Western Lake Erie Tributary Water Monitoring Summary

March 1, 2016 - July 31, 2016

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.

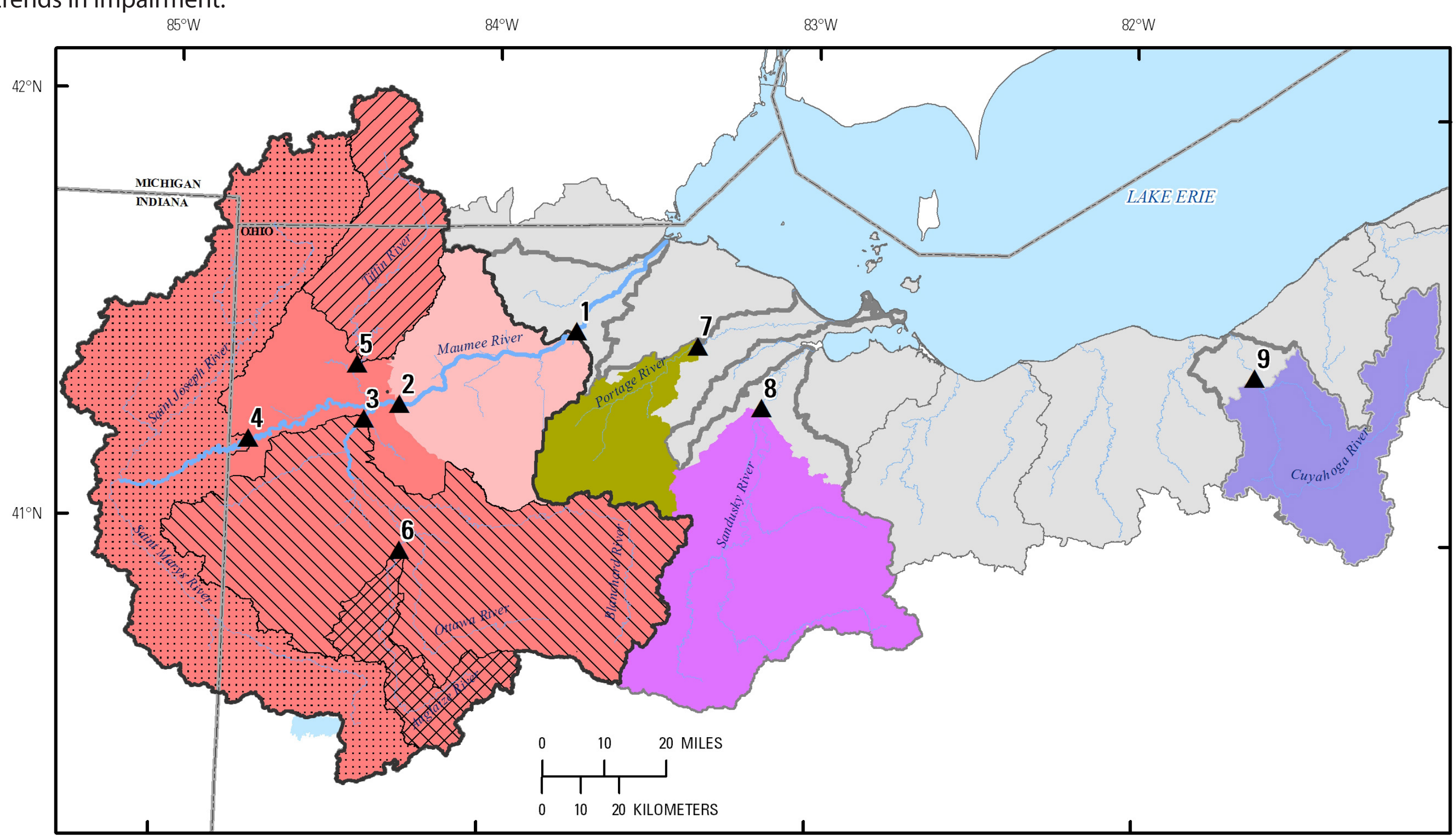

Figure 1: Sampling stations discussed in this report.

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 2016?

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.

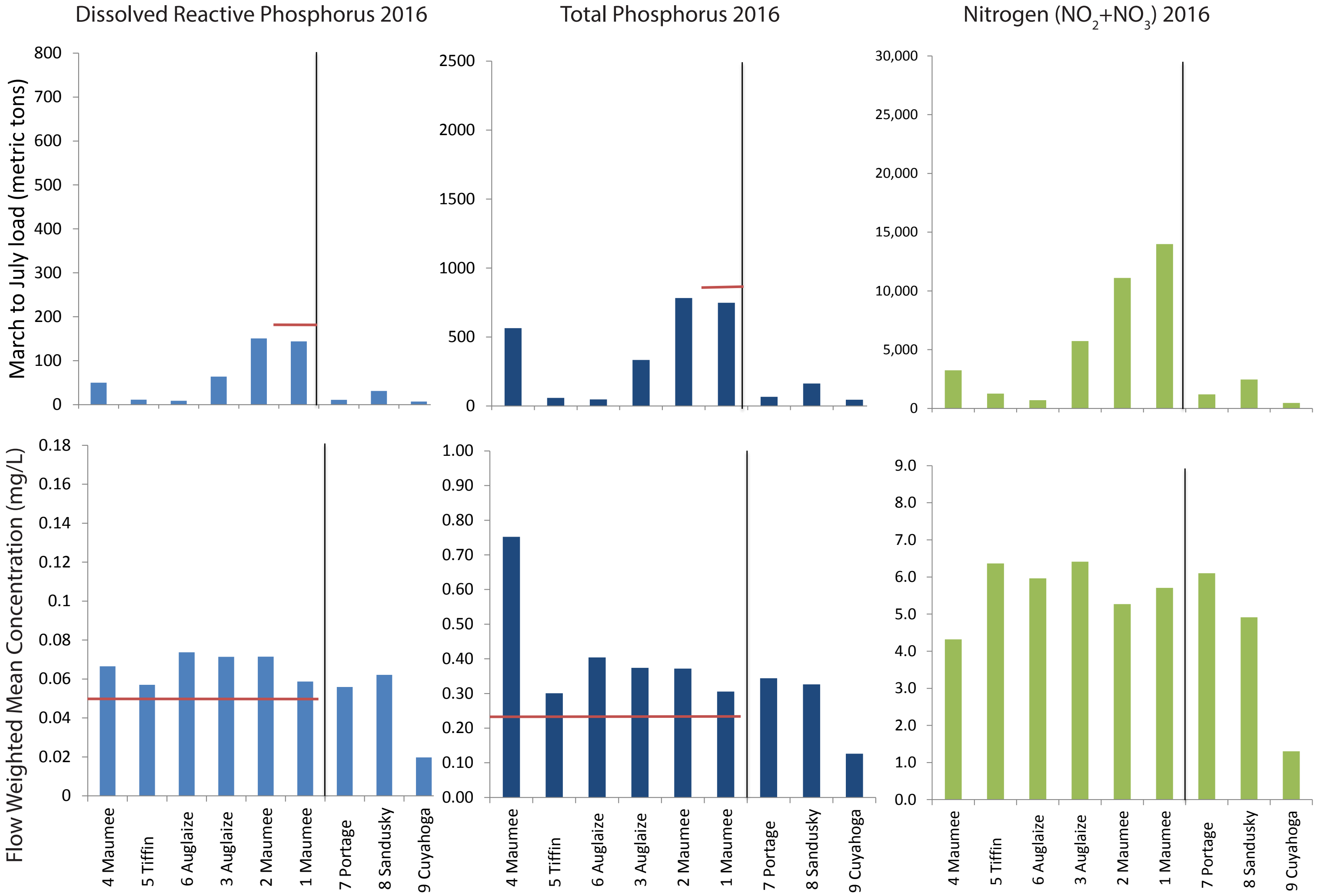

Figure 2: Side by side comparison of loads and flow weighted mean concentrations. Axis titles at bottom and left. Red lines indicate target levels at the points where they apply (not all targets are the same at all locations).

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 2016, the Annex 4 target loads were met for both dissolved reactive phosphorus and total phosphorus 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 0.056 to 0.074 milligrams/liter (mg/L) in the Maumee, Portage, and Sandusky Rivers.

Total phosphorus flow weighted mean concentrations for all stations except the Maumee at Antwerp ranged from 0.13 mg/L in the Cuyahoga River to 0.40 mg/L in the Auglaize at Fort Jennings.

The Maumee River at Antwerp had the highest flow weighted mean concentration for total phosphorus at 0.75 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 2016, despite meeting the load targets, 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.

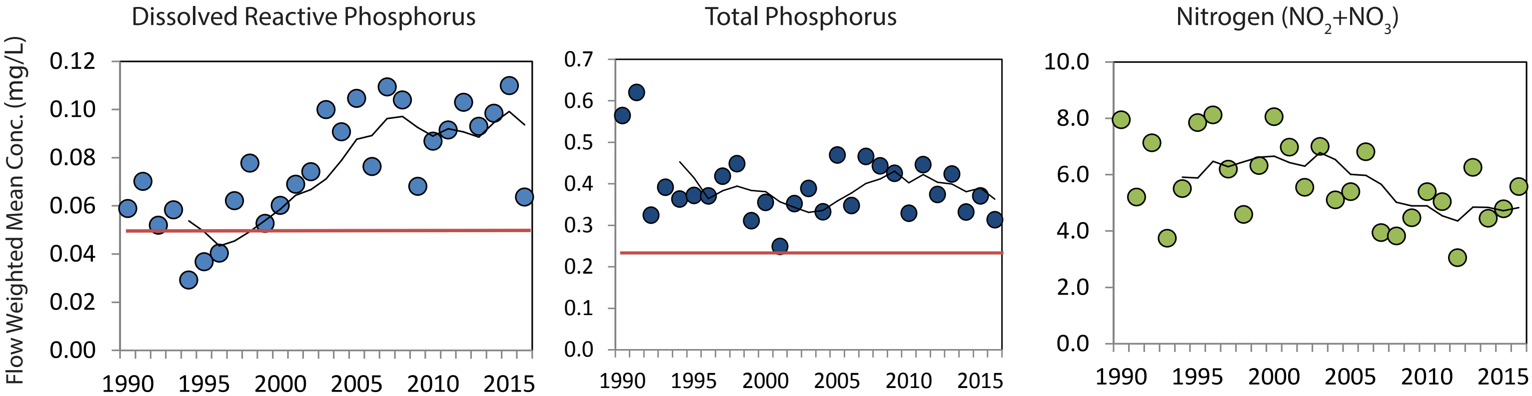

Figure 3: Annual nutrient flow weighted mean concentrations for the Maumee River at Waterville by water year. The five-year running average (black line) smooths out annual variation and shows trends. The red line is the Annex 4 target flow weighted mean concentrations.

How does 2016 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. **The dry spring of 2016 led to much lower dissolved reactive phosphorus flow weighted mean concentrations for the year as a whole, and total phosphorus was also lower, but the targets were still not met.** Nitrogen levels were about the same as they have been.

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 very similar at all the Maumee subwatershed stations (2, 3, 4, 5, & 6), between 0.06-0.07 mg/L, and were also in this range at the Portage (7) and Sandusky (8). The total phosphorus load was highest on the Maumee River main stem at Defiance: 783 metric tons (MT) (2) and just a little less on the Maumee main stem at Waterville: 749 MT (1). The Sandusky River at Fremont (8) had a relatively low total phosphorus load (163 MT). The Cuyahoga River (9) had the lowest dissolved reactive phosphorus concentrations (0.02 mg/L) and the lowest load (45 MT) of all tributaries. The Portage River has relatively low total phosphorus loadings due to its small size (67 MT), but the dissolved reactive phosphorus concentration values (0.056 mg/L) were still just a little higher than the target value for the Maumee River (0.05 mg/L).

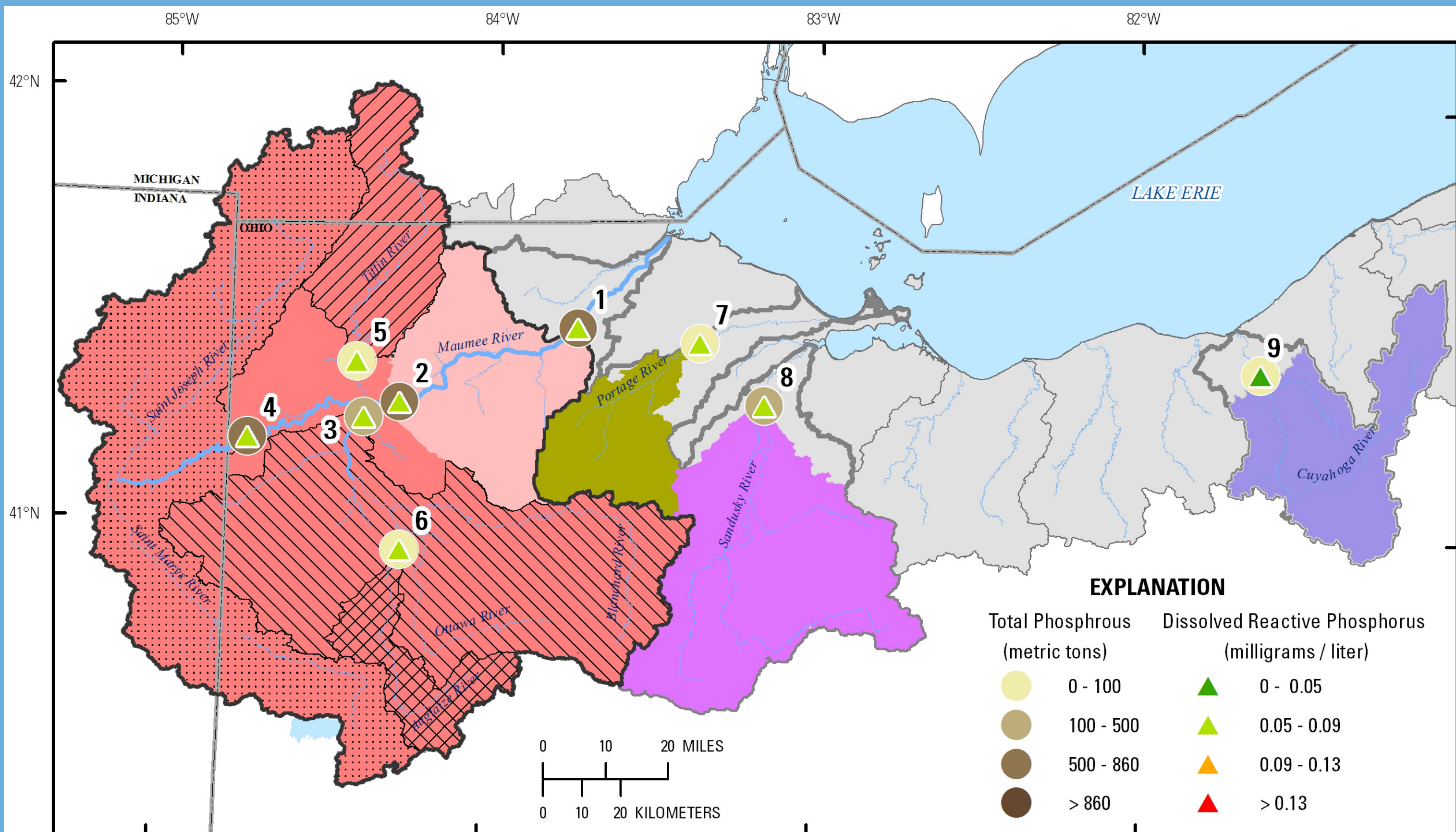

Figure 4: Phosphorus monitoring in the Lake Erie watershed. Data from March 1, 2016 - July 31, 2016.

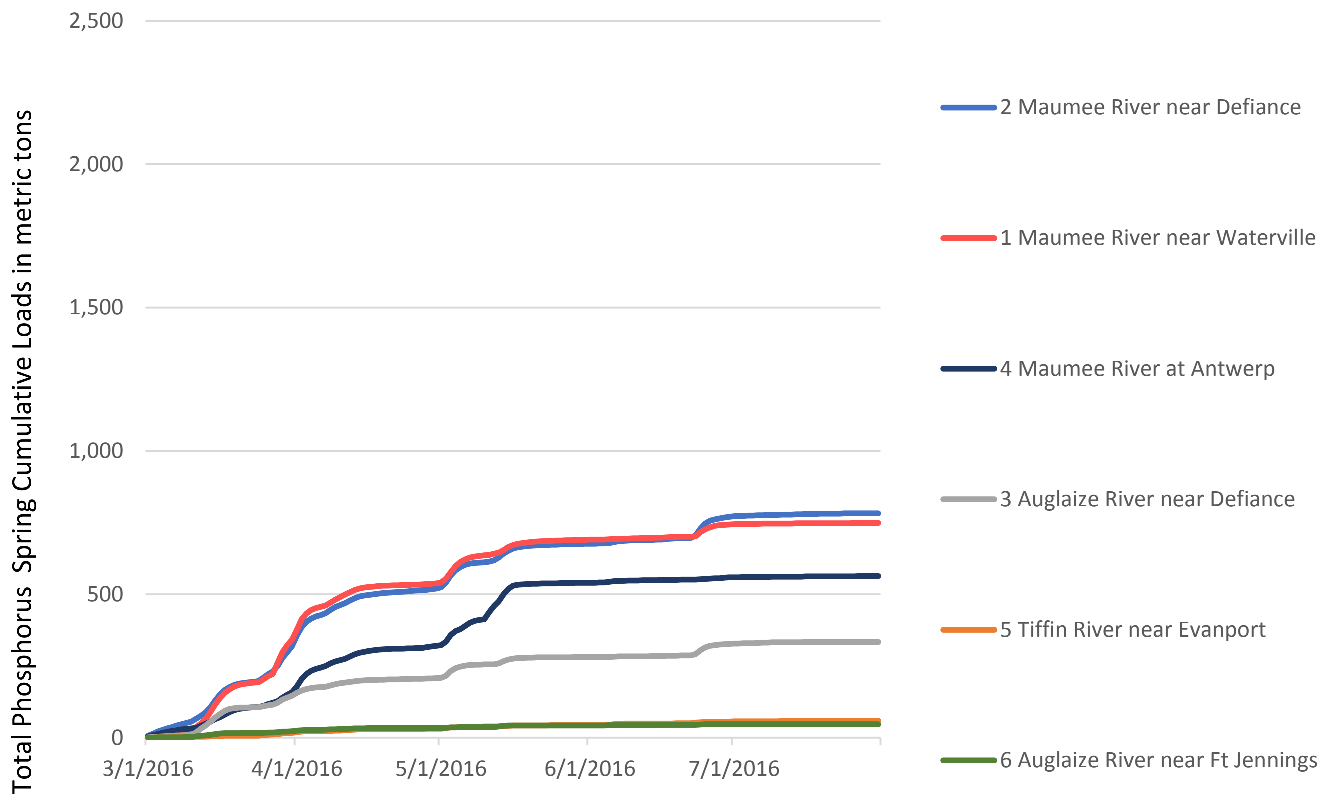

Figure 5: Cumulative total phosphorus loads at monitoring stations in the Maumee River watershed.

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, 2016. 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 2016, rainfall was lower in the spring than it has been in recent years, although the effect of rain events can still be seen.

The load increased gradually during spring and the final total phosphorus load in the Maumee River near Waterville (1) was 749 MT, about 87% of the Annex 4 target load of 860 MT.

The Maumee River at Antwerp (4) and the Auglaize River near Defiance (3) are similar sized watersheds and usually have similar flow amounts. In 2016, the total phosphorus concentration in the Maumee River at Antwerp was higher than in the Auglaize River near Defiance, so the summed load was higher.

Rainfall in April and May resulted in a higher cumulative load 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.

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 2016 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, 2016, flow in the Maumee River at Waterville was 2.49 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 2016 was both less than the target year - only about 65% of the amount of flow recorded in 2008 - and lower than the recent past average.

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

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National Center for Water Quality Research, Heidelberg University