Indiana's Great Lakes Water Quality Agreement (GLWQA)

DOMESTIC ACTION PLAN (DAP)

for the

WESTERN LAKE ERIE BASIN (WLEB)

December 2023

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FOREWORD

Lake Erie faces significant challenges due to excessive phosphorus loading which leads to harmful algal blooms (HABs) and water quality degradation. Phosphorus is a nutrient essential for plant growth, but when it enters aquatic ecosystems in excessive amounts, it fuels the growth of harmful algae which can produce toxins harmful to aquatic life, humans, and animals.

Indiana's Great Lakes Water Quality Agreement (GLWQA) Domestic Action Plan (DAP) to reduce phosphorous to the Western Lake Erie Basin (WLEB) is the product of a dedicated advisory committee comprised of representatives from different stakeholder sectors and led by the Indiana Department of Environmental Management (IDEM). Founded on the principle of adaptive management, this DAP is a dynamic document acknowledging that phosphorous loading in particular, and nutrient pollution in general, is a complex problem caused by point and nonpoint sources across all sectors, which requires a multi-dimensional solution. The first version of the Indiana DAP was published in February 2018 and this document serves as a revision to that plan.

Figure 1. The confluence of the St. Marys River (left) and the St. Joseph River (right) to form the Maumee River (bottom) in Fort Wayne, Indiana. Photo courtesy of Allen County SWCD.

BACKGROUND

Indiana has been an active member of the Nutrients Annex 4 Binational Subcommittee of the GLWQA since its establishment in 2013. The Nutrients Annex 4 Binational Subcommittee is charged with coordinating binational actions to manage phosphorous loadings and concentrations in the Great Lakes. The GLWQA Lake Ecosystem Objectives include the following:

- Minimize the extent of hypoxic zones in the Great Lakes due to excessive phosphorous loading with emphasis on Lake Erie.
- Maintain levels of algal biomass below nuisance level conditions.
- Maintain algal species consistent with healthy aquatic ecosystems in nearshore waters.
- Maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health.
- Maintain an oligotrophic state, relative algal biomass, and algal species consistent with healthy aquatic ecosystems in the open waters of Lakes Superior, Michigan, Huron, and Ontario.
- Maintain mesotrophic conditions in the open waters of the western and central basins of Lake Erie, and oligotrophic conditions in the eastern basin of Lake Erie.

Indiana has completed or is in progress of the commitments under the Nutrients Annex which include the following:

- By 2016, develop binational substance objectives for phosphorus concentrations, loading targets, and loading allocations for Lake Erie (outlined in Indiana 2018 DAP).
- By 2018, develop binational phosphorus reduction strategies and domestic action plans to meet the objectives for phosphorus concentrations and loading targets in Lake Erie (developed Indiana 2018 DAP).
- Assess, develop, and implement programs to reduce phosphorus loadings from urban, rural, industrial and agricultural sources. This will include proven best management practices, along with new approaches and technologies (implemented strategies that were outlined in Indiana 2018 DAP, assessed, and revised and published Indiana 2023 DAP).
- Identify priority watersheds that contribute significantly to local algae development, and develop and implement management plans to achieve phosphorus load reduction targets and controls (priority watersheds identified in Indiana 2018 DAP & Indiana 2023 DAP).
- Undertake and share research, monitoring and modeling necessary to establish, report on and assess the management of phosphorus and other nutrients and improve the understanding of relevant issues associated with nutrients and excessive algal blooms (continue to attend regional and national meetings while hosting local meetings to share and track information).

On February 22, 2016, Canada and the United States adopted the following phosphorus reduction targets (compared to a 2008 baseline) for Lake Erie:

- **To minimize the extent of hypoxic zones in Lake Erie:** a 40 percent reduction in total phosphorus (TP) entering the western basin of Lake Erie—from the United States and from Canada.
- **To maintain algal species consistent with healthy aquatic ecosystems in the nearshore waters of the western and central basins of Lake Erie**: a 40 percent reduction in spring TP and dissolved reactive phosphorus (DRP) loads from the Maumee River.
- **To maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health in the waters of the western basin of Lake Erie**: a 40 percent reduction in spring TP and DRP loads from the Maumee River in the United States. Using 2008 as the baseline, this equates to a spring (March-July) load of 860 metric tons TP (0.23 mg/L Flow Weighted Mean Concentration) and 186 metric tons DRP (0.05 mg/L Flow Weighted Mean Concentration).

In February 2018, Indiana released the Indiana GLWQA DAP that provided the framework for reducing phosphorus entering Lake Erie by 40 percent. Since then, Indiana's DAP Advisory Committee (Advisory Committee) and other partners have been committed to achieving the goals and objectives outlined in the DAP as resources allowed. The Advisory Committee continues to meet, share information, and track progress to steer Indiana in the best direction for achieving phosphorus reductions in the Western Lake Erie Basin. The Committee met in November of 2023 to discuss updates to the 2018 document. The updated DAP was put on public notice with a 30-day comment period during which time no comments were received. This DAP update will report efforts and spell out the next steps to continue progress in reducing phosphorus.

GOALS

The focus of Indiana's DAP is the Western Lake Erie Basin as Indiana's only tributary to Lake Erie is the Maumee River, which has its mouth in the WLEB. Thus, particularly pertinent to Indiana is the GLWQA Lake Ecosystem Objective to maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health.

From applying, cross-referencing, and analyzing seven different models, the Nutrients Annex 4 Binational Subcommittee concluded that springtime (March through July) loading of phosphorus from the Maumee River is the prevailing source of phosphorus causing cyanobacteria blooms in the WLEB (Annex 4 Targets and Objectives Task Team, May 11, 2015, p. 33). Using 2008 as the base year, the Nutrients Annex 4 Binational Subcommittee determined that a reduction of 40 percent in springtime loads of both total and dissolved reactive phosphorus is required to limit the formation of nuisance/harmful algal blooms in nine out of ten years. Nine out of ten years acknowledges the probability of an extremely wet year in which the goal would not be attainable. The 40 percent reduction target load is equal to 860 metric tons (MT) of TP and 186 MT of DRP, which translate to a flow weighted mean concentration (FWMC) of 0.23 mg/L TP and 0.05 mg/L DRP. This target load is expected to

produce a bloom similar to that which occurred in 2012, which marked the smallest bloom quantified by the cyanobacteria metric in the last two decades.

Indiana's goal is to meet the springtime FWMC targets of 0.23 mg/L and 0.05 mg/L for TP and DRP respectively in the Maumee River as it flows across the border into Ohio. Indiana, in concert with the U.S. Environmental Protection Agency (EPA), affirms the reduction planned for the Maumee River will address Indiana's obligation for the 40% phosphorous load reductions entering the WLEB, which in turn, positively affects the Central Basin. While phosphorus is the nutrient of focus and primary driver of eutrophication in the WLEB, the addition of nitrogen significantly increases the production of algal blooms. The relationship of algal bloom size, timing and other factors, such as water temperature, to the production of algal toxins is not fully understood and the role that nitrogen plays in algal toxins is being examined. Therefore, nitrogen as well as other parameters listed in Table 4 are being collected in Indiana's current and proposed monitoring projects in the WLEB to provide data for this research and to achieve a better understanding.

Timeframe to Meet Load Reduction Goals

The lag time between the installation of conservation or best management practices (BMPs) on the landscape and positive, statistically significant changes in the water quality of a large river, such as the Maumee, can take decades. Reductions in phosphorus loads to smaller streams and tributaries may be manifest in improved water quality sooner, just as positive changes are realized sooner on the agricultural edge-of-field scale and at point source outfalls. Thus, Indiana will use various indicators to track progress annually from different sectors.

STAKEHOLDERS AND PARTNERS

The State of Indiana recognizes that early involvement of stakeholders and partners provides transparency of the process, allows time for trust to develop, permits incorporating local knowledge, and makes it possible to deal most effectively with misperceptions and manage expectations. All of this helps gain buy-in and cooperation from stakeholders and partners and increases the likelihood of moving toward effective and sustainable solutions.

The Indiana WLEB DAP Advisory Committee (Advisory Committee) was formed to bring together stakeholders to develop, implement, and track progress of Indiana's GLWQA DAP. The Advisory Committee was formed in 2016 and met monthly in 2016 and 2017 to coordinate the development of the DAP. Since that time, the Advisory Committee meets once or twice a year to discuss progress in meeting its goals. Meeting minutes may be found on the Indiana DAP website.

Members of the Advisory Committee consist of Adams County Soil and Water Conservation District (SWCD), Allen County SWCD, City of Fort Wayne, DeKalb County SWCD, Conservation Cropping Systems Initiative, Indiana Farm Bureau, Indiana Pork Producers, Indiana University Purdue University Fort Wayne, Indiana State Department of Agriculture, Indiana Department of Natural Resources, Indiana Department of Environmental Management, Maumee Watershed Alliance, Natural Resource Conservation Service of United States Department of Agriculture,

Save Maumee, Sierra Club, St. Joseph Watershed Initiative, Steuben County SWCD, The Nature Conservancy, Indiana Agriculture Nutrient Alliance, and United States Geological Survey. As time allows: Agricultural Research Service, United States Department of Agriculture, Allen County MS4, Hoosier Environmental Council, Maumee River Basin Commission, Purdue University, and producers.

Indiana is a national leader in fostering cooperative, progressive and productive state-wide partnerships and has served as a model for other states. The Advisory Committee utilizes a network of partnerships to accomplish activities that further the goals of the Indiana DAP. Some of these partnerships are described below.

Indiana Conservation Partnership (ICP): As both a leadership body and as stakeholders in Indiana's water quality, the Indiana Conservation Partnership actively works to address environmental issues across Indiana at local, state and federal levels. The mission of the ICP is to provide technical, financial and educational assistance needed to implement economically and environmentally compatible land and water stewardship decisions, practices and technologies. The ICP provides a roadmap for addressing Indiana's conservation issues, and in so doing, functions collectively to touch many other organizations and individuals.

Through ICP, tillage and cover crop transects are completed each year throughout the state. ICP also tracks sediment and nutrient load reductions on all assisted (cost-share) conservation practices/BMPs from a variety of state and federal programs using the U.S. EPA Region 5 model. ICP develops county level conservation reports every year for each county in Indiana along with an annual work plan to bolster collaboration among the partners and leverage resources.

State Soil Conservation Board (SSCB) – The Indiana State Soil Conservation Board is another key group of stakeholders in Indiana's water quality. The SSCB appoints Supervisors as recommended by County Soil and Water Conservation Districts and sets policy governing programs of the Indiana State Department of Agriculture (ISDA) Division of Soil Conservation (DSC) and the activities of SWCDs. Through ISDA and the policies set by the SSCB, this board serves SWCDs by providing state appropriated funding for SWCD operations, providing technical assistance through ISDA DSC employees, and builds district capacity by facilitating information exchange between the SWCDs through SWCD Annual Conference, publications, workshops, and the efforts of the DSC Resource Specialists.

The SSCB also serves as a body for advice and consultation for ISDA and the SWCDs as well as assists in securing federal and state agency help for district programs. Lastly, the board administers Clean Water Indiana, a water quality-related erosion and sediment reduction program.

Soil and Water Conservation Districts (SWCDs): Indiana's 92 County SWCDs are the grassroots partners in Indiana's effort to improve its waters. Districts not only bring a local environmental perspective to land users and economic developers but act as local hubs for any and all citizens whom they serve to find information regarding conservation issues and programs available to them. SWCDs most often share residence with local Farm Service Agency (FSA) and Natural

Resources Conservation Service (NRCS) offices as well as DSC employees or are located in close proximity. This not only allows for cooperation and shared resources, but ensures that farmers, landowners and developers can access conservation programs and technical support at local, state and federal levels when they respond to outreach from SWCDs or they themselves reach out to any of these partners.

Agricultural Commodity Groups and Organizations: Indiana Corn, Soybean, Pork, Beef, Dairy and Poultry commodity groups, as well as the Indiana Farm Bureau, the Agribusiness Council of Indiana (ACI), and Purdue University Extension are actively engaged in identifying and approaching the challenges of nutrient loading and soil health, subsequently improving water quality. These groups with the addition of members from the ICP and The Nature Conservancy, worked to develop what was referred to as the nutrient management and soil health strategy. As a result of this effort, the Indiana Agriculture Nutrient Alliance (IANA) was created in 2018 to further coordinate the efforts of the agricultural community beyond federal and state cost-share programs. The formation of IANA from the nutrient management/soil health strategy workgroup is an example of a key refinement of adaptively managing our needs.

IANA is dedicated to keeping Indiana at the forefront of proactive nutrient management and soil health practices that improve farm viability and ultimately reduce nutrient loss to water. Across the state, a large number of public and private sector agencies and organizations are working toward the same goal of reducing nutrient loss and improving water quality. IANA focuses on bridging multi-partner efforts to create practical, cohesive, and significant effect across Indiana.

Municipalities: The Advisory Committee works with the municipalities in the WLEB to ensure they remain in compliance and are active partners in the DAP. Primarily those with municipal separate storm sewer systems (MS4s), major wastewater treatment plants (WWTP) (greater than 1 million gallons design flow per- MGD), and those with combined sewer overflow systems (CSOs) are actively engaged in implementing their Storm Water Quality Management Plans (SWQMPs), National Pollutant Discharge Elimination System (NPDES) permits, and Long Term Control Plans (LTCPs) respectively to reduce nutrients and other pollutants to Indiana's waterways. Municipalities may also update local ordinances that help improve water quality.

The Indiana Chapter of The Nature Conservancy (TNC): The Indiana Chapter of The Nature Conservancy is another key stakeholder and partner in improving Indiana's water quality. TNC focuses on conserving the lands and waters on which all life depends. Utilizing science to develop its conservation targets and approach, TNC has initiated broad, whole system projects to accomplish its mission. TNC has applied this goal to Indiana's waters, and to accomplish this goal, TNC is working with agency, commodity, and academic partners across the state to improve water quality by collaborating and coordinating to consistently promote efforts that will move 50% of row crop acres being managed for soil health, enhance nutrient management and restoring 20,000 acres of floodplains.

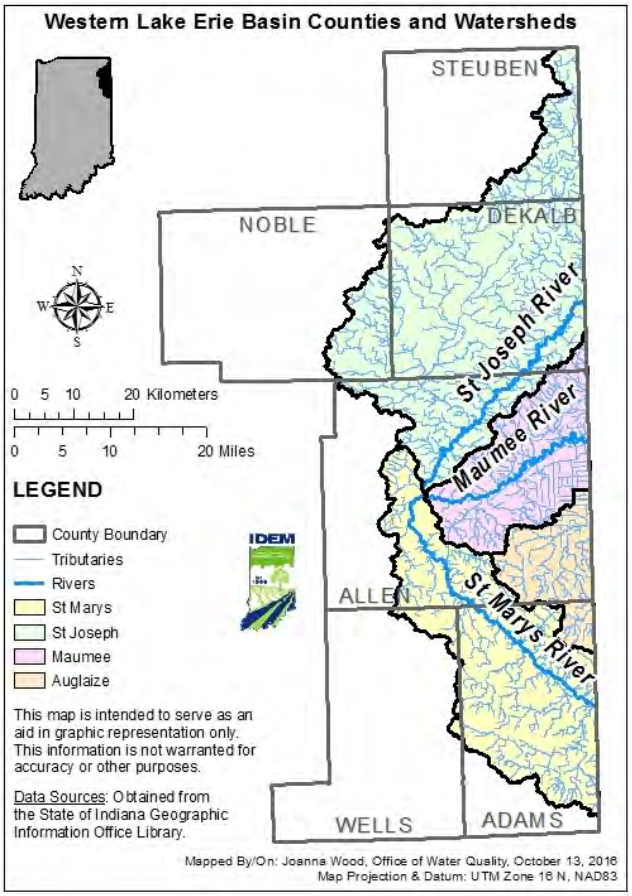
TNC was instrumental in assisting with setting up and launching the 4R Nutrient Stewardship Certification Program for Indiana in 2020. They have also been completing Agricultural Conservation Planning Framework (ACPF) analysis on the subwatersheds in the WLEB.

The United States Geological Survey (USGS): The USGS is another key stakeholder and partner in improving Indiana's water quality by providing streamflow and discharge data and water quality monitoring data throughout key areas of the state. This data and the USGS's cooperation and involvement in many projects and studies is vital to knowing the state of our waters and where more work is needed to improve the water quality.

PHOSPHORUS LOADING IN INDIANA

Background and Land Use in the WLEB

Figure 2: Indiana's Portion of the WLEB



Indiana drains roughly 12 percent of the WLEB and is comprised of the St. Joseph, Maumee, Auglaize, and St. Marys watersheds that encompass approximately 821,300 acres in the counties of Steuben, DeKalb, Allen, Noble, Adams, and Wells[1]. The St. Joseph River and the St. Marys River enter Indiana from Ohio and, at their confluence near Fort Wayne, form the Maumee River, which flows approximately 29 miles eastward into and through Ohio for another 108 miles to its mouth at Maumee Bay in Lake Erie near Toledo. This portion of the WLEB is home to nearly a half million people. The largest city is Fort Wayne with a population of approximately 260,000.

About 70 percent of the WLEB is agricultural, 16 percent is developed, and the remaining 14 percent is comprised of forests, wetlands, and open water. Land use has slightly changed since 2012 with the pasture land reduced by 9.5% and row crops increasing by 8.4%. (Table 1)

[1] Appx. ac. by county: Steuben ≈ 50,210, Noble ≈ 52,050, DeKalb ≈ 224,520, Allen≈ 315,400, Wells ≈ 17,600, Adams ≈ 161,520

Table 1: Land Use in the Indiana WLEB (USGS NLCD, 2021)

Land Use	Total In Acres	Percentage of Total	Percent Change Since 2012
Row Crops	505,097.81	61.50%	8.40%
Hay/Pasture	66,114.43	8.05%	-9.50%
Developed	133,871.45	16.30%	1.30%
Forested	63,814.80	7.77%	-1.63%
Wetland	38,600.97	4.70%	2%
Scrub/Shrub	5,502.69	0.67%	-0.73%
Open Water	8,295.11	1.01%	-0.19%
Total	**821,297.26**	**100.00%**	

Urban Point Sources (Regulated)

A point source is a pollutant source at a specific location that discharges directly into the river. These discharges typically occur through pipes and are often associated with human activities and industrial processes. Indiana Department of Environmental Management (IDEM) regulates these sources to control and minimize their impact on the environment.

There are five major (one million gallons/day) NPDES[2] permitted municipal WWTPs, each with a TP effluent limit of 1 mg/L. These include Auburn, Butler, Decatur, Garrett, and Fort Wayne. This is an increase from the 2018 Indiana GLWQA DAP with the Garrett WWTP being a new addition. These WWTPs average a discharge concentration below the 1mg/L TP limit. Besides the WWTPs listed above, there are an additional six minor NPDES facilities with a 1 mg/L phosphorus limit and thirteen minor NPDES facilities with nitrogen limits as of November 2023 (Figure 3). As of December 2023, the WWTPs follow their required NPDES permits and there are no open violations. WWTPs will continue to employ optimization techniques by analyzing their current operation and maintenance processes to seek better nutrient removal.

Within the developed areas, there are seven CSO[3] communities including Auburn, Berne, Butler, Decatur, Fort Wayne, New Haven, and Waterloo, each with an approved LTCP or consent decree with compliance schedules. CSO communities will continue to implement their LTCPs and associated compliance schedules and track progress.

[2] NPDES permits are issued by IDEM to control direct discharges to waters of the State. These permits place limits on the amount of pollutants that may be discharged to waters of the State by each discharger. These limits are set at levels protective of both the aquatic life in the waters which receive the discharge and of human health. For more information see http://www.in.gov/legislative/iac/T03270/A00030.PDF

[3] CSOs are wastewater collection systems that convey sanitary wastewaters (domestic, commercial, and industrial wastewaters) and storm water through a single-pipe system to a Publicly Owned Treatment Works (POTW). A CSO is the discharge from a combined sewer system at a point prior to the POTW. CSOs are point sources subject to NPDES permit requirements including both technology-based and water quality-based requirements of the Clean Water Act (CWA).

There are 13 designated MS4s[4] with approved SWQMPs including one in Adams County, 11 in Allen County, and one in DeKalb County. MS4s are conveyance systems designed and used to drain stormwater. Like nonpoint source pollution associated with precipitation events, these regulatory point sources have their pollutant signatures during precipitation events. Efforts continue to occur in MS4 communities to reduce overall stormwater drainage by implementation of low impact development (LID) and other green infrastructure projects.

These types of projects increase infiltration and evaporation of precipitation which in turn reduces urban runoff and phosphorus from entering the waterways. MS4 communities will continue to implement their SWQMPs and track progress. Construction site sediment runoff controls will be implemented according to the Notice of Intent (NOI)[5] and living stabilization covers will be used that minimize nutrient inputs. Industrial site runoff controls will be implemented according to the NOI.

Rural Point Sources (Regulated)

Animal operations may generate large quantities of animal manure, which may be used as fertilizer on nearby fields. If not managed properly, the manure can contain elevated levels of phosphorus. When applied to fields in excess, phosphorus can be carried off by runoff into nearby waterways. IDEM regulates an animal feeding operation if it is considered to be a confined feeding operation (CFO) or a concentrated animal feeding operation (CAFO). CFOs as defined by Indiana Code (IC 13-18-10) are any confined feeding of at least 300 cattle; 600 swine or sheep; 30,000 fowl; or 500 horses and are permitted under the Confined Feeding Control Law.[6] CAFOs are larger animal operations that are permitted under the same CFO rule, but have a few added requirements under Indiana regulation. There are 81 active CFOs in the WLEB with 55 in Adams County, 11 in Allen County, 11 in DeKalb County, one in Steuben, and three in Wells County[7]. 33 of those 81 active CFOs are classified as CAFOs (IDEM Confined Feeding Operations 2023; Figure 3). These numbers do not account for the numerous livestock operations that fall below the threshold of regulation under the CFO rule.

IDEM encourages the beneficial reuse of biosolids, industrial waste products, and pollutant-bearing water by land application in a manner that protects human health and the environment. Land application involves spraying or spreading these materials onto the land surface or injecting or incorporating them into the soil. Approximately 6,600 of the 505,098 acres of row crop (1.3%) in the WLEB receives regulated land application (IDEM Land Application 2023). Land application has reduced by 7% since the 2018 DAP.

[4] MS4s are defined as a conveyance or system of conveyances owned by a state, city, town, or other public entity that discharges to waters of the United States and is designed or used for collecting or conveying storm water. Regulated conveyance systems include roads with drains, municipal streets, catch basins, curbs, gutters, storm drains, piping, channels, ditches, tunnels, and conduits. It does not include CSOs and POTWs.

[5] The application for a Construction Site Run-off general permit is called a Notice of Intent, or NOI, because the "applicant" or "project site owner" is notifying IDEM of his or her intent to operate their proposed construction project in a manner consistent with the Rule. The applicant follows all guidelines and requirements for submittal of the general permit.

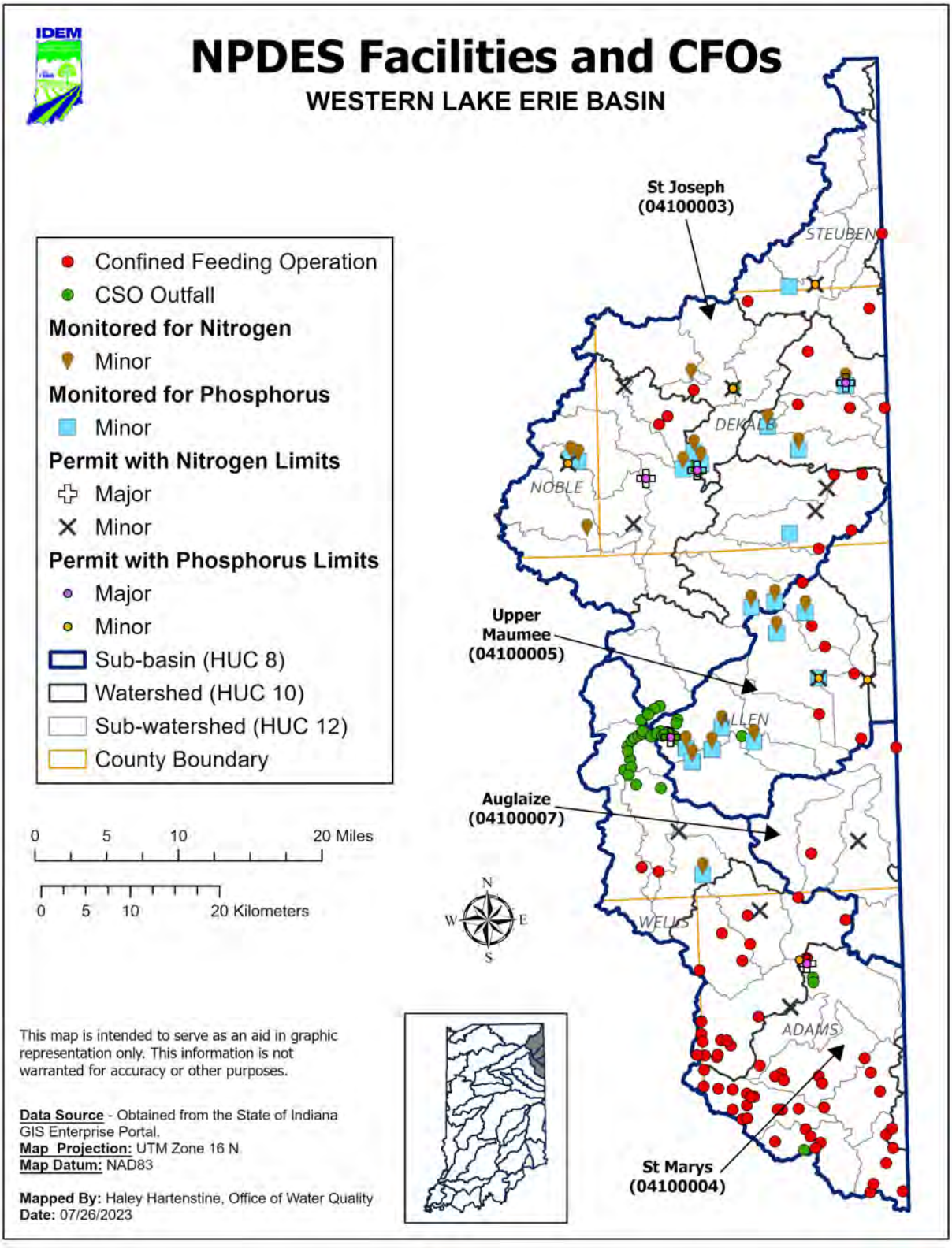
[6] Additionally, a CFO is any animal feeding operation electing to be subject to IC 13-18-10; or any animal feeding operation that is causing a violation of water pollution control laws, any rules of the board; or of IC 13-18-10.

[7] There are many livestock and poultry farms located in the WLEB that do not meet the definition of CFOs and are not specifically regulated under Indiana Code.

Thirty-five years ago, Indiana became the first state in the nation to protect its lakes and waterways by prohibiting the use of laundry detergents containing phosphorous under IC 13-18-9 and, in 2012, the state legislature extended the phosphorus ban to detergents used in residential automatic dishwashers. On July 28, 2010, the Indiana rule, Certification for Distributors and Users of Fertilizer Materials, 355 IAC 7-1.1, went into effect. The date for full compliance with the requirements of this rule was January 1, 2012. The purpose of this rule is to ensure that fertilizer users are competent to apply and handle these materials safely and effectively and in a manner that minimizes negative impacts on water quality and the environment.

IDEM will continue to ensure compliance with the CFO and Fertilizer rules via routine inspections and timely investigate reports of nutrient mismanagement or runoff from regulated farms and spills from unregulated farms.

Figure 3: NPDES Facilities and CFOs



Nonpoint Sources (Unregulated)

Nonpoint source pollution originates from diffuse sources and typically occurs when precipitation carries the pollutants from various sources across the landscape and into waterways. Nonpoint source pollutants are a challenge since it can be difficult to pinpoint the exact sources and pathways and is typically unregulated in Indiana. Some of the main activities and land uses that result in nonpoint source pollution in the Western Lake Erie Basin include the following:

Agriculture: The extensive agricultural activity in Indiana contributes phosphorus to the Western Lake Erie Basin. Exposed soil along with the use of fertilizers and manure on fields contribute to nonpoint source pollution. Row crop agricultural land (61% of the WLEB area) with corn and soybean rotation predominating, is mostly drained by subsurface tiles which, during significant rainfall events, discharge to streams transporting phosphorus, nitrogen, and suspended sediment. Phosphorus loading can be reduced through promoting precision farming techniques, nutrient management, soil health and implementing BMPs.

Indiana has promoted the adoption of BMPs in agriculture, such as no-till farming, cover crops, and precision nutrient management throughout the years yet more outreach is needed. ICP conducts an annual conservation transect survey in each county every year to estimate the adoption of cover crops and post-harvest tillage. Since 2018, these surveys have shown that the amount of cover crop and reduced tillage acreage has remained relatively unchanged. Most years no-till implementation has been over 80% while cover crop implementation has slightly increased from 4% in 2018 to 13% in 2022 (ISDA Cover Crop and Tillage Transect Data).

Land Development: Developed land is the second biggest land use (16.3%) in the WLEB and urban/suburban sprawl is expected to increase in the future. Development typically leads to the expansion of impervious surfaces like roads, parking lots, and buildings. These surfaces prevent rainwater from infiltrating into the ground and instead promote rapid stormwater runoff. Stormwater runoff from roads, parking lots, and residential areas can carry pollutants like sediment and fertilizer from lawns into the waterways.

Land development can also fragment natural habitats, leading to the loss of vegetation along streams and rivers which can result in streambank destabilization and sediment and nutrients entering the waterways. Hydromodification, or altered hydrology, also typically occurs with land development. Land development can change the natural flow patterns of streams which often leads to increased peak flows during storms and reduced baseflow during dry periods. These changes to flow result in higher sedimentation and nutrient loading to our waterways as well as higher water temperatures, lower dissolved oxygen, degradation of aquatic habitat structure, and declines in biological communities.

To mitigate the impact of land development and hydromodification on water quality, Indiana promotes various strategies and BMP implementation with the following approaches:

Urban landscapes:

- Support practices that promote infiltration, bio-retention, and slow or more natural water release.
- Seek the installation of larger, regional or multipurpose green infrastructure and LID that are often more cost-effective.
- Ensure that the maintenance of green infrastructure and LID practices is included in cost estimates and budgets.
- Provide technical and financial support to install rain gardens, green roofs, rain barrels, and porous pavement in industrial, commercial, and residential settings.
- Promote smart growth and compact urban development to reduce the extent of impervious surfaces.
- Enforcing land use planning and zoning regulations that consider water quality and protection of natural areas.

Rural landscapes:

- Restore stream sinuosity and riparian buffers.
- Restore and reconnect riparian wetlands and floodplains.
- Employ practices from the *Indiana Drainage Handbook* for the maintenance of legal drains such as retaining native vegetation on one streambank while staging maintenance equipment on the side with easier drain access.
- Install 2-stage ditches where feasible on both regulated and non-regulated drains.
- Install drainage water management BMPs and saturated buffers on working lands.

Septic Systems:

Failing septic systems can leak phosphorus into soil which may make its way to waterways and thus contribute to nutrient loading. The total amount of septic systems in the WLEB area for Indiana is unknown, but the Indiana Department of Health (IDOH) estimates that there are more than 800,000 septic systems in use throughout Indiana with 200,000 of these septic systems being inadequate, have failed, or are in the process of failing.

The Advisory Committee will continue to promote efforts to educate homeowners about proper septic system maintenance and the importance of addressing leaks. Septic system installation, operation, maintenance, and repair should follow the site-specific design regulations and additional outreach and education on design and repair requirements should be more readily available. Expanding financial assistance programs should be examined since repair or replacement can be costly and current programs are limited.

Indiana will continue to foster collaboration between federal and state funding sources and local unsewered communities to continue the extension of municipal sanitary sewer connections to known septic tank problem areas. For example, Adams County has used the Indiana Finance Authority (IFA) State Revolving Loan Fund to connect around 900 households or businesses to municipal sanitary sewers since 2018.

Wildlife and Pets: Animal waste from both wild and domestic animals like pets can contribute nutrients and bacteria to waterways. At this time, it is unknown how much animal waste from wildlife and pets is produced in the WLEB therefore its contribution to the phosphorus load is unknown. Indiana continues to promote education efforts to homeowners about the importance of proper pet waste removal.

MAJOR ACCOMPLISHMENTS FROM 2018-2023

The tireless efforts of the dedicated Advisory Committee, stakeholders, and community partners have cumulated a series of noteworthy accomplishments that have had a lasting positive impact on the Western Lake Erie Basin. These efforts allowed a majority of the action items from the 2018 DAP Action Milestone Table to be completed. This section highlights a few of these accomplishments from 2018-2023 that serves as a testament to the collective dedication and determination that have driven Indiana toward meeting the overall goals for the Western Lake Erie Basin.

Regulatory Changes

The Indiana General Assembly in the 2023 legislative session, passed laws and updated the state budget that allowed for further conservation practices to be implemented. HEA 1304 was passed which increased funds available for Indiana Department of Natural Resources (DNR) LARE grants by raising boat registration fees. The estimated additional $3.2 million a year increase for LARE grants will go towards technical and financial assistance to projects that protect and enhance aquatic fish and wildlife.

The Indiana General Assembly increased funding to the Clean Water Indiana Program which is administered by the Division of Soil Conservation under the direction of the State Soil Conservation Board. Funds available for the competitive conservation projects grant program increased from $1 million to $2 million and there will also be additional funding to expand the Indiana Conservation Reserve Enhancement Program and to match funding for Inflation Reduction Act proposals through the United States Department of Agriculture. Other state budget approvals included $30 million for trail projects and an additional $10 million to the President Benjamin Harrison Conservation Trust Fund for land conservation.

HEA 1639 was also passed in 2023 which creates an option for Indiana counties to join together to form Watershed Development Commissions. These commissions can provide a funding mechanism to improve water quantity and water quality issues in their watershed by using small assessments on the properties in their watershed boundaries.

Since 2018, IDEM and DNR worked together to streamline the waterway permitting process to reduce violations and confusion about the ever-changing permitting process. They developed the Indiana Waterways webpage that provides state waterway permitting information in one location so applicants do not have to go to different agency websites. The agencies also

developed the Indiana Waterways Inquiry Request tool where applicants can put in project information and learn which permits they will need to apply for. A joint IDEM-DNR Waterways application was created so qualifying projects only need to apply for permits on one form rather than multiple applications. These efforts will keep construction projects in compliance and thus help reduce sediment and nutrients from entering the waterways.

At the local level, Fort Wayne City Utilities updated their Chapter 53 of the Fort Wayne Indiana Code of Ordinances in 2022. These updates included Stormwater Pollution Prevention Plan Reviews and Inspections, city managed regulated drains, and updates to miscellaneous stormwater charges.

Watershed Planning

All watersheds in the Indiana portion of the WLEB now have an IDEM and U.S. EPA approved CWA Section 319 Watershed Management Plan (WMP). The Flatrock Creek/Auglaize WMP was approved in March 2023 and was the last watershed without a WMP since the last DAP was published in 2018. These plans establish project eligibility for federal funding and to help determine priority areas for best management practices. These plans will continue to be reviewed and updated as needed. For example, the Cedar Creek WMP is currently being rewritten due to changes within the watershed and is expected to be completed in February of 2025.

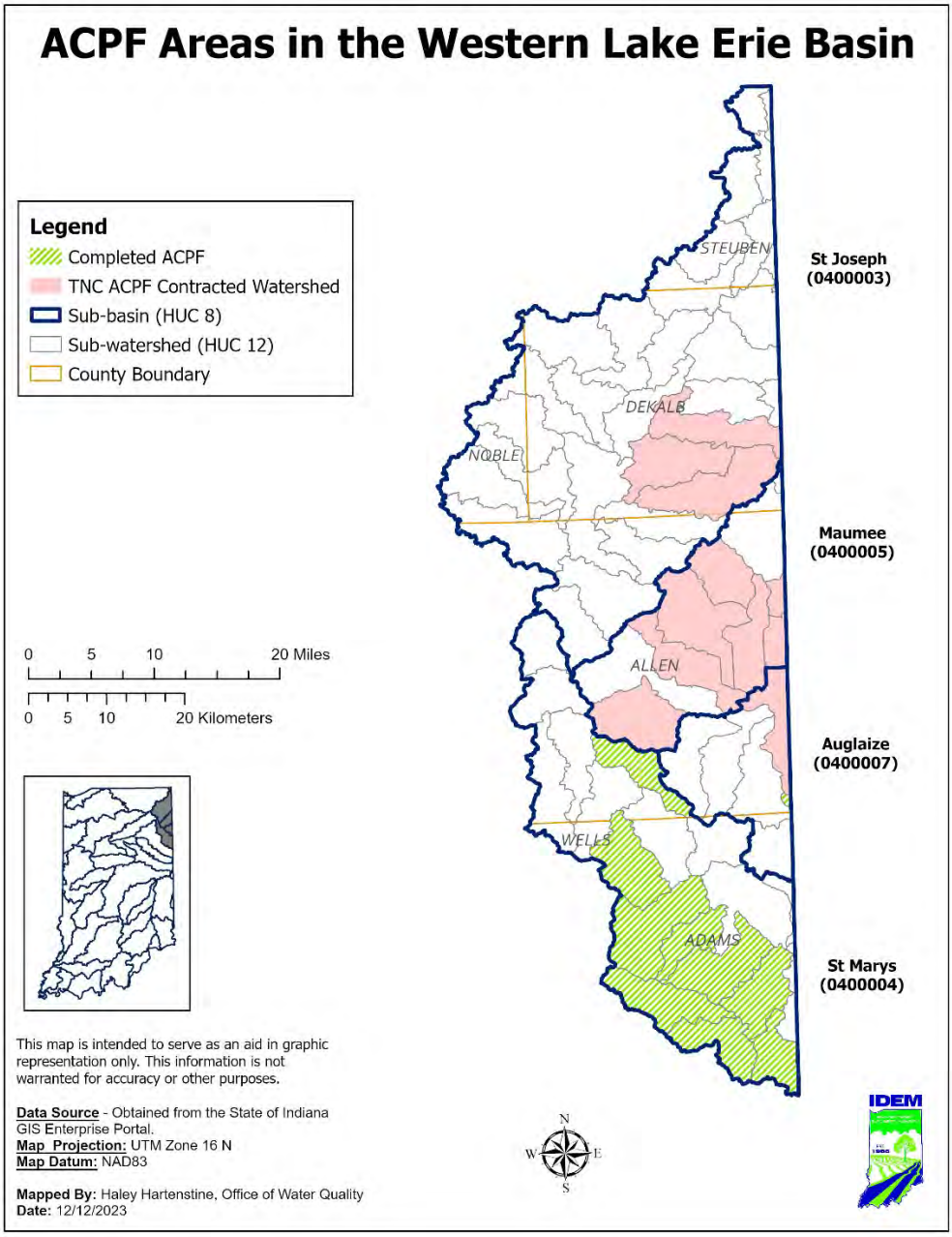
Other non-WMP plans that were completed after the publication of the 2018 DAP include:

- Cedar Creek Engineering Feasibility Study (LARE; 2019)
- St. Marys River Channel Stability and Flood Risk Assessment (MRBC; 2019)
- St. Joseph River Stream Assessment (319; 2021)
- St. Marys River Watershed Initiative (319; 2022)
- Cedar Creek Site Design (LARE; 2023)

Agricultural Conservation Planning Framework (ACPF) Analysis

While not originally part of the 2018 DAP Action Milestone Table, ISDA, TNC, and other partners have started completing ACPF Geographic Information System (GIS) analysis in the WLEB. ACPF uses high-resolution data and ArcGIS to identify site-specific opportunities to install agricultural conservation practices across small watersheds. The ACPF analysis, along with local knowledge of water and soil resource concerns, helps facilitate conversations with producers on what best management practices may work best for their operations. Figure 4 shows watersheds at the HUC12 level where ACPF has already been completed or planned to be completed in the immediate future.

Figure 4: ACPF Analysis in the Western Lake Erie Basin for Indiana



BMP Implementation

The Indiana Conservation Partnership tracks BMP load reductions from multiple agencies including NRCS, DSC, SWCDs, DNR, IDEM, and ISDA. From 2018-2022, BMP implementation has resulted in a phosphorus load reduction of 343,621 lb/yr with 2019 being the highest year for load reductions (Table 2). The St. Joseph watershed (HUC 04100003) has had the most BMPs installed with the Auglaize watershed (HUC 04100007) having the least (Table 3). Now that the Auglaize WMP has been approved and the availability of funding sources has increased, the Advisory Committee is hopeful that there will be more BMP implementation in the Auglaize

watershed. It's important to note that these BMP numbers are only calculated for one year of load reduction and do not account for each year the BMP is in place.

Table 2. BMP Implementation by Year (ICP, 2023)

Year	BMP Count	Phosphorus Load Reduction (lb/yr)
2018	N/A	56,645
2019	1,597	103,928
2020	1,219	75,067
2021	881	53,343
2022	811	54,638
TOTAL	**4,508**	**343,621**

Table 3. BMP Implementation by Watershed (ICP, 2023)

Watershed	HUC	BMP Count	Phosphorus Load Reduction (lb/yr)
St. Joseph	04100003	2,226	206,270
St. Marys	04100004	1,363	66,441
Maumee	04100005	685	56,901
Auglaize	04100007	234	14,010
TOTAL		**4,508**	**343,622**

The 2018 DAP Action Milestone Table identified specific implementation projects to be completed. The Advisory Committee and partners have worked diligently on executing these identified projects:

- Cedar Creek Watershed Land Treatment (LARE; closed 2019)
- Upper Maumee P-Risk Reduction Pilot (319; closed 2019)
- DeKalb and Steuben SWCD Implementation (CWI; closed 2019)
- Save Maumee Riparian Buffer Initative (GLRI; closed 2020)
- Steuben County SWCD Urban Implementation (CWI; closed 2021)
- Upper Maumee River Implementation (GLRI; closed 2022)
- Steuben County Cost-Share Program (SWCD; ongoing)

Highlighted Project: Adams County Sewer Extension

Adams County Regional Sewer District has successfully completed extensions of municipal sewers to existing septic tanks at 942 residences. Project Five is in the beginning phase of construction. At completion, the Adams County RSD will service 1,078 residences. New construction homes and some county residences have run private lines to tie into the main line in addition to the 1,078 residences that are part of the extension project.

Highlighted Project: Settlers Wetland

Settlers Wetland is a 3.5 acre closed preserve with the Clear Lake Township Land Conservancy in Steuben County established through property purchase and land donation. It is located along Cyrus Brouse ditch which flows into Clear Lake. The constructed wetland includes an artificial riffle on the north end to slow flow and a two-stage ditch on the south end. The project was completed in 2021 and has stopped 120 pounds of nitrogen, 71 tons of sediment and 60 pounds of phosphorus from entering Clear Lake. In July 2023, a Conservation Education Tour took place on the property where participants, which included state legislators, learned the importance of wetland complexes and how they relate to water quality.

Point Source Improvements

In accordance with 327 IAC 5-10-2(a) & (b), as the treatment facility discharges into receiving waters located within the Lake Erie drainage basins, phosphorus removal facilities shall achieve a degree of reduction as prescribed in the sliding scale of phosphorus removal in Footnote [2] of their permit or produce an effluent containing no more than 1.0 mg/L total phosphorus, whichever is more stringent. Monitoring is to be conducted five (5) times weekly by 24-hour composite sampling. In addition, IDEM plans to confer with the major POTWs (5) in the WLEB on what, if any reduction they may be able to make.

Highlighted Project: Ft. Wayne Deep Rock Tunnel

A noteworthy project is the Ft. Wayne Three Rivers Protection and Overflow Reduction Tunnel (3RPORT) and the Tunnel Works program which will collect and transport sewage and stormwater to the sewage treatment plant that would have otherwise been directed to Fort Wayne's combined sewer overflow system. Tunnel Works will reduce the amount of sanitary sewage and stormwater that is discharged into Ft. Wayne's rivers. Completion of Consent Decree, including the 3RPORT and Tunnel Works will result in a 94% reduction of combined sewage overflows to the St. Marys and Maumee Rivers, nearly 900 billion gallons on average each year. Combined sewer overflows will be reduced from 71 to 4 occurrences during a typical year on the St. Marys and Maumee Rivers. The St. Joseph River achieved compliance to 1 overflow occurrence per typical year through projects outside of the Tunnel Works program. By the end of 2023, Fort Wayne will have connected about 45,000 residents and 15,000 properties to the tunnel and will be fully operational by the end of 2025. The watershed contributing the most TP to the Maumee is the St. Marys River. The Ft. Wayne tunnel project will reduce nutrient inputs to both the St. Marys and Maumee Rivers.

Education and Outreach

In the ongoing journey to reduce phosphorus and improve water quality in the WLEB, education and outreach have played an integral role in driving change, raising awareness, and fostering a sense of shared responsibility. The collective outreach efforts of the Advisory Committee and partners have allowed many of the action items from the 2018 DAP Action Milestone Table to be completed and have reached thousands of individuals. From engaging

communities to empowering individuals, the below efforts and more have played a pivotal role in advancing the DAP mission to safeguard the Maumee River and its surrounding environment.

Highlighted Project: City of Fort Wayne Stormwater Outreach

Every year, the City of Fort Wayne completes numerous outreach events with the goal of improving stormwater education for Fort Wayne residents. In 2022, they distributed stormwater education material at 28 public events and translated education signs into other languages for their residents. The City of Fort Wayne has also created Cloudburst, a stormwater pollution prevention game, and demonstrated this game along with a watershed model at community events that reached approximately 11,000 individuals.

Highlighted Project: Farmer Advocate for Conservation

Indiana participated in the pilot program Farmer Advocate for Conservation which trains soil health farmers to lead peer learning and assistance efforts in the Maumee Watershed. So far 20 advocates have been trained and manage soil health on their 19,000 acres. Program-wide, an estimated 3,000 producers have engaged with direct peer-to-peer mentoring resulting in over 400,000 acres adopting soil health practices.

Highlighted Project: Black Loam Conference

Led by Legacy Taste of the Garden and their local partners, CCSI assisted with the Black Loam Conferences targeting underserved communities, especially those facing food desert hardships. The conference is part of a five-year cooperative agreement with NRCS to support and advance equity goals by providing critical outreach and technical assistance to Black, Indigenous, and People of Color (BIPOC) farmers and producers throughout the State of Indiana. Conferences were held in Fort Wayne in 2022 and 2023 where individuals that attended the events learned about soil health, nutrition, programs, business planning, and more.

WATER QUALITY MONITORING

To track Indiana's progress in meeting its phosphorus target loads on the Maumee River, the Advisory Committee determined that the most representative site is at Antwerp, Ohio, which is 7.6 river miles downstream of the Indiana border. The USGS operates both a stream-flow gage and an auto-sampler there and follows the recommended Annex 4 protocol with collection of the necessary parameters (See Table 4). Originally, the Advisory Committee proposed using the IDEM, Allen County SWCD, and the City of Fort Wayne fixed station site on State Road 101, which is 5.6 river miles upstream of the border: however, this site misses some of Indiana's pollution contribution as interceptor ditches on each side of the Maumee River discharge downstream of this location. Field reconnaissance revealed that there is no safe, accessible site directly on the Indiana border and that land use from the border to Antwerp is consistent with land use from State Road 101 to the border making it the best site.

Indiana's average total phosphorus annual load for 2018-2022 showed a reduction of 124,656 lbs. as compared to the baseline year of 2008. Dissolved reactive phosphorus monitoring did

not begin until 2018, so a comparison to the baseline year of 2008 cannot be done. However, the 5-year average (2018-2022) shows a decrease in both spring (321,513 lbs) and annual (756,552 lbs) loads for DRP as compared to 2018. The watershed contributing the most phosphorus to the Maumee River in Indiana appears to be the St. Marys. Using different models, analysis of water quality monitoring data from IDEM, Allen County Soil and Water Conservation District (SWCD), Tri-State Watershed Alliance (TSWA), and the City of Fort Wayne indicates the highest TP concentrations and loads here. Based on the FWMC target for TP and DRP, most of the sampling events exceed the target across all flow conditions signifying both point sources and nonpoint sources. To better characterize nutrient loading in the St. Marys watershed, IDEM will continue to collect TP and DRP samples at fixed station sites in the WLEB and support USGS gages and additional monitoring by the local water monitoring entities.

Table 4. Water Quality Monitoring Parameters that are/will be Collected and Frequency

Parameters	Number of samples per visit		Approximate number of samples per year at each site	Notes
Total Kjehldahl Nitrogen (mg/L-N) *[TKN]* **Total nitrogen** (mg/L-N) *[TN]* **Dissolved ammonia** (mg/L-N) *[NH4]* **Dissolved nitrate + nitrite** (mg/L-N) *[NO3+NO2]* **Orthophosphate** (mg/L-P) *[PO_4]* **Total phosphorus** (mg/L-P) *[TP]* **Suspended sediment** (mg/L-P) *[SS]* Sample Type	Equal-width increment sample	Autosampler		
Monthly samples	1 sample	1 sample	About 24	May coincide with even samples. Drought, ice, or other unfavorable conditions may impede the collection of monthly samples.
Event samples (5–8 events)	1 sample	4 – 6 samples	20 – 48	May coincide with monthly samples.
Selected baseline samples	-	1 sample	2 – 8	Autosampler triggered before an event.
Selected smaller events	-	1 – 4 samples	2 – 8	Autosampler samples picked up after a smaller event.

To optimize resources and establish a regional network, IDEM, Ohio Kentucky Indiana USGS Water Science Center (OKI), Ohio Environmental Protection Agency (OEPA), Ohio Department

of Natural Resources (ODNR), and U.S. EPA Region 5 are collaborating on monitoring activities. Ohio will continue to support the USGS monitoring activities at Maumee River at Antwerp, OH (USGS station ID – 04183500). A multi-parameter sensor provides continuous water quality data in near real-time via the USGS website. To characterize their respective contributions of phosphorus loads across their borders, Indiana and Ohio establish as priorities the following monitoring sites:

- The St. Marys River at Wilshire, OH (USGS station ID – 04181049). Ohio is funding USGS auto-sampler monitoring and annual load analysis through a U.S. EPA Great Lakes Restoration Initiative (GLRI) grant for a minimum of three years.
- The St. Joseph River at Newville, OH (USGS station ID – 04178000). Ohio is funding USGS auto-sampler monitoring and annual load analysis through a U.S. EPA GLRI grant for a minimum of three years.
- The St. Marys River near Fort Wayne (USGS station ID – 04182000). This location is prior to the St. Marys River's confluence with the St. Joseph River to form the Maumee River. Indiana is funding USGS auto-sampler monitoring and annual load analysis through a U.S. EPA GLRI grant for a minimum of three years.
- Blue Creek near Pleasant Mills, IN (USGS station ID – 04181100). This is a smaller tributary in the Maumee River Basin. Indiana is funding USGS auto-sampler monitoring and annual load analysis at this site for up to 4 years.

WATERSHED PRIORITIZATION

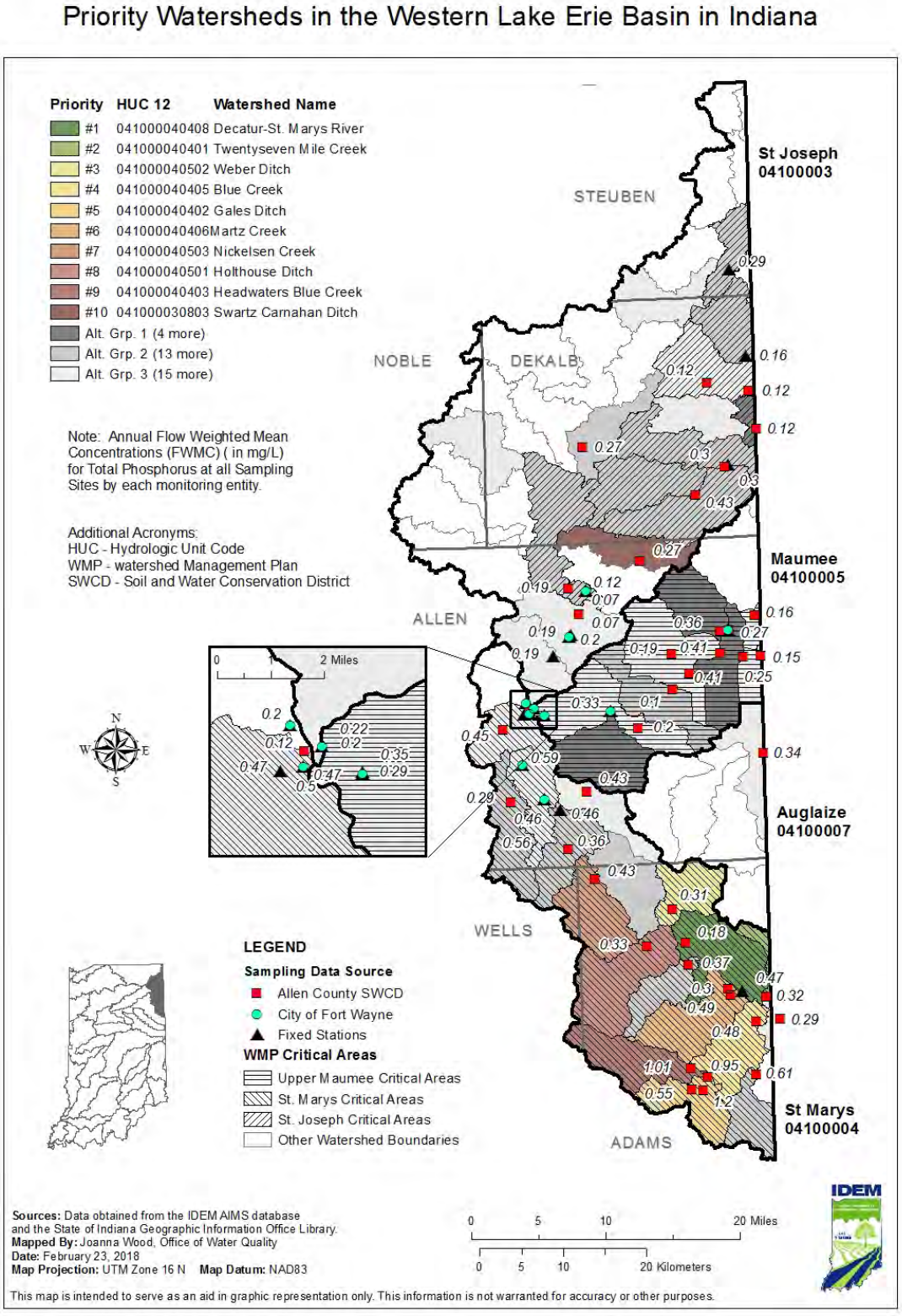
At the 8-digit hydrologic unit code (HUC)[8] scale, the watershed contributing the most TP to the Maumee River is the St. Marys.[9] This determination is based on an analysis of water quality monitoring data from IDEM's 12 WLEB fixed station sites for the period 2008 through 2015 and is corroborated by subsequent analyses of vetted water quality monitoring data collected more frequently by local entities. Analyses of more recent data (2016-2022) confirms that the St. Marys continues to contribute the most TP to the Maumee River. Collection of DRP at IDEM's 12 WLEB fixed station sites commenced in 2018. Those data show that DRP concentrations are highest in the St. Marys River watershed. Springtime flow weighted mean concentrations exceeded the 0.05 mg/L target every year since sampling commenced. Most of the sampling events exceed the target for TP across all flow conditions signifying both point sources and nonpoint sources of TP. Point sources such as WWTPs (or sources that behave as point sources, such as septic systems) discharge regularly, regardless of weather. Thus, during normal or low-flow conditions, nutrients and other pollutants associated with point sources are present in the stream. Whereas, in precipitation driven, high-flow conditions, including storms and snow-melt, nonpoint pollution sources predominate. (Appendix 2 includes a description of the analyses as well as station-by-station results).

[8] Hydrologic unit codes are a way of identifying all of the drainage basins in the United States in a nested arrangement from largest (Regions) to smallest (Cataloging Units). The term watershed is often used in place of drainage basin. The smaller the HUC number, the larger the drainage area. For example, a HUC 8 watershed is larger than a HUC 12.

[9] Albeit the St. Marys watershed is identified as the major exporter of TP requiring attention, many efforts are underway and are being planned for all of the 8-digit HUC watersheds within the WLEB.

Prioritizing at the 12-digit HUC watershed scale is important because ambient water quality changes occur more quickly at a smaller watershed scale in response to targeted land-based BMPs and reductions in point source discharges. The process employed by the DAP Advisory Committee to prioritize at the sub-watershed scale included mapping critical areas from WMPs along with NRCS modeled areas of greatest phosphorus export potential, and then overlaying them with vetted water quality data to identify the intersections (see Figure 5). The water quality data from the Allen County SWCD and City of Fort Wayne were grab samples collected weekly as opposed to monthly by IDEM; thus, these data are more likely to capture storm events. The intersections are ranked as the top priorities and the hypotheses and actions proposed to address them serve as the basis of the adaptive management plan included in this DAP. Only those 12-digit HUCs where there are monitoring data are priority ranked. Those watersheds identified by either the NRCS prioritization tool or the critical areas in the WMPs are identified as alternative groups one through three and are colored in different shades of grey on the map to indicate areas where additional monitoring will be prioritized in the future.

Figure 5: Priority Watershed in the Western Lake Erie Basin in Indiana



To better characterize sources and thereby provide a more rigorous baseline for setting nutrient loading targets in the sub-watersheds, Indiana installed:

- A USGS operated and maintained auto-sampler on the Maumee River at the Landin Road bridge to help determine the influence of urban storm water;
- An auto-sampler at the IDEM fixed station site on the St. Marys River at Pleasant Mills to evaluate the nutrient load reductions achieved by the Adams Co. RSD sewer extension project; and
- A USGS stream-flow gage and auto-sampler in the Blue Creek Watershed.

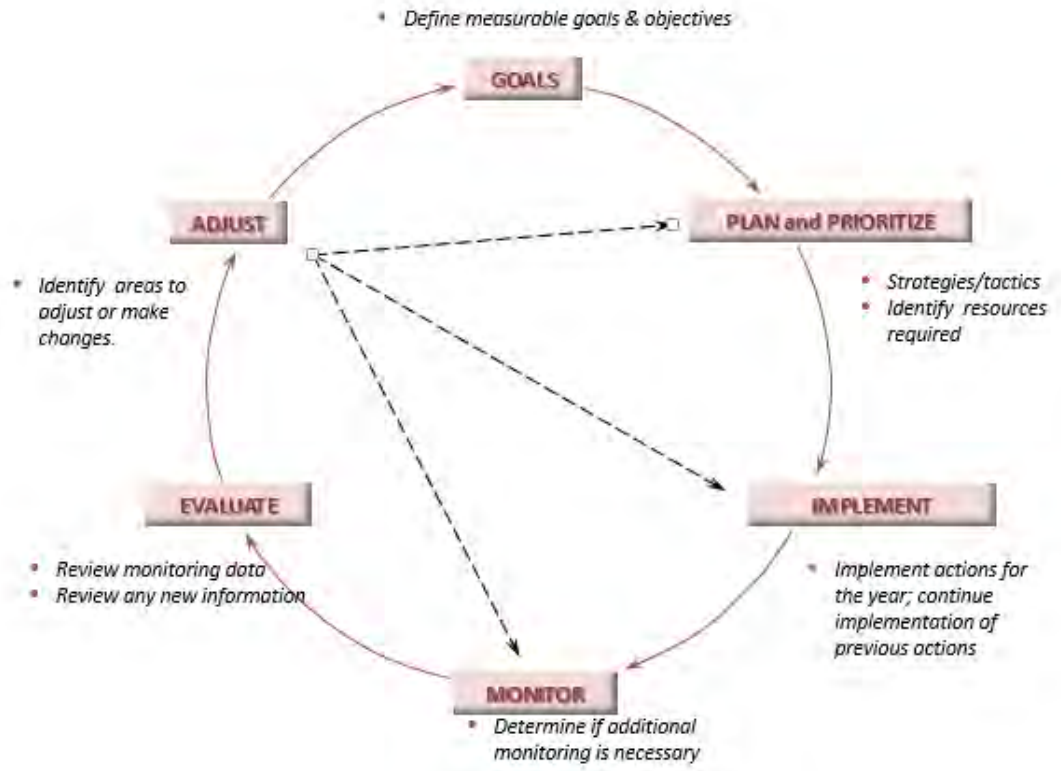
These additional monitoring sites will constitute a higher resolution water sampling data set from which to measure progress in reducing nutrient loads.

ADAPTIVE MANAGMENT

When developing the 2018 DAP, Indiana incorporated adaptive management (Figure 6) into the plan approach and implementation. This update continues to use adaptive management by utilizing a systematic approach to ensure that the plan remained flexible and responsive to changing conditions. Some of the key steps that were used to integrate adaptive management into the plan update include:

- Reviewing the existing plan and identifying what worked well and where improvements or adjustments are needed.
- Clearly define the objectives and goals the Advisory Committee aims to achieve with the updated plan.
- Engage stakeholders in the plan update process to gather their input on what is working, what needs improvement, and any new concerns.
- Evaluate monitoring protocols and update strategies accordingly.

Figure 6. Adaptive management process for Indiana's WLEB DAP.



Based on the lessons learned, stakeholder input, and current data, strategies and actions outlined in this plan were updated accordingly. Adaptive management is well-suited to address the dynamic and interconnected nature of phosphorus loading in the Western Lake Erie Basin. It allows for flexibility, learning from experiences, and adjusting strategies as needed, ultimately working toward a sustainable and healthier environment for all stakeholders in the region.

OBJECTIVES AND APPROACH

In the ongoing effort to reduce phosphorus loading and improve water quality in the Western Lake Erie Basin, a multifaceted approach is essential. Four main objectives have emerged as integral components of this DAP: watershed planning, laws and regulations, nonpoint source load reduction, and education and outreach. Incorporating these four main objectives creates a well-rounded and adaptive approach to reducing phosphorus loading. Each of these main objectives will have individual objectives and actions with timelines outlined in the DAP Action Milestone Table (Appendix 1). The completion of these action items will help keep Indiana on track towards meeting the overall 40% reduction goal.

Watershed Planning

Watershed planning provides a structured framework for understanding, managing, and mitigating negative impacts, such as elevated phosphorus loading, to the watershed. It helps identify critical areas where phosphorus loading is most significant, set local phosphorus reduction goals, and create an implementation plan that outlines strategies on how to reach

those reduction goals. The execution of these plans will help with the overall efforts to meet Lake Erie Annex 4 targets and aid in BMP placement.

Indiana has been committed to watershed planning in the WLEB. At the state level, all watersheds within the WLEB now have an IDEM and U.S. EPA approved CWA Section 319 WMP. These seven plans allow for focused long-term commitment to reducing phosphorus loading and help secure the funding needed for BMPs that will work best for that specific watershed.

Since Indiana has reached its goal of having watershed management plans for the entire WLEB, the next phase of the Indiana GLWQA DAP for watershed planning will be to 1) update WMPs and TMDLs as needed, 2) continue to complete feasibility studies, and 3) support planning at the local level.

Indiana views WMPs as living documents that require periodic updates as land use and water quality change over time and BMPs are implemented. The Advisory Committee will continue to support efforts at the regional level to review WMPs and determine if they need to be updated or not. For example, the Cedar Creek WMP is currently being updated by the City of Fort Wayne through a CWA Section 205(j) grant due to heavy changes in land use and human development since it was first written. Typically, completed feasibility studies and regional plans are incorporated into WMPs when they are developed or updated so the WMP can provide a holistic approach to its planning efforts.

Total Maximum Daily Load (TMDL) reports are assessments of water quality in rivers, lakes, and streams in a given watershed where impairments exist. The report contains an overview of the waterbodies, the sources of pollutants, the methods used to analyze data, reductions in levels of pollutants needed to restore water quality, actions that need to be taken to reduce pollutant levels, and actions that are being taken to improve water quality.

Indiana will also continue to support focused feasibility studies that promote the sustained efforts to achieving and maintaining water quality improvements over time. Feasibility studies play a vital role in addressing problem areas identified in watershed plans by providing an in-depth assessment of the practicality and viability of proposed solutions. These studies help identify actions that are cost-effective and technically feasible at achieving the desired outcomes. One heavily utilized funding mechanisms for feasibility studies is the Indiana DNR Lake and River Enhancement (LARE) Program. More recently awarded LARE grants include an engineering stream assessment on Cedar Creek and a design study on the St. Joseph River awarded in 2023 and for design studies on Cedar Creek and Maumee River awarded in 2022. Typically, these plans lead to focused implementation efforts such as a streambank stabilization project on Cedar Creek that was analyzed by a previous feasibility study.

Regional plans can incorporate watershed plans by recognizing the specific needs, goals, and strategies outlined in watershed plans and integrating them into broader regional planning efforts. By incorporating watershed plans into regional planning efforts, regions can foster a more holistic and integrated approach to land use, development, and environmental

conservation. This collaboration promotes sustainable growth and ensures the health and resilience of the WLEB watershed within the broader regional context.

The Advisory Committee will encourage new watershed planning and studies at all levels to 1) align goals with the Lake Erie Annex 4 targets, 2) incorporate other monitoring and planning efforts in the area, 3) address potential impacts of extreme weather on water resources and communities, and 4) ensure that all communities, regardless of their socioeconomic status or demographics, have equitable access to clean water.

Laws and Regulations

Laws and regulations play a fundamental role in improving water quality by providing the legal framework, standards, and enforcement mechanisms necessary to protect water quality, manage water resources, and safeguard the environment. The Advisory Committee will continue to promote the combination of federal, state, and local laws and regulations that help reduce phosphorus loading.

The Advisory Committee will also promote, and provide technical assistance when requested, laws and regulations aimed at safeguarding our water resources. Comprising experts, stakeholders, and community representatives, the Advisory Committee and partners serve as a platform for collaborative dialogue and informed decision-making. It can provide critical insights, scientific expertise, and real-world feedback to lawmakers and regulatory bodies when needed.

Regulated facilities and permits play a fundamental role in improving water quality by enforcing environmental standards and responsible practices. Through monitoring and enforcement, regulatory agencies like IDEM will continue to hold facilities and operators in compliance. No WWTP violations occurred within the past five years and IDEM will work with operators to keep them in compliance for the next five years.

Nonpoint Source Load Reduction

Phosphorus loading from nonpoint source pollution is one of the largest inputs that needs to be reduced the most. While urban and rural BMP implementation will both be explored and executed, rural BMPs will be the main focus since the majority of the land in the watershed is rural (83.7%), main land use is agriculture (70%), and animal operations have increased since the 2018 DAP. Watersheds identified as high priority in the watershed characterization section will be targeted for BMP implementation. Funding to implement these BMPs will come from federal programs such as U.S. Farm Bill programs, CWA Section 319, and GLRI; state programs such as Indiana DNR LARE and ISDA Clean Water Indiana (CWI); and private-public partnerships with interested nonprofits, educational institutions, and corporations.

Each approved Section 319 watershed management plan contains a list of BMPs that have been deemed to be appropriate for that particular watershed. These BMPs will be encouraged to be adopted with an emphasis on the BMPs that are popular in that area. The Advisory Committee has found that visually seeing a BMP in practice on a peer's field helps that producer become a first-time adopter themself. Once they establish a more common BMP on their land, then they

may examine other BMPs or strategies to further reduce pollutants. Table 5 lists the five most popular BMPs that were installed in the WLEB within the last five years while Table 6 lists the next five most popular BMPs.

Table 5. Top Five Best Management Practices

NRCS FOTG IN Code	BMP
327	Conservation Cover
340	Cover Crops
590	Nutrient Management
512	Pasture and Hay Planting
329 & 345	Residue and Tillage Management, No-Till & Reduced Till

Table 6. Top 6-10 Best Management Practices

NRCS FOTG IN Code	BMP
647	Early Successional Habitat Development/Management
382	Fence
528	Prescribed Grazing
612	Tree/Shrub Establishment
657 & 659	Wetland Restoration/Enhancement

The following BMPs can also be used to reduce phosphorus loads from agricultural lands and help keep soil in place to prevent erosion.

•Conservation Buffers – Strips of land planted with trees and/or grasses help control pollutants by slowing water runoff, preventing erosion, trapping sediment and fertilizers, and enhancing infiltration within the buffer area. Buffers can include riparian areas, grass filter strips, and grassed waterways.

•Grade Stabilization Structures – these are practices that hold soil in place to prevent excessive erosion in high flow areas.

•Blind Inlets – using blind inlets in place of tile risers in the field can filter excess water and P loss to tile drains.

•Soil Testing – conducting a soil test provides an opportunity to check the nutrient levels in the soil, thereby allowing accurate nutrient recommendations and management to be made for the field.

Urban or community based BMPs have not been as heavily adopted historically compared to rural BMPs. The expansion of grant programs will allow for more implementation. For example, U.S. EPA Water Infrastructure Finance and Innovation Act (WIFIA) program is providing billions of dollars in funding to help revitalize water systems, especially in underserved communities. There are BMP selection tools to assist watershed groups with selecting urban best

management practices for their situation and resources such as the Indiana Storm Water Quality Manual.

Education and Outreach

Education and outreach programs are integral components of effective watershed management and essential to being able to reach our goals. Education and outreach programs provide information about the importance of conservation, the value of water quality, and the consequences of environmental degradation. It can help shift attitudes by providing the knowledge, inspiration, and motivation for individuals and communities to take an active role in adopting best management practices. The Advisory Committee will continue to implement and expand on the existing comprehensive education and outreach efforts that the partnership network has created.

The Advisory Committee will continue to work together to make sure partners are delivering consistent and accurate messaging throughout the WLEB. Consistency in messaging avoids conflicting or contradictory information, which reduces confusion and enables individuals to make more informed choices. It helps build credibility and trust which is essential for creating behavior changes and long-term engagement and expansion. The Advisory Committee will continue to use existing successful outreach programs like 4R Nutrient Stewardship and ICP Soil Health Philosophy and will examine new ones like One Water to see how additional audiences can be reached.

Education and outreach programs should convey scientifically accurate and evidence-based information. The Advisory Committee will work with partners to develop forums, workshops, and webinars that deliver messages with scientific data to back it up. Data from the Indiana WLEB will first be used when possible followed by data from other parts in Indiana or other parts of the WLEB in different states.

Local workshops and field days with tailored messaging for the specific community where it is presented can lead to BMP adoption. The tailored messaging should acknowledge and address community-specific concerns. On-site BMP demonstrations where questions are encouraged have been highly successful in attendees eventually adopting their own BMPs. NRCS and SWCD staff along with other partners will continue to provide technical assistance with individuals when requested on implementing and maintaining BMPs.

The next phase of the DAP will focus on expanding education and outreach programs to the different communities within the WLEB area. Effective programs should engage a wide range of stakeholders regardless of their socioeconomic status or demographics. Inclusivity ensures that diverse perspectives and knowledge contribute to the success of our efforts. A variety of communication channels, including social media, community meetings, workshops, printer material and local media, will be utilized ensuring that information is accessible to people with varying communication preferences.

PROGRAMS AND INITATIVES TO ADDRESS NUTRIENT REDUCTIONS

Opportunities exist to reduce nutrient inputs from both urban and rural landscapes, including both point and nonpoint sources. Emphasis is on using existing regulatory and non-regulatory programs and implementing voluntary BMPs. The federal, state, county, and municipal regulatory authorities are outlined in this section along with funding mechanisms ranging from cost-share programs, grants, and loans to storm water utility fees. Technical, financial, and managerial assistance is available for the implementation of programs and projects from all levels of government, academia, nongovernmental organizations (NGOs), businesses, and concerned citizens. Implementation occurs at the local community level on both public and private lands with subsequent watershed and regional water quality benefits for the WLEB.

Point Source Regulatory Programs Administered by IDEM

National Pollutant Discharge Elimination Systems (NPDES): To significantly reduce the discharge of nutrients to surface waters of the state and to protect downstream water uses, IDEM set a practical state treatment standard of 1.0 mg/L of TP for sanitary wastewater dischargers with design flows of 1 million gallons/day (MGD) or greater (Nonrule Policy Document, 2014). Phosphorus limitations are also included per 327 IAC 5-10-2 (phosphorus removal requirements), 5-10-4 (lake dischargers and sinkhole discharges), for discharges directly to stream segments impaired for nutrients (thru informal agreement with U.S. EPA), and as specified by TMDL wasteload allocations.

Additionally, IDEM will implement Total Maximum Dail Load (TMDL) reductions as written and approved for total phosphorous upon the renewal of any affected permit. IDEM's position is that applying the state treatment standard of 1 mg/L total phosphorus to this limiting nutrient sufficiently addresses potential water quality impacts from point sources to freshwater systems; thus, there is no need to interpret Indiana's narrative criteria into water quality-based effluent limits at this time. https://www.in.gov/idem/cleanwater/wastewater-permitting/national-pollutant-discharge-elimination-system-npdes/

Non-Point Source Regulatory Programs Administered by IDEM

Wellhead Protection Program: IDEM's Wellhead Protection Program is an essential educational awareness program focusing on source water protection and promoting the resource value of groundwater. Community Water Systems (CWS), which utilize groundwater as their source of drinking water, are responsible for planning for the prevention of groundwater to become contaminated through the implementation of their Wellhead Protection Plan. CWS planning activities include educating the public on pollution prevention, identifying potential sources of contamination within their Wellhead Protection Area, and promoting the value of the groundwater resources. IDEM developed the Groundwater Monitoring Network (GWMN) to gather groundwater quality information across Indiana to be able to establish a baseline of groundwater quality within Indiana's aquifers. Together, Indiana's Wellhead Protection Program and the GWMN are essential steps in Indiana's protection, characterization and

improvements of groundwater quality. IDEM utilizes CWA Section 106 funding to support GWMN. https://www.in.gov/idem/cleanwater/information-about/groundwater-monitoring-and-source-water-protection/wellhead-protection-program/

Confined Feeding Operations (CFOs): All regulated animal feeding operations in Indiana are considered CFOs with CAFO designation based on size of the operation resulting in a few additional permit requirements.

Anyone who plans to operate or start construction or expansion of a farm that meets the requirements of Indiana's Confined Feeding Control Law (Indiana Code 13-18-10) must submit an application and receive a permit from IDEM prior to beginning construction or expansion of an operation. The laws and rules that govern IDEM's Confined Feeding Operation Program are found in 327 Indiana Administrative Code (IAC) 19 (CFO Rule) and 327 IAC 15-16 (NPDES CAFO Rule). IDEM's permitting, compliance, and enforcement sections implement the rules and the requirements of the laws.

The CFO rule requires that CFO operations apply manure to their fields on the basis of the nitrogen needs for the crop to be grown or the soil's phosphorus content. Previously, manure was applied to fields based only on nitrogen needs for the coming crop. Fields with soil test phosphorus levels of 0 to 50 parts per million (ppm) may use nitrogen-based manure application levels. Current regulations require that manure application on soils with soil test phosphorus levels greater than 50 ppm are not to exceed 200 ppm based on the phosphorus content of the manure, soil, and on the crop to be grown on the field. If soil test phosphorus levels are greater than 200 ppm, manure from a CFO may not be applied to that land. That means that farmers will need to monitor soil phosphorus concentrations and work to begin the gradual process of reducing the phosphorus content of their fields.

Additionally, there are rules specific to CFO operators regarding winter manure application and soil phosphorus. Under these regulations, manure application on frozen or snow-covered ground is not permitted with exceptions for emergency situations. Operators can apply for special permits that allow for winter application if a farm was previously permitted with less than 120 days of manure storage. CAFO sized operations are prohibited from spreading manure on frozen or snow-covered ground unless they get an Individual NPDES permit under 327 IAC15-16. https://www.in.gov/idem/cfo/.

Storm Water Runoff Programs:

Municipal Separate Storm Sewer Systems (MS4s) are required to develop SWQMPs as part of their permit requirements. As part of their Public Education component, MS4s have taken an active role to educate the general public and commercial industry on the use of fertilizer, including the use of phosphorus free options. In addition to these education efforts, MS4s are required to address this issue on those facilities that they own and/or operate. The rule specifically states "minimization of pesticide and fertilizer use." While this is a basic non-descriptive requirement, MS4s have incorporated this element into their SWQMPs. As the Storm Water Program re-evaluates future requirements, this topic will continue to be assessed

and where appropriate and applicable, provisions and requirements will become part of the regulation.

Industrial Site Run-off can be problematic due to the diversity and uniqueness of industrial facilities. Therefore, IDEM deals with such facilities on a case-by-case basis. Issues that are considered in such an approach include, but are not limited to, concentration and loading of the discharge, the applicable aspects (flow, impairments, downstream uses, etc.) of the receiving stream, and the facilities' treatment capabilities.
https://www.in.gov/idem/stormwater/

Voluntary Programs

ISDA Clean Water Indiana (CWI) Grant Program: Administered by ISDA under the direction of the State Soil Conservation Board, CWI is supported through the Indiana cigarette tax revenue on a biannual basis to provide financial assistance to landowners and conservation groups. The financial assistance supports the implementation of conservation practices that reduce NPS of water pollution through education, technical assistance, training, and cost-share programs. The program is responsible for providing local matching funds, as well as competitive grants for sediment and nutrient reduction projects through Indiana's SWCDs and other conservation partners. Furthermore, the CWI Program has supported non-SWCD led grants such as the Conservation Cropping Systems Initiative (CCSI) which focuses on a management system approach to crop production that results in improved soil and water quality as well as profitability on Indiana cropland. Implementation from CWI grants in the WLEB is expected to grow due to the CWI budget expanding.

ISDA Conservation Reserve Enhancement Program (CREP): CREP is a voluntary federal and state natural resource conservation program that aims to improve water quality and address wildlife issues by reducing erosion, sedimentation and nutrients, and enhancing wildlife habitats. This program is designed to help alleviate some of the concerns of high nonpoint source sediment, nutrient, pesticide, and herbicide losses from agricultural lands by restoring grass and riparian buffers and wetlands to improve water quality, as well as to protect land from frequent flooding and excessive erosion by planting hardwood trees in floodplain areas along rivers and streams. The program will be expanded in 2024 to include the entire state of Indiana, so the WLEB will be a part of this expansion. Conservation Buffers, Riparian Buffers, Bottomland Timber Establishments, and Wetland Restorations will be the conservation practices that will be eligible to landowners through the Indiana CREP.

DNR Lake and River Enhancement (LARE) Grant Program (IC 6-6-11-12.5): The goal of the Indiana DNR Division of Fish and Wildlife's LARE Program is to protect and enhance aquatic habitat for fish and wildlife, and to insure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities. This is accomplished through measures that reduce nonpoint sediment and nutrient pollution of surface waters to a level that meets or surpasses state water quality standards. The amount of projects is expected to increase due to the budget increasing during the last legislative cycle.

IDEM CWA Section 319(h): The IDEM Nonpoint Source Section administers CWA Section 319(h) grants which provide funding for various types of projects that work to reduce NPS water pollution. Funds may be used to conduct assessments, develop and implement TMDLs and WMPs, provide technical assistance, demonstrate new technology, and provide education and outreach. In recent years, Indiana has generally received around three and a half million dollars each year for 319 grant funding. Since 1994, Indiana has directed over 66 million dollars of its U.S. EPA 319 nonpoint source grant funding to projects related to reducing nutrient loads to Indiana's surface waters.

IFA State Revolving Fund (SRF) Loan Program: The State Revolving Fund Loan Programs provide low-interest loans to Indiana communities for projects that improve wastewater and drinking water infrastructure. The Indiana Finance Authority administers the SRF Loan Programs, which protect both the environment and public health. Recently, the SRF Loan Programs have also implemented a program to fund nonpoint source projects. As of October 2023, SRF has provided more than $6.1 billion dollars for wastewater and drinking water infrastructure improvements and over $410 million in nonpoint source projects.

Natural Resource Conservation Service Programs

Environmental Quality Incentives Program (EQIP): EQIP is a voluntary conservation program that helps agricultural producers in a manner that promotes agricultural production and environmental quality as compatible goals. Through EQIP, farmers and ranchers receive financial and technical assistance to implement structural and management conservation practices that optimize environmental benefits on working agricultural land. EQIP is open to all eligible agricultural producers without discrimination or bias.

Conservation Stewardship Program (CSP): CSP helps farmers build on their existing conservation efforts while strengthening their operations. NRCS can custom design a CSP plan to help farmers looking to improve grazing conditions, increase crop yields, or develop wildlife habitat. NRCS helps farmers schedule timely planting of cover crops, develop a grazing plan that will improve their forage base, implement no-till to reduce erosion, or manage forested areas in a way that benefits wildlife habitat.

Great Lakes Restoration Initiative (GLRI): GLRI helps NRCS accelerate conservation efforts on private lands located in the WLEB. Through GLRI, NRCS works with farmers and landowners to combat invasive species, protect watersheds and shorelines from nonpoint source pollution and restore wetlands and other habitat areas. Indiana GLRI funds are targeted in the Western Lake Erie Basin.

Agricultural Conservation Easements Program (ACEP): The Agricultural Conservation Easement Program provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect and enhance enrolled wetlands. The ACEP consolidates three former programs

– the Wetlands Reserve Program, Grassland Reserve Program, and the Farm and Ranchland Protection Program.

Regional Conservation Partnership Program (RCPP): The RCPP promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. Indiana's priorities are: water quality, soil quality, and at-risk species habitat. The Western Lake Erie Basin RCPP is a tri-state collaboration between Indiana, Michigan, and Ohio to work with farmers, universities, and non-governmental organizations to offer assistance to producers. Funding from partners will go toward the installation of conservation BMPs and educating landowners of the importance of soil health and decreased nutrient loading.

Conservation Cropping Systems Initiative (CCSI): The Conservation Cropping Systems Initiative is a program of the ICP with a mission of improving soil health on Indiana cropland. This mission is accomplished primarily through education and outreach efforts that are based on farmer-proven management practices and peer-reviewed agronomic and social science.

Developed in partnership with technical experts from USDA-NRCS, Purdue University, and expert farmers, CCSI's full training curriculum is central to ICP soil health education, including Indiana NRCS's Long-Term Soil Health Strategy (03/2018). Since CCSI's inception in 2010, CCSI has participated in over 760 events, reaching approximately 45,750 attendees. These events have been instrumental in the delivery of consistent soil health information and technical assistance by conservation staff and ag professionals.

4R Nutrient Stewardship Program in Indiana: The 4R Nutrient Stewardship Certification Program is a voluntary program for ACI members that encourages agricultural retailers, nutrient service providers and other independent crop consultants to adopt proven best practices through the 4Rs, which refers to using the Right Source of nutrients at the Right Rate at the Right Time in the Right Place. This approach provides a science-based framework for plant nutrition management and sustained crop production while considering specific individual farms' needs. It is a proactive, responsible commitment aimed at the long-term improvement of water quality.

The 4R Nutrient Stewardship Certification Program was launched statewide in November of 2020 with five companies in the state that went through the pilot audit process. It is available to all Indiana-based agricultural retailers and nutrient service providers and provides them the opportunity to participate in efforts to improve nutrient management and efficiencies and to improve water quality in Indiana and beyond. As of 2023, there are four retailers that are 4R certified.

MONITORING AND TRACKING

Having a good monitoring and tracking system helps measure progress towards goals and is a critical component of the adaptive management framework. It helps evaluate actions being taken so that adjustments can be made if needed. The Advisory Committee and partners will continue to track BMP implementation along with a long-term water quality monitoring program. While progress has been made in meeting nutrient reduction goals, much work remains.

Best management practices within the regulatory framework and proactive, voluntary conservation measures matter. Conservation practices have a positive impact on water quality in nutrient pollution reduction both within the state of Indiana and in water bodies outside the state. The many state and federal conservation programs, initiatives and actions illustrate the means by which the state can provide reports and accountability of assisted conservation practices reported by staff in the ICP.

These impacts are shown in a number of ways:

1. Continuation of the use of the Indiana Tillage and Cover Crop Transects and corresponding reports,

2. The use of the U.S. EPA Region 5 Nutrient Load Reduction Model as a means to annually estimate and track sediment, nitrogen and phosphorus load reductions from BMP implementation across Indiana on a watershed-wide scale,

3. An annual preparation of one page load reduction reports for significant waterbodies within Indiana,

4. The use of a GIS Story Map for the WLEB in Indiana that tells the story of conservation going on in Indiana,

5. Instream water quality monitoring for performance measures to look for watershed improvements and trend analysis of data, and

6. Reviewing Edge-of-Field (EOF) monitoring data.

Regulatory framework nutrient reduction best management practices:

1. Publicly Owned Treatment Works (POTW) discharge monitoring reports are submitted monthly and will be graphed annually,

2. Pertinent information from MS4 annual reports will be compiled and reported annually,

3. Long-Term Control Plans (LTCP) pertinent progress will be reported annually.

Indiana's Tillage and Cover Crop Transects

The tillage transect is a cropland survey conducted each spring following planting in each Indiana county by ICP personnel and volunteers. Using a predetermined route, staff look at

farm fields in their county collecting data on tillage methods, plant cover, residue, etc. in order to tell the story of conservation efforts in Indiana. The survey uses GPS technology and provides a statistically reliable method for estimating farm management and related annual trends. Transects are usually conducted bi-annually in the spring after crops are planted. ISDA maintains tillage transect reports dating back to 1990 on their website at https://www.in.gov/isda/divisions/soil-conservation/conservation-transect/ which includes the most recent transect results.

A fall cover crop and tillage transect is also conducted each year after harvest, and results of the fall transect go back to the fall of 2014. This is also done as part of a collaborative effort between ISDA, NRCS, Indiana's 92 SWCDs and other members of the ICP.

The ICP will continue the fall and spring cover crop and tillage transects in future years. To review reports and maps from the transect data showing acres, percentages and trends of conservation tillage and cover crops, visit the Cover Crop and Tillage Transect Data page on the ISDA website. As one of the national leaders in the use of cover crops, nutrient management and advocating of soil health and productivity, Indiana is a great example in the nation for the benefits that improving soils' nutrient uptake and water-holding capacities can do to reduce nutrient loss and excessive runoff from agricultural and other managed lands.

U.S. EPA Region 5 Nutrient Load Reduction Modeling and Mapping

The Region 5 Nutrient Load Reduction Model developed by U.S. EPA estimates sediment, nitrogen and phosphorus load reductions from individual BMPs on the ground. IDEM utilizes this Region 5 model for its 319 funded projects as required by U.S. EPA. ISDA saw the value of using this model as a means to measure the load reductions coming from all technical assisted projects in Indiana, not just for 319 implementation projects. Its use has been standardized by ISDA, and the Region 5 model was adopted by the ICP in 2013 and is now used statewide to model all the conservation practices that are implemented through assistance of all the ICP partnership staff. Cooperation in this effort by local, state and federal partners in the ICP allows for conservation tracking and load reduction estimation at an order of magnitude greater than any single agency or entity could achieve alone.

Indiana collects conservation practice data such as type of practice, practice locations, measurements, and other necessary parameters from ICP partners for all federal, state and local programs, and through the process of data collection, the Advisory Committee can see the impact of the number of conservation practices that are implemented annually. The collected data is then run through the Region 5 model to analyze the sediment, nitrogen and phosphorus load reductions for specific practices.

The accountability/verification and annual reporting on implementation are current expectations among Indiana's Conservation Partners and are regularly being refined and improved. The ICP utilizes the end products of this process to measure load reduction trends by watershed for each calendar year, and serves as a tangible component of the 2023 Indiana GLWQA DAP. An Annual Accomplishments Report for the state is prepared each year and can

be found on the ISDA State Nutrient Reduction Strategy webpage: https://www.in.gov/isda/divisions/soil-conservation/indiana-state-nutrient-reduction-strategy/#Related_Links.

Strengthening and Improving Our Method

The Region 5 model is used to determine nitrogen and phosphorus load reductions that are tied directly to sediment. As a result, nutrients that are dissolved and carried by runoff waters are not accounted for in the model; therefore dissolved nutrients such as nitrate and dissolved phosphorus is missing. Also, there are several practices that cannot be run through the model due to the practice not being tied to sediment, such as nutrient management. The ICP would like to strengthen and improve this existing method of capturing nutrient load reductions so that dissolved nutrients and other practices not tied to sediment can be captured, which will lead to more accurate reductions and better assess the progress being made on improving water quality.

Monitoring conducted around the Midwest and in Indiana provides new understanding of the effectiveness of in-field and edge-of-field conservation practices in reducing nitrogen and phosphorus loads from agricultural fields. This research will be compiled, reviewed and be used to improve the current method that Indiana uses to calculate reductions in sediment, nitrogen, and phosphorus loads by identifying or developing a standardized tool and procedure for calculating nutrient load reductions from conservation practices, and be used in determining the percent efficiency of certain conservation practices on reducing the nitrogen and phosphorus loads.

This component will also include having a collective list and consistent definitions of conservation practices while considering their estimated nitrogen and phosphorus loss reductions, as well as the economic and agronomic feasibility of the practices.

Monitoring and Research

Water quality monitoring will continue at the established monitoring stations previously identified. This data will track nutrient trends over time. Monitoring data from IDEM fixed stations, USGS gage station and auto-sampler sites, and grab sample sites operated at the local and municipal level will be submitted to IDEM and analyzed by the Indiana DAP Monitoring Subcommittee.

To determine if the BMPs installed are resulting in water quality improvements, IDEM conducts follow-up (performance measures) in-stream ambient water quality monitoring. IDEM consults with other members of the ICP to identify 12-digit HUCs where conservation practices have been in place for at least five years. The parameters sampled are based on the water quality impairments for which the stream is listed on the 303(d) List of Impaired Waters; most are for impaired biotic communities. IDEM's monitoring is showing that the watershed approach

employed by the ICP is resulting in water quality improvements. Watershed success stories are found at http://www.in.gov/idem/nps/3360.htm.

Research plays a pivotal role in understanding the complex WLEB system and the phosphorus sources and pathways through that system. It provides the knowledge, evidence, and guidance needed to design and implement effective nutrient reduction strategies. The Advisory Committee will continue to work with partners in identifying and executing research through various funding mechanisms that will help reach the goals and targets outlined in this plan.

Some of the research and analysis that the Advisory Committee would like to consider completing include:

- Map wetland and floodplain restoration opportunities
- Septic system inventory that analyzes the impact of failing septic systems to the WLEB
- Implement additional edge-of-field monitoring projects
- Support or conduct research on drainage water management
- Continue analyzing the impact dissolved reactive phosphorus has on phosphorus loading to the WLEB
- Continue to support research on nitrogen's role in hazardous algal blooms
- Complete ACPF on all the sub-watersheds in the WLEB and analyze findings to communicate with landowners
- Determine the influence of extreme weather and increased precipitation on water quantity and phosphorus input

Reporting

The Advisory Committee will use the abovementioned reporting systems and request partner updates annually to track progress on meeting overall goals and the DAP Action Milestone Table. The DAP Action Milestone Table (Appendix 1) includes the various project implementation schedules. The Indiana DAP will be revised every five years with the next revision being in 2028.

Indiana will stay committed to coordinating with U.S. EPA on providing updates and tracking information in a consistent and timely manner. Reports and data will be provided to U.S. EPA when requested. Partners will continue to report to the ISDA WLEB RCPP SharePoint site for activities reporting.

The IDEM Office of Water Quality (OWQ) develops Indiana's 303(d) List of Impaired Waters as part of the state's Integrated Water Monitoring and Assessment Report (IR), which is submitted to the U.S. EPA every two years in accordance with Sections 305(b) and 303(d) of the Clean Water Act (CWA). Assessment units for the WLEB is included in these reports. The next Integrated Report will be released in 2024.

Progress and updates will be reported to the public through multiple platforms including public meetings, press releases, forums and webinars, and website updates. Targeted briefings will be provided to key stakeholders and impacted groups. Regular reporting, with the ability for input and feedback, will allow stakeholders to hear about progress, lessons learned, research results, and help shape the path forward on meeting nutrient reduction goals. Reports and information will be available on the ISDA Western Lake Erie Basin webpage. https://www.in.gov/isda/divisions/soil-conservation/western-lake-erie-basin/.

Indiana will continue to participate on the Annex 4 overarching binational Subcommittee and with its related task teams and work groups to stay abreast of the evolving science, to provide input, and to seek further direction for continued efforts in addressing nutrient related problems in Lake Erie. If new data and information evaluated within the context of the current assumptions and management strategies for Lake Erie (and the WLEB in particular) determine that phosphorus or other targets need to be adjusted, Indiana will take that into account for modifying its DAP.

CONCLUSION

Reducing phosphorus loading into Lake Erie from Indiana's watersheds is a complex challenge that demands a multi-faceted approach. It affects not only those who live, work or recreate in the watershed, but also the ecosystem and economics of the region. Hoosiers are making a positive difference by managing nutrients on their lawns and farms; building healthy soils; and restoring wetlands, floodplains, and streams.

Employing adaptive management principals, engaging stakeholders and partners, and implementing best management actions and regulatory measures will be essential in achieving the goal of improved water quality in Lake Erie and the preservation of its ecosystem. The DAP provides the framework for Indiana to address the issue of phosphorus loading into Lake Erie while ensuring flexibility and adaptability to changing conditions. Collaboration, commitment, and a long-term perspective are essential to achieve success in this endeavor.

APPENDIX 1

ACTION MILESTONE TABLE

Indiana's GLWQA DAP Action Milestone Table (2024-2028)	
Goal 1: Watershed Monitoring and Planning	
Action Item	**Time-frame**
City of Fort Wayne complete a revised Cedar Creek Watershed Management Plan	2025
Continue funding and securing data from the auto-samplers on the St. Marys River and Maumee River	Continuous
IDEM continues to monitor water quality at Fixed Stations in the WLEB	Monthly
IDEM continues to collect DRP data at Fixed Stations in the WLEB	Monthly
City of Fort Wayne Utilities conducts in-stream water quality sampling.	Continuous
Complete the LARE funded Cedar Creek Stream Assessment	2027
Complete LARE design studies on Cedar Creek and Maumee River	2027
IN WLEB Advisory Committee meets bi-annually to go over Milestone Table and collaborate efforts.	Biannual
IN DAP Monitoring Subcommittee shall analyze phosphorus load concentrations	Continuous
Complete Region 5 Modeling for installed BMPs when appropriate to provide to ISDA each year.	Continuous
Continue to complete ACPF in the subwatersheds of WLEB	2028
Support and provide technical assistance for focused feasibility studies and local planning efforts	Continuous
Review and update WMPs and TMDLs as needed	Continuous
Provide regular progress and update reports to public through multiple communication channels	Continuous
Continue the use of a GIS Story Map to promote WLEB conservation efforts.	Continuous
IN WLEB Advisory Committee prepares an annual preparation of one page load reduction reports for significant waterbodies within Indiana.	Annually
Partners will continue to report to the ISDA WLEB RCPP SharePoint site for activities reporting.	2026
ICP members continue to conduct the spring and fall cover crop and tillage transect survey in the counties in the WLEB.	Biannual
Goal 2: Laws and Regulations	
Action Item	**Time-frame**
Complete the Ft. Wayne Deep Rock Tunnel, or The Three Rivers Protection & Overflow Reduction Tunnel (3RPORT).	2025
CFO/CAFOs stay in compliance	Continuous
WWTP and other major NPDES facilities stay in compliance	Continuous

Promote the use of River Basin Commissions and Watershed Development Commissions as a funding mechanism to address water quantity and water quality issues within the WLEB.	Continuous
Adams County Regional Sewer District complete Project 5 of extension of municipal sanitary sewers to existing septic tank relief areas.	2028
Goal 3: Nonpoint Source Load Reductions	
Action Item	**Time-frame**
Steuben County SWCD continue the WLEB Cost Share Program	2028
MS4s promote urban BMPs for storm water management from streets, parking lots, and other impervious pavement surfaces to community members and homeowners.	2024-2028
Implement LID and green infrastructure practices in urban areas	2024-2028
Promote and implement BMPs that are known to reduce phosphorus loading	2024-2028
Promote and implement BMPs to reduce in-stream phosphorus loading	2024-2028
Expand equipment rental programs with SWCDs that promote BMPs	2024-2028
High priority watersheds will be targeted for BMP implementation.	2024-2028
Promote wetland creation/restoration/preservation	2024-2028
Promote financial assistance programs for septic systems	2024-2028
Promote funding programs identified in the IN WLEB DAP to implement BMPs in the WLEB.	2024-2028
Implement streambank stabilization and riparian restoration projects	2024-2028
Complete native tree plantings in the WLEB	2024-2028
Goal 4: Education and Outreach	
Action Item	**Time-frame**
Continue the promotion and expansion of the 4R Program	2024-2028
ISDA annually compiles ICP accomplishments to show load reductions for phosphorus, nitrogen, sediment and carbon sequestration.	Annually
SWCD Offices in the WLEB provide annual youth education events. Topics may include water quality, soil health, or other conservation-related subjects.	Annually
SWCD Offices in the WLEB hold annual agronomy field days to educate producers on production practices related to water quality issues in the WLEB .	Annually

SWCD Offices in the WLEB host annual meetings, presentations, various district workshops, and booths at 4H Fairs, to educate producers/landowners on production/urban practices related to water quality issues in the WLEB.	Annually
Complete education and outreach programs to increase urban audiences' awareness about water quality and soil conservation practices.	Biannually
Host education and outreach events promoting water quality and conservation to the Amish community.	Biennial
MS4s provide education on a variety of stormwater and water quality related topics to neighborhood groups and other organizations.	Annually
Provide hands-on rain garden workshops and incentives for residents to install a rain garden.	Biennial
Promote water quality and conservation efforts at the Ft Wayne Farm Show each year	Annually
Complete LID maintenance trainings at least once every two years.	Biennial
Promote and host septic system education events	Annually
Promote CCSI events in the WLEB	Quarterly
Promote and expand Farmer Advocate for Conservation in Indiana	2028
Promote ICP Soil Health Philosophy in education material	Continuous

APPENDIX 2

WATER QUALITY DATA ANALYSIS

and

WATERSHED PRIORITIZATION

Annex 4 Summary using IDEM, Allen County SWCD and the City of Fort Wayne Data

Load calculations and flow weighted mean concentrations were calculated using results from the USGS LOADEST model in R. This model uses flow data from USGS gaging stations, which are primarily located on larger streams and river systems. Most of the sampling sites along the main stems are collocated with or have a proximity to gaging stations which results in more precise modelling estimates. Some of the sites along tributaries have much smaller drainage areas than the nearest stream gage which introduces error to the estimates. Load estimates for the smaller tributaries without stream gages might not be reliable, but the calculations can still be used to compare load contributions across the tributaries or within a tributary across time. Bias estimators were calculated as part of the LOADEST model, and analyses were excluded if the absolute value of the bias estimator was greater than 25.

Here is the breakdown of the dataset, both holistically and by basin:

Entire Dataset
N=31 sites
87% of sites (N = 27) have a Drainage Area Ratio >90% and <110%
84% of sites (N = 26) fail the Annual FWMC target of 0.23 mg/L (0.63 Max, 0.16 Min, 0.36 Mean)
90% of sites (N = 28) fail the Seasonal FWMC target of 0.23 mg/L (0.68 Max, 0.19 Min, 0.37 Mean)

St Joseph River
N=11 Sites
91% of sites (N = 10) have a Drainage Area Ratio >90% and <110%
72% of sites (N = 8) fail the Annual FWMC (0.30 Max, 0.18 Min, 0.25 Mean)
91% of sites (N = 10) fail the Seasonal FWMC (0.34 Max, 0.21 Min, 0.27 Mean)

St Marys River
N=12 Sites
67% of sites (N = 8) have a Drainage Area Ratio >90% and <110%
83% of sites (N = 10) fail the Annual FWMC target of 0.23 mg/L (0.63 Max, 0.16 Min, 0.43 Mean)
83% of sites (N = 10) fail the Seasonal FWMC target of 0.23 mg/L (0.68 Max, 0.19 Min, 0.46 Mean)

Maumee River
N=8 Sites
86% of sites (N = 7) have a Drainage Area Ratio >90% and <110%
100% of sites fail the Annual FWMC target of 0.23 mg/L (0.49 Max, 0.36 Min, 0.39 Mean)
100% of sites fail the Seasonal FWMC target of 0.23 mg/L (0.46 Max, 0.36 Min, 0.40 Mean)

St. Marys River Basin

The St. Marys River (STM) originates in Ohio and flows into Indiana near the town of Pleasant Mills. It flows in the northwest direction until it reaches the City of Fort Wayne (CFW), Indiana where it bends north and east to meet with the St. Jospeh River (STJ). The St. Marys and the St. Joseph rivers join to form the Maumee River (M) which flows eastward back into Ohio.

Total Phosphorus

The furthest upstream site on the St. Marys River is an Allen County Soil and Water Conservation District (SWCD) site that sits on the Ohio side of the border (STM-205) at 40.5 miles upstream of the confluence and has an annual FWMC of 0.44 mg/L. STM-37 (IDEM) and STM-222 (SWCD) are the next sites sitting another 4.2 miles downstream in Pleasant Mills, Indiana. These two sites represent the phosphorus load that is coming into Indiana from Ohio and have an annual FWMC of total phosphorus at 0.48 mg/L. In the 4-mile stretch of river upstream of the two Pleasant Mills sites, the drainage area increases by 168 square miles due to Twentyseven Mile Creek and Blue Creek watersheds, which may be contributing to the increase in phosphorus loadings.

Another 6.4 miles downstream is site STM-221 (SWCD). This site had load estimates for the years 2014-2017 and had the lowest average FWMC of sites on the St. Marys mainstem at 0.24 mg/L. The year 2016 was a drought year and may help explain why the average concentration was so low during this time period. The Nickelsen Creek watershed joins the St. Marys River at 16.9 river miles upstream of the confluence and is monitored by Allen County at site NC-STM-211 (SWCD). This site is not a mainstem site, but a site located on the tributary. The annual FWMC was 0.39 mg/L of total phosphorus, which is relatively high for a tributary.

STM-212 (SWCD) is just 1.4 miles downstream of the Nickelsen Creek watershed and the annual FWMC was 0.5 mg/L of total phosphorus. STM-11 (IDEM) and STM-F (Ferguson Rd. CFW) both sit 9.9 miles upstream of the confluence and have an average FWMC of 0.55 mg/L. Snyder ditch and Simmerman Ditch watersheds contribute to the increase in phosphorus loadings between STM-212 and STM-11/STM-F.

The next site downstream is STM-P (Paulding St. CFW), and represents the first site in Fort Wayne, Indiana. The annual FWMC at STM-P was 0.54 mg/L of total phosphorus. The final mainstem site is just 0.5 miles upstream of the confluence with the St. Joseph River at site STM-.8 (IDEM). The FWMC of the St. Marys River at this location is 0.63 mg/L of total phosphorus.

Just 0.4 miles before the confluence, another small tributary enters the St. Marys called Spy Run Creek. The total phosphorus loadings contributed by the Spy Run Creek watershed is measured at the site SRC-STM-C (Clinton St. CFW) and is estimated to have an annual FWMC of 0.16 mg/L.

Table 1. The flow weighted mean concentration (FWMC) of total phosphorus (mg/L) is estimated for sites along the St. Marys River. The white rows are sites on the mainstem of the St. Joseph River and the grey rows are tributary sites. The sites are listed in order from the furthest upstream site to the confluence with the St. Joseph River where the Maumee is formed. River miles are measured upstream from the confluence. The target FWMC is 0.23 mg/L of total phosphorus.

Site	River Miles Upstream	Years	Drainage Area (mi^2)	Annual FWMC (mg/L)	Springtime FWMC (mg/L)
STM-205	40.5	2012-2022	386	0.44	0.46
STM-37	36.3	2008-2022	554	0.48	0.52
STM-222	36.3	2020-2022	554	0.48	0.40
STM-221	29.9	2014-2017	615	0.24	0.29
Nickelsen Creek	16.9				
NC-STM-211		2018-2021	13	0.39	0.43
STM-212	15.5	2012-2022	730	0.50	0.55
STM-11	9.9	2008-2022	761	0.55	0.57
STM-F	9.9	2008-2022	765	0.55	0.58
STM-P	6.2	2013-2022	781	0.54	0.58
STM-.8	0.5	2011-2022	821	0.63	0.68
Spy Run Creek	0.4				
SRC-STM-C		2013-2022	15	0.16	0.19

Orthophosphate / Dissolved Reactive Phosphorus (DRP)

There was only 1 site in the St. Marys River Basin where orthophosphate was modeled. The Nickelsen Creek site NC-STM-211 (SWCD) had an annual FWMC of 0.19 mg/L of orthophosphate.

Table 2. The flow weighted mean concentration (FWMC) of orthophosphate (mg/L) is estimated for sites along the St. Marys River. The only site where the FWMC of orthophosphate was measured was at a tributary site in Nickelsen Creek (NC). River miles are measured on the St. Marys River upstream of the confluence and represent where Nickelsen Creek flows into the St. Marys. The target FWMC is 0.05 mg/L of orthophosphate.

Site	River Miles Upstream	Years	Drainage Area (mi^2)	Annual FWMC (mg/L)	Springtime FWMC (mg/L)
Nickelsen Creek	16.9				
NC-STM-211		2018-2021	13	0.19	0.17

St. Joseph River Basin

The headwaters of the St. Joseph River originate in Michigan. The river flows through Northwest Ohio before entering Northeast Indiana. St. Joesph River flows in the southwest direction into Fort Wayne, Indiana, where it meets the St. Marys River. The St. Joseph and St. Marys rivers join to form the Maumee River which flows eastward back into Ohio.

Total Phosphorus

The furthest upstream site on the St. Joseph River (STJ-163) is monitored by Allen Co SWCD and sits 42.3 river miles upstream near the Ohio-Indiana border in Ohio. The annual FWMC is 0.18 mg/L of total phosphorus. The next site is 6 miles downstream at STJ-36 (IDEM) and sits just inside the Ohio-Indiana border in Indiana. This site represents the total phosphorus contribution of Ohio and Michigan entering Indiana. The estimated annual FWMC is 0.23 mg/L of total phosphorus. In the 6-mile stretch between the first two sites upstream there are three watersheds that potentially contribute to the increase in phosphorus loads including Buck Creek, Sol Shank Ditch, and Willow Run watersheds.

At 14.8 river miles upstream of the confluence, the river is dammed to form the Cedarville Reservoir. The next mainstem site is STJ-M (Mayhew Rd. CFW) and is located 5.3 river miles downstream of the dam. STJ-M had an annual FWMC of 0.23 mg/L of total phosphorus.

Between the Cedarville Reservoir dam and site STJ-M, Cedar Creek flows into the St. Joseph at 13.4 miles upstream of the confluence. The Cedar Creek is a large tributary the St. Joseph and has a drainage area of about 270 mi^2. There are four sites along Cedar Creek. The furthest upstream site is CC-STJ-105 (SWCD) and is 22 river miles upstream of where Cedar Creek flows into the St. Joseph. The annual FWMC at this site is 0.26 mg/L of total phosphorus. Site CC-STJ-100 (SWCD) sits 5.8 miles upstream and has an annual FWMC of 0.3 mg/L of total phosphorus. The final two sites, CC-4 (IDEM) and CC-STJ-H (Hursh Rd. CFW) at 3.6 river miles upstream. The IDEM site estimated an annual FWMC of 0.26 mg/L and the City of Fort Wayne site estimated 0.3 mg/L of total phosphorus. Both sites had water samples collected monthly and the City of Fort Wayne data predicted higher total phosphorus loading and higher FWMC values compared the IDEM data.

At 5.6 river miles upstream on the St. Joesph mainstem, site STJ-4 (IDEM) represents the first site in Fort Wayne. This site had an estimated annual FWMC of 0.25 mg/L of total phosphorus for the years. The last two sites, STJ-.5 (IDEM) and STJ-T (Tennessee Ave. CFW), sit just 0.4 river miles upstream of the confluence and had an estimated FWMC of 0.23 and 0.22 mg/L of total phosphorus, respectively. The annual FWMC in the St. Joseph River just before it joins with the St. Marys to form the Maumee is at or below the target concentration of 0.23 mg/L of total phosphorus.

Table 3. The flow weighted mean concentration (FWMC) of total phosphorus (mg/L) is estimated for sites along the St. Joseph River. The white rows are sites on the mainstem of the St. Joseph River and the grey rows are tributary sites. The sites are listed in order from the furthest upstream site to the confluence with the St. Marys River where the Maumee is formed. River miles are measured on the St. Joseph River upstream of the confluence with the St. Marys River, except in the case of the multiple sites along Cedar Creek, where the river miles represent the river miles upstream of where Cedar Creek joins the St. Joseph River. The target FWMC is 0.23 mg/L of total phosphorus.

Site	River Miles Upstream	Years	Drainage Area (mi^2)	Annual FWMC (mg/L)	Springtime FWMC (mg/L)
STJ-163	42.3	2014-2022	610	0.18	0.21
STJ-36	36.3	2008-2022	650	0.23	0.25
Cedar Creek	13.4				
CC-STJ-105	22 (CC)	2014-2022	87	0.26	0.30
CC-STJ-100	5.8 (CC)	2014-2022	269	0.30	0.34
CC-4	3.6 (CC)	2008-2022	270	0.26	0.26
CC-STJ-H	3.6 (CC)	2008-2022	270	0.30	0.30
STJ-M	9.5	2008-2022	1065	0.23	0.26
STJ-4	5.6	2011-2022	1082	0.25	0.27
STJ-.5	0.4	2008-2022	1093	0.23	0.25
STJ-T	0.4	2008-2022	1094	0.22	0.24

Orthophosphate / Dissolved Reactive Phosphorus (DRP)

Orthophosphate was estimated to be at a FWMC of 0.08 mg/L in Cedar Creek as it flows into the St. Joseph River. The next site downstream had an estimated annual FWMC of 0.10 mg/L of orthophosphate. The final site (STJ-.5) which sits near the confluence with St. Marys River had an estimated FWMC of 0.11 mg/L of orthophosphate. The average FWMC of these sites never met the target FWMC of 0.05 mg/L of orthophosphate, though the values calculated in individual years did sometimes meet the target.

Table 4. The flow weighted mean concentration (FWMC) of orthophosphate (mg/L) is estimated for sites along the St. Joseph River and its tributaries. River miles are measured on the St. Joseph River upstream of the confluence except where the Cedar Creek site is measured upstream of where Cedar Creek flows into St. Joseph River. The target FWMC is 0.05 mg/L of orthophosphate.

Site	River Miles Upstream	Years	Drainage Area (mi^2)	Annual FWMC (mg/L)	Springtime FWMC (mg/L)
Cedar Creek	13.4				
CC-4	3.6 (CC)	2018-2022	270	0.08	0.07
STJ-4	5.6	2018-2022	1082	0.10	0.09
STJ-.5	0.4	2018-2022	1093	0.11	0.09

Maumee River

The Maumee River begins where the St. Marys River and the St. Joseph River meet, in Fort Wayne, Indiana. It flows in an east to northeast direction out of Indiana and into Ohio.

Total Phosphorus

Two sites are in Fort Wayne and are the furthest upstream sites on the Maumee River, M-A (Anthony Blvd. CFW) and M-132 (IDEM). The annual FWMC of the upstream part of the river, as measured by the City of Fort Wayne, was 0.38 mg/L of total phosphorus. The annual FWMC at M-132 was 0.36 mg/L of total phosphorus.

Another 6 river miles downstream are sites M-L (Landin St. CFW) and M-129 (IDEM) in New Haven, Indiana. The annual FWMC of these two sites are 0.38 mg/L and 0.36 mg/L, respectively. Downstream, Sixmile Creek joins the Maumee River and Bottern Ditch contributes to the Maumee further downstream. The next large watershed to join the Maumee is the Black Creek, which is monitored by Allen Co SWCD at site BC-M-304. The FWMC was 0.49 mg/L of total phosphorus at the site where Black Creek flows into the Maumee.

The last site downstream on the Maumee River mainstem is M-SR101 (SR 101, CFW), M-114 (IDEM), and M-312 (SWCD). This location represents the phosphorus load that is exiting Indiana and going into Ohio. The FWMC measured by the three agencies were 0.42, 0.36, and 0.37 mg/L of total phosphorus, respectively. The differences in the average annual FWMC are likely due to differences in sampling frequency. The Allen County SWCD collects samples weekly from April to October, IDEM and City of Fort Wayne collected samples monthly, but the City of Fort Wayne had several missing samples in the winter months.

Table 5. The flow weighted mean concentration (FWMC) of total phosphorus (mg/L) is estimated for sites along the Maumee River. The white rows are sites on the mainstem of the Maumee River and the grey rows are tributary sites. The sites are listed in order from the furthest upstream site at the confluence of St. Joseph and St. Marys rivers. River miles are measured on the Maumee River downstream of start of the Maumee River. The target FWMC is 0.23 mg/L of total phosphorus.

Site	River Miles Downstream	Years	Drainage Area (mi^2)	Annual FWMC (mg/L)	Springtime FWMC (mg/L)
M-A	1.3	2008-2022	1935	0.38	0.41
M-132	1.3	2008-2022	1935	0.36	0.37
M-L	7.3	2008-2022	1977	0.38	0.41
M-129	7.3	2008-2022	1977	0.36	0.36
Black Creek	21.3				
BC-M-304		2015-2022	19	0.49	0.43
M-SR101	22.5	2008-2022	2090	0.42	0.45
M-114	22.5	2008-2022	2090	0.36	0.36
M-312	22.5	2014-2022	2090	0.37	0.39

Orthophosphate / Dissolved Reactive Phosphorus (DRP)

Site M-129 (IDEM) is 7.3 miles downstream and the annual FWMC was 0.16 mg/L of orthophosphate. The last site before the Maumee River reaches Ohio is 22.5 miles downstream (M-114) and the annual FWMC was 0.17 mg/L of orthophosphate.

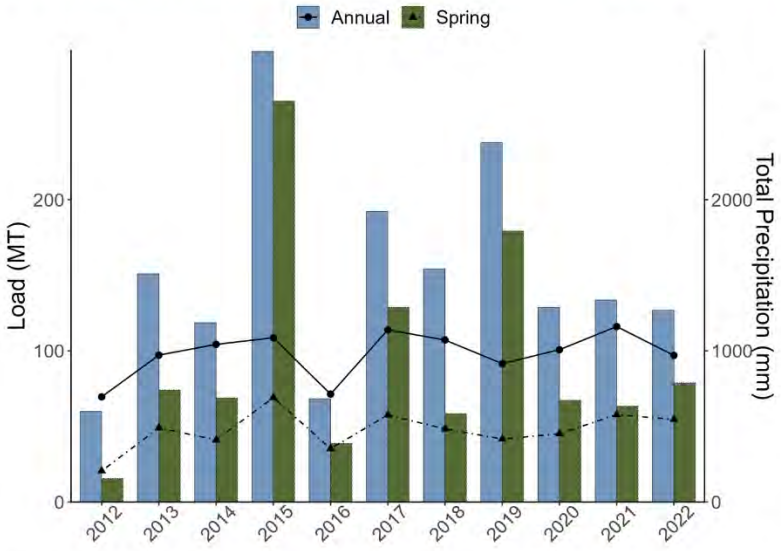
Table 6. The flow weighted mean concentration (FWMC) of orthophosphate (mg/L) is estimated for sites along the Maumee River. River miles are measured on the Maumee River downstream of start of the Maumee River. The target FWMC is 0.05 mg/L of orthophosphate.

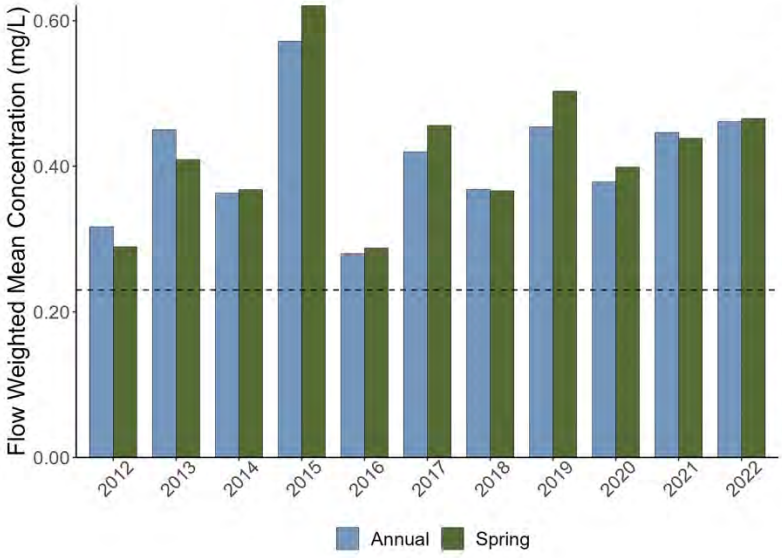
Site	River Miles Downstream	Years	Drainage Area (mi^2)	Annual FWMC (mg/L)	Springtime FWMC (mg/L)
M-129	7.3	2018-2022	1977	0.16	0.13
M-114	22.5	2018-2022	2090	0.17	0.14

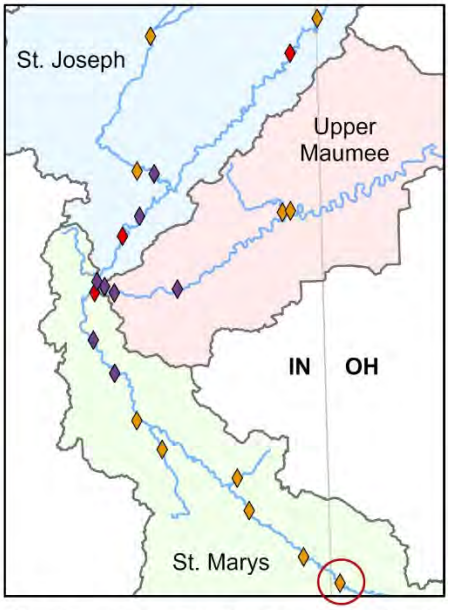
St. Marys River Mainstem

at OH-IN border (Allen Co STM-205)

Total Phosphorus (TP)	
USGS Streamgage	04181500
Drainage Area Ratio	0.62
Allen Co SWCD Data (April – October)	2012-2022
Average Annual Load (pounds/year)	575,136
Average Springtime Load (1 Mar – 31 Jul)	350,593
Reduction Needed to Meet Spring Target	176,378







Site Allen Co SWCD site STM-205 is the far upstream site on the St. Marys River in Ohio at the border with Indiana (red circle and orange diamond in map). TP samples were collected weekly from April to October in 2012-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

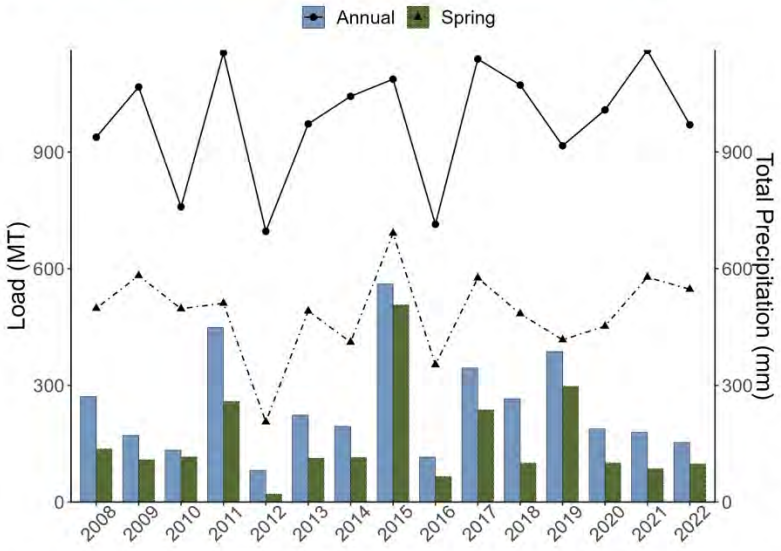
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

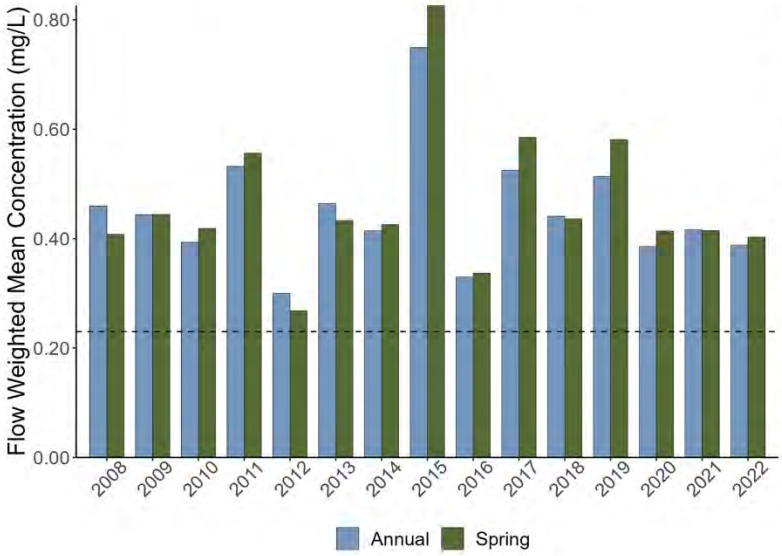
Results There is a large variation in the load estimates across years with the highest values occurring in 2015 and 2019. Load estimates have been relatively stable since 2020. Springtime TP loads made up an average of 61% of total annual loads.

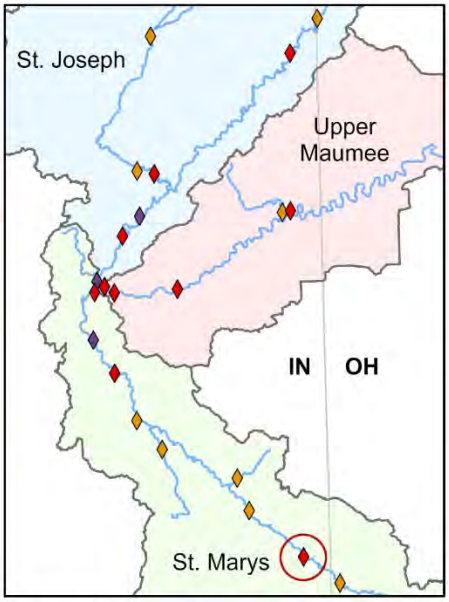
St. Marys River Mainstem

at OH-IN border (Fixed Station STM-37)

Total Phosphorus (TP)	
USGS Streamgage	04181500
Drainage Area Ratio	0.89
IDEM Fixed Station Data	2008-2022
Average Annual Load (pounds/year)	546,432
Average Springtime Load (1 Mar – 31 Jul)	347,008
Reduction Needed to Meet Spring Target	192,228







Site IDEM Fixed Station site STM-37 is collocated with the Allen Co site STM-222. It is a far upstream site on the St. Marys River in Indiana and sits at the border with Ohio (red circle and red diamond in map). TP samples were collected monthly in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

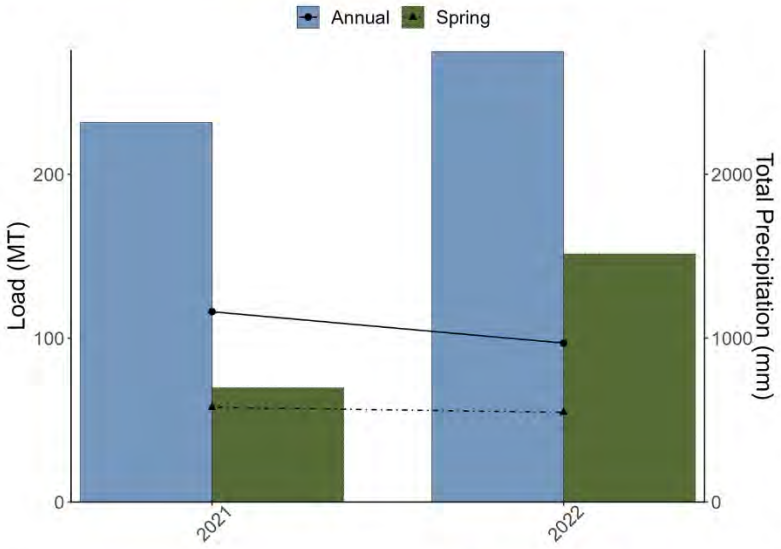
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

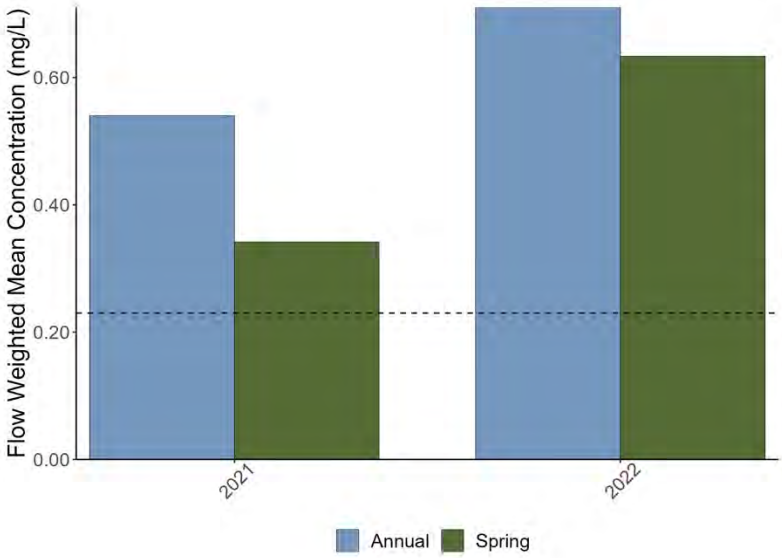
Results The lowest precipitation years (2012 and 2016) resulted in the lowest TP load and flow weighted mean concentration. Springtime TP loads made up an average of 64% of total annual loads.

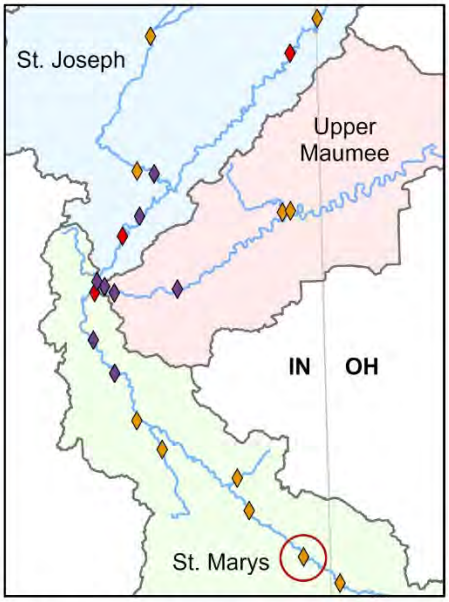
St. Marys River Mainstem

Upstream (Allen Co STM-222)

Total Phosphorus (TP)	
USGS Streamgage	04181500
Drainage Area Ratio	0.89
Allen Co SWCD Data (April – October)	2021-2022
Average Annual Load (pounds/year)	463,677
Average Springtime Load (1 Mar – 31 Jul)	200,734
Reduction Needed to Meet Spring Target	84,193







Site Allen Co SWCD site STM-222 is collocated with IDEM site STM-37. It is an upstream site on the St. Marys River in Pleasant Mills, Indiana (red circle and orange diamond in map). TP samples were collected weekly from April to October in 2021-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

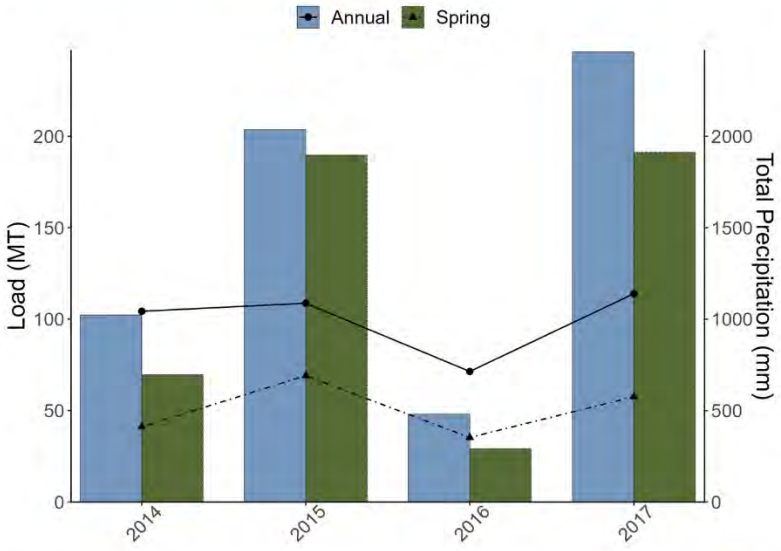
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

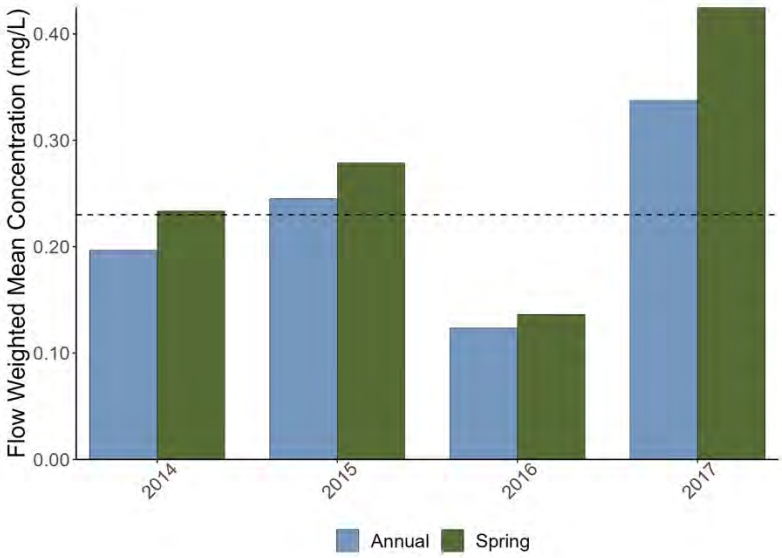
Results The flow weighted mean concentration was never below the target of 0.23 mg/L. Springtime TP loads made up an average of 43% of total annual loads.

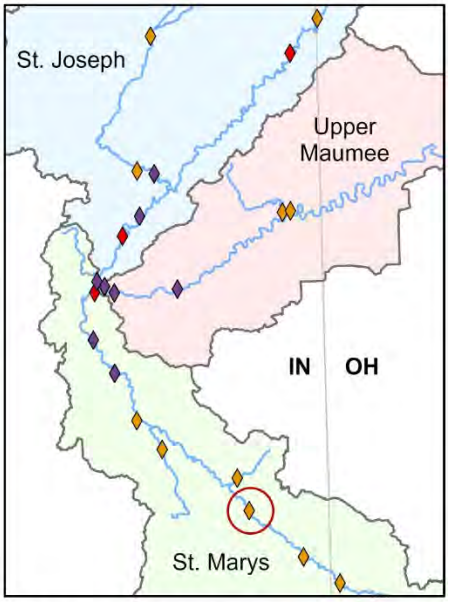
St. Marys River Mainstem

Upstream (Allen Co STM-221)

Total Phosphorus (TP)	
USGS Streamgage	04181500
Drainage Area Ratio	0.99
Allen Co SWCD Data (April – October)	2014-2017
Average Annual Load (lb./yr.)	330,817
Average Springtime Load (1 Mar – 31 Jul)	264,671
Reduction Needed to Meet Spring Target	56,117







Site Allen Co SWCD site STM-221 is an upstream site on the St. Marys River in Indiana (red circle and orange diamond in map). TP samples were collected weekly from April to October in 2014-2017.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

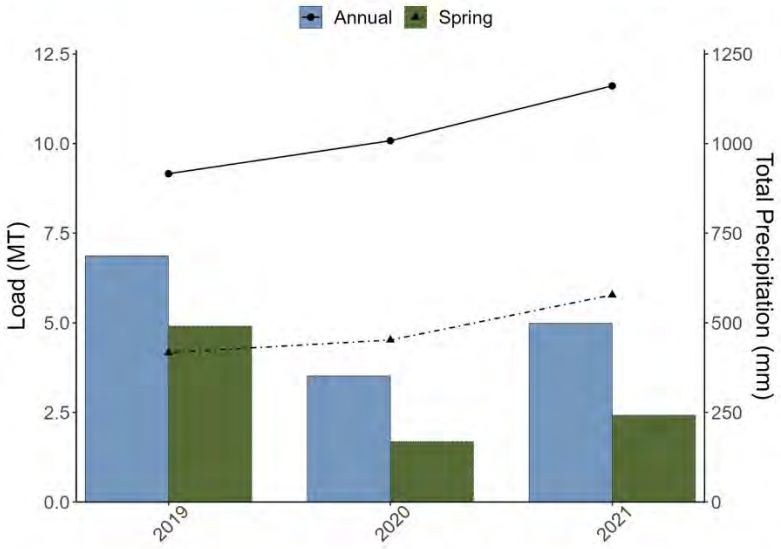
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

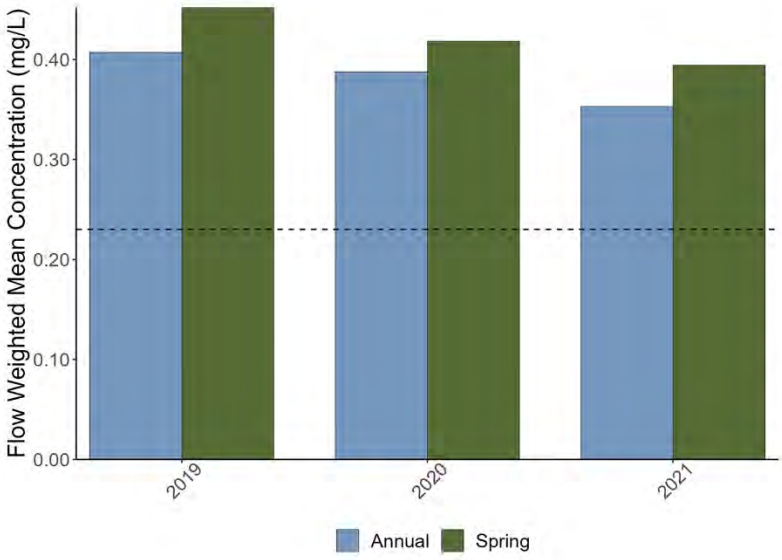
Results The springtime flow weighted mean concentration was lower than the target in 2016 (dry year). Springtime TP loads made up an average of 80% of total annual loads.

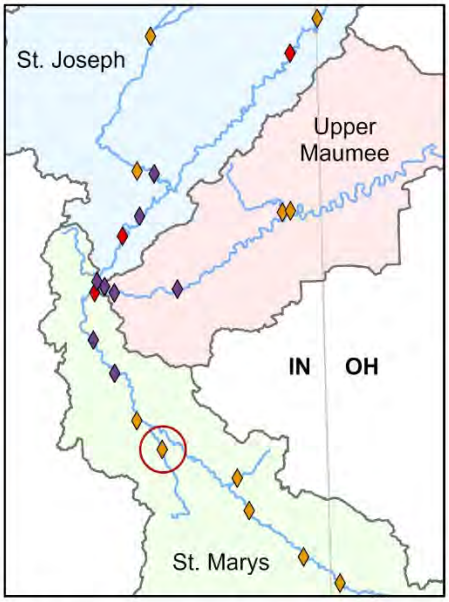
Nickelsen Creek (St. Marys)

Tributary to St. Marys (Allen Co NC-STM-211)

Total Phosphorus (TP)	
USGS Streamgage	04181755
Drainage Area Ratio	1
Allen Co SWCD Data (April – October)	2019-2021
Average Annual Load (lb./yr.)	9,961
Average Springtime Load (1 Mar – 31 Jul)	6,633
Reduction Needed to Meet Spring Target	3,074







Site Allen Co SWCD site NC-STM-211 is on a tributary to the St. Marys called Nickelsen Creek in Indiana (red circle and orange diamond in map). TP samples were collected weekly from April to October 2019 – 2021.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

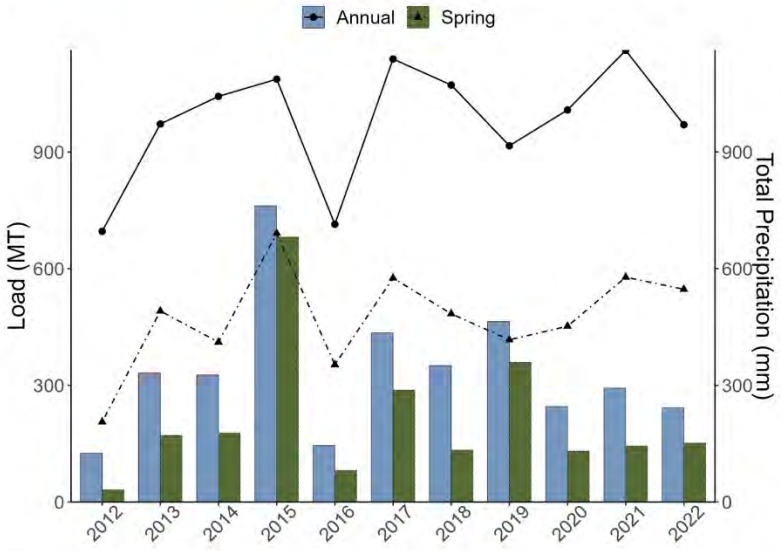
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

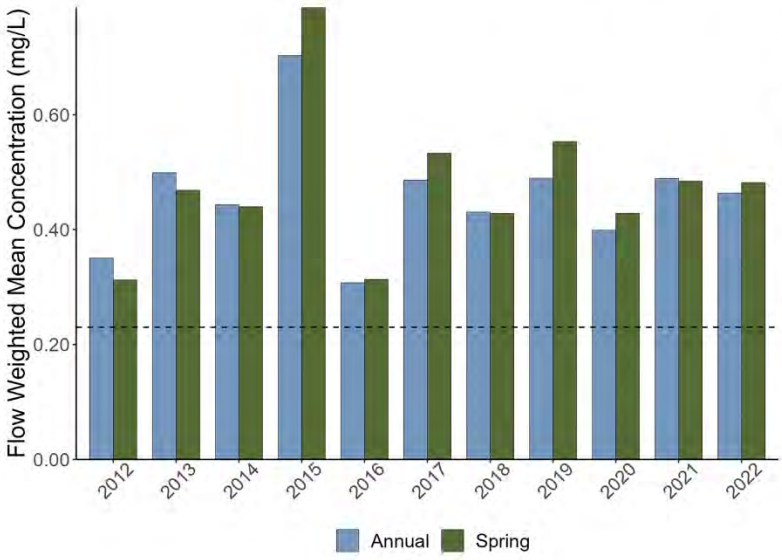
Results The springtime flow weighted mean concentration was higher than the annual mean concentrations for all years in 2019-2021. Springtime TP loads made up an average of 67% of total annual loads.

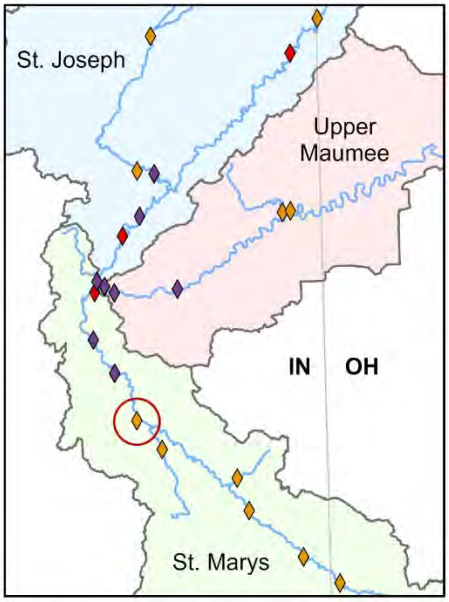
St. Marys River Mainstem

Midstream (Allen Co STM-212)

Total Phosphorus (TP)	
USGS Streamgage	04182000
Drainage Area Ratio	0.96
Allen Co SWCD Data (April – October)	2012-2022
Average Annual Load (lb./yr.)	774,956
Average Springtime Load (1 Mar – 31 Jul)	483,302
Reduction Needed to Meet Spring Target	279,582







Site Allen Co SWCD site STM-212 is a midstream site on the St. Marys River in Indiana (red circle and orange diamond in map). TP samples were collected weekly from April to October in 2012-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

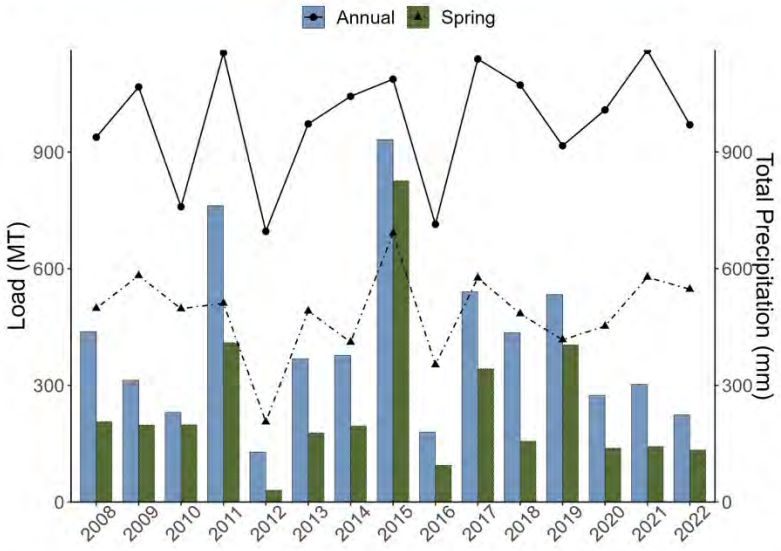
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

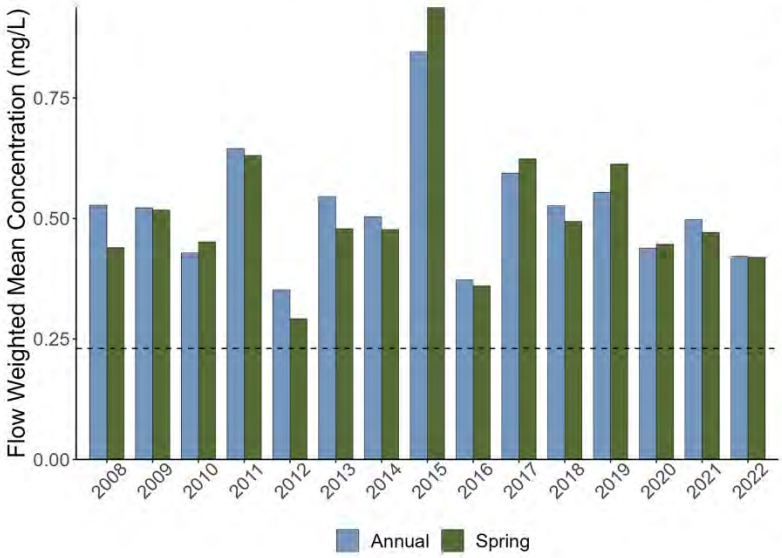
Results The lowest precipitation years (2012 and 2016) resulted in the lowest loadings. The flow-weighted mean concentration was the greatest in 2015 and has been relatively stable since 2017. Springtime TP loads made up an average of 62% of total annual loads.

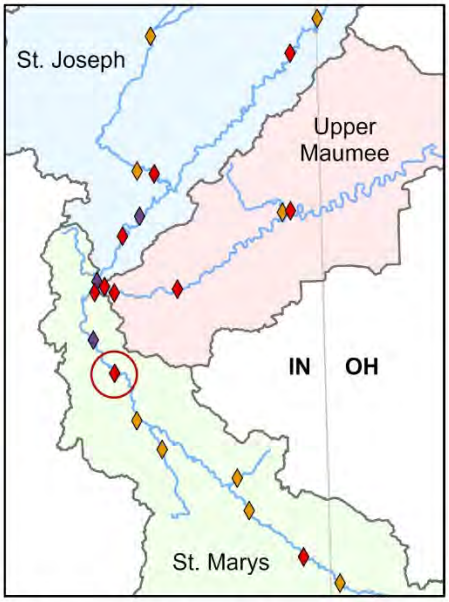
St. Marys River Mainstem

Midstream (Fixed Station STM-11)

Total Phosphorus (TP)	
USGS Streamgage	04182000
Drainage Area Ratio	1
IDEM Fixed Station Data	2008-2022
Average Annual Load (lb./yr.)	887,766
Average Springtime Load (1 Mar – 31 Jul)	537,666
Reduction Needed to Meet Spring Target	320,109







Site The IDEM Fixed Station site STM-11 is collocated with the City of Fort Wayne site STM-F. It is a midstream site on the St. Marys River in Indiana (red circle and red diamond in map). TP samples were collected monthly in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

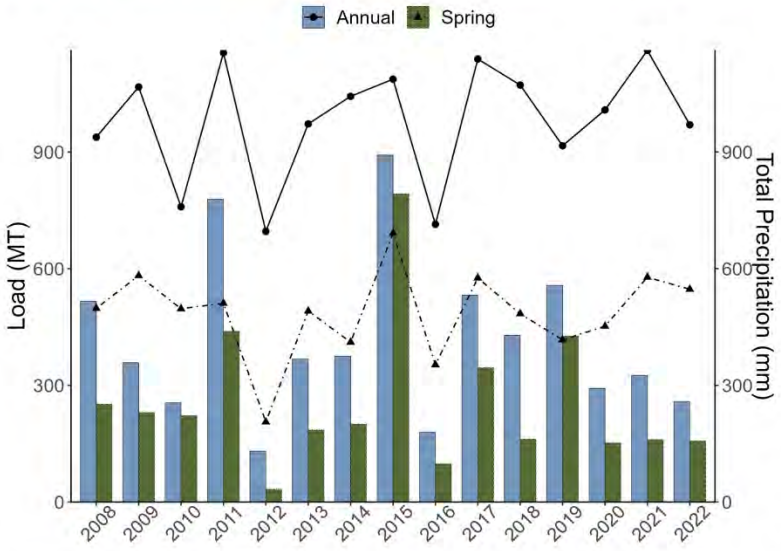
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

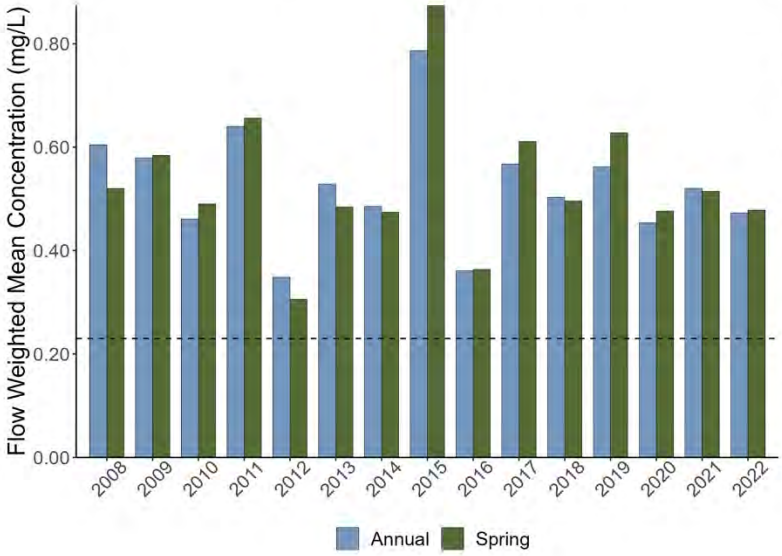
Results Heavy precipitation in the months outside of the springtime season contributed to very high annual loads in 2011. Springtime precipitation in 2015 was the highest and contributed to high TP loads and FWMC. Springtime TP loads made up an average of 61% of total annual loads.

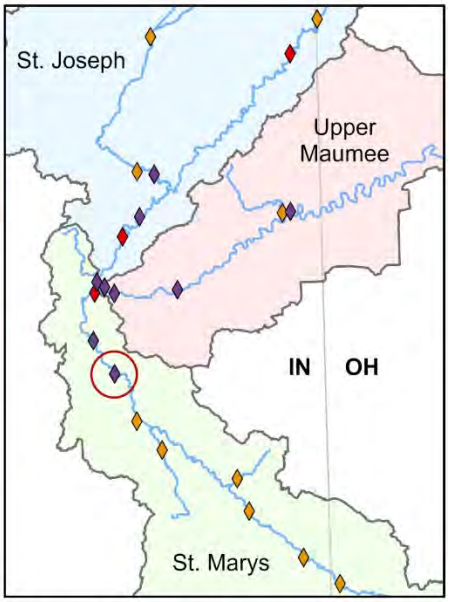
St. Marys River Mainstem

Midstream (City of Fort Wayne STM-F)

Total Phosphorus (TP)	
USGS Streamgage	04182000
Drainage Area Ratio	1
City of Fort Wayne Data	2008-2022
Average Annual Load (lb./yr.)	918,417
Average Springtime Load (1 Mar – 31 Jul)	567,156
Reduction Needed to Meet Spring Target	343,143







Site The City of Fort Wayne site STM-F is collocated with IDEM site STM-11. It is a midstream site on the St. Marys River in Indiana (red circle and purple diamond in map). TP samples were collected weekly April-October and monthly November-March in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

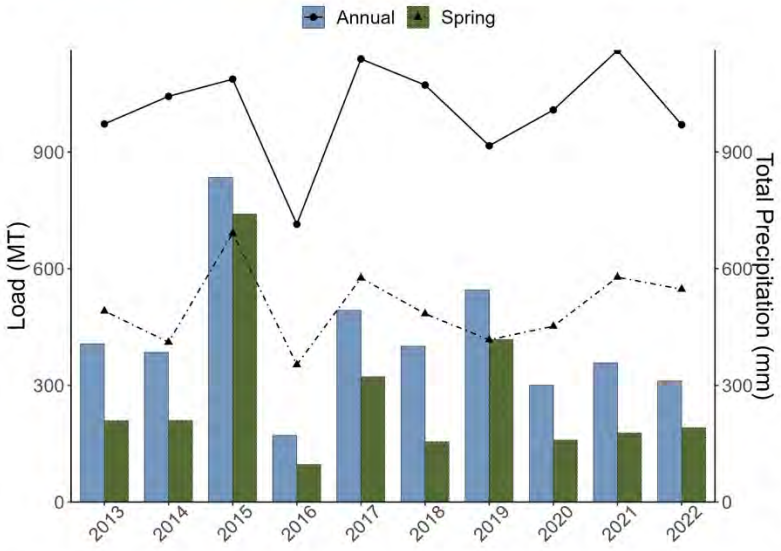
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

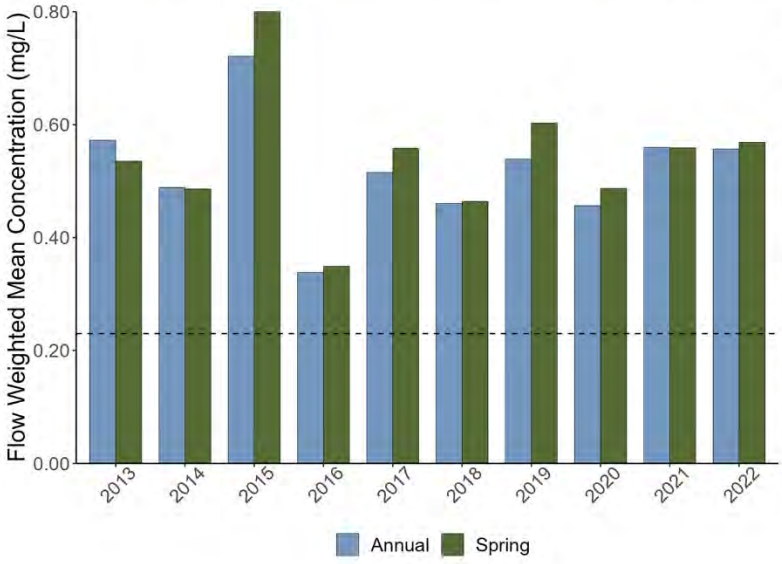
Results Springtime precipitation in 2015 was the highest and contributed to high TP loads and FWMC. Loads and mean concentrations have remained steady in 2020-2022. Springtime TP loads made up an average of 62% of total annual loads.

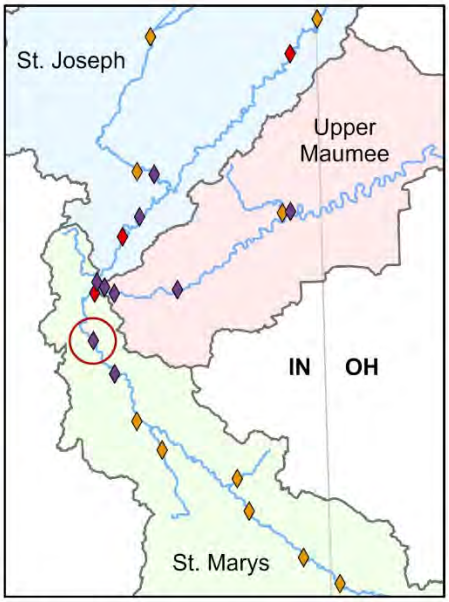
St. Marys River Mainstem

Midstream (City of Fort Wayne STM-P)

Total Phosphorus (TP)	
USGS Streamgage	04182000
Drainage Area Ratio	1
City of Fort Wayne Data	2013-2022
Average Annual Load (lb./yr.)	927,536
Average Springtime Load (1 Mar – 31 Jul)	591,238
Reduction Needed to Meet Spring Target	357,296







Site The City of Fort Wayne site STM-P is a midstream site on the St. Marys River in Indiana (red circle and purple diamond in map). TP samples were collected weekly April-October and monthly November-March in 2013-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

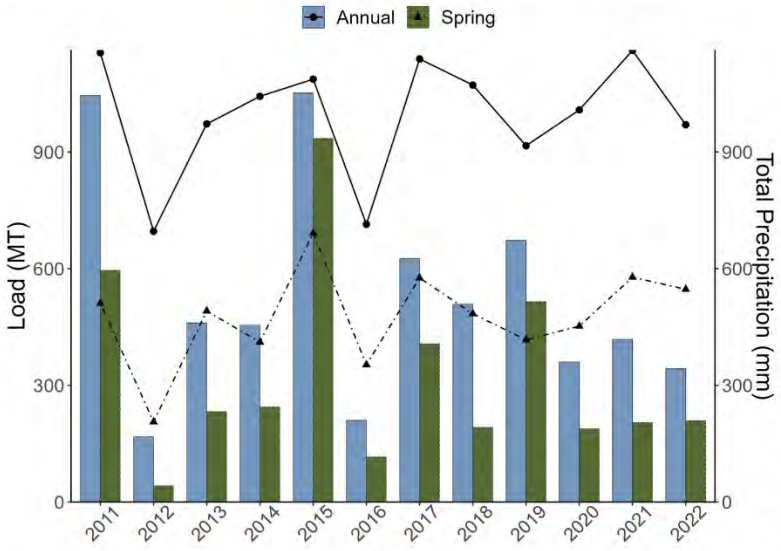
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

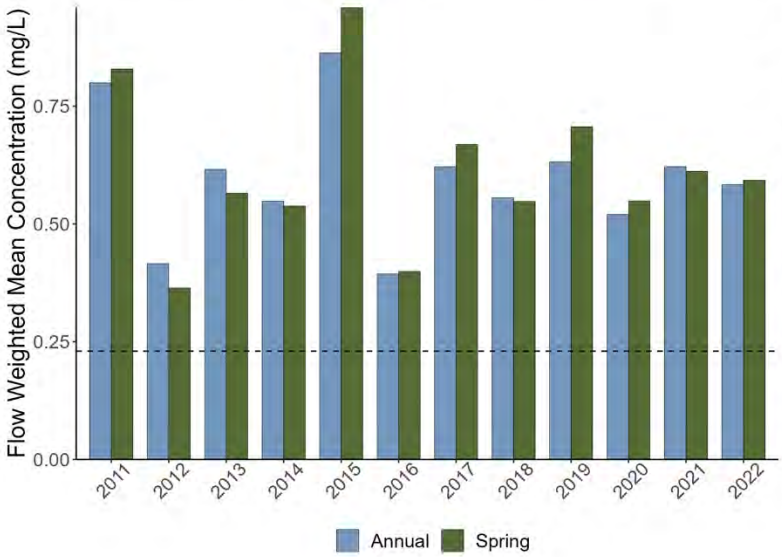
Results Springtime precipitation in 2015 was the highest and contributed to high TP loads and FWMC. Loads and mean concentrations have remained steady in 2021 & 2022. Springtime TP loads made up an average of 64% of total annual loads.

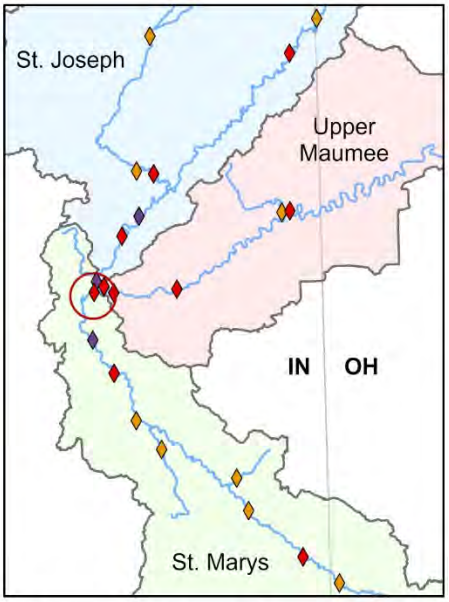
St. Marys River Mainstem

Downstream at confluence (Fixed Station STM-.8)

Total Phosphorus (TP)	
USGS Streamgage	04182000
Drainage Area Ratio	0.96
IDEM Fixed Station Data	2011-2022
Average Annual Load (lb./yr.)	1,161,012
Average Springtime Load (1 Mar – 31 Jul)	713,853
Reduction Needed to Meet Spring Target	473,484







Site The IDEM Fixed Station site STM-.8 is a downstream site on the St. Marys River in Fort Wayne Indiana just before the confluence with St. Joseph River (red circle and red diamond in map). TP samples were collected monthly in 2011-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

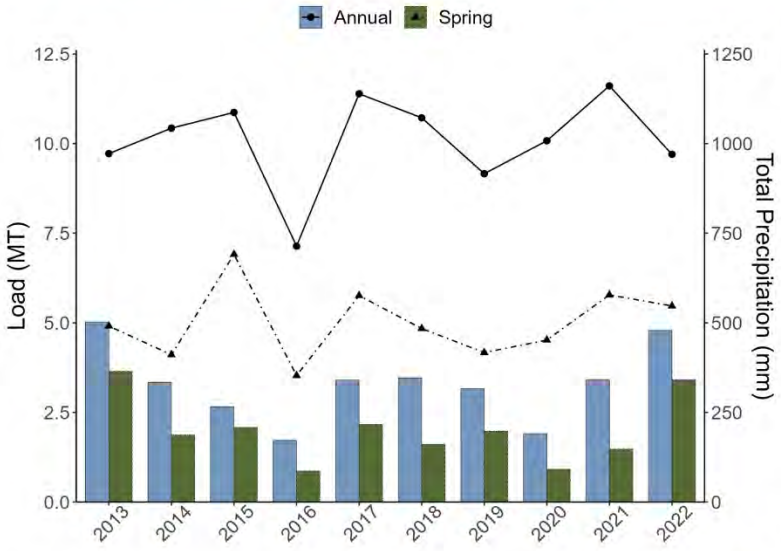
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

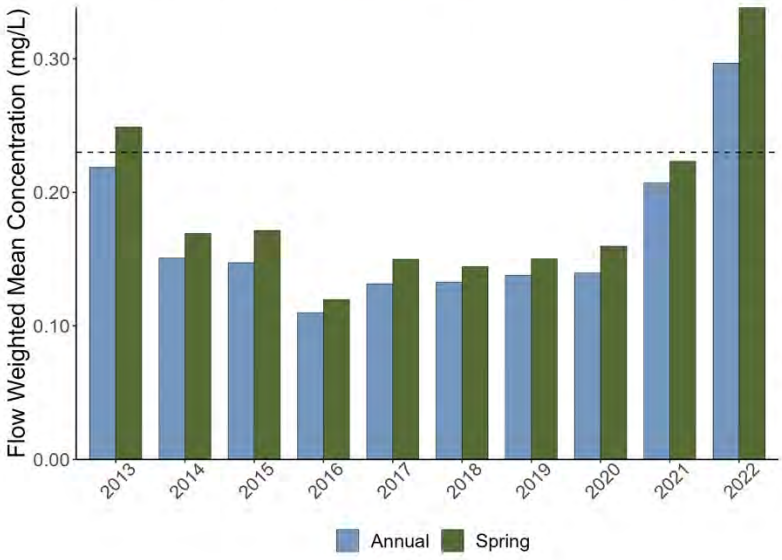
Results Heavy precipitation in the spring of 2015 contributed to very high annual loads and mean concentration. Mean concentration has remained relatively stable since 2017. Springtime TP loads made up an average of 61% of total annual loads.

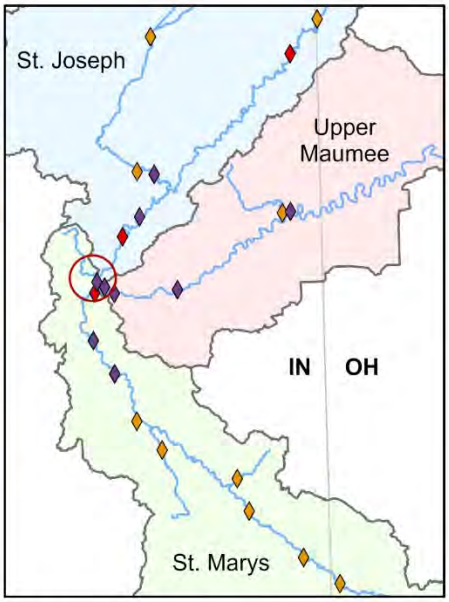
Spy Run Creek (St. Marys)

Tributary St. Marys (City of Fort Wayne SRC-STM-C)

Total Phosphorus (TP)	
USGS Streamgage	04182808
Drainage Area Ratio	1.1
City of Fort Wayne Data	2013-2022
Average Annual Load (lb./yr.)	7,250
Average Springtime Load (1 Mar – 31 Jul)	4,423
Reduction Needed to Meet Spring Target	0







Site The City of Fort Wayne site SRC-STM-C is a downstream site on Spy Run Creek, a tributary to the St. Marys River, in Fort Wayne, Indiana (red circle and purple diamond in map). TP samples were collected weekly April-October and monthly November-March in 2013-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

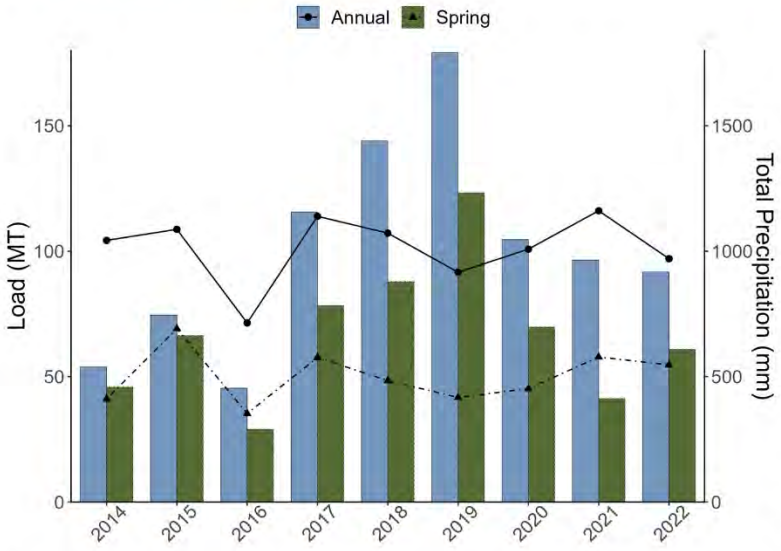
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

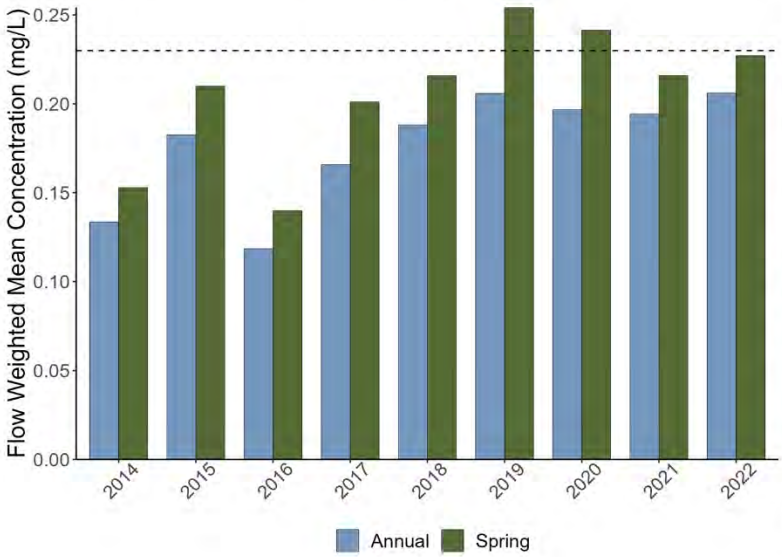
Results Flow weighted mean concentration has increased since 2020 and was not meeting the springtime target of 0.23 mg/L in 2022. Springtime TP loads made up an average of 61% of total annual loads.

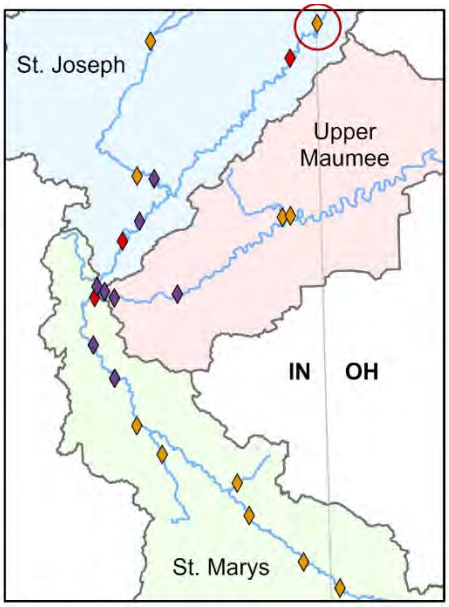
St. Joseph River Mainstem

Upstream OH-IN border (Allen Co STJ-163)

Total Phosphorus (TP)	
USGS Streamgage	04178000
Drainage Area Ratio	1
Allen Co SWCD Data (April – October)	2014-2022
Average Annual Load (lb./yr.)	221,811
Average Springtime Load (1 Mar – 31 Jul)	147,674
Reduction Needed to Meet Spring Target	0







Site The Allen Co SWCD site STJ-163 is an upstream site on the St. Joseph River in Ohio at the border of Indiana (red circle and orange diamond in map). TP samples were collected weekly from April to October in 2014-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

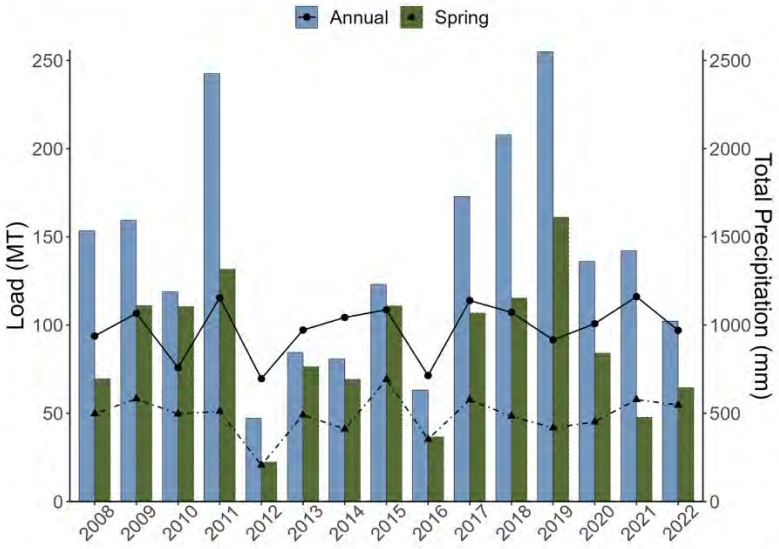
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

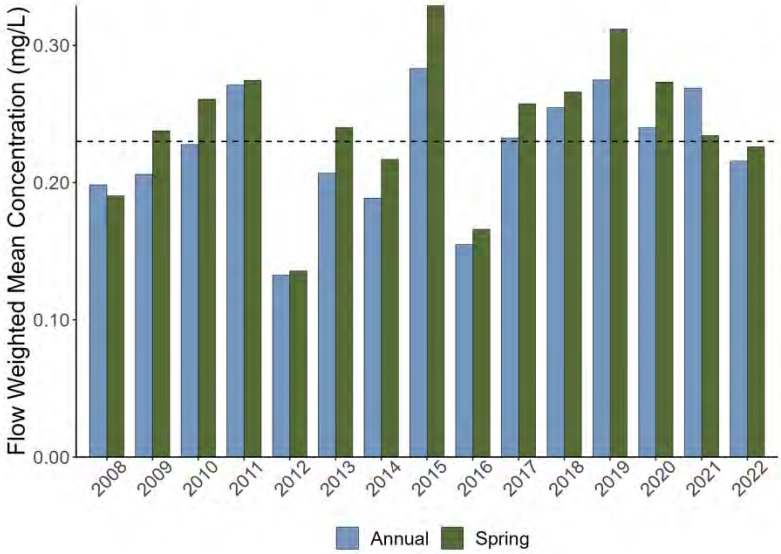
Results Springtime flow weighted mean concentration in 2019 and 2020 was above the target concentration of 0.23 mg/L, but all other springtime and annual flow weighted means were below the target. Springtime TP loads made up an average of 67% of total annual loads.

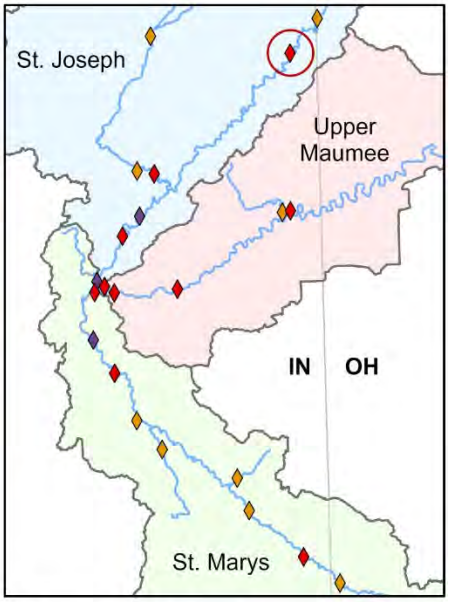
St. Joseph River Mainstem

Upstream OH-IN border (Fixed Station STJ-36)

Total Phosphorus (TP)	
USGS Streamgage	04178000
Drainage Area Ratio	1
IDEM Fixed Station Data	2008-2022
Average Annual Load (lb./yr.)	307,191
Average Springtime Load (1 Mar – 31 Jul)	193,854
Reduction Needed to Meet Spring Target	15,953







Site The IDEM Fixed Station site STJ-36 is an upstream site on the St. Joseph River in Ohio at the border of Indiana (red circle and orange diamond in map). TP samples were collected monthly in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

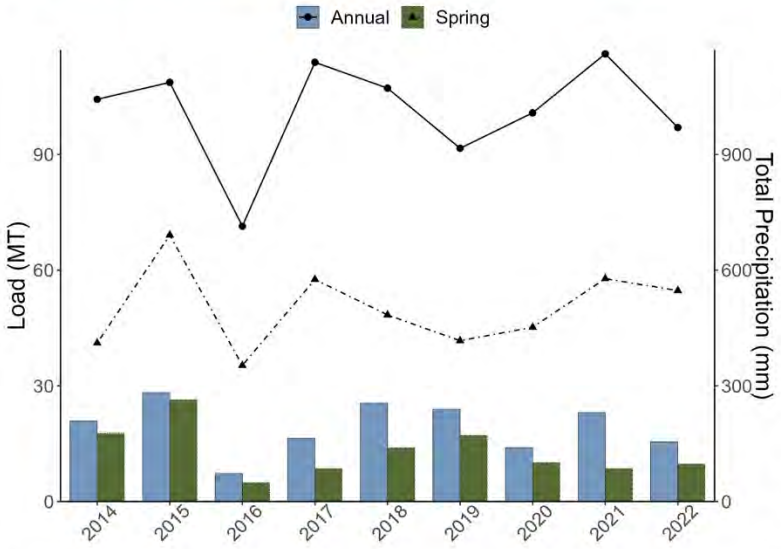
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

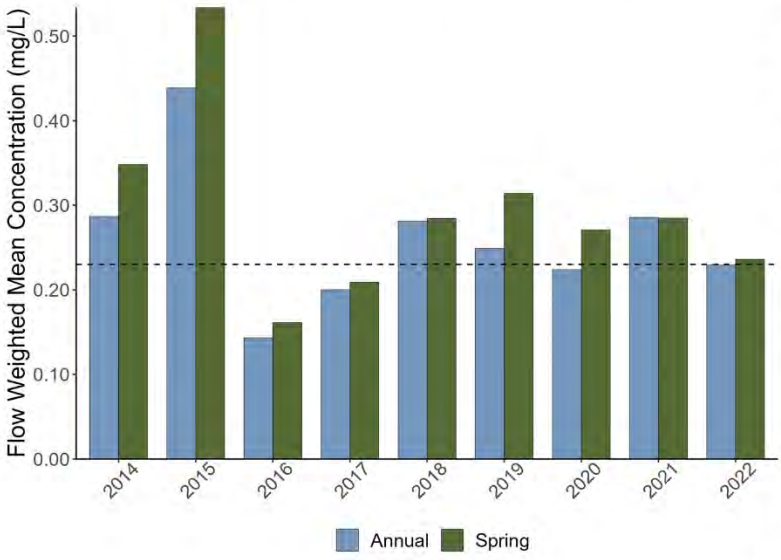
Results The 2022 springtime flow weighted mean concentration was under the target concentration of 0.23 mg/L. Five years total had springtime mean concentrations below the target. Springtime TP loads made up an average of 63% of total annual loads.

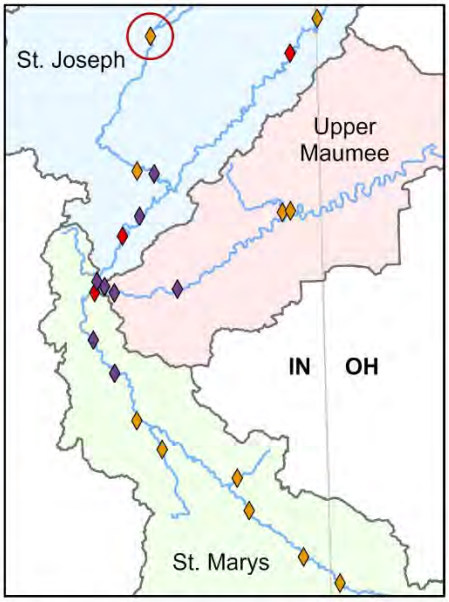
Cedar Creek (St. Joseph)

Tributary to St. Joseph (Allen Co CC-STJ-105)

Total Phosphorus (TP)	
USGS Streamgage	04179520
Drainage Area Ratio	0.96
Allen Co SWCD Data (April to October)	2014-2022
Average Annual Load (lb./yr.)	42,777
Average Springtime Load (1 Mar – 31 Jul)	28,619
Reduction Needed to Meet Spring Target	7,012







Site The Allen Co SWCD site CC-STJ-105 is an upstream site on the Upper Cedar Creek, a tributary to St. Joseph River, in Indiana (red circle and orange diamond in map). TP samples were collected weekly from April to October in 2014-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

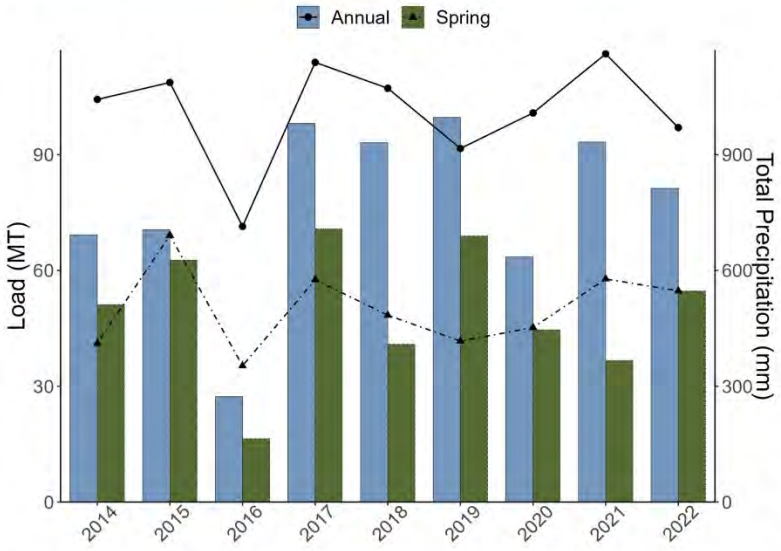
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

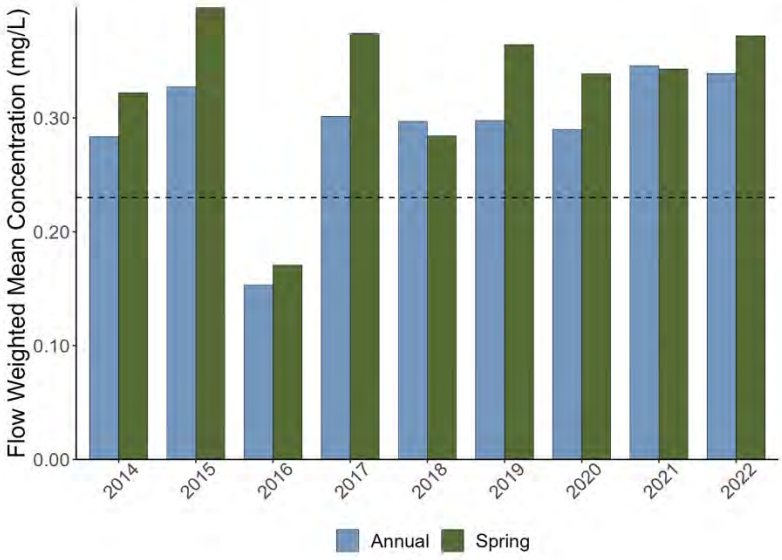
Results The annual flow weighted mean concentration (FWMC) in 2022 was below the target, and the springtime FWMC was just above the target of 0.23 mg/L. Springtime FWMC was below the target in 2016 (dry year) and 2017. Springtime TP loads made up an average of 67% of total annual loads.

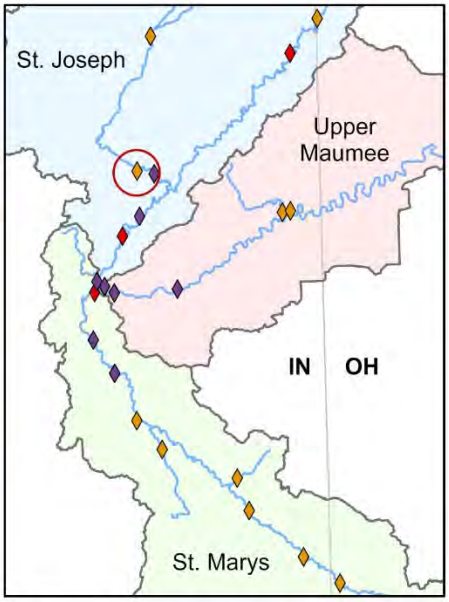
Cedar Creek (St. Joseph)

Tributary to St. Joseph (Allen Co CC-STJ-100)

Total Phosphorus (TP)	
USGS Streamgage	04180000
Drainage Area Ratio	1
Allen Co SWCD Data (April to October)	2014-2022
Average Annual Load (lb./yr.)	170,518
Average Springtime Load (1 Mar – 31 Jul)	109,490
Reduction Needed to Meet Spring Target	35,086







Site The Allen Co SWCD site CC-STJ-100 is a downstream site on Cedar Creek, a tributary to the St. Joseph River, in Indiana (red circle and orange diamond in map). TP samples were collected weekly from April to October in 2014-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

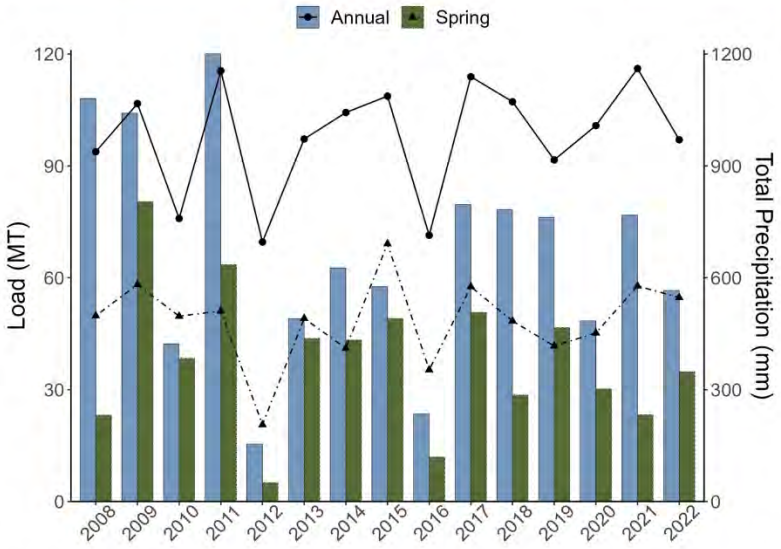
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

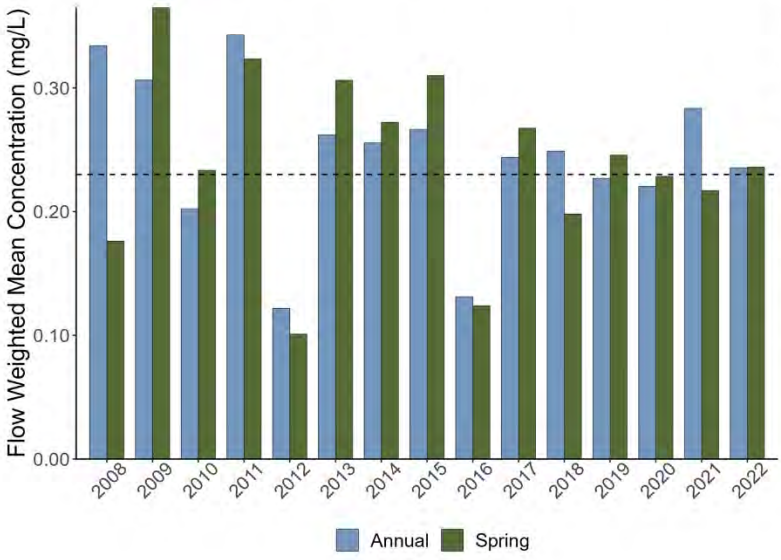
Results The flow weighted mean concentration was under the target concentration for only a single year in 2016 (dry year). Springtime TP loads made up an average of 64% of total annual loads.

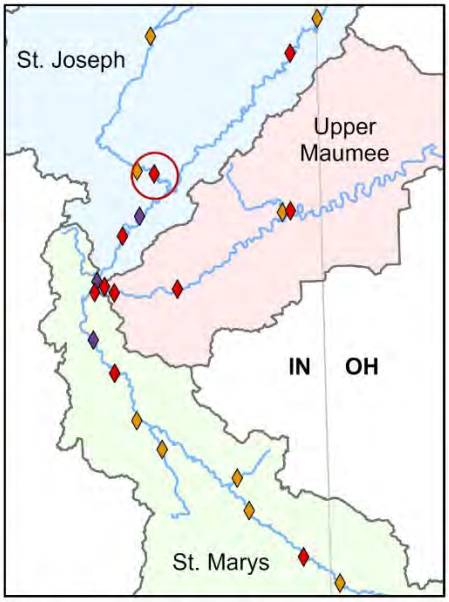
Cedar Creek (St. Joseph)

Tributary to St. Joseph (Fixed Station CC-4)

Total Phosphorus (TP)	
USGS Streamgage	04180000
Drainage Area Ratio	1
Allen Co SWCD Data (April to October)	2008-2022
Average Annual Load (lb./yr.)	146,813
Average Springtime Load (1 Mar – 31 Jul)	84,240
Reduction Needed to Meet Spring Target	8,835







Site The IDEM Fixed Station site CC-4 is a downstream site on Cedar Creek, a tributary to the St. Joseph River, in Indiana (red circle and red diamond in map). TP samples were collected monthly in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

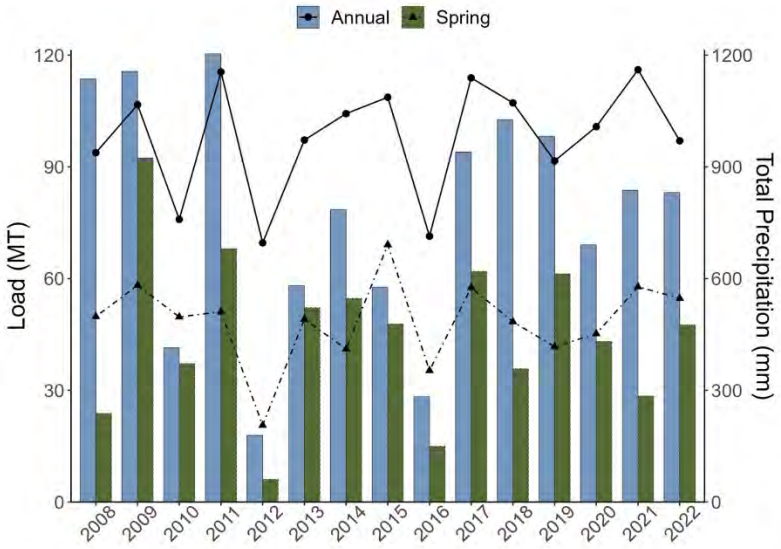
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

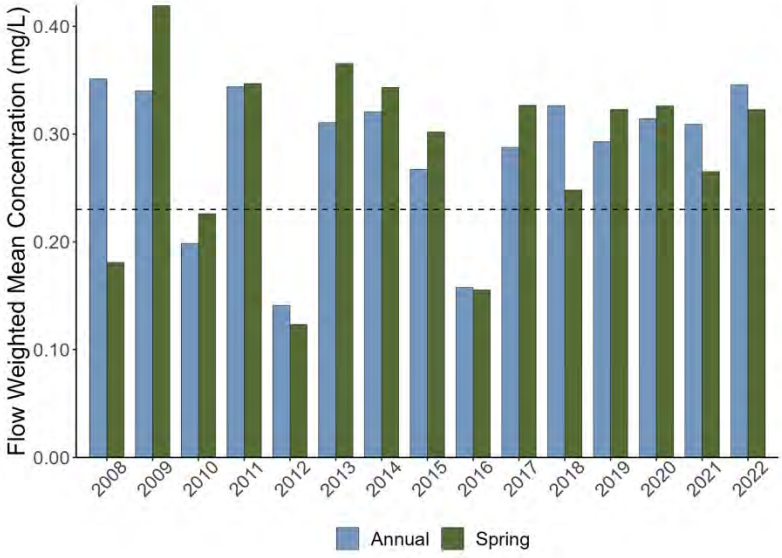
Results The springtime flow weighted mean concentration was under the target concentration for 6 years. Springtime TP loads made up an average of 57% of total annual loads.

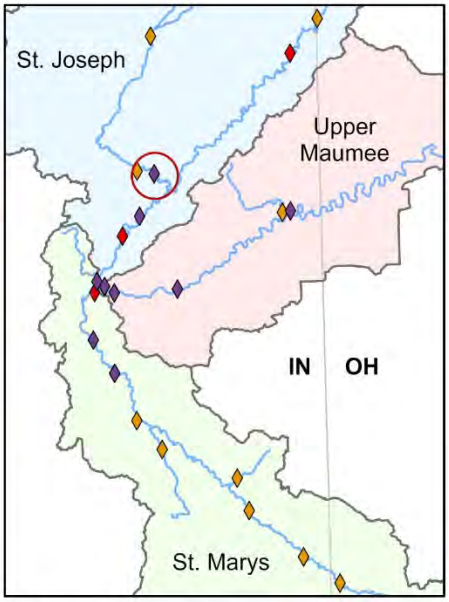
Cedar Creek (St. Joseph)

Tributary St. Joseph (City of Fort Wayne CC-STJ-H)

Total Phosphorus (TP)	
USGS Streamgage	04180000
Drainage Area Ratio	1
City of Fort Wayne Data	2008-2022
Average Annual Load (lb./yr.)	170,891
Average Springtime Load (1 Mar – 31 Jul)	99,319
Reduction Needed to Meet Spring Target	23,900







Site The City of Fort Wayne site CC-STJ-H is collocated with IDEM site CC-4. It is a downstream site on Cedar Creek, a tributary to the St. Joseph River, in Indiana (red circle and purple diamond in map). TP samples were collected monthly in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

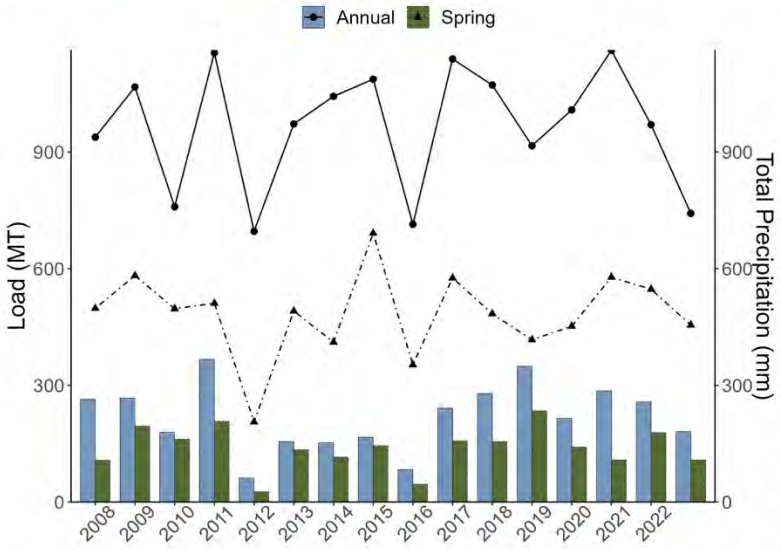
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

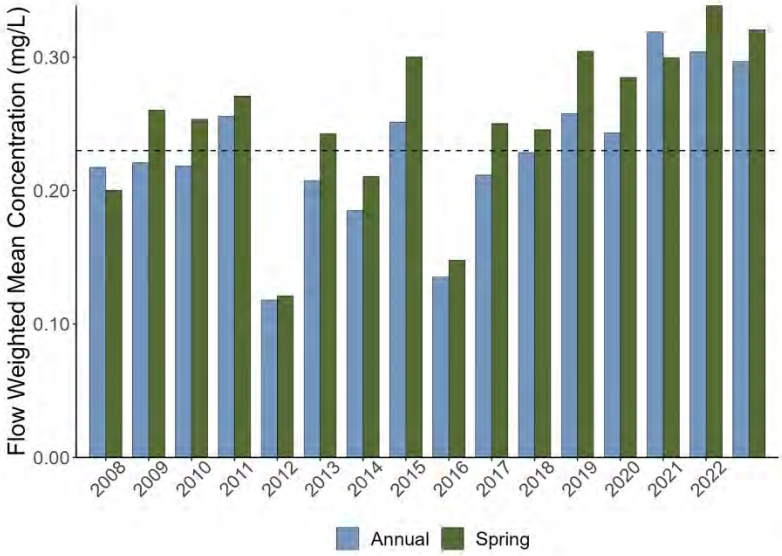
Results The springtime flow weighted mean concentration was under the target concentration for 4 years. Springtime TP loads made up an average of 58% of total annual loads.

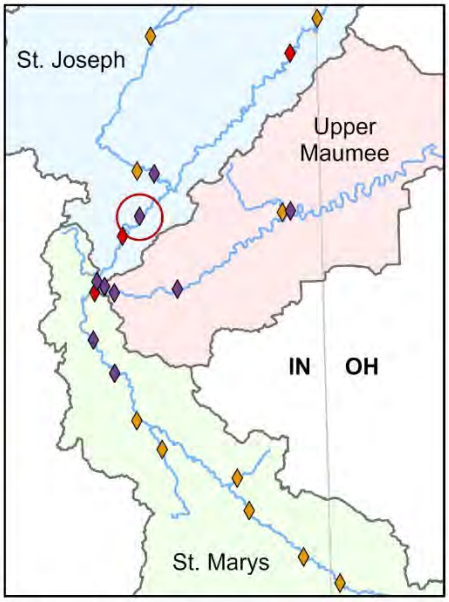
St. Joseph River Mainstem

Midstream (City of Fort Wayne STJ-M)

Total Phosphorus (TP)	
USGS Streamgage	04180500
Drainage Area Ratio	1
City of Fort Wayne Data	2008-2022
Average Annual Load (lb./yr.)	483,418
Average Springtime Load (1 Mar – 31 Jul)	306,999
Reduction Needed to Meet Spring Target	34,996







Site The City of Fort Wayne site STJ-M is a midstream site on St. Joseph River in Indiana (red circle and purple diamond in map). TP samples were collected weekly April-October and monthly November-March in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

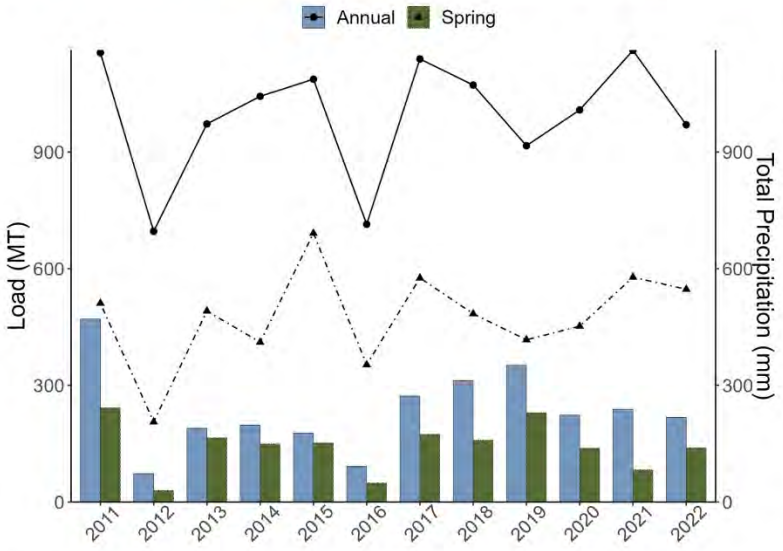
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

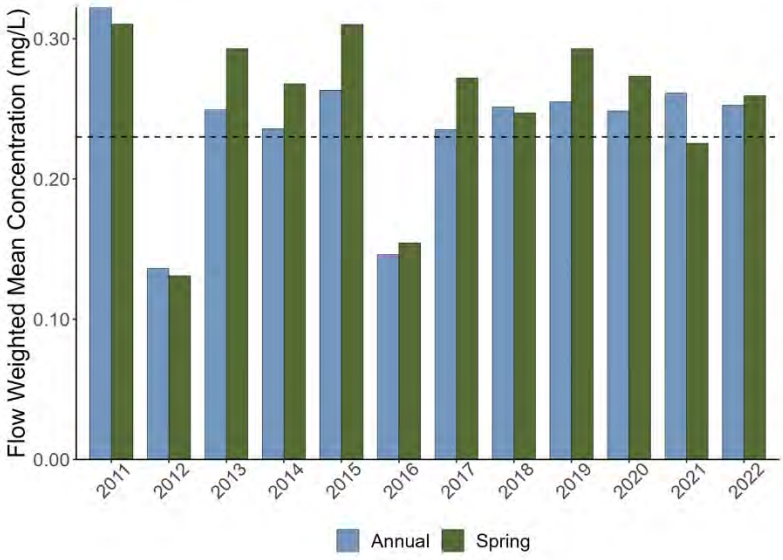
Results The springtime flow weighted mean concentration was under the target concentration for 4 years. 2020-2022 were years with some of the highest flow weighted mean concentrations and have remained steady. Springtime TP loads made up an average of 63% of total annual loads.

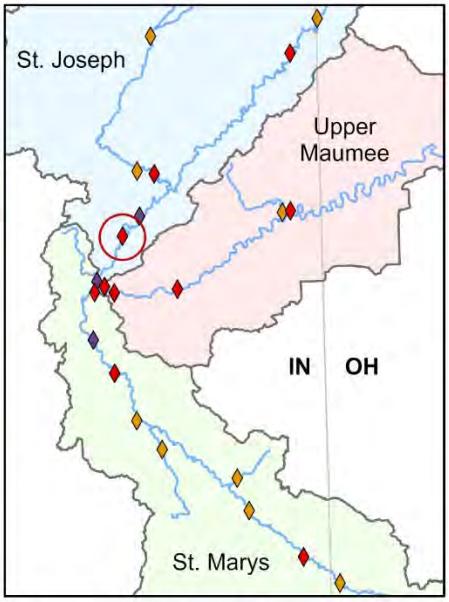
St. Joseph River Mainstem

Downstream (Fixed Station STJ-4)

Total Phosphorus (TP)	
USGS Streamgage	04180500
Drainage Area Ratio	1.02
IDEM Fixed Station Data	2011-2022
Average Annual Load (lb./yr.)	517,404
Average Springtime Load (1 Mar – 31 Jul)	314,558
Reduction Needed to Meet Spring Target	43,384







Site The IDEM Fixed Station site STJ-4 is a downstream site on the St. Joseph River in Indiana (red circle and red diamond in map). TP samples were collected monthly in 2011-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

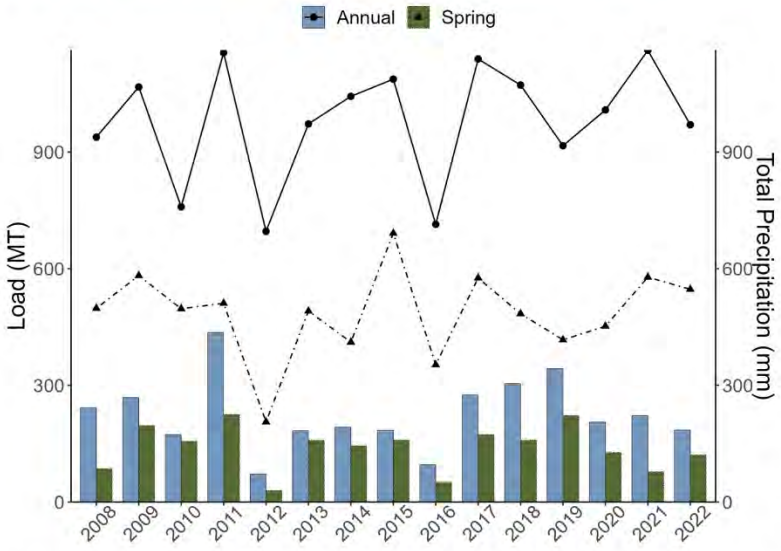
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

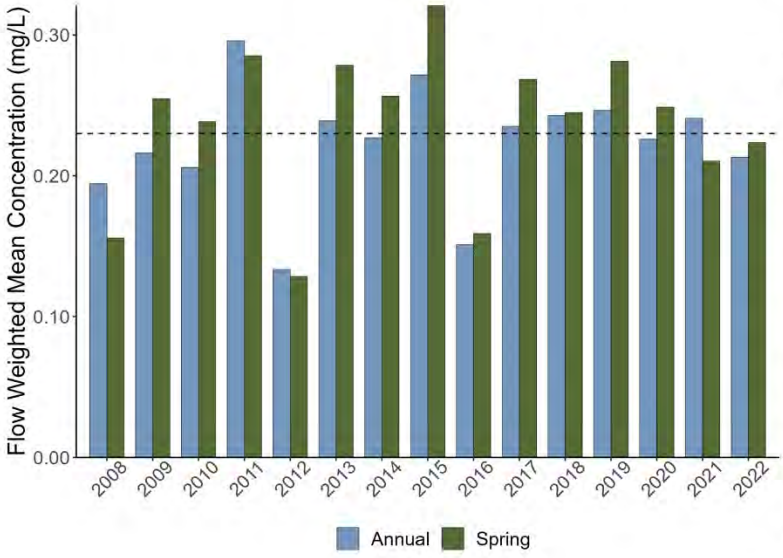
Results The springtime flow weighted mean concentration was below the target of 0.23 mg/L in 2021, in addition to the two dry years (2012 and 2016). Springtime TP loads made up an average of 61% of total annual loads.

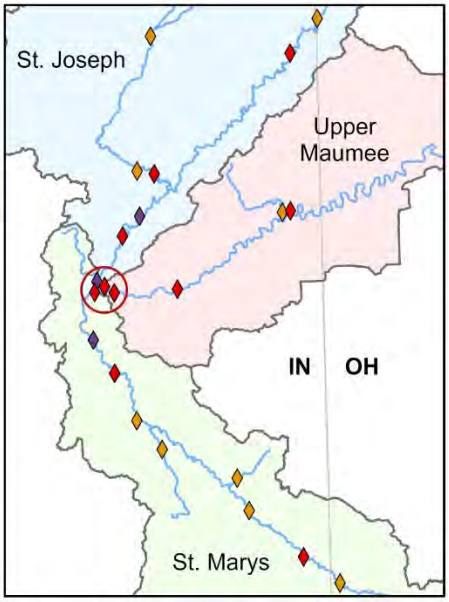
St. Joseph River Mainstem

Downstream at confluence (Fixed Station STJ-.5)

Total Phosphorus (TP)	
USGS Streamgage	04180500
Drainage Area Ratio	1
IDEM Fixed Station Data	2008-2022
Average Annual Load (lb./yr.)	497,618
Average Springtime Load (1 Mar – 31 Jul)	307,132
Reduction Needed to Meet Spring Target	21,029







Site The IDEM Fixed Station site STJ-.5 is collocated with the City of Fort Wayne site STJ-T. It is a downstream site on the St. Joseph River in Fort Wayne, Indiana (red circle and red diamond in map) near the confluence with St. Marys. TP samples were collected monthly in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

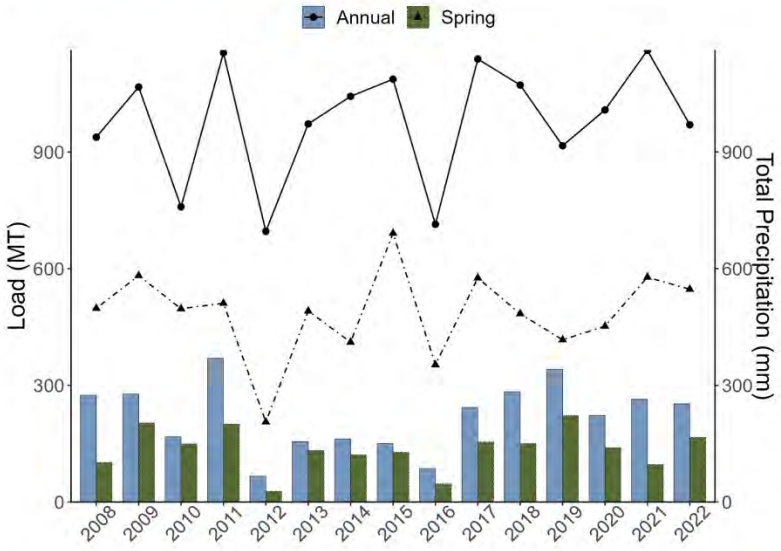
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

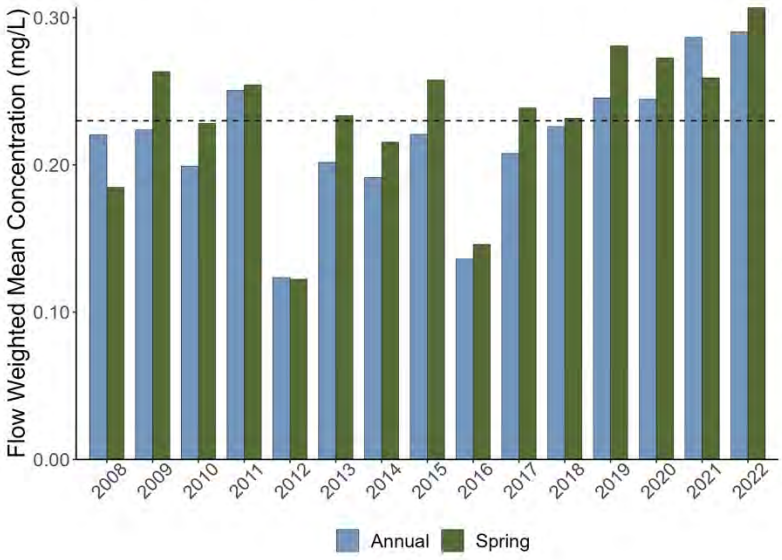
Results The springtime flow weighted mean concentration was below the target of 0.23 mg/L in 2021 and 2022, in addition to the two dry years (2012 and 2016) and the baseline year (2008). Springtime TP loads made up an average of 62% of total annual loads.

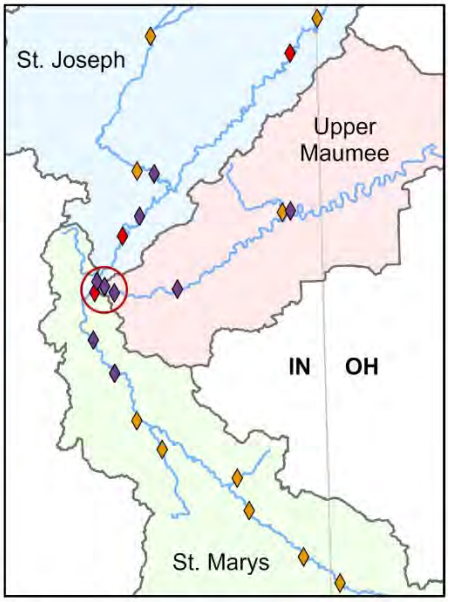
St. Joseph River Mainstem

At confluence (City of Fort Wayne STJ-T)

Total Phosphorus (TP)	
USGS Streamgage	04180500
Drainage Area Ratio	1
City of Fort Wayne Data	2008-2022
Average Annual Load (lb./yr.)	487,838
Average Springtime Load (1 Mar – 31 Jul)	300,293
Reduction Needed to Meet Spring Target	14,059







Site The City of Fort Wayne site STJ-T is collocated with IDEM site STJ-.5. It is a downstream site on the St. Joseph River in Fort Wayne, Indiana (red circle and purple diamond in map) near the confluence with St. Marys. TP samples were collected weekly April-October and monthly November-March in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

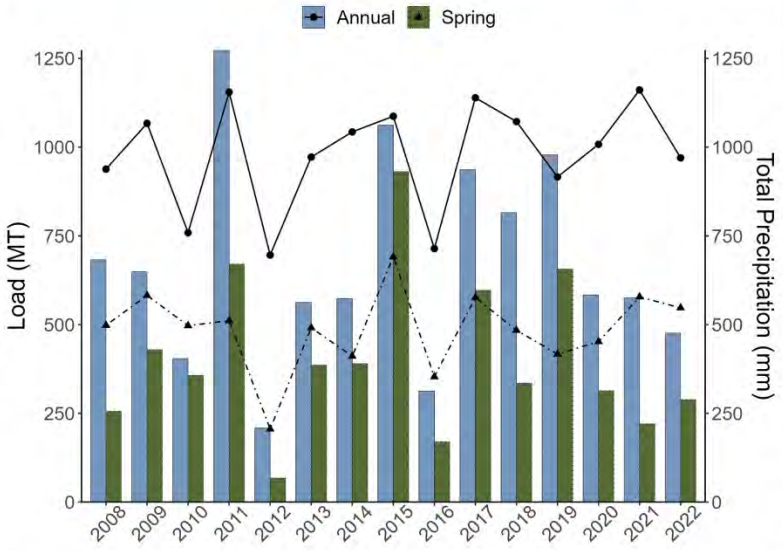
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

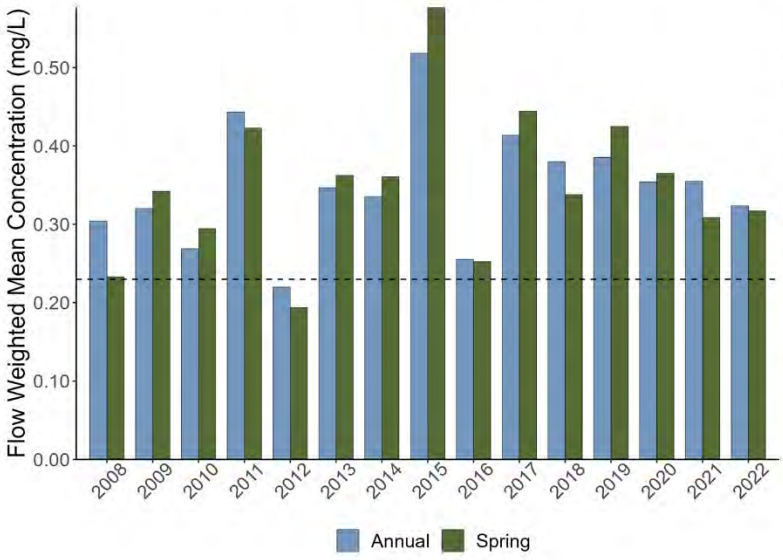
Results The springtime flow weighted mean concentration was at or below the target of 0.23 mg/L for 6 years. Springtime TP loads made up an average of 62% of total annual loads.

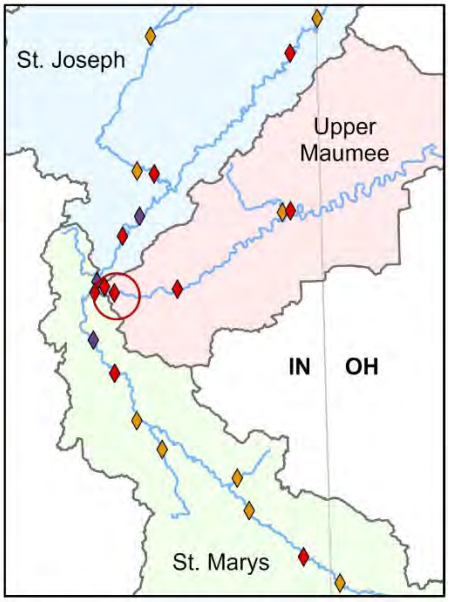
Maumee Mainstem

Upstream at confluence (Fixed Station M-132)

Total Phosphorus (TP)	
USGS Streamgage	04183000
Drainage Area Ratio	0.98
IDEM Fixed Station Data	2008-2022
Average Annual Load (lb./yr.)	1,483,678
Average Springtime Load (1 Mar – 31 Jul)	892,637
Reduction Needed to Meet Spring Target	341,454







Site The IDEM Fixed Station site M-132 is collocated with the City of Fort Wayne site M-A. It is an upstream site on the Maumee River in Fort Wayne, Indiana near the confluence of the St. Marys and St. Joseph rivers (red circle and red diamond in map). TP samples were collected monthly in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

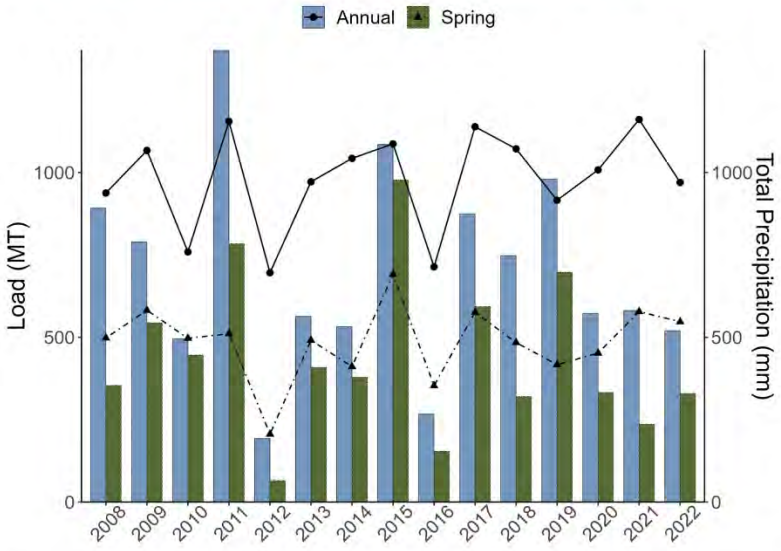
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

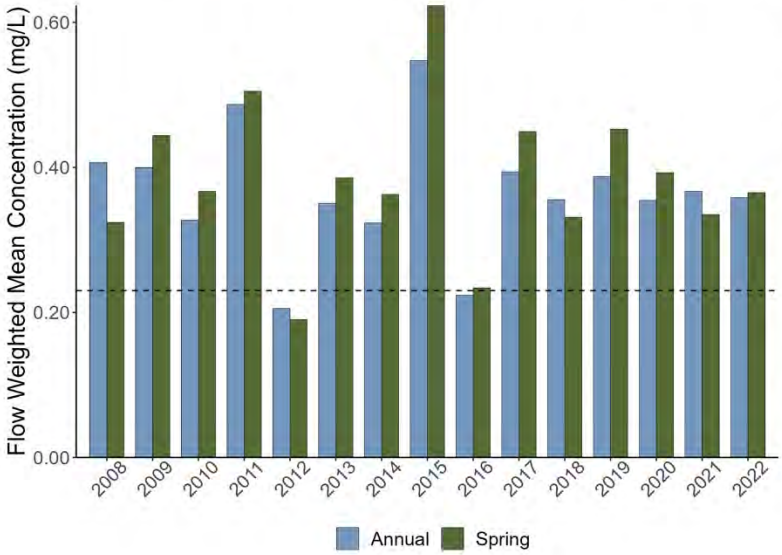
Results The springtime flow weighted mean concentration was below the target of 0.23 mg/L in 2012 (dry year). Springtime TP loads made up an average of 60% of total annual loads.

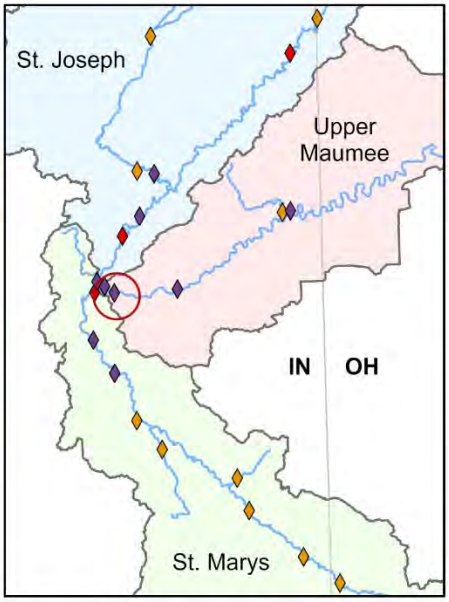
Maumee Mainstem

Upstream at confluence (City of Fort Wayne M-A)

Total Phosphorus (TP)	
USGS Streamgage	04182950
Drainage Area Ratio	1
City of Fort Wayne Data	2008-2022
Average Annual Load (lb./yr.)	1,538,476
Average Springtime Load (1 Mar – 31 Jul)	973,789
Reduction Needed to Meet Spring Target	431,134







Site The City of Fort Wayne site M-A is collocated with IDEM site M-132. It is an upstream site on the Maumee River in Fort Wayne, Indiana near the confluence of the St. Marys and St. Joseph rivers (red circle and purple diamond in map). TP samples were collected weekly April-October and monthly November-March in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

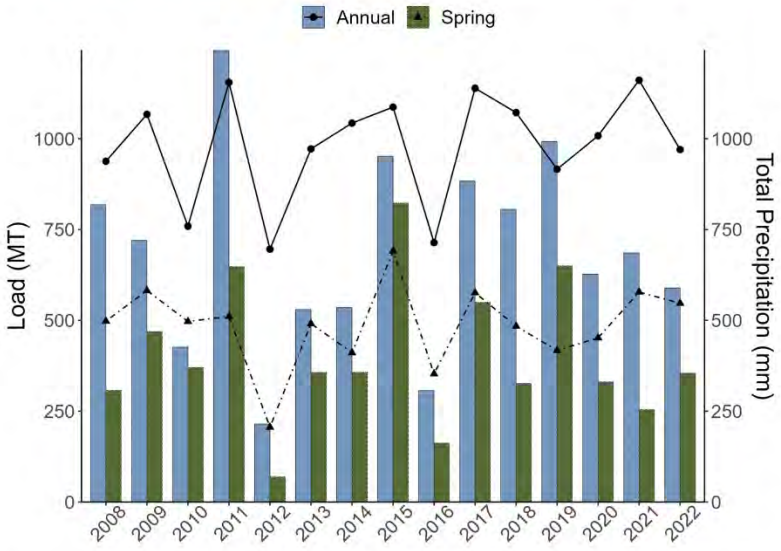
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

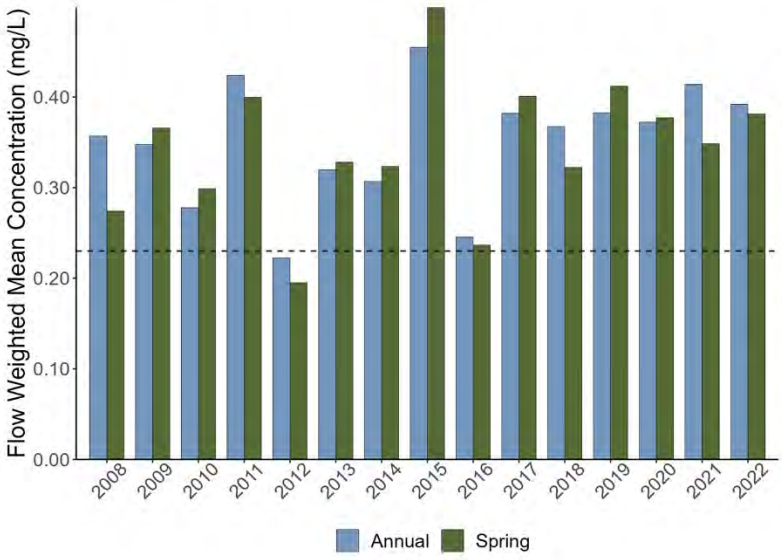
Results The springtime flow weighted mean concentration was below the target of 0.23 mg/L in 2012 (dry year). Springtime TP loads made up an average of 63% of total annual loads.

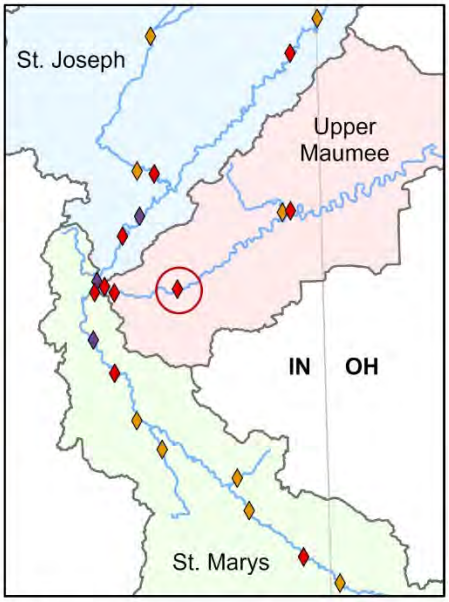
Maumee Mainstem

Midstream (Fixed Station M-129)

Total Phosphorus (TP)	
USGS Streamgage	04183000
Drainage Area Ratio	1
IDEM Fixed Station Data	2008-2022
Average Annual Load (lb./yr.)	1,518,653
Average Springtime Load (1 Mar – 31 Jul)	886,839
Reduction Needed to Meet Spring Target	323,815







Site The IDEM Fixed Station site M-129 is a midstream site on the Maumee River in Indiana (red circle and red diamond in map). TP samples were collected monthly in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

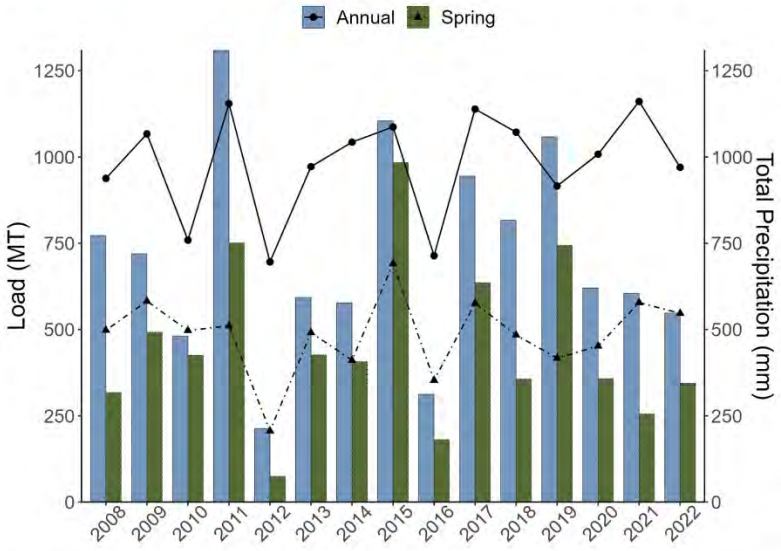
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

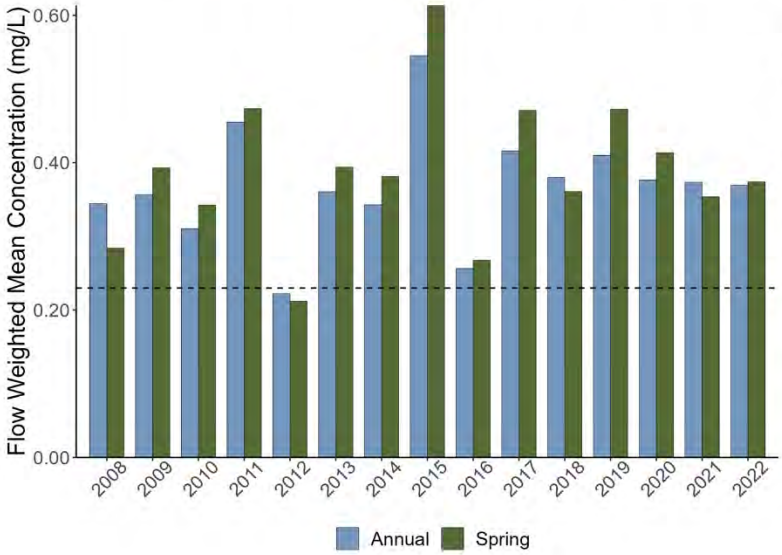
Results The springtime flow weighted mean concentration was below the target of 0.23 mg/L in 2012 (dry year). Springtime TP loads made up an average of 58% of total annual loads.

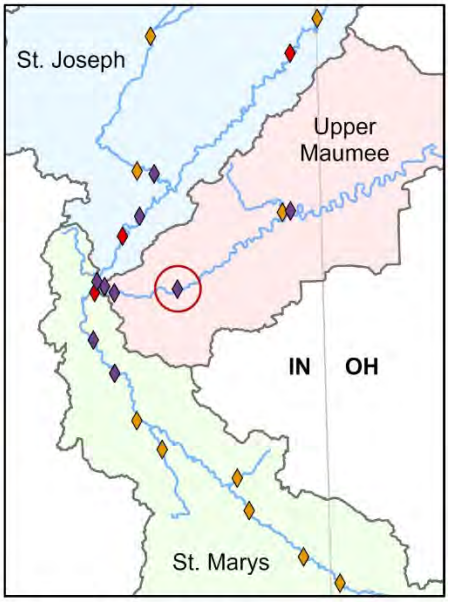
Maumee Mainstem

Upstream at confluence (City of Fort Wayne M-L)

Total Phosphorus (TP)	
USGS Streamgage	04182950
Drainage Area Ratio	1
City of Fort Wayne Data	2008-2022
Average Annual Load (lb./yr.)	1,569,299
Average Springtime Load (1 Mar – 31 Jul)	992,863
Reduction Needed to Meet Spring Target	438,222







Site The City of Fort Wayne site M-L is collocated with IDEM site M-129. It is an upstream site on the Maumee River in Indiana (red circle and purple diamond in map). TP samples were collected weekly April-October and monthly November-March in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

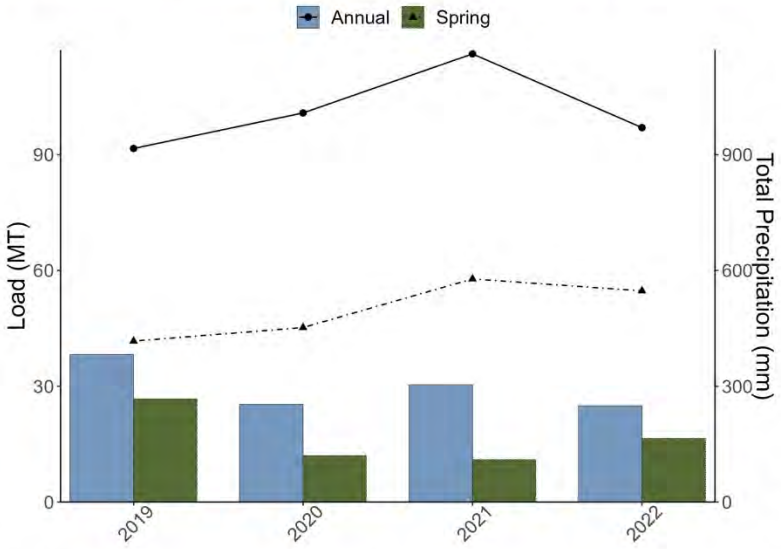
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

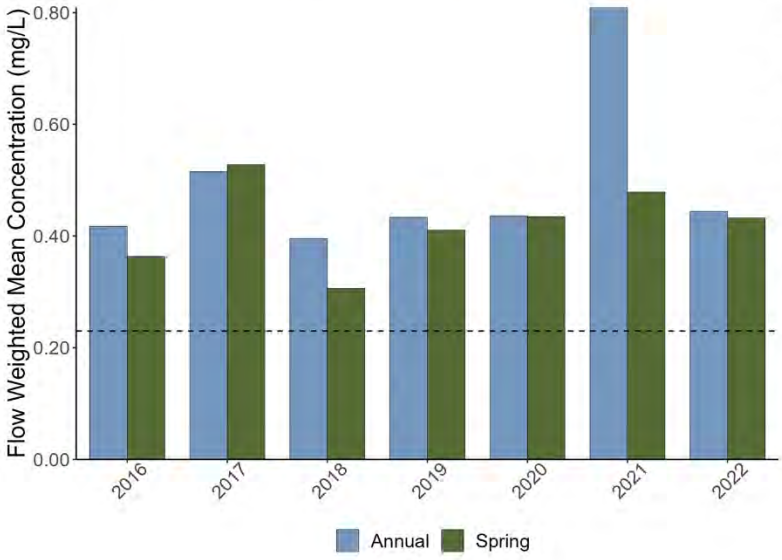
Results The springtime flow weighted mean concentration was below the target of 0.23 mg/L in 2012 (dry year). Springtime TP loads made up an average of 63% of total annual loads.

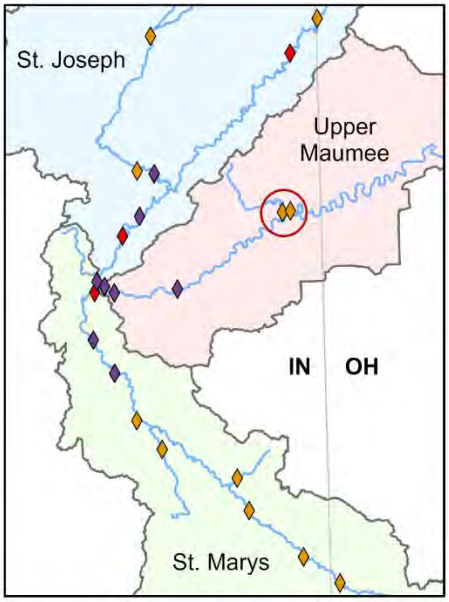
Black Creek (Maumee)

Tributary to Maumee (Allen Co BC-M-304)

Total Phosphorus (TP)	
USGS Streamgage	04183038
Drainage Area Ratio	1.52
Allen Co SWCD Data (April to October)	2016-2022
Average Annual Load (lb./yr.)	14,694
Average Springtime Load (1 Mar – 31 Jul)	7,345
Reduction Needed to Meet Spring Target	3,421







Site The Allen Co SWCD site BC-M-304 is a downstream site on Black Creek, a tributary to the Maumee River, in Indiana (red circle and orange diamond in map). TP samples were collected weekly April to October in 2016-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

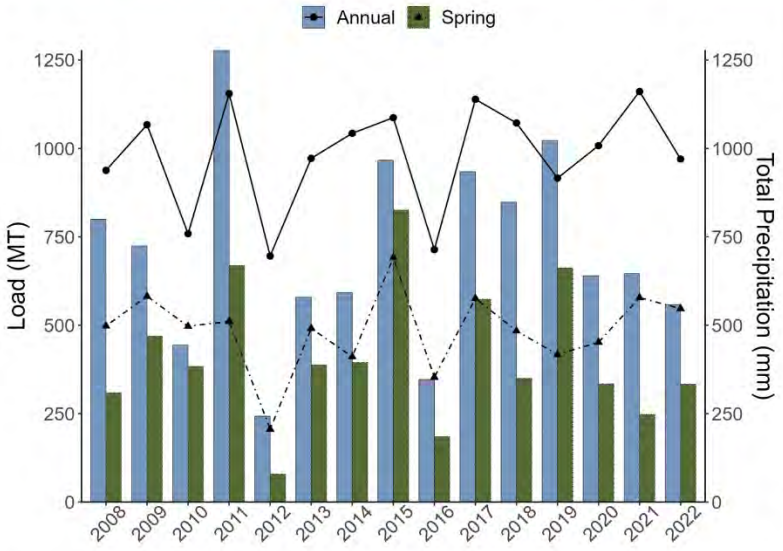
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

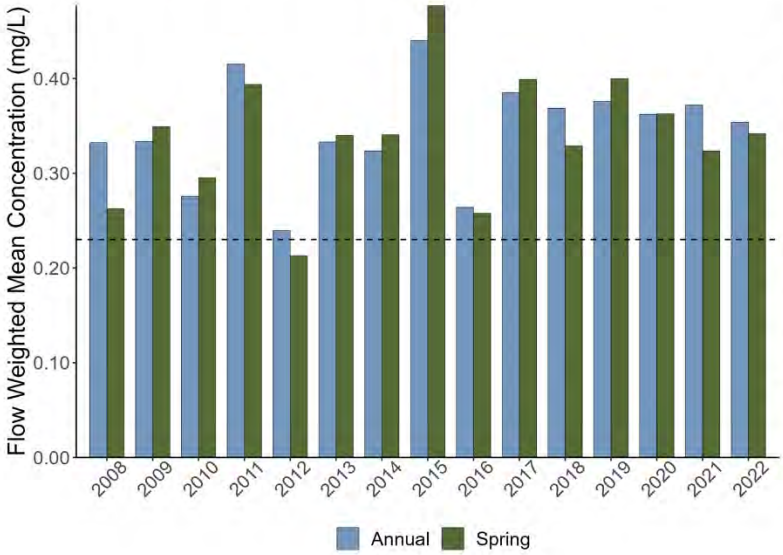
Results The flow weighted mean concentration never met the target of 0.23 mg/L. Springtime TP loads made up an average of 50% of total annual loads.

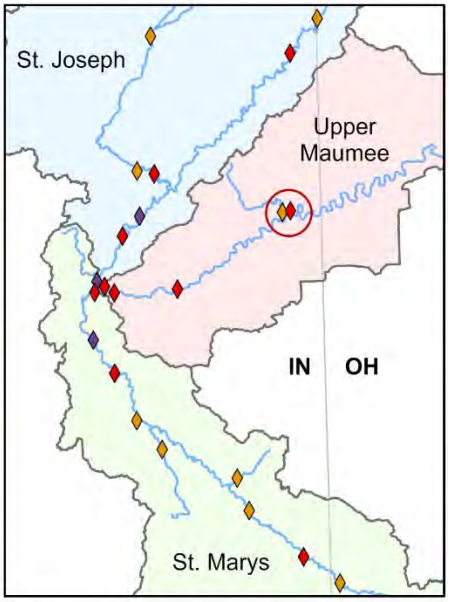
Maumee Mainstem

Downstream (Fixed Station M-114)

Total Phosphorus (TP)	
USGS Streamgage	04183000
Drainage Area Ratio	1.05
IDEM Fixed Station Data	2008-2022
Average Annual Load (lb./yr.)	1,561,523
Average Springtime Load (1 Mar – 31 Jul)	912,698
Reduction Needed to Meet Spring Target	321,968







Site The IDEM Fixed Station site M-114 is collocated with M-312 and M-SR101. It is a downstream site on the Maumee River near the border of Ohio in Indiana (red circle and red diamond in map). TP samples were collected monthly in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

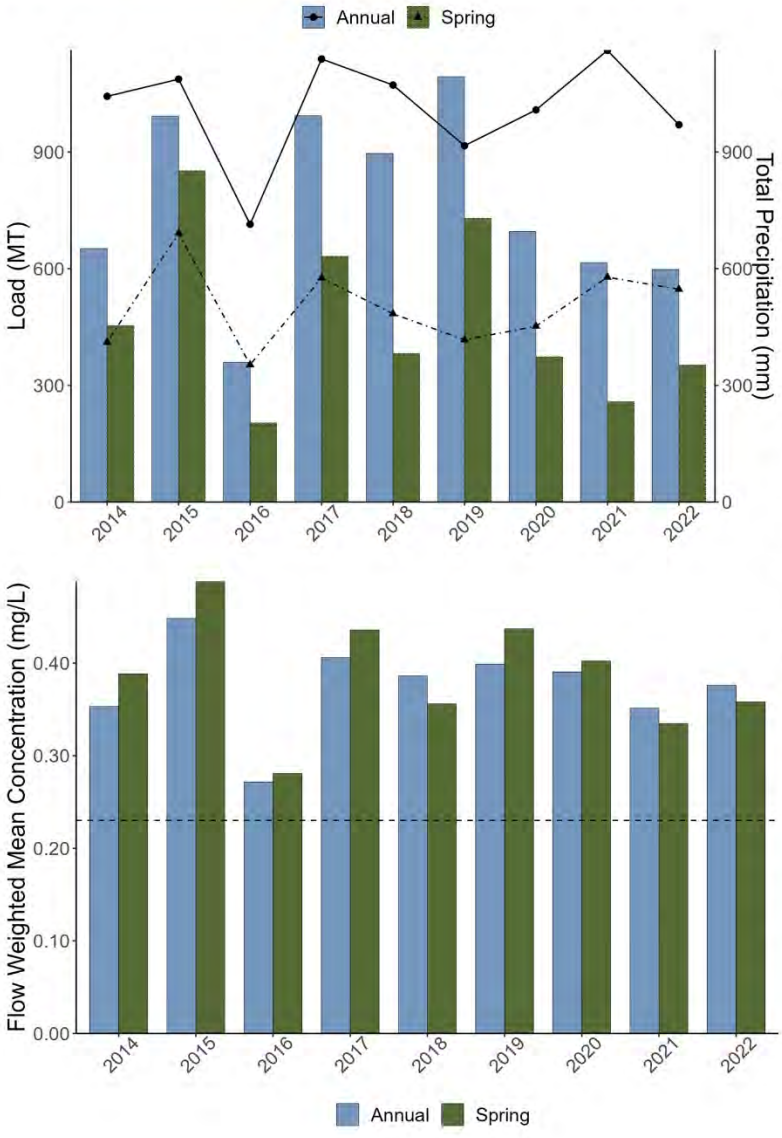
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

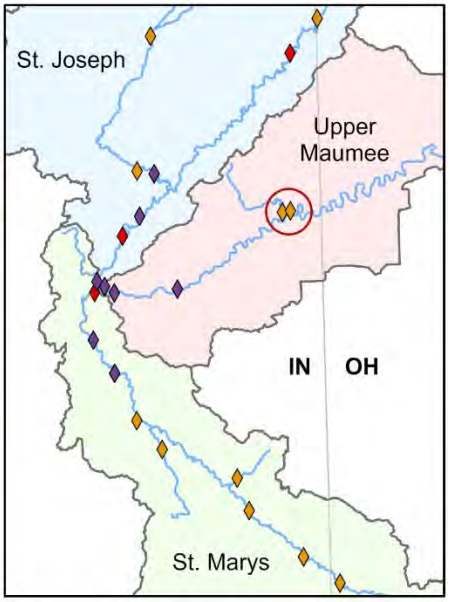
Results The springtime flow weighted mean concentration was below the target of 0.23 mg/L in 2012 (dry year). Springtime TP loads made up an average of 58% of total annual loads.

Maumee Mainstem

Downstream (Allen Co M-312)

Total Phosphorus (TP)	
USGS Streamgage	04183000
Drainage Area Ratio	1.06
Allen Co SWCD Data (April to October)	2014-2022
Average Annual Load (lb./yr.)	1,972,729
Average Springtime Load (1 Mar – 31 Jul)	1,167,773
Reduction Needed to Meet Spring Target	483,063





Site The Allen Co SWCD site M-312 is collocated with M-114 and M-SR101. It is a downstream site on the Maumee River near the border of Ohio in Indiana (red circle and red diamond in map). TP samples were collected weekly from April to October in 2014-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

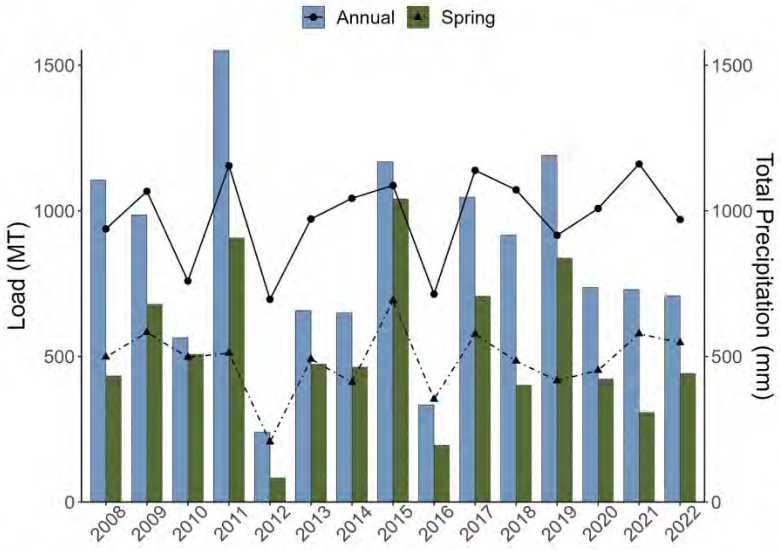
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

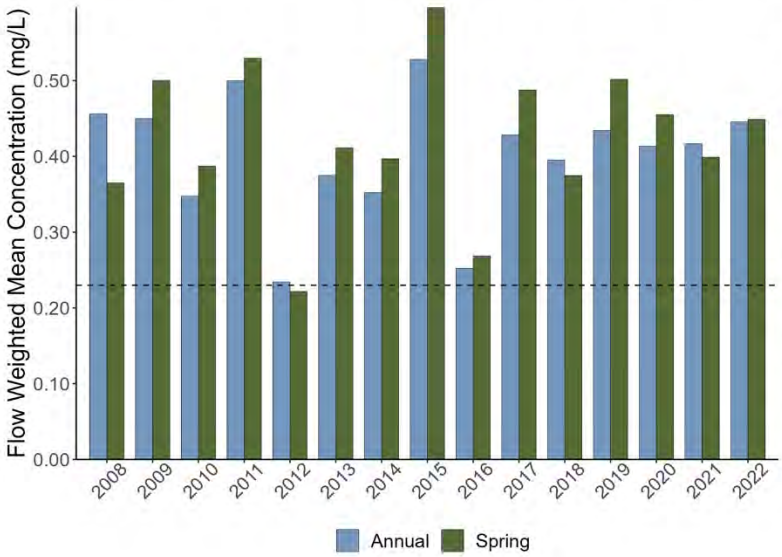
Results Springtime TP loads made up an average of 59% of total annual loads.

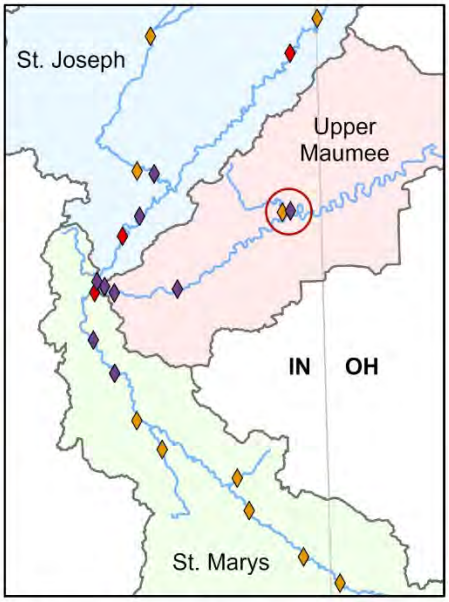
Maumee Mainstem

Downstream (City of Fort Wayne M-SR101)

Total Phosphorus (TP)	
USGS Streamgage	04183000
Drainage Area Ratio	1.06
City of Fort Wayne Data	2008-2022
Average Annual Load (lb./yr.)	2,105,177
Average Springtime Load (1 Mar – 31 Jul)	1,287,119
Reduction Needed to Meet Spring Target	636,437







Site The City of Fort Wayne site M-SR101 is collocated with M-114 and M-312. It is a downstream site on the Maumee River near the border of Ohio in Indiana (circled purple diamond in map). TP samples were collected monthly in 2008-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

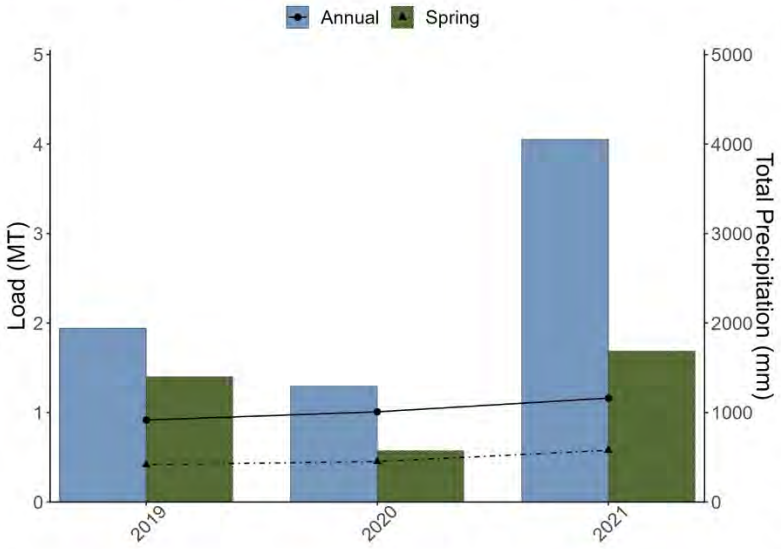
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the total phosphorus target concentration of 0.23 mg/L.

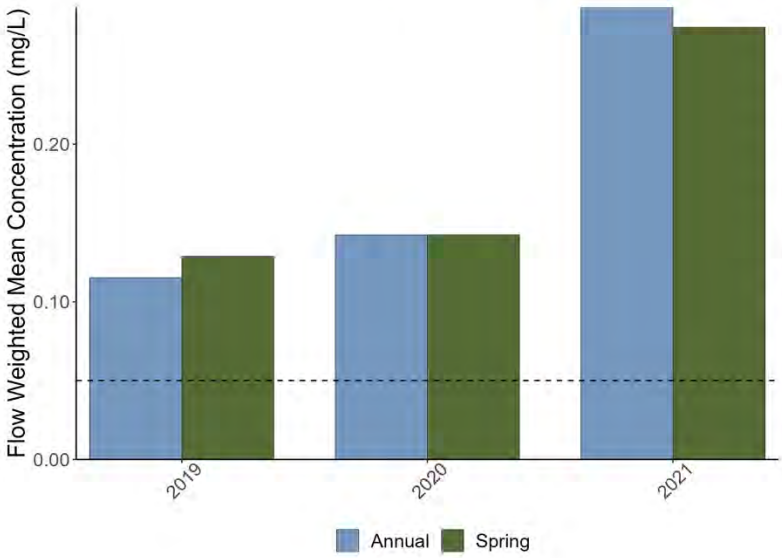
Results The springtime flow weighted mean concentration was under the target in 2012 (dry year). Springtime TP loads made up an average of 61% of total annual loads.

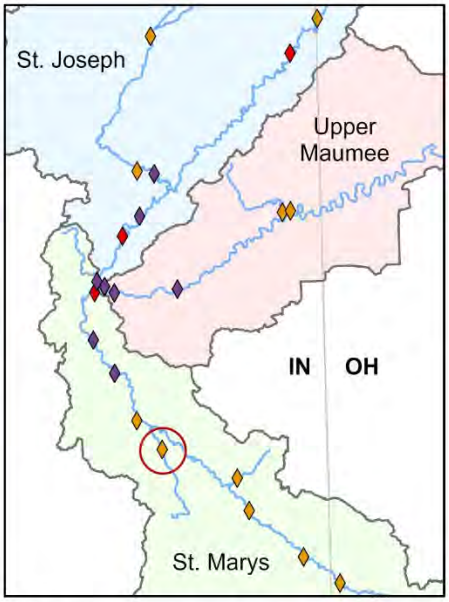
Nickelsen Creek (St. Marys)

Tributary to St. Marys (Allen Co NC-STM-211)

Orthophosphate	
USGS Streamgage	04181755
Drainage Area Ratio	1
Allen Co SWCD Data (April – October)	2019-2021
Average Annual Load (lb./yr.)	4,712
Average Springtime Load (1 Mar – 31 Jul)	2,693
Reduction Needed to Meet Spring Target	1,919







Site Allen Co SWCD site NC-STM-211 is on a tributary to the St. Marys called Nickelsen Creek in Indiana (red circle and orange diamond in map). Orthophosphate samples were collected weekly from April to October 2019 – 2021.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

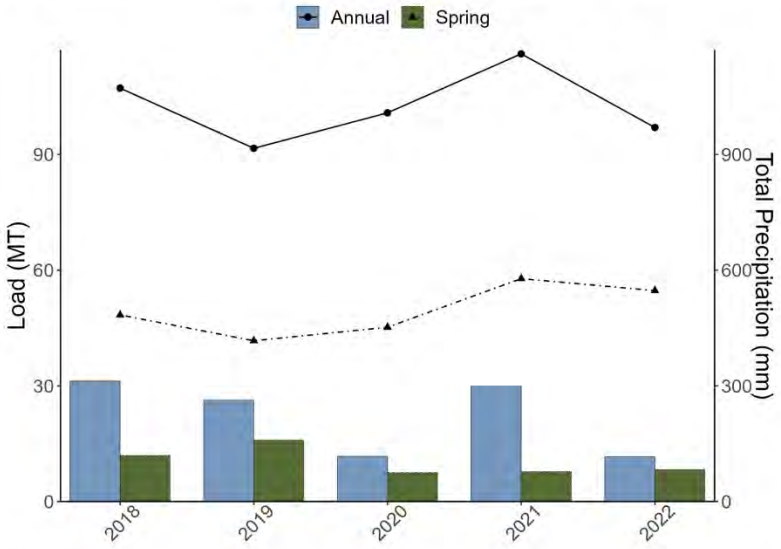
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the orthophosphate target concentration of 0.05 mg/L.

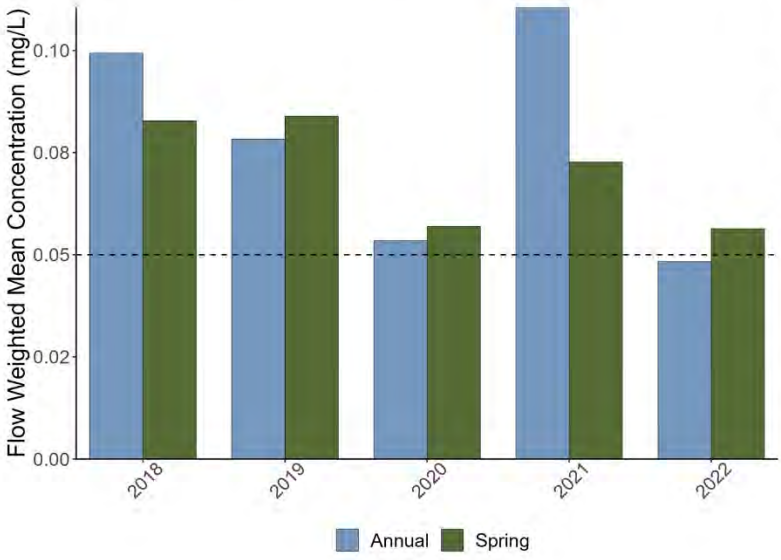
Results The springtime flow weighted mean concentration was higher than the annual mean concentrations for all years in 2019-2021. Springtime orthophosphate loads made up an average of 57% of total annual loads.

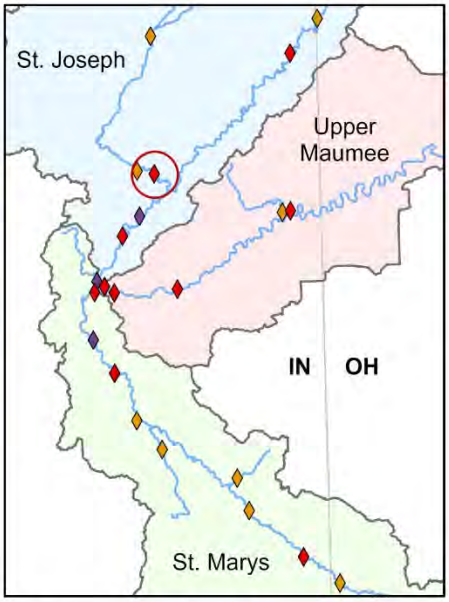
Cedar Creek (St. Joseph)

Tributary to St. Joseph (Fixed Station CC-4)

Orthophosphate	
USGS Streamgage	04180000
Drainage Area Ratio	1
IDEM Fixed Station Data	2018-2022
Average Annual Load (lb./yr.)	48,865
Average Springtime Load (1 Mar – 31 Jul)	22,714
Reduction Needed to Meet Spring Target	6,815







Site The IDEM Fixed Station site CC-4 is a downstream site on Cedar Creek, a tributary to the St. Joseph River, in Indiana (red circle and red diamond in map). Orthophosphate samples were collected monthly in 2018-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

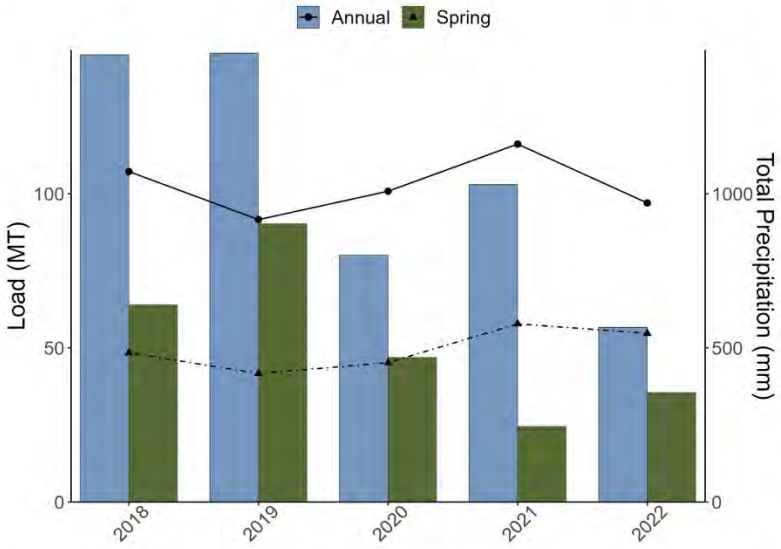
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the orthophosphate target concentration of 0.05 mg/L.

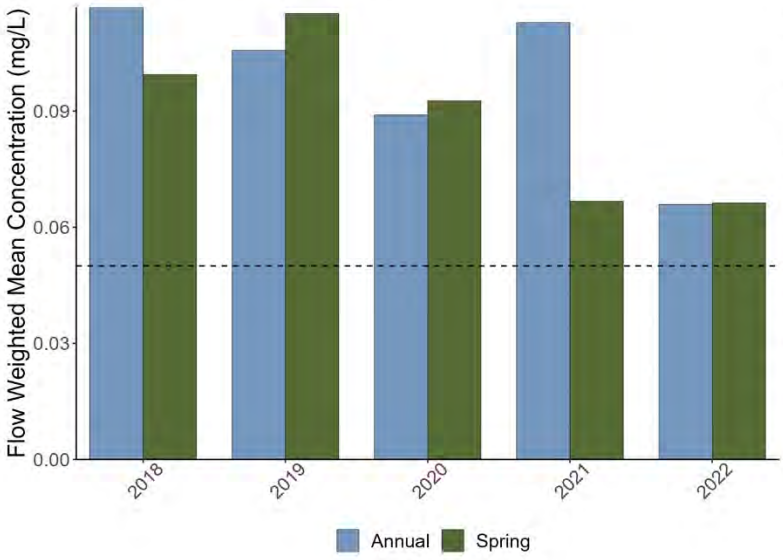
Results The annual flow weighted mean concentration was under the target concentration of 0.05 mg/L in 2022. Springtime orthophosphate loads made up an average of 46% of total annual loads.

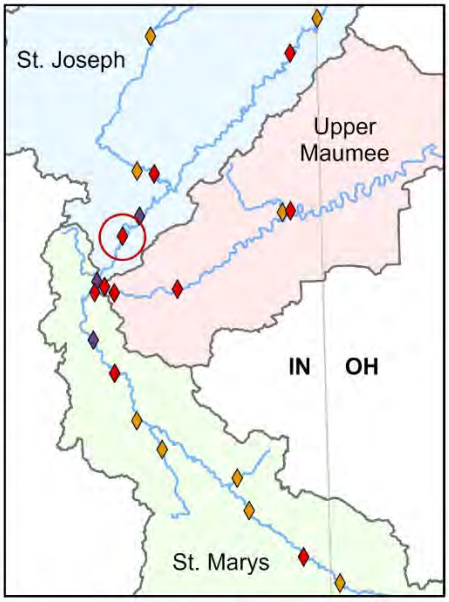
St. Joseph River Mainstem

Downstream (Fixed Station STJ-4)

Orthophosphate	
USGS Streamgage	04180500
Drainage Area Ratio	1.02
IDEM Fixed Station Data	2018-2022
Average Annual Load (lb./yr.)	233,909
Average Springtime Load (1 Mar – 31 Jul)	115,235
Reduction Needed to Meet Spring Target	52,667







Site The IDEM Fixed Station site STJ-4 is a downstream site on the St. Joseph River in Indiana (red circle and red diamond in map). Orthophosphate samples were collected monthly in 2018-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

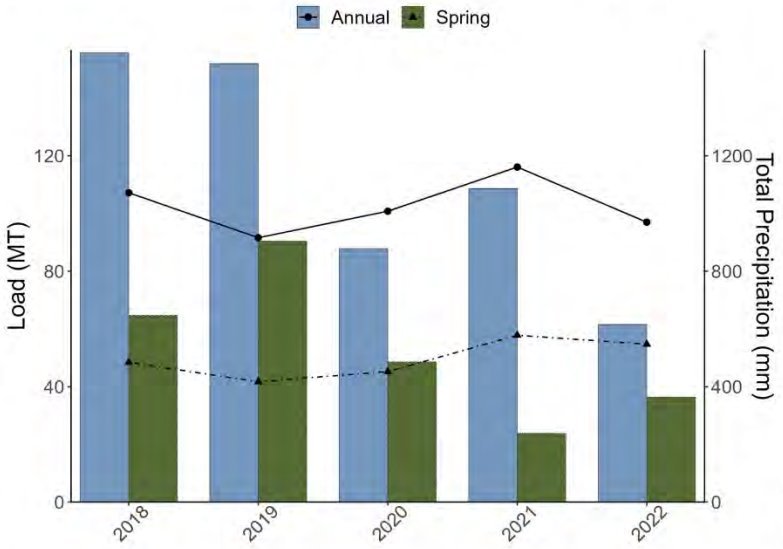
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the orthophosphate target concentration of 0.05 mg/L.

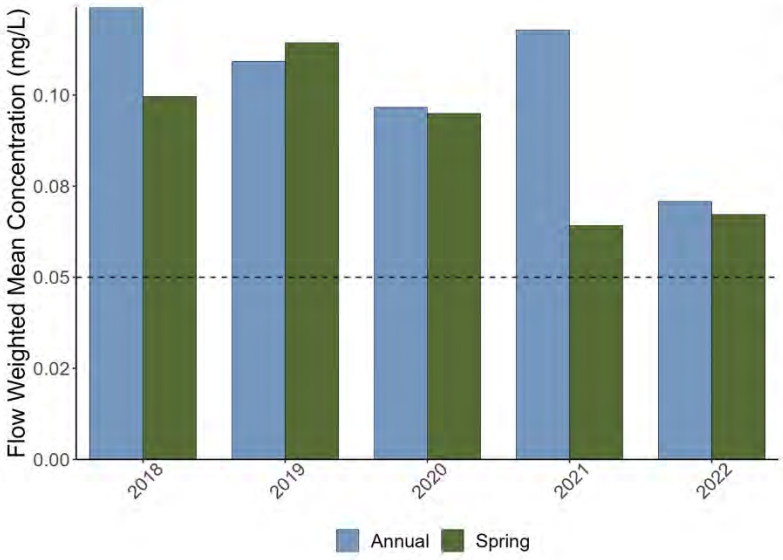
Results The flow weighted mean concentration was never below the target of 0.05 mg/L. Springtime orthophosphate loads made up an average of 49% of total annual loads.

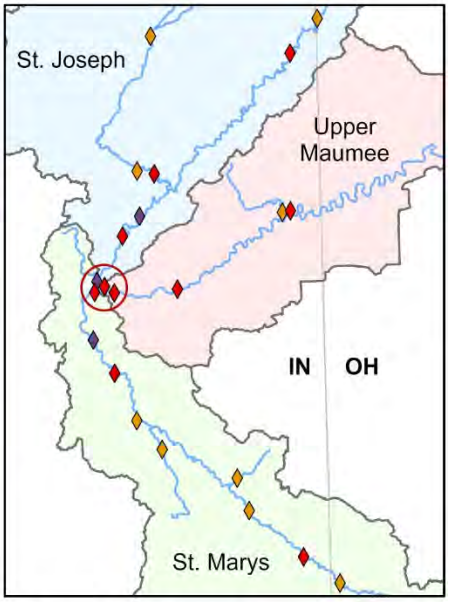
St. Joseph River Mainstem

Downstream at confluence (Fixed Station STJ-.5)

Orthophosphate	
USGS Streamgage	04180500
Drainage Area Ratio	1
IDEM Fixed Station Data	2018-2022
Average Annual Load (lb./yr.)	249,447
Average Springtime Load (1 Mar – 31 Jul)	116,481
Reduction Needed to Meet Spring Target	53,281







Site The IDEM Fixed Station site STJ-.5 is a downstream site on the St. Joseph River in Fort Wayne, Indiana near the confluence with St. Marys (red circle and red diamond in map). Orthophosphate samples were collected monthly in 2018-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

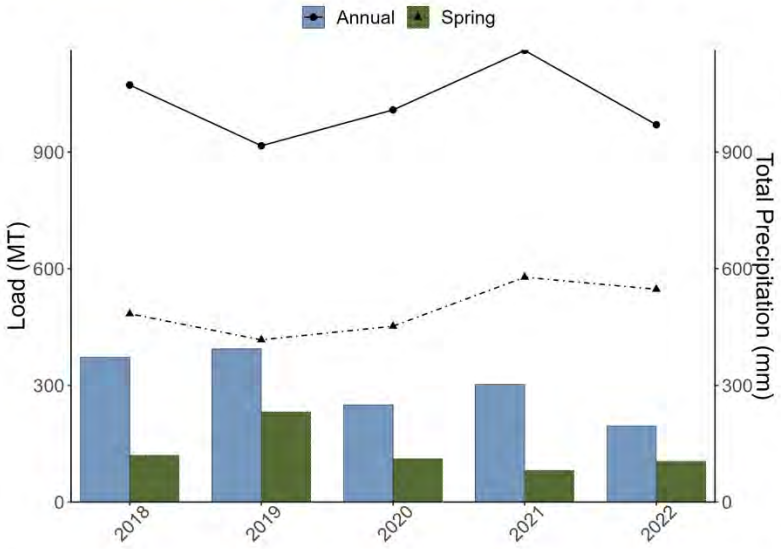
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the orthophosphate target concentration of 0.05 mg/L.

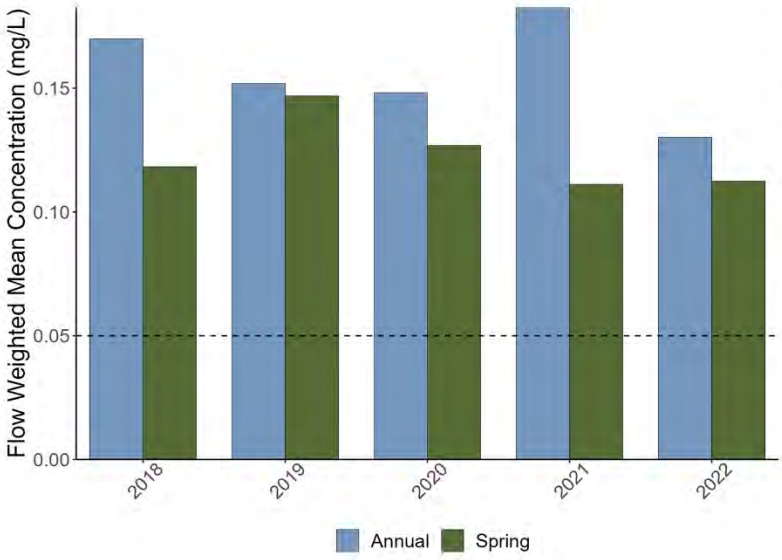
Results The flow weighted mean concentration was never below the target of 0.05 mg/L. Springtime orthophosphate loads made up an average of 47% of total annual loads.

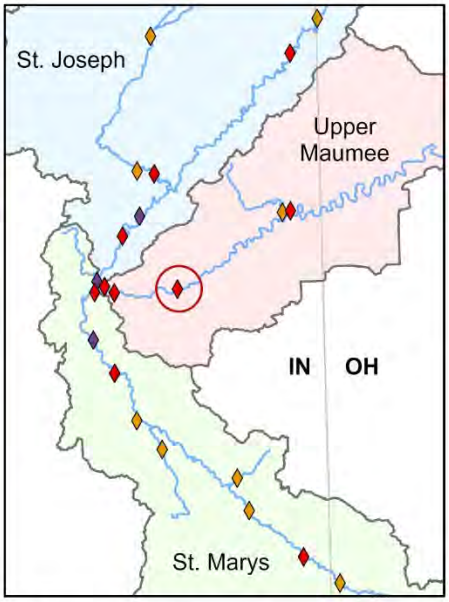
Maumee Mainstem

Midstream (Fixed Station M-129)

Orthophosphate	
USGS Streamgage	04183000
Drainage Area Ratio	1
IDEM Fixed Station Data	2018-2022
Average Annual Load (lb./yr.)	667,963
Average Springtime Load (1 Mar – 31 Jul)	286,441
Reduction Needed to Meet Spring Target	173,259







Site The IDEM Fixed Station site M-129 is a midstream site on the Maumee River in Indiana (red circle and red diamond in map). Orthophosphate samples were collected monthly in 2018-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

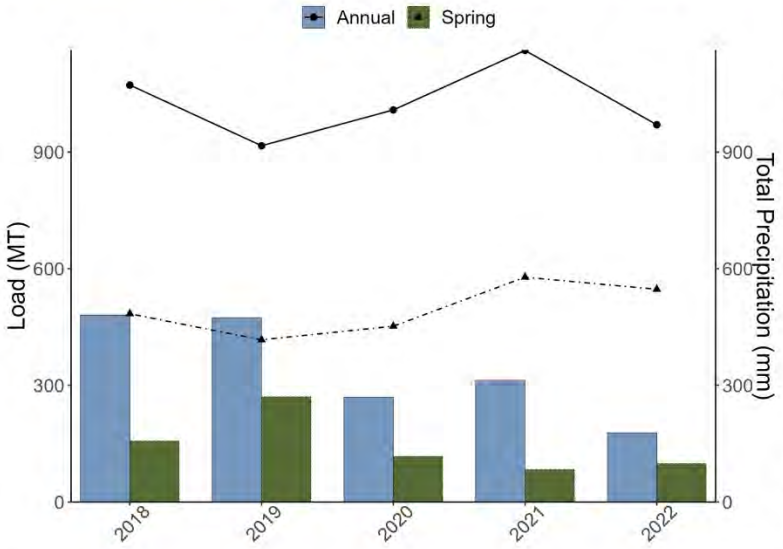
Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the orthophosphate target concentration of 0.05 mg/L.

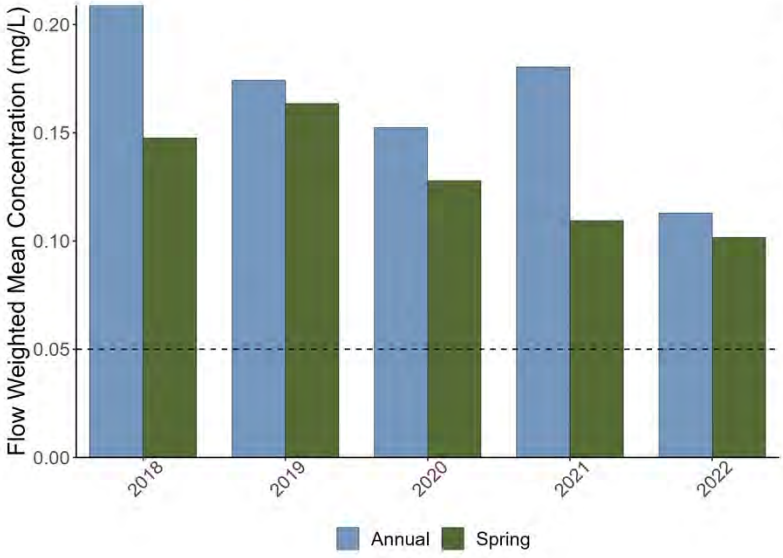
Results The flow weighted mean concentration was never below the target of 0.05 mg/L. Springtime orthophosphate loads made up an average of 43% of total annual loads.

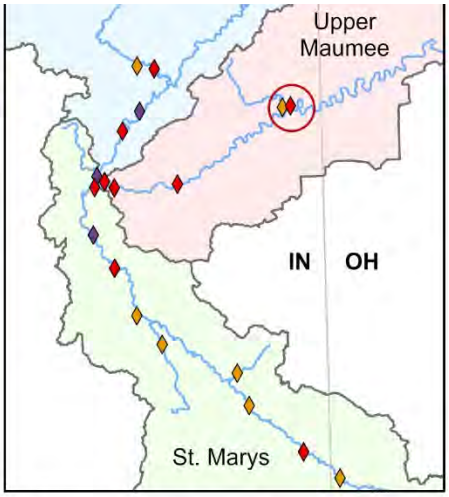
Maumee Mainstem

Downstream (Fixed Station M-114)

Orthophosphate	
USGS Streamgage	04183000
Drainage Area Ratio	1.05
IDEM Fixed Station Data	2018-2022
Average Annual Load (lb./yr.)	756,551
Average Springtime Load (1 Mar – 31 Jul)	321,512
Reduction Needed to Meet Spring Target	202,761







Site The IDEM Fixed Station site M-114 is a downstream site on the Maumee River near the border of Ohio in Indiana (red circle and red diamond in map). Orthophosphate samples were collected monthly in 2018-2022.

Figure 1. (upper left) The colored bars represent the estimated total annual (blue) and springtime (green) load (metric tons; primary y-axis). The lines represent the total annual (solid) and springtime (dashed) precipitation (mm; secondary y-axis).

Figure 2. (lower left) The colored bars represent the average estimated annual (blue) and springtime (green) flow-weighted mean concentration (mg/L). The horizontal line represents the orthophosphate target concentration of 0.05 mg/L.

Results The flow weighted mean concentration was never below the target concentration of 0.05 mg/L. Springtime orthophosphate loads made up an average of 42% of total annual loads.