TETRA TECH

Sandusky Bay 3D Eutrophication Modeling to Support the Sandusky Bay Initiative

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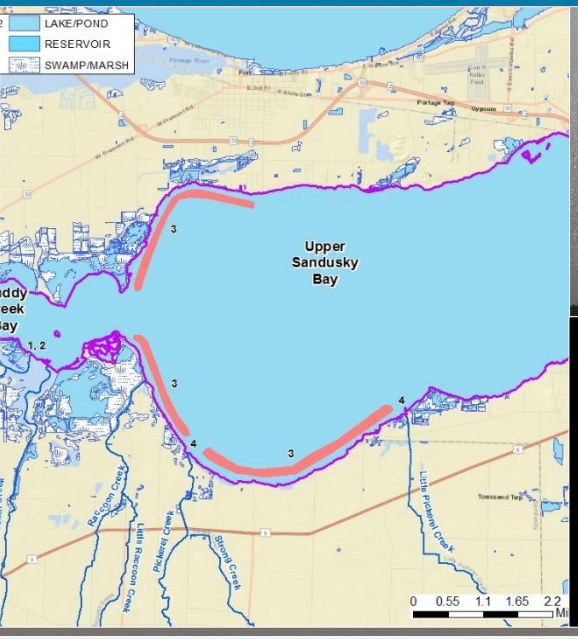

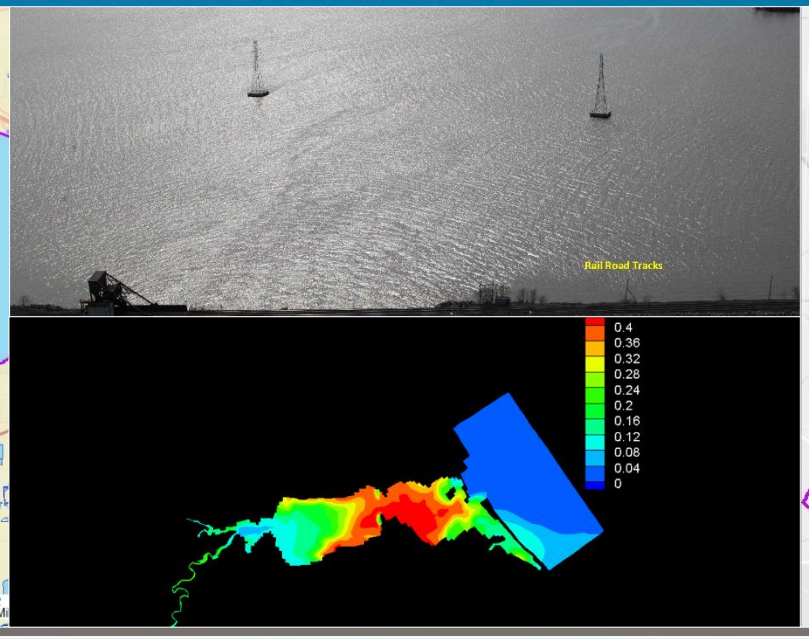

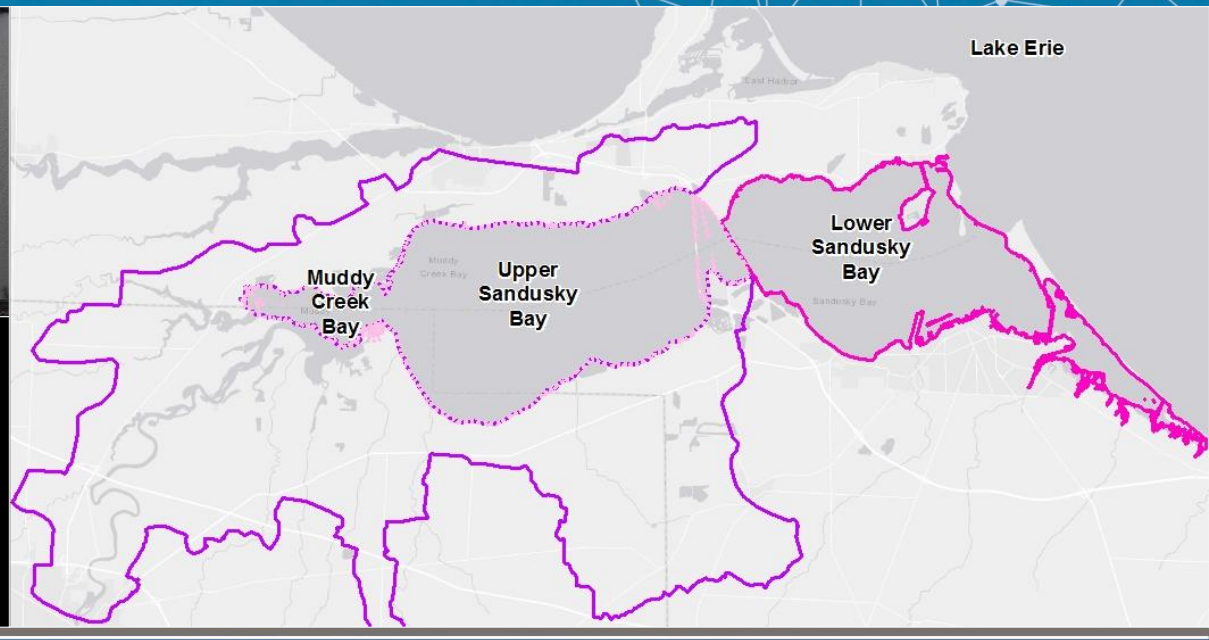

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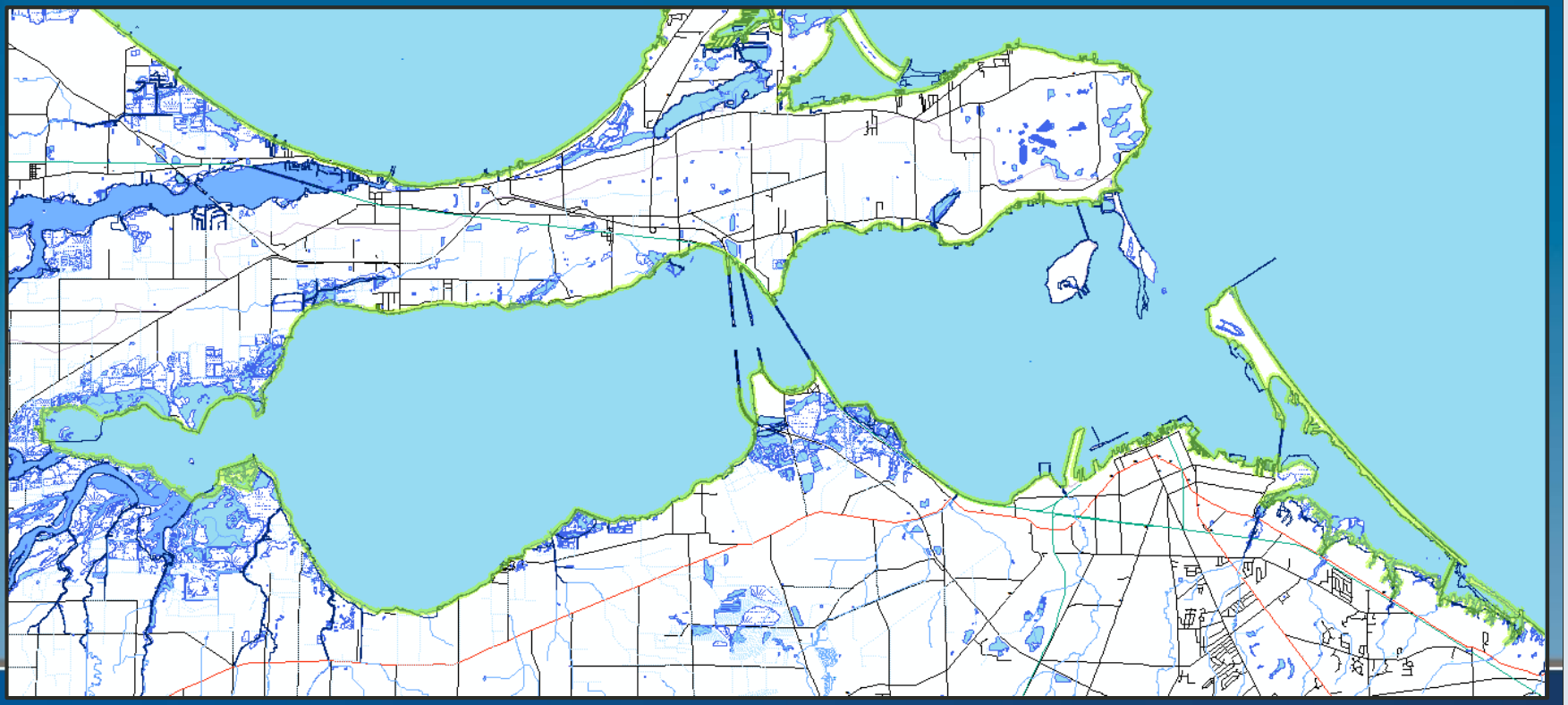
Outline

Sandusky Bay Initiative
Overview of Modeling Effort
Modeling Results

Sandusky Bay Initiative

64 square miles – 1 million of land drainage.

Priority system within Lake Erie and Great Lakes for nutrient management, fisheries and coastal wetlands.



- Improve Sandusky Bay water quality by reducing nutrient and sediment loads.
- Enhance coastal wetland and fisheries habitat.
- Where feasible promote public access and enhance recreational use.
- Work with local restoration partners and coordination with agencies.

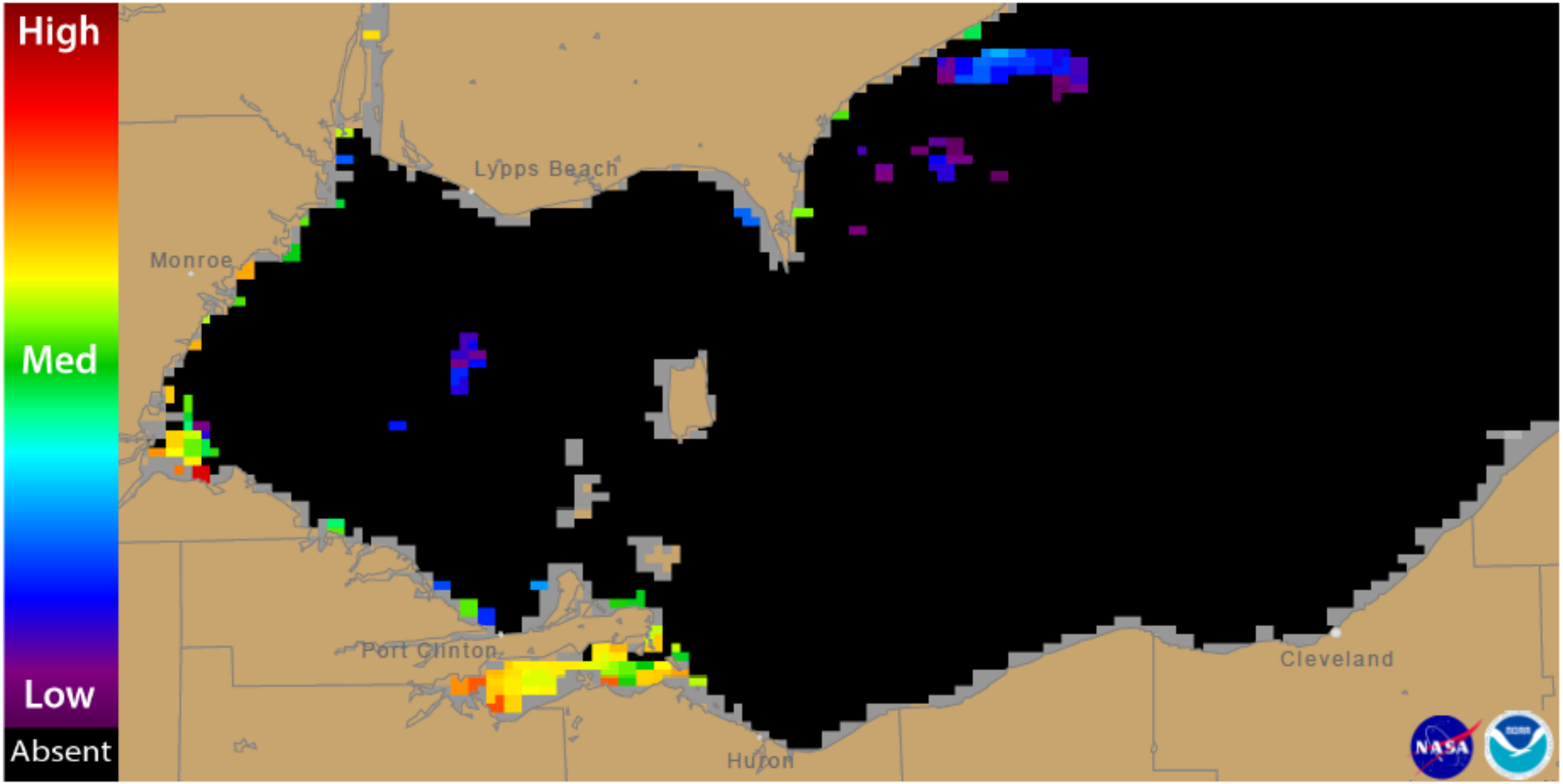


Figure 1. Cyanobacterial Index from NASA's MODIS-Aqua data collected 29 August, 2016 at 13:31 EST. Grey indicates clouds or missing data. The estimated threshold for cyanobacteria detection is 20,000 cells/mL.

Projects - Systems Approach Design

Monitoring and Data Collection

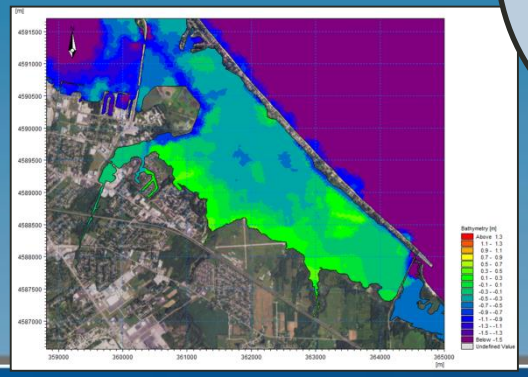
Portfolio of Projects that work together to meet multiple goals for a resilient Sandusky Bay.

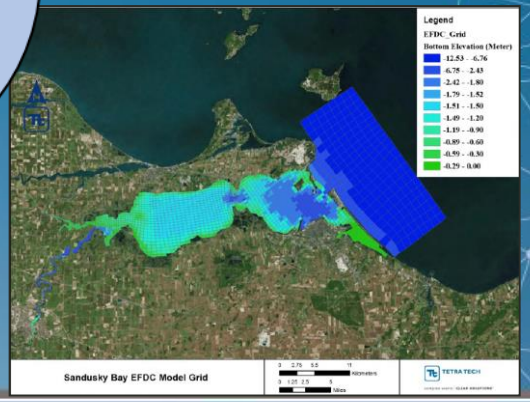
Setting Targets and Scenarios

Site Design

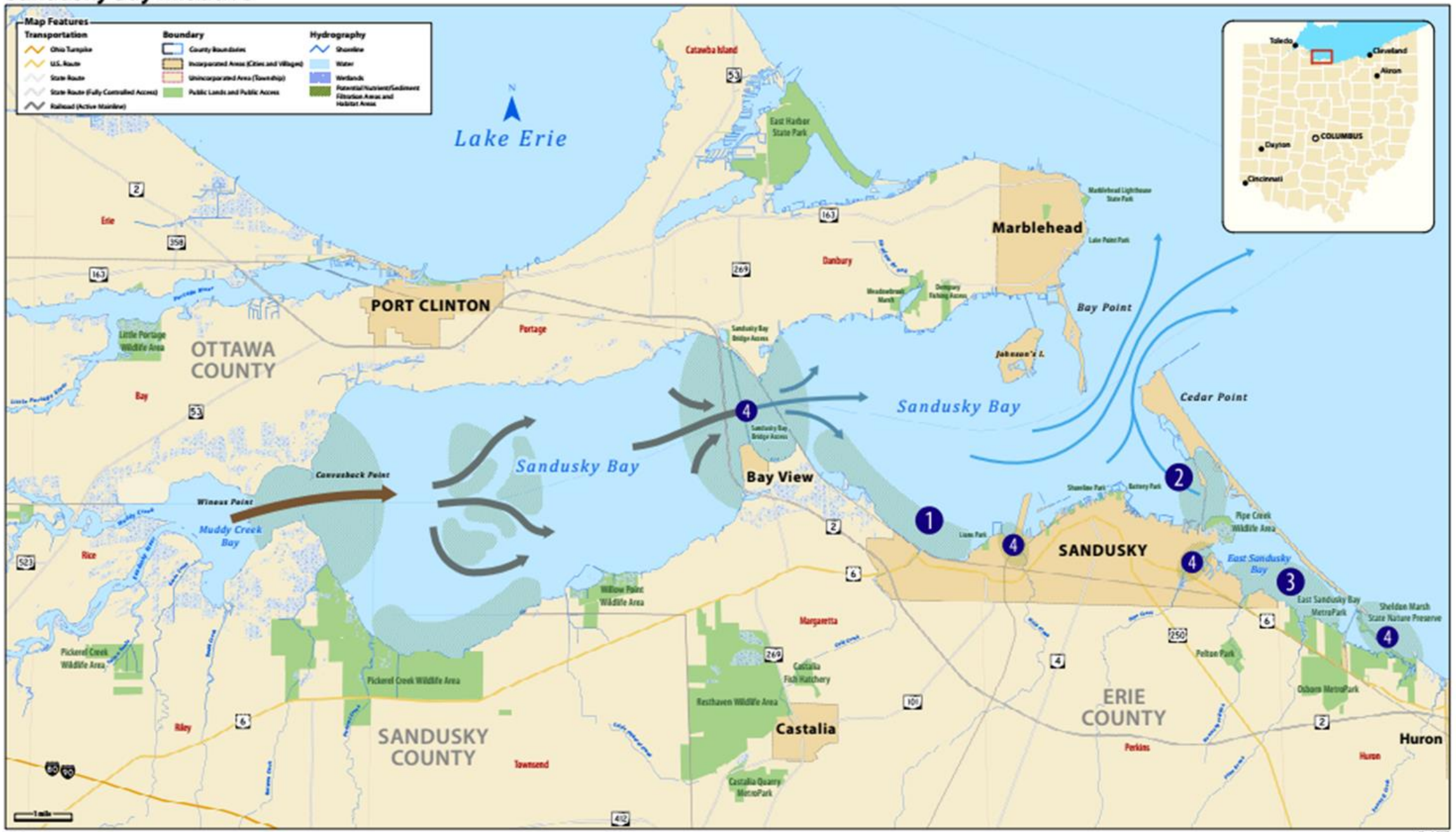
Planning

Model



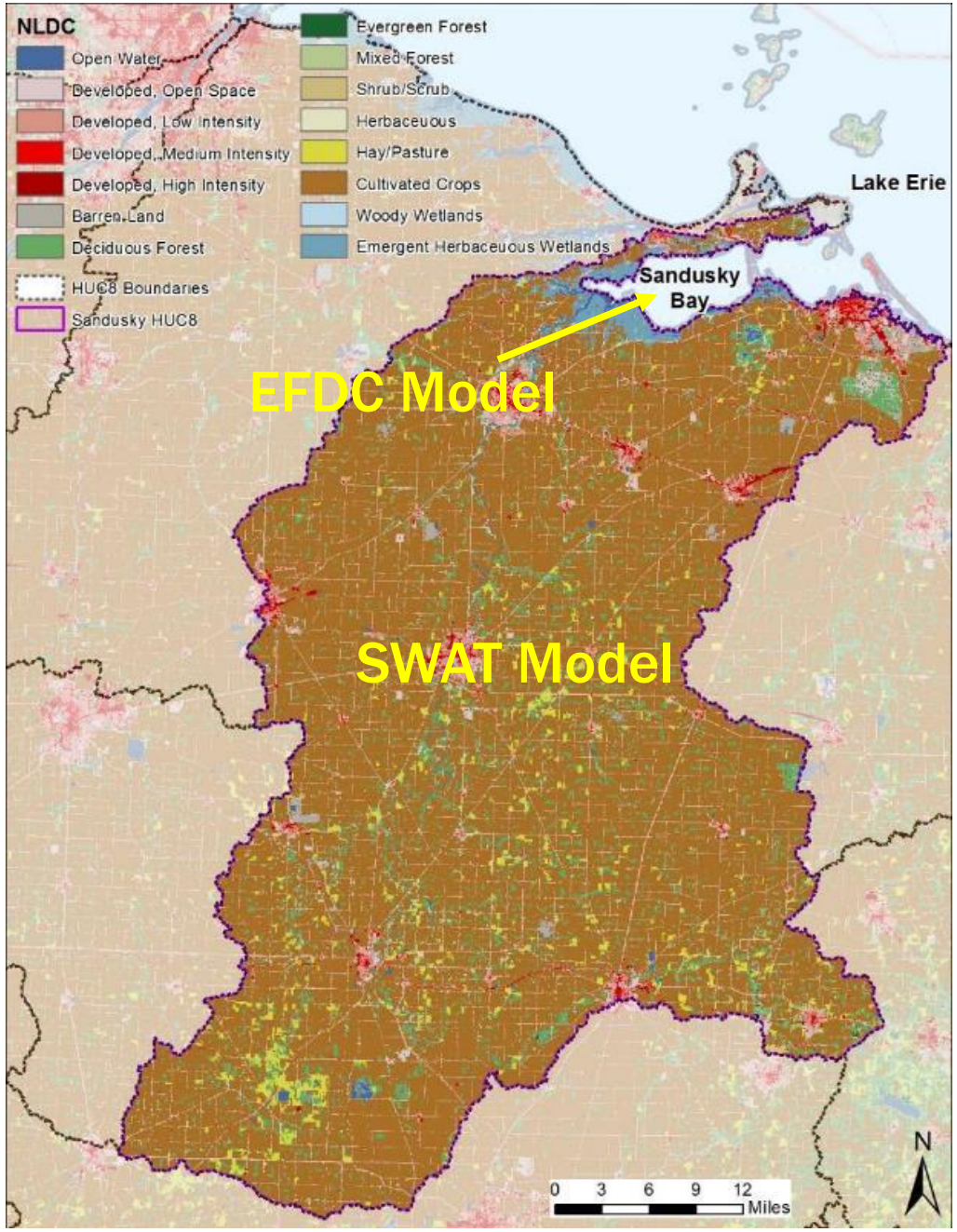


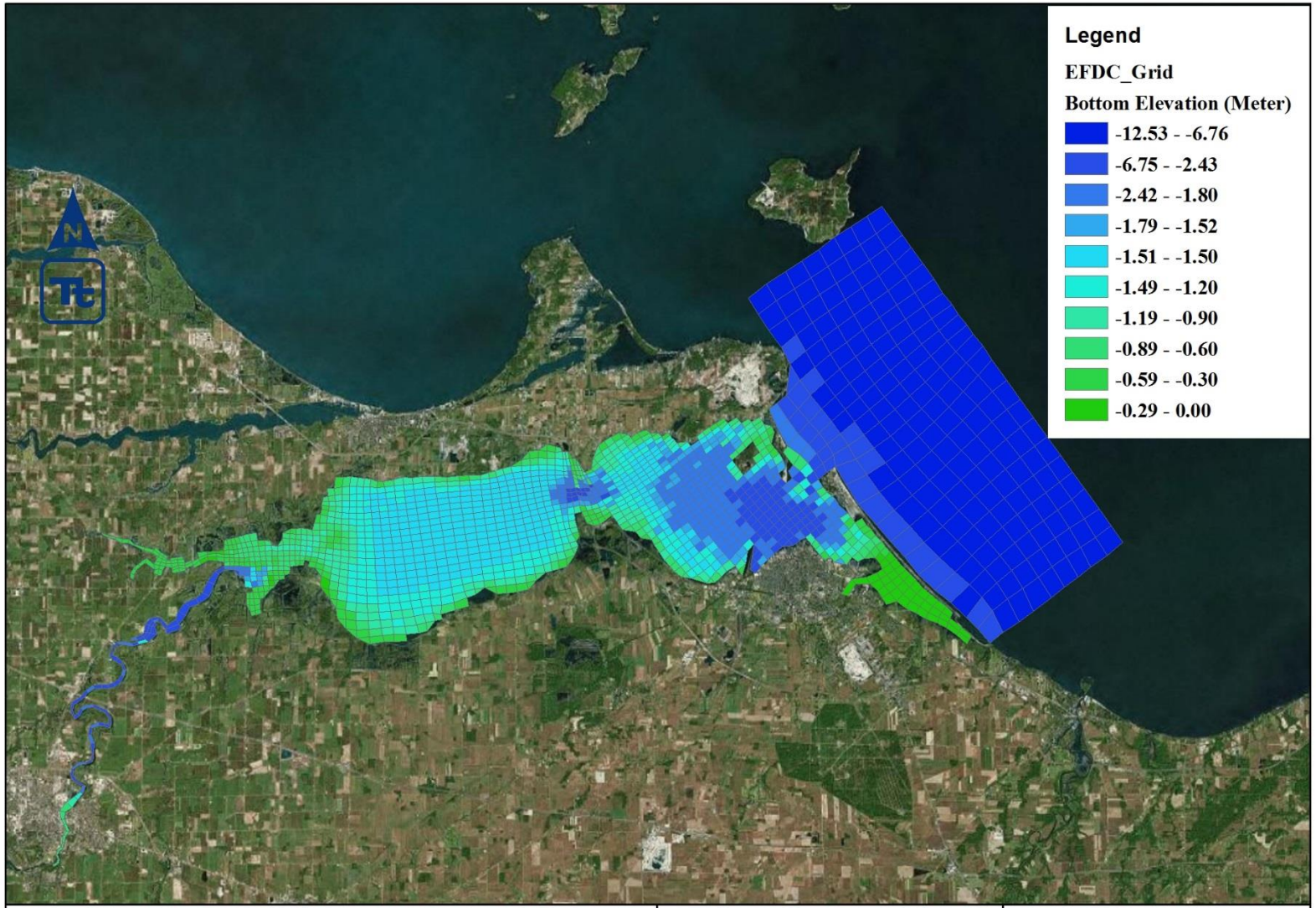
Sandusky Bay Initiative



Purpose of Modeling

- **Better understand how nutrients and sediments are transported through the Sandusky Bay system and how they impact water quality conditions**
- **Use results to guide management decisions**
  - Controlling tributary loadings
  - Assessing the importance of internal loading
  - Selecting and designing optimal living shoreline, wetland, and other types of restoration projects

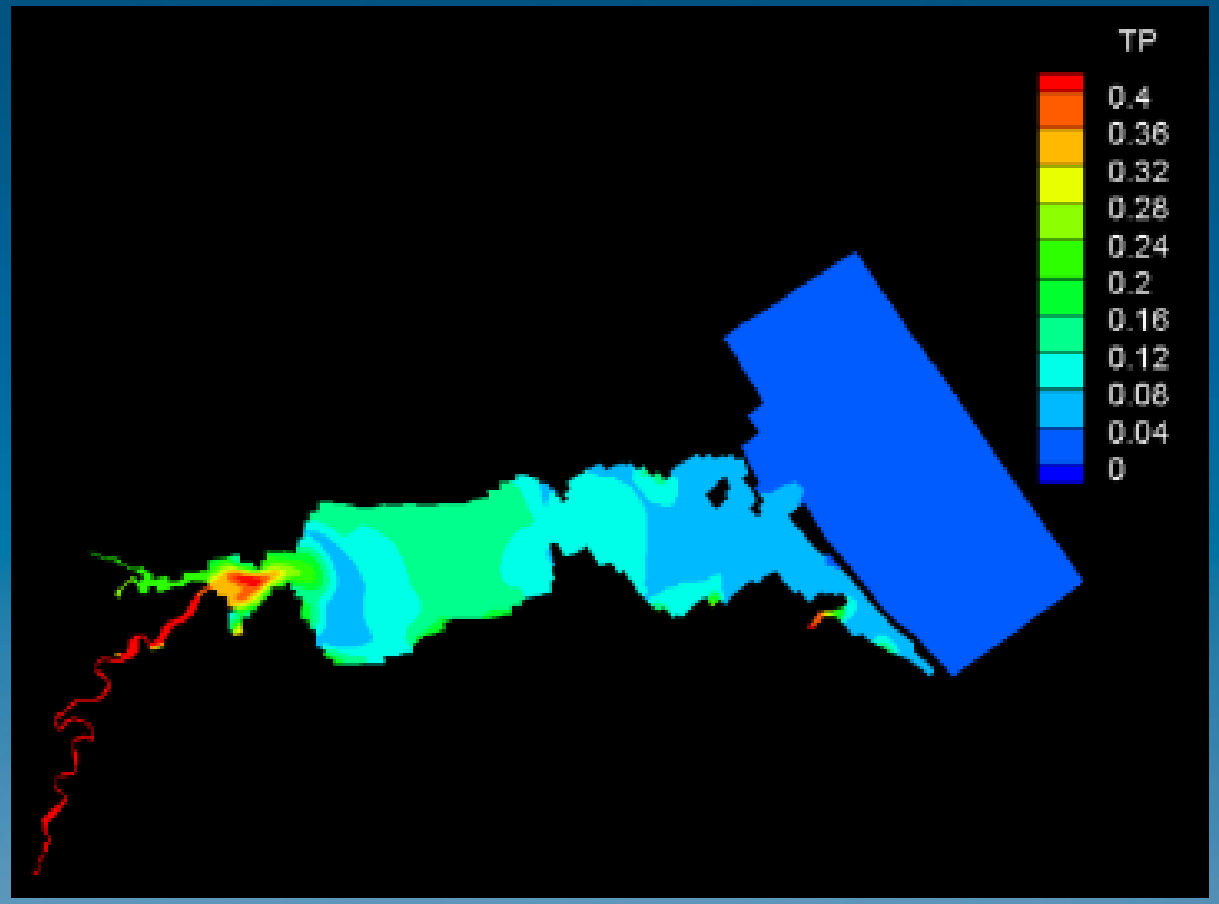

NLDC
Open Water
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Barren Land
Deciduous Forest
HUC8 Boundaries
Sandusky HUC8
Evergreen Forest
Mixed Forest
Shrub/Scrub
Herbaceuous
Hay/Pasture
Cultivated Crops
Woody Wetlands
Emergent Herbaceuous Wetlands
Lake Erie
Sandusky Bay
EFDC Model
SWAT Model
0 3 6 9 12
Miles
N



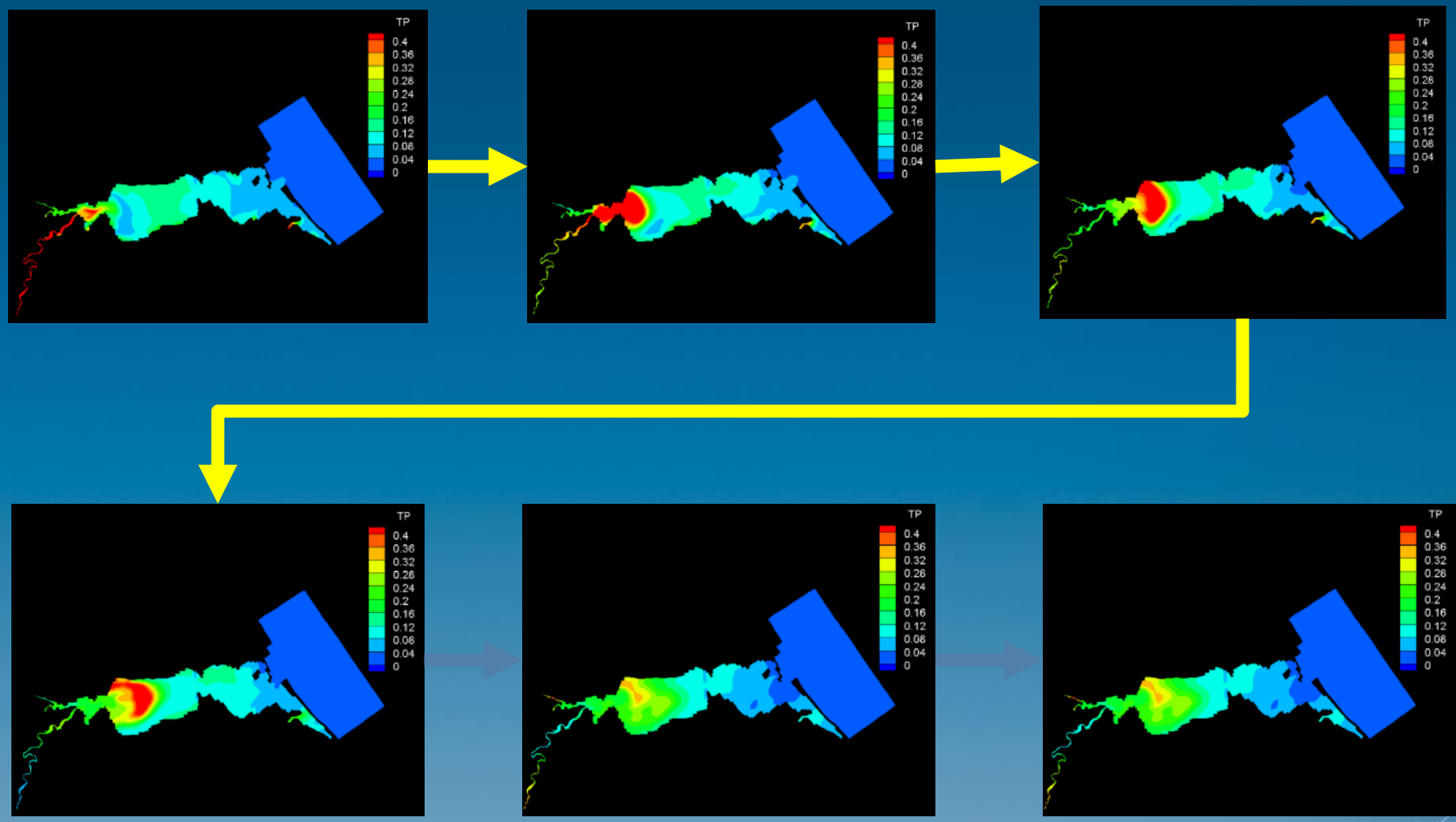
Sandusky Bay EFDC Model Grid


Legend
Water Quality Sites
EFDC Grid
N
Sandusky Channel Bells
ODNR 2
ODNR 1
Clemons
Environment Canada Station EC 1163
ODNR 4
ODNR 6
Bay Intake
0 1.75 3.5 7
Kilometers
0 0.75 1.5 3
Miles
TETRA TECH
Water Quality Monitoring Sites in Sandusky Bay

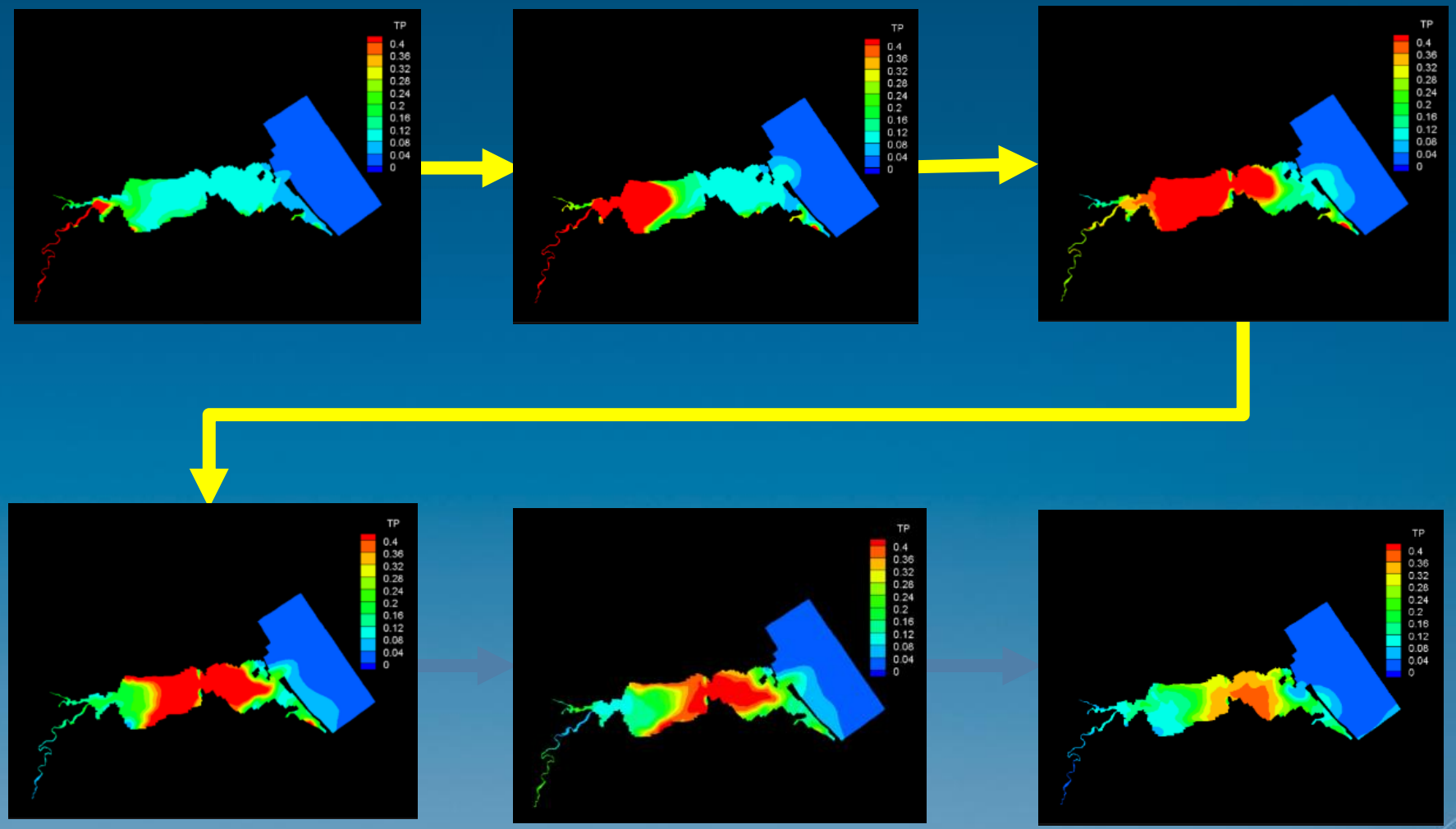
EFDC Model – Animation



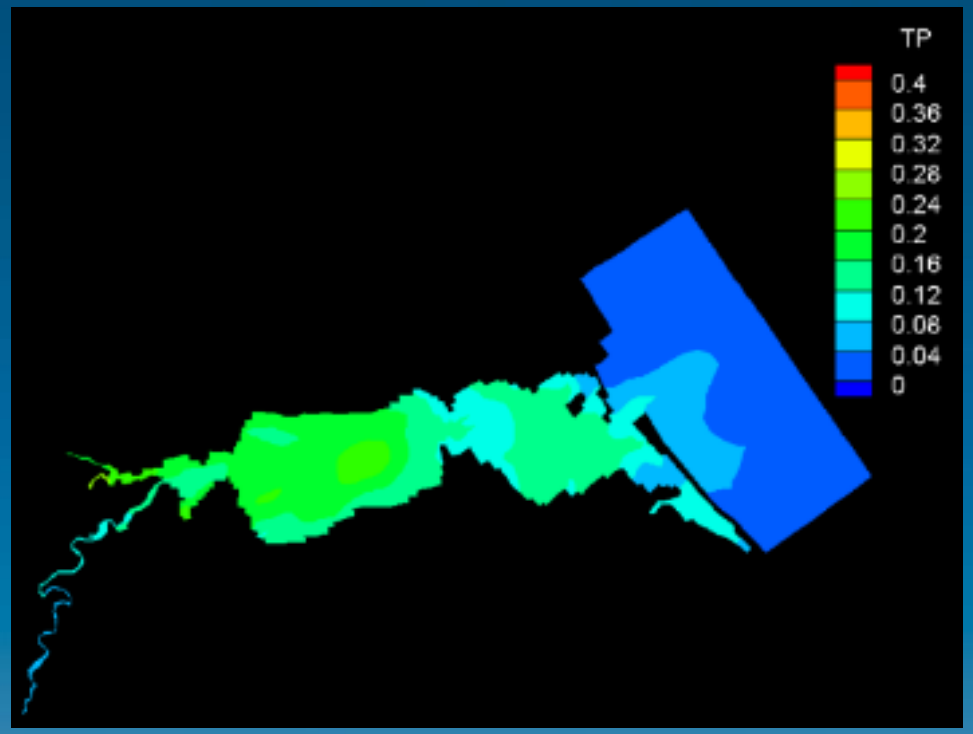
EFDC Model – Typical Storms

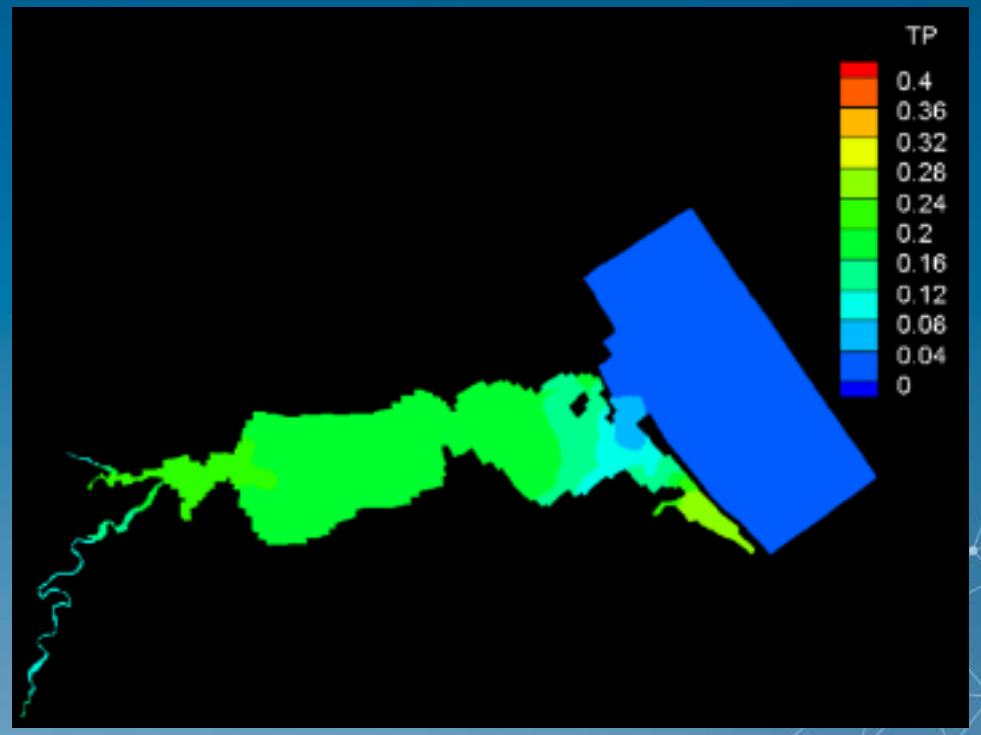


EFDC Model – Largest Couple of Storms Per Year

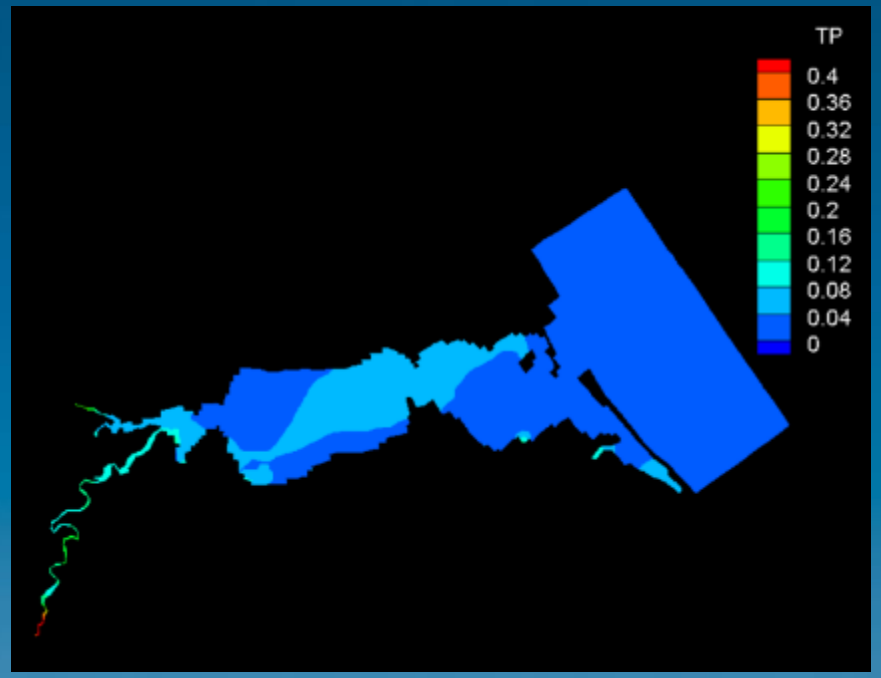


EFDC Model – Mid- to Late-Summer

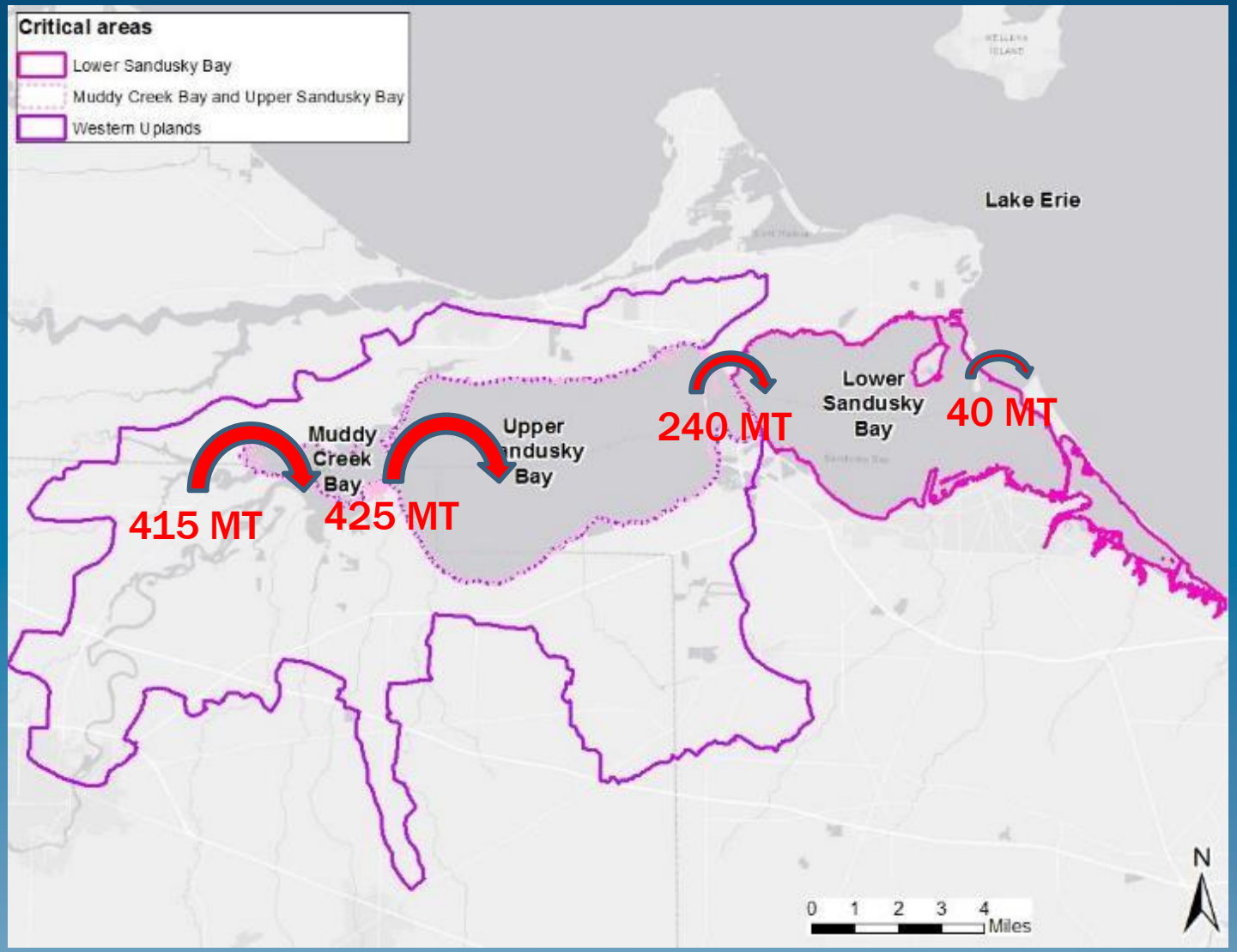




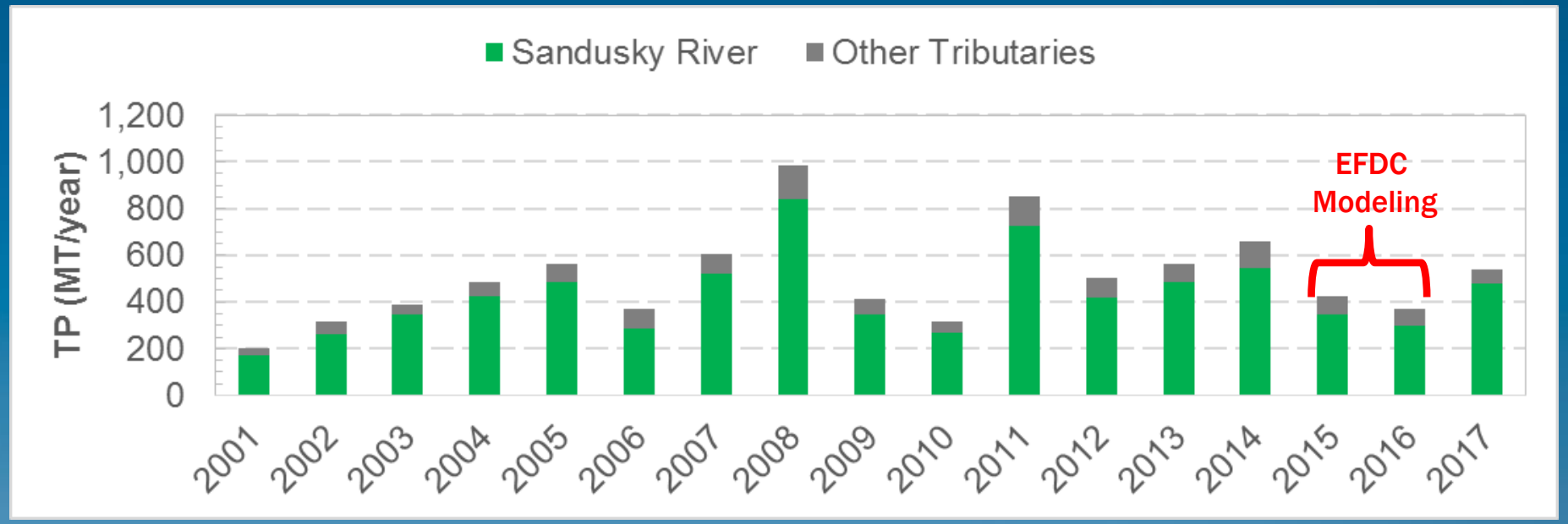
EFDC Model – Winter



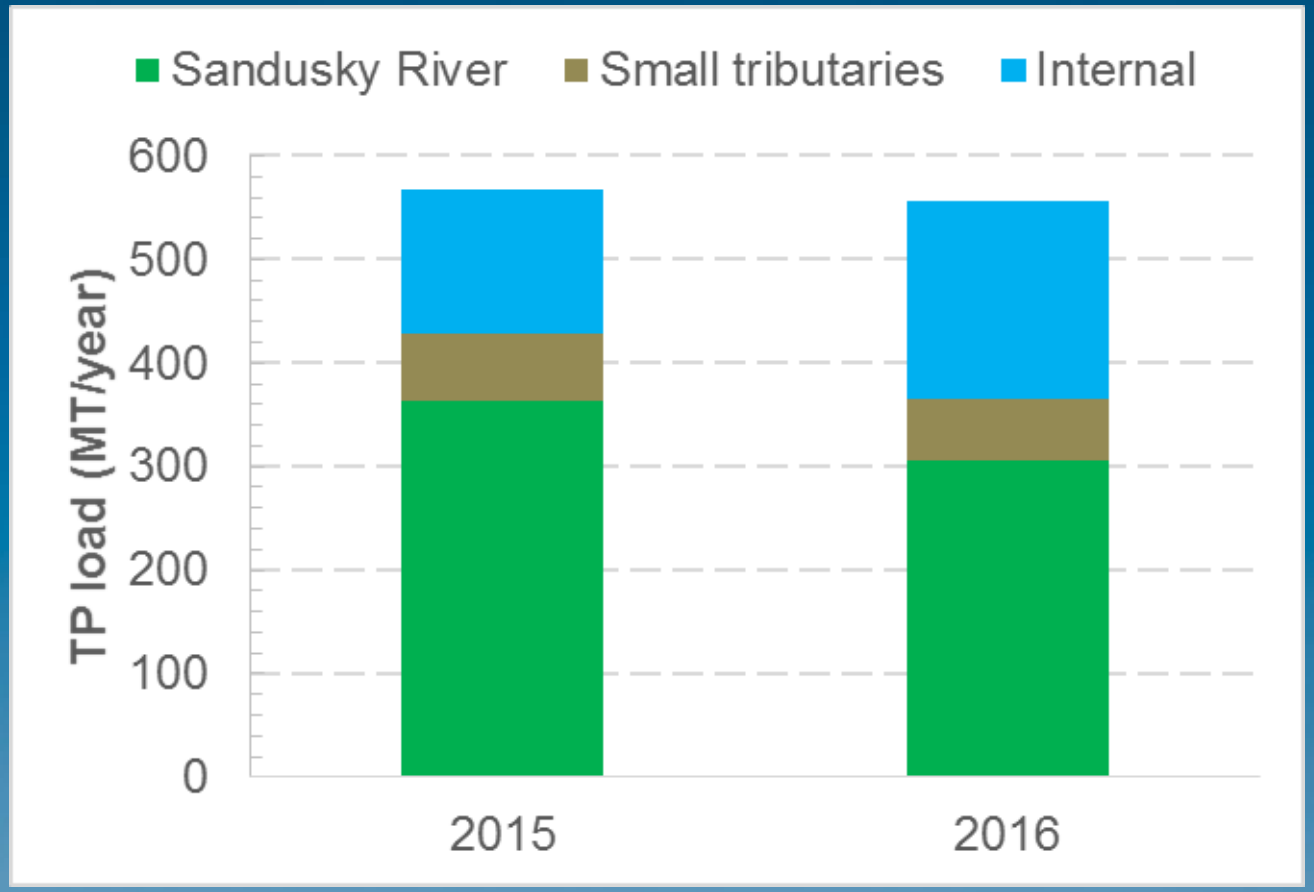
EFDC Model – Simulated TP Flux in 2015



SWAT Model – Simulated TP Loads

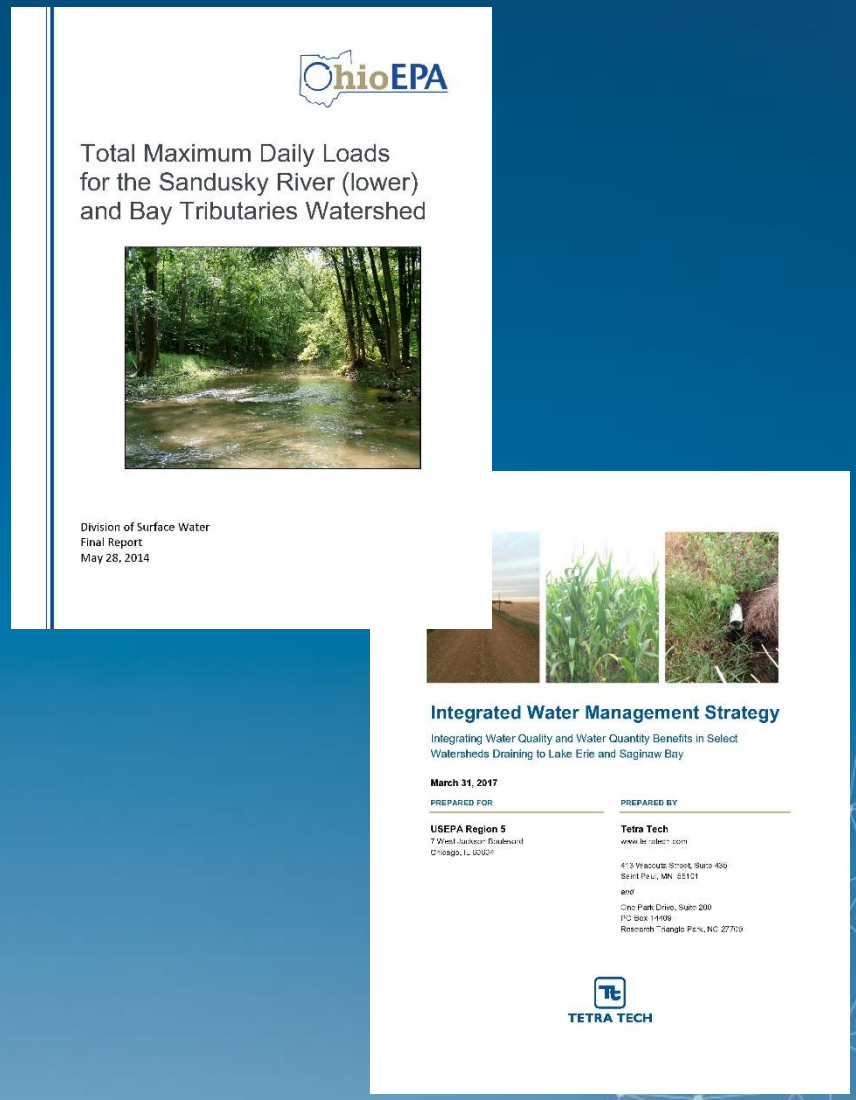


EFDC Model – Sources of Annual TP



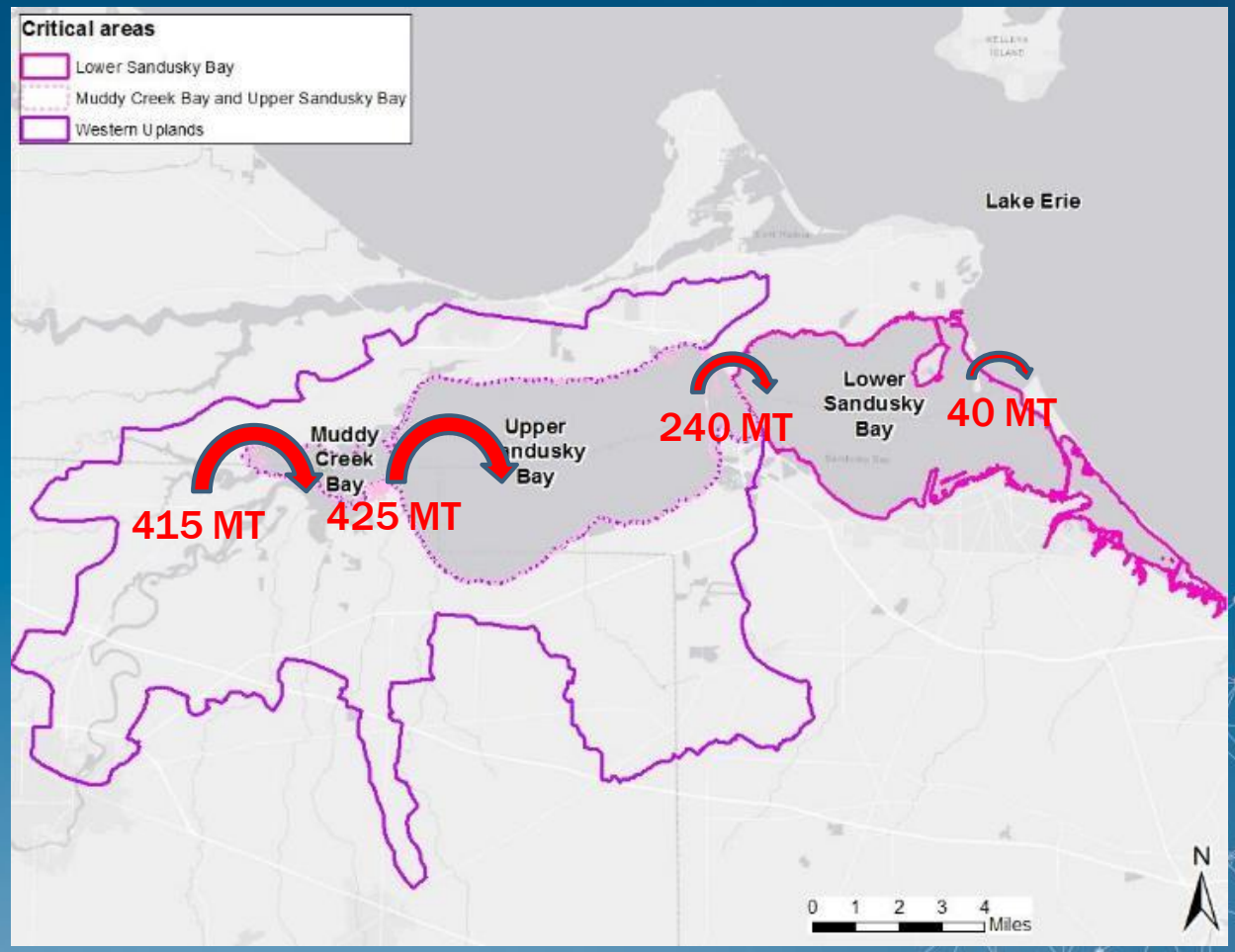
Using Model Results to Guide Implementation

- **Largest source of TP loading is from Sandusky River**
  - Implement TMDL and other ongoing efforts to reduce loading from the larger watershed (outside the direct scope of our project)



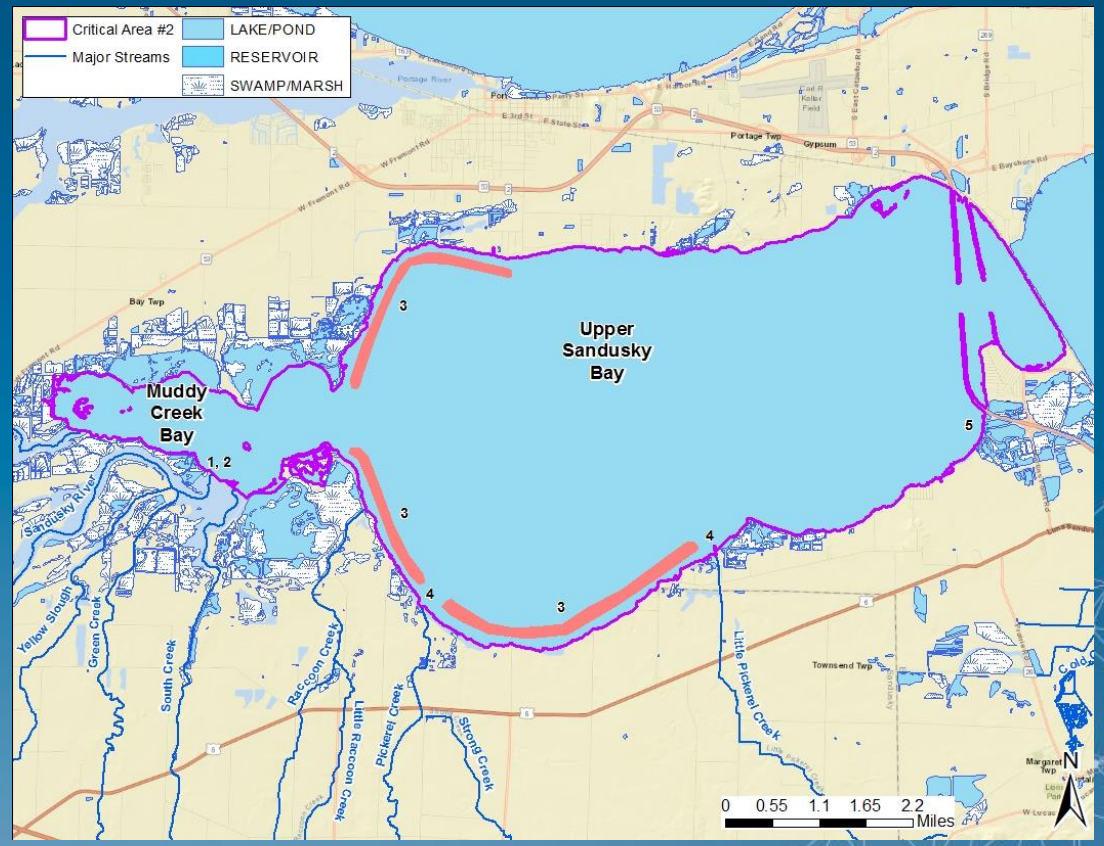
Using Model Results to Guide Implementation

- **May be significant trapping of phosphorus within Sandusky Bay and little net loading to Lake Erie**
  - Need to further evaluate, especially during wetter years
  - Focus on improving conditions within the bay



Using Model Results to Guide Implementation

- **Significant internal loading and loading from Muddy Creek Bay to Upper Sandusky Bay**
  - <u>Objective 1:</u> Restoration of at least 500 acres of coastal and lacustrine wetlands in Muddy Creek Bay (about one-fifth of the bay's area), focusing on the mouth of the Sandusky River.
  - <u>Objective 2:</u> Restoration of at least 10 miles of coastline along the shores of Upper Sandusky Bay, focusing on the southwest lobe and northwest lobe of the bay.
  - <u>Objective 3:</u> Conduct feasibility studies to evaluate the creation of islands in the open waters of Upper Sandusky Bay, focusing on the western portion of the bay closest to Muddy Creek Bay



Using Model Results to Guide Implementation

- **Third largest source of TP is small tributaries**
  - **Objective 1:** Reduce nutrient- and sediment-loads from 3,300 acres of cropland using drainage water management.
  - **Objective 2:** Improve stream channel morphology and implement riparian management strategies in at least 5 miles of stream channel along the bay tributaries (excluding the Sandusky River mainstem).
  - **Objective 3:** Install 160 acres of off-line wetland/detention stormwater treatment systems, potentially with alum injection, at publicly managed lands adjacent to the bay shoreline.

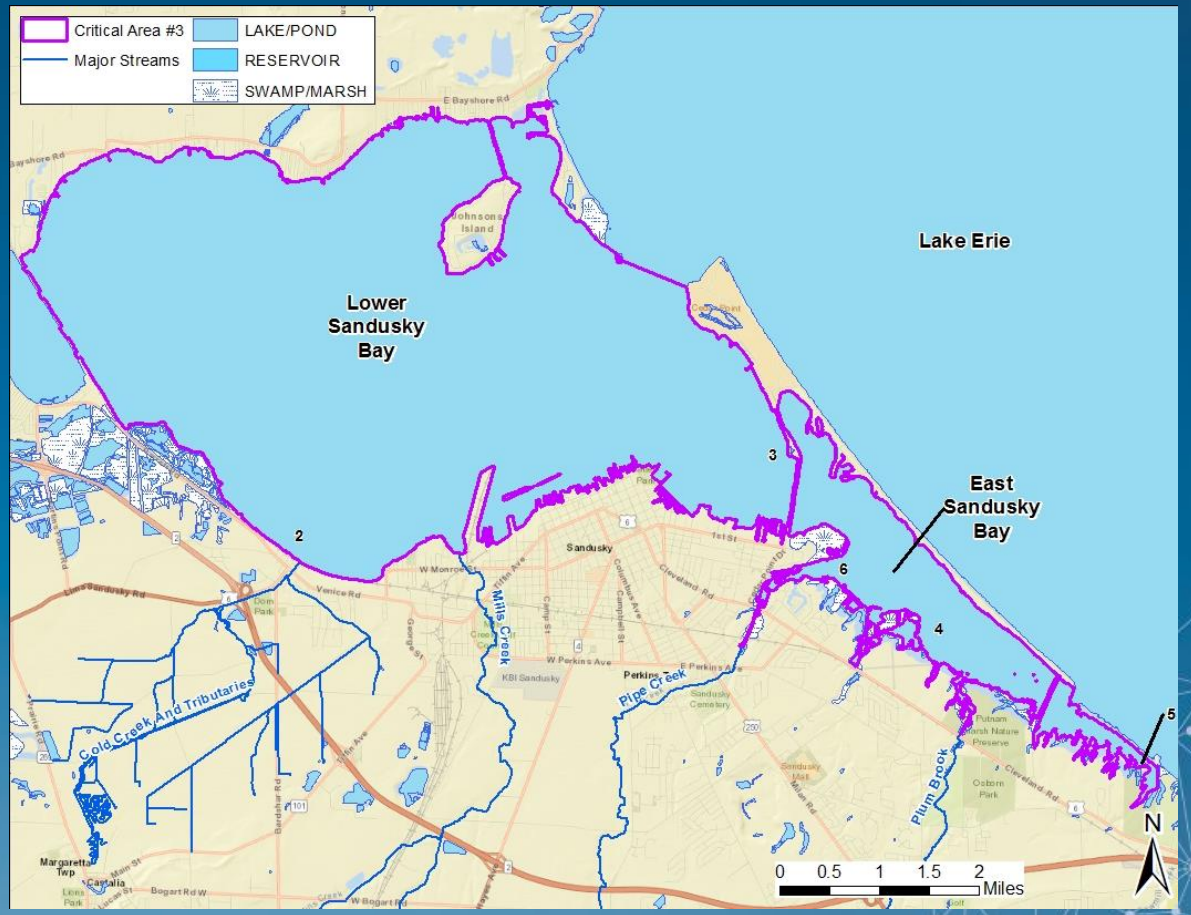
Example Wetland Treatment System on Grand Lake St. Marys

Using Model Results to Guide Implementation

- **Significant trapping of nutrients in Upper Sandusky Bay**
  - Objective 4: Conduct a feasibility study to evaluate potential modifications of the Thomas A. Edison Memorial Bridge, the former Sandusky Bay bridge, and the Norfolk Southern railroad bridge to alter the hydrodynamics of the constriction between Upper Sandusky Bay and Lower Sandusky Bay.

Using Model Results to Guide Implementation

- **Opportunity to capture plumes from small tributaries and test different types of projects in Lower Sandusky Bay**
  - <u>Objective 1:</u> Restoration of at least 5 miles of coastline along the shores of Lower Sandusky Bay, including Johnson's Island and the bayside shores of the Marblehead and Cedar Point peninsulas but excluding East Sandusky Bay.
  - <u>Objective 2:</u> Restoration of at least 2 miles of coastline along the shores of East Sandusky Bay, including the bayside shore of the Cedar Point Peninsula.



Using Model Results to Guide Implementation

- **Still significant data gaps and lack of understanding regarding complex relationship between phosphorus loading, nitrogen loading, algal dynamics, HABs, etc.**
  - Need to continue working on a number of fronts

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