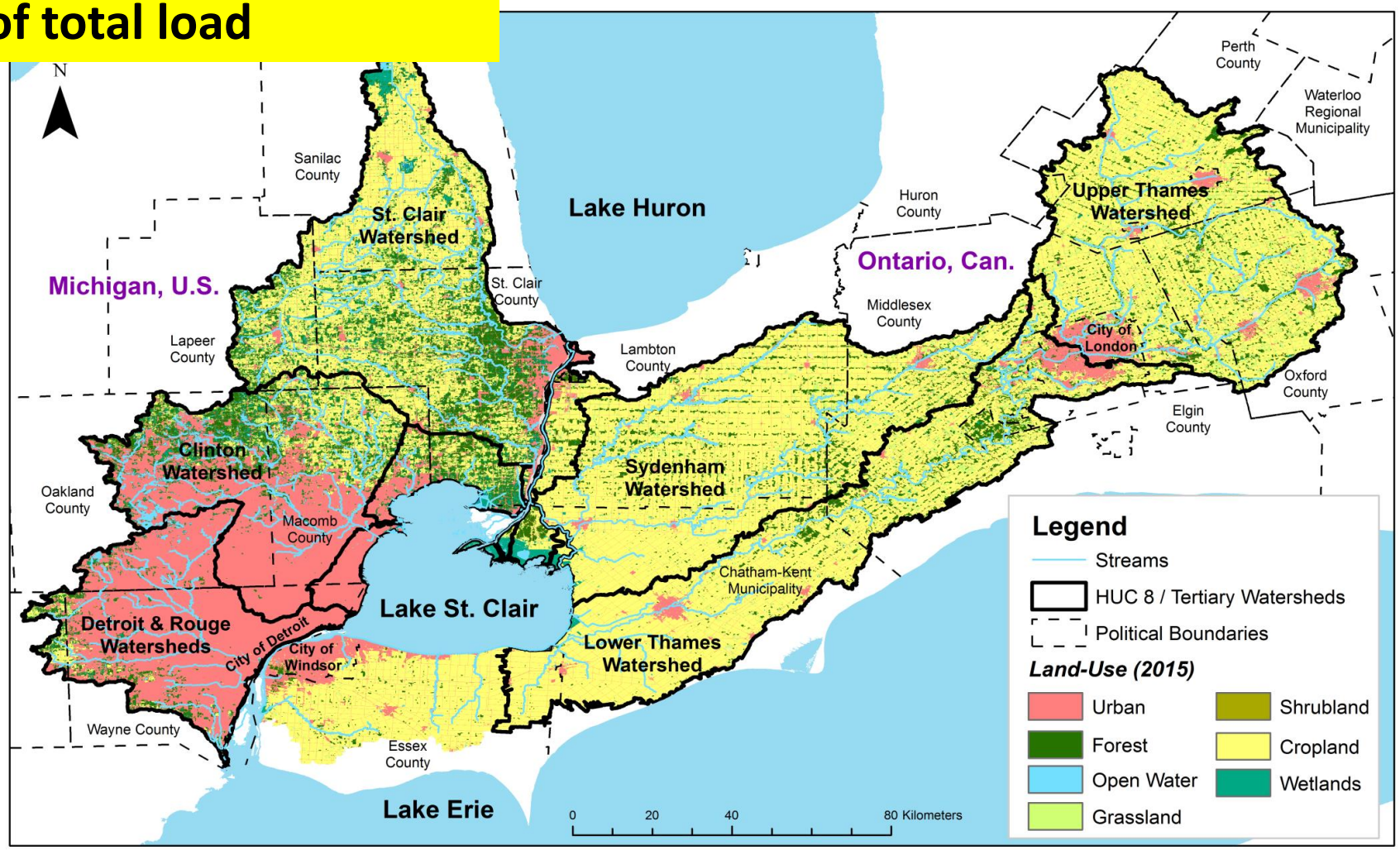
CONFERENCE OF GREAT LAKES AND ST-LAWRENCE GOVERNORS AND PREMIERS
CONFÉRENCE DES GOUVERNEURS ET DES PREMIERS MINISTRES DES GRANDS LACS ET DU SAINT-LAURENT

40% reduction of P loads to Western Basin by 2025

WESTERN BASIN OF LAKE ERIE COLLABORATIVE AGREEMENT

Study Area: Watershed of Huron-Erie Corridor

35% of Western Basin load
21% of total load



Project Details & Objectives

Timeline: 2016 – 2018

Funding: Erb Family Foundation

Objectives:

- Engage policy and management community
- Develop watershed models to assess nutrient loads from different sources.
- Explore options for reducing P loads from the most important sources

Advisory Group

Agricultural or Urban focus

Environmental focus

OHIO FARM BUREAU

MICHIGAN FARM BUREAU

SEMCOG

GREAT LAKES WATER AUTHORITY

The Nature Conservancy

SIERRA CLUB FOUNDED 1892

MABA

MAEAP

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DEQ

NATIONAL WILDLIFE FEDERATION

FRESHWATER FUTURE

Fred A. and Barbara M. Erb Family Foundation

OGL MICHIGAN OFFICE OF THE GREAT LAKES

ALLIANCE for the GREAT LAKES

IPNI

INTERNATIONAL JOINT COMMISSION • COMMISSION MIXTE INTERNATIONALE 1909

THE CITY OF WINDSOR ONTARIO, CANADA

GLIER Great Lakes Institute for Environmental Research

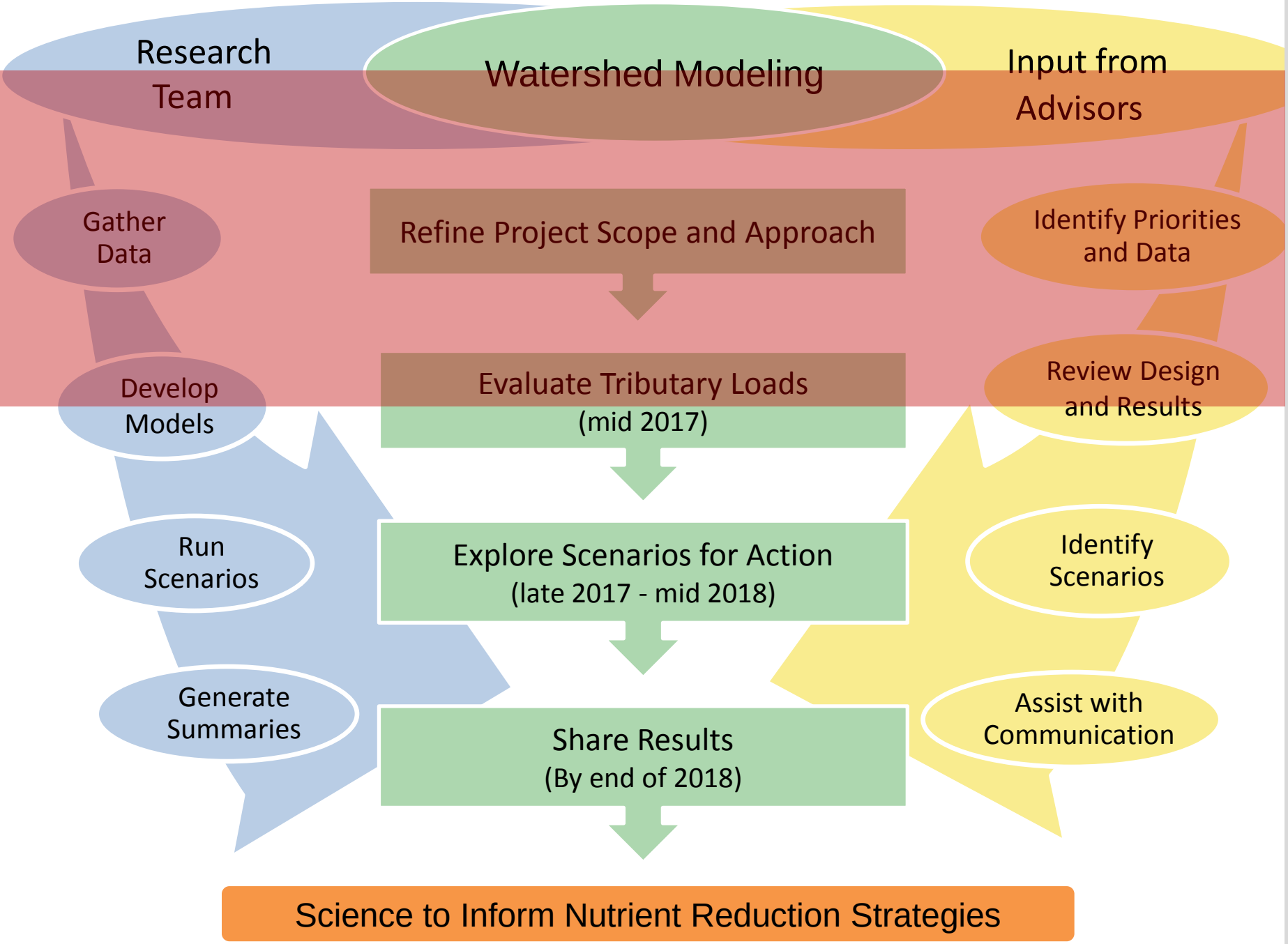
Freshwater Future Canada

Ontario Ministry of Agriculture, Food and Rural Affairs

Ontario Ministry of the Environment

Essex Region Conservation Authority

Environment and Climate Change Canada


Research Team
Watershed Modeling
Input from Advisors
Gather Data
Refine Project Scope and Approach
Identify Priorities and Data
Develop Models
Evaluate Tributary Loads (mid 2017)
Review Design and Results
Run Scenarios
Explore Scenarios for Action (late 2017 - mid 2018)
Identify Scenarios
Generate Summaries
Share Results (By end of 2018)
Assist with Communication
2016
2017
2018
Science to Inform Nutrient Reduction Strategies

Modeling Approach

Develop and calibrate:

- Soil & Watershed Assessment Tool Model (SWAT) for entire study area *(Muenich, Kalcic, and others)*
- Urban models for Detroit, Windsor, and urban parts of Clinton and Rouge watersheds *(Kerkez and others)*
- Lake St. Clair model to estimate retention and delivery properties *(Bocaniov)*

Link and test the combined models

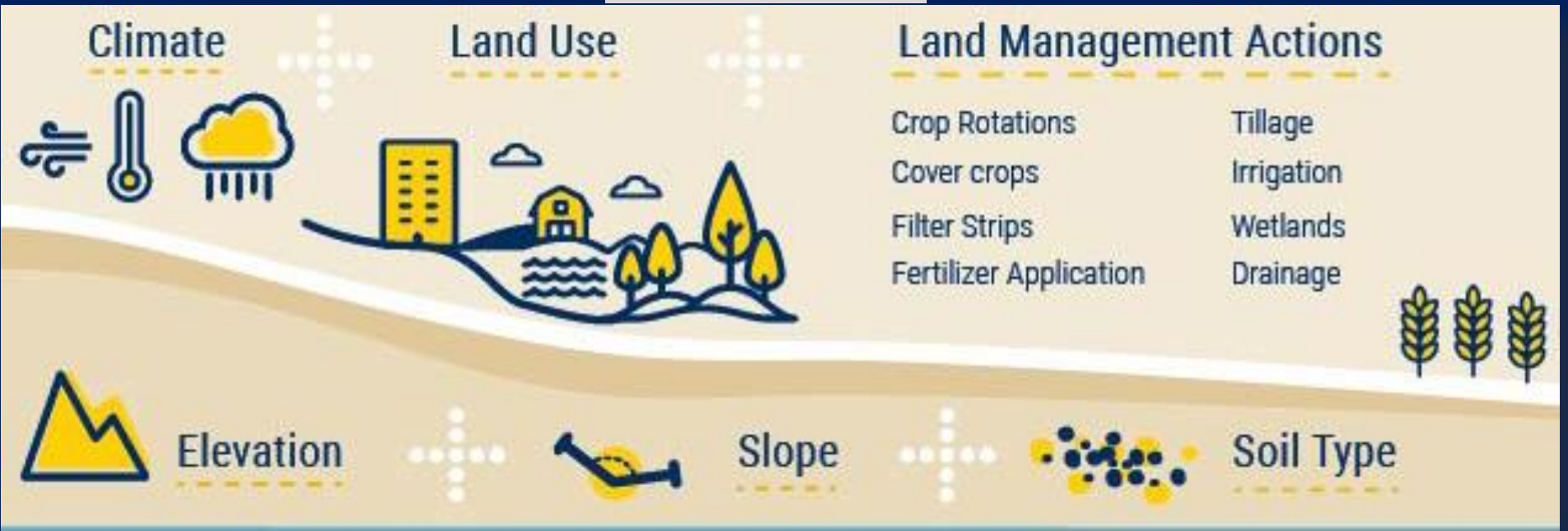
Use models to explore potential action scenarios

Iterate with agriculture, NGOs, and government

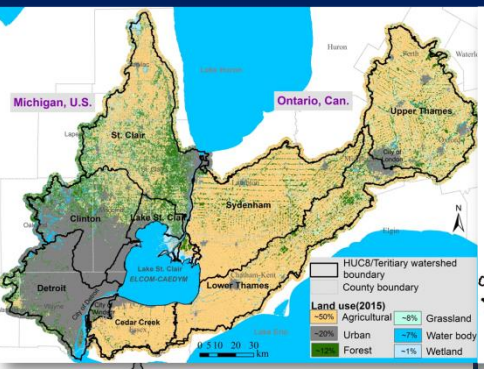
SWAT Modeling

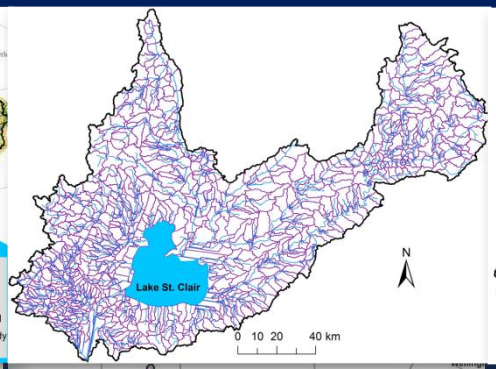
- Eco-hydrological watershed model
  - **S**oil and **W**ater **A**ssessment **T**ool (**SWAT**)

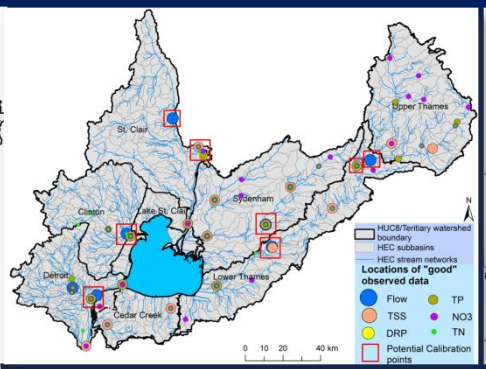
Data Inputs

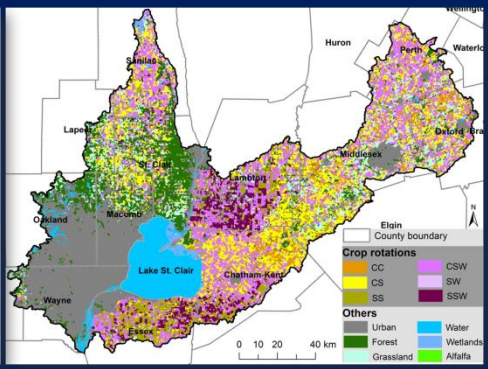


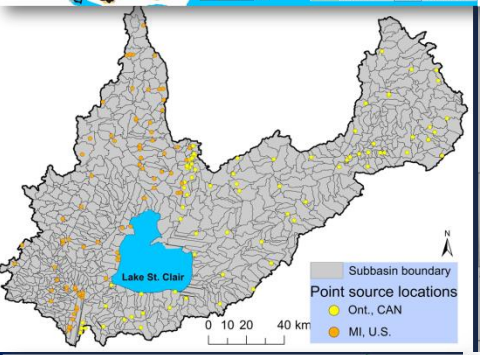
SWAT Modeling

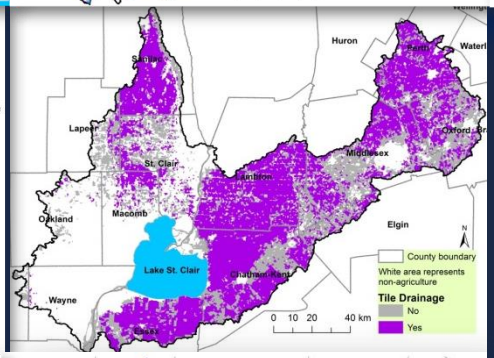


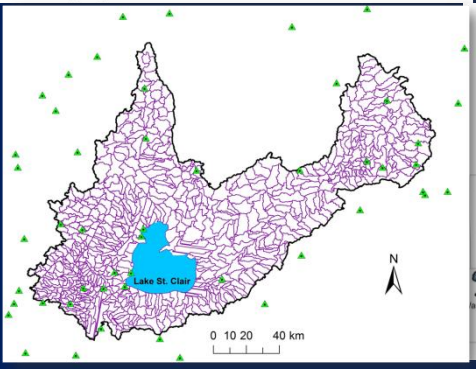


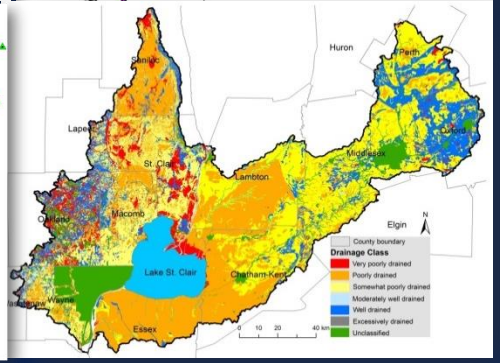






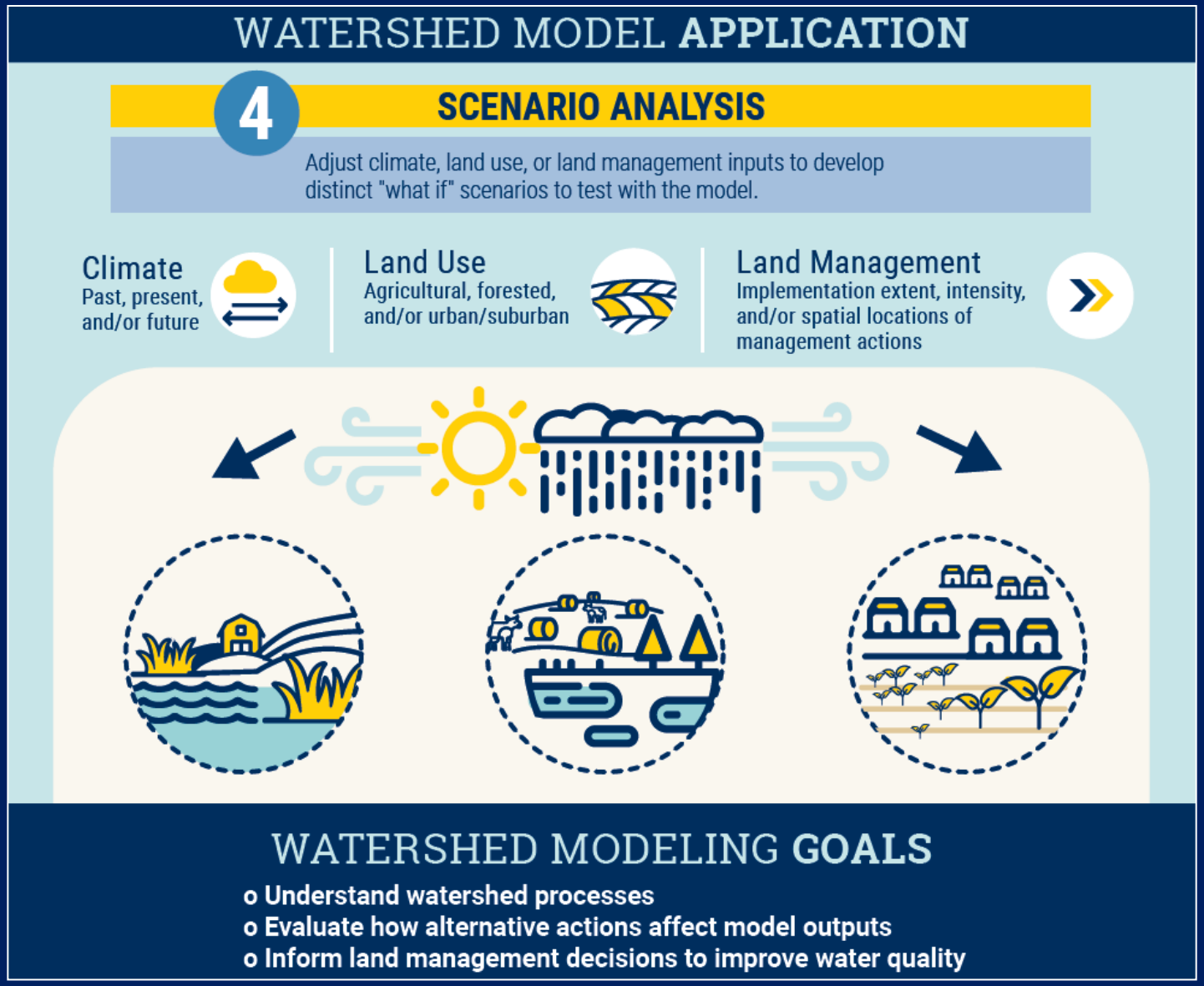






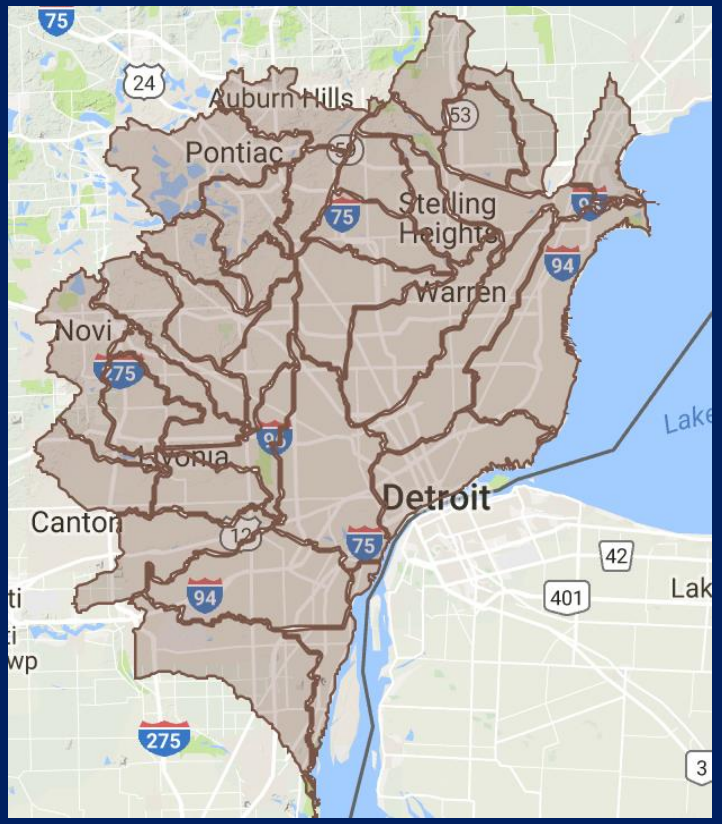
- Detailed Inputs
- Detailed calibration & validation at various spatial & temporal points
- Output at many scales includes: crop yields, water quality, water quantity, etc.

SWAT Modeling

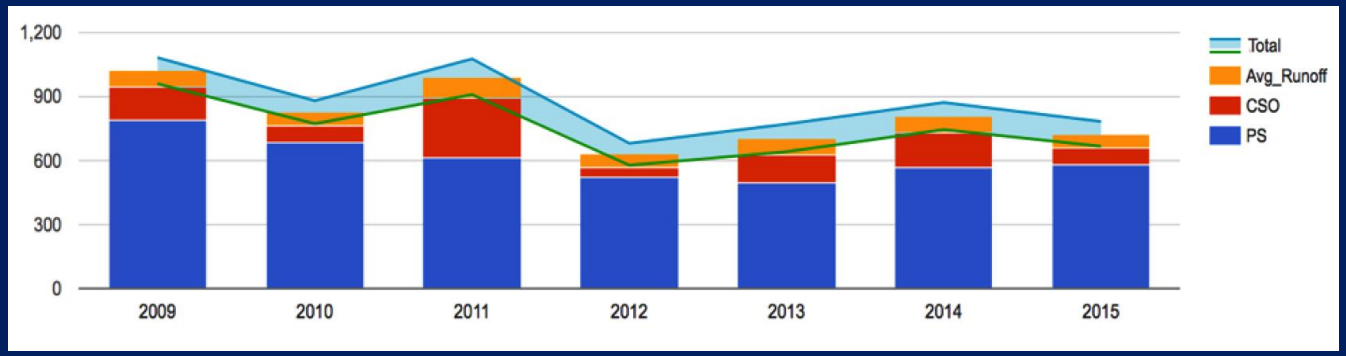


Urban Modeling

- Initial Urban Assessment
  - Analysis of urban data in Detroit metro-area



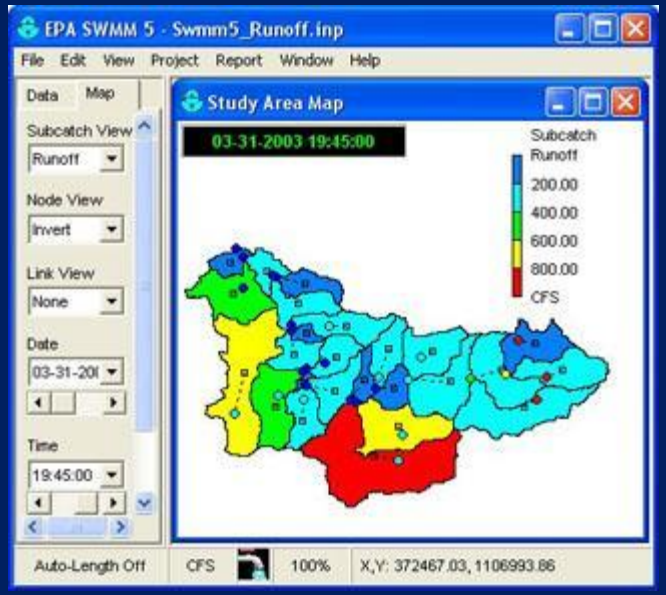
Total P (MTA)



Draft, preliminary results

Urban Modeling

- Future Urban Modeling
  -SWMM model for Detroit
  -Expand analysis and model to other urban areas



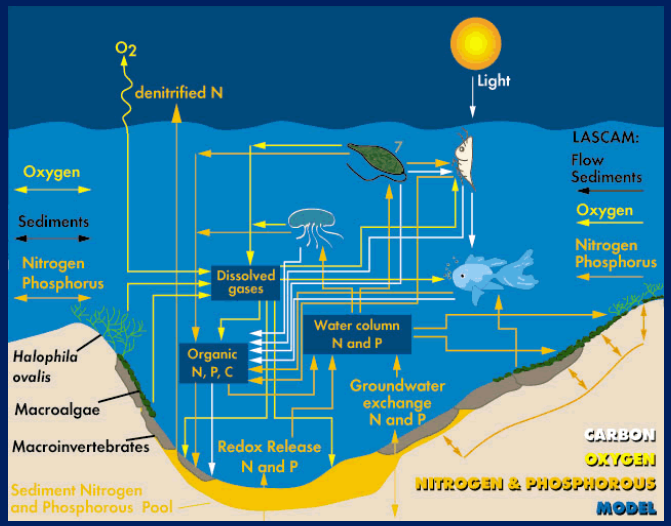
Lake St. Clair Modeling: ELCOM-CAEDYM

Estuary & **L**ake **CO**mputer **M**odel (**ELCOM**):

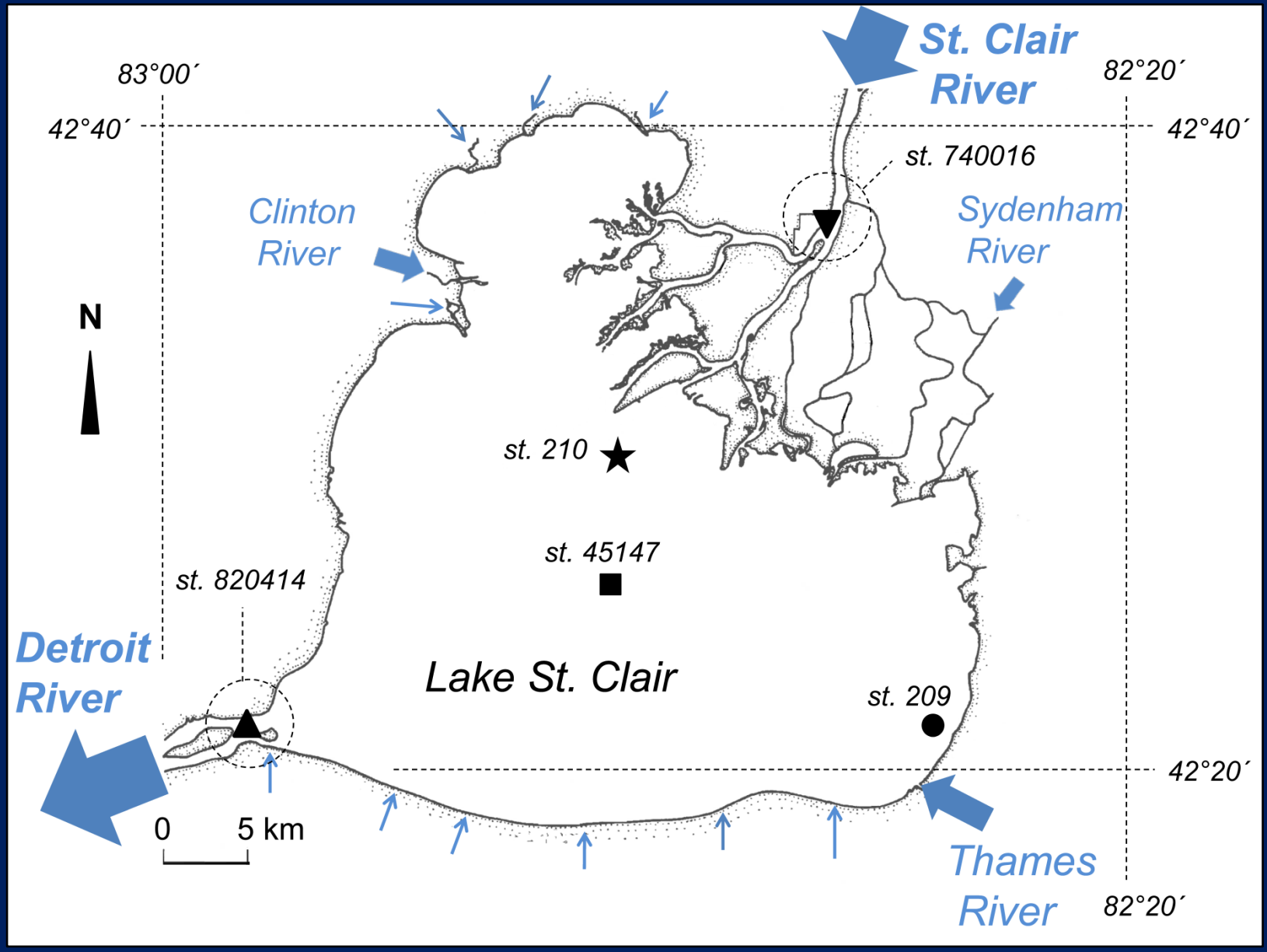
- 3D hydrodynamic model
- baroclinic & barotropic responses
- tidal forcing, wind stresses
- surface thermal forcing, inflows & outflows

Computational **A**quatic **E**cosystem **DY**namics **M**odel (**CAEDYM**):

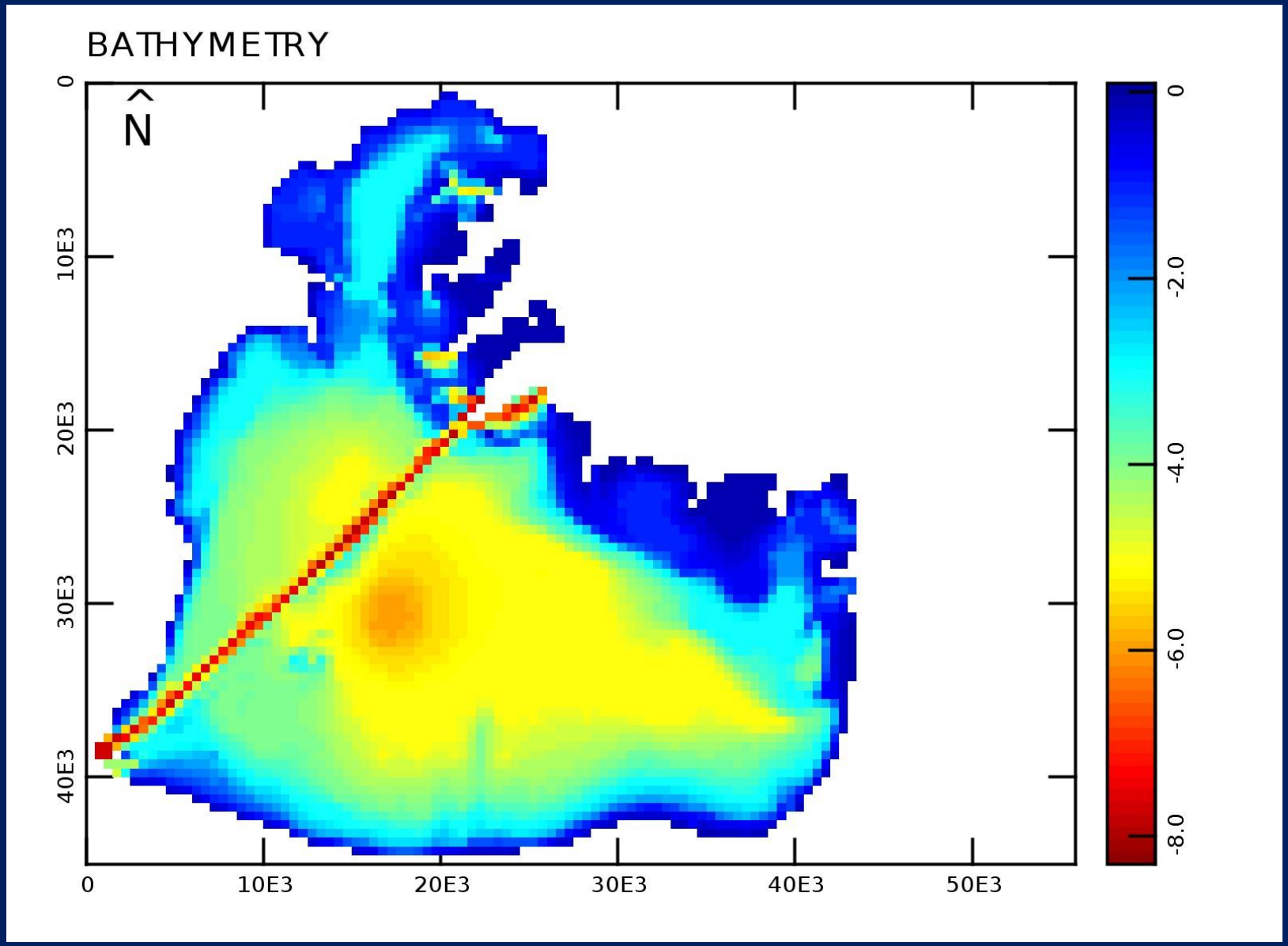
- ecological & water quality model
- C, P, N, Si, O_2 & metal cycling
- sediment dynamics
- phytoplankton & zooplankton
- mussels
- fish, fish eggs and larvae



Map of Lake St. Clair and its tributaries



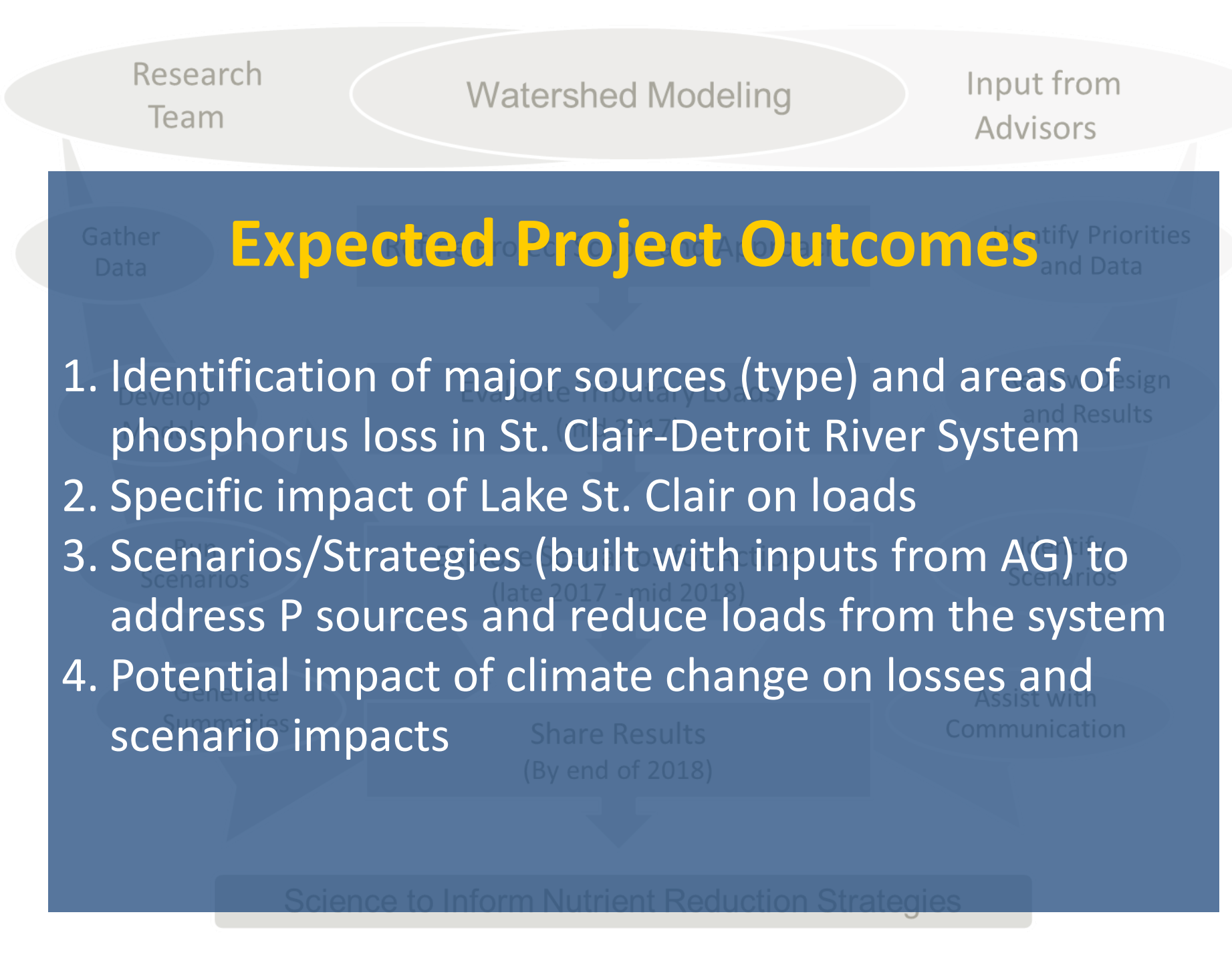
Lake bathymetry and its representation in the model



Major Research Questions for LSC Model

- Is Lake St. Clair a source or sink of TP and DRP, and what determines that?

- Is it possible to attribute loads of nutrients LEAVING the lake to different sources ENTERING the lake (*e.g. Thames vs Clinton vs St. Clair Rivers*)?



Expected Project Outcomes

1. Identification of major sources (type) and areas of phosphorus loss in St. Clair-Detroit River System
2. Specific impact of Lake St. Clair on loads
3. Scenarios/Strategies (built with inputs from AG) to address P sources and reduce loads from the system
4. Potential impact of climate change on losses and scenario impacts