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# **Water Quality Monitoring for Lake Erie and the Great Lakes Nutrient Initiative (GLNI) 2011-2016**

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# Issues Facing the Great Lakes

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- In the Great Lakes, phosphorus (P) is the primary nutrient controlling the growth of algae
- Blankets of bottom algae first witnessed in lower Great Lakes in the 1970s.
- Improved municipal wastewater treatment (P removal) initially controlled algal blooms.
- However, they re-appeared in the mid-1990s and nearshore blooms have been particularly problematic in the last several years
- While P is still a major issue, excess algae is also linked to changes in the Great Lakes ecosystem:
  - increased share of bioavailable P in tributary inputs
  - invasive species (zebra and quagga mussels)

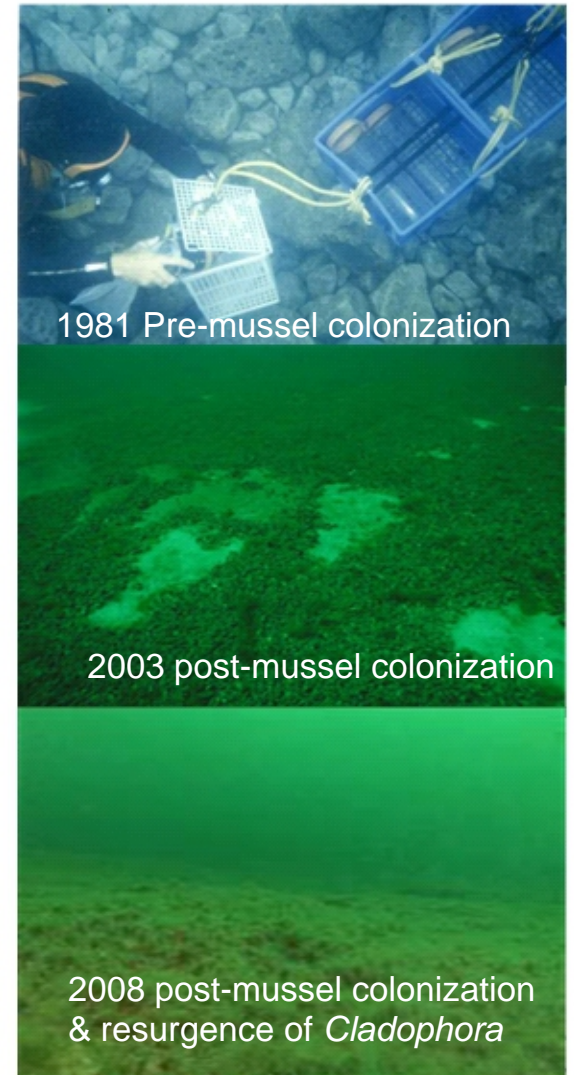
# Changed Ecosystem

## Nearshore Phosphorus shunt:

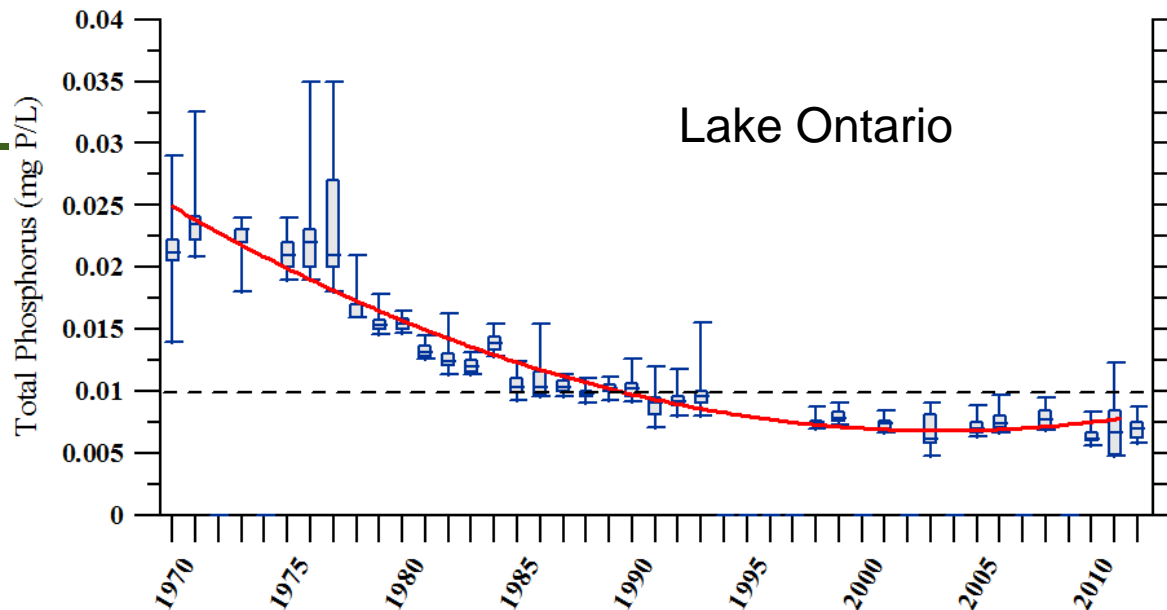
- Invasive zebra & quagga mussels remove phytoplankton and other particles from the water
- Increased water clarity leads to a larger zone for *Cladophora* growth
- Mussels release nutrients at the lake bed, providing more food for *Cladophora* growth
- Mussel harden the substrate, providing the right surface for *Cladophora* to grow on

Nearshore shunt concentrates nutrients and productivity in the nearshore at the lake bed and diminishes productivity in the offshore:

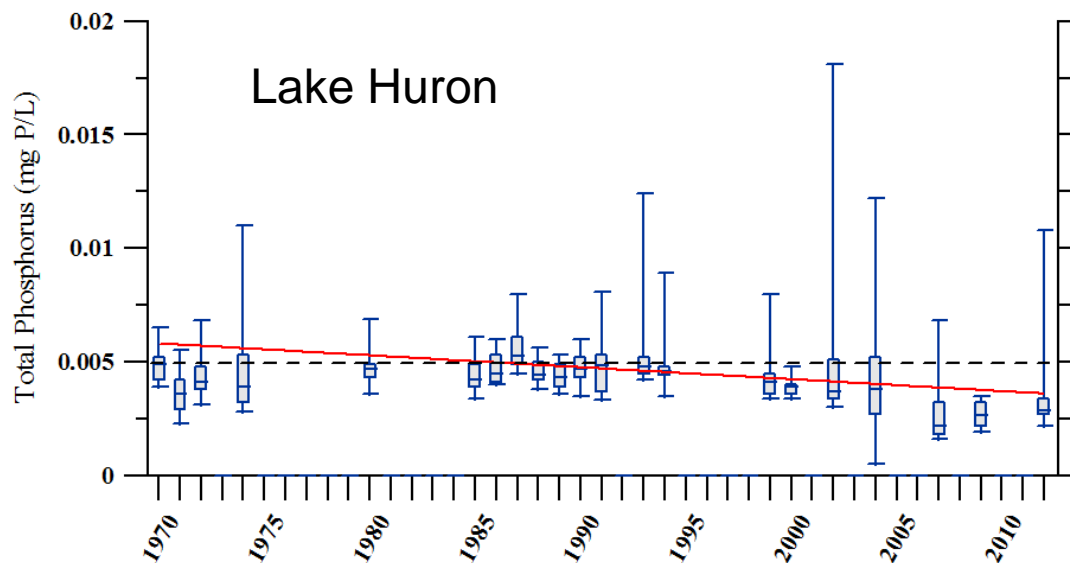
*Too many invasive mussels, too much algae nearshore  
Too little fish food, too few fish offshore*

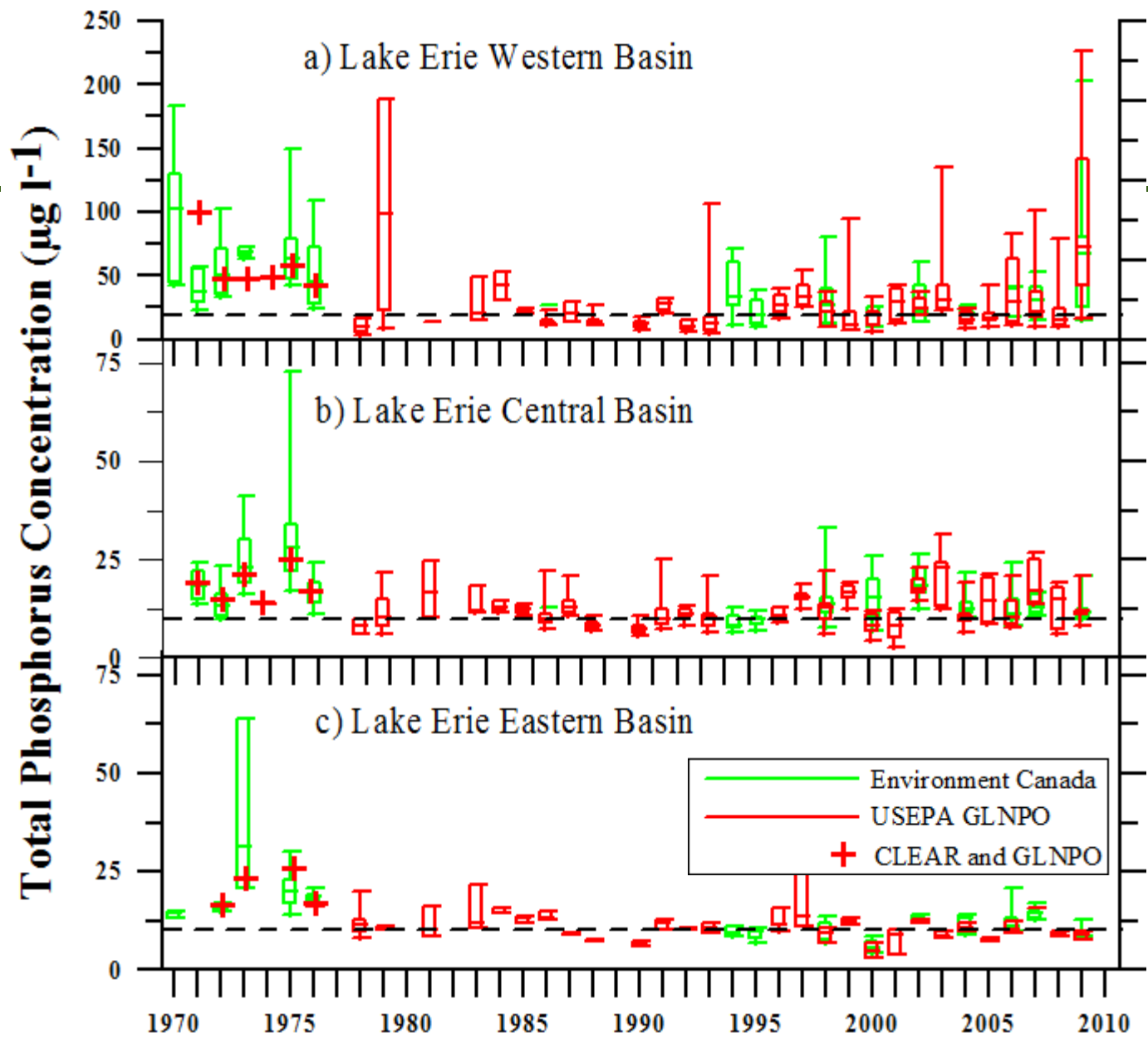


# Great Lakes Phosphorus Concentrations



Open Lake Total Phosphorus (TP) concentrations are below Great Lakes Water Quality Agreement (GLWQA) targets in Lakes Huron and Ontario.







# Goals of Great Lakes Nutrient Initiative

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- Great Lakes Nutrient Initiative (GLNI) will focus resources on understanding and addressing issues related to nearshore water quality and aquatic ecosystem health, and toxic and nuisance algae in nearshore and open waters of Lake Erie.
- Concentrating efforts on Lake Erie addresses the lake at greatest risk, while producing science and policy approaches which may be transferrable to the other Great Lakes and elsewhere in Canada.

# Monitoring Activities under GLNI

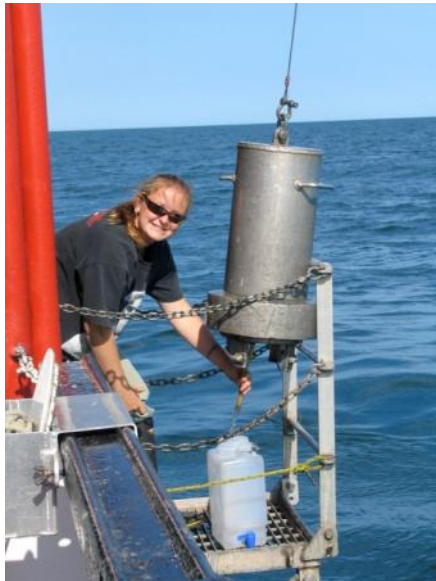
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- Measure total and bioavailable P loadings from tributaries discharging into Lake Erie
- Assess water quality conditions in selected Canadian nearshore waters of Lake Erie
- Assess biological conditions (algae, mussels, gobies and benthos) in selected Canadian nearshore waters of Lake Erie



# GLNI: Building on the Foundation

- Existing Water Quality Monitoring & Surveillance foundational monitoring programs and resources in support of the Canada-US GLWQA:



- **Great Lakes Surveillance Program**
- **Great Lakes Precipitation Network**
- **Great Lakes Connecting Channels Program**



# Tributary Program

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- Priority Tributaries plus Detroit River
- Sites co-located at Water Survey Gauging stations to provide flow
- Year round water sampling to provide:
  - An adequate number of samples
    - Rain and snow events
    - Low flow samples
  - Winter and spring emphasis
  - Sampling for soluble P fractions
  - Precipitation nutrient load to system

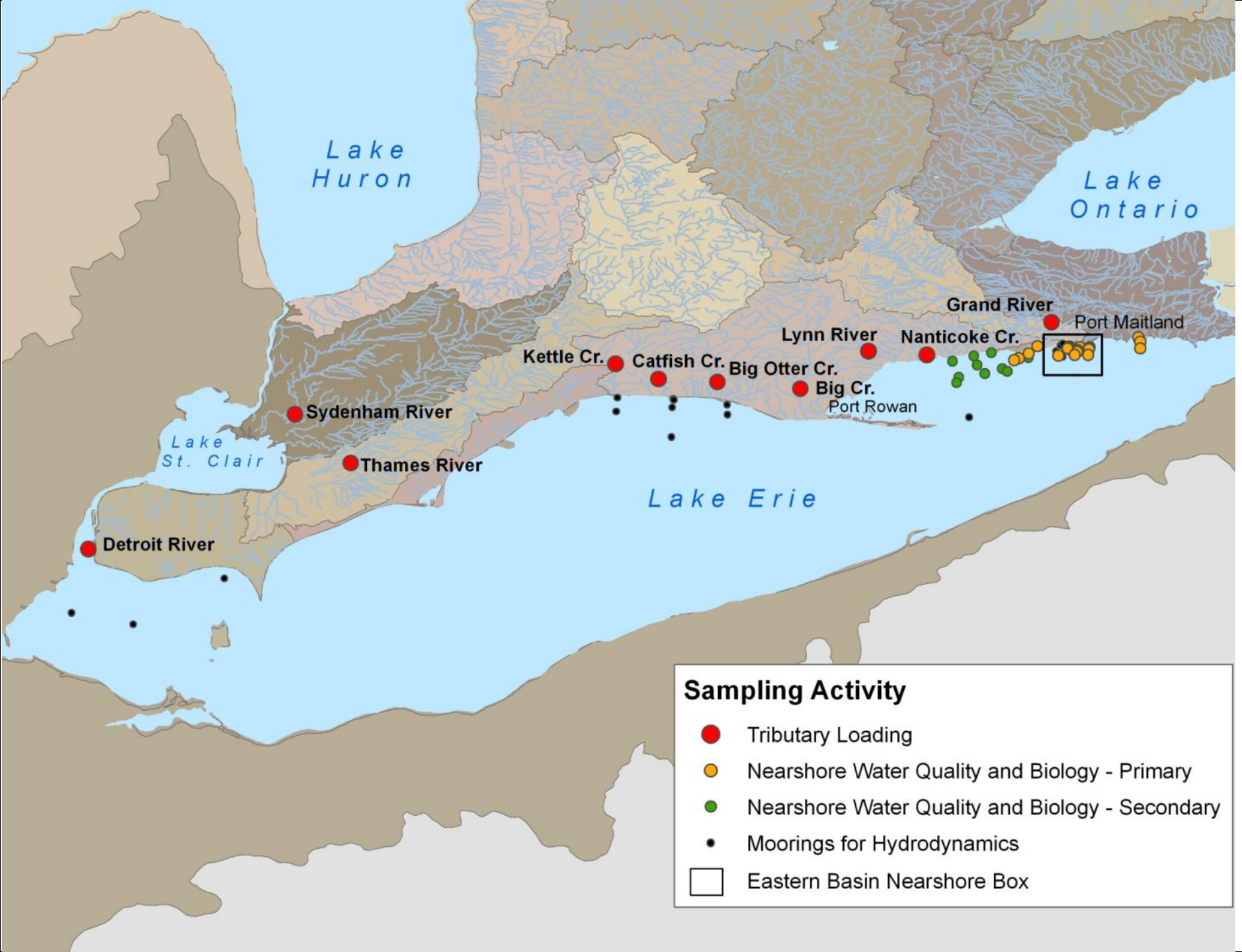


# Tributary Water Quality Parameters

- Anions
  - Fluoride
  - Chloride
  - Sulphate
- Nitrogen
  - Total Kjeldahl Nitrogen
  - NO<sub>3</sub>+NO<sub>2</sub>
  - NH<sub>3</sub>
- Phosphorus
  - Total Phosphorus (Unfiltered)
  - Total Phosphorus (Filtered)
  - Soluble Reactive Phosphorus
- Total Suspended Solids



Strategy is to sample every 8 hours; analyze selected samples



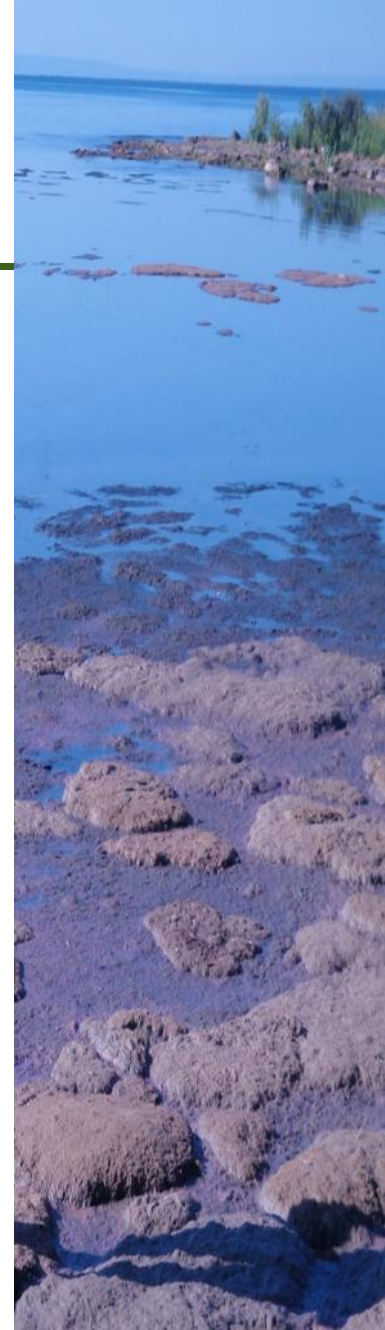
# Detroit River Sampling Sites for Nutrient Loading Study (2007)



# Nearshore Program

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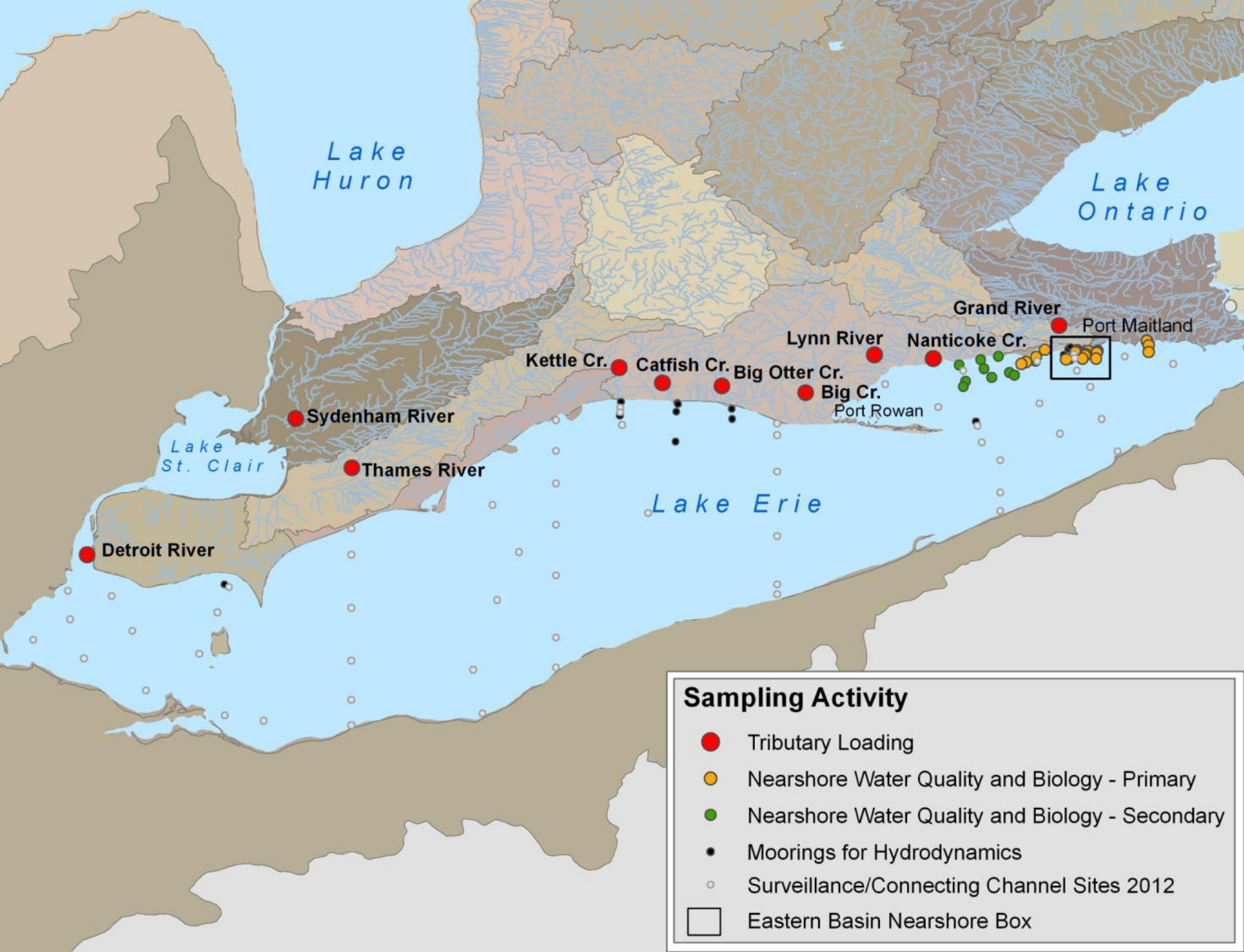
- Water Quality
  - Nutrient sampling in nearshore waters that are affected by priority tributaries
- Benthic Community
  - Mussel sampling for biomass and P tissue concentration
- Cladophora
  - Biomass and tissue P concentration
- Hydrodynamics
  - Water movement in nearshore areas affected by priority tributaries



# Nearshore Water Quality Parameters

- Clarity (Secchi disk)
- PAR
- Anions (Silica, Fluoride, Chloride, Sulphate)
- Nitrogen (Total, TKN, NO<sub>3</sub>+NO<sub>2</sub>, NH<sub>3</sub>)
- Phosphorus (TP, TFP, SRP, Particulate)
- Total Suspended Solids and turbidity
- Chlorophyll a
- Particulate organic carbon and nitrogen

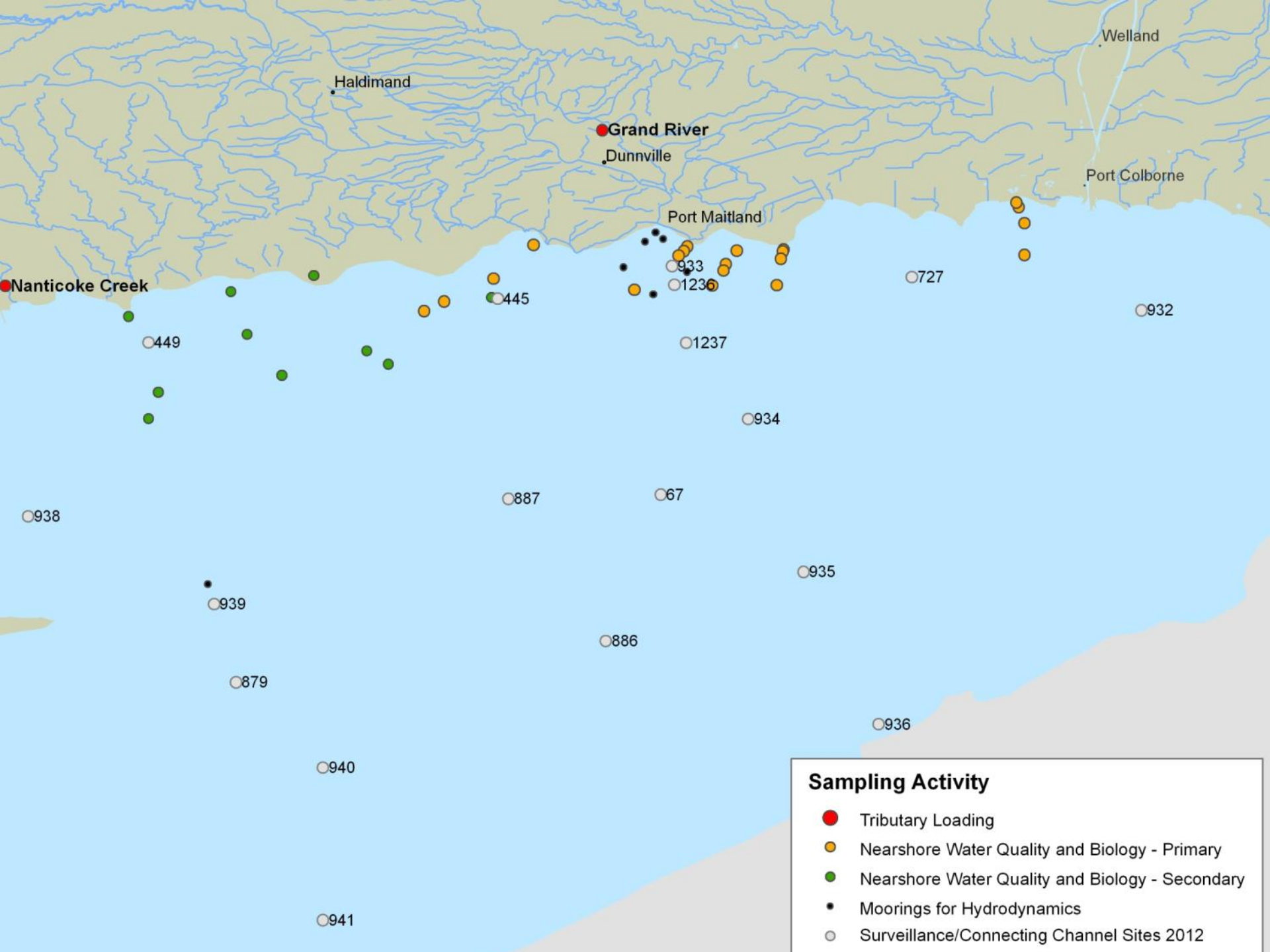




### Sampling Activity

- Tributary Loading
- Nearshore Water Quality and Biology - Primary
- Nearshore Water Quality and Biology - Secondary
- Moorings for Hydrodynamics
- Surveillance/Connecting Channel Sites 2012
- Eastern Basin Nearshore Box





# There is a Need to Better....

## Understand Nearshore Processes:

- Intensively map water quality in problem areas in conjunction with intensive tributary monitoring
- Model nearshore water dynamics and biological (algae) response to nutrients
- Identify nearshore ecosystem targets
- Derive restoration objectives, related water quality targets for problem areas

## Understand Land-based Processes:

- Intensively monitor key tributaries during storm events
- Develop GIS-based models to estimate relative loadings and identify priority watersheds
- Validate the pollution impacts of best management practices (urban and rural watersheds)
- Estimate potential watershed contaminant load reductions

## Understand Nearshore-Offshore Processes:

- Model water dynamics and ecosystem response to nutrients (e.g. lower food web productivity, fish community response)
- Identify offshore ecosystem restoration objectives (e.g. fish community objectives), related water quality targets for problem areas

