

Western Lake Erie Tributary Water Monitoring Summary

March 1, 2015 - July 31, 2015

lakeerie.ohio.gov

Why is water monitoring done, and by whom?

Federal, state, and educational institutions conduct water monitoring for a variety of reasons.

The U. S. Geological Survey (USGS), along with its federal, state, and local partners, investigates the occurrence, quantity, quality, distribution, and movement of surface and ground waters and shares data with the public and other agencies involved with managing our water resources.

Ohio EPA conducts water monitoring for Total Maximum Daily Load development and to assess trends in impairment.

ODNR is interested in protecting recreation, fish, and wildlife water uses.

Educational institutions such as Heidelberg University's National Center for Water Quality Research do water testing to answer research questions.

What do we measure?

A large number of components are measured. This summary focuses on total phosphorus, dissolved reactive phosphorus, and nitrogen in the form of nitrate (NO_2) + nitrite (NO_3).

The amount of water in the rivers is measured by USGS at their streamflow gaging stations.

Why this summary?

This summary provides a simplified overview of nutrient loads and concentrations that have been shown to be highly correlated with harmful algal blooms in Lake Erie.

Summarizing the results of these water monitoring efforts provides critical information to agencies and the public. This summary is a tool for tracking annual changes and comparisons to water quality goals established by Annex 4 of the Great Lakes Water Quality Agreement and the Western Basin of Lake Erie Collaborative Agreement.

Where is the water monitored?

Ohio EPA, ODNR, USGS, and Heidelberg University have established many sampling stations in the Lake Erie watershed. Some of these stations are in the same locations to take advantage of USGS streamflow gage locations.

The stations in Figure 1 were chosen from a larger set to indicate the nutrient contributions upstream of the lake influenced sections of the rivers. Due to its large size, several tributaries to the Maumee River were also included.

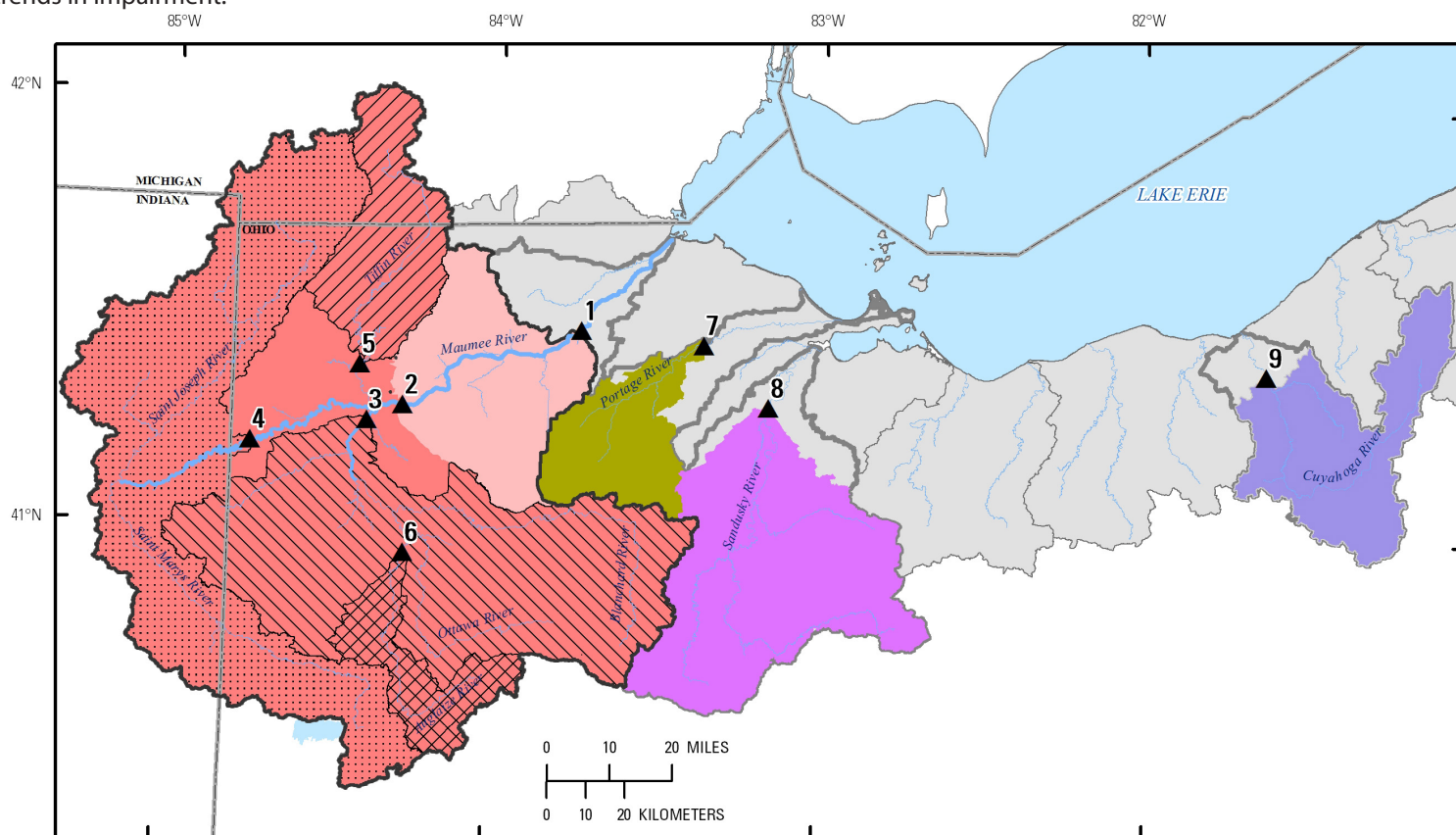


Figure 1: Sampling stations discussed in this report.

Station 1: Gage 04193500 - Maumee River at Waterville

Station 2: Gage 04192500 - Maumee River near Defiance

Station 3: Gage 04191500a - Auglaize River near Defiance d/s Dam

Station 4: Gage 04183500 - Maumee River at Antwerp

Station 5: Gage 04185318 - Tiffin River near Evansport

Station 6: Gage 04186500 - Auglaize River near Fort Jennings

Station 7: Gage 04195500 - Portage River at Woodville

Station 8: Gage 04198000 - Sandusky River near Fremont

Station 9: Gage 04208000 - Cuyahoga River at Independence

What were the nutrient levels for Spring 2015?

This set of charts compares nutrient levels at these stations for the spring months of March through July. This period is used because the Annex 4 subcommittee determined that phosphorus contributions in the spring correlate well with the occurrence of harmful algae blooms. Nitrogen is included because of its potential role in augmenting the blooms or their toxicity. The six Maumee River stations are grouped together to the left of the vertical line for ease of comparison, going roughly upstream to downstream from the left to right.

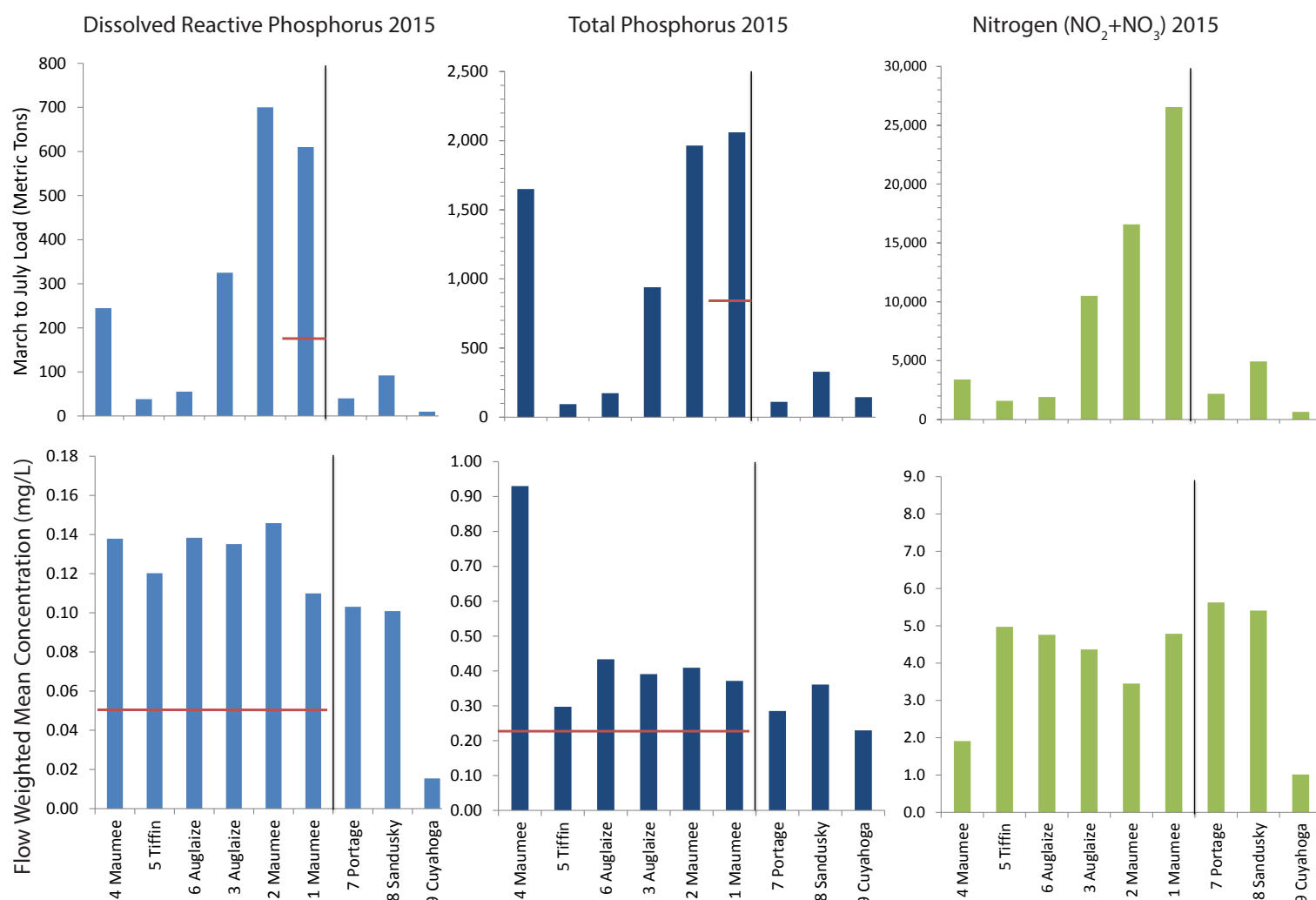


Figure 2: Side by side comparison of loads and flow weighted mean concentrations. Axis titles at bottom and left. Red lines indicate target levels at the points where they apply (not all targets are the same at all locations).

March-July Load (MT)

The three graphs across the top show that the two farthest downstream sites on the main stem of the Maumee River have the largest nutrient loads. The Portage, Sandusky, and Cuyahoga have a much lower contribution to the overall nutrient loading.

In 2015, the Annex 4 target loads were exceeded for both dissolved reactive phosphorus (228% over) and total phosphorus (139% over)

as indicated by the red lines at the Maumee River near Waterville station where the target is applied.

Flow Weighted Mean Concentration (mg/L)

Dissolved reactive phosphorus ranged from 0.11 to 0.146 milligrams/liter (mg/L) in the Maumee River, slightly higher than in the Portage and Sandusky Rivers.

Total phosphorus flow weighted mean concentrations for all sta-

tions except the Maumee at Antwerp ranged from 0.23 mg/L in the Cuyahoga River to 0.43 mg/L in the Maumee at Waterville.

The Maumee River at Antwerp had the highest flow weighted mean concentration for total phosphorus at 0.93 mg/L. This is a large subwatershed area that includes both the St. Joseph and St. Marys tributaries, and areas within Ohio, Michigan, and Indiana.

In 2015, the Annex 4 target flow weighted mean concentrations were exceeded at all Maumee River stations for both total phosphorus and dissolved reactive phosphorus. This target applies throughout the watershed.

Although the flow weighted mean concentration of nitrogen in the Maumee River at Waterville was not notably high, the volume of flow resulted in a relatively high total load.

What is Flow Weighted Mean Concentration (FWMC)?

The FWMC represents the total load for the time period divided by the total discharge for the time period. FWMC standardizes the measure of phosphorus delivery from a tributary so that year-to-year and trib-to-trib performance can be compared despite different flows.

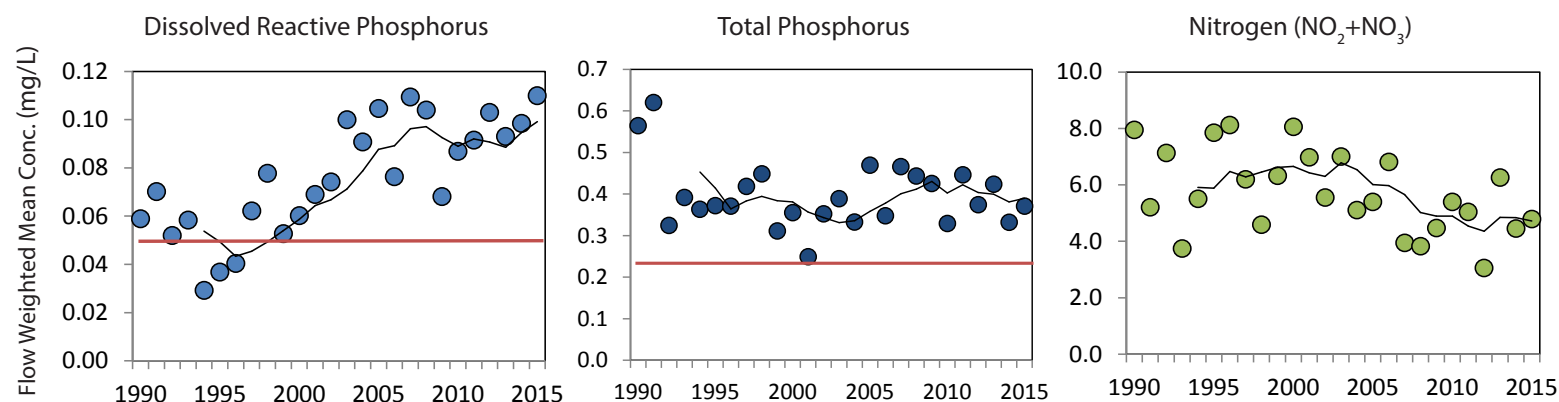


Figure 3: Annual nutrient flow weighted mean concentrations for the Maumee River at Waterville by water year. The five-year running average (black line) smooths out the annual variation and gives an indication of the trends. The red line indicates the Annex 4 target flow weighted mean concentrations.

How does 2015 compare to previous years?

Figure 3 shows that total phosphorus and nitrogen have been decreasing, and dissolved reactive phosphorus has been at about 0.09 mg/L since 2003, after increasing from its recent lows in the mid-1990s. Note that in the mid-1990s, the dissolved reactive phosphorus flow weighted mean concentrations were below the 0.05 mg/L Annex 4 target level, but more recently are nearly twice as high.

Where are the nutrients coming from?

This map shows the spatial distribution of dissolved reactive phosphorus flow weighted mean concentrations (triangles) superimposed on total phosphorus load (circles) across the nine stations. Dissolved reactive phosphorus flow weighted mean concentration was over 0.12 mg/L at all the Maumee subwatershed stations (2, 3, 4, 5, & 6), and highest in the Maumee River at Defiance: 0.146 mg/L (2). The total phosphorus load was highest on the Maumee River main stem at Waterville: 2060 metric tons (MT) (1) and also notably high on the Maumee main stem at Antwerp: 1650 MT (4). The Sandusky River at Fremont (8) had high dissolved reactive phosphorus concentrations at 0.10 mg/L, but a relatively low total phosphorus load (329 MT). The Cuyahoga River (9) had the lowest dissolved reactive phosphorus concentrations (0.01 mg/L) and a lower load (145 MT) than either the Sandusky River at Fremont (8) or Maumee River at Waterville (1). The Portage River has relatively low loadings due to its small size, but the concentration values are still higher than the target values for the Maumee.

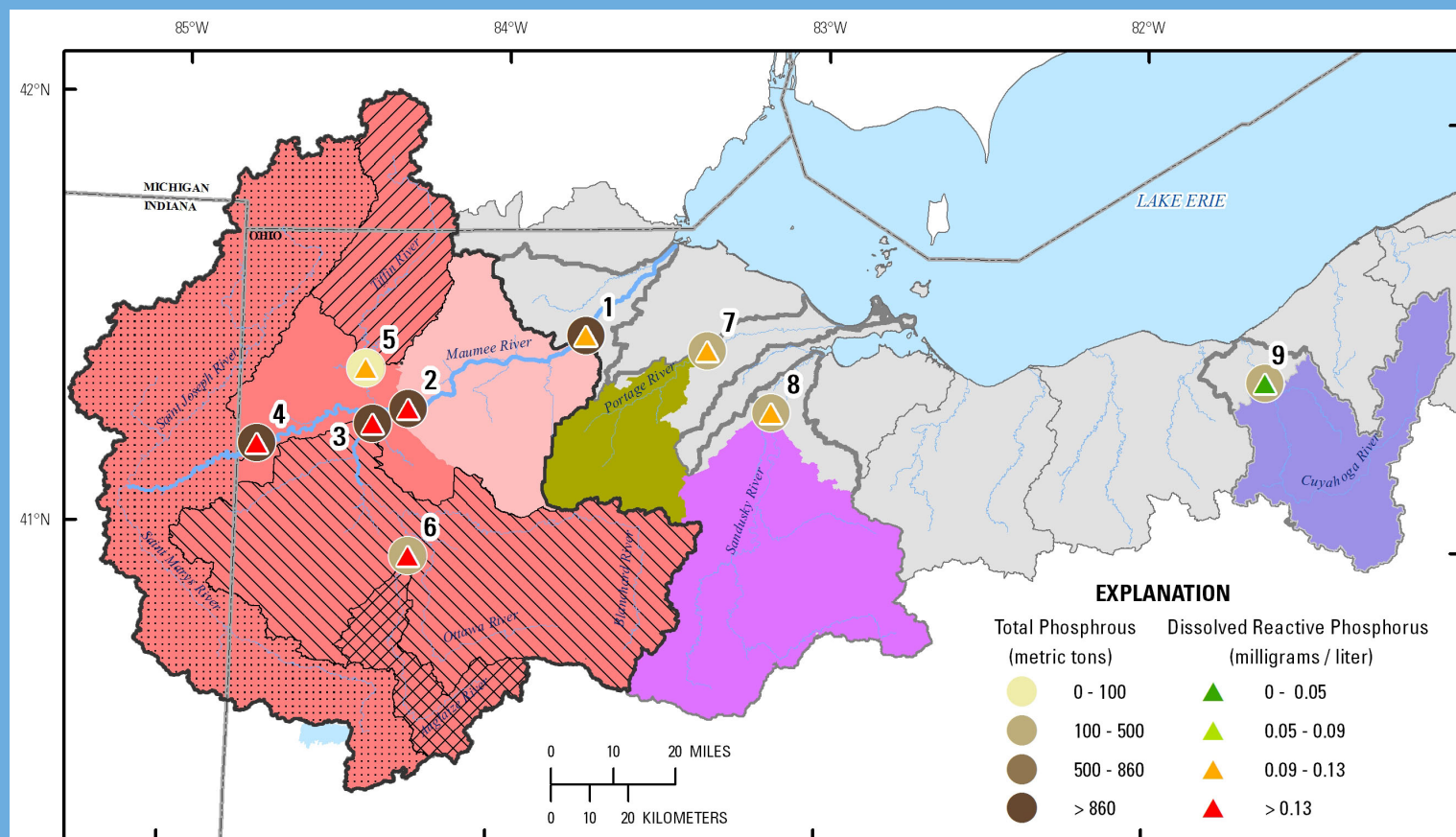


Figure 4: Phosphorus monitoring in the Lake Erie watershed. Data from March 1, 2015 - July 31, 2015.

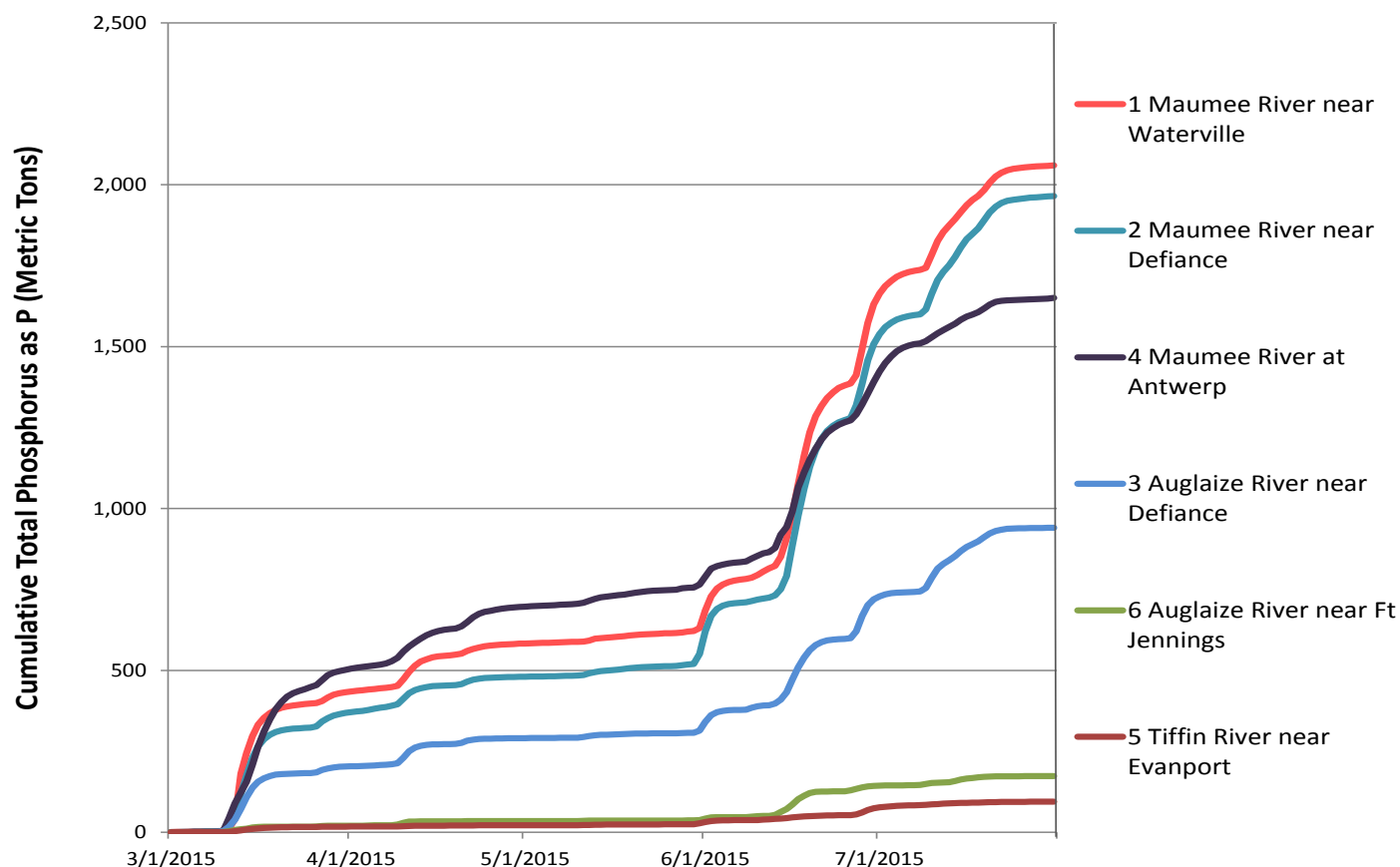


Figure 5: Cumulative total phosphorus loads at monitoring stations in the Maumee River watershed.

When does total phosphorus enter the rivers?

This graph shows a comparison of the cumulative load of total phosphorus at each of the Maumee River stations for March 1 to July 31, 2015. It is apparent that total phosphorus moves through the system closely coupled to the timing of rainfall in the spring.

Each day, the water carries additional load past the monitoring station which is summed to create the running cumulative total. When the amount of water moving through the river

network increases dramatically due to rainfall, the load increases, as can be seen by the large jumps on the figure in mid-June and early July.

In 2015, unusually heavy rains in June and July increased the total phosphorus load in the Maumee River at Waterville above the 860 MT Annex 4 target load by early summer. The final total was over 2000 MT, more than two times the target.

The Maumee River at Antwerp (4) and the Auglaize River near

Defiance (3) are similar sized watersheds and usually have similar flow amounts. In 2015, the total phosphorus concentration in the Maumee River at Antwerp was much higher than in the Auglaize River near Defiance, so the total load was higher. From this chart, it is apparent that rainfall in March resulted in a higher cumulative total in the early part of the season for the Maumee River at Antwerp. This may be due to the pattern of rainfall across

the watershed area, and/or the timing relative to agricultural activities in the spring.

Note that the total load in the Maumee River at Waterville is not a simple sum of the loads from the five upstream stations. Transport is not instant. This may, for example, be due to particulates settling out along the way.

How wet was spring 2015 in comparison to spring in the target year of 2008?

The amount of flow for the period is a major factor influencing how much phosphorus and nitrogen moves down the river into the lake as runoff. For the period March 1-July 31, 2015, flow in the Maumee River at Waterville was 5.5 km³. By comparison, flow for March 1-July 31, 2008 (base year for the target loads and concentrations, and selected because it represented a wet year) was 3.76 km³. Flows at this station for these months for the period 2000-2014 averaged 2.93 km³. So, 2015 was much wetter than a recent typical year.

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