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Nutrient enrichment in the Lower Great Miami River -

Municipal coalition seeking clarity

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The Lower Great Miami River (LGMR) watershed in Southwest Ohio is a beautiful place to live and work. The Great Miami River, which drains the watershed, is enjoyed by thousands of people each year – from fishermen to rowers to bird watchers. The underlying Great Miami River Buried Valley Aquifer, which provides drinking water to close to 2 million people, is a natural asset without equal in the area. To say the region is blessed with water resources may be an understatement. However, despite great improvements in river water quality and wildlife over the past fifty years, concerns remain over the health of the river. Most notably, nutrient enrichment of the river is now arguably the biggest challenge to the long-term wellness of this vital resource.

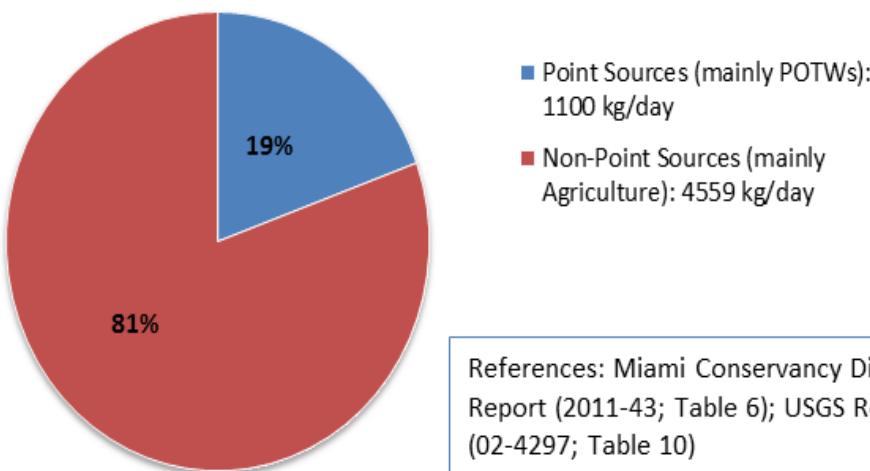
Nutrient enrichment, which is caused by too much nitrogen and phosphorus in the water, can lead to harmful algal blooms, oxygen depletion, degraded biological communities, non-attainment of State water quality standards, and other environmental problems. While nutrient enrichment is often associated with lakes, it is also a problem for free-flowing rivers. As such, from 2010 through 2012 the Ohio Environmental Protection Agency (Ohio EPA) performed monitoring on the LGMR and its tributaries in an attempt to quantify the impact of nutrient enrichment on water quality. As predicted, Ohio EPA found that nutrients do threaten the river system, and that nutrient reduction efforts are necessary to ensure the integrity of the resource.

In light of these findings, Ohio EPA in 2013 began informing Publicly Owned Treatment Works (POTWs) discharging into the LGMR that upcoming NPDES permits – set to expire in 2014 – would likely contain effluent limits for phosphorus. Ohio EPA concluded that reducing phosphorus discharges from local wastewater treatment plants would help reduce nutrient enrichment impacts on the river. In an effort to share information and discuss ramifications of new phosphorus limits, including cost and rate implications, of new phosphorus limits, a diverse group of over 15 impacted wastewater treatment plant operators from north of Dayton to the

Ohio River began to meet regularly – thus the unofficial birth of the “LGMR POTW Coalition”. These meetings were initially spearheaded by Montgomery County and the City of Dayton – de facto leaders within the group as the largest POTWs operating in the LGMR. Dayton in particular was well-versed on nutrient concerns as a ‘Founding Member’ in the Great Miami River Nutrient Trading Pilot Program – a voluntary and State-endorsed program that for over a decade had helped to fund and implement agricultural best management practices to reduce nutrient pollution within the watershed as an alternate to end-of-pipe treatment upgrades at wastewater plants. Dave Wilson, former Water Reclamation Manager for the City of Dayton, recalls: “There was a lot going on at the time – the State’s Nutrient Reduction Strategy was just released, the Technical Advisory Group (TAG) was working with Ohio EPA on new Ohio standards for nutrients, the TMDL for our River was under development, and Ohio EPA was telling many of us local plants to expect phosphorus limits. We got everyone together so we could all be updated on the status of these things. We needed to be educated so that we could act in the best interest of both our rate payers and the local water environment.”

One of the main concerns of the Coalition from the start was that Ohio EPA was suggesting the inclusion of phosphorus limits in NPDES permits prior to the completion and release of the Total Maximum Daily Load (TMDL) study and associated “pollution diet” for the LGMR. Ohio EPA was having problems getting the TMDL water quality model to calibrate, resulting

Sources of Total Phosphorus to the Great Miami River watershed, near Fairfield



in the postponement of the study's release. In an effort to address this and other concerns, the Coalition invited Ohio EPA to a round-table meeting in October 2013. At the meeting Ohio EPA presented evidence from recent monitoring efforts indicating that nutrient enrichment in the River during dry-weather / low-flow conditions was caused and sustained primarily by phosphorus loads from POTWs. Ohio EPA also discussed the sources of wet-weather nutrient loadings – namely non-point sources from agricultural activities – and their associated impacts downstream including contributions to the “dead zone” in the Gulf of Mexico (also known as Gulf Hypoxia). Ohio EPA suggested that it would focus first on the dry-weather issues and local nutrient enrichment impacts, and address wet-weather issues at a future time. Accordingly, the Agency stated that it would concentrate initially on local wastewater treatment plants. Ohio EPA verbally indicated that upcoming NPDES permits would be issued in advance of the TMDL, and would include:

- ◆ Year-round concentration-based phosphorus limits (1 mg/l) with a 3 year schedule for compliance, with the potential for more stringent limits in subsequent permits; and
- ◆ No allowance to use point to non-point nutrient trading to secure compliance.

In April 2014 a follow up meeting was held between Ohio EPA and the LGMR POTW Coalition. At that meeting representatives from the Coalition made the following points to Ohio EPA:

- ◆ Despite concerns of nutrient enrichment threatening the health of the River, the LGMR has shown steady improvement over the past 25 years in terms of attainment of state water quality standards, especially biological criteria;
- ◆ In light of the improving conditions in the River, the Coalition desired completion of the TMDL and the study's prescribed allocations of pollutants before new phosphorus limits were incorporated into NPDES permits;
- ◆ If the final and approved TMDL ultimately supported effluent phosphorus limits, the Coalition desired seasonal and mass-based limits (versus year round concentration-based limits) to address impairment under dry-weather conditions; and
- ◆ The Coalition supported the use of all compliance tools, including nutrient trading, to meet terms and conditions of NPDES permits.

The Coalition also suggested that Ohio EPA's proposed approach to focus primarily on point sources of nutrients in the watershed was short-sighted, as over 80% of the annual total phosphorus load to the watershed originates from non-point sources – namely farming activities. (See figure 1 for breakdown of nutrient sources to the Great Miami River) The Coalition suggested that the impacts of non-point source phosphorus loads – and especially the dynamics of nutrient transport into and out of sediment during low-flow conditions – should be better understood before regulatory decisions were made forcing point sources like POTWs to invest in multi-million dollar plant upgrades

to reduce phosphorus levels. Kevin Krejny, Assistant Water Reclamation Manager for Montgomery County, recalls: “It was important to the group to have the TMDL completed first – before new permit limits. We wanted the science and data validated. Once validated, the science would drive the policy and regulatory decisions – including necessary permit changes. The group was not opposed to upgrading its treatment plants to better control phosphorus, but wanted assurances that any required upgrades would in fact lead to improvements in water quality.”

Throughout the summer and fall of 2014, Coalition members and Ohio EPA representatives continued to discuss the issues. Ohio EPA continued to make a case for year-round, concentration-based phosphorus limits for all LGMR dischargers as a means of reducing the negative effects of nutrient enrichment during low-flow conditions, while the Coalition continued to push for more scientific analysis of the watershed and examination of the impacts of non-point sources of nutrients on water quality before permit modifications. Despite the fact that all the NPDES permits had expired at this point and there were still major disagreements between both groups relative to a best path forward, all those involved continued to engage in meaningful dialogue on the issues.

One of the ideas proposed through this dialogue was an offer by the Coalition to fund an independent, Ohio EPA-endorsed water quality study of the LGMR and an associated nutrient management plan. The objectives of the effort were to develop a refined and calibrated water quality model to augment Ohio EPA's data and help Ohio EPA finalize the TMDL, and develop a sequenced adaptive management approach looking at all watershed-based solutions to reduce nutrient impairment in the River. The Coalition offered to fund this effort – at a cost of up to \$500,000 – in exchange for Ohio EPA's agreement to delay any new phosphorus limits in permits until the study and the TMDL were completed. The Coalition suggested the water quality study and nutrient management plan could be completed in 18-24 months, once a consultant was selected.

Through the end of 2014 and into the spring of 2015, Ohio EPA and the Coalition collaborated on the details of the proposed study and ultimately came to agreement on the study's scope and deliverables. Although Ohio EPA declined to delay all phosphorus limits until study completion – and in fact issued draft permits in July 2015 containing seasonal, mass-based phosphorus limits to the City of Dayton and Montgomery County – the Coalition decided to proceed with the project nonetheless. While Dayton and Montgomery County, owners of the two largest wastewater treatment plants in the watershed, received phosphorus limits, the permits issued by Ohio EPA to the other smaller LGMR dischargers did not include phosphorus limits. Ohio EPA did acknowledge the water quality study in all the draft permits by including provisions to allow POTWs to potentially propose alternate phosphorus reduction strategies for compliance with future limits, if such

strategies are technically supported by the study. "Long term, the water quality model and the nutrient management plan benefit all parties involved – from State regulators to sewer customers to the fish and organisms that live in the River," Says Jason Hunold, Wastewater Superintendent for the City of Fairfield. "With an improved understanding of the existing conditions, we'll be better equipped to craft a master plan to reduce nutrient impairment in the future. These are complex problems and there is only so much money to put towards solutions, so we need to get it right from the start. We are stewards of the environment, but also stewards of our rate-payers dollars. We don't want to invest in major capital improvements if they don't help solve the problem – especially if other major causes of impairment are left unchecked."

In October 2015, a Request for Proposals for the "Lower Great Miami River Nutrient Management Project" was released by the Miami Conservancy District (MCD) – the partner agency managing the project on behalf of the Coalition. The major deliverables of the project include compilation and synthesis of existing water quality data; model development and calibration; and analysis of watershed-based compliance options necessary to achieve the required phosphorus reductions to ensure attainment of state water quality standards. Seven proposals were submitted to MCD on November 30, 2015. Following review by MCD and Coalition representatives, the Coalition selected LimnoTech – based out of Ann Arbor, Michigan – to complete the project. LimnoTech was selected in part as a result of the firm's vast experience in developing water quality models and performing TMDL determinations – many in collaboration with state environmental regulatory agencies.

LimnoTech "hit the ground running" in early 2016 with a focus on model development and calibration. In conjunction with modeling work, additional Coalition-funded targeted sampling efforts were conducted, including sediment studies, with the goal of filling existing data gaps to enable model completion. Throughout the summer of 2016 Limnotech staff worked with Coalition members and Ohio EPA staff to refine model inputs, baseline conditions, and model "endpoints". Ultimately it was agreed upon to focus on dissolved oxygen levels, instream phosphorus concentrations, and chlorophyll levels as the primary parameters of interest within the model framework.

After several months of hard work, Limnotech presented a final calibrated model to the Coalition and Ohio EPA in the Fall of 2016. While a few technical issues are still being addressed, the model is basically complete and the Coalition is satisfied with its quality and accuracy. Moving forward Limnotech will be running a series of up to eight (8) model "scenarios", effectively looking at the modeled impact of various nutrient input changes on such things as instream dissolved oxygens levels (average and diurnal), total and dissolved phosphorus levels, and sestonic and benthic algae (chlorophyll) levels.

Scenarios likely to be evaluated include:

- ◆ Dayton and Montgomery County POTWs discharging effluent at 0.75 mg/l Total Phosphorus (53% Ortho-P), July through October;
- ◆ Dayton and Montgomery County POTWs discharging effluent at 0.0 mg/l Total Phosphorus, July through October;
- ◆ All major POTWs in Lower Great Miami River Watershed discharging effluent at 0.75 mg/l Total Phosphorus (53% Ortho-P), July through October;
- ◆ All major POTWs in Lower Great Miami River Watershed discharging effluent at 0.0 mg/l Total Phosphorus, July through October;
- ◆ Nonpoint source (agricultural) Total Phosphorus annual load reduction of 15%;
- ◆ Nonpoint source (agricultural) Total Phosphorus annual load reduction of 15%, AND all major POTWs in Lower Great Miami River Watershed discharging effluent at 0.75 mg/l Total Phosphorus (53% Ortho-P), July through October;
- ◆ Nonpoint source (agricultural) Total Phosphorus annual load reduction of 15%, AND all major POTWs in Lower Great Miami River Watershed discharging effluent at 0.75 mg/l Total Phosphorus (53% Ortho-P), July through October, AND removal of two low-head dams (Tait Station at River Mile 76.6 and Hutchings Station at River Mile 63.5).

Ultimately the final water quality model, scenario results, and technical report will be provided to Coalition members and Ohio EPA by early-summer 2017. The final report will include recommendations on environmentally-viable, cost effective, and achievable watershed-based nutrient reduction options aimed at attainment of water quality standards and improved river health. The hope of the Coalition is that the model will be used as a resource and a scientific "check and balance" validation tool to help guide future regulatory decisions aimed at improving water quality conditions in the area.

Partners supporting the "Lower Great Miami River Nutrient Management Project"

- ◆ Dayton
- ◆ Englewood
- ◆ Fairfield
- ◆ Franklin
- ◆ Hamilton
- ◆ Miamisburg
- ◆ Middletown
- ◆ Springboro
- ◆ Troy
- ◆ Union
- ◆ West Carrollton
- ◆ Tri-Cities Wastewater Authority (Huber Heights, Vandalia, Tipp City)
- ◆ Montgomery County