Western Lake Erie Tributary Water Monitoring Summary

March 1, 2017 - July 31, 2017

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.

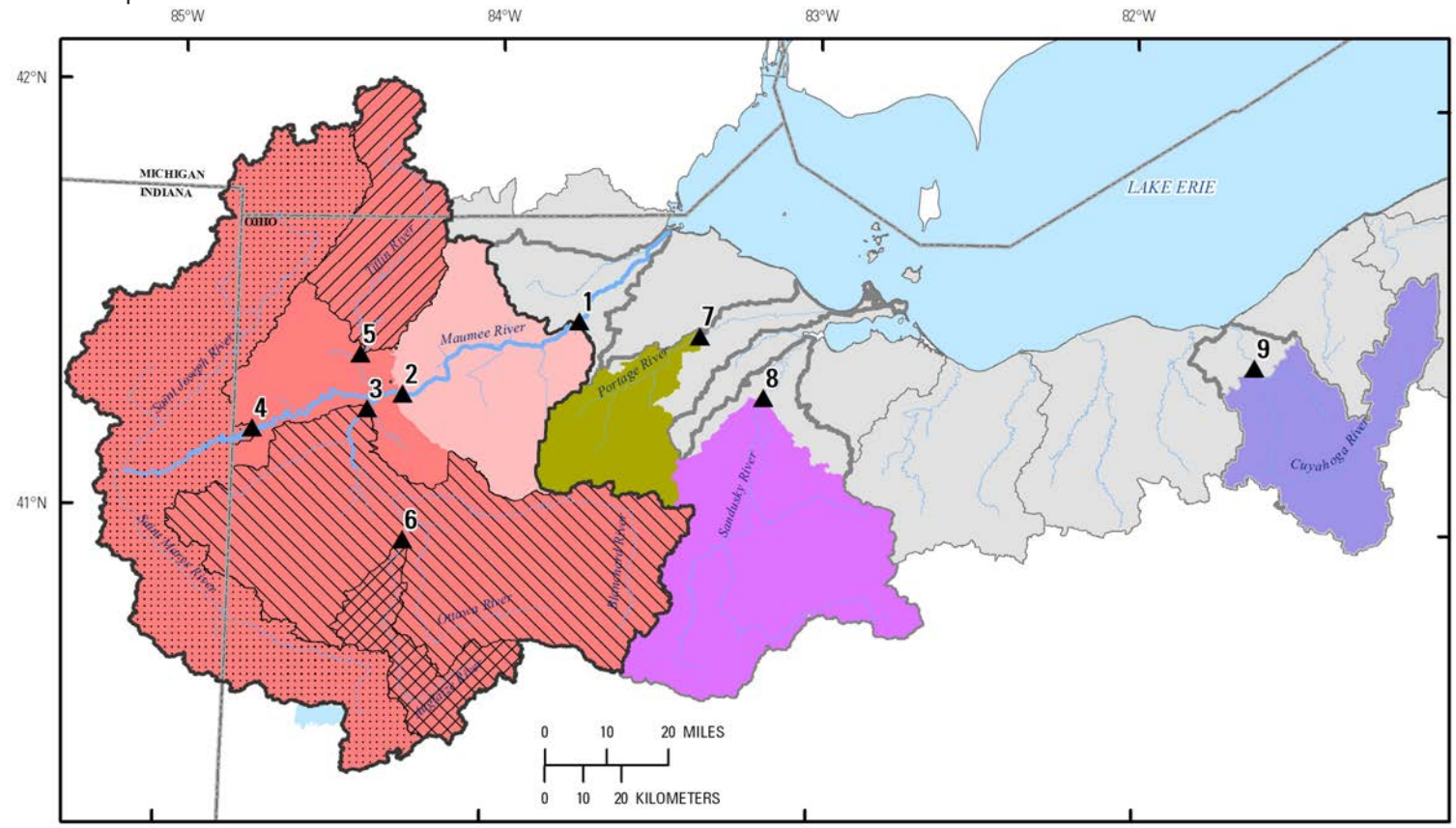

Figure 1: Sampling stations discussed in this report.

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 2017?

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.

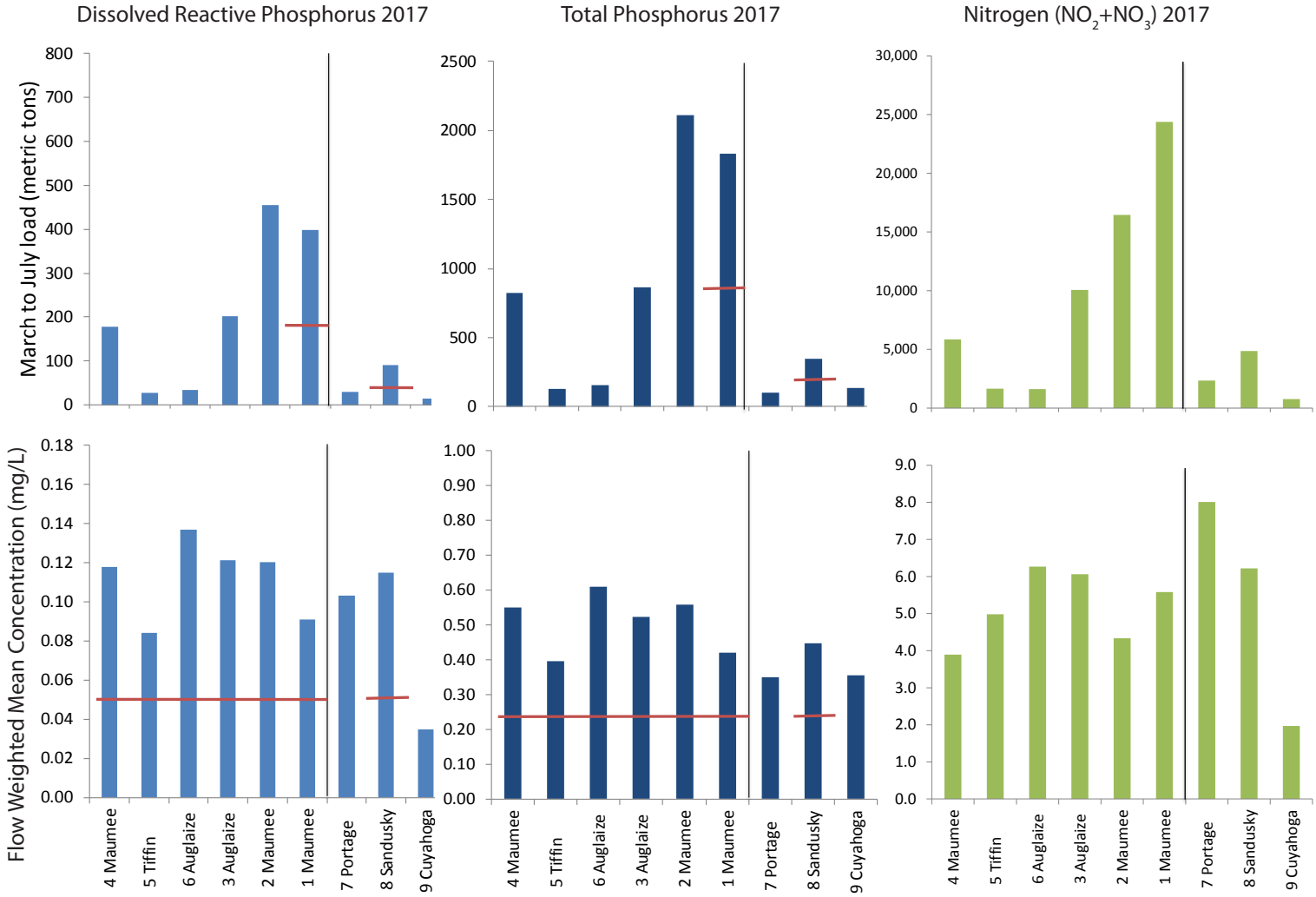

Figure 2: Side by side comparison of loads and flow weighted mean concentrations. Axis titles at bottom and left. Red lines indicate target levels at the points where they apply (not all targets are the same at all locations).

March-July Load (MT)

The loading 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 Rivers have a much lower contribution to the overall nutrient loading.

Within the Maumee River, the smaller watersheds of the Tiffin and upper Auglaize River also have relatively low loads.

In 2017, the Annex 4 target loads were exceeded for both dissolved reactive phosphorus and total phosphorus (more than double for each) as indicated by the red lines at the Maumee River near Waterville station where the target is applied. The Sandusky River load targets were also exceeded.

There are no targets for nitrogen, but the pattern of sources of loading is similar because it is also influenced by the amount of flow.

Flow Weighted Mean Concentration (mg/L)

The corresponding concentration graphs are shown across the bottom. Dissolved reactive phosphorus concentrations ranged from 0.084 to 0.137 milligrams/liter (mg/L) in the Maumee, Portage, and Sandusky Rivers.

Total phosphorus flow weighted mean concentrations for all stations ranged from 0.36 mg/L in the Cuyahoga River to 0.61 mg/L in the Auglaize at Fort Jennings.

In 2017, the Annex 4 target flow weighted mean concentrations were exceeded at all stations for both total phosphorus and dissolved reactive phosphorus. This target applies throughout the Maumee River watershed and for the Sandusky River.

The Portage River had the highest flow weighted mean concentration of nitrogen.

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.

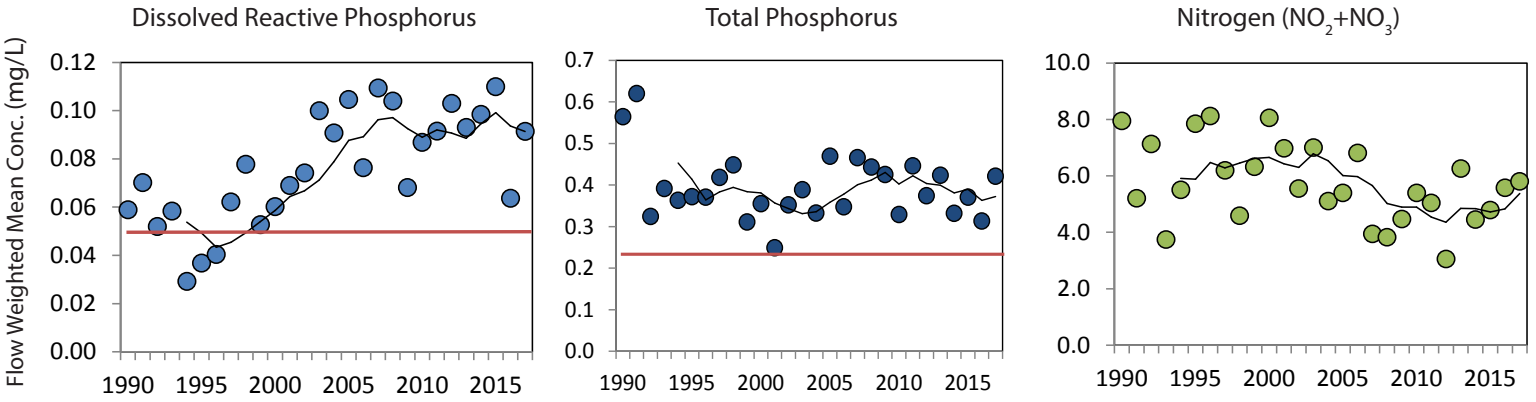

Figure 3: Annual nutrient flow weighted mean concentrations for the Maumee River at Waterville by water year. The five-year running average (black line) smooths out annual variation and shows trends. The red line is the Annex 4 target flow weighted mean concentrations.

How does 2017 compare to previous years?

Figure 3 shows that total phosphorus decreased from its high levels in the early 1990s, but have been about the same at around 0.4 mg/L since. 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. Nitrogen levels seem to have increased slightly the last two years but are still lower than the averages in the 1990s.

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 was highest in the Auglaize River at Ft. Jennings: 0.14 mg/L (6), but the total phosphorus load was highest on the Maumee River main stem at Defiance (2): 2112 MT and at Waterville (1): 1833 MT. The Sandusky River at Fremont (8) and the Portage River at Woodville (7) had slightly higher dissolved reactive phosphorus concentrations: 0.1 mg/L, than the Maumee at Waterville (1): 0.09 mg/L, but much lower total phosphorus loads at 350 MT and 102 MT respectively. Within the Maumee River watershed, the Tiffin River near Evansport (5) had both the lowest dissolved reactive phosphorus levels at 0.08 mg/L and the lowest total phosphorus load at 131 MT. The Cuyahoga River (9) had the lowest dissolved reactive phosphorus concentrations (0.035 mg/L) and a low total phosphorus load (138 MT).

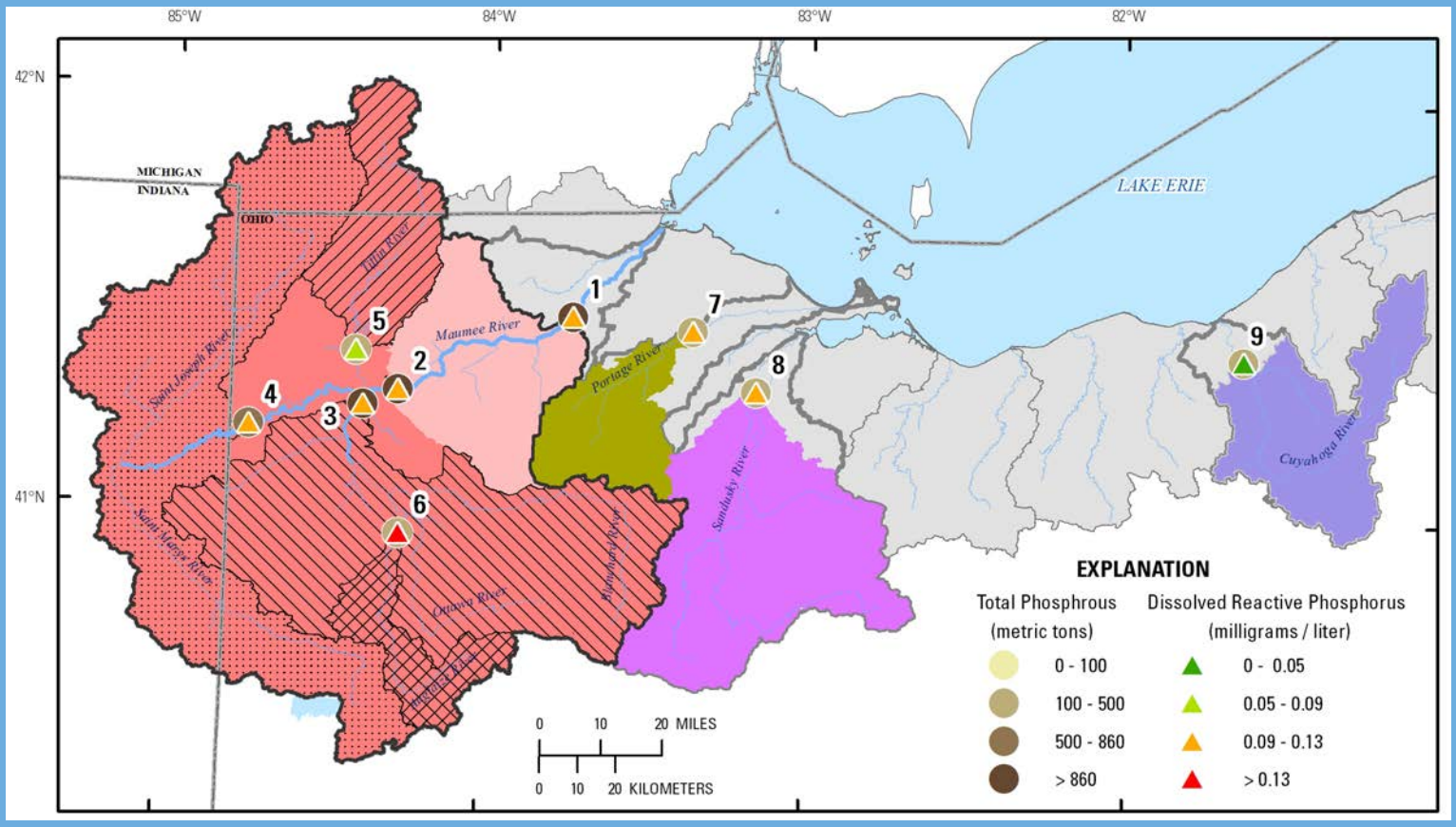

Figure 4: Phosphorus monitoring in the Lake Erie watershed. Data from March 1, 2017 - July 31, 2017.

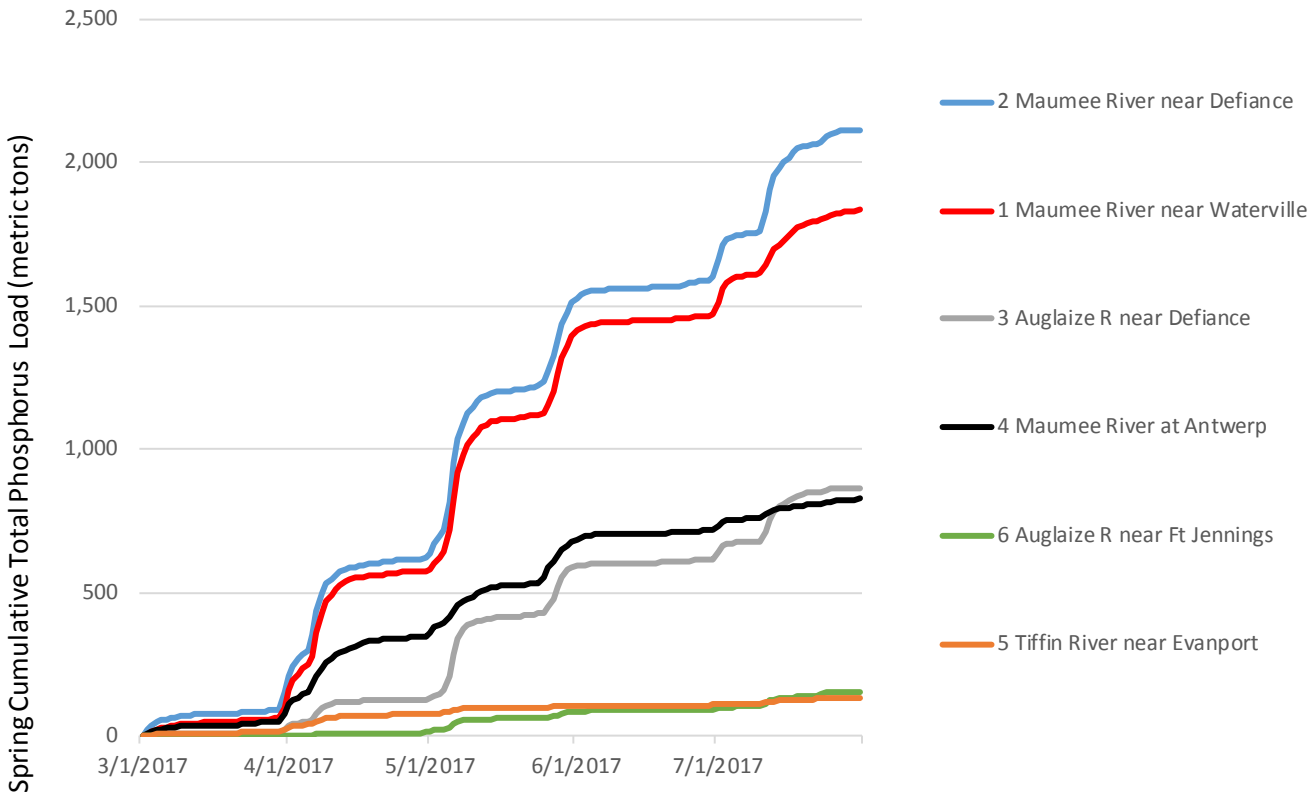

Figure 5: Cumulative total phosphorus loads at monitoring stations in the Maumee River watershed.

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, 2017. Each day, the water carries more load past the monitoring station which is summed to create the running cumulative total. When the amount of water moving through the river increases due to rainfall, the load increases.

Total phosphorus movement through the system is closely coupled to the timing of rainfall in the spring, as shown by the jumps on the figure in April and May. In 2017, rains in March and April increased the total phosphorus load in the Maumee River at Waterville (1) above the 860 MT Annex 4 target load early in May. More rainfall in May and July led to a final total over 1800 MT, slightly more than twice as high as 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 2017, the total phosphorus load in the Maumee River at Antwerp ended the spring lower than in the Auglaize River near Defiance, which had a late rain event.

The Tiffin River near Evanport (5) and the Auglaize River near Ft Jennings are also similar size watersheds and had similar, and relatively low, loadings.

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 2017 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, 2017, flow in the Maumee River at Waterville was 4.37 km^3. 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 km^3. Flows at this station for these months for the period 2000-2016 averaged 3.06 km^3. So, flow in 2017 was both wetter than the target year - about 16% greater than the amount of flow recorded in 2008 - and wetter than the recent past average.

Concentration and Loading information can be accessed at http://arcg.is/21i9CUF (USGS) and https://ncwqr.org/ (Heidelberg).

A publication of the Ohio Lake Erie Commission with the assistance of the following partners:

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USGS science for a changing world

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