Nutrient Mass Balance for Ohio Watersheds

Josh Griffin and Dale White (retired)

Division of Surface Water

Modeling, Assessment and TMDL Section

March 6, 2019 – Operator Training Committee of Ohio

Ohio Environmental Protection Agency

Objectives of Nutrient Mass Balance Project

Guide Ohio EPA policy & management

- Relative loads (by watershed)
- Load sources (Combined sewer overflows vs. nonpoint sources vs. wastewater)

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Objectives of Nutrient Mass Balance Project

Support national programs –

- Lake Erie algae reduction goals, Annex 4
- Gulf of Mexico Hypoxia (Dead Zone) Task Force

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Objectives of Nutrient Mass Balance Project

From HB 64, statutory obligation 6111.03 (U) requires Agency.

- Total load, load sources
- Report every 2 years

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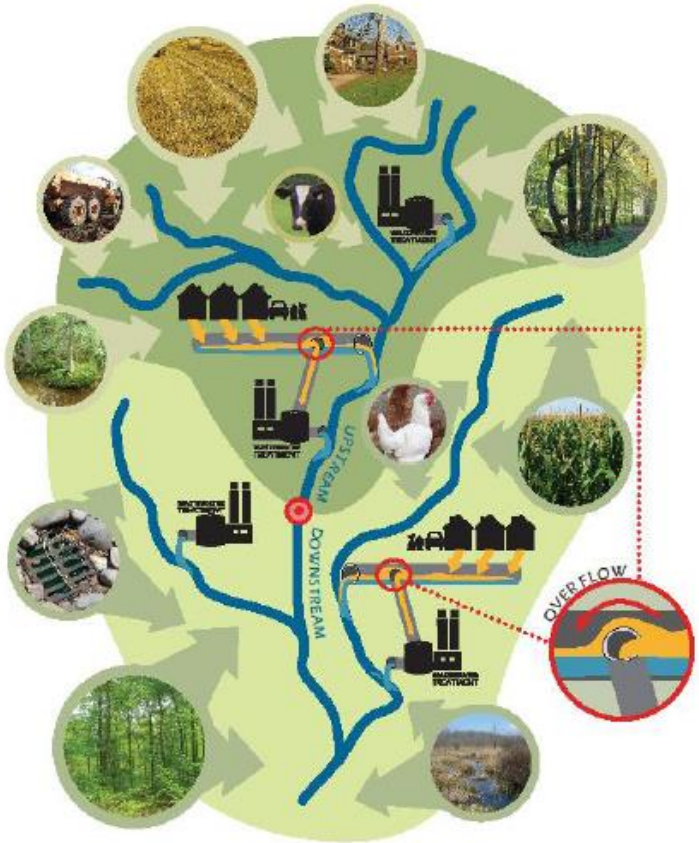
Nutrient Mass Balance Study for Ohio's Major Rivers



Report available at:

http://epa.ohio.gov/Portals/35/documents/Nutrient Mass Balance Study 2018_Final.pdf

Division of Surface Water

Modeling, Assessment and TMDL Section

April 16, 2018

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Far-field vs. Near-field Impacts

- **Far-field: i.e. Lake Erie or Gulf of Mexico**
  - Annual NMB most informative
  - Most load delivered in high flows
  - Increasing importance of nonpoint sources
- **Near-field: i.e. Streams**
  - Annual NMB less informative
  - Lower Flow Index Period (May-Oct)
  - Shifting responsibility…point sources

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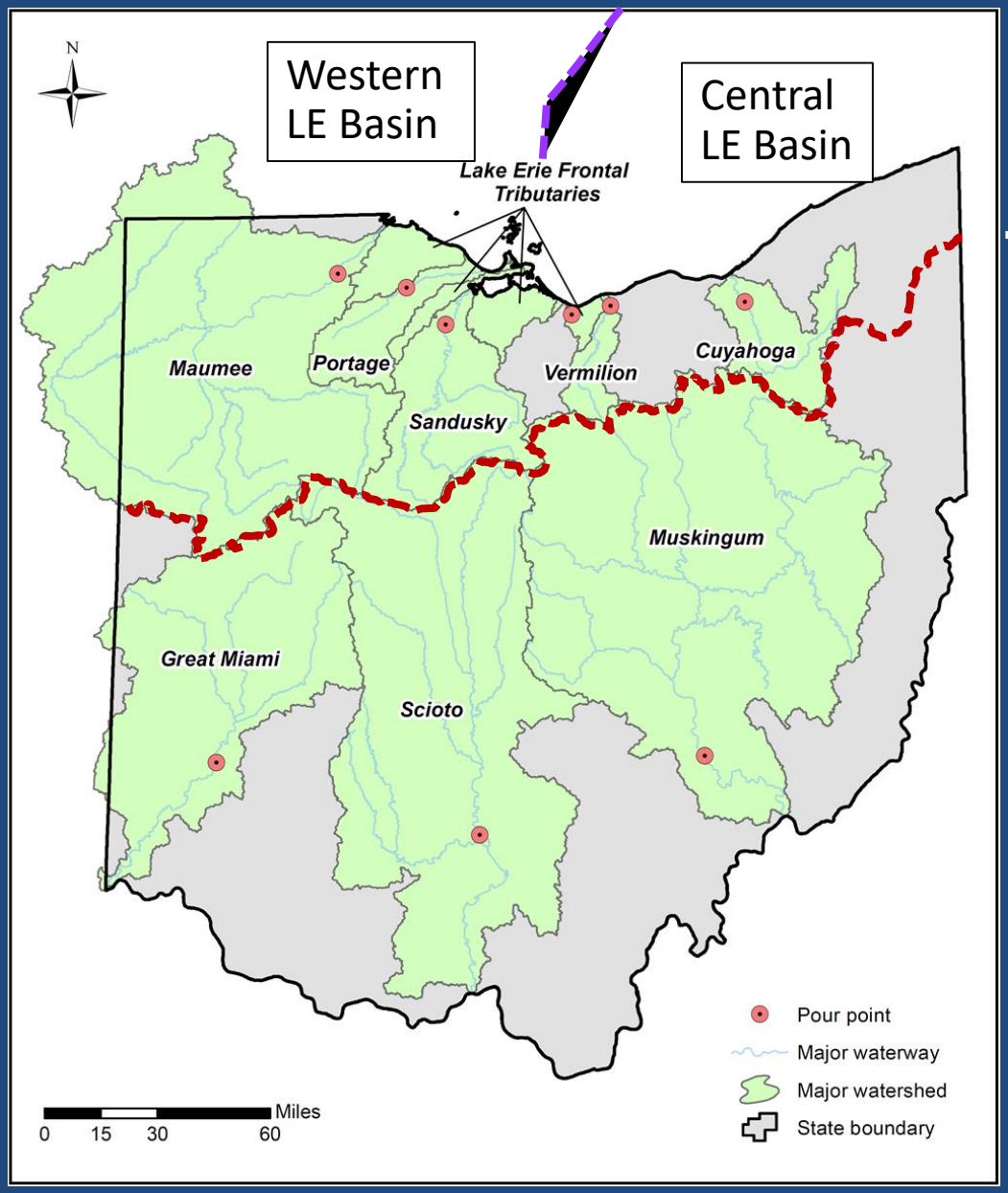
Study Area



Lake Erie Basin

Ohio River Basin

- 8 watersheds
  + frontal L Erie drainages
- 29,600 mi^2 (in Ohio)
- 66% Ohio's land area

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Data Analysis Period

Loads calculated for ‘water years’
(Oct. 1 to Sept. 30 basis)

- Most recent complete data available was water year 2017
- Designated “wy13” - “wy17”
- Matches related efforts in reporting
  e.g., GLWQA - Annex 4, NCWQR, USGS

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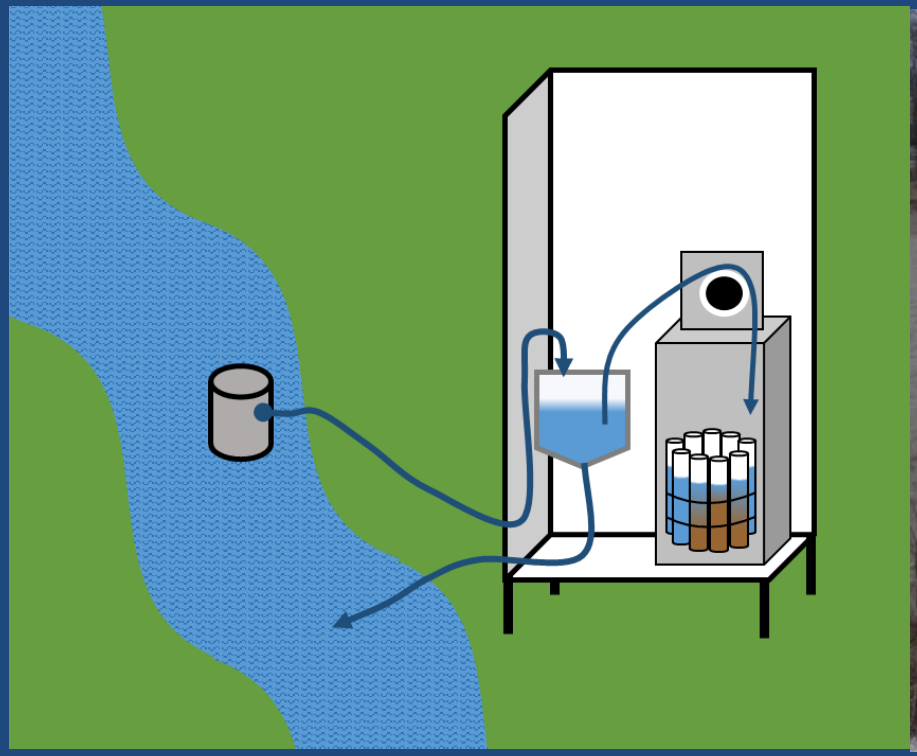
Pour Point Nutrient Load Monitoring



Schematic of water quality monitoring at USGS gages

The stream gage and water quality sampling station at the Sandusky River near Fremont, Ohio (Site # 4198000)

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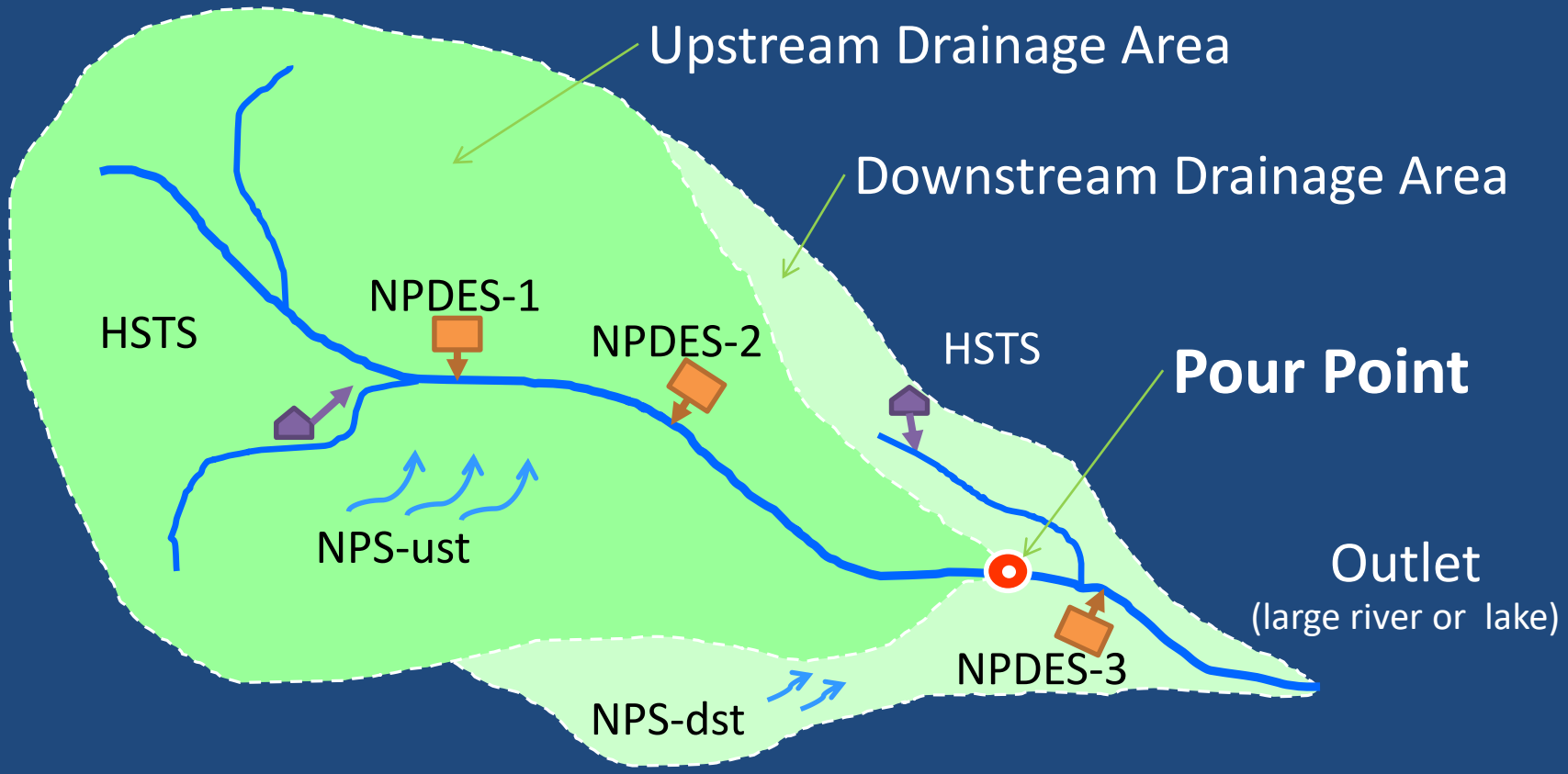
Watershed Schematic for Calculation



$$\textbf{Pour Point: } Total_{ust} = PS + HSTS + NPS_{ust}$$

$$\textbf{Total Load} = \textbf{Pour Point} + PS_{dst} + HSTS_{dst} + NPS_{dst}$$

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Calculation: Point Sources

- **NPDES (National Pollution Discharge Elimination System)**
  - Municipal NPDES
    - Use reported data from DMR (discharge monitoring reports)
  - CSOs (all wet weather) includes bypass flows
    - Actual reporting data or LTCP if under-represented
    - CSO concentration fixed (0.73 mg/L for TP and 20 mg/L for TN)
    - SSOs not report flow (only occurrence) – not considered (small)
  - Industrial facilities
    - Use reported data (DMR)
    - If no nutrient monitoring, assume *de minimis* contribution

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Calculation: HSTS

Household sewage treatment systems (HSTS)

- Population using HSTS (2010 U.S. Census)
- Nutrient yield (lb/person/year): from literature
- Differentiated by regional 2012 survey (ODH, 2013)
  - direct discharge vs. onsite

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Calculation: NPS

- **Nonpoint source**
  - NPS upstream of pour point
  - NPS downstream of pour point
- Not differentiated between sources

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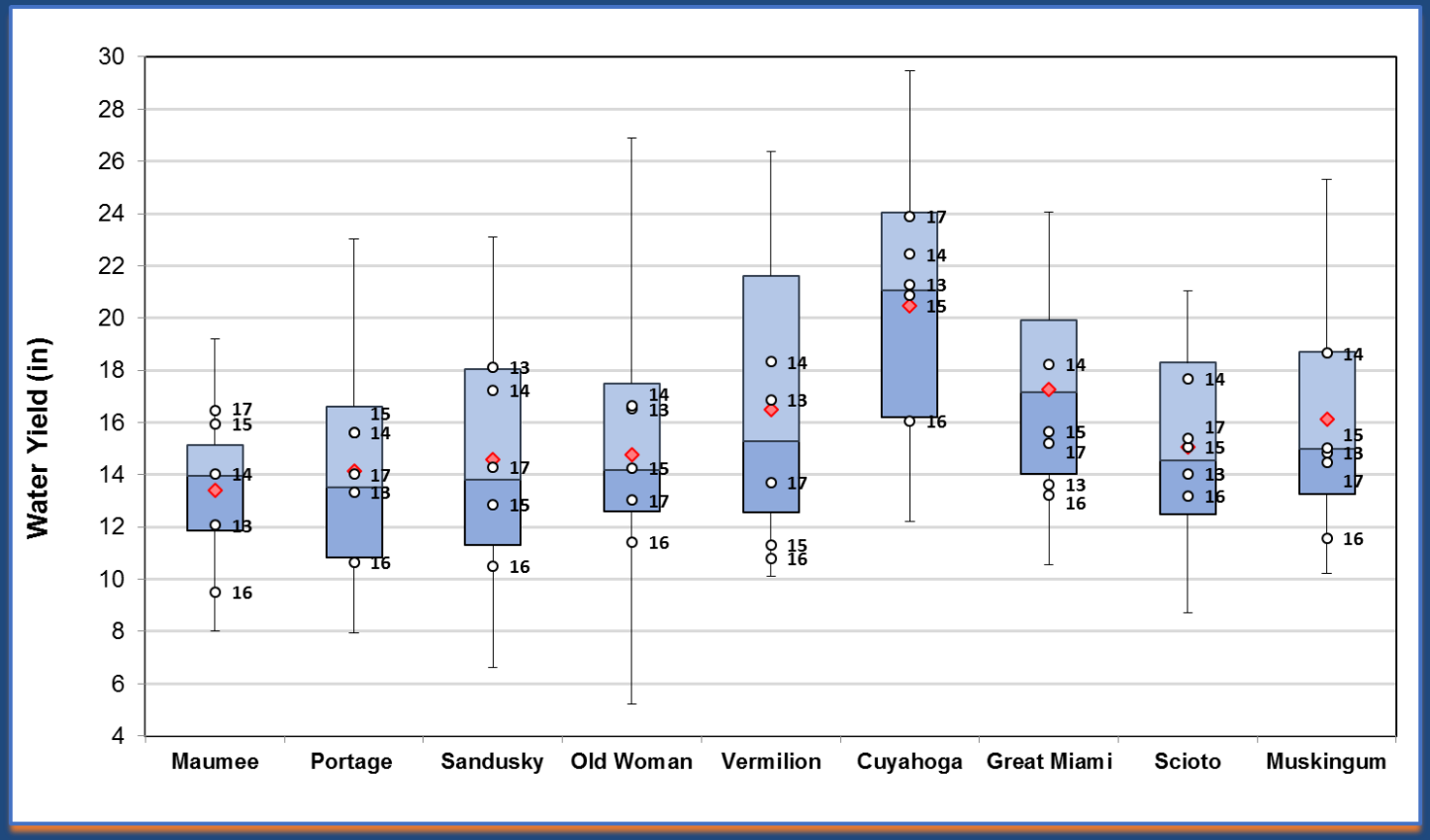
Water Yield: Study vs. 20-year* History

water yield = total discharge / watershed area



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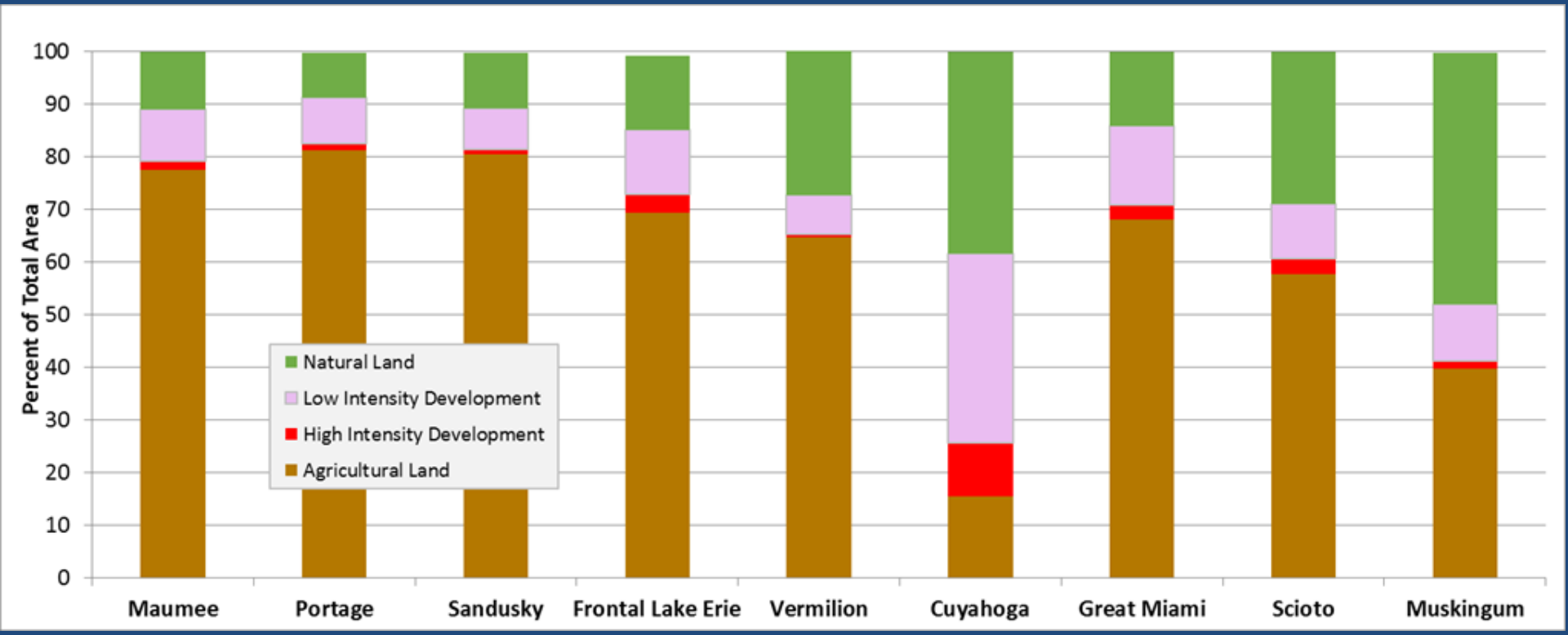
Land Use



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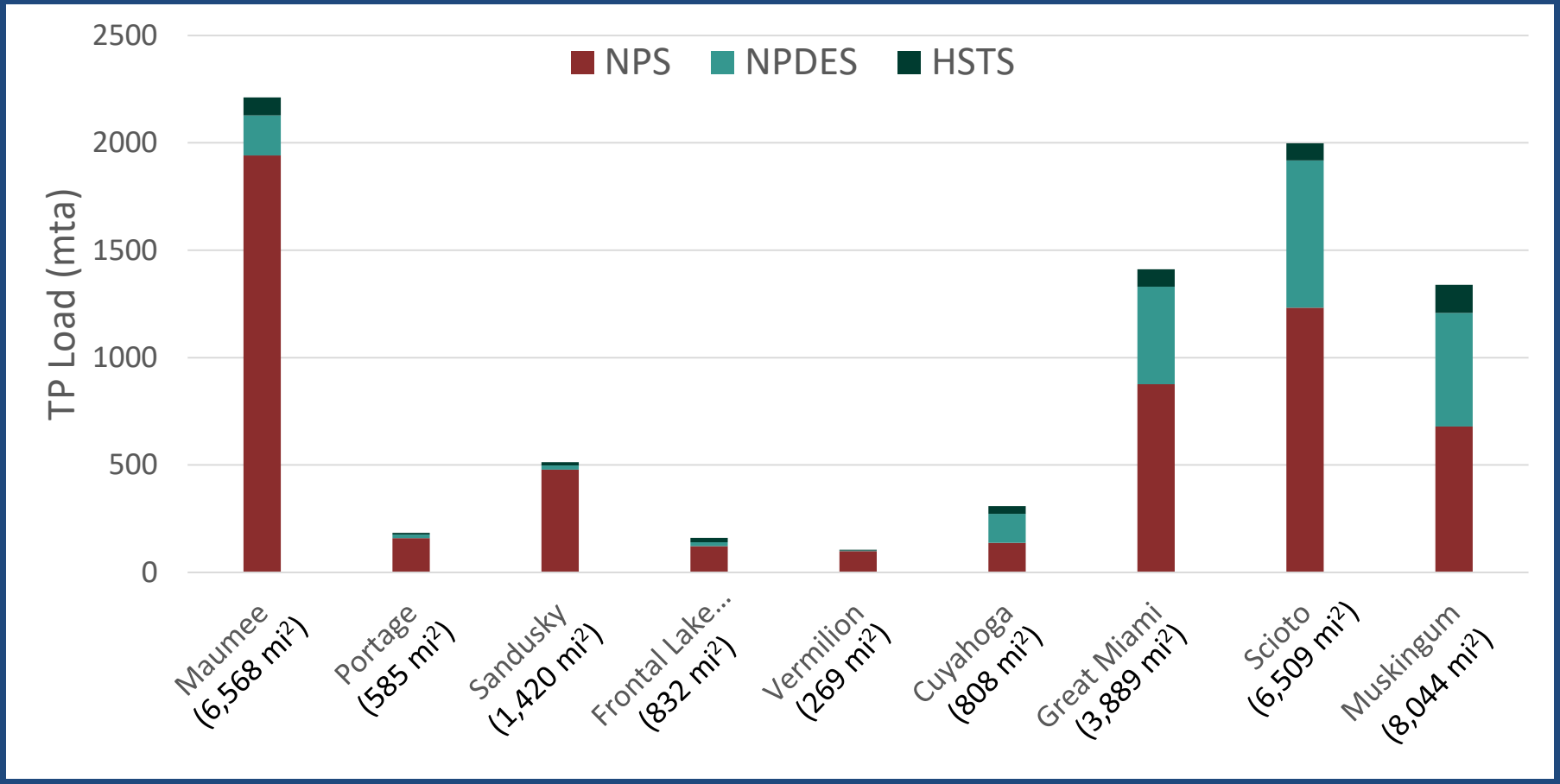
Total P: Load

Average 2013-2017



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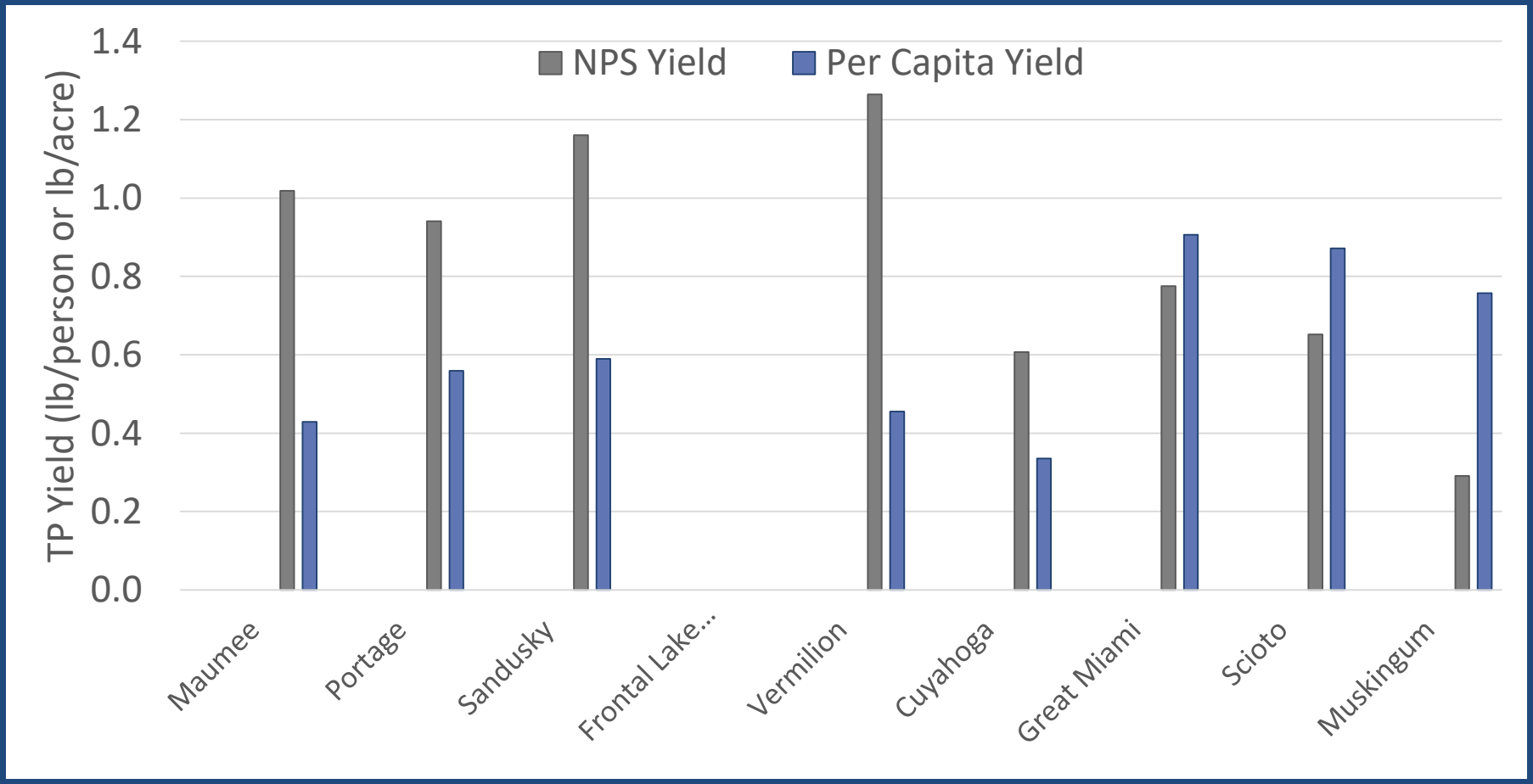
Total P: Yield

Average 2013-2017



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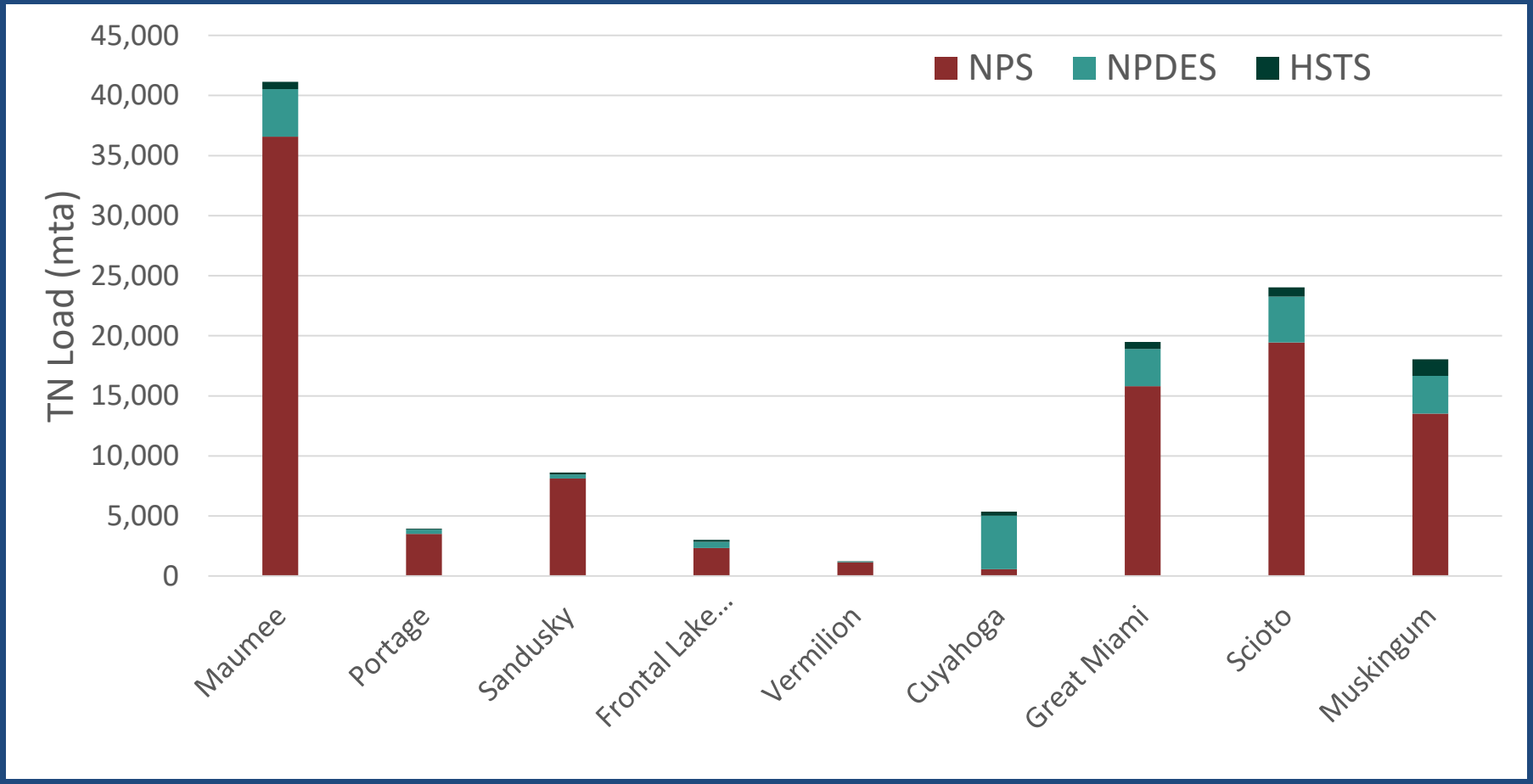
Total N: Load

Average 2013-2017



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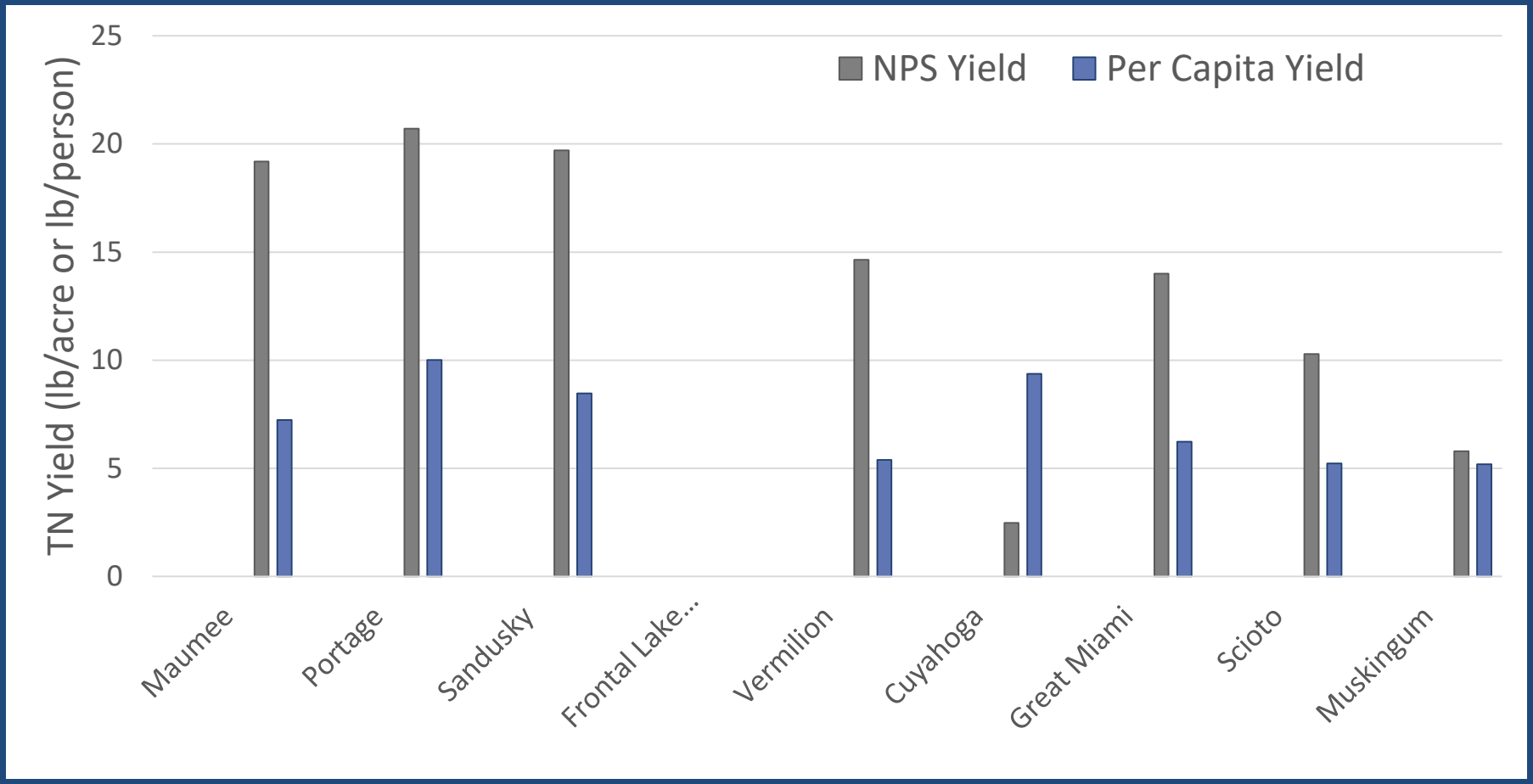
Total N: Yield

Average 2013-2017



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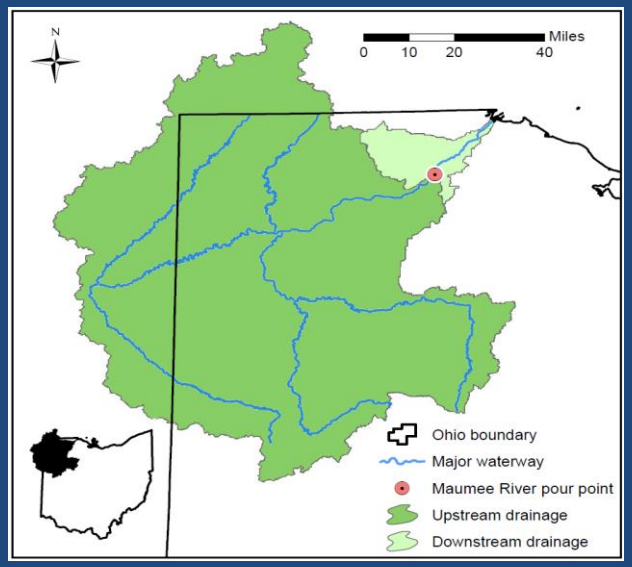
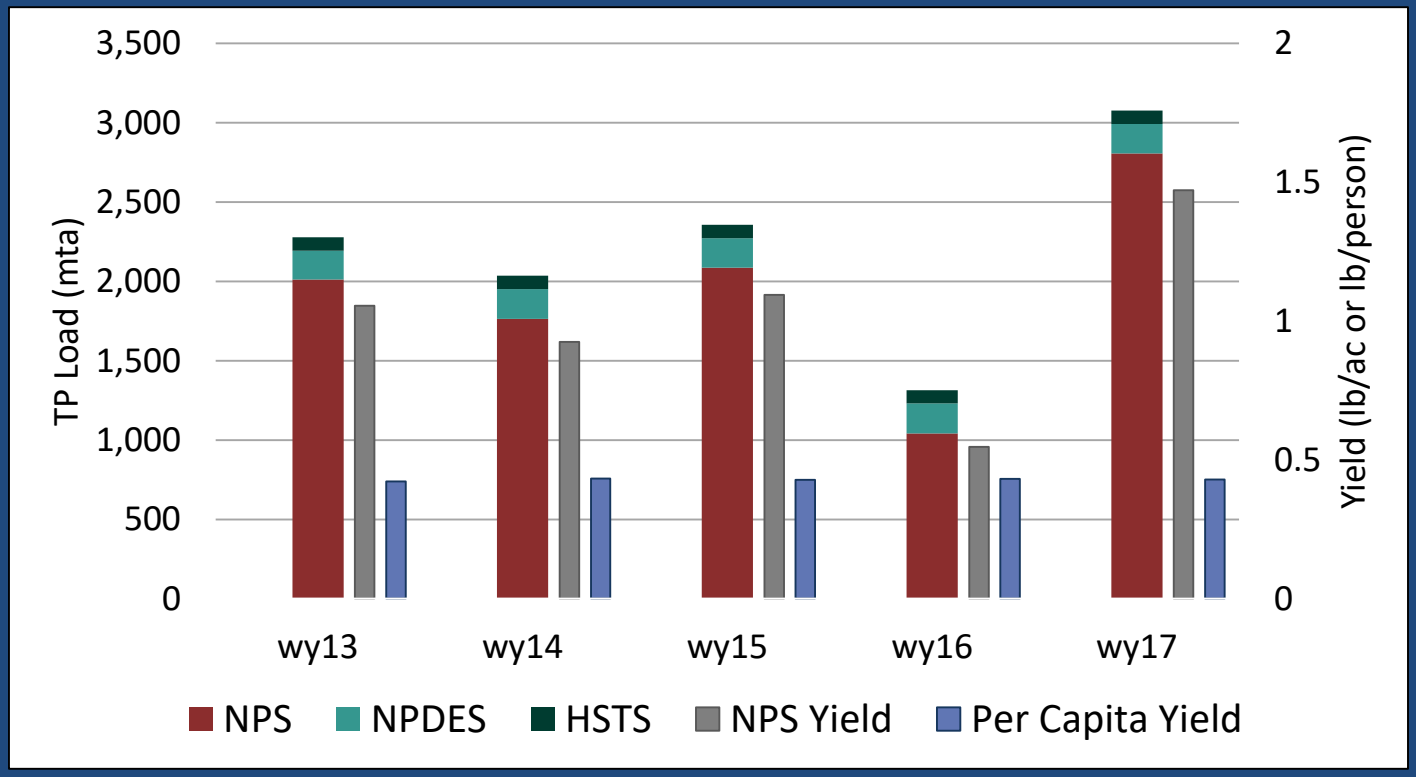
Loading Breakdown - Maumee

Total P – by Water Year





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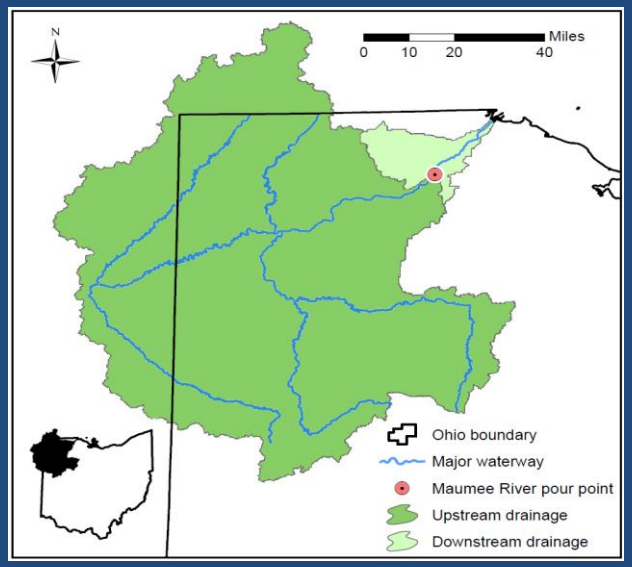

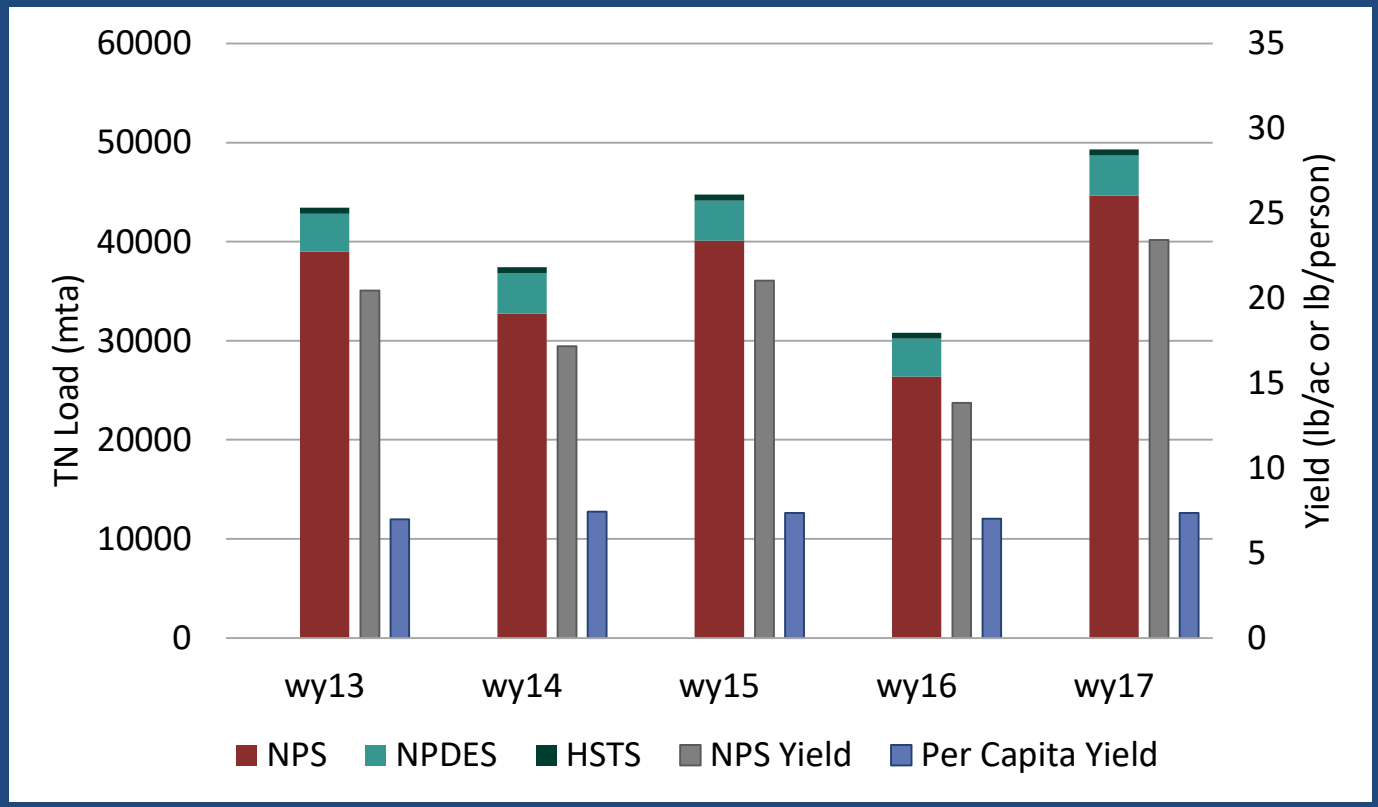

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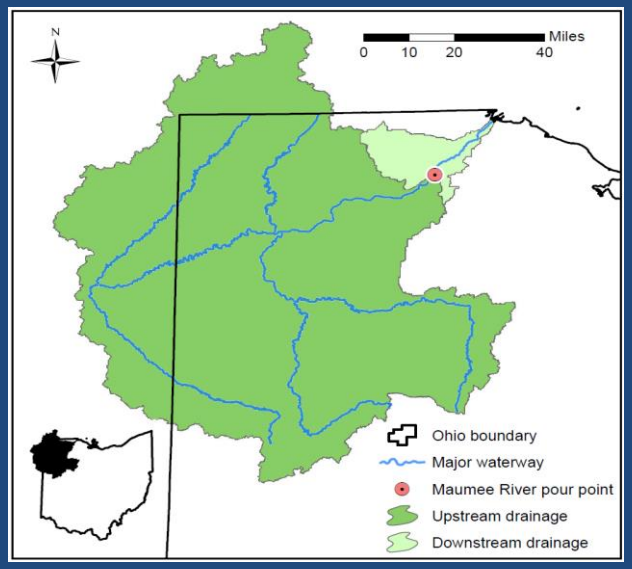
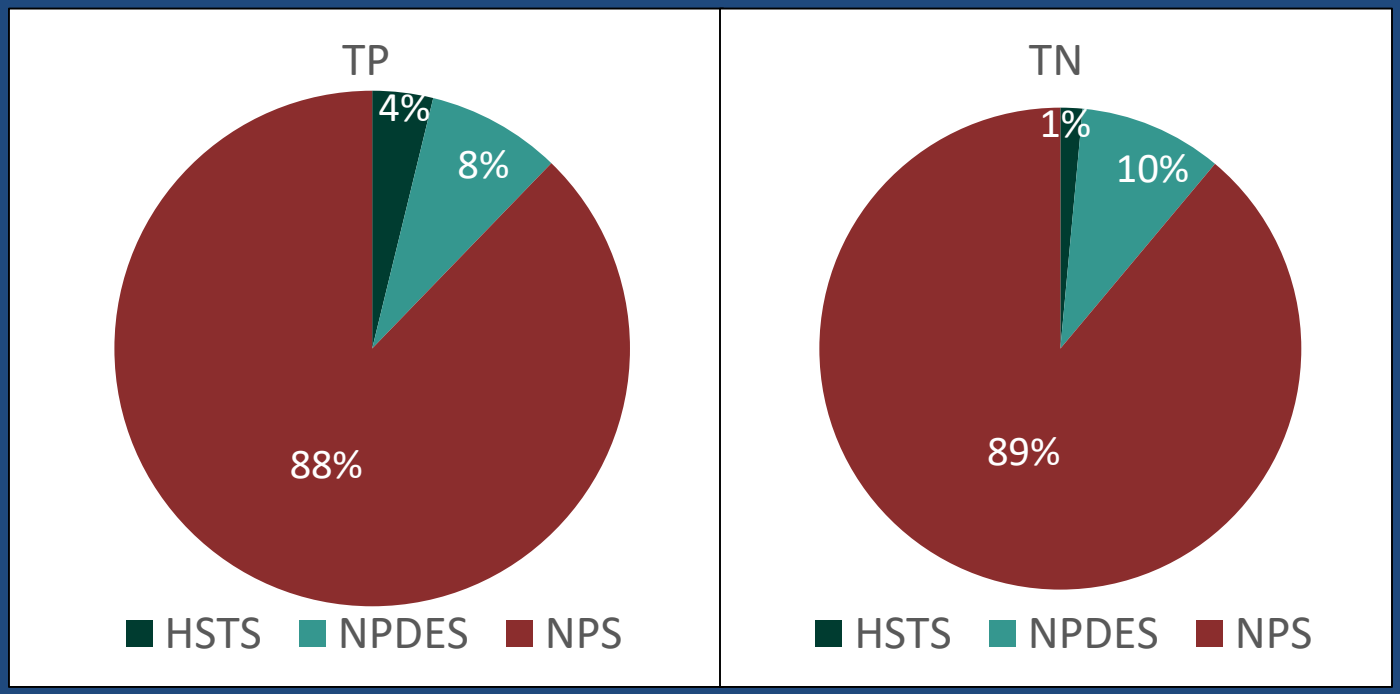
Loading Breakdown - Maumee

Proportions of Total P and Total N
Average of 5 years





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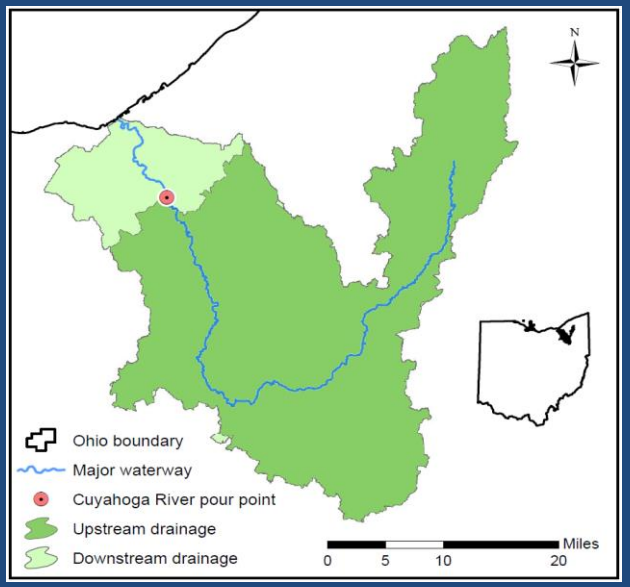
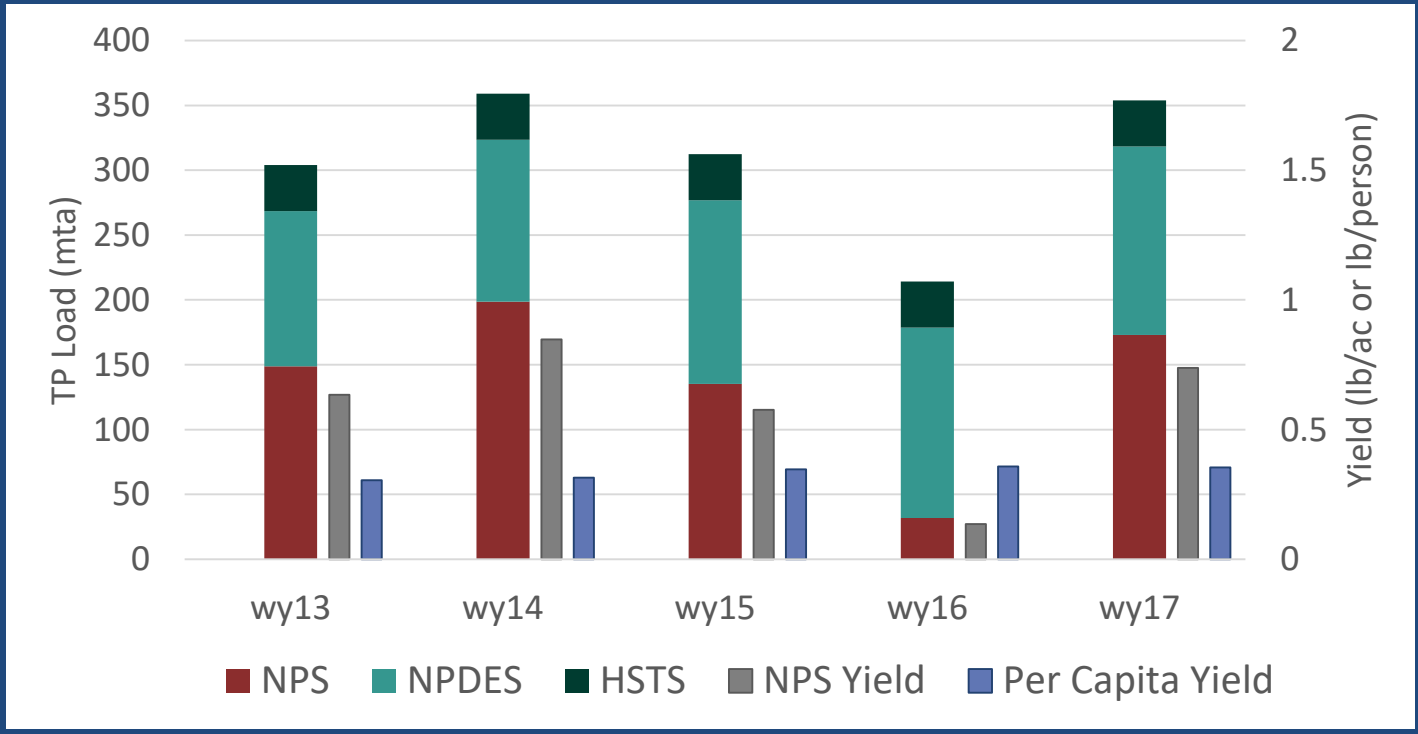
Loading Breakdown - Cuyahoga

Total P – by Water Year





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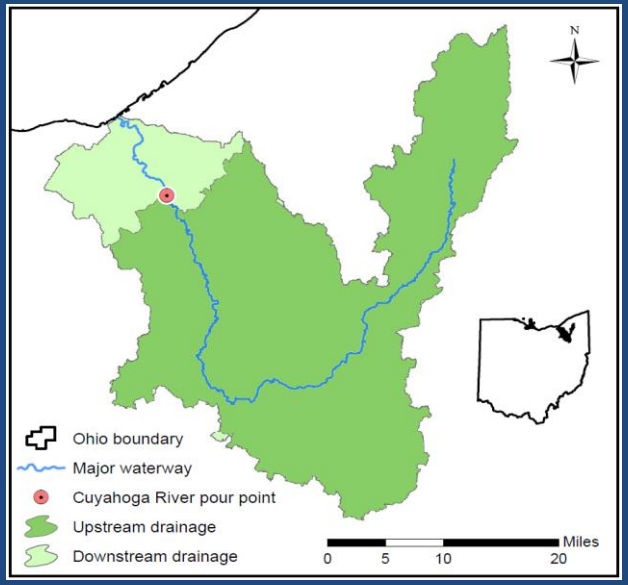
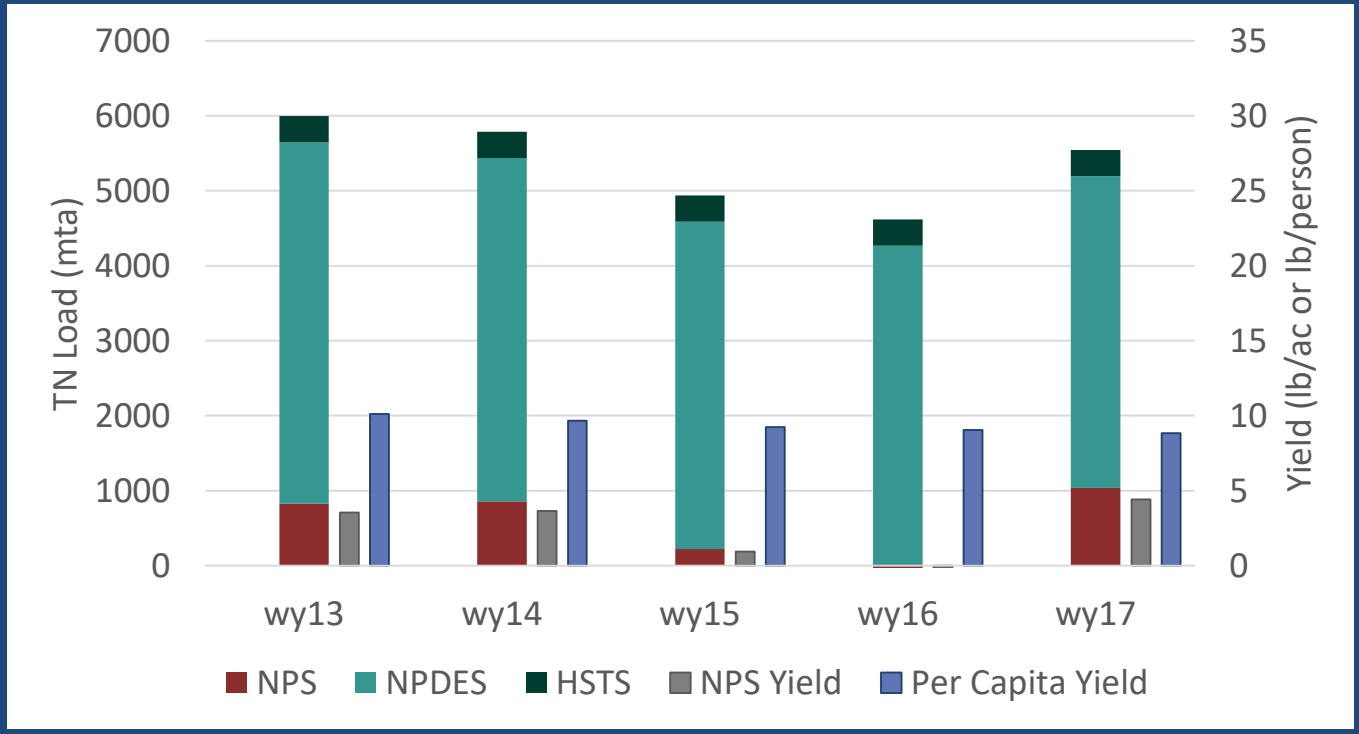
Loading Breakdown - Cuyahoga

Total N – by Water Year





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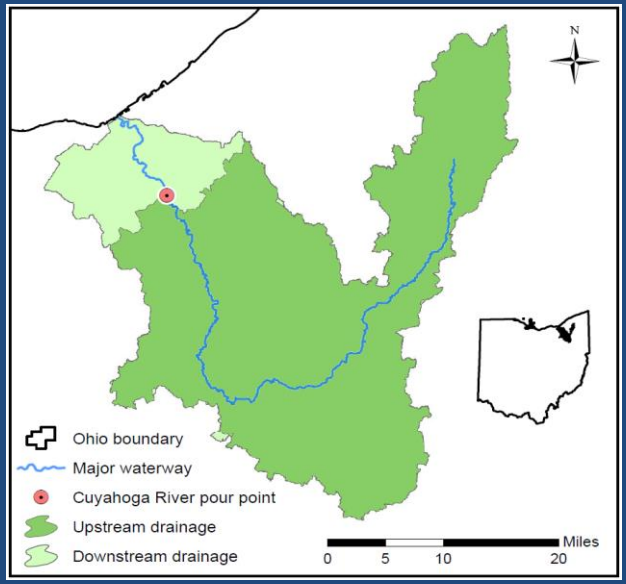

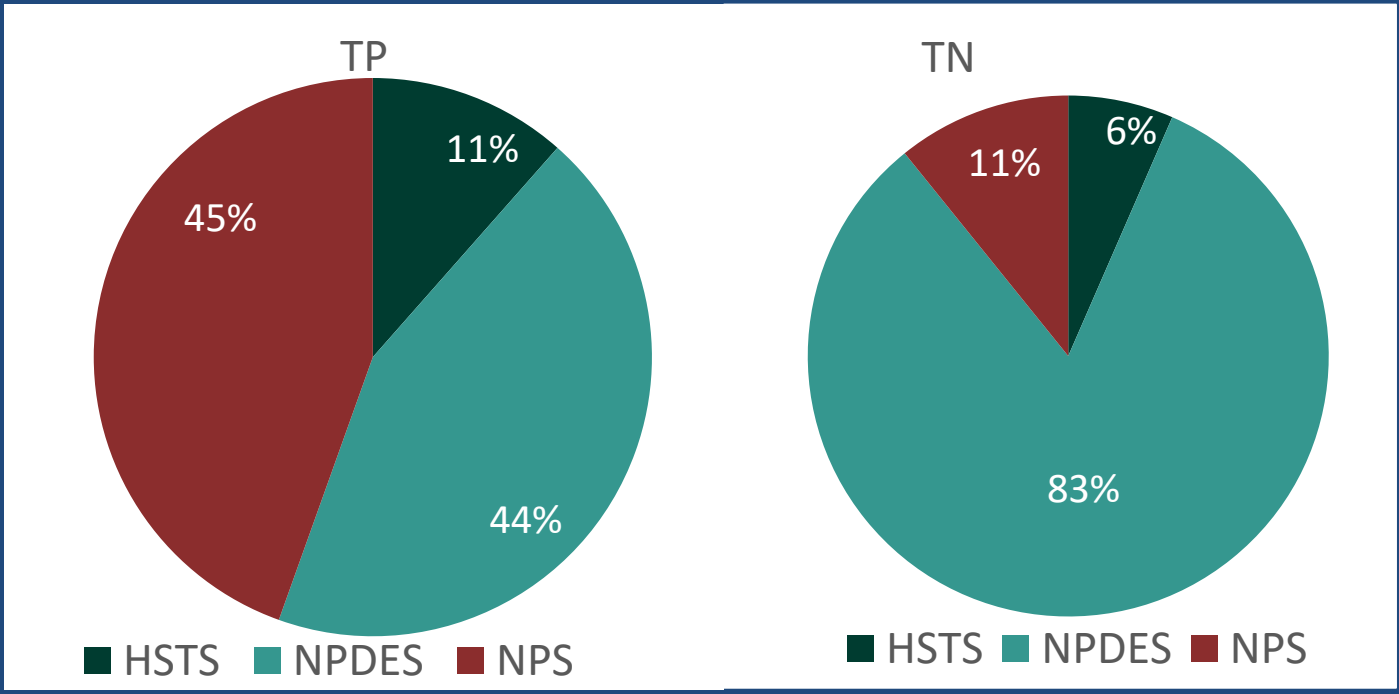

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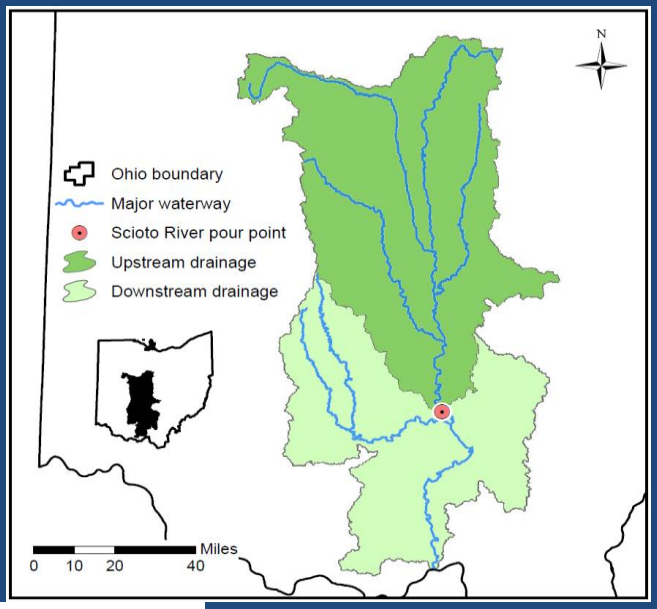
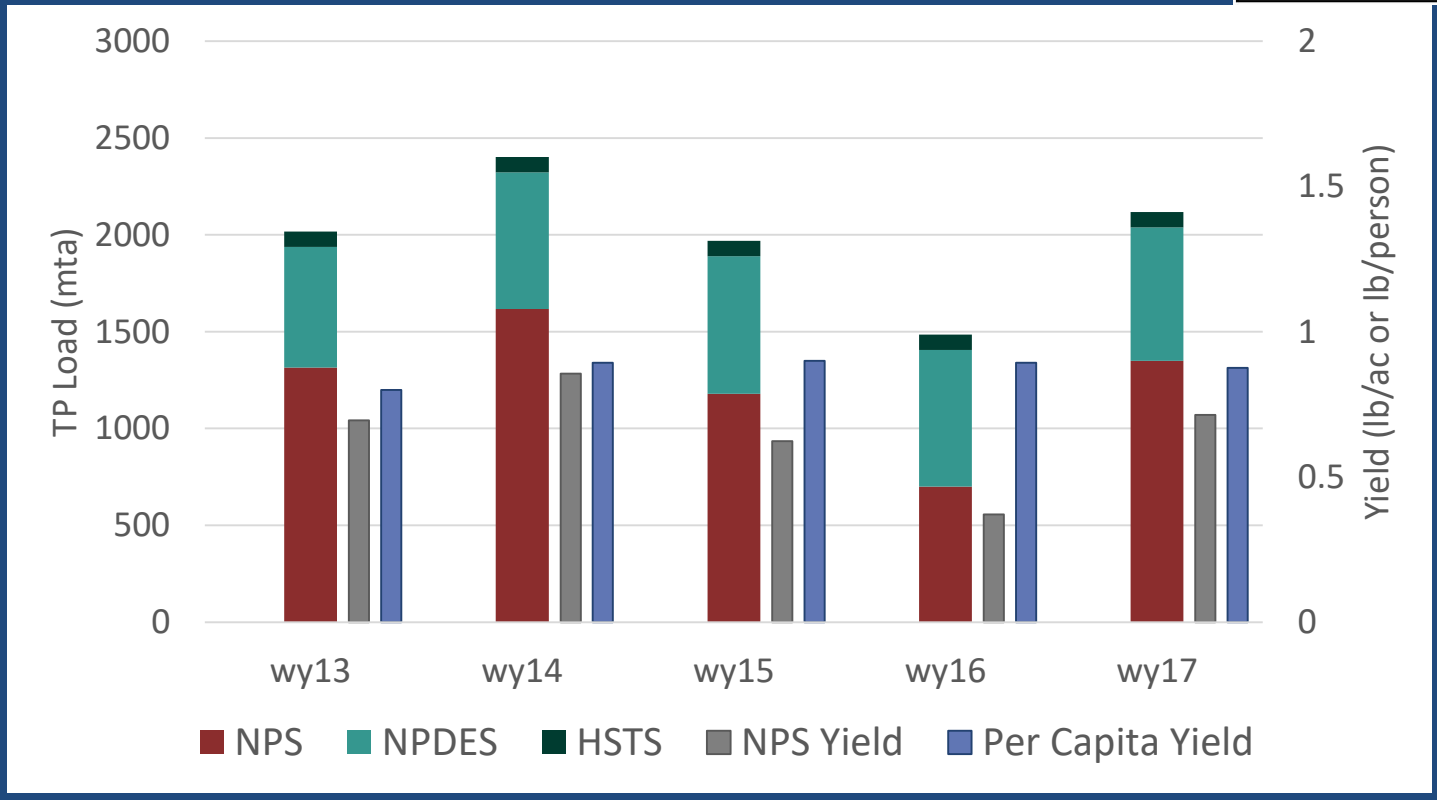
Loading Breakdown - Scioto

Total P – by Water Year





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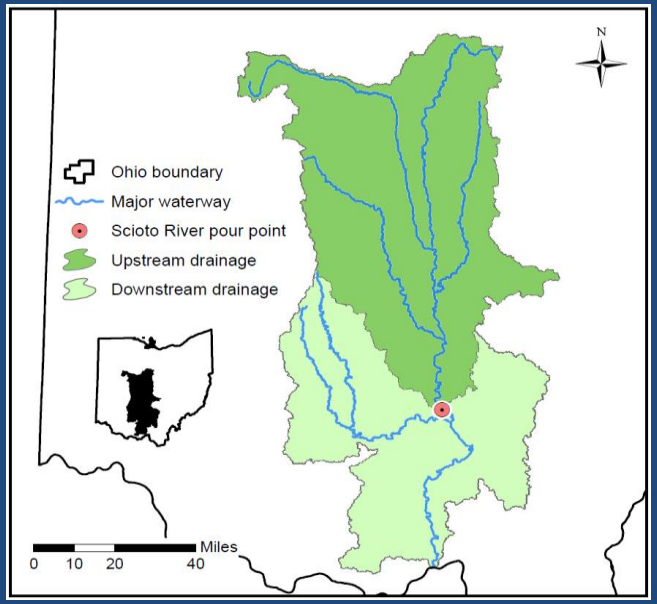

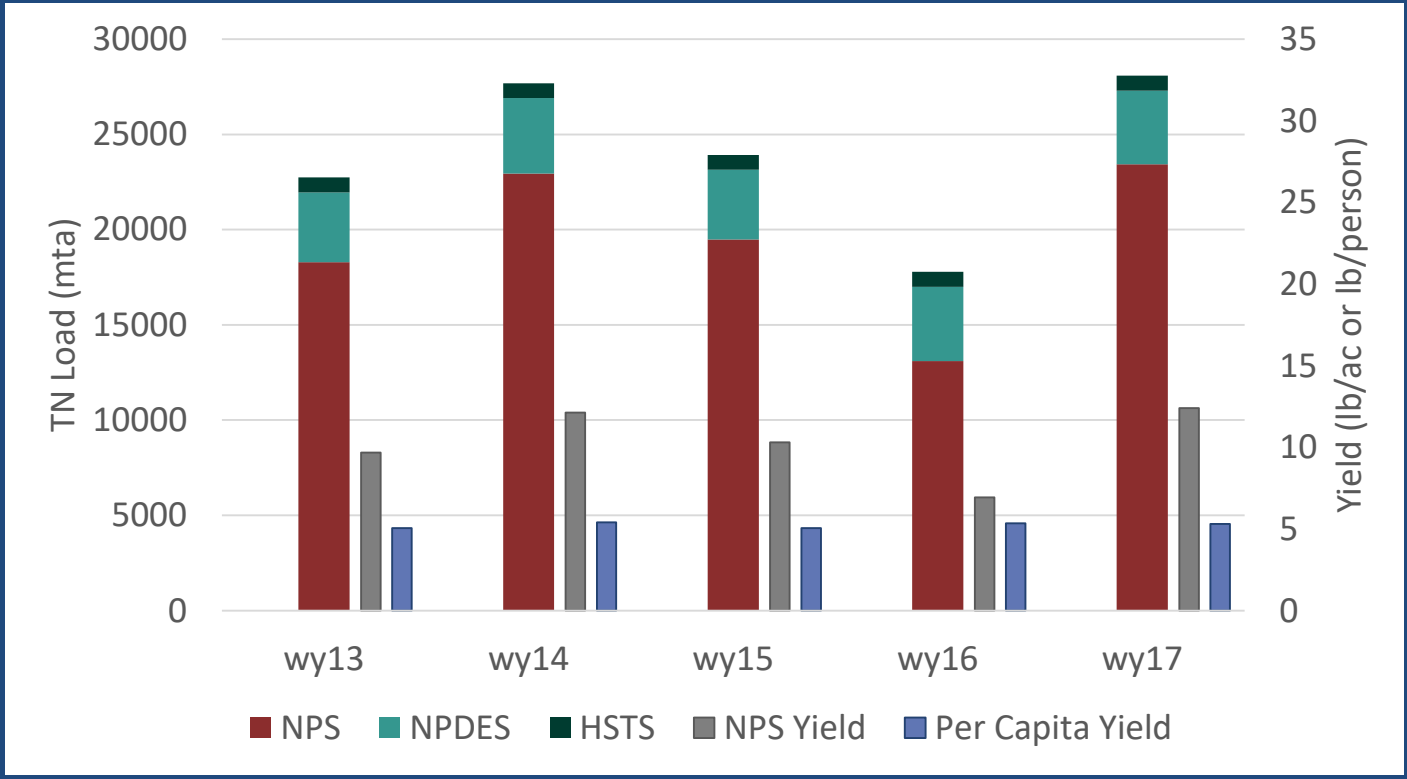

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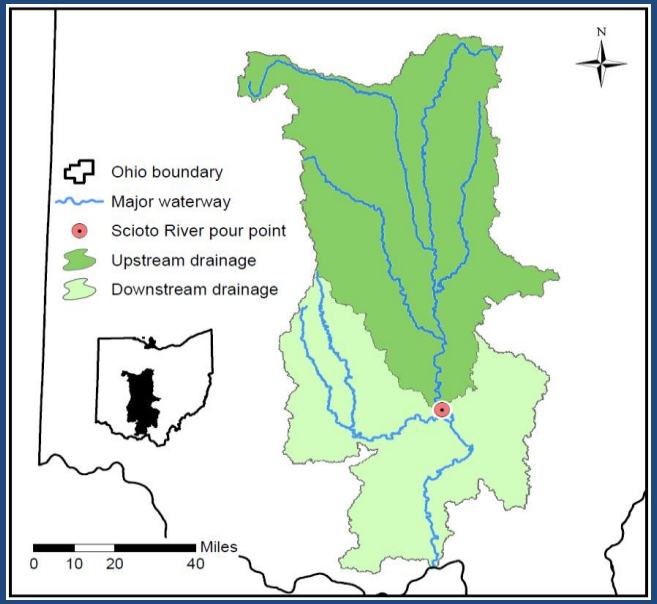

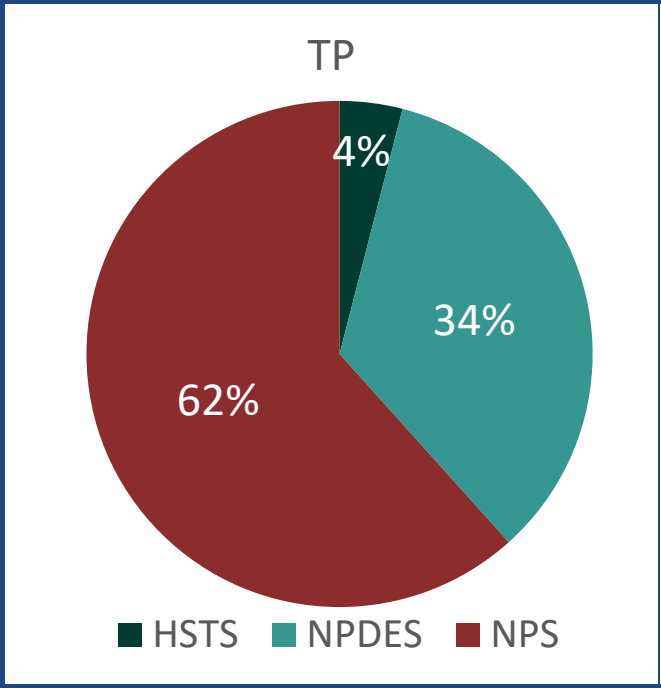

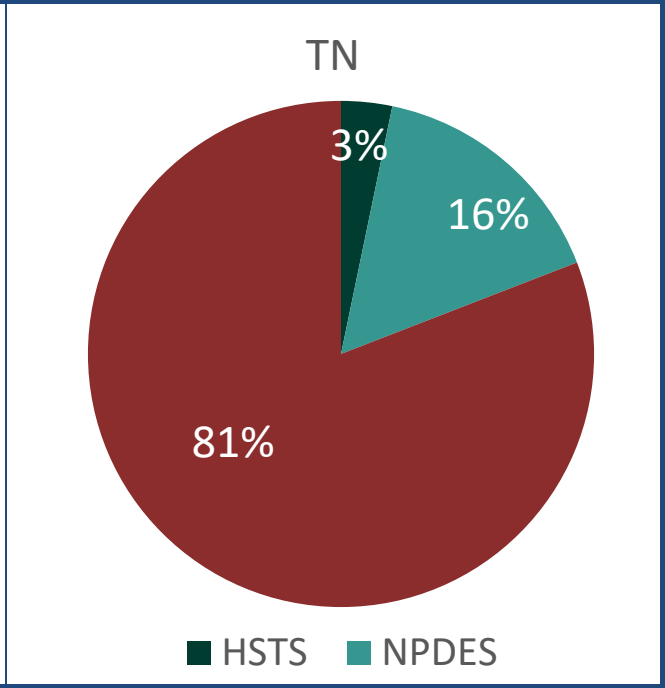

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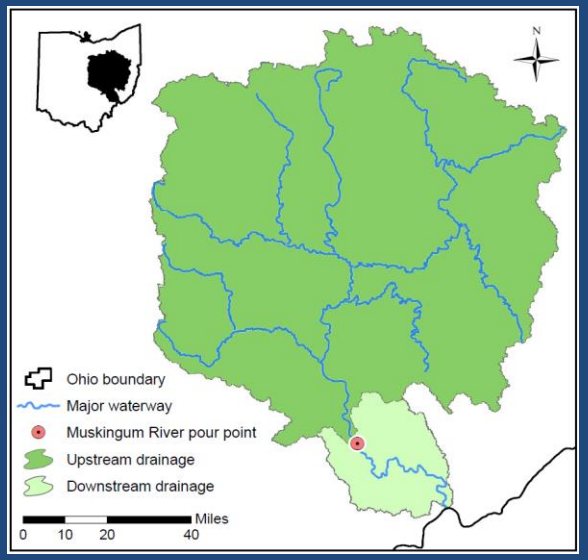
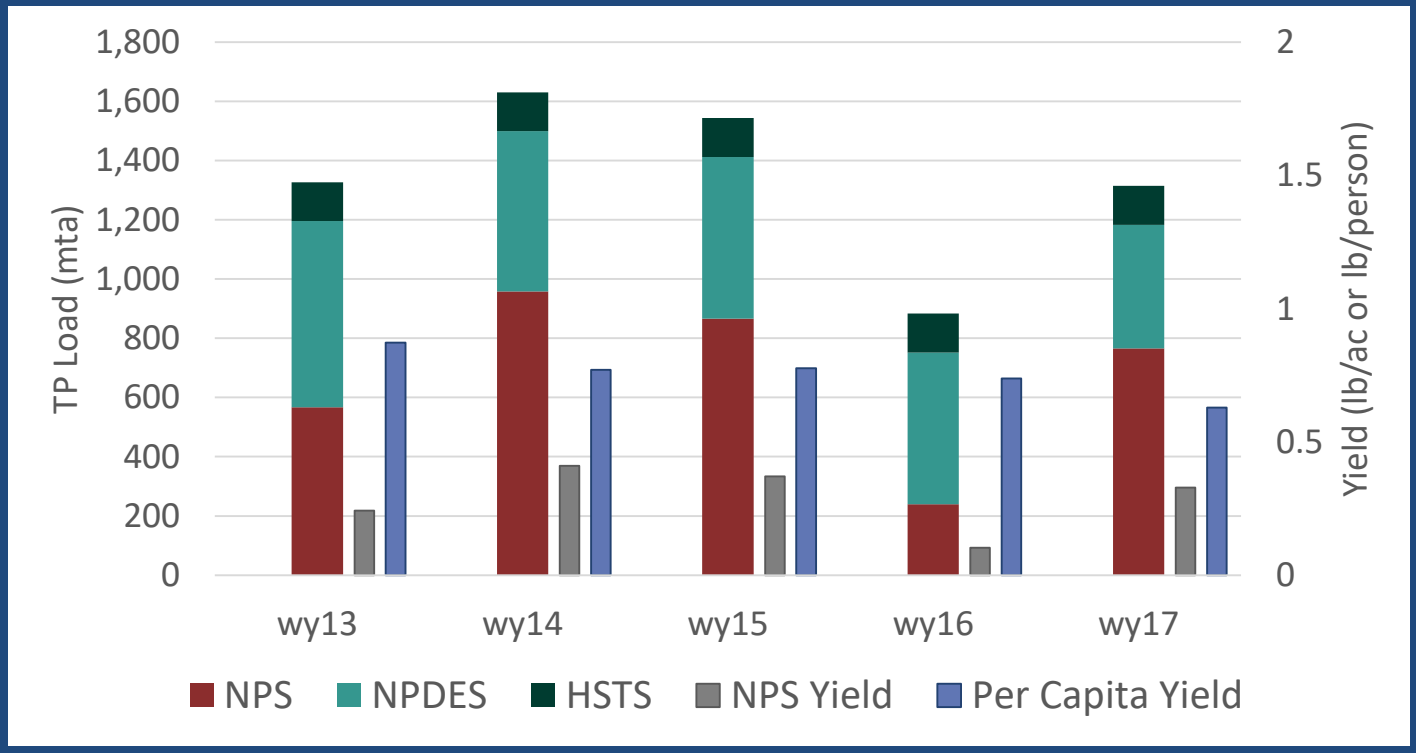
Loading Breakdown - Muskingum

Total P – by Water Year





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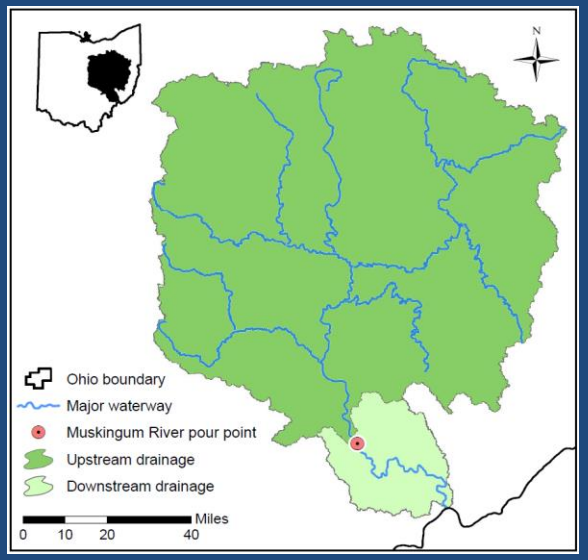
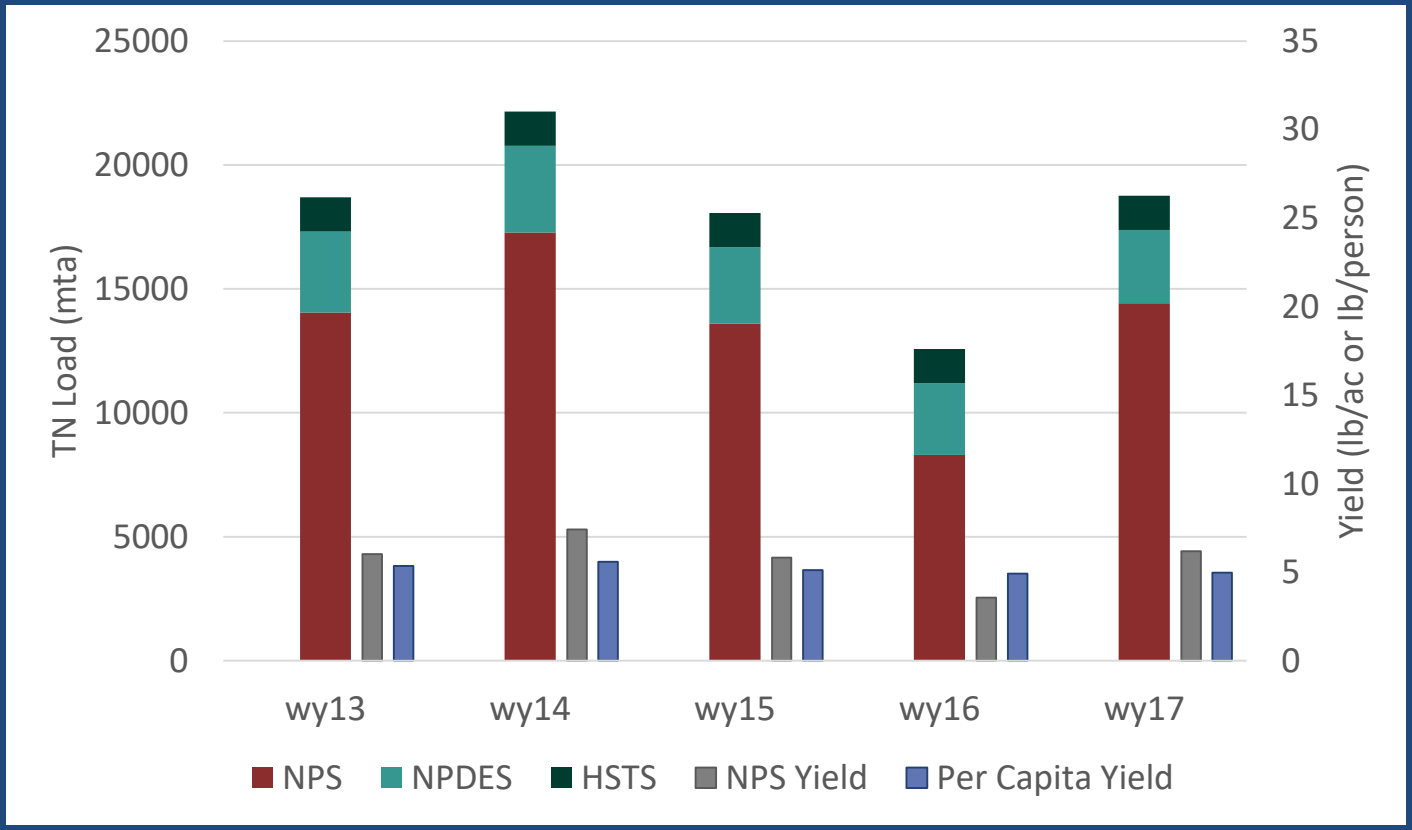
Loading Breakdown - Muskingum

Total N – by Water Year





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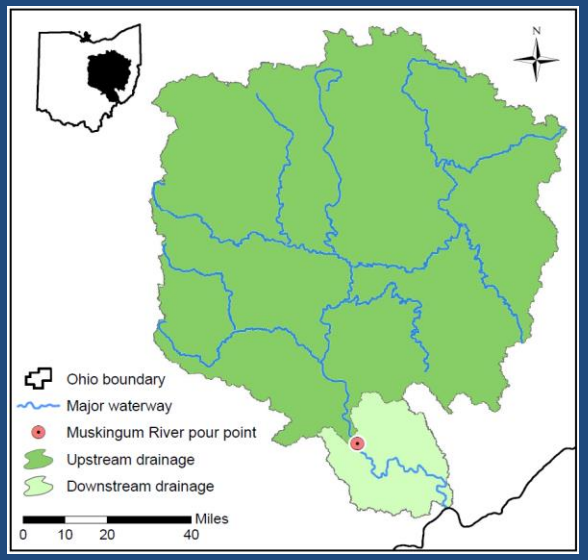

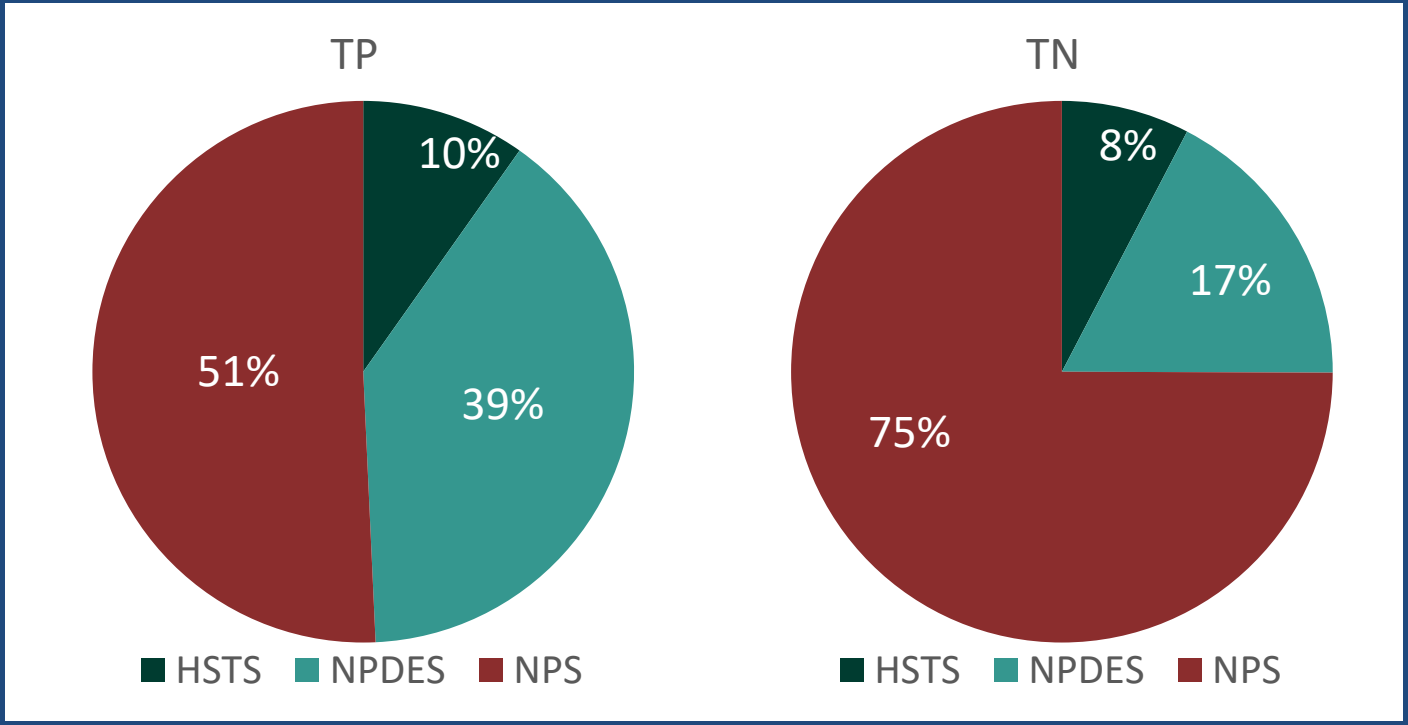

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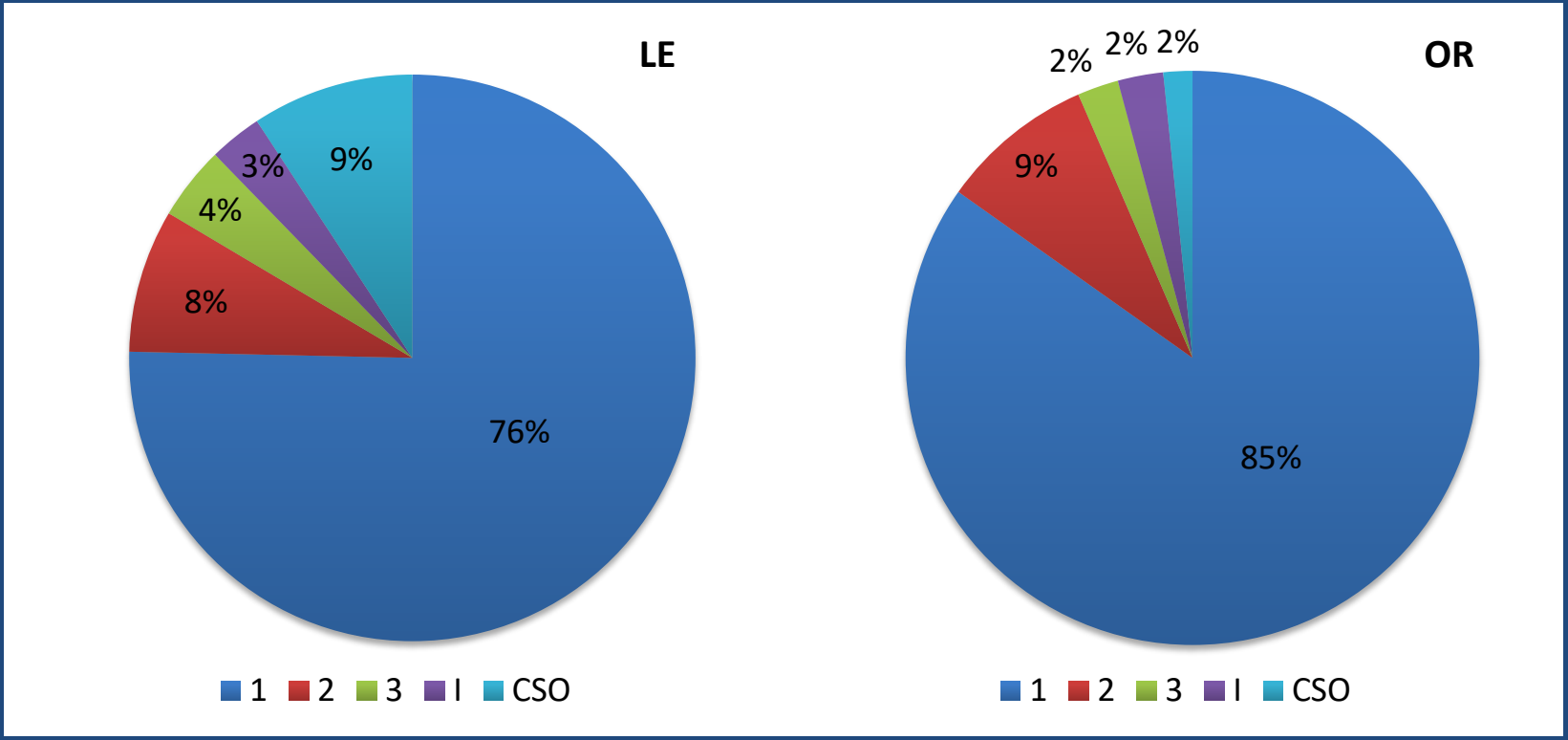
NPDES – Lake Erie vs. Ohio River Total P



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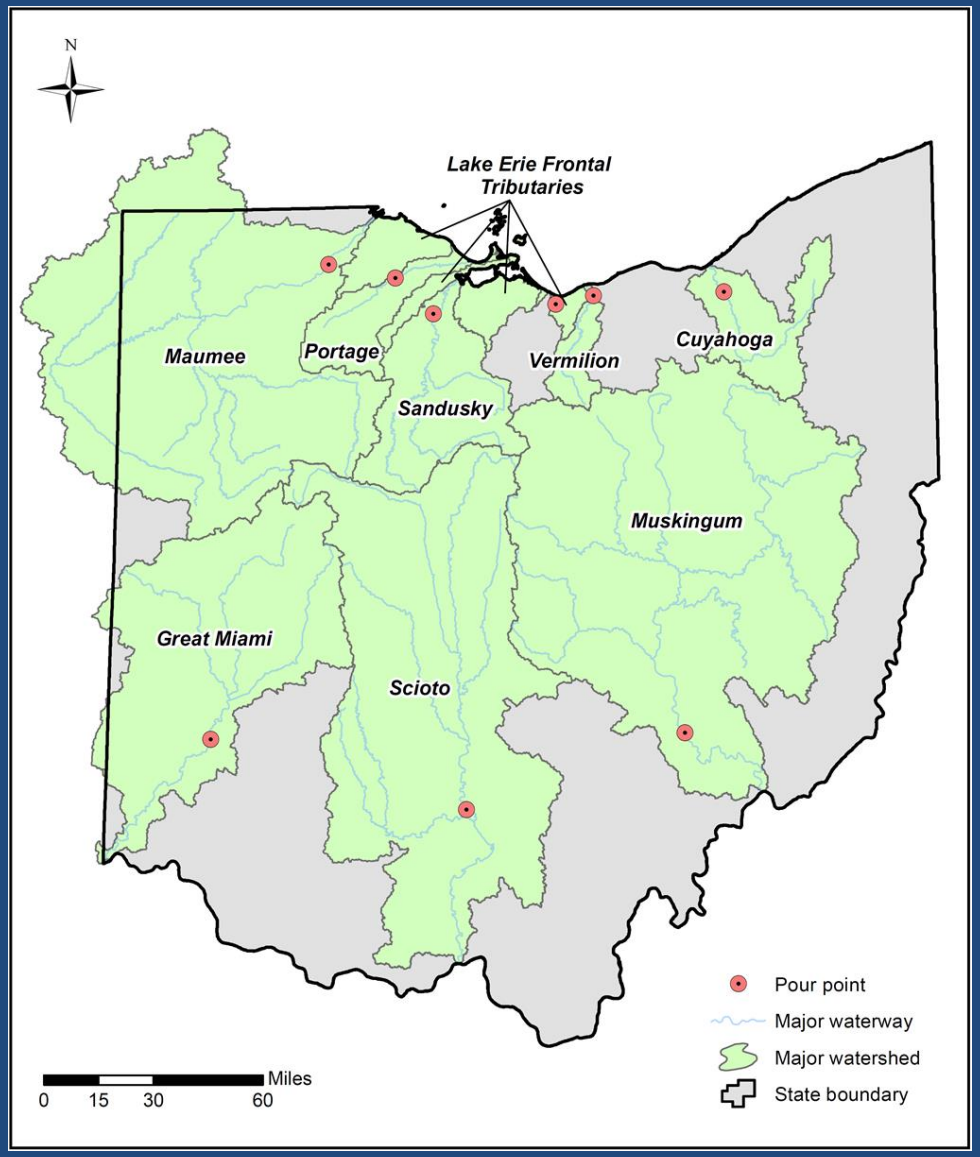
Future Work



Continue to expand the domain (Ohio) covered by mass balance calculations

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Future Work

Refine NPS load estimates

- Separate urban storm water component
- Differentiate agricultural loads by nutrient source

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Closing Note

While the report was not intended to make recommendations about how to achieve nutrient reductions, the information within could and should inform the Agency and others about the most effective ways of achieving reductions.

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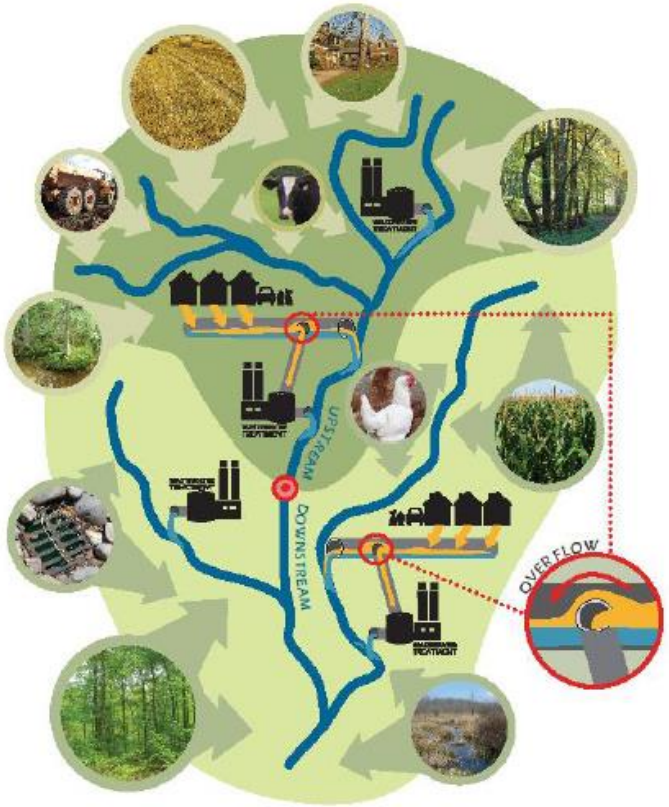
Nutrient Mass Balance Study for Ohio's Major Rivers



Questions?

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joshua.griffin@epa.ohio.gov

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