Indiana's Great Lakes Water Quality Agreement (GLWQA)

DOMESTIC ACTION PLAN (DAP)

for the

WESTERN LAKE ERIE BASIN (WLEB)

February 2018

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FOREWORD

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).[1] 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 very complex problem caused by point and nonpoint sources across all sectors, which requires a multi-dimensional solution.

The Advisory Committee was formed in April of 2016, met ten times in person, and held one conference call. The minutes of those meetings may be found at: Indiana's Great Lakes Water Quality Agreement (GLWQA) Domestic Action Plan (DAP) for the Western Lake Erie Basin (WLEB), http://www.in.gov/isda/3432.htm. Additionally, members who conduct surface water quality monitoring did site reconnaissance and held several meetings and conference calls to review water quality data analyses in order to prioritize watersheds and to refine the Advisory Committee's hypotheses for the basis of adaptive management.

The draft DAP was put on public notice for a 60-day comment period, from August 14-October 13, 2017. Seven public meetings were held in the following locations

- Fort Wayne, August 23rd
    - 1:00 PM session- 14 attendees (U.S. EPA attended)
    - 5:30 PM session- 16 attendees
- Auburn, August 24th (U.S.EPA attended)
    - 10:30 AM session- 30 attendees
    - 5:30 PM session- 12 attendees
- Decatur, August 28th
    - 8:00 AM session- 18 attendees
    - 5:30 PM session- 9 attendees
- Indianapolis, September 26th
    - 6:00 PM session- 8 attendees

A summary of the public comments received through Survey Monkey and the responses to them may be found in Appendix 3.

[1] Adam's Co. Soil and Water Conservation District (SWCD), Allen Co. SWCD, City of Fort Wayne, DeKalb County SWCD, Indiana Farm Bureau, Indiana Pork Producers, Indiana University Purdue University Fort Wayne, Indiana State Department of Agriculture, Indiana Department of Natural Resources, Natural Resource Conservation Service of USDA, Sierra Club, St. Joseph Watershed Alliance, Steuben Co. SWCD, The Nature Conservancy, Tri-State Watershed Alliance, United States Geological Survey. As time allows: Agribusiness Council of Indiana, Agricultural Research Service, USDA, Allen Co. MS4, City of Auburn, Hoosier Environmental Council, Purdue University, The Andersons, Inc.

This DAP will be web-based after its February 2018 release. The Action/Milestone Table found in Appendix 1 will be updated as projects and programs are implemented and new ones are initiated. If you have questions or would like to become involved, please find contact information at http://www.in.gov/isda/3432.htm. We look forward to hearing from you as we strive to reduce phosphorous to the WLEB!

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 (Subcommittee) of the GLWQA since its establishment in 2013. The 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 bio-mass, 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.

Commitments under the Nutrients Annex include the following:

- By February 2016, establish binational phosphorous objectives, loading targets, and allocations for the nearshore and offshore waters to achieve the Lake Ecosystem Objectives (LEOs) for each lake, starting with Lake Erie. [2]
- Assess and where necessary, develop/implement regulatory and non-regulatory programs/measures to reduce phosphorous loadings from agricultural, rural non-farm, urban, and industrial point and nonpoint sources.
- By February 2018, develop a binational phosphorous reduction strategy and *Domestic Action Plans (DAPs)* designed to meet nearshore and open water phosphorous objectives and loading targets for Lake Erie.

On February 22, 2016, the United States and Canada adopted new phosphorus reduction targets for Lake Erie. They are noted in Table 1.

[2] For more information, please see the June 2016 Progress Report of the Parties to the Great Lakes Commission.

Table 1: Binational Phosphorus Load Reduction Targets

BINATIONAL PHOSPHORUS LOAD REDUCTION TARGETS		
Lake Ecosystem Objectives Great Lakes Water Quality Agreement Annex 4, Section B	**Western Basin of Lake Erie**	**Central Basin of Lake Erie**
Minimize the extent of hypoxic zones in the Waters of the Great Lakes associated with excessive phosphorus loading, with particular emphasis on Lake Erie	40 percent reduction in total phosphorus (TP) entering the Western Basin and Central Basin of Lake Erie – from the United States and from Canada – to achieve a 600 Metric Tons (MT) Central Basin load	
Maintain algal species consistent with healthy aquatic ecosystems in the nearshore Waters of the Great Lakes	40 percent reduction spring total and dissolved reactive phosphorus (DRP) loads from the following watersheds where localized algae is a problem:	
	Thames River – Canada Maumee River – U.S. River Raisin – U.S. Portage River – U.S. Toussaint Creek – U.S. Leamington Tributaries - Canada	Sandusky River – U.S. Huron River, OH – U.S.
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 Great Lakes	40 percent reduction in spring TP = 860 MT = 0.23 mg/L Flow Weighted Mean Concentration (FWMC)] and DRP = 186 MT = 0.05 mg/L FWMC loads from the Maumee River (U.S.)	N/A

Via the Subcommittee, each state (Indiana, Michigan, New York, Ohio, and Pennsylvania) and the Province of Ontario agreed to follow a standard outline to develop DAPs by 2018 that at a minimum will:

- Identify implementation targets toward meeting Lake Erie Ecosystem objectives.
- Provide focus for allocation of resources.
- Identify actions and potential policy/program needs.
- Outline measures/methods to track progress.

Founded on the principle of adaptive management, this first iteration of Indiana's DAP to reduce phosphorus to Lake Erie is the product of a dedicated Advisory Committee comprised of representatives from different stakeholder sectors[3] and led by the Indiana Department of Environmental Management (IDEM). The DAP Advisory Committee agreed to the following standards for developing the DAP: (1) decision-making is made by consensus with all votes equal and dissenting opinions or positions noted; (2) the DAP is a dynamic document that acknowledges nutrient problems are complex, multi-faceted, and caused by point and nonpoint

[3] Adam's Co. Soil and Water Conservation District (SWCD), Allen Co. SWCD, City of Fort Wayne, DeKalb County SWCD, Indiana Farm Bureau, Indiana Pork Producers, Indiana University Purdue University Fort Wayne, Indiana State Department of Agriculture, Indiana Department of Natural Resources, Natural Resource Conservation Service of USDA, Sierra Club, St. Joseph Watershed Alliance, Steuben Co. SWCD, The Nature Conservancy, Tri-State Watershed Alliance, United States Geological Survey. As time allows: Agribusiness Council of Indiana, Agricultural Research Service, USDA, Allen Co. MS4, City of Auburn, Hoosier Environmental Council, Purdue University, The Andersons, Inc.

sources across all sectors of Indiana with the solutions being likewise; and (3) the DAP is data driven but not deterred or deferred by the inconclusive or unknown.

This document is informed by the intensive planning, research, and steadfast work that is already underway in the WLEB by individuals, non-governmental organizations, universities, professional associations, for-profit industries, and governmental entities at the town/municipal, county, state, and federal levels.[4] It is in keeping with the principles and approaches in Indiana's *State Nutrient Reduction Strategy*. This DAP identifies data, resource and research needs, as well as next steps and proposes a time-line for meeting/achieving them. It also notes challenges posed by predicted changing conditions such as climate and land use patterns. The criteria by which priorities, next steps, and the allocation of resources are evaluated include the following:

- Use existing programs and optimize partnerships.
- Effect the most change with the least cost.
- Prioritize resources to areas with the most phosphorus export and/or reduction potential.[5]
- Seek to engage citizens who are unengaged or not participating in conservation efforts.
- Make use of social indicators to guide outreach activities and best management practices (BMPs).
- Employ adaptive management.

GOALS

The focus of Indiana's DAP is the Western Lake Erie Basin (WLEB) 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" (Table 1 highlight). From applying, cross-referencing, and analyzing seven different models, the Subcommittee concludes that spring-time (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 Subcommittee determined that a reduction of 40 percent in spring-time 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 total phosphorus (TP) and 186 MT of dissolved reactive phosphorus (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 decade.

[4] Nonpoint source pollution abatement plans and actions in progress are listed with hyperlinks under "Major Actions Since 2008."

[5] This does not preclude support to areas or activities that are not identified as top priorities.

Indiana's goal is to meet the spring-time 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 Action (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 3 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.

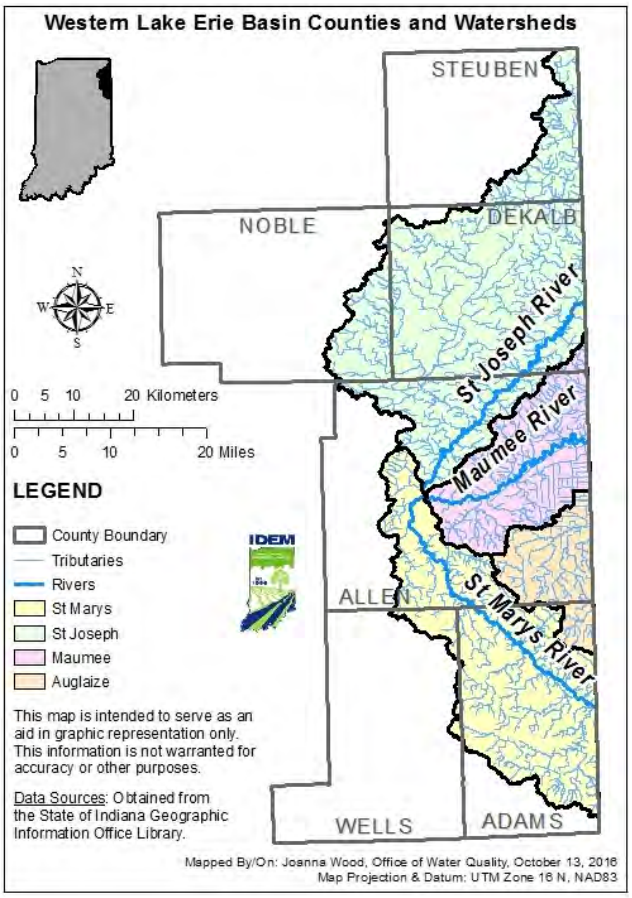
Timeframe to meet load reduction goals

The lag time between the installation of conservation or BMPs on the landscape and positive, statistically significant changes in the water quality of a large river, such as the Maumee, can take decades.[6] 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 including social indicators to track progress annually from different sectors and will use 2020 as a checkpoint to determine progress toward the target phosphorus loads on the Maumee to validate or re-evaluate the priority watersheds, programs, and practices put forth in this DAP. By that time, Indiana plans to have more baseline monitoring at the smaller, sub-watershed scale that will facilitate setting specific phosphorous target loads in the priority sub-watersheds to be met by 2025 in order to make progress in meeting the FWMC on the Maumee.

[6] Donald W. Meals and Steven A. Dressing. 2008. Lag time in water quality response to land treatment. Tech Notes 4, September 2008. Developed for U.S. Environmental Protection Agency by Tetra Tech, Inc., Fairfax, VA, 16 p. Available online at https://www.epa.gov/sites/production/files/2016-05/documents/tech_notes_4_dec2013_lag.pdf

INDIANA'S PORTION OF THE WLEB

Figure 1: 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[7]. 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.

Land Use in the WLEB and Major Sources of Phosphorus

More than 70 percent of the WLEB is agricultural, 15 percent is developed, and the remaining 15 percent is comprised of forests, wetlands, and open water. Row crop agricultural land with corn and soybean rotation predominating, is mostly drained by subsurface tiles which, during significant rainfall events, discharge to streams transporting phosphorus, nitrogen, and in some cases suspended sediment.

Table 2: Land Use in the Indiana WLEB (USDA-NASS, Washington, DC, 2012)

Land Use	Total in Acres	Percentage of Total
Agriculture	436,100.05	53.10 %
Hay/Pasture	141,174.25	17.20%
Developed	123,604.83	15.00%
Forested	76,910.81	9.40%
Wetland	22,168.99	2.70%
Scrub/Shrub	11,743.78	1.40%
Open Water	9,594.56	1.20%
Total	821,297.26	100.00%

[7] Approximate acres by county: Steuben ≈ 50,210, Noble ≈ 52,050, DeKalb ≈ 224,520, Allen≈ 315,400, Wells ≈ 17,600, Adams ≈ 161,520

There are four major (one million gallons/day) National Pollutant Discharge Elimination System (NPDES)[8] permitted municipal wastewater treatment plants (WWTPs), each with a TP effluent limit of 1 mg/L. These include Fort Wayne, Decatur, Auburn, and Butler. These WWTPs average a discharge concentration below the 1mg/L TP limit. There are three minor municipal WWTPs and an additional seven industrial/other minor dischargers.

Within the developed areas, there are seven combined sewer overflow (CSO)[9] communities including Auburn, Berne, Butler, Decatur, Fort Wayne, New Haven, and Waterloo, each with an approved Long Term Control Plan (LTCP) or consent decree with compliance schedules. There are 13 designated municipal separate storm sewer systems (MS4s)[10] with approved Storm Water Quality Management Plans (SWQMPs) including one in Adams County, 11 in Allen County, and one in DeKalb County. Like nonpoint source (NPS) pollution associated with precipitation events, these regulatory point sources have their pollutant signatures during precipitation events.

Confined feeding operations (CFOs) as defined by Indiana Code (IC 13-18-10) mean any confined feeding of at least 300 cattle; 600 swine or sheep; 30,000 fowl; or 500 horses.[11] There are 78 active CFOs in the WLEB with 50 in Adams County, 12 in Allen County, 12 in DeKalb County, one in Steuben, and three in Wells County[12]. Approximately 8.3% or 36,000 of the 436,100 acres used for agriculture within the Indiana WLEB are used for application of manure generated by CFOs. This does not account for the numerous livestock operations that fall below the threshold of regulation under the CFO rule. The density of those operations and the acres of land used for application of manure from them will be documented during 2018. A map of state permitted livestock facilities as well as WWTP (NPDES) facilities is found in Figure 2.

[8] 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

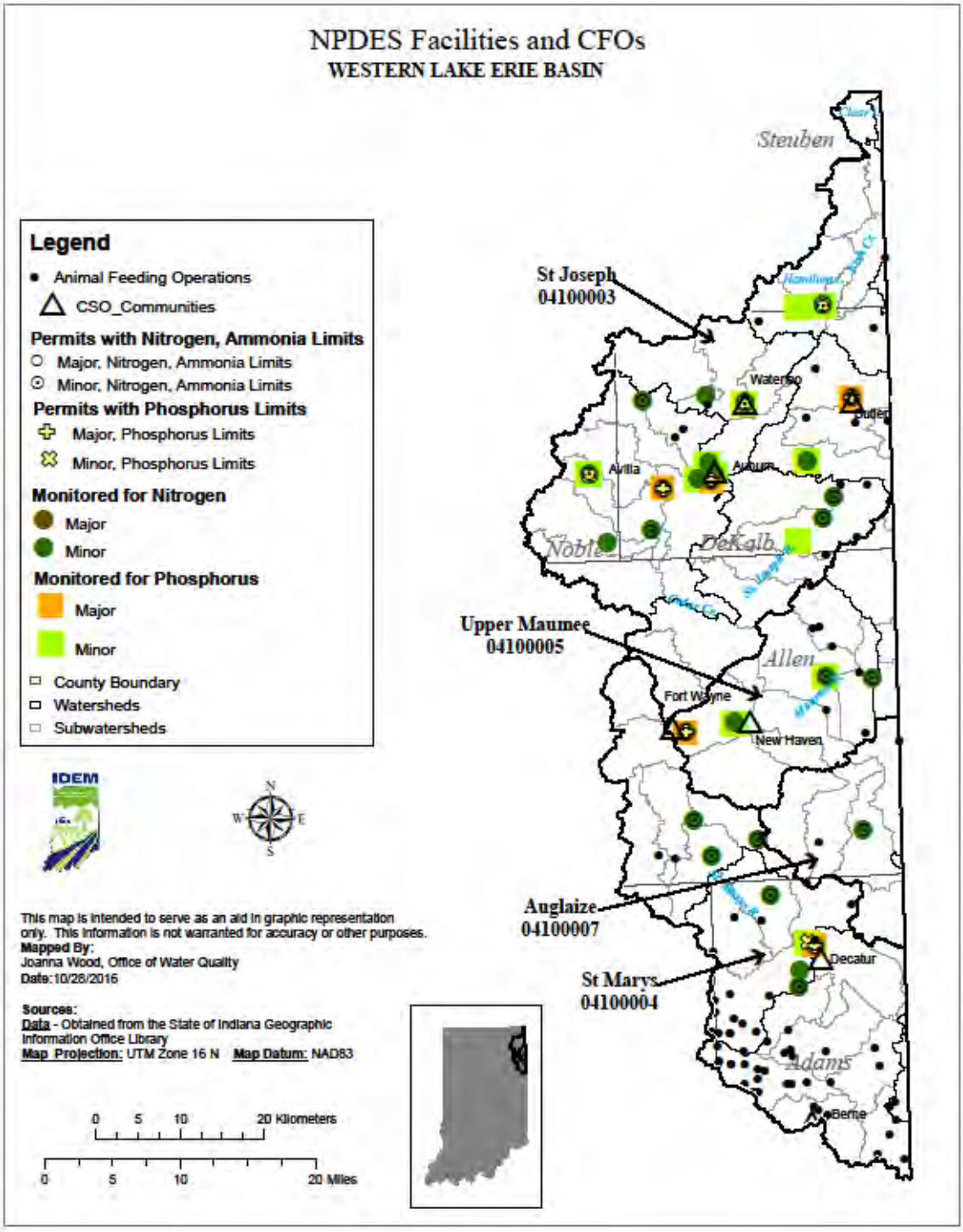
[9] CSOs are wastewater collection systems that convey sanitary wastewaters (domestic, commercial, and industrial wastewaters) and storm water through a single-pipe system to a Publicly Owned Treatment Works (POTW). A CSO is the discharge from a combined sewer system at a point prior to the POTW. CSOs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

[10] 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.

[11] 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.

[12] 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.

Figure 2: NPDES Facilities and CFOs



WATERSHED PRIORITIZATION

At the 8-digit hydrologic unit code (HUC)[13] scale, the watershed contributing the most TP to the Maumee River is the St. Marys.[14] 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. Various models show the highest TP concentrations and loads in the St. Marys watershed; DRP was not collected at the IDEM fixed station sites during that period[15]. Additionally, using the FWMC of 0.23 mg/L as a target, the load duration curves show the results from 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 analysis as well as station-by-station results). Figure 3 depicts the FWMC at each of IDEM's fixed station sites.

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 watershed management plans (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 4). The water quality data from the Allen County SWCD, City of Fort Wayne, and the Tri-State Watershed Alliance 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.

[13] 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.

[14] 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.

[15] Sampling for DRP at the IDEM fixed station sites will commence in 2018.

Figure 3

Total Phosphorus Loading at Fixed Station Sites
of the Western Lake Erie Basin

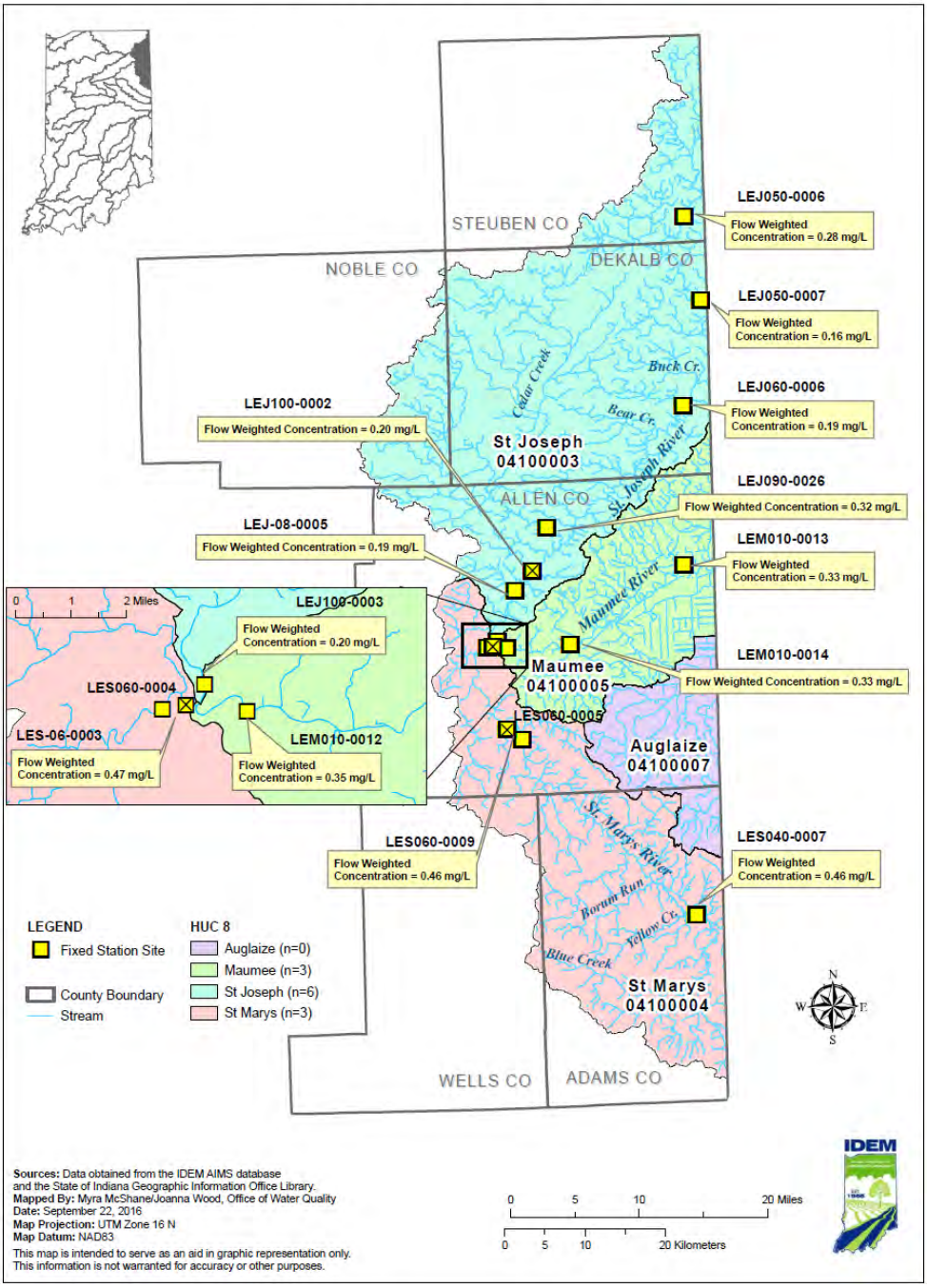
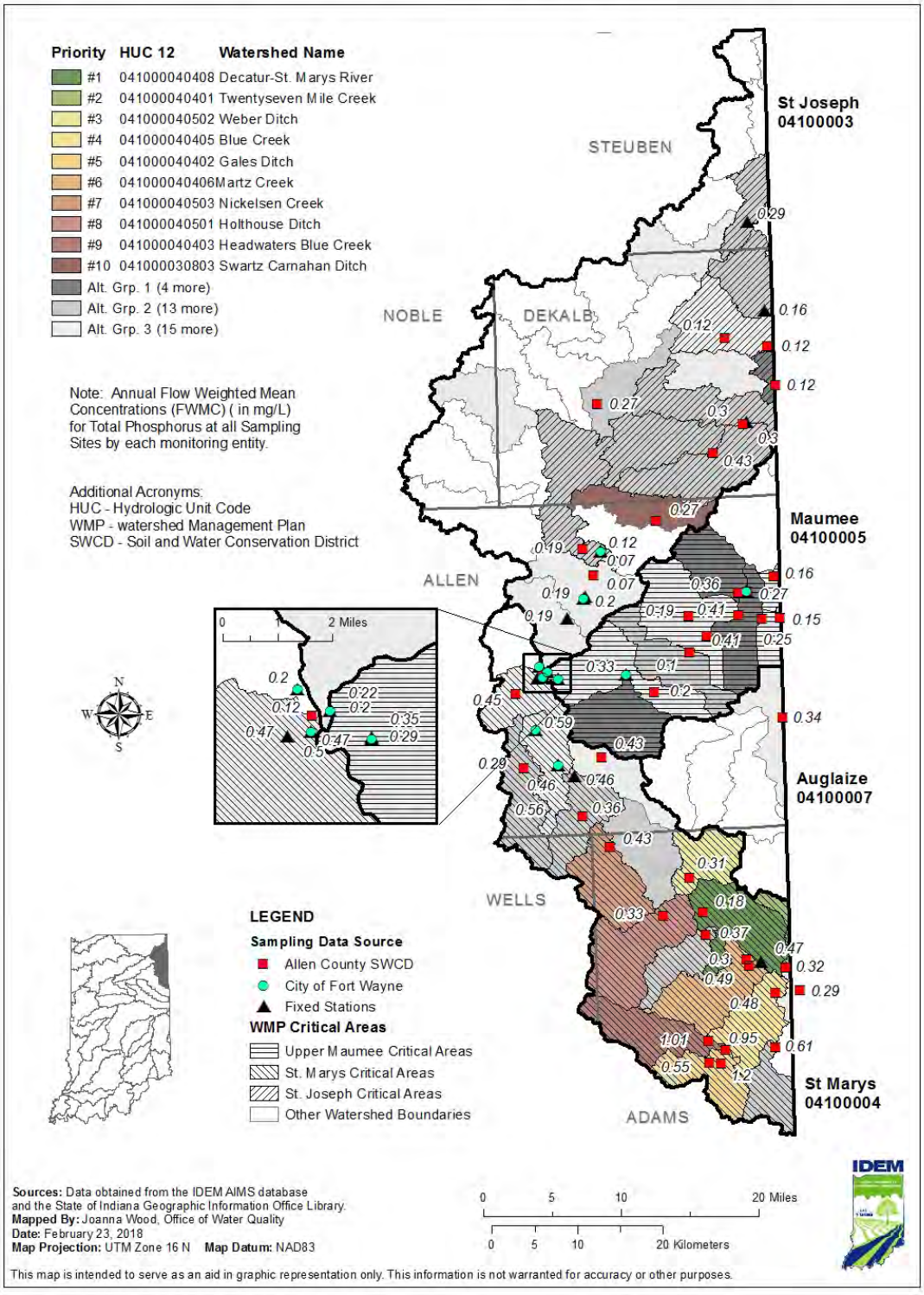


Figure 4

Priority Watersheds in the Western Lake Erie Basin in Indiana



GUIDING PRINCIPLES FOR ACHIEVING WATER QUALITY IMPROVEMENTS

Opportunities exist to reduce nutrient inputs from both urban and rural landscapes, including both point and nonpoint sources. Emphasis is on using existing regulatory instruments and implementing voluntary BMPs.

Point Sources/Regulated

Urban Rural

- WWTPs and POTWs will employ optimization techniques by analyzing their current operation and maintenance processes to seek better nutrient removal.
- CSO communities will implement their LTCPs and associated compliance schedules and track progress. Nutrient load reductions will be quantified via modeling and, where possible, by ambient water quality monitoring as projects and practices are implemented.
- Storm water management:
  - MS4 communities will implement their SWQMPs and track progress.
  - Construction site sediment runoff controls will be implemented according to the Notice of Intent (NOI)[16] and living stabilization covers will be used that minimize nutrient inputs.
  - Industrial site runoff controls will be implemented according to the NOI.
- Extend sewers to communities with failing septic systems by putting infrastructure in place.
- Septic system installation, operation, maintenance, and repair:
  - Will follow the site specific design regulations.
  - Will utilize existing county outreach programs in the WLEB as a model.
  - Will provide additional outreach and education on design and repair requirements.

Agriculture

- Ensure compliance with the CFO and Fertilizer Certification rules via routine inspections.
- Timely investigate reports of nutrient mismanagement or runoff from regulated farms and spills from unregulated farms.

Nonpoint Sources

The overall goals will be to enhance nutrient management, promote soil health practices, and restore more natural hydrology and ecological functions by promoting drainage water management (rather than moving water off the landscape quickly) and emphasizing the importance of allowing water to infiltrate where it falls.

Hydromodification is the alteration of the natural flow of water through a landscape that reduces precipitation infiltration and changes drainage patterns causing rainfall to discharge into streams more quickly with higher energy. Large flow events occur more frequently and local drought and flood cycles may be exacerbated. The United States Environmental Protection Agency (U.S. EPA) indicates that hydromodification is one of the leading sources of water

[16] 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.

quality degradation in our nation's waters.[17] Examples of hydromodification include channelization and dredging; streambank denuding; removal of riparian corridors, wetlands, and floodplains; stream relocation; dams; streambank and shoreline hardscapes; subsurface drainage (agricultural and residential); and conversion of open landscape to roads, buildings, parking lots, and other impervious surfaces. 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.

Opportunities for mitigation include but are not limited to the following approaches:

Urban landscapes: create a green infrastructure (GI) paradigm by seeking incentives and opportunities for it.[18]

- Support practices that promote infiltration, bio-retention, and slow or more natural water release.
- Seek the installation of larger, regional or multipurpose GI practices that are often more cost-effective.
- Ensure that the maintenance of GI 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.

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.

Agricultural landscapes:

- **Promote nutrient management**:
    - Optimize inputs and uptake by crops through employing the "4 Rs" namely, applying the right nutrient source at the right rate at the right time in the right place.
    - Increase outreach on manure management to livestock farms.
- **Emphasize soil health**: Healthy soil with a higher organic content reduces erosion, requires less nutrient inputs, ameliorates the effects of flood and drought, and reduces nutrient and sediment loading to streams and rivers. The four key principles to increasing organic matter and building healthy soils are:
    - Minimize disturbance through no till or conservation tillage practices.

[17] National Management Measures to Control Nonpoint Source Pollution from Hydromodification, EPA 841-B-07-002, July 2007.
[18] U.S. EPA's website for Green Infrastructure is a great resource for design and implementation measures as well as funding sources, and Indiana's manual entitled the *Planning and Specification Guide for Effective Erosion and Sediment Control and Post-Construction Water Quality* shows pollutant removal expectations for the various BMPs.

- Maximize soil cover.
- Keep living roots growing as long as possible.
- Grow a variety of plants.

MAJOR ACTIONS FROM 2008-2016

Since 2008, the base year from which progress is being measured, policies, and various programs and practices have been implemented to reduce nutrients from entering Indiana's waters. An excellent overview of many of the past and ongoing activities is provided in the Western Lake Erie Basin Story Map, and the current and planned activities to address the issues outlined in this DAP are enumerated in the Action/Milestone Table at the end of this document. A listing of a few key major actions follow.

Regulatory

- 2010 (readopted 2016) - 355 IAC Article 7: Certification for Distributors and Users of Fertilizer Material
  - Rule administered by the Indiana Office of the State Chemist (IOSC) to ensure fertilizer materials are applied, handled, and transported effectively and safely in a manner that protects water quality.
  - Pertains to:
    - Application of manure from an IDEM regulated CFO and out-of-state farms that meet IDEM regulatory thresholds.
    - For-hire applications of commercial fertilizer and manure.
- 2012 - 355 IAC Article 8: Fertilizer Material Use, Distribution, and Recordkeeping.
  - Requires routine soil sampling.
  - Requires nutrient application based on agronomic needs of crops grown.
  - Contains limits for manure application from all farms based upon volume of manure production with limited exceptions for farms with less than 10 cubic yards or 4,000 gallons of manure.
- 2012 - Confined Feeding Operation Rule 327 IAC 19: The program has three main areas of focus to protect ground and surface water:
  - Design, construction, and capacity requirements for confinement buildings, manure storage structures, and other waste management structures.
  - Operation and maintenance requirements including self-inspections, record keeping, and spill response.
  - Land application requirements including setbacks, application at agronomic rates, and avoiding weather conditions that could lead to contaminated runoff, such as restrictions on application to frozen and snow-covered ground.
  - Soil P is not to exceed 200 parts per million (PPM) by 2018.
- 2012 - Concentrated Animal Feeding Operation Rule 327 IAC 15-16.
  - Adopted federal rule by reference which applies to livestock operations that discharge to waters.
  - As of October 2017, no regulated farms in Indiana are discharging from the production site so none require a discharge permit of this type.

- 2015 - Satellite Manure Storage Structures Rule 227 IAC 20.
    - IDEM Regulates manure storage structures not located at the site of a livestock or poultry production area if they will store:
        - At least one million gallons of manure; or
        - At least 5000 cubic yards of manure.
    - The same construction standards apply as if the structure were located at aCFO.
    - Operational requirements are similar to those established for manure storage structures located at a CFO.
- 2015 - All CSO communities have an approved LTCP or other state or federal enforceable mechanism in place.

Non-regulatory

- 2010 - Indiana Department of Natural Resources (IDNR) and IDEM became official members in the Indiana Conservation Partnership (ICP).[19]
- The Indiana Nutrient Management/Soil Health Strategy, developed by representatives of the agricultural commodities' organizations, was incorporated into *Indiana's State Nutrient Reduction Strategy* as the action plan for agriculture.
- InField Advantage (formerly On Farm Network) was established at the Indiana State Department of Agriculture (ISDA).
- 2016 - Version 4 of *Indiana's State Nutrient Reduction Strategy* was put on the ISDA website and is being converted into a story map.

Watershed Planning

- 2015/2016 - *Indiana Western Lake Erie Action Plan*.
- March 2016 - Western Lake Erie Basin Partnership Strategic Plan and Western Lake Erie Basin Initiative Strategy, Years 2016-2018.

Approved CWA §319 Watershed Management Plans[20]

- 2008 - *St. Joseph River (Lower)-Bear Creek WMP*.
- 2009 - *St. Mary's River WMP*.
- 2013 - *St. Joseph River (Middle) WMP*.
- 2014 - Maumee River (Upper) WMP.
- 2015 - *St. Joseph River (Upper) WMP*.

[19] The ICP is comprised of eight Indiana agencies and organizations who share a common goal of promoting conservation. To that end, its mission is to provide technical, financial and educational assistance needed to implement economically and environmentally compatible land and water stewardship decisions, practices and technologies. The eight entities include: Indiana Association of Soil and Water Conservation Districts (IASWCD) and the 92 SWCDs, State Soil Conservation Board, Indiana State Department of Agriculture (ISDA) Division of Soil Conservation, IDNR, IDEM, Purdue University Extension Service, USDA Farm Services Agency (FSA) and USDA Natural Resources Conservation Service (NRCS).

[20] WMPs for Cedar Creek and St. Joseph River (Maumee) WMP (including Ohio and Michigan portions) were approved prior to 2008 as was a TMDL for the St. Marys and Maumee rivers.

PARTNERS AND AREAS OF AUTHORITY/RESPONSIBILITY AND PROGRAMS TO ADDRESS NUTRIENT REDUCTION

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.

Cities and Towns (taxation and utility fee authority)

- Comprehensive planning.
- Zoning ordinances.
- Building permits.
- Infrastructure.
    - Transportation.
    - Drinking water.
    - Wastewater.
    - Storm water.
- Parks and Recreation.
    - Management of city owned public lands.
- Surface water quality monitoring (some).

Counties (taxation and drainage assessment authority)

- Comprehensive planning.
- Drainage board.
    - Legal drains.
    - Some with MS4 oversight.
- Storm water (some with MS4 oversight).
    - Public outreach and education program.
    - Illicit discharge detection and elimination program.
    - Construction and post construction storm water run-off control program.
    - Pollution prevention and good housekeeping program.
    - Storm water pollution prevention plans.
- Wellhead protection.
- Source water protection.
- Parks and Recreation.
    - Management of county owned public lands.
- Health Departments.
    - Septic system permitting.

    - Some with surface water quality oversight.
    - Some with hazardous materials spill response.
- Soil and Water Conservation Districts.
    - Construction storm water control plan review and inspection program (327 IAC 15-5).
    - Education and outreach.
    - Technical assistance with conservation planning and practices.
    - Some provide surface water quality monitoring.
    - Funding sources include local, state, and federal grant opportunities as well as partnering with non-governmental organizations for watershed planning and BMP installation.

Indiana Department of Environmental Management

- National Pollutant Discharge Elimination System (NPDES) permitting and compliance (327 IAC 5-2-2).
    - Municipal, semi-public, state, or federal (sanitary-type discharger).
    - Industrial.
    - Pre-treatment.
    - Constructed wetland (non-rule policy).
    - Stormwater.
        - Municipal.
        - Industrial.
        - Construction.
- Wetland CWA §401 water quality certifications and State isolated wetland permitting.
- CFOs and concentrated animal feeding operations (CAFO).
    - Design and construction standards for manure storage structures.
    - Land application requirements.
    - Operational requirements for the facility.
- Surface water and ground water quality monitoring.
- Drinking water oversight, wellhead, and source water protection plans.
- Natural resource damage program.
- Watershed programs.
    - Total maximum daily load (TMDL): Section 303(d) of the CWA established authority for the TMDL program designed to determine the extent of impaired waters[21] and develop reports that identify the causes of the impairment, the reductions of pollutants needed, and the actions needed to improve water quality. The 303(d) List of Impaired Waters is used by IDEM and other ICP cost-share programs to help prioritize watershed restoration activities.

[21] Impaired waters do need meet designated water quality standards and do not support one or more designated uses, such as recreational, protection of aquatic life, drinking water, and fish consumption.

- Nonpoint source program § 319(h) and 205(j) grant administration: Named for the portion of the CWA that authorizes each of these programs, they are federal pass-through grant programs aimed at improving water quality in the state.
  - § 319(h): Provides 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. Organizations eligible for funding include nonprofit organizations, universities, and local, State or Federal government agencies. A 40 percent (non-federal) in-kind or cash match of the total project cost must be provided.
  - 205(j): Provides for projects that gather and map information on nonpoint and point source water pollution, develop recommendations for increasing the involvement of environmental and civic organizations in watershed planning and implementation activities, and to develop watershed management plans.

Indiana Department of Natural Resources

- Flood control and floodway management (312 IAC 10).
  - Dams, dikes, and levees.
  - Logjam removal.
- Construction on a public freshwater public lake (IC 14-26-2, 312 IAC 11).
- Construction in a navigable waterway (IC 14-29-4).
- Mineral extraction from a navigable waterway (IC 14-29-3).
- Well construction and withdrawal (IC 25-39, 312 IAC 13).
- Invasive species control.
- Lake and River Enhancement Grant program (IC 6-6-11-12.5): The goal of the Division of Fish and Wildlife's Lake and River Enhancement (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.

Indiana State Department of Agriculture

- InField Advantage (INFA) program: The INFA program is a collaborative opportunity for farmers to collect and understand personalized, on-farm data to optimize their management practices and to ultimately improve their bottom line while benefitting the environment. Participating farmers use precision agricultural tools and technologies such as aerial imagery and the corn stalk nitrate test, to conduct research on their own farms to determine nitrogen use efficiency in each field that they enroll.

- Clean Water Indiana (CWI) grant program: Administered by ISDA under the direction of the State Soil Conservation Board, the 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.
- Phosphorus soil sampling program through a U.S. EPA grant.
- Through ICP data sharing, tracking of sediment and nutrient load reductions on all assisted (cost-share) conservation practices/BMPs using the U.S. EPA Region 5 model.
- In cooperation with the Indiana Association of Soil and Water Conservation Districts (IASWCD), the Conservation Cropping Systems Initiative (CCSI) focuses on a management system approach to crop production that results in improved soil and water quality as well as profitability on Indiana cropland.

Natural Resource Conservation Service (the Agricultural Act of 2014 - financial and technical assistance for conservation planning and practice implementation)

- Environmental Quality Incentives Program (EQIP): The 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, increases 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.
- Wetland Reserve Easements (WRE): The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the WRE component, NRCS helps to restore, protect and enhance enrolled wetlands.

- Western Lake Erie Basin Initiative (WLEB): The WLEB was made a priority area by USDA as agricultural land was determined to be one of the sources of increased phosphorus in surface water due to water and wind erosion.
- Regional Conservation Partnership Program (RCCP): 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.
- Conservation Technical Assistance (CTA): The CTA program provides voluntary conservation technical assistance to landowners, communities, tribes, units of state and local government, and other federal agencies in planning and implementing conservation systems. This assistance is for planning and implementing conservation practices that address natural resource issues. It helps people voluntarily conserve, improve and sustain natural resources.

Agricultural Research Service

- Research and edge-of-field monitoring.

United States Geological Survey

- Stream flow gage operation and maintenance.
- Stream monitoring.
- Edge-of- field monitoring.

Indiana Conservation Partnership

- ICP Accomplishment Reporting: In 2013, members of the ICP adopted the U.S. EPA Region 5 Nutrient Load Reduction Model that determines the sediment, nitrogen, and phosphorus load reductions achieved through conservation practices funded through the afore-mentioned state programs (ISDA's Clean Water Indiana Program and the IDNR Lake and River Enhancement Program), and the federally funded programs including the IDEM administered Section 319 Program and USDA's Farm Bill Programs.
- Tillage and cover crop transects.
- Annual Work Plan to bolster collaboration among the partners and leverage resources.

The Nature Conservancy (funding activities through a combination of public and private grants and donations)

- TNC Western Lake Erie Basin Agriculture Project (tristate).
    - 4R Nutrient Stewardship Certification Program.
    - Education and outreach.
    - Implementation and monitoring work on three miles of two-stage ditch.

- Support water quality sampling in the St. Joseph watershed.
- Efforts on two-stage ditches led to first cost-share and NRCS practice.

Agriculture Organizations

- Nutrient Management/Soil Health Strategy adopted in 2012 through collaboration of agriculture organizations, TNC, Purdue, and government agencies.
- Support addressing nutrient loss from agricultural lands through enhancements like improved awareness by farmers, bolstering research and monitoring, more widespread education and implementation of practices to reduce nutrient loss, improving soil health, and increasing edge-of-field water management.

WATER QUALITY MONITORING

To track Indiana's progress in meeting its P 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 3). 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.

Results for TP at the Antwerp site calculated by the Ohio USGS show that the FWMC has been two to three times higher than the value calculated from the IDEM fixed station site at SR 101 over the Maumee.[22] While a difference is not surprising given the greater frequency of collection at the Antwerp site which captures high-flow events, the magnitude is significant. Further analysis of the Allen County SWCD and Fort Wayne weekly grab sample data show a pattern, albeit much lower, consistent with the Antwerp data. While it is highly probable that the difference between the two sites is due to grab sampling missing peak and high flows at SR 101, to verify this and validate that using the Antwerp site is the best choice for Indiana, the USGS will install and operate an auto-sampler at SR 101 for a period of not less than 12 months. By so doing, an "apples to apples" comparison of the two sites can be made so that there is no question or concern regarding using the Antwerp site to measure Indiana's progress.

To optimize resources and establish a regional network, IDEM, Indiana USGS, Ohio Environmental Protection Agency (OEPA), Ohio Department of Natural Resources (ODNR), Ohio USGS, and U.S. EPA Region 5 are collaborating on monitoring activities. Ohio will continue to support the USGS monitoring activities at Antwerp and is supporting the addition of a USGS continuous monitoring multi-parameter sensor there that will provide real-time data via the

[22] http://lakeerie.ohio.gov/

USGS website. To characterize their respective contributions of phosphorus loads across their borders, Indiana and Ohio establish as priorities the following new monitoring sites:

- The St. Marys River at Wilshire, OH. Ohio is funding USGS auto-sampler monitoring through a U.S. EPA GLRI grant for a minimum of three years.
- On the St. Joseph River at Newville, OH. Ohio is funding USGS auto-sampler monitoring through a U.S. EPA GLRI grant for a minimum of three years.
- The St. Marys prior to its confluence with the St. Joseph to form the Maumee. Indiana is funding USGS auto-sampler monitoring through a U.S. EPA GLRI grant for a minimum of three years. The purpose of this sampling is to better characterize nutrient loading on the St. Marys within Indiana's borders. The auto-sampler will be located at the current IDEM sampling location on Ferguson Road. This site has a drainage area of less than 1 percent difference from the USGS streamgage and can be considered co-located. Water-quality samples will be collected at low-, moderate-, and high-flow conditions during routine monthly and event trips.

Table 3. 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 better characterize sources and thereby provide a more rigorous baseline for setting nutrient loading targets in the sub-watersheds, Indiana is planning to install in the 2018-2019 period the following:

- 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 or near the IDEM fixed station site on the St. Marys River at Pleasant Mills to evaluate the nutrient load reductions achieved by the Adams Co. Regional Sewer District (RSD) sewer extension project; and
- Stream-flow gages in the Blue Creek Watershed and perhaps, stream flow gages on the interceptor ditches.

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

MEASURING AND REPORTING PROGRESS

Indiana is participating in the Great Lakes Commission (GLC) pilot project for the WLEB to develop a consistent reporting framework, entitled ErieStats, for the states and Ontario to report their progress in meeting the GLWQA lake ecosystem objectives. The first product of that pilot will be available in February of 2018. Toward that end, Indiana has provided the GLC with its current and proposed tracking tools for consideration in developing ErieStats.

In addition to participating in the domestic and binational efforts to track and report progress under the GLWQA Annex 4, such as ErieStat, Indiana will continue using the following methods for tracking and annually reporting its progress:

- Ambient water quality monitoring data for the fixed station grab sample sites operated at the state, local, and municipal levels. The reporting frequency for the USGS auto-sampler sites will be at least annually and perhaps more frequently.
- Edge-of-field (EOF) monitoring data.[23]
- Tillage and cover crop transect data.
- The nutrient load reductions calculated using the Region 5 BMP load reduction model for all ICP assisted conservation practices.
- POTW discharge monitoring reports are submitted monthly and will be graphed annually.
- Pertinent information from MS4 annual reports will be compiled and reported annually.
- LTCP pertinent progress will be reported annually.
- Cost-share program project milestones and updates.
- Social indicator survey work for farmers will be reported as available.

In addition to the monitoring and reporting noted above, the DAP Action/Milestone Table (Appendix 1) includes the various project implementation schedules and where feasible, the nutrient load reductions associated with those activities. The year 2020 will serve as a checkpoint for cross-referencing the expected rates for BMP implementation and their modeled load reductions with EOF and ambient water quality data to see how effective the programs and BMPS are. This will serve as an opportunity for adaptive management and any necessary shifting of priorities or approaches.

Challenges

1. **Precipitation Events and Temperature**

   According to the Great Lakes Integrated Sciences and Assessments Center, a joint effort of the University of Michigan and Michigan State University, anticipated increases in average temperatures and wet-season precipitation will have an adverse impact on algal

[23] EOF done for research purposes will not be available until the studies are published.

levels in the Great Lakes (http://glisa.umich.edu/media/files/GLISA_climate_change_summary.pdf).

The center reports that annual average temperatures in the Great Lakes region in the United States have increased by two degrees Fahrenheit since 1900 and are expected to increase by another 1.8 to 5.4 degrees F by 2050 and 3.6 to 11.2 degrees F by 2100. Total annual precipitation in the region has increased by 10.8 percent since 1900 and is expected to continue to increase, particularly during the spring.

The impact of higher average temperatures and increased springtime rainfall, along with other expected changes, such as increased stratification of lake water temperatures, could increase the threat of algal blooms in the lakes, particularly Lake Erie. "Stronger storms, warmer temperatures, and nutrient loading are conspiring to produce more hypoxic dead zones and toxic algal blooms," the center states.

2. **Rural Population Growth and Expansion of Unregulated Livestock Operations**

   Local accounts indicate that there has been and continues to be more farmland acquisition by nontraditional landowners for livestock operations with animal counts below the threshold for regulation by IDEM's Confined Feeding Operation Rule 327 IAC 19. *Local officials have expressed concern regarding their preclusion by State law to regulate the activities associated with livestock production.*

3. **Influx of Manure from Out-of-State**

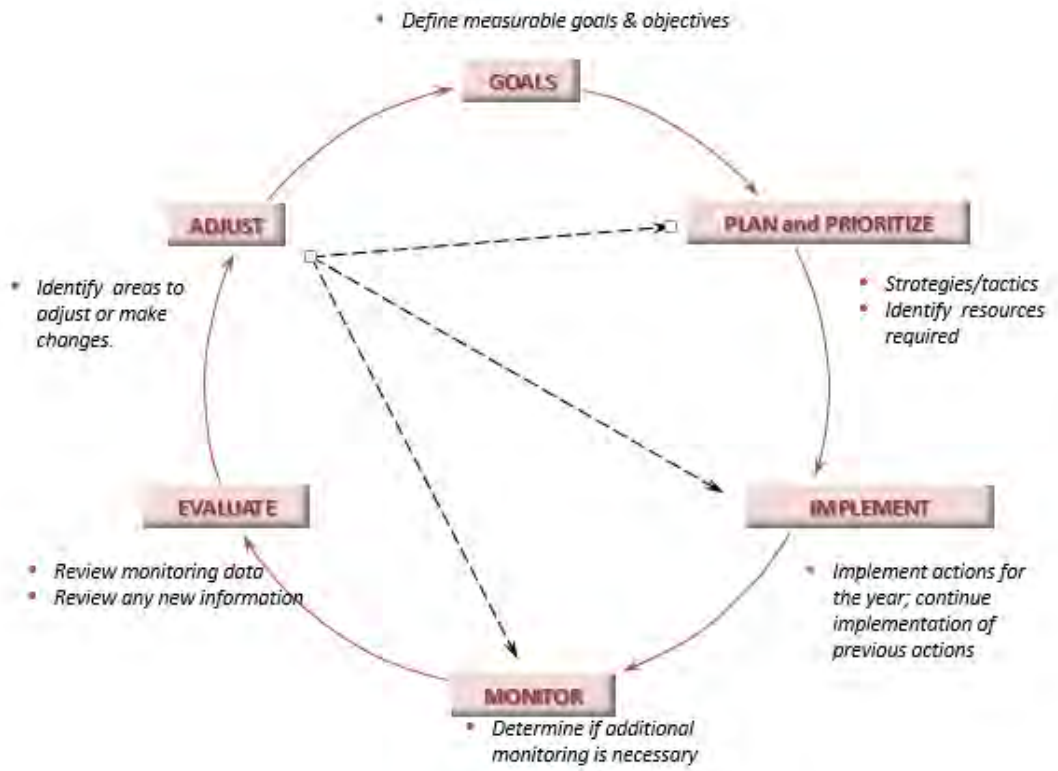
   Manure generated from farms outside of Indiana is not regulated under Indiana's land application rule, and many farmers in the WLEB own farms in both Indiana and Ohio. With the expansion of poultry farms in southwest Ohio and the passage of Ohio's ban on manure application in the Grand Lake St. Marys watershed from December 15th to March 1st, the incentive to transport manure into Indiana may increase.

Noting Indiana's WLEB baseline conditions for these issues during 2018 and then tracking trends in them, particularly issues 2 and 3 above, will help determine if changes in policy, programs, regulations and/or incentives will be required to effectively manage any associated increases in nutrients derived from them.

ADAPTIVE MANAGEMENT

Vital to Indiana's success in implementing this DAP is an adaptive management strategy that tests the hypotheses put forth in the DAP and applies the lessons learned therefrom to future management decisions.

Figure 5: Adaptive Management



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.

Hypotheses/Tactics

1. <u>Measuring Progress on the Maumee</u>
   The Advisory Committee will test its hypothesis that there is no statistical difference in the FWMC for TP between the Antwerp, OH USGS monitoring site and the Indiana SR 101 fixed station site by installing for a period of at least 12 months, the same auto-sampling protocol at SR 101 that exists at Antwerp. If this hypothesis is true, then Indiana will decommission the SR 101 auto-sampler and proceed with using the Antwerp, OH site as its site for measuring progress in meeting its commitment for TP and DRP target loads on the Maumee.

   If there is a statistical difference between the two sites, then Indiana will seek resources to maintain the auto-sampler at SR 101 and investigate for potential nutrient sources between the SR 101 site and the Antwerp site. Based on the findings, the Advisory

Committee will re-evaluate where the most representative monitoring site should be located in order to determine Indiana's progress and proceed with establishing that site.

2. Priority 8-digit HUC and 12-digit HUC Watersheds
   Based on available data and the various analyses completed by the Advisory Committee, the watershed contributing the most P to the Maumee River is the St. Marys and within it, the Blue Creek 12-digit HUCs are the top priorities. (See Appendix 2) The major sources appear to be failing septic systems in the unincorporated areas of Adams County and unregulated livestock operations.

   Major actions are underway to address these issues. The Adams County Regional Sewer District (RSD) is extending sewers to the communities of Pleasant Mills, Arcadia Village, Rivare, Linn Grove, and Monmouth/Roe Acres.

   Adams County, local producers and private landowners are constructing two emergency manure storage lagoons, one in the northern part and one in the southern part of the county to prevent manure application on frozen ground and to prevent excessive application. Further education and outreach on nutrient management is underway and a process for timely response to reports of manure mismanagement is being formalized.

These actions will be documented and monitored and additional stream data sampling will be conducted. An auto-sampler will be installed in close proximity to the IDEM fixed station site in Pleasant Mills and sampling will follow the protocol indicated in Table 3. The Advisory Committee postulates that sewering Pleasant Mills will result in decreased phosphorus loads to the receiving stream within a few years. Likewise, providing emergency manure storage lagoons should decrease land application during unfavorable conditions. Monitoring data comparing the historic and current conditions to post construction will be evaluated to see if and by how much water quality has improved. Areas of adjustment will be identified if warranted.

Outcomes will be appraised as they manifest and will be reported at least annually. In the last quarter of 2020, the Advisory Committee will evaluate the progress in meeting the goals of this DAP. Based on that evaluation, the priorities, next steps, and necessary adjustments will be implemented and included in a revised DAP within the first quarter of 2021, with a revision cycle of every five years.[24]

Future Endeavors and Resource/Research Gaps

Listed in the DAP Action/Milestone Table (Appendix 1) are specific projects or actions to be carried forth or initiated in the next few years. Listed here are concerns as well as information gaps for which data or research are needed or for which possible actions will be taken, but for which responsible parties and timelines have not been established:

[24] The DAP and the Action/Milestone Table will be web-based. Defined as "dynamic documents," they will updated as new information/data, research findings, and activities evolve. A pdf of the final DAP of February 2018 will be stored on the website to allow for comparisons.

- Use ErieStats upon its development and assess its utility for guiding Indiana's actions to reduce phosphorus to Lake Erie via the Maumee.
- Participate in the Erie P Trading pilot project for WLEB.
    - At this time, Indiana does not have an industrial discharger seeking compliance at an incremental level (meaning that an industrial discharger that is very close to achieving the 1 mg/L TP effluent limit may trade to achieve full compliance); therefore, Indiana will pursue the Stewardship - "adopt an acre" campaign.
- Map wetland and floodplain restoration opportunities.
- Convene a WLEB multi-county septic system workgroup.
- Seek establishment of a federal/binational funding source for a long-term Lake Erie monitoring network.
- Install more auto-samplers at the 12-digit HUC level.
- Implement additional edge-of-field monitoring projects.
- Support/conduct social indicators research on the adoption of BMPs, particularly drainage water management.
- Support/conduct research on drainage water management.
- Continue to support research on nitrogen's role in hazardous algal blooms.
- Research/assess the ratio of invasive species to native species in riparian corridors.

Success in the WLEB

Watershed nutrient pollution in the WLEB is a complex, multi-faceted problem caused by point and nonpoint sources across all sectors of our community. It affects not only those who live, work or recreate in the watershed, but also the ecosystem and economics of the region. To successfully address this problem, a multi-faceted approach is required that includes using existent regulatory instruments and implementing a strong system of voluntary BMPs. Hoosiers are making a positive difference by managing nutrients on their lawns and farms; building healthy soils; and restoring wetlands, floodplains, and streams. This DAP enumerates that much more needs to be done.

APPENDIX 1

ACTION/MILESTONE TABLE

Indiana's GLWQA DAP Action/Milestone Table						January 25, 2018
Objectives/Goals	**Action/Activity**	**Tools/Resources**	**Responsible Parties**	**Time-frame**	**Target Reduction**	**Outcomes**
Draft DAP public noticed	1. Develop draft DAP, as well as Milestone and Action Table 2. Develop PN with questions for comment period (60 days) 3. Post draft DAP and Milestone and Action Table for PN and comment period.		1. Advisory Committee 2. IDEM 3. IDEM, ISDA, and Advisory Committee	8/2017 – 10/2017		Complete
Determine priority areas	Use monitoring data map, WMP critical areas, NRCS phosphorus export spreadsheet, and all ambient WQM data	Water quality data, GIS, and NRCS spreadsheet	Agencies completing monitoring and Advisory Committee subcommittee	11/2017		Complete
Programs/Projects						
Restore Natural Hydrology and Ecological Functions						
Rethinking Drainage for the 21st Century workshop	1. Workshop with county surveyors and drainage professionals to learn about activities and barriers 2. The goal is to establish an innovative drainage pilot project	Staff time, travel, and meeting and implementation expenses	The Nature Conservancy and Purdue Extension	6/22/2017		First workshop held, additional workshops will follow
Ecological maintenance of regulated & unregulated drains to reduce hydrological modification & maintenance needs	Convene a drainage work group with county surveyors, members of the drainage boards, stream ecology/watershed restoration professionals, and concerned citizens	Indiana demonstration sites, as well as scientific literature and current research findings	DAP Advisory Committee	2018, on-going		

Indiana's GLWQA DAP Action/Milestone Table

January 25, 2018

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Parties	Time-frame	Target Reduction	Outcomes
Programs/Projects						
Point Source, Urban						
City of Fort Wayne LTCP (outlined at https://www.cityoffortwayne.org/utilities/162-clean-river-team/3208-long-term-control-plan.html)	Reduce CSOs to the St. Marys and Maumee Rivers	Staff time and implementation expenses	City of Fort Wayne	2025	71 CSOs to 4 CSOs	Tunnel Works Project began in 2017 and will be complete in 2025
Stormwater NPDES MS4 Permit	Manage stormwater discharges	Staff time and implementation expenses	City of Fort Wayne and co-permittees			In progress
Municipal NPDES permit	Provide guidelines and standards for water quantity and quality management	Staff time and implementation expenses	City of Fort Wayne			In progress
Adams County RSD sewer extension	Extend sewer to unincorporated areas within Adams County, including the Town of Pleasant Mills	Staff time and implementation expenses	Adams County RSD			Extension began in 2017 and is on-going
Nonpoint Source, Urban						
Local ordinances and technical design standards	Provide guidelines and standards for water quantity and quality management	Staff time and implementation expenses	City of Fort Wayne Utilities			In progress
Revegetate urban stream banks with native plants in the Upper Maumee River	Work with local non-profits to organize native planting opportunities for the community	Two to three community events per year	Save Maumee			In progress
Install 2,800 linear feet of riparian buffers with woody vegetation in three Upper Maumee critical subwatersheds; Trier ditch (04100005010010), Bullerman (04100005010040), and Six-mile Creek (04100005010060)	Organize three native tree planting opportunities for the community	Work with local non-profits	Save Maumee		Nitrogen 426.66 lb/yr, phosphorus 253.32 lb/yr, and sediment 253.34 tons/yr	

Indiana's GLWQA DAP Action/Milestone Table						January 25, 2018
Objectives/Goals	**Action/Activity**	**Tools/Resources**	**Responsible Parties**	**Time-frame**	**Target Reduction**	**Outcomes**
Programs/Projects						
Nonpoint Source, Rural						
Adams County emergency manure lagoons, one located north and one located south in Adams County	1. One northern lagoon holding ten million gallons of manure 2. One southern lagoon holding 996,000 gallons of manure	1. Manure kept from excessive application and application on frozen ground 2. Sediment and nutrient load reductions	Adams County, local producers, and private landowners	2018		In progress
Phosphorus-Risk Reduction Pilot, 319(h) grant project, reimbursing for the reduction of phosphorus-risk potential by implementing conservation practices, including Black Creek (0410050104), Marsh Ditch (0410050106), Sixmile Creek (0410050103), Trier Ditch (0410050102), and Bottern Ditch (0410050105)	1. Develop the phosphorus-risk reduction reimbursement program 2. Implement the phosphorus-risk reduction reimbursement program	1. Phosphorus-risk calculator to determine the potential phosphorus-risk pre- and post-conservation practice implementation 2. Sediment and nutrient load reductions	Allen County SWCD, project partners, Advisory Committee, and Steering Committee	1/19/2019	4,800 tons sediment, 8,300 lbs phosphorus, and 16,300 lbs nitrogen	In progress
Upper Maumee River Implementation, GLRI grant project, reducing nutrient and sediment loading through implementation of conservation practices, including Black Creek (0410050104), Marsh Ditch (0410050106), Sixmile Creek (0410050103), and Trier Ditch (0410050102).	1. Develop a cost-share program targeting conservation practices addressing nutrient loss 2. Implement the cost-share program reimbursing the full cost of conservation practices 3. Conduct an education and outreach program to bring about behavioral change	Sediment and nutrient load reductions	Allen County SWCD, project partners, and Steering Committee	5/5/2020		In progress

Indiana's GLWQA DAP Action/Milestone Table						January 25, 2018
Objectives/Goals	**Action/Activity**	**Tools/Resources**	**Responsible Parties**	**Time-frame**	**Target Reduction**	**Outcomes**
Programs/Projects						
Nonpoint Source, Rural						
St. Marys River Watershed Initiative, 319(h) grant project, implementing a paired watershed monitoring project, including the Weber Ditch (041000040502) and the Nickelsen Creek (041000040503) sub-watersheds	1. Develop and implement a watershed-wide coordination program 2. Develop and implement a targeted education and outreach program 3. Develop and implement targeted social indicator surveyors 4. Perform and complete paired watershed monitoring and modeling 5. Perform and complete soil health monitoring	1. A water quality sample and conservation practice location database, a watershed conditions database, and a water quality database 2. 4 Conservation practice demonstration workshops, 4 field days, and 4 tours 3. 2 targeted social indicator survey events 4. QAPP, monitoring program including equipment and protocols, and targeted watershed (L-THIA-LID) model	Project Coordinator and project partners including Purdue University, Indiana Farm Bureau, Indiana Dairy Producers, Indiana Pork, Indiana State Poultry Association, Agri-Business Council of Indiana, Indiana Soybean Alliance, Indiana Corn Marketing Council, IDEM, as well as SWCD, NRCS, ISDA, and TNC staff located within the WLEB	6/5/2021		In progress
Reduce sediment and nutrient loading through installation and adoption of watershed land treatment practices	Administer grant and allocate funds for producers	2015 IDNR LARE grant	DeKalb SWCD	2018		In progress

Indiana's GLWQA DAP Action/Milestone Table						January 25, 2018
Objectives/Goals	**Action/Activity**	**Tools/Resources**	**Responsible Parties**	**Time-frame**	**Target Reduction**	**Outcomes**
Programs/Projects						
Nonpoint Source, Rural						
Reduce streambank erosion, repair streambank damage, and improve wildlife habitat through the City of Auburn	Complete feasibility study on Cedar Creek from Morning Star Road to Eckhart Park	IDNR LARE grant	DeKalb County	1/2019		In progress
Reduce sediment and nutrient runoff through adoption and installation of conservation practices	Cover crops, gypsum application, blind inlets, and streambank stabilization	2017 CWI grant	DeKalb and Steuben County SWCDs	12/31/2019		In progress
Reduce nutrient loading from failed septic systems	Lead septic issues, update of ordinance, and provide cost-share funds for assisting with repair/replacement of septic systems	Updated Onsite Sewage System and Installation Ordinance and DeKalb County SWCD cost-share program	DeKalb County Health Department, Commissioners, and Supervisors, as well as Septic Issues Steering Committee	7/31/17		Ordinance passed 7/31/2017
Support InField Advantage program by working with participants on data collection and nutrient stewardship (http://www.infieldadvantage.org/)	Help landowners/producers participating in the program to understand their nitrogen management plan Groups participating include: 1. INWL – WLEB group 2. INWA – Adams/Wells group 3. INST – Steuben/LaGrange group	Group leaders time, ISDA staff time, and farmer/producer participation	ISDA and Group Leaders			In progress
Support rigorous enforcement of environmental rules & regulations	Determine legitimacy of claims of inconsistent implementation, identify barriers to execution, and establish a process for full implementation	Reports of violations and field surveys	IDEM, OISC, local SWCDs, and others TBD	2018, on-going		

Indiana's GLWQA DAP Action/Milestone Table

January 25, 2018

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Parties	Time-frame	Target Reduction	Outcomes
Programs/Projects						
Nonpoint Source, Rural						
4R Nutrient Stewardship Certification program	Identify willing landowners, apply for grants, install BMPs, and engage universities in on-farm research	Staff time and travel	The Nature Conservancy, Ohio Agribusiness Association, and Nutrient Stewardship Council	80% of farmed acres under certified management by 2020	Research in progress TBD, and goal is 40% reduction of TP and DRP by 2025	Indiana has one certified facility and is in dialogue to start a 4R program
Establish woody plants for long-term erosion control and improvement of water quality, enhancing aesthetics, and wildlife habitat	Fourteen acres of trees planted within the West Branch, Fish Creek subwatershed	District cost-share funding	Steuben County SWCD			Completed 2016 and 2017
Develop a response process for reports of manure mishandling & runoff from unregulated livestock operations or land application	Determine agency resources required	Current rules and regulations, as well as time and travel study model	IDEM, OISC, local SWCDs, and others TBD	2018		
Sustainable, functional septic systems throughout the WLEB via ordinances identifying best practices installation, maintenance & repair	Convene a WLEB septic system workgroup	Model ordinances and health department experts	WLEB local health departments with DAP support	2018, on-going		
Soil Health Partnership	Identify willing landowners, attend field days, and share results, as well as five to ten years of tillage, nutrient management, and cover crops	Staff time and travel	The Nature Conservancy, landowners, Soil Health Partnership, and local SWCDs	2015, on-going	1. Research in progress 2. Goal is better yields with less inputs	In progress (five to ten years of tillage, nutrient management, and cover crops)

Indiana's GLWQA DAP Action/Milestone Table						January 25, 2018
Objectives/Goals	**Action/Activity**	**Tools/Resources**	**Responsible Parties**	**Time-frame**	**Target Reduction**	**Outcomes**
Programs/Projects						
Nonpoint Source, Rural						
Cover crop discount program	Provide assistance to local small farmers for cover crops and education on benefits of cover crops	Demo Farm grant	Adams County SWCD, NRCS, and ISDA	2017		Complete
Monitoring						
Secure GLRI grant for auto-sampler on the St. Marys River	Submit application		IDEM and USGS			Complete
Add capacity to sample for DRP laboratory analysis	Secure laboratory equipment for the ISDH	MOU between IDEM and ISDH, as well as IDEM lab account funding	IDEM and ISDH	2017		100% Funds secured and MOU executed
Collect DRP at IDEM fixed stations in the WLEB	Investigate necessary resources for collecting and analyzing for DRP	Time and travel study	IDEM	2017		DRP sample collection and analysis began on 1/18
Collect TP, DRP, and nitrate-nitrite samples at 27 sites during recreational season	Tri-State Watershed Weekly Water Quality Monitoring program	TSWA, SJRWI, City of Fort Wayne, USDA ARS, and Allen SWCD support	TSWA and Allen SWCD			In progress
In-stream water quality	Monthly and storm grab samples at locations within Fish Creek watershed	Staff time, travel, lab work SJWI, Steuben County SWCD, and Joyce Foundation	Steuben County SWCD and the Nature Conservancy	2014 through 2017		Complete
Ecology of two-stage ditches	Macroinvertebrate sampling at constructed two-stage ditch sites in St. Joseph watershed	Staff time, travel, and lab work IPFW and Joyce Foundation	IPFW and the Nature Conservancy	2015 through 2018		In progress

Indiana's GLWQA DAP Action/Milestone Table

January 25, 2018

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Parties	Time-frame	Target Reduction	Outcomes
Education and Outreach						
In-stream water quality	Weekly sampling during recreation season and monthly sampling during non-recreation season at ten locations	Staff time, travel, and lab work	City of Fort Wayne Utilities	Annually		In progress
Use the WLEB GIS Story Map to showcase the conservation and monitoring activities going on in the Indiana WLEB watershed	Update Story Map annually, as necessary	ISDA staff and WLEB Story Map located at http://isda.maps.arcgis.com/apps/MapSeries/index.html?appid=75881b3341714bc28b5d820405accacb	ISDA			In progress
Continue to conduct the spring and fall cover crop and tillage transect survey in the counties in the WLEB (http://www.in.gov/isda/2383.htm)	Partnership staff in Adams, Allen, DeKalb, Noble, Steuben, and Wells counties will conduct this transect in the spring following planting on an annual or bi-annual basis	ICP staff and time	ICP	April through June, every two years, and October through December, annually		In progress
Report the nutrient load reductions for all ICP assisted conservation practices within the WLEB on an annual basis (http://www.in.gov/isda/3261.htm)	ISDA staff will use the Region 5 Model to analyze practices and show sediment and nutrient load reductions	Region 5 Model and ISDA staff time	ISDA and ICP	March, annually	Sediment 34,000 tons/yr, Nitrogen 86,000 lbs/yr, and phosphorus 42,000 lbs/yr	In progress
Provide soil health education to 100+ farmers, retailers, and CCAs	Seeing Green: Fields and Profits conservation day	NRCS GLRI grant, Soil Health Partnership (SHP), and Upper 319 grant	NRCS NE Area, SHP, Adams County and Allen County SWCD	8/10/2017		Complete

Indiana's GLWQA DAP Action/Milestone Table

January 25, 2018

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Parties	Time-frame	Target Reduction	Outcomes
Education and Outreach						
Educate producers on production practices related to water quality issues in the WLEB	Annual agronomy field day, held in conjunction with The Andersons, Purdue Extension, and surrounding SWCDs	Partial funding provided through 2015 and 2017 CWI grants	DeKalb and Steuben Counties	Annually		On going
Educate the public on the WLEB issues	Planned and implemented the Watershed-n-Spread event. Dr. Chad Penn presented "WLEB: the perfect storm"	Completed as part of the programing efforts of the SJRWI	SJRWI, Purdue Extension, City of Auburn, and DeKalb SWCD	3/2/2017		Complete
Educate producers/landowners on production/urban practices related to water quality issues in the WLEB	Annual meeting, presentations, various district workshops, booth at 4H Fair, and educational materials	Funding provided through District Base of Operations	Steuben County SWCD	Annually		In progress, hundreds impacted
Youth education	Educational materials provided on pollinators, soil health, trees, water quality, and summer conservation camps	Staff time, travel, and educational material fees	Steuben County SWCD and NE Conservation Districts	Annually		In progress, an average of 1,450 students, annually
Youth education for 32 years, hands-on educational event for 4th grade students of the Metropolitan School District of Steuben County to teach soil health water quality, and other conservation-related subjects	4th grade youth conservation field day	Staff and volunteer time, travel, and educational material fees	Steuben County SWCD	Annually		In progress, an average of 300 students, annually
Educate homeowners/landowners urban practices related to water quality issues in the Maumee WLEB	Promote urban BMPs for storm water management from streets, parking lots, and other impervious pavement surfaces to community members and homeowners in the city	Funding through grants and in-kind donations	Save Maumee, City Utilities of Fort Wayne, and ACPWQ			In progress

Indiana's GLWQA DAP Action/Milestone Table						January 25, 2018
Objectives/Goals	**Action/Activity**	**Tools/Resources**	**Responsible Parties**	**Time-frame**	**Target Reduction**	**Outcomes**
Education and Outreach						
Partner with local non-profits to harvest and collect native seeds	Seed harvest event in wetland, preserve, or natural habitat	Public and private land owners, as well as one to two local groups	Little River wetlands project, ACRES Land Trust, Save Maumee	Annually		In progress
Work with local non-profits to organize community urban stream bank restoration projects within the upper Maumee watershed	Collect/purchase 100 lbs native seeds to be planted on the stream and riverbanks and collect/ purchase 1,100 native trees to be planted on severely eroded riverbanks and streams; secure GLRI funding	One to two active local community non-profit groups	Save Maumee	Two seed harvest projects, annually and two projects in April and October, annually	Nitrogen 426.66 lb/yr, phosphorus 253.32 lb/yr, and sediment 253.34 tons/yr	In progress
Sponsor and present at soil health, 4R, and farmer working group field days and events in IN	Two to three events/year, serve on Tri-State Watershed Alliance Board, and sponsor and help host annual expo	Staff time, travel, and sponsorship/exhibitor fees	The Nature Conservancy and event partners			In progress (direct contact with 1,000 WLEB stakeholders)
Youth education	River Camp	Hoosier Riverwatch, GoFishIN, and Project WET (education ages 8-12)	FWP&R, Environmental Resources Center, and ACPWQ	July 5-8, 2016 and August 7-11, 2017		Complete
Youth and adult education	Johnny Appleseed Festival	Project WET, Project Wild, and HWHP (child and adult)	ACPWQ and Central Lions	September 19-20, 2015, September 17-18, 2016, and September 16-17, 2017		Complete

Indiana's GLWQA DAP Action/Milestone Table

January 25, 2018

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Parties	Time-frame	Target Reduction	Outcomes
Education and Outreach						
Youth education	Izaak Walton League Conservation Camp	Project WET and Hoosier Riverwatch (ages 6-16)	IWL and ACPWQ	6/25/2015 and 6/23/2016		Complete
Youth education	Envirothon/aquatics	Hoosier Riverwatch (G10-12)	NE IN Schools, SWCDs, NRCS, IDNR, and ACPWQ	3/19/2015 and 3/17/2016		Complete
Youth education	Canterbury Day of Service	Project WET and Hoosier Riverwatch (G5-8)	Canterbury MS, TSWA, and ACPWQ	5/20/2015, 5/26/2016, and 6/7/2017		Complete
Provide education on cover crops, wetlands, filter strips, and wildlife habitat and water quality issues	Land management field day	CREP and Region 5 Model	Adams County SWCD, DNR, Little Turtle Wetland, NRCS, Davey Resources, NTFF, and ISDA	2015		Complete
Adult and youth education	Various pasture walks at farms, including the Amish	Cooperative Amish Outreach grant and Demo Farm grant	Adams County SWCD and NRCS	Annually		In progress
Public education on BMPs, soil health, watersheds, water quality, and pollinators	Booth at Adams County 4H Fair		Adams County SWCD	Annually		In progress, thousands impacted
Youth education	Earthworms, investigating soil health, frogs, owls, butterflies, and trees		Adams County SWCD	Annually		In progress, thousands impacted
For 22 years, all 6th graders from public, parochial, and homeschool attend to learn lessons in conservation	Splash event: watershed, common water, trees, pollinators, earthworms, nematodes, and soil health		Adams County SWCD	Annually		In progress, thousands impacted

Indiana's GLWQA DAP Action/Milestone Table

January 25, 2018

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Parties	Time-frame	Target Reduction	Outcomes
Education and Outreach						
Adult education	Various field days focused on water quality and soil health topics	Cooperative Amish Outreach grant, Demo Farm grant, and various other funding sources	Adams & Allen County SWCDs, and other partners	Annually		In progress, hundreds impacted
Provide education materials explaining the WLEB and how actions affect others (promotes BMPs), how watersheds are connected and effect one another, and proper management of manure and how it effects phosphorus in the soil	Adams County Watershed, Adams County Watershed Maps, and Manure Management Practices booklets	Amish Outreach grant	Adams County SWCD, NRCS, and ISDA	2016		Complete, hundreds dispersed
Education on cover crops and how it helps phosphorous levels on farms	Cover Crop PARP meeting	Center Seeds	Center Seeds, Purdue Extension, and Adams County SWCD	2016		Complete, over a hundred impacted
Public promotion of soil health and water quality (combined annual meeting of SWCD, Farm Bureau, and Pork Producers)	Ag extravaganza		Adams County SWCD, Pork Producers, and Farm Bureau	Annually		In progress, hundreds impacted
Education of proper management of manure and reducing our phosphorous and education on value of manure and the IN State Chemist standards	Winter ag meeting	Amish Outreach grant	Adams County SWCD, NRCS, and ISDA	2017		Complete
Designed and disbursed nutrient management packets to encourage manure management and to ease record keeping for our producers	Nutrient management packets	Amish Outreach grant	Adams County SWCD, NRCS, and ISDA	2017		Complete

Indiana's GLWQA DAP Action/Milestone Table

January 25, 2018

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Parties	Time-frame	Target Reduction	Outcomes
Education and Outreach						
Education on importance of soil testing and the levels of phosphorous, soil health and best management practices are encouraged, as well as follow-up meeting to interpret test and provide aerial map of farm	Soil testing	Amish Outreach grant	Adams County SWCD, NRCS, and ISDA	6/2015 through 6/2017		Complete, over a hundred tests
Education on the importance of manure and its value and a follow-up farm visit	Manure tests	Amish Outreach grant	Adams County SWCD, NRCS, and ISDA	6/2015 through 6/2017		Complete
Provide education on WLEB, phosphorous levels in our area, and water and marine life testing	OSU Stone Lab tour on Lake Erie	Demo Farm grant	Adams County SWCD, NRCS, and ISDA	6/2017		Complete
Two meetings (am and pm) regarding education on WLEB, effects on phosphorous, water quality, and benefits and use of gypsum	Connect the Dots water quality meeting	Amish Outreach grant, Dr. Chris Winslow	Adams County SWCD, NRCS, and ISDA	3/14/2016		Complete
Promote use and benefits of cover crops and no-till practices, specifically drill being modified to be pulled by horses or tractor	Purchase of new Land Pride 7' no-till drill	Demo Farm grant	Adams County SWCD and NRCS	6/2017		Complete
Educate on a variety of stormwater and water quality related topics to neighborhood groups and other organizations	Speakers available to discuss stormwater and water quality related topics	Staff time, as well as meeting and material expenses	City of Fort Wayne Utilities			In progress
Hands-on rain garden workshops and incentives for City of Fort Wayne residents to install a rain garden	Hands-on rain garden workshop held locally in Fort Wayne to provide rain garden and stormwater education	Staff time, meeting and material expenses, travel expenses, and incentives to Fort Wayne residents	City of Fort Wayne Utilities	Annual meetings typically held in spring		In progress

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. This model uses flow data from USGS gaging stations, which primarily are located on larger stream/river systems. The majority of the sampling sites along the main stems are co-located with, or have a close proximity to these gaging stations which results in more precise modelling estimates. The majority of the sites along tributaries have much smaller drainage areas than the nearest stream gage which adds error to the modelling estimates. While exact figures for these smaller tributaries may be highly unreliable, the calculations are still relative when comparing load contributions across the tributaries. Due to this introduced error, concentrations are left out of the summary for smaller tributaries that have short data ranges and/or small drainage area ratios and they are ranked for comparison purposes.

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

Entire Dataset

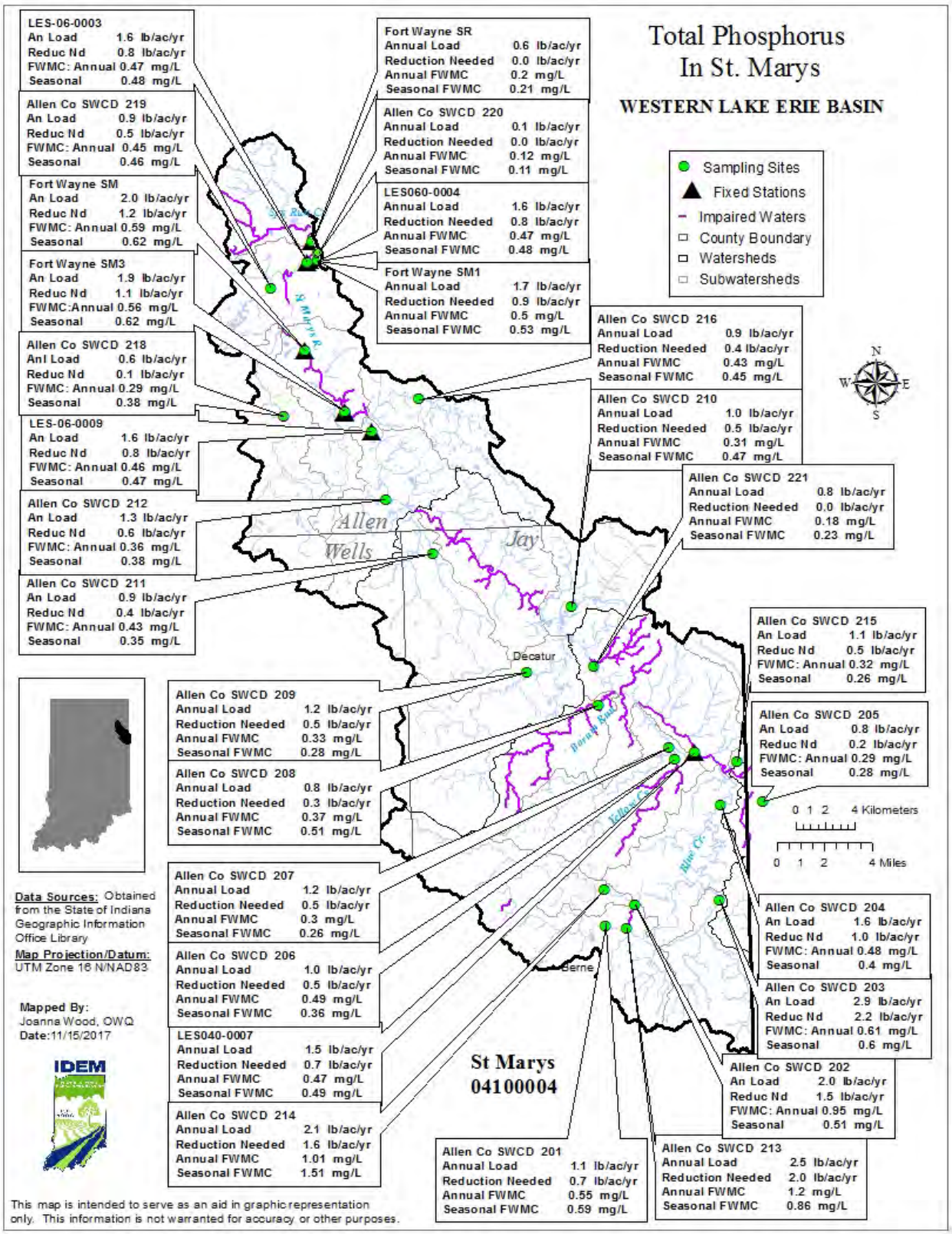
N=65 sites
29 of 65 sites have a Drainage area Ratio >90% or <110%
44 of 65 sites fail the Annual FWMC (1.2 Max, 0.07 Min, 0.34 Mean)
44 of 65 sites fail the Seasonal FWMC (1.51 Max, 0.09 Min, 0.35 Mean)

St Joseph River HUC 8
N=18 Sites
10 of 18 sites have a Drainage area Ratio >90% or <110%
6 of 18 sites fail the Annual FWMC (0.43 Max, 0.07 Min, 0.21 Mean)
6 of 18 sites fail the Seasonal FWMC (0.5 Max, 0.09 Min, 0.24 Mean)

St Mary's River HUC 8
N=27 Sites
10 of 27 sites have a Drainage area Ratio >90% or <110%
25 of 27 sites fail the Annual FWMC (1.2 Max, 0.18 Min, 0.49 Mean)
25 of 27 sites fail the Seasonal FWMC (1.51 Max, 0.21 Min, 0.49 Mean)

Auglaize River HUC 8
N=1 Site
The site doesn't have a Drainage area Ratio >90% or <110% (15%)
The site failed the Annual FWMC (0.34)
The site failed the Seasonal FWMC (0.41)

Maumee River HUC 8
N=16 Sites
7 of 16 sites have a Drainage area Ratio >90% or <110%
11 of 16 sites fail the Annual FWMC (0.41 Max, 0.1 Min, 0.27 Mean)
11 of 16 sites fail the Seasonal FWMC (0.4 Max, 0.1 Min, 0.28 Mean)


Total Phosphorus
In St. Marys
WESTERN LAKE ERIE BASIN
Sampling Sites
Fixed Stations
Impaired Waters
County Boundary
Watersheds
Subwatersheds
LES-06-0003
An Load 1.6 lb/ac/yr
Reduc Nd 0.8 lb/ac/yr
FWMC: Annual 0.47 mg/L
Seasonal 0.48 mg/L
Allen Co SWCD 219
An Load 0.9 lb/ac/yr
Reduc Nd 0.5 lb/ac/yr
FWMC: Annual 0.45 mg/L
Seasonal 0.46 mg/L
Fort Wayne SM
An Load 2.0 lb/ac/yr
Reduc Nd 1.2 lb/ac/yr
FWMC: Annual 0.59 mg/L
Seasonal 0.62 mg/L
Fort Wayne SM3
An Load 1.9 lb/ac/yr
Reduc Nd 1.1 lb/ac/yr
FWMC:Annual 0.56 mg/L
Seasonal 0.62 mg/L
Allen Co SWCD 218
Anl Load 0.6 lb/ac/yr
Reduc Nd 0.1 lb/ac/yr
FWMC: Annual 0.29 mg/L
Seasonal 0.38 mg/L
LES-06-0009
An Load 1.6 lb/ac/yr
Reduc Nd 0.8 lb/ac/yr
FWMC: Annual 0.46 mg/L
Seasonal 0.47 mg/L
Allen Co SWCD 212
An Load 1.3 lb/ac/yr
Reduc Nd 0.6 lb/ac/yr
FWMC: Annual 0.36 mg/L
Seasonal 0.38 mg/L
Allen Co SWCD 211
An Load 0.9 lb/ac/yr
Reduc Nd 0.4 lb/ac/yr
FWMC: Annual 0.43 mg/L
Seasonal 0.35 mg/L
Fort Wayne SR
Annual Load 0.6 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.2 mg/L
Seasonal FWMC 0.21 mg/L
Allen Co SWCD 220
Annual Load 0.1 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.12 mg/L
Seasonal FWMC 0.11 mg/L
LES060-0004
Annual Load 1.6 lb/ac/yr
Reduction Needed 0.8 lb/ac/yr
Annual FWMC 0.47 mg/L
Seasonal FWMC 0.48 mg/L
Fort Wayne SM1
Annual Load 1.7 lb/ac/yr
Reduction Needed 0.9 lb/ac/yr
Annual FWMC 0.5 mg/L
Seasonal FWMC 0.53 mg/L
Allen Co SWCD 216
Annual Load 0.9 lb/ac/yr
Reduction Needed 0.4 lb/ac/yr
Annual FWMC 0.43 mg/L
Seasonal FWMC 0.45 mg/L
Allen Co SWCD 210
Annual Load 1.0 lb/ac/yr
Reduction Needed 0.5 lb/ac/yr
Annual FWMC 0.31 mg/L
Seasonal FWMC 0.47 mg/L
Allen Co SWCD 221
Annual Load 0.8 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.18 mg/L
Seasonal FWMC 0.23 mg/L
Allen Co SWCD 215
An Load 1.1 lb/ac/yr
Reduc Nd 0.5 lb/ac/yr
FWMC: Annual 0.32 mg/L
Seasonal 0.26 mg/L
Allen Co SWCD 205
An Load 0.8 lb/ac/yr
Reduc Nd 0.2 lb/ac/yr
FWMC: Annual 0.29 mg/L
Seasonal 0.28 mg/L
Allen Co SWCD 209
Annual Load 1.2 lb/ac/yr
Reduction Needed 0.5 lb/ac/yr
Annual FWMC 0.33 mg/L
Seasonal FWMC 0.28 mg/L
Allen Co SWCD 208
Annual Load 0.8 lb/ac/yr
Reduction Needed 0.3 lb/ac/yr
Annual FWMC 0.37 mg/L
Seasonal FWMC 0.51 mg/L
Allen Co SWCD 207
Annual Load 1.2 lb/ac/yr
Reduction Needed 0.5 lb/ac/yr
Annual FWMC 0.3 mg/L
Seasonal FWMC 0.26 mg/L
Allen Co SWCD 206
Annual Load 1.0 lb/ac/yr
Reduction Needed 0.5 lb/ac/yr
Annual FWMC 0.49 mg/L
Seasonal FWMC 0.36 mg/L
LES040-0007
Annual Load 1.5 lb/ac/yr
Reduction Needed 0.7 lb/ac/yr
Annual FWMC 0.47 mg/L
Seasonal FWMC 0.49 mg/L
Allen Co SWCD 214
Annual Load 2.1 lb/ac/yr
Reduction Needed 1.6 lb/ac/yr
Annual FWMC 1.01 mg/L
Seasonal FWMC 1.51 mg/L
Allen Co SWCD 204
An Load 1.6 lb/ac/yr
Reduc Nd 1.0 lb/ac/yr
FWMC: Annual 0.48 mg/L
Seasonal 0.4 mg/L
Allen Co SWCD 203
An Load 2.9 lb/ac/yr
Reduc Nd 2.2 lb/ac/yr
FWMC: Annual 0.61 mg/L
Seasonal 0.6 mg/L
Allen Co SWCD 202
An Load 2.0 lb/ac/yr
Reduc Nd 1.5 lb/ac/yr
FWMC: Annual 0.95 mg/L
Seasonal 0.51 mg/L
Allen Co SWCD 201
Annual Load 1.1 lb/ac/yr
Reduction Needed 0.7 lb/ac/yr
Annual FWMC 0.55 mg/L
Seasonal FWMC 0.59 mg/L
Allen Co SWCD 213
Annual Load 2.5 lb/ac/yr
Reduction Needed 2.0 lb/ac/yr
Annual FWMC 1.2 mg/L
Seasonal FWMC 0.86 mg/L
St Marys
04100004
Allen
Wells
Jay
Decatur
Berne
N
W
E
S
0 1 2 4 Kilometers
0 1 2 4 Miles
Data Sources: Obtained from the State of Indiana Geographic Information Office Library
Map Projection/Datum: UTM Zone 16 N/NAD83
Mapped By: Joanna Wood, OWQ
Date:11/15/2017
IDEM
This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

St. Mary's River Basin

The St. Mary's River originates in Ohio and when it enters Indiana the seasonal flow weighted mean concentration (FWMC) is 0.28 mg/L (SWCD 205). Approximately 4 river miles downstream the next site along St. Mary's has a seasonal FWMC of 0.49 mg/L (fixed station LES040-0007). This increase in concentration could be due to the difference in data (monthly vs weekly over different time periods), however there are also two tributaries that enter the St. Mary's River between these two sites that could be contributing significant nutrient loads. Shortly after entering Indiana two tributaries enter St. Mary's River. Twenty-seven Mile Creek drains 28 square miles (the majority of the drainage area is in Ohio) and Blue Creek drains 80 square miles in Indiana and has a much higher TP load contribution than 27 Mile Creek. The SWCD has six sites along Blue Creek or tributaries to Blue Creek, all of which support elevated TP loads.

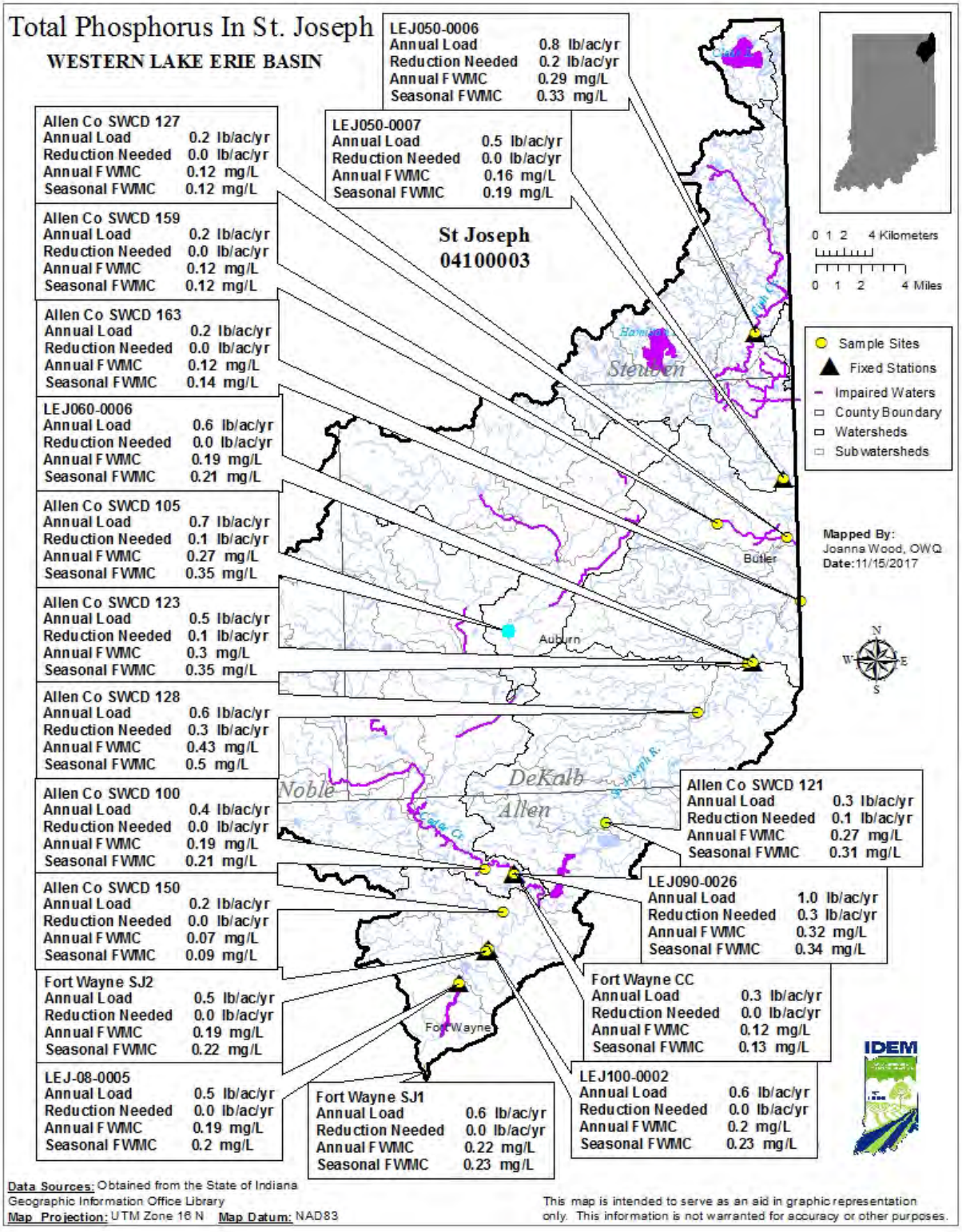
The next site downstream along the St. Mary's River (SWCD 221) has a FWMC of 0.23 mg/L which is lower than the closest site upstream. Take note that SWCD 221 had no data from November – March. Several tributaries enter the main stem between the fixed station site (LES040-0007) and SWCD 221. All of these tributaries show elevated TP concentrations and in comparison to each other they rank highest to lowest Borum Run (DA =13.4mi^2), Martz Ditch (DA = 9.1 mi^2), and Yellow Creek (DA = 24 mi^2).

Moving downstream along St. Mary's River there are several sites in close proximity (SWCD 212 FWMC = 0.38 mg/L, IDEM LES060-0005 FWMC = 0.47 mg/L, and Ft. Wayne SM3 FWMC = 0.62 mg/L). While the concentrations vary, all show TP reductions are needed. The tributaries entering the main stem between these sites and the closest site upstream include (ranked highest FWMC to lowest): Gerke Ditch, Houk Ditch, Nickelson Creek, and Holthouse Ditch.

The St. Mary's River prior to the confluence with Spy Run Creek has a FWMC of 0.48 mg/L (IDEM LES-06-0003). There are two tributaries that enter the main stem between the nearest site upstream and they include, ranked highest FWMC to lowest, Junk Ditch and Harber Ditch. Spy Run flows into St. Mary's right before the confluence with the St. Joseph River. Spy Run Creek drains 15 mi^2 and has two sites located on the Creek (SWCD 220 FWMC = 0.11 mg/L; Ft Wayne SR FWMC = 0.21 mg/L) both of which are below the target concentration of 0.23 mg/L.

The St. Mary's River before the confluence with the St. Joseph River has a FWMC of 0.48 mg/L (IDEM site LES060-0004) and 0.53 mg/L (Ft. Wayne Site SM1).

The ranking of the tributaries in the entire basin from highest contributions to lowest are Upper Blue Creek, Upper Gates Ditch, Little Blue Creek, Habegger Ditch, Gates Ditch, Borum Run, Gerke Ditch, Junk Ditch, Houk Ditch, Blue Creek, Harbor Ditch, Martz Ditch, Nickelson Creek, Holthouse Ditch, Yellow Creek, 27 Mile Creek, and Spy Run Creek. The first five tributaries with the highest TP concentration are all located in the Blue Creek watershed.


Total Phosphorus In St. Joseph
WESTERN LAKE ERIE BASIN
St Joseph
04100003
LEJ050-0006
Annual Load 0.8 lb/ac/yr
Reduction Needed 0.2 lb/ac/yr
Annual FWMC 0.29 mg/L
Seasonal FWMC 0.33 mg/L
LEJ050-0007
Annual Load 0.5 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.16 mg/L
Seasonal FWMC 0.19 mg/L
Allen Co SWCD 127
Annual Load 0.2 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.12 mg/L
Seasonal FWMC 0.12 mg/L
Allen Co SWCD 159
Annual Load 0.2 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.12 mg/L
Seasonal FWMC 0.12 mg/L
Allen Co SWCD 163
Annual Load 0.2 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.12 mg/L
Seasonal FWMC 0.14 mg/L
LEJ060-0006
Annual Load 0.6 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.19 mg/L
Seasonal FWMC 0.21 mg/L
Allen Co SWCD 105
Annual Load 0.7 lb/ac/yr
Reduction Needed 0.1 lb/ac/yr
Annual FWMC 0.27 mg/L
Seasonal FWMC 0.35 mg/L
Allen Co SWCD 123
Annual Load 0.5 lb/ac/yr
Reduction Needed 0.1 lb/ac/yr
Annual FWMC 0.3 mg/L
Seasonal FWMC 0.35 mg/L
Allen Co SWCD 128
Annual Load 0.6 lb/ac/yr
Reduction Needed 0.3 lb/ac/yr
Annual FWMC 0.43 mg/L
Seasonal FWMC 0.5 mg/L
Allen Co SWCD 100
Annual Load 0.4 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.19 mg/L
Seasonal FWMC 0.21 mg/L
Allen Co SWCD 150
Annual Load 0.2 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.07 mg/L
Seasonal FWMC 0.09 mg/L
Fort Wayne SJ2
Annual Load 0.5 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.19 mg/L
Seasonal FWMC 0.22 mg/L
LEJ-08-0005
Annual Load 0.5 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.19 mg/L
Seasonal FWMC 0.2 mg/L
Fort Wayne SJ1
Annual Load 0.6 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.22 mg/L
Seasonal FWMC 0.23 mg/L
Allen Co SWCD 121
Annual Load 0.3 lb/ac/yr
Reduction Needed 0.1 lb/ac/yr
Annual FWMC 0.27 mg/L
Seasonal FWMC 0.31 mg/L
LEJ090-0026
Annual Load 1.0 lb/ac/yr
Reduction Needed 0.3 lb/ac/yr
Annual FWMC 0.32 mg/L
Seasonal FWMC 0.34 mg/L
Fort Wayne CC
Annual Load 0.3 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.12 mg/L
Seasonal FWMC 0.13 mg/L
LEJ100-0002
Annual Load 0.6 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.2 mg/L
Seasonal FWMC 0.23 mg/L
0 1 2 4 Kilometers
0 1 2 4 Miles
Sample Sites
Fixed Stations
Impaired Waters
County Boundary
Watersheds
Subwatersheds
Mapped By:
Joanna Wood, OWQ
Date:11/15/2017
Steuben
Noble
DeKalb
Allen
Auburn
Butler
Fort Wayne
IDEM
Data Sources: Obtained from the State of Indiana Geographic Information Office Library
Map Projection: UTM Zone 16 N Map Datum: NAD83
This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

St. Joseph River Basin

The St. Joseph River originates in Ohio and Michigan and when it enters Indiana the seasonal flow weighted mean concentration (FWMC) is 0.21 mg/L (IDEM Fixed Station LEJ060-0006). Approximately 13 river miles downstream the next site along St. Joseph River at Van Zile Road has a seasonal FWMC of 0.31 mg/L (SWCD site 121). This increase in concentration could be due to the difference in data time series (monthly vs weekly over different time periods), however there are also numerous small tributaries that enter the St. Joseph River between these two sites that could be contributing significant nutrient loads. Allen County SWCD site 128 on Bear Creek at Indiana State Road 1 which drains approximately 27 sq. miles has a seasonal FWMC of 0.50 mg/L, as an example of tributary loads. However, this FWMC is only a reflection of data from April through October in 2014, which is a small dataset.

Approximately 5 miles downstream the Cedar Creek tributary draining approximately 270 sq. miles flows into the St. Joseph River. IDEM fixed Station Site LEJ090-0026 (0.34 mg/L seasonal FWMC) and Fort Wayne Site CC (0.13mg/L seasonal FWMC) are both co-located at the Hursh Rd. Bridge. These sites have conflicting seasonal FWMC, which may need further analysis to determine the causation. There are two additional sites on Cedar Creek upstream of the confluence of the St. Joseph River. Allen County SWCD site 100 on Tonkel Road has a seasonal FWMC of 0.21 mg/L, and drains approximately 269 sq. miles. The second site is Allen County SWCD site 105 which has a drainage area of 85 square miles and has a seasonal FWMC of 0.35 mg/L.

Moving down the main stem of the St. Joseph River approximately another 5 stream miles, 10 stream miles downstream from the closest main stem St. Joseph River site to IDEM fixed station LEJ100-0003 which is co-located with Fort Wayne Site SJ2 at Mayhew Road. These sites seasonal FWMC correspond with each other at 0.23mg/L and 0.22mg/L respectively.

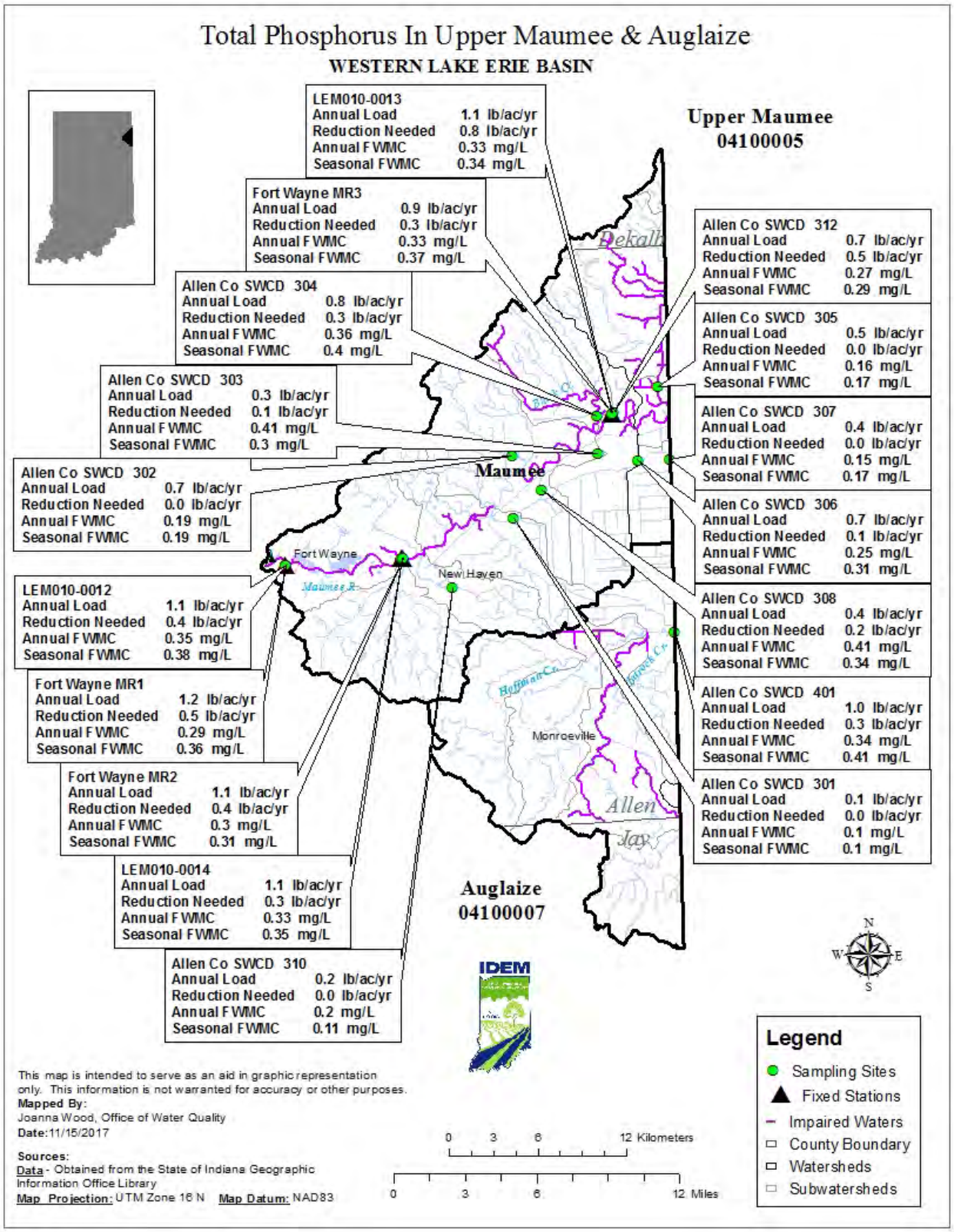
Continuing downstream approximately 3 river miles to IDEM fixed Station site LEJ-08-0005 located at the Shoaff Park boat ramp, the seasonal FWMC is 0.2 mg/L.

The final sites on the main stem St. Joseph River before it meets with the St. Mary's River in Fort Wayne to form the Maumee River are IDEM fixed Station site LEJ100-003 and Fort Wayne site SJ1, these sites are both located at Tennessee Ave. These two sites both have a seasonal FWMC of 0.23 mg/L.

The Fish Creek tributary and the Bug Run Tributary in Indiana flow back into Ohio before joining the St. Joseph River main stem. Two IDEM fixed station sites on Fish Creek LEJ050-0006 and LEJ050-0007 have seasonal FWMC of 0.33 and 0.19 respectively.

The ranking of the tributaries in the entire basin from highest contributions to lowest are Bear Creek, Upper Cedar Creek, Shank Ditch, Cedar Creek (Hursh Road), Fish Creek (upstream -State Road 427), Cedar Creek (Tonkel Road), Fish Creek (downstream - Artic), Big Run, and Ely Run.

The St. Joseph River meets the seasonal FWMC concentration goal of 0.23mg/L however as shown in the tributary analysis of the Allen County SWCD data there are individual tributaries that could benefit from additional load reductions.


Total Phosphorus In Upper Maumee & Auglaize
WESTERN LAKE ERIE BASIN
LEM010-0013
Annual Load 1.1 lb/ac/yr
Reduction Needed 0.8 lb/ac/yr
Annual FWMC 0.33 mg/L
Seasonal FWMC 0.34 mg/L
Upper Maumee
04100005
Fort Wayne MR3
Annual Load 0.9 lb/ac/yr
Reduction Needed 0.3 lb/ac/yr
Annual FWMC 0.33 mg/L
Seasonal FWMC 0.37 mg/L
Allen Co SWCD 312
Annual Load 0.7 lb/ac/yr
Reduction Needed 0.5 lb/ac/yr
Annual FWMC 0.27 mg/L
Seasonal FWMC 0.29 mg/L
Allen Co SWCD 304
Annual Load 0.8 lb/ac/yr
Reduction Needed 0.3 lb/ac/yr
Annual FWMC 0.36 mg/L
Seasonal FWMC 0.4 mg/L
Allen Co SWCD 305
Annual Load 0.5 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.16 mg/L
Seasonal FWMC 0.17 mg/L
Allen Co SWCD 303
Annual Load 0.3 lb/ac/yr
Reduction Needed 0.1 lb/ac/yr
Annual FWMC 0.41 mg/L
Seasonal FWMC 0.3 mg/L
Allen Co SWCD 307
Annual Load 0.4 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.15 mg/L
Seasonal FWMC 0.17 mg/L
Allen Co SWCD 302
Annual Load 0.7 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.19 mg/L
Seasonal FWMC 0.19 mg/L
Maumee
Allen Co SWCD 306
Annual Load 0.7 lb/ac/yr
Reduction Needed 0.1 lb/ac/yr
Annual FWMC 0.25 mg/L
Seasonal FWMC 0.31 mg/L
Fort Wayne
New Haven
Maumee R.
LEM010-0012
Annual Load 1.1 lb/ac/yr
Reduction Needed 0.4 lb/ac/yr
Annual FWMC 0.35 mg/L
Seasonal FWMC 0.38 mg/L
Allen Co SWCD 308
Annual Load 0.4 lb/ac/yr
Reduction Needed 0.2 lb/ac/yr
Annual FWMC 0.41 mg/L
Seasonal FWMC 0.34 mg/L
Fort Wayne MR1
Annual Load 1.2 lb/ac/yr
Reduction Needed 0.5 lb/ac/yr
Annual FWMC 0.29 mg/L
Seasonal FWMC 0.36 mg/L
Allen Co SWCD 401
Annual Load 1.0 lb/ac/yr
Reduction Needed 0.3 lb/ac/yr
Annual FWMC 0.34 mg/L
Seasonal FWMC 0.41 mg/L
Monroeville
Fort Wayne MR2
Annual Load 1.1 lb/ac/yr
Reduction Needed 0.4 lb/ac/yr
Annual FWMC 0.3 mg/L
Seasonal FWMC 0.31 mg/L
Allen Co SWCD 301
Annual Load 0.1 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.1 mg/L
Seasonal FWMC 0.1 mg/L
Allen
Jay
LEM010-0014
Annual Load 1.1 lb/ac/yr
Reduction Needed 0.3 lb/ac/yr
Annual FWMC 0.33 mg/L
Seasonal FWMC 0.35 mg/L
Auglaize
04100007
Allen Co SWCD 310
Annual Load 0.2 lb/ac/yr
Reduction Needed 0.0 lb/ac/yr
Annual FWMC 0.2 mg/L
Seasonal FWMC 0.11 mg/L
IDEM
N
W
E
S
Legend
Sampling Sites
Fixed Stations
Impaired Waters
County Boundary
Watersheds
Subwatersheds
This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.
Mapped By:
Joanna Wood, Office of Water Quality
Date:11/15/2017
Sources:
Data - Obtained from the State of Indiana Geographic Information Office Library
Map Projection: UTM Zone 16 N Map Datum: NAD83
0 3 6 12 Kilometers
0 3 6 12 Miles

Auglaize River Basin

There is only one site in the entire basin (SWCD 401) which represents Indiana's load contribution as it flows into Ohio. The seasonal FWMC is 0.41 mg/L which is above the target concentration.

Maumee River Basin

The St. Joseph River (FWMC of 0.23 mg/L at the confluence) and the St. Mary's River (FWMC of ~0.50 mg/L at the confluence) join to form the Maumee River. The two sites on the Maumee immediately after the two rivers join have seasonal FWMC of 0.36 mg/L (Fort Wayne MR1) and 0.38 mg/L (IDEM LEM010-0012).

Six miles downstream, the Maumee River has a FWMC of 0.31 mg/L (Fort Wayne MR2) and 0.35 mg/L (IDEM LEM010-0014). The only major tributary entering the main stem upstream of these sites is Paul Trier Ditch which did not have any sampling sites.

Fourteen river miles downstream along the Maumee (State Road 101) the FWMC is 0.34 (IDEM LEM010-0013), 0.37(Fort Wayne MR3), and 0.29 (SWCD 312) mg/L. There are several tributaries entering the main stem between this site and the next nearest site upstream. Those tributaries with data ranked in order from highest FWMC to lowest include Black Creek, Grover Ditch, Wilbur Drain, Bottern Drain, A. Martin Drain and Six Mile Creek.

Five river miles downstream the Maumee flows into Ohio. There are no sites closer to the State Line to represent the actual contribution to Ohio, however, there are three tributaries that enter the main stem between the last site and the Ohio State Line. Only one of these tributaries had a seasonal FWMC higher than the target concentration. Those tributaries ranked in order from highest FWMC to lowest include Marsh Ditch, Hamm Interceptor and Viland Ditch.

The ranking of the tributaries in the entire basin from highest contributions to lowest are Black Creek, Grover Ditch, Marsh Ditch, Wilbur Drain, Bottern Drain, Hamm Interceptor, Viland Ditch, A. Martin Drain, and Six Mile Creek.

Although the Maumee basin has a seasonal FWMC above the target of 0.23 mg/L, as you work downstream through the basin the total phosphorus concentrations remain about the same from where the St. Mary's and St. Joseph Rivers join to the Ohio State Line. While some tributaries indicate higher nutrient loads, other tributaries are well below the target seasonal FWMC which balances the total load to the basin.

Antwerp vs New Haven

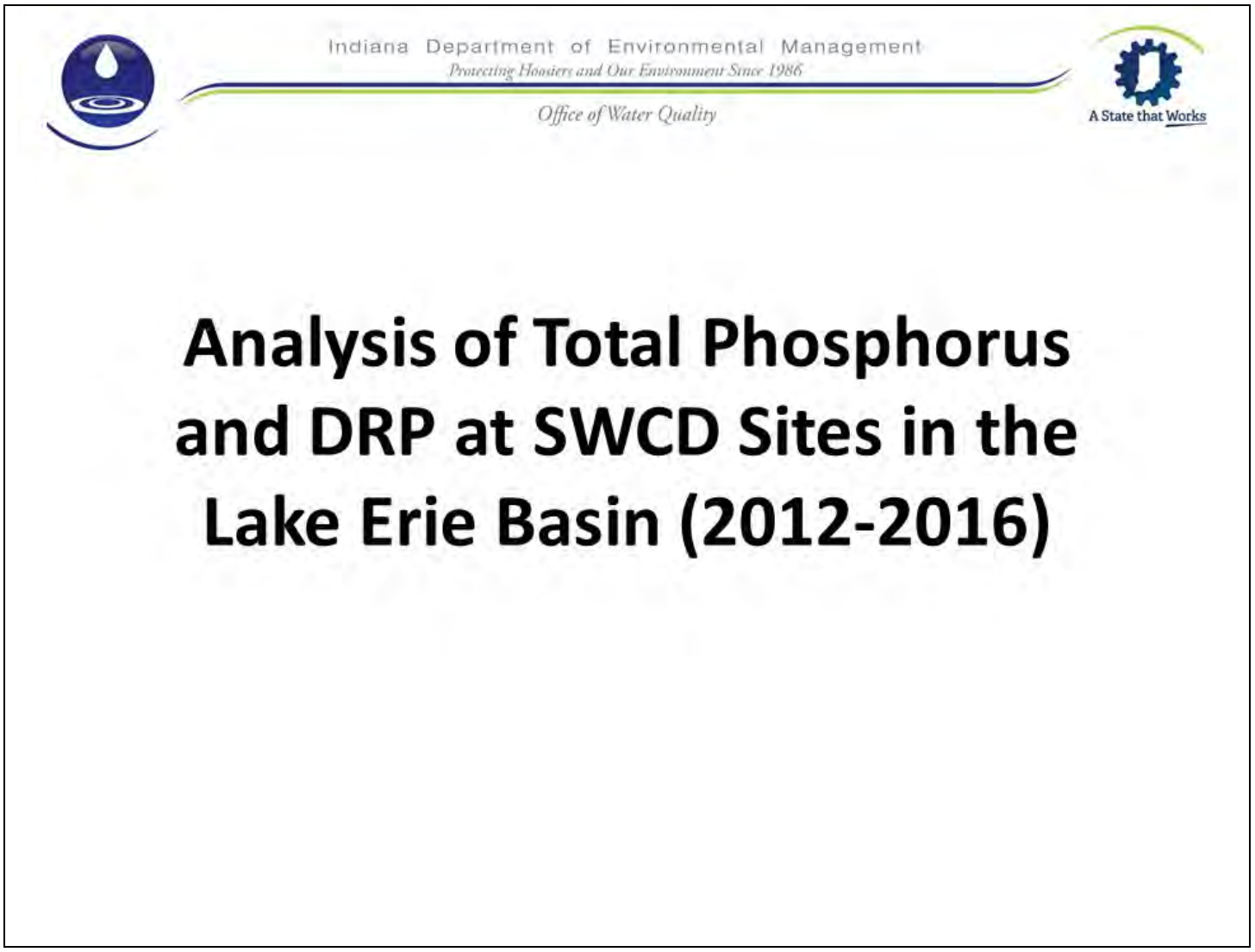
We combined the data for the three sites co-located at SR 101, IDEM Fixed Station LEM010-0013, Ft. Wayne MR3, and SWCD 312. This gave us a total of 138 sampling events from 2014-2016.

The results using the gage data from New Haven are:

New Haven (January 2014- December 2016)				
2014	Annual Average Daily Load	**3,180.21**	Annual Flow Weighted Mean Concentration	0.29
	Annual Average Daily Flow	**2,050.09**		
	Seasonal Average Daily Load	**5030.644**	Seasonal Flow Weighted Mean Concentration	0.30
	Seasonal Average Daily Flow	**3097.552**		
2015	Annual Average Daily Load	**4,072.83**	Annual Flow Weighted Mean Concentration	0.31
	Annual Average Daily Flow	**2,459.90**		
	Seasonal Average Load	**8032.541**	Seasonal Flow Weighted Mean Concentration	0.32
	Seasonal Average Flow	**4625.654**		
2016	Annual Average Daily Load	**2,038.68**	Annual Flow Weighted Mean Concentration	0.26
	Annual Average Daily Flow	**1,465.59**		
	Seasonal Average Load	**2766.224**	Seasonal Flow Weighted Mean Concentration	0.27
	Seasonal Average Flow	**1924.827**		

The results using the gage data from Antwerp (gage was missing January and February data from 2014) are:

Antwerp (March 2014- December 2016)				
2014	Annual Average Daily Load	**2,949.35**	Annual Flow Weighted Mean Concentration	0.29
	Annual Average Daily Flow	**1,892.84**		
	Seasonal Average Daily Load	**4936.418**	Seasonal Flow Weighted Mean Concentration	0.30
	Seasonal Average Daily Flow	**3015.669**		
2015	Annual Average Daily Load	**4,118.58**	Annual Flow Weighted Mean Concentration	0.31
	Annual Average Daily Flow	**2,474.04**		
	Seasonal Average Load	**8075.542**	Seasonal Flow Weighted Mean Concentration	0.32
	Seasonal Average Flow	**4615.108**		
2016	Annual Average Daily Load	**2,096.83**	Annual Flow Weighted Mean Concentration	0.26
	Annual Average Daily Flow	**1,499.16**		
	Seasonal Average Load	**2813.084**	Seasonal Flow Weighted Mean Concentration	0.27
	Seasonal Average Flow	**1950.701**		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Analysis of Total Phosphorus and DRP at SWCD Sites in the Lake Erie Basin (2012-2016)

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IDEM Fixed Station Data

- There are Fixed Station data from the St. Joseph River (4), the Maumee River (3), Saint Mary's River (5), Cedar Creek (1), and Fish Creek (2).
- Currently only 12 of these sites are actively being monitored
- Data used in the analysis included monthly sampling events from 2012 through 2015
- Three sites were moved due to safety hazards
  - LES060-0004 moved to LES-06-0003 (~0.5 miles apart)
    - These sites were considered comparable in this analysis due to the close proximity and BPJ of fixed station field staff.
  - LEJ100-0002 moved to LEJ-08-0005 (~4 miles apart)
    - These sites were NOT considered comparable in this analysis.
  - LES060-0005 moved to LES-06-0009 (~1.5 miles apart)
    - These sites were considered comparable in this analysis due to the close proximity and BPJ of fixed station field staff.

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City of Fort Wayne Data

- The City of Fort Wayne provided IDEM with total phosphorus data from the St. Joseph River (2), the Maumee River (3), Saint Mary's River (3), Cedar Creek (1), and Spy Run Creek (1).
- Data used in the analysis included sampling events from 2011 through 2016
- Weekly data collection from March through October
- Monthly data collection from November through February
- Exceptions
  - Spy Run Creek data from 2013 through 2016
  - St. Marys at Paulding Road data from 2013 through 2016
  - Maumee at Hwy 101 data from 2012 through 2016; monthly sampling events only and incomplete for some years
  - Cedar Creek monthly sampling from 2012 through 2016; sampling incomplete for some years

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Allen County SWCD Data

- The Allen County SWCD provided IDEM with total phosphorus data from the St. Joseph River (2), the Maumee River (1), Saint Mary's River (3), and 34 locations on tributaries.
- DRP was also collected and analyzed, however results may be unreliable given the low number of samples and the dates of collection. Samples were collected in a portion of 2014 and 2016 and the majority of 2015. The highest precipitation amounts over the last 9 years fell in 2015 making the estimated loads likely higher than normal.
- Data used in the analysis included what was provided which varies between sites.
  - Sampling ranged between 12 and 133 events at each site.
  - Ranges spanned a single year up to six years of data at a site.

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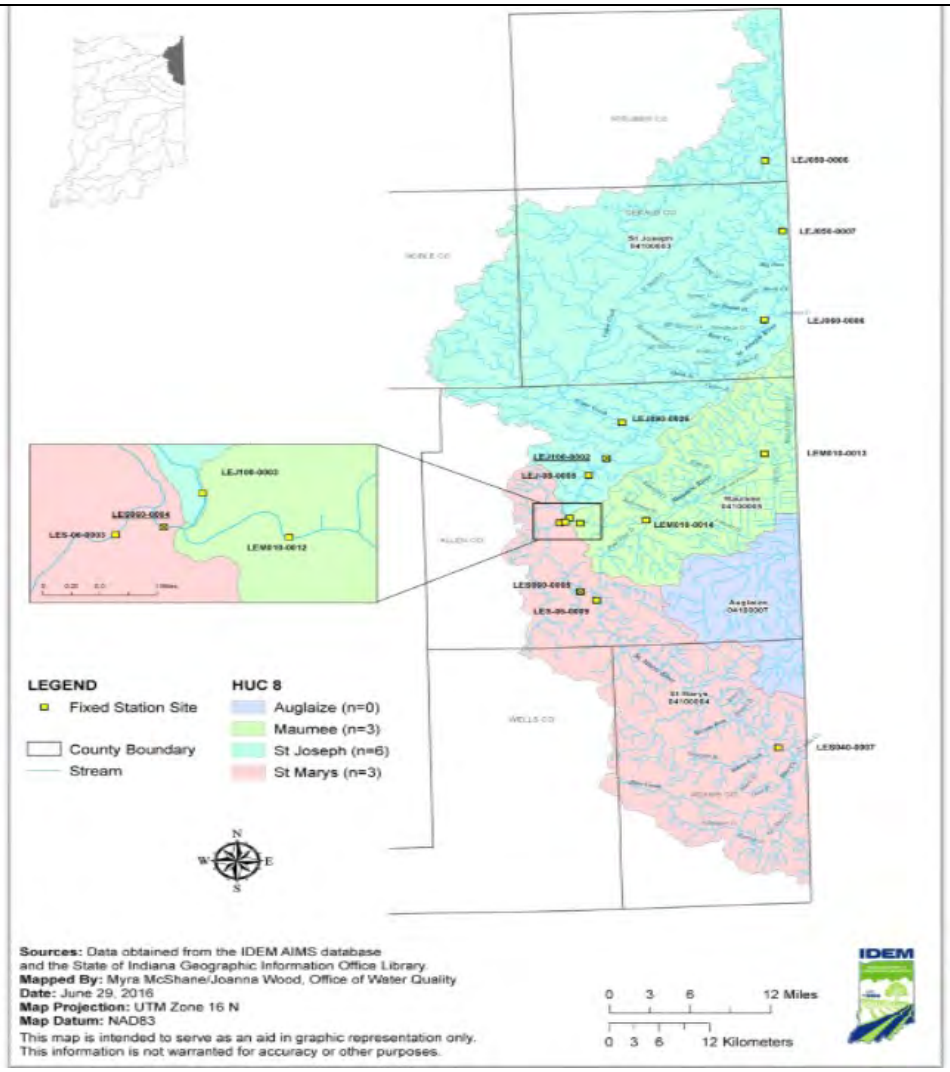
Analysis

- The USGS Load Estimator (LOADEST) model (both the Purdue Interface and USGS Desktop Application) were used to estimate annual loads and load reductions needed based on a 0.23 mg/L Total Phosphorus concentration.
  - Given a time series of streamflow, fixed station data and the target concentration (0.23 mg/L) LOADEST develops a regression model for the estimation of loads (calibration). The formulated regression model then is used to estimate loads over a user specified time interval (estimation). Mean load estimates, standard errors, and 95% confidence intervals are developed on a monthly and seasonal basis.
  - The Adjusted Maximum Likelihood Estimation (AMLE) method was used for these graphs.
  - The Purdue Web-based Load Calculation using LOADEST interface (https://engineering.purdue.edu/~ldc/LOADEST/) and the USGS LOADEST model were used in this analysis. The Purdue interface is easier to use but we calculated loads using both models to ensure the results were accurate.
- Information from the most representative USGS stream gage was used in the LOADEST model.
- Mean annual loads, mean seasonal loads, annual flow weighted concentrations and seasonal flow weighted concentrations were calculated for each site.
- Precipitation data found on the Indiana State Climate Office webpage (https://climate.agry.purdue.edu/climate/index.asp) from Station Decatur 1 N (IN) along the Saint Mary's River.
- **Note: The drainage area ratio was calculated and reported for each site. More error is introduced as the drainage area ratio gets smaller. This primarily effects the tributaries since USGS stream gages are often located on larger stream/rivers.**


LEGEND
Fixed Station Site
County Boundary
Stream
HUC 8
Auglaize (n=0)
Maumee (n=3)
St Joseph (n=6)
St Marys (n=3)
N
W
E
S
Sources: Data obtained from the IDEM AIMS database and the State of Indiana Geographic Information Office Library.
Mapped By: Myra McShane/Joanna Wood, Office of Water Quality
Date: June 29, 2016
Map Projection: UTM Zone 16 N
Map Datum: NAD83
This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.
0 3 6 12 Miles
0 3 6 12 Kilometers
IDEM

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Cedar Creek at Tonkel Road SWCD Site 100

- This site along Cedar Creek just west of IDEM Fixed Station site LEJ090-0026. It I represents the water quality that is flowing into the St. Joseph River.
- USGS stream gage on Cedar Creek near Cedarville, IN (04180000) used in the analysis of this site. Drainage Area ratio is 1.00 (100%).

LOADEST Results

	TP	TP	DRP	DRP
	Beginning Date	Ending Date	Beginning Date	Ending Date
FlowData	1946 - 11 - 21	2016 - 12 - 31	1946 - 11 - 21	2016 - 12 - 31
Water Quality Data	2014 - 04 - 14	2016 - 10 - 25	2014 - 11 - 12	2016 – 5 - 17
	Total (lb/yr)	Per Acre (lb/ac/yr)	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	74,503	0.4	51,691	0.3
Maximum Annual Load to Meet Target	91,306	0.5	21,587	0.1
Load Reduction Needed to Meet Target	0	0	30,103	0.2
Average Annual Seasonal Load	52,379	0.3	27,400	0.2

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Cedar Creek at Hursh Road Bridge LEJ090-0026 (CC-4)

- Flows into the St. Joseph River downstream of site LEJ060-0006 and upstream of site LEJ100-0002
- USGS stream gage on Cedar Creek near Cedarville, IN (04180000) used in the analysis of this site. Drainage Area ratio is 1.002 (100%).

LOADEST Results

	Beginning Date	Ending Date
FlowData	1946 - 10 - 30	2016 - 6 - 26
Water Quality Data	2008 - 01 - 22	2016 - 04 - 05
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	170,597	0.99
Maximum Annual Load to Meet Target	124,209	0.72
Load Reduction Needed to Meet Target	46,387 (27%)	0.27
Average Annual Seasonal Load	112,149	

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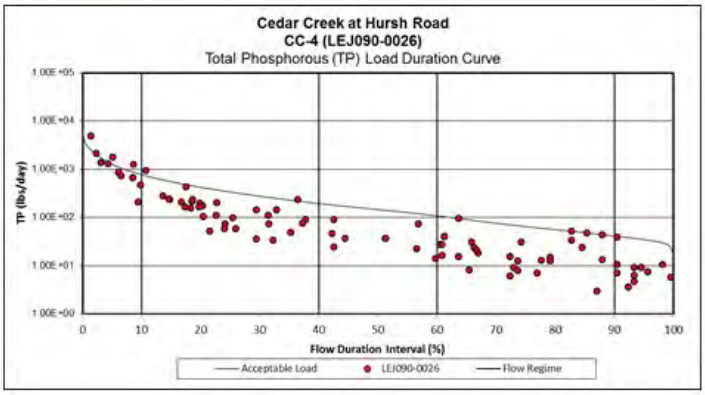

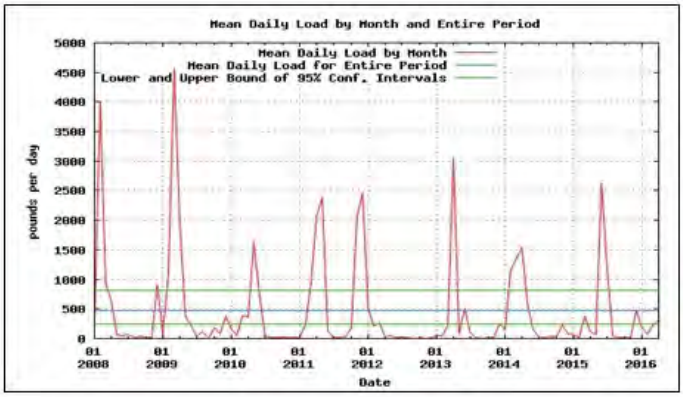

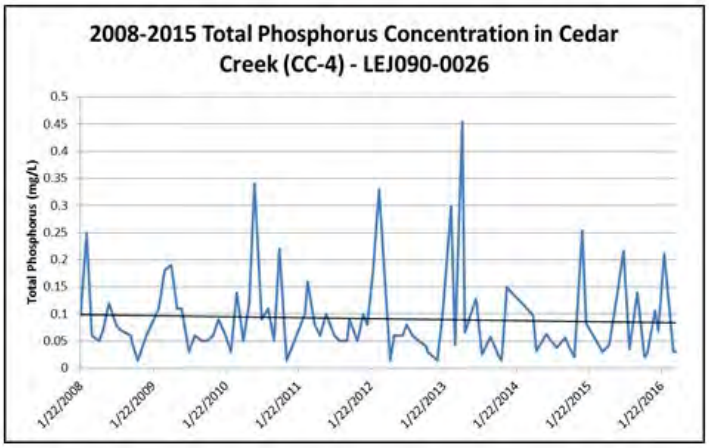

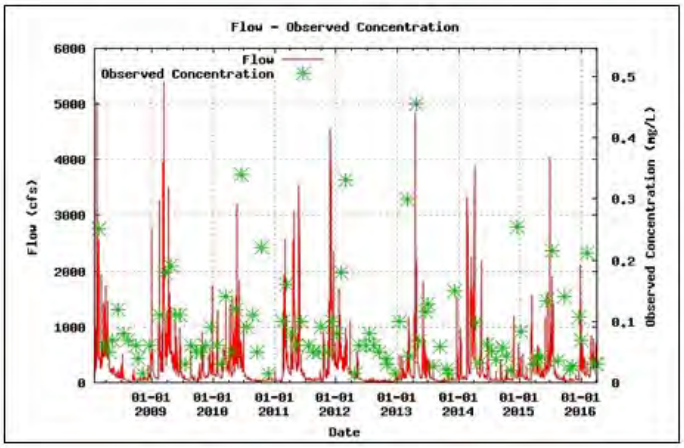

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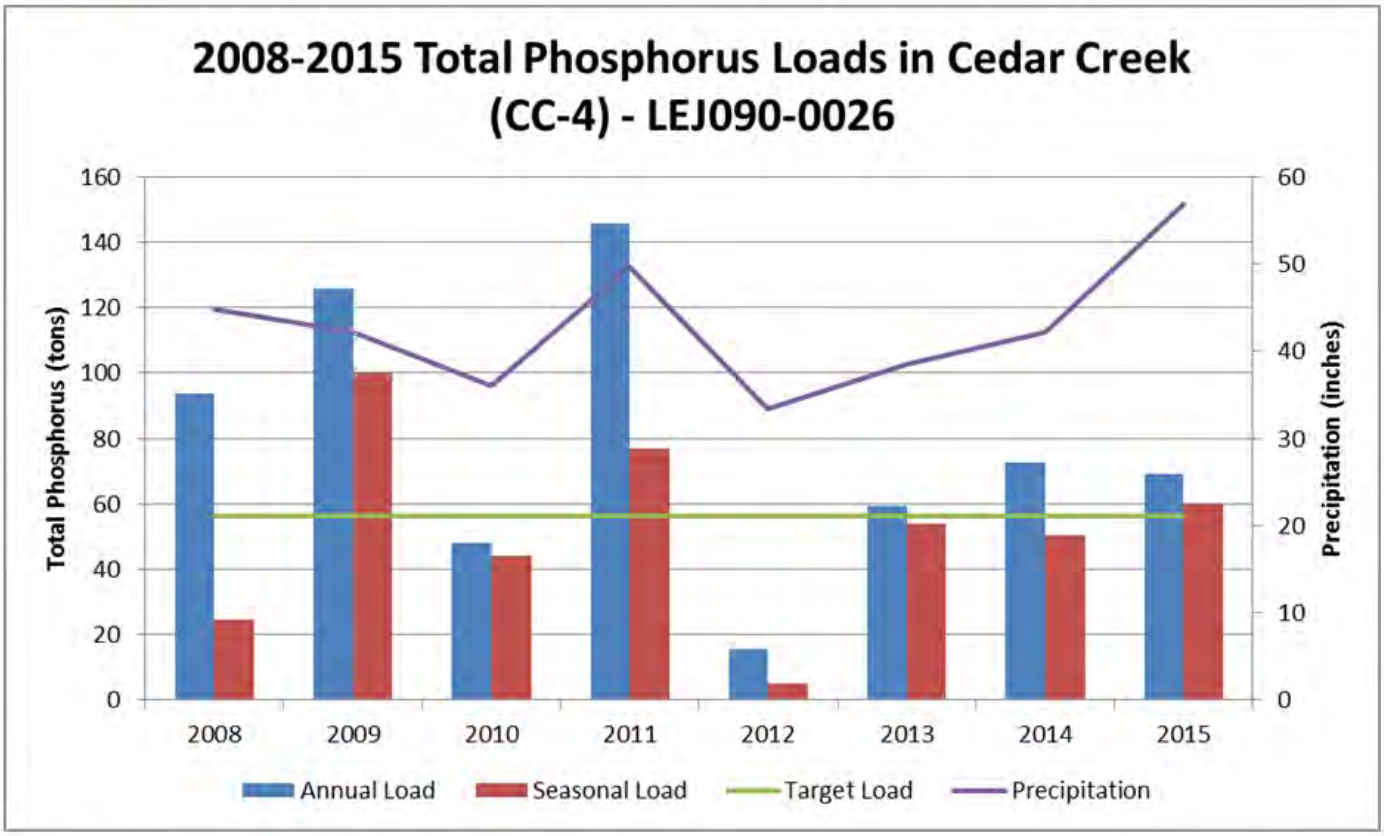

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Cedar Creek (LEJ090-0026) Results

- Based on the load duration curve most sampling events that exceeded the water quality target of 0.23 mg/L occur during very high flow events. This is often a indicator of precipitation driven non-point source pollution.
- Total phosphorus concentrations have remained constant from 2005-2014.
- An annual load reduction of 27% (46,387 lbs./ year) are needed to meet target (0.23 mg/L) annual loads.
- Though precipitation increased (increasing trend) from 2013 to 2015 total phosphorus loads have remained relatively low and constant (between 60-80 tons).
- During the 8 year study focus (2008-2015) the average annual load exceeded the target load 6 years (75%).

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St. Joseph River at SR 8 in Newville SWCD Site 163

- This site along the St. Joseph River is just west of the Ohio/Indiana border. It I represents the water quality that is flowing into Indiana from Ohio.
- USGS stream gage on the St. Joseph River near Newville, IN (04178000) used in the analysis of this site. Drainage Area ratio is 1.00 (100%).

LOADEST Results

	TP	TP	DRP	DRP
	Beginning Date	Ending Date	Beginning Date	Ending Date
FlowData	1946 - 11 - 21	2016 - 12 - 31	1946 - 11 - 21	2016 - 12 - 31
Water Quality Data	2014 – 04 - 15	2016 - 10 - 25	2014 - 11 - 12	2016 – 5 - 17
	Total (lb/yr)	Per Acre (lb/ac/yr)	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	93,826	0.2	159,505	0.4
Maximum Annual Load to Meet Target	173,393	0.4	49,574	0.1
Load Reduction Needed to Meet Target	0	0	109,930	0.3
Average Annual Seasonal Load	165,491	0.4	112,149	0.3

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St. Joseph River at SR 8 in Newville LEJ060-0006 (STJ-36)

- This site along the St. Joseph River is just west of the Ohio/Indiana border. It I represents the water quality that is flowing into Indiana from Ohio.
- USGS stream gage on the St. Joseph River near Newville, IN (04178000) used in the analysis of this site. Drainage Area ratio is 1.00 (100%).

LOADEST Results

	Beginning Date	Ending Date
FlowData	1946 - 11 - 21	2016 - 06 - 21
Water Quality Data	2008 - 01 - 02	2016 - 03 - 01
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	226,680	0.57
Maximum Annual Load to Meet Target	273,118	0.68
Load Reduction Needed to Meet Target	0	0
Average Annual Seasonal Load	155,754	

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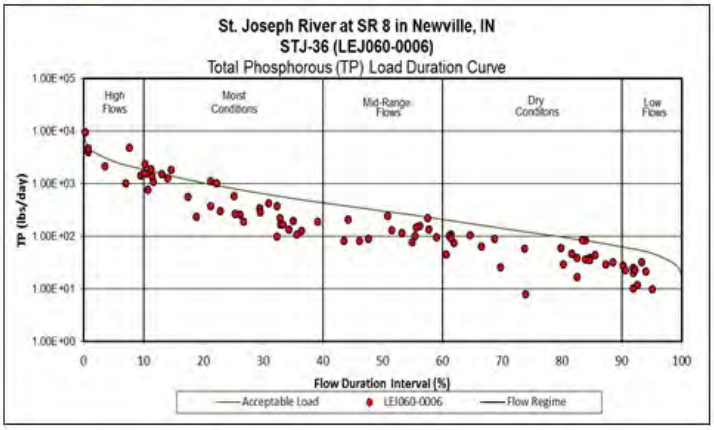

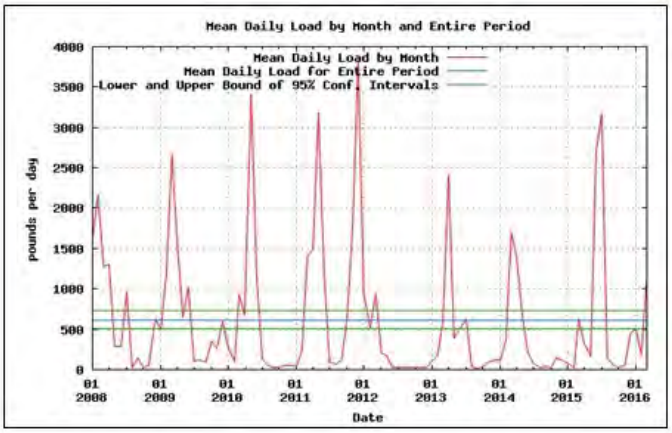

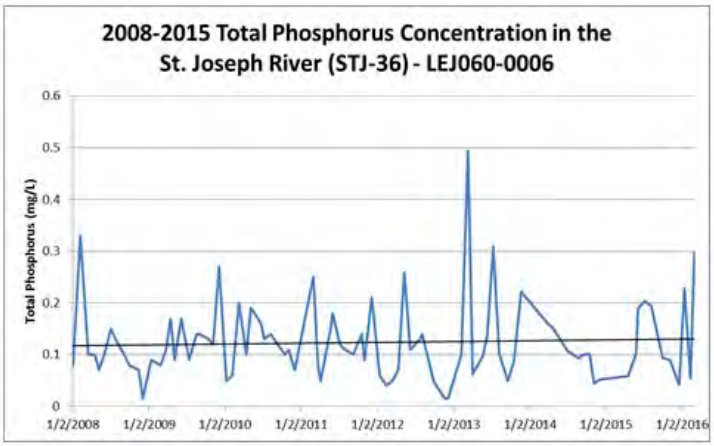

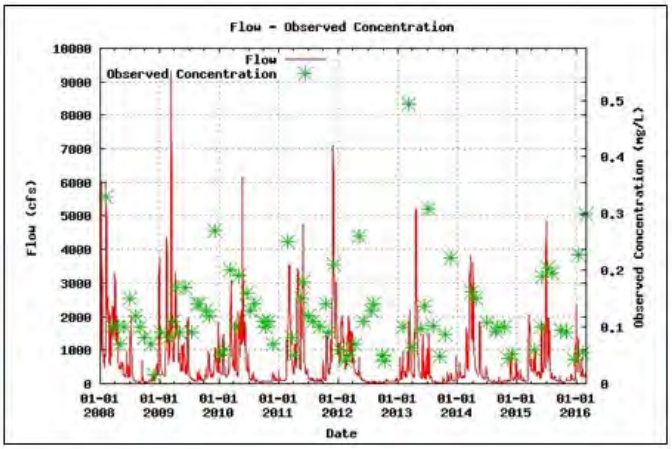

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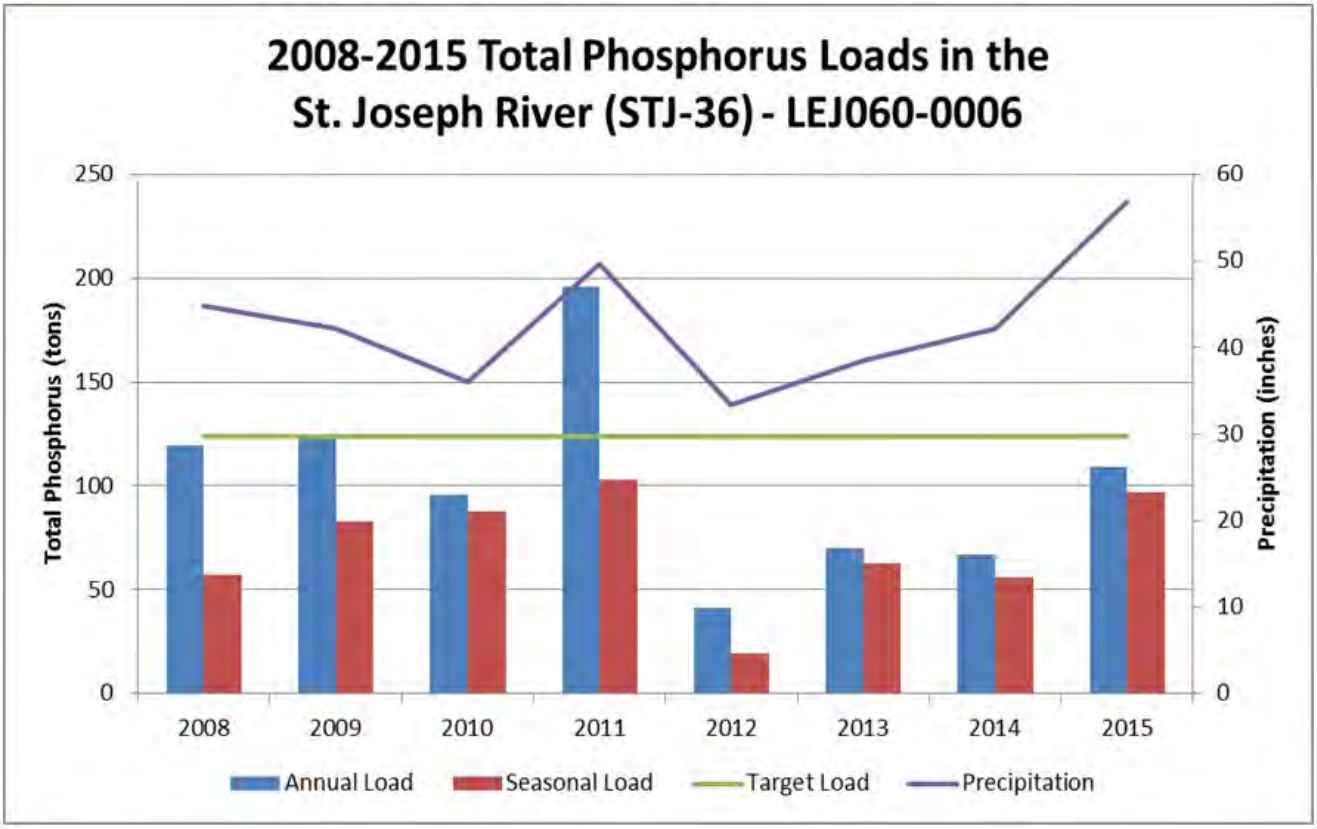

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St. Joseph River Results

- Based on the load duration curve most sampling events that exceed the water quality target of 0.23 mg/L occur during moderate to very high flow events. This is often a indicator of precipitation driven non-point source pollution.
- Total phosphorus concentrations have a slight upward trend from 2008-2016.
- During the 8 year study focus (2008-2016) the average annual load exceeded the target load only 1 year (12.5%) in 2011. Rainfall in 2011 was ~50 inches. However, in 2015 rainfall was ~55 inches and the annual load did not exceed the target load.
- SWCD and IDEM results consistent for TP. No reduction needed.
- DRP results unreliable due to low sample observations and the majority of them occurring during a year with very high rainfall.

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St. Joseph River at Mayhew Road Northeast of Fort Wayne - LEJ100-0002 (STJ-8)

- This site along the St. Joseph River is located downstream of the confluence with Cedar Creek.
- The site is no longer active due to safety concerns.
- USGS stream gage on the St. Joseph River near Fort Wayne, IN (04180500) used in the analysis of this site. Drainage Area ratio is 1.00 (100%).

LOADEST Results

	Beginning Date	Ending Date
FlowData	1983 - 10 - 01	2015 - 10 - 23
Water Quality Data	2008 - 02 - 19	2011 - 03 - 09
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	427,294	0.63
Maximum Annual Load to Meet Target	490,401	0.72
Load Reduction Needed to Meet Target	0	0
Average Annual Seasonal Load	330,174	

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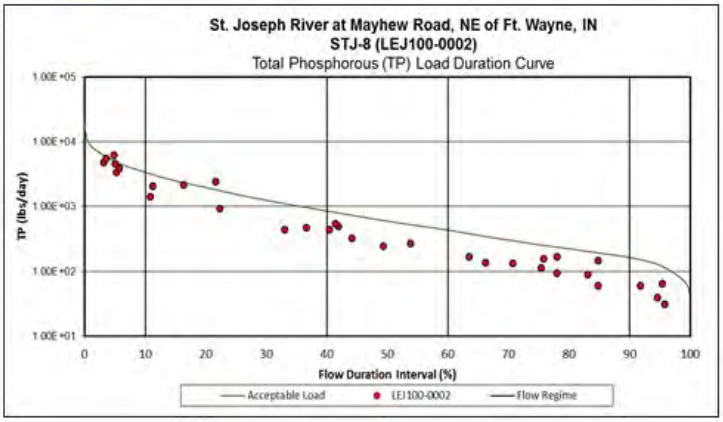

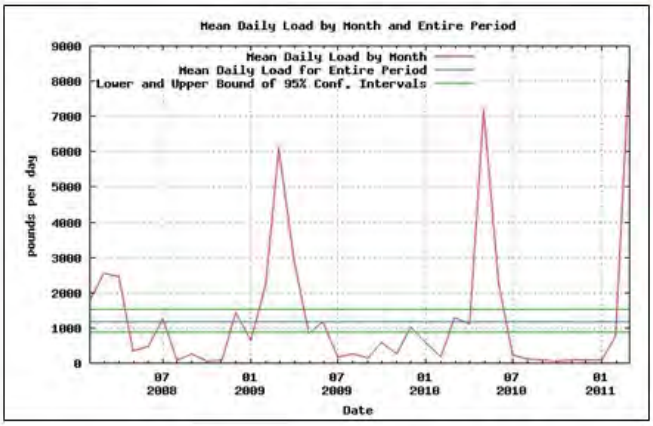

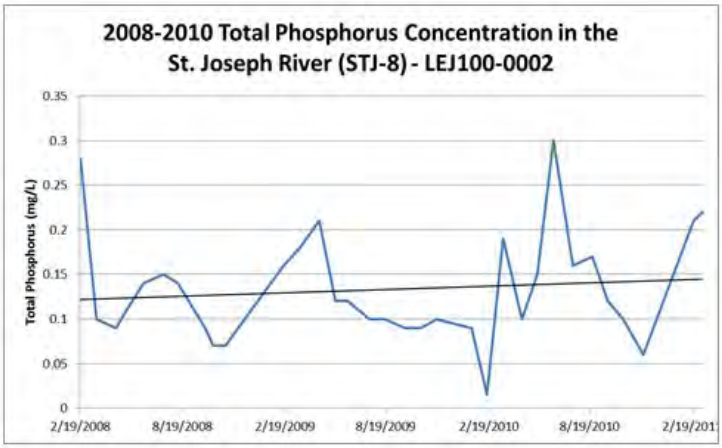

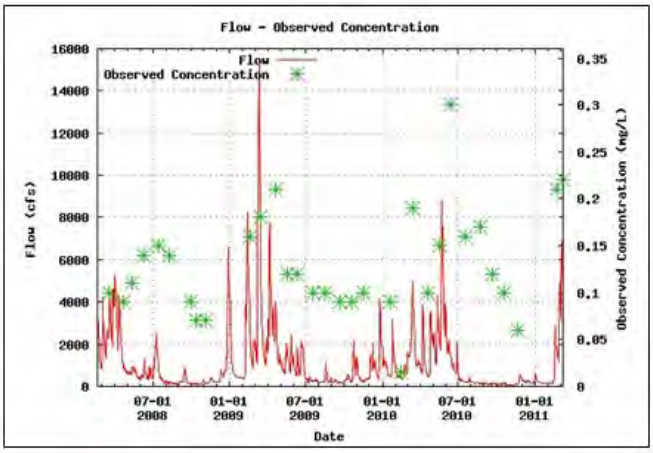

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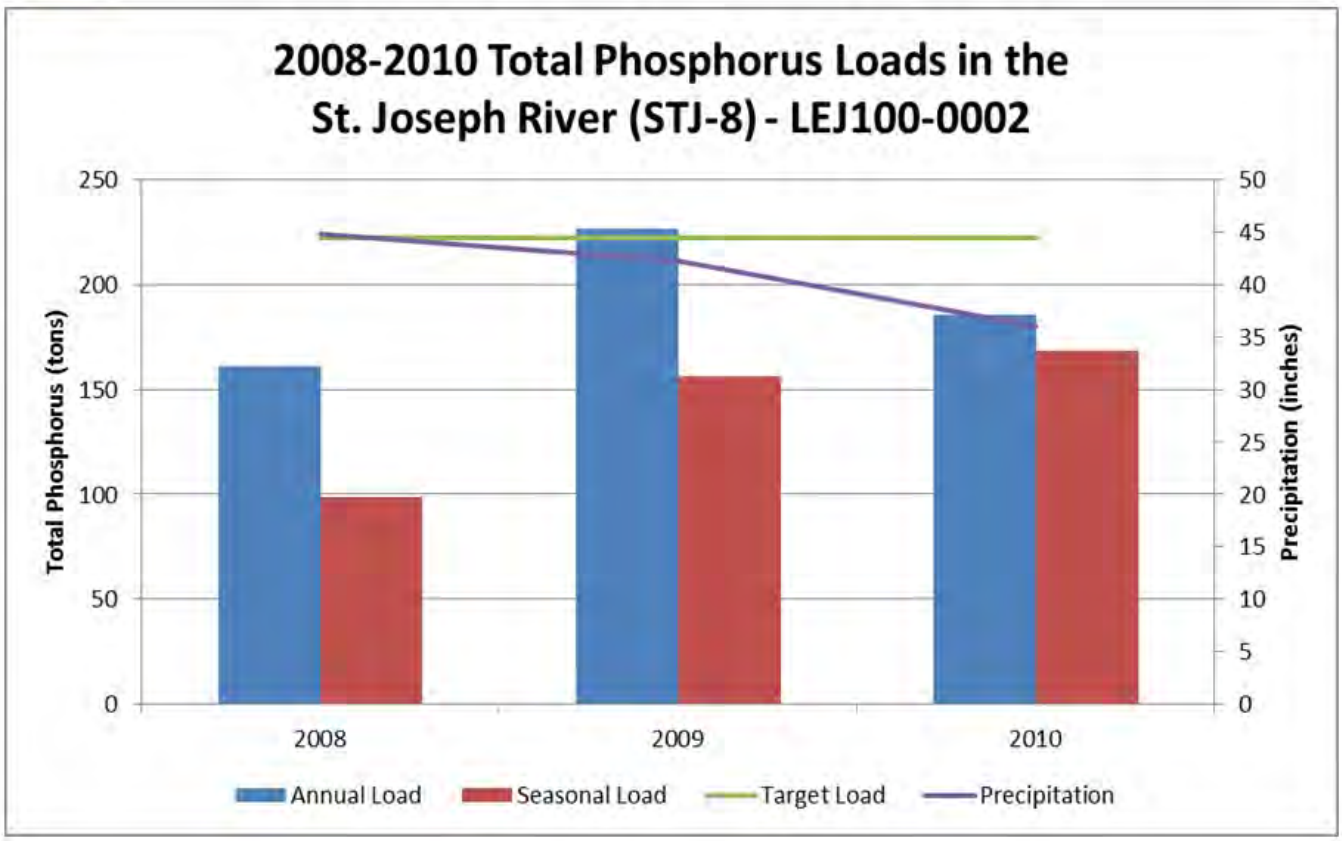

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St. Joseph River (LEJ100-0002) Results

- Based on the load duration curve most sampling events that exceed the water quality target of 0.23 mg/L occur during moderate to very high flow events. This is often a indicator of precipitation driven non-point source pollution.
- Total phosphorus concentrations have a slight upward trend from 2008-2016.
- This site has exceeded the annual target load (slightly) 33% (1/3 years) of the time. The annual target load is exceeded when more than ~40 inches of rainfall occur in a year.

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St. Joseph River at Shoaff Park Northeast of Fort Wayne – LEJ-08-0005 (STJ-4)

- This site along the St. Joseph River is located downstream of the confluence with Cedar Creek.
- The site only has data from 2011 to present.
- USGS stream gage on the St. Joseph River near Fort Wayne, IN (04180500) used in the analysis of this site. Drainage Area ratio is 1.018 (98%).

LOADEST Results

	Beginning Date	Ending Date
FlowData	1983 - 10 - 01	2015 - 10 - 23
Water Quality Data	2011 - 04 - 13	2016 - 04 - 05
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	359,890	0.52
Maximum Annual Load to Meet Target	438,000	0.63
Load Reduction Needed to Meet Target	0	0
Average Annual Seasonal Load	236,842	

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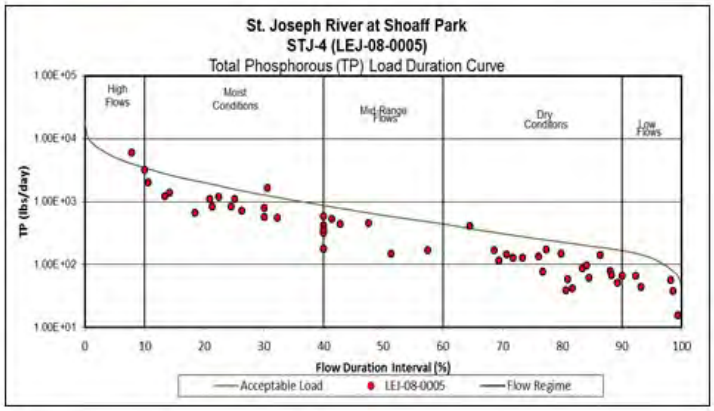

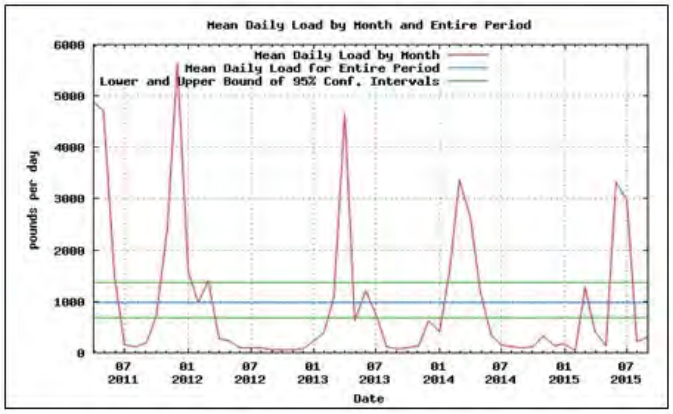

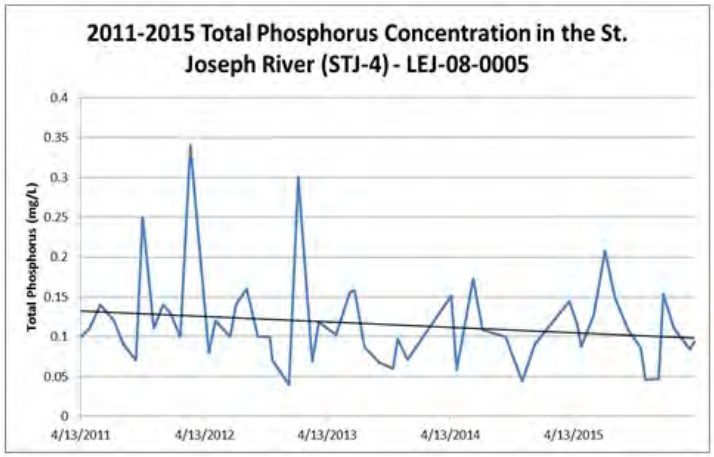

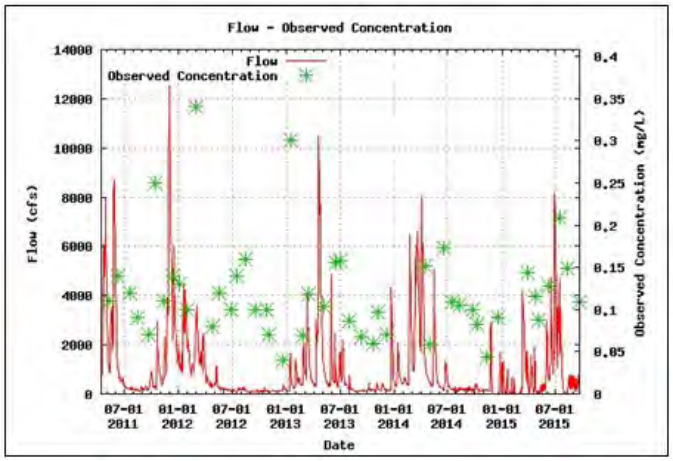

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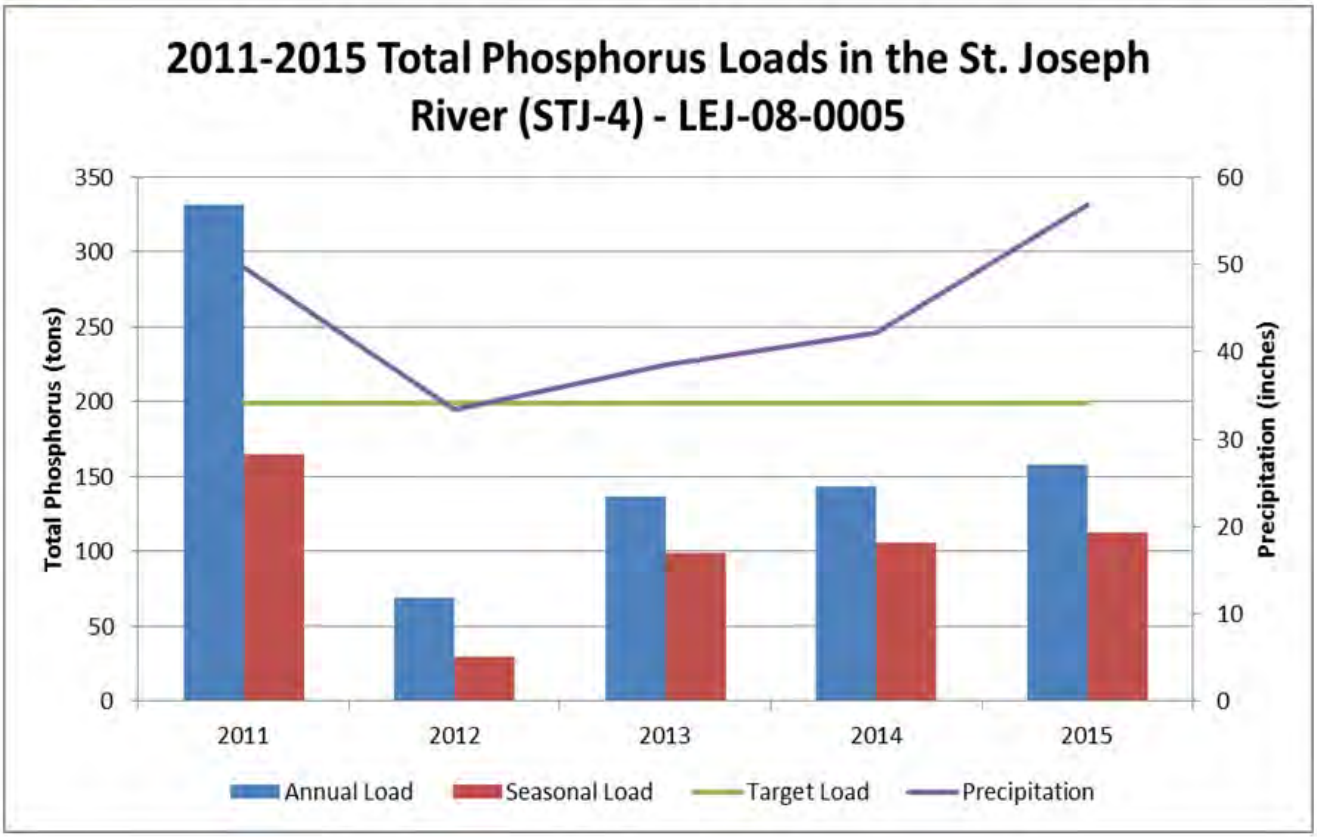

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St. Joseph River (LEJ-08-0005) Results

- Based on the load duration curve most sampling events that exceed the water quality target of 0.23 mg/L occur during moderate to very high flow events. This is often a indicator of precipitation driven non-point source pollution.
- Total phosphorus concentrations have a slight downward trend from 2011-2015.
- This site has exceeded the annual target load only one time (in 2011) between 2011-2015.

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St. Joseph River at Tennessee Street in Fort Wayne – LEJ100-0003 (STJ-.5)

- This site along the St. Joseph River is located in Fort Wayne just before it enters the Maumee River. This site represents the pour point of the St. Joseph River watershed.
- USGS stream gage on the St. Joseph River near Fort Wayne, IN (04180500) used in the analysis of this site. Drainage Area ratio is 1.029 (97%).
- This USGS stream gage changed locations and USGS in the process of determining if a new rating curve will be needed. This may impact the 2015 discharge data used in analysis.

LOADEST Results

	Beginning Date	Ending Date
FlowData	1983 - 10 - 01	2015 - 10 - 23
Water Quality Data	2008- 02 - 19	2016 - 04 - 05
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	415,457	0.60
Maximum Annual Load to Meet Target	471,100	0.67
Load Reduction Needed to Meet Target	0	0
Average Annual Seasonal Load	289,170	

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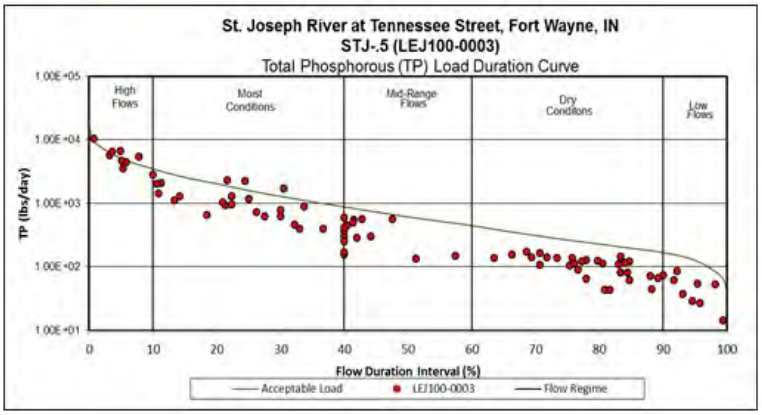

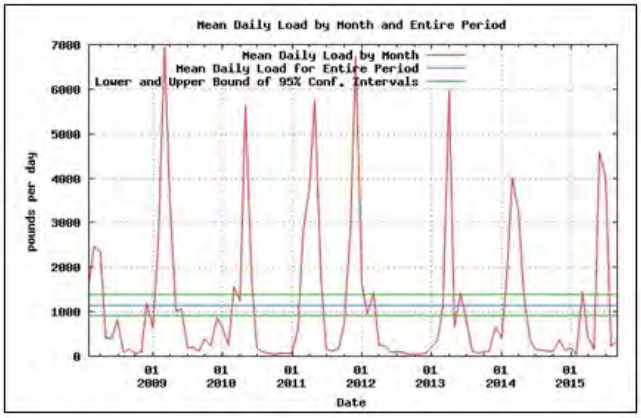

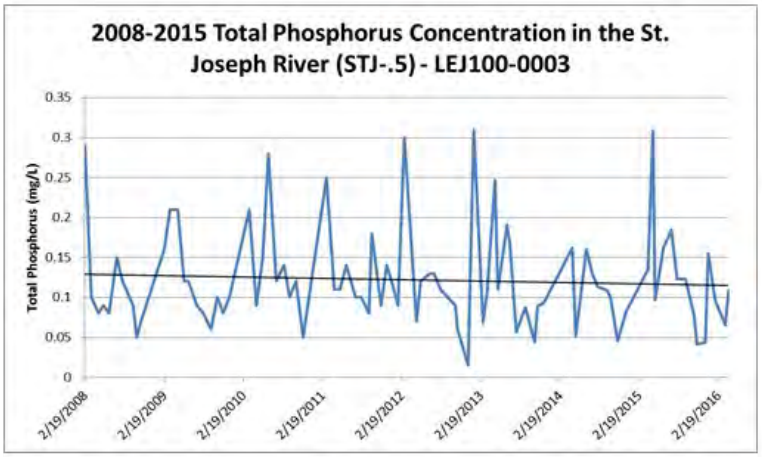

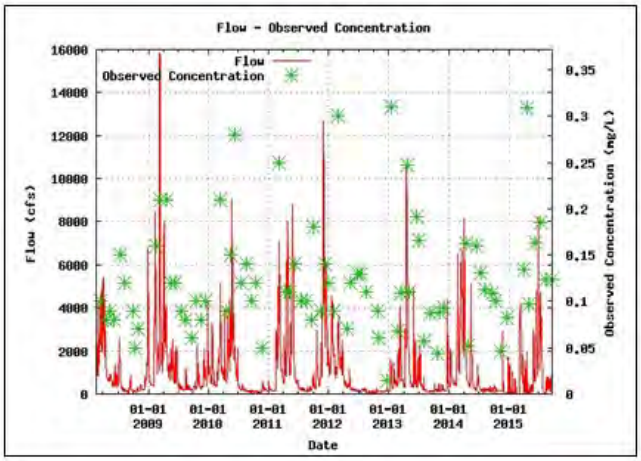

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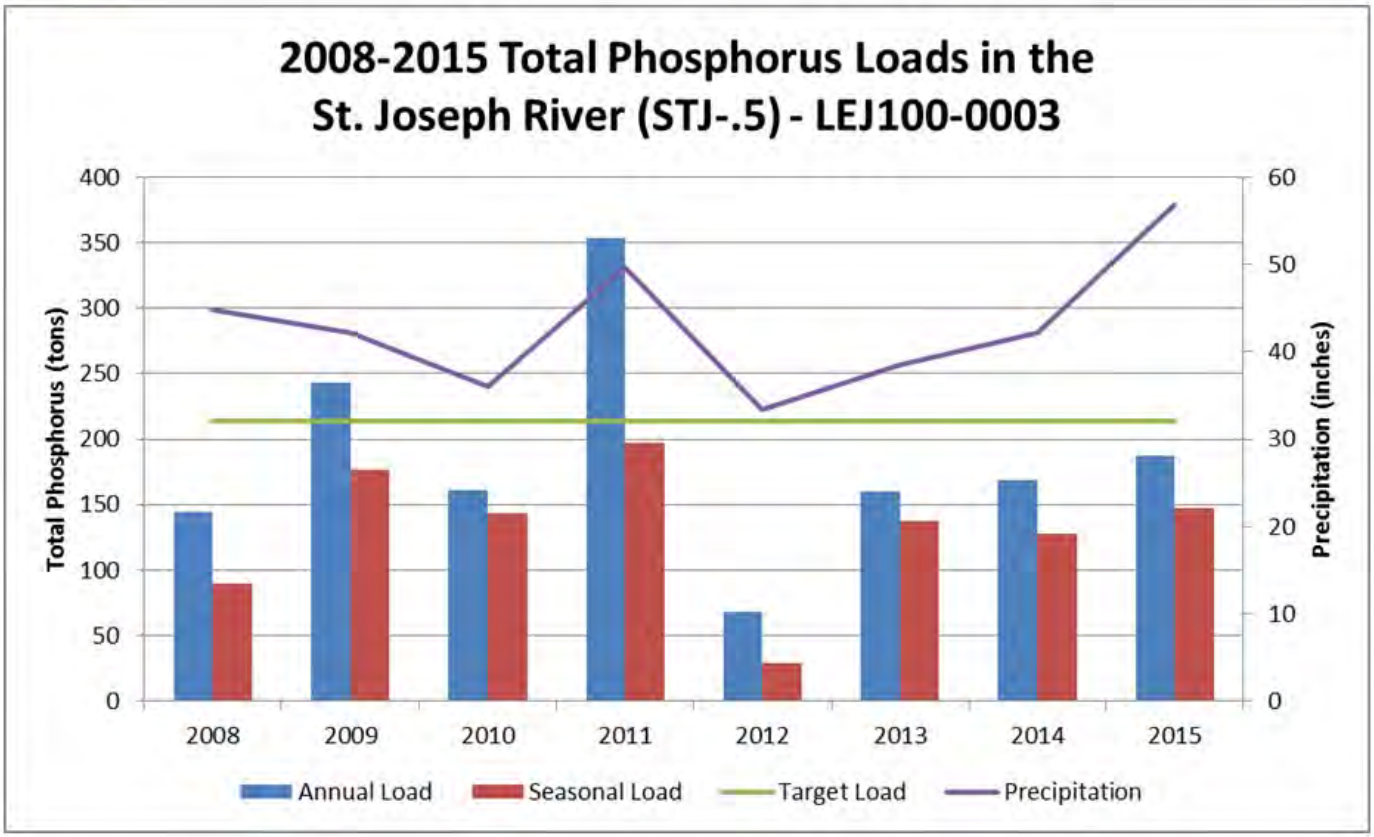

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St. Joseph River (LEJ100-0003) Results

- Based on the load duration curve most sampling events that exceed the water quality target of 0.23 mg/L occur during high to very high flow conditions. This is often a indicator of precipitation driven non-point source pollution.
- Total phosphorus concentrations have a slight downward trend from 2008-2016.
- Over the 8 year study period (2008-2015) this site exceeded the target load 2 times (25%: years- 2009 & 2011).

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St. Marys River at OH Line, SR 81
SWCD Site 205

- This site along the St. Marys River is located near the Ohio/Indiana state line. This site represents what is entering Indiana from Ohio.
- USGS stream gage on the St. Marys River near Rockford, OH (04180988) used in the analysis of this site. Drainage Area ratio is 1.13 (88%).

LOADEST Results

	TP	TP	DRP	DRP
	Beginning Date	Ending Date	Beginning Date	Ending Date
FlowData	2005 – 10 - 01	2016 - 12 - 31	2005 – 10 - 01	2016 - 12 - 31
Water Quality Data	2012 - 05 - 24	2016 - 10 - 25	2014 - 11 - 12	2016 – 5 - 17
	Total (lb/yr)	Per Acre (lb/ac/yr)	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	202,210	0.8	200,016	0.8
Maximum Annual Load to Meet Target	155,044	0.6	50,459	0.2
Load Reduction Needed to Meet Target	47,165	0.2	149,557	0.6
Average Annual Seasonal Load	133,875	0.5	156,060	0.6

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St. Marys River at SR 1, North of Pleasant Mills – LES040-0007 (STM-37)

- This site along the St. Marys River is located in near Pleasant Mills just west of the Ohio/Indiana state line. This site represents what is entering Indiana from Ohio.
- USGS stream gage on the St. Marys River near Decatur, IN (04181500) used in the analysis of this site. Drainage Area ratio is 0.89 (89%).
- There was a gap in flow data in 2013 which explains why the annual and target loads are very low. This 2013 data is not representative of this site.

LOADEST Results

	Beginning Date	Ending Date
FlowData	1947 - 04 - 01	2016 - 06 - 26
Water Quality Data	2008 - 01 - 02	2016 - 03 – 01
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	538,969.74	1.5229
Maximum Annual Load to Meet Target	296,933.62	0.7627
Load Reduction Needed to Meet Target	269,036.12 (50%)	0.7602
Average Annual Seasonal Load	349,146.00	

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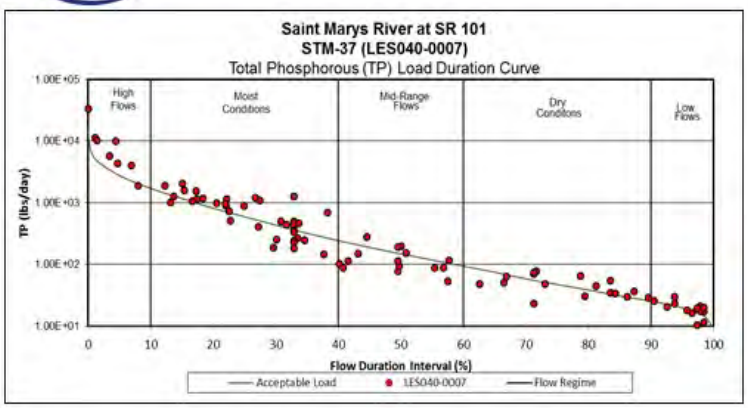

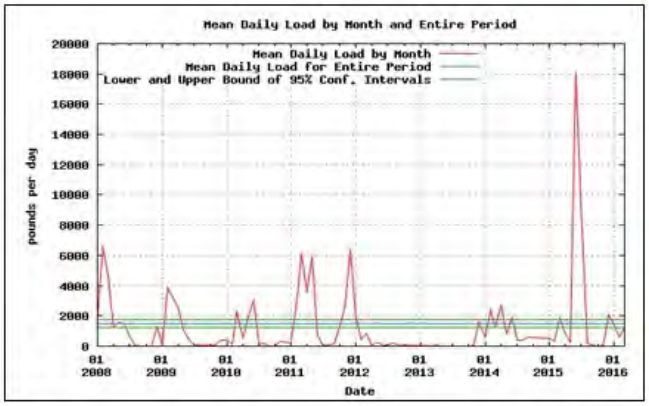

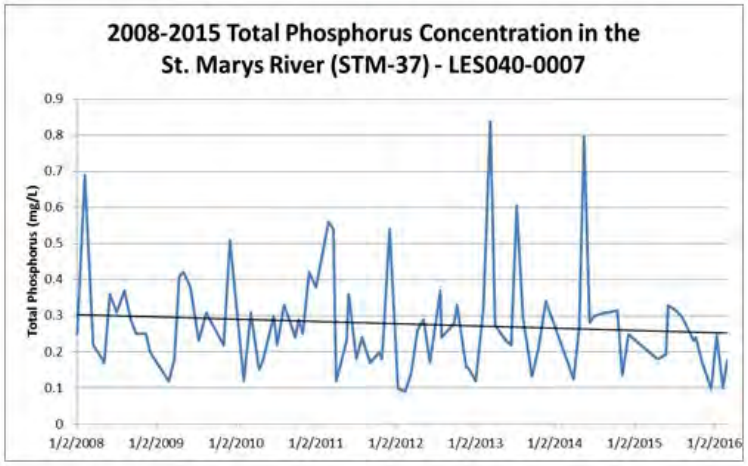

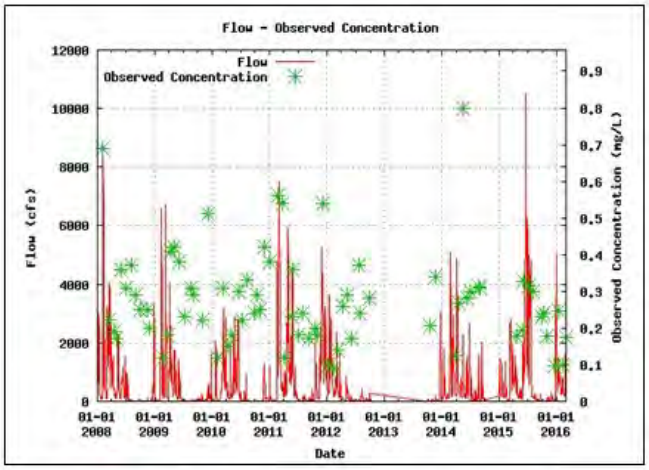

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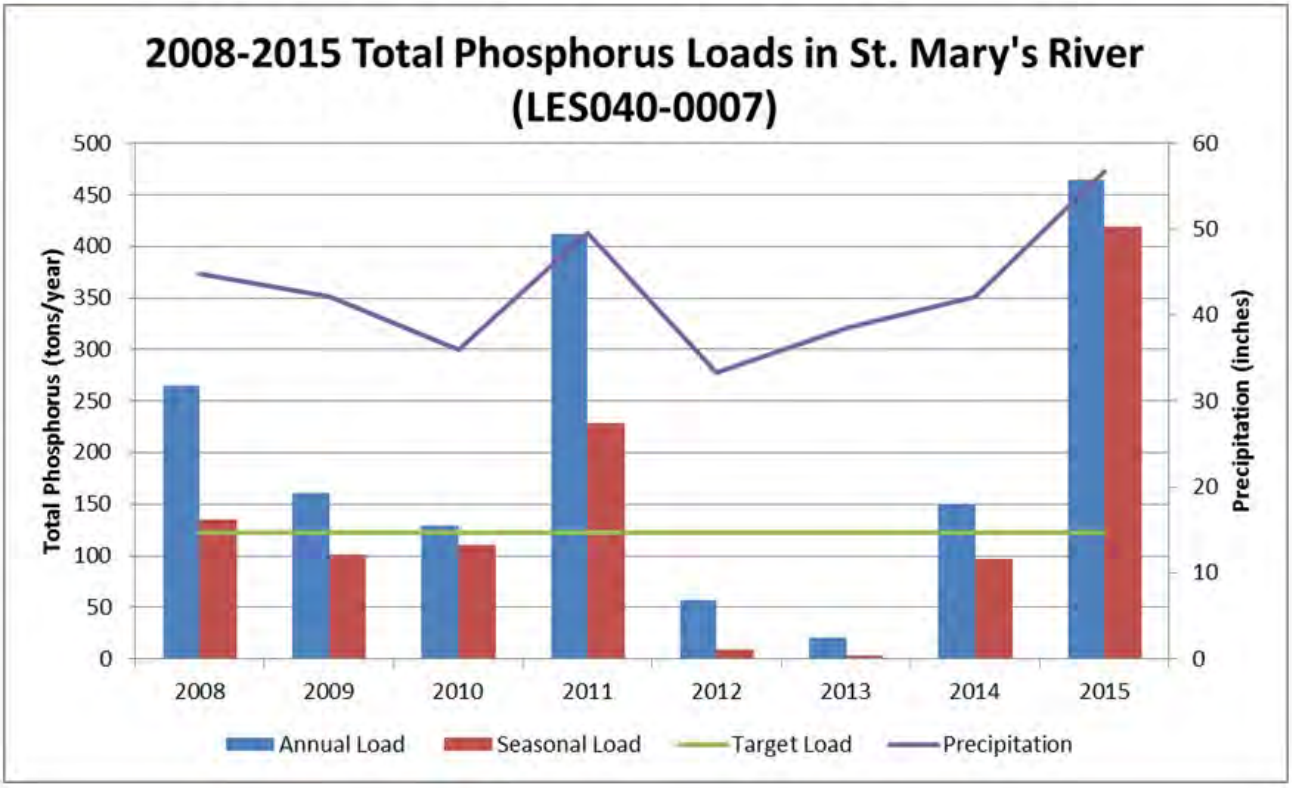

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St. Marys River (LES040-0007) Results

- Based on the load duration curve most of the sampling events exceed the water quality target of 0.23 mg/L. Exceedances occur across all flow conditions. This is often a indicator of both point and nonpoint sources.
- Total phosphorus concentrations have a slight decreasing trend from 2008-2016.
- This site has exceeded the annual target load 85% of the time between 2008-2015 (excluding 2013).
- This site is representative of the contributing loads entering IN from OH, a likely source for the high nutrient concentrations is the Grand Lake Saint Mary of which a portion of flows into the St. Marys River.

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St. Mary's River at Hoagland Road near Fort Wayne – SWCD Site 212

- USGS stream gage on the St. Marys River near Fort Wayne, IN (04182000) used in the analysis of this site. Drainage Area ratio is 0.96 (96%).

LOADEST Results

	TP	TP	DRP	DRP
	Beginning Date	Ending Date	Beginning Date	Ending Date
FlowData	1930 – 11 - 07	2016 – 12 - 31	1930 – 11 - 07	2016 – 12 - 31
Water Quality Data	2012 – 05 - 24	2016 – 10 - 25	2014 – 11 - 12	2016 – 05 - 17
	Total (lb/yr)	Per Acre (lb/ac/yr)	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	614,660	1.3	436,175	0.9
Maximum Annual Load to Meet Target	336,275	0.7	84,099	0.2
Load Reduction Needed to Meet Target	278,384	0.6	352,075	0.7
Average Annual Seasonal Load	417,690	0.9	276,777	0.6

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St. Mary's River at Ferguson Road in Fort Wayne– LES060-0005 and LES060-0009 (STM-11 and STM-12)

- This site along the St. Marys River is located in Fort Wayne.
- USGS stream gage on the St. Marys River near Fort Wayne, IN (04182000) used in the analysis of this site. Drainage Area ratio is 0.99 (100%).

LOADEST Results

	Beginning Date	Ending Date
FlowData	1930 – 11 – 07	2016 – 06 – 26
Water Quality Data	2008 – 01 – 22	2016 – 04 – 04
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	800,945.05	1.64
Maximum Annual Load to Meet Target	401,991.95	0.82
Load Reduction Needed to Meet Target	398,953.10 (50%)	0.81
Average Annual Seasonal Load	492,048	

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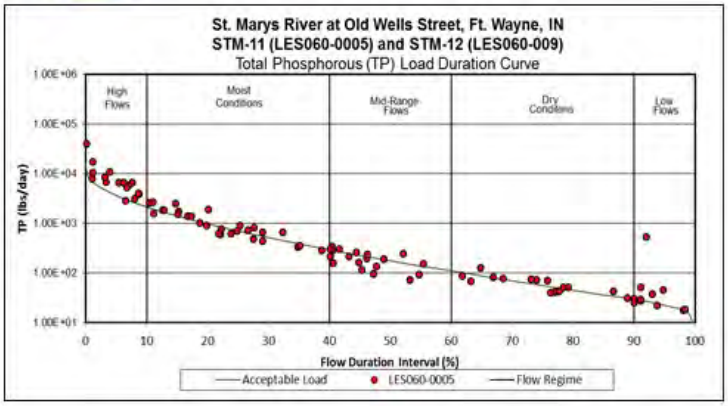

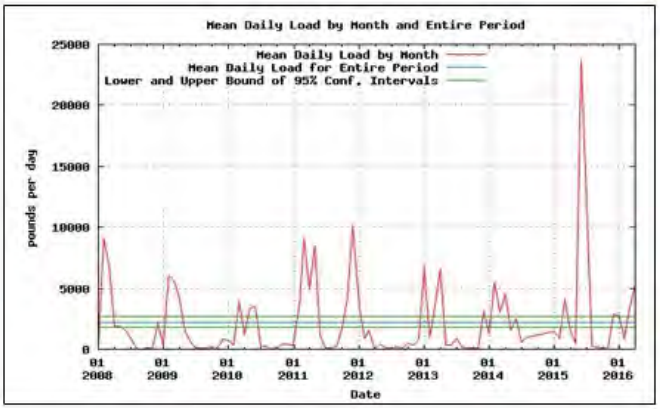

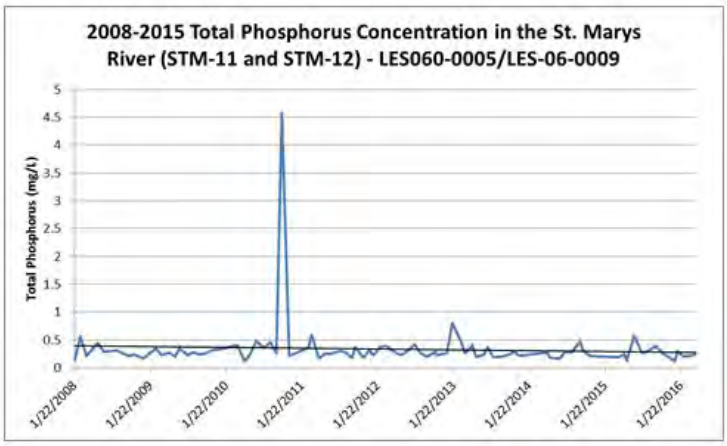

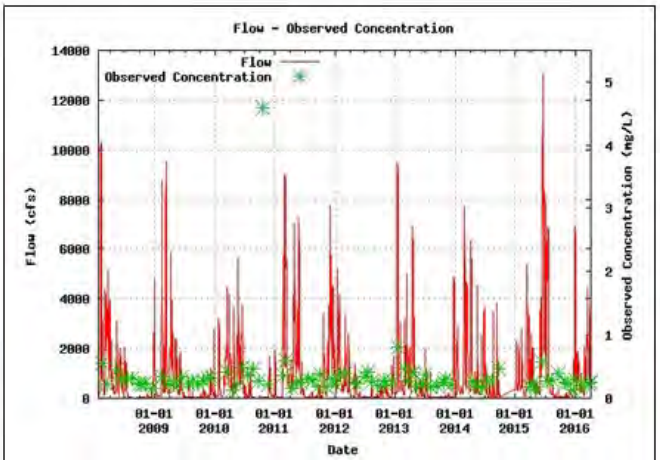

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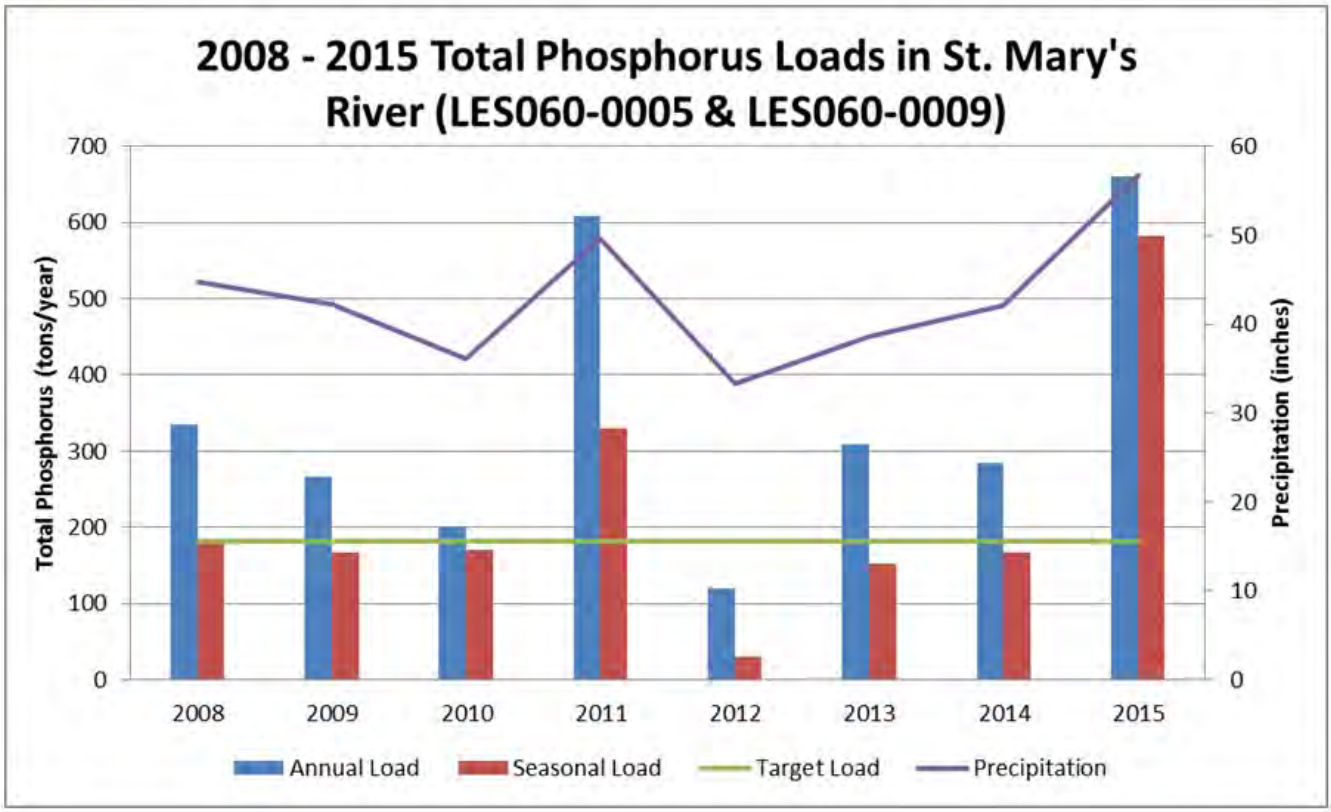

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St. Marys River (LES060-0005) Results

- Based on the load duration curve most of the sampling events exceed the water quality target of 0.23 mg/L. Exceedances occur across all flow conditions. This is often a indicator of both point and nonpoint sources.
- Total phosphorus concentrations have remained relatively constant from 2008-2016.
- This site has exceeded the annual target load 87% of the years between 2008-2015.
- The upstream site had high loads coming in from OH and they appear to be maintained, if not increased as you move in a downstream direction.

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St. Marys River in Fort Wayne– LES060-0004 (STM-.2) and LES-06-0003 (STM-.8)

- These sites along the St. Marys River are located in Fort Wayne just upstream of the confluence with the Maumee River. These sites represent the pour point of the St. Marys River watershed.
- Site LES060-0004 is no longer active.
- The data for these two sites was combined in the model and all the graphs because of their proximity (DA is 823 vs 840 sq. mi.) to each other and based on BPJ from the fixed station field staff they have comparable characteristics.
- USGS stream gage on the St. Marys River near Fort Wayne, IN (04182000) used in the analysis of this site. Drainage Area ratio is 1.08 (93%).

LOADEST Results

	Beginning Date	Ending Date
FlowData	1930 – 11 – 07	2016 – 06 – 26
Water Quality Data	2008 – 02 – 19	2016 – 04 – 05
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	846,234	1.58
Maximum Annual Load to Meet Target	418,453	0.78
Load Reduction Needed to Meet Target	427,781 (50%)	0.80
Average Annual Seasonal Load	548,046	

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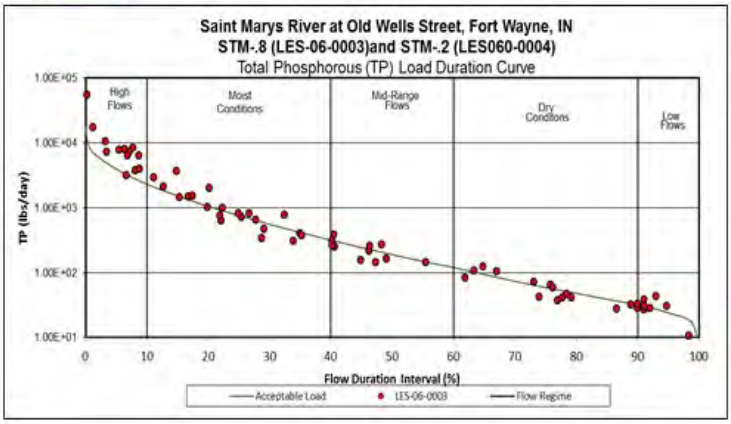

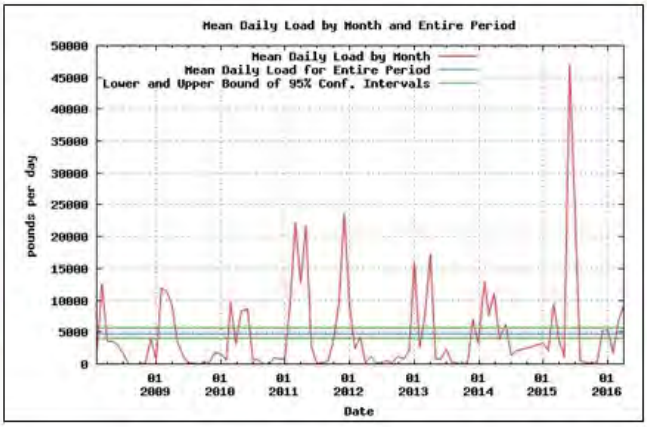

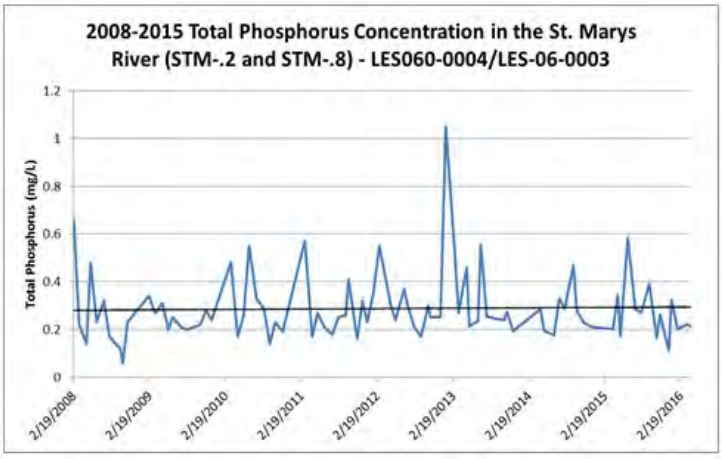

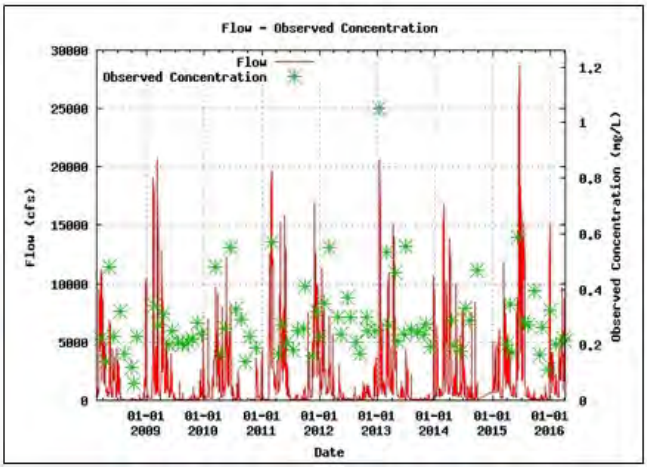

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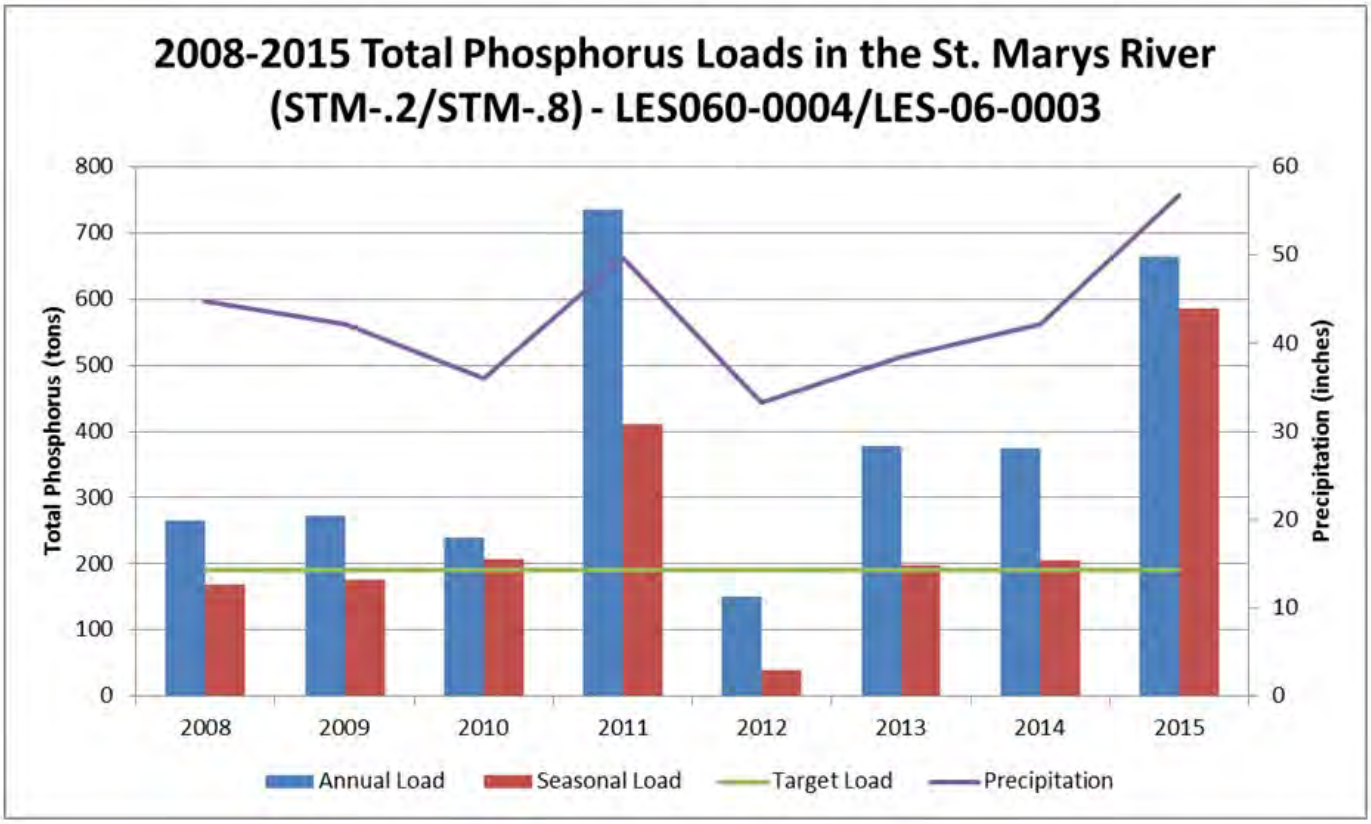

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St. Marys River (LES060-0004 and LES-06-0003) Results

- Based on the load duration curve most of the sampling events exceed the water quality target of 0.23 mg/L. Exceedances occur across all flow conditions. Nearly all samples taken during high to very high flow condition were in exceedance of the target. These signatures are often an indicator of both point and nonpoint sources.
- Total phosphorus concentrations are relatively consistent across all years from 2008-2016.
- This site has exceeded the annual target load 87% of the time between 2008-2015.
- The upstream site had high loads coming in from OH and they appear to be maintained, if not increased as you move in a downstream direction.

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Maumee River at Anthony Blvd. in Fort Wayne– LEM010-0012 (M-132)

- This site along the Maumee River is located in Fort Wayne. This site is immediately downstream of the confluence with the St. Marys River and the St. Joseph River.
- USGS stream gage on the Maumee River near New Haven, IN (04183000) used in the analysis of this site. Drainage Area ratio is 0.98 (98%).
- Flow data was only available through 2012 so annual loads could not be calculated for 2013 and 2014.

LOADEST Results

	Beginning Date	Ending Date
FlowData	1956 – 10 – 01	2016 – 06 – 26
Water Quality Data	2008 – 01 – 22	2016 – 04 – 04
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	1,419,364	1.15
Maximum Annual Load to Meet Target	1,760,693	1.42
Load Reduction Needed to Meet Target	0	0
Average Annual Seasonal Load	963,900,	

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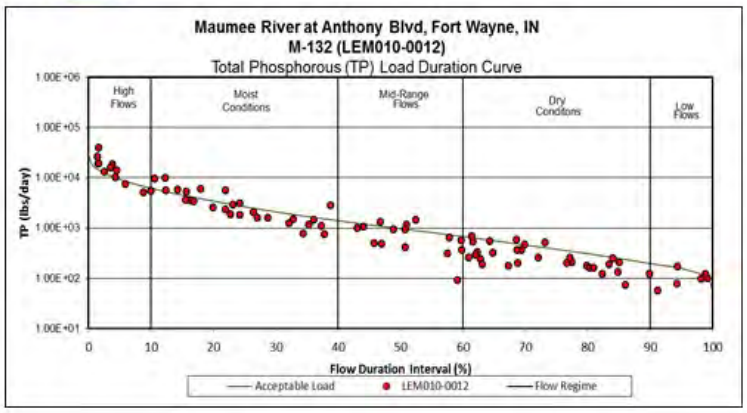

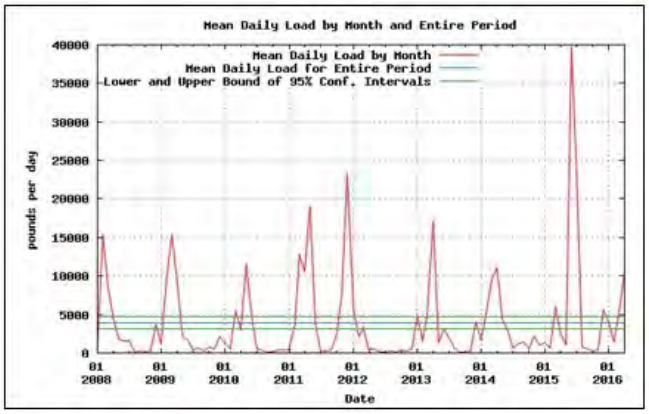

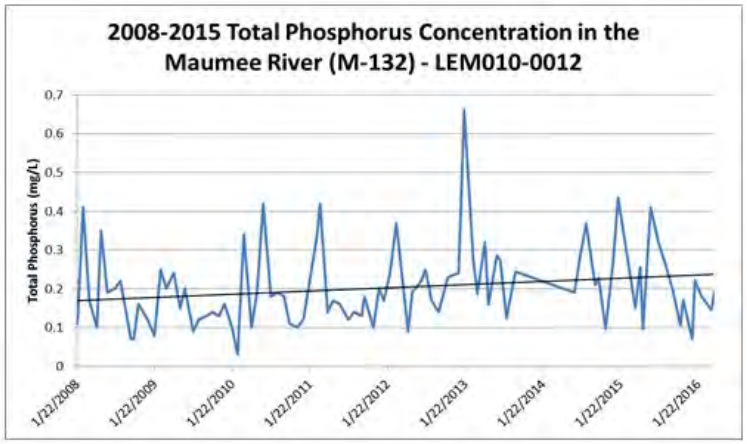

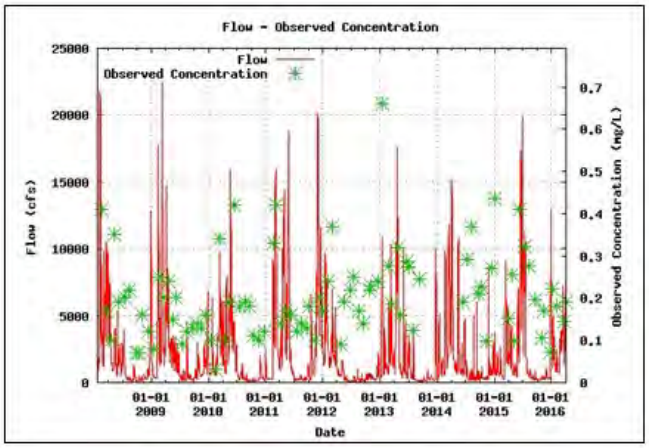

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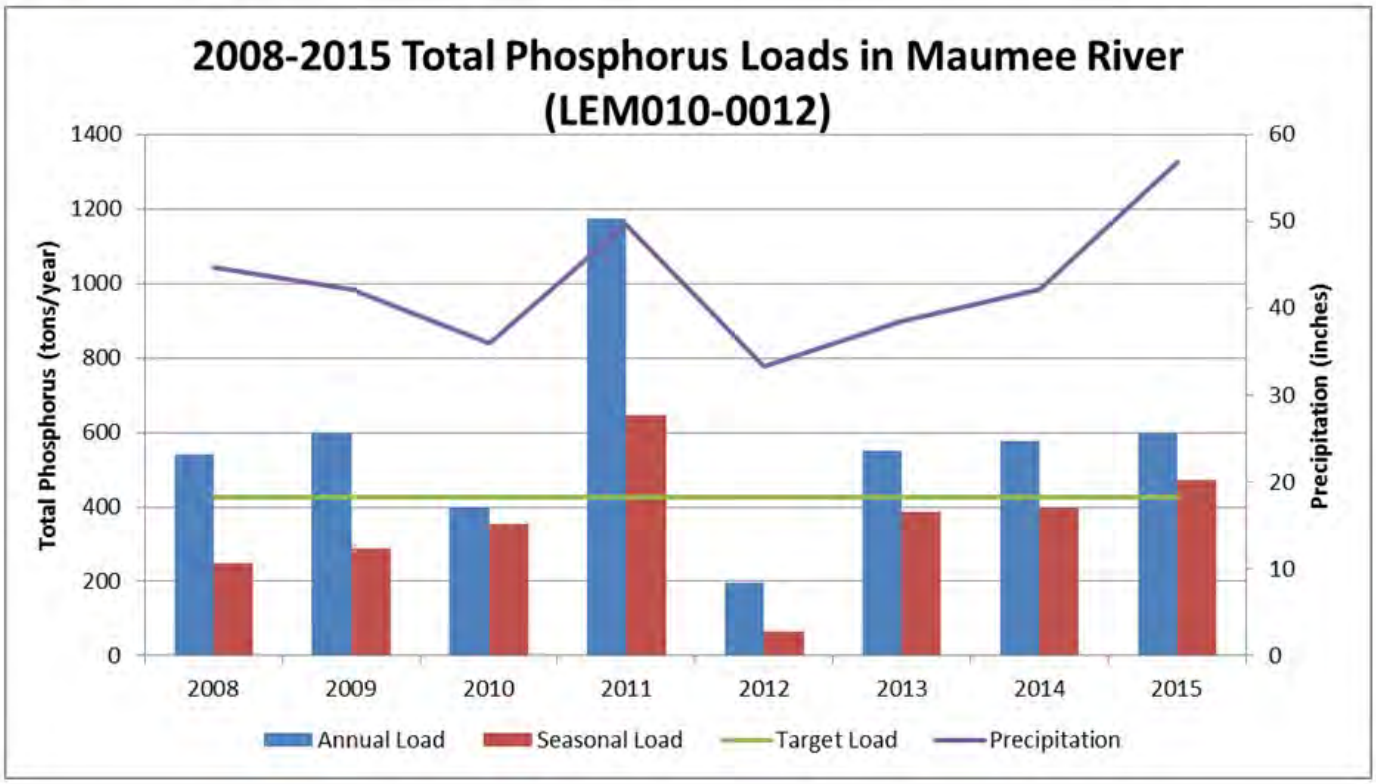

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Maumee River LEM010-0012 (M-132)

Results

- Based on the load duration curve most of the sampling events exceed the water quality target of 0.23 mg/L. Exceedances occur across all flow conditions. Nearly all samples taken during high to very high flow condition were in exceedance of the target. These signatures are often an indicator of both point and nonpoint sources.
- Total phosphorus concentrations show an increasing trend from 2008-2016.
- This site has exceeded the annual target load 25% of the years (2011 and 2015) between 2008-2015.

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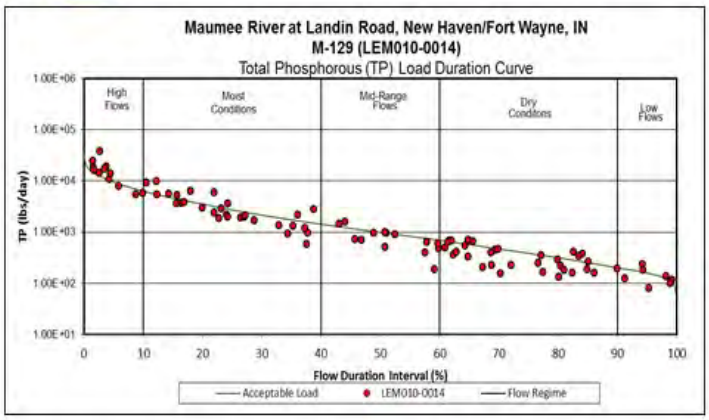

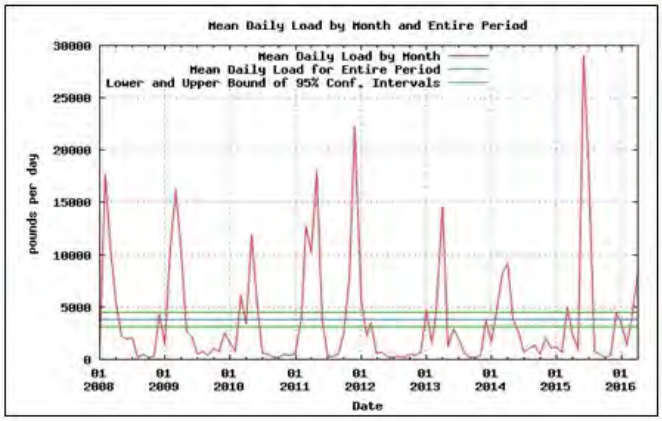

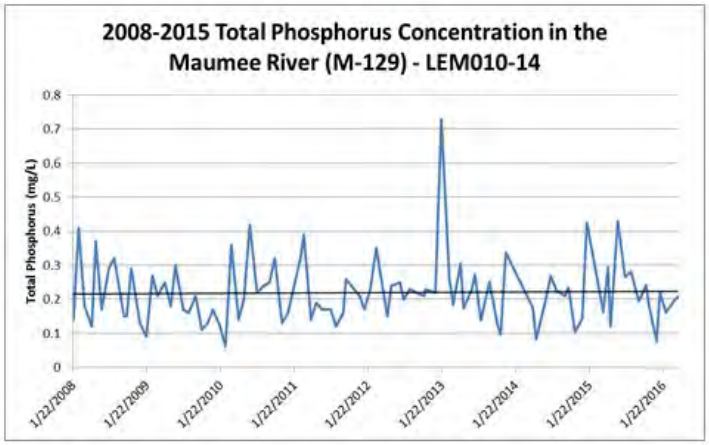

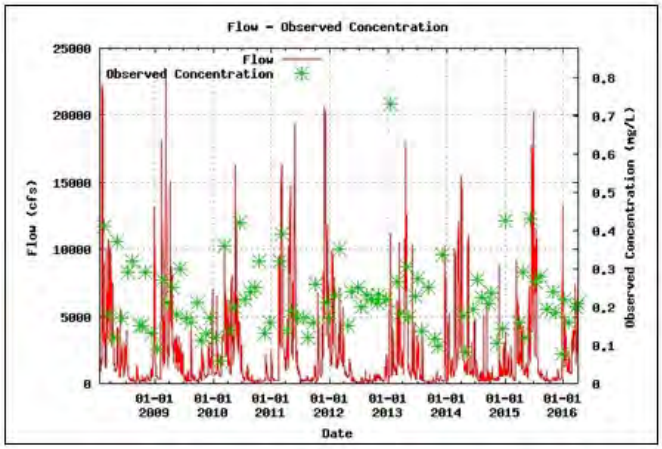

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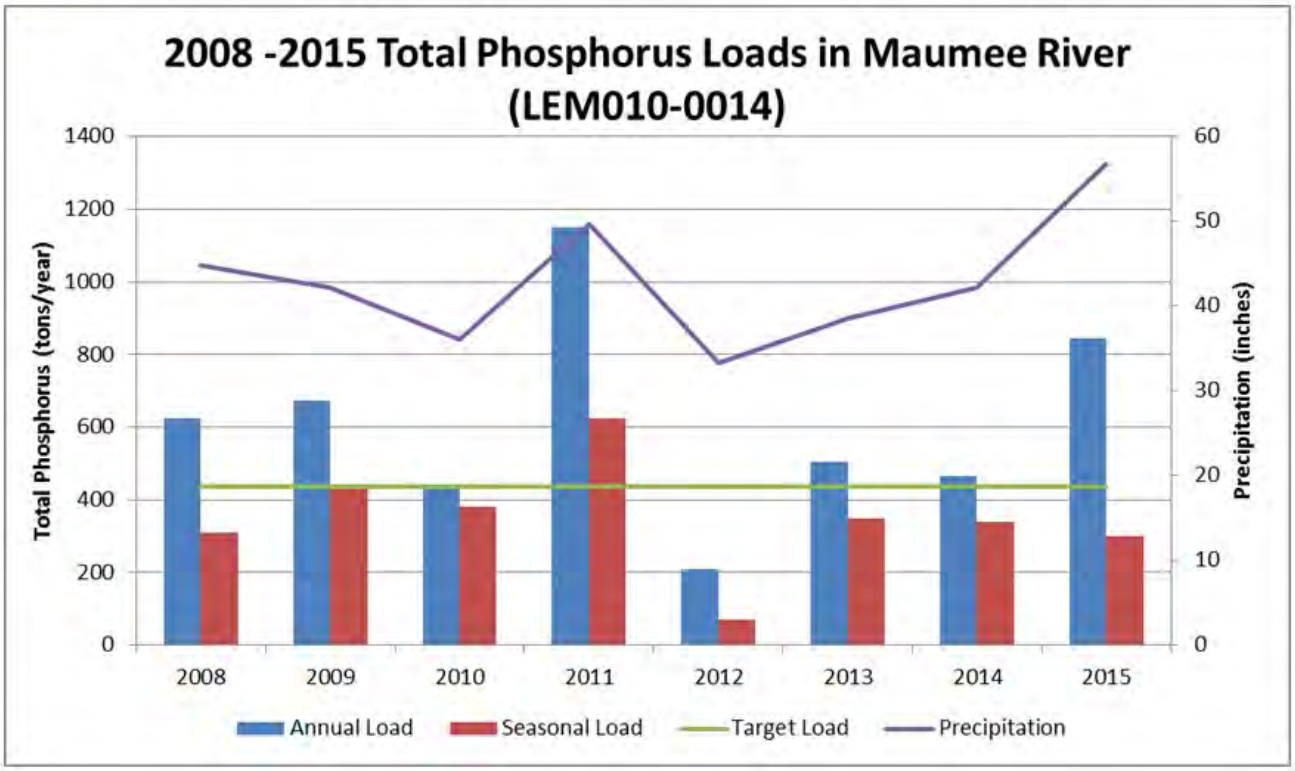

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Maumee River LEM010-0014 (M-129) Results

- Based on the load duration curve the sampling events that exceed the water quality target of 0.23 mg/L occur across all flow conditions. These signatures are often an indicator of point and nonpoint sources.
- Total phosphorus concentrations show a decreasing trend from 2005-2014.
- This site has exceeded the annual target load 87% of the years (2012 was a draught year) between 2008-2015.

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Maumee River at SR 101
SWCD Site 312

- This site along the Maumee River is located in North of Woodburn, IN and the site represents the Maumee River as it leaves Indiana and enters Ohio.
- USGS stream gage on the Maumee River at Antwerp, OH (04183500) used in the analysis of this site. Drainage Area ratio is 1.018 (98%).

LOADEST Results

	TP	TP	DRP	DRP
	Beginning Date	Ending Date	Beginning Date	Ending Date
FlowData	1921 – 10 - 01	2016 – 12 - 31	1921 – 10 - 01	2016 – 12 - 31
Water Quality Data	2014 – 05 - 20	2016 – 10 - 25	2014 – 11 - 12	2016 – 05 - 17
	Total (lb/yr)	Per Acre (lb/ac/yr)	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	937,685	0.7	828,185	0.6
Maximum Annual Load to Meet Target	276,542	0.2	192,860	0.1
Load Reduction Needed to Meet Target	661,142	0.5	635,324	0.5
Average Annual Seasonal Load	692,325	0.5	459,918	0.3

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Maumee River at SR 101 North of in Woodburn– LEM010-0013 (M-114)

- This site along the Maumee River is located in North of Woodburn, IN and the site represents the Maumee River as it leaves Indiana and enters Ohio.
- USGS stream gage on the Maumee River near New Haven, IN (04183000) used in the analysis of this site. Drainage Area ratio is 1.006 (94%).

LOADEST Results

	Beginning Date	Ending Date
FlowData	1956 – 10 – 01	2016 – 06 – 26
Water Quality Data	2008 – 01 – 22	2016 – 04 – 04
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	1,462,930	1.10
Maximum Annual Load to Meet Target	1,020,345	0.76
Load Reduction Needed to Meet Target	442,585	0.33
Average Annual Seasonal Load	937,125	

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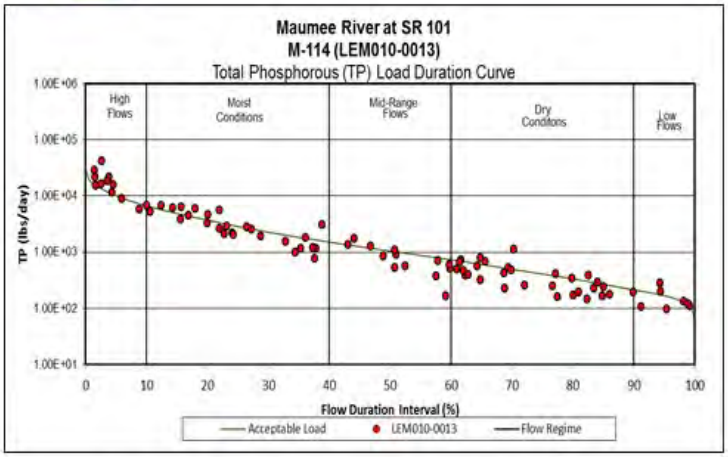

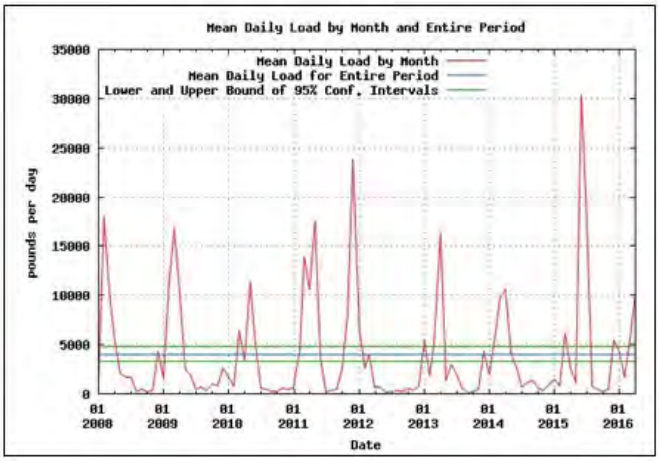

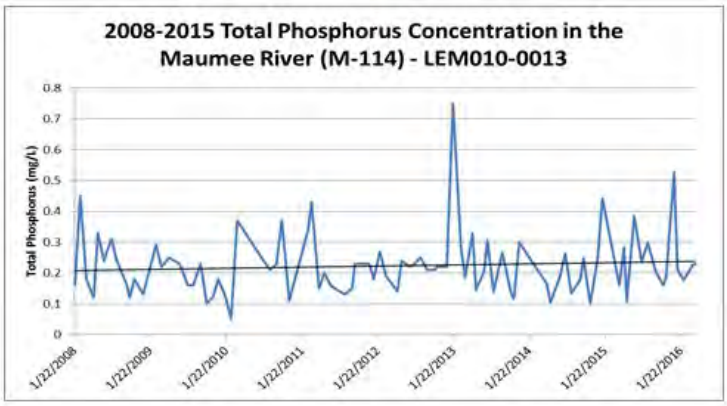

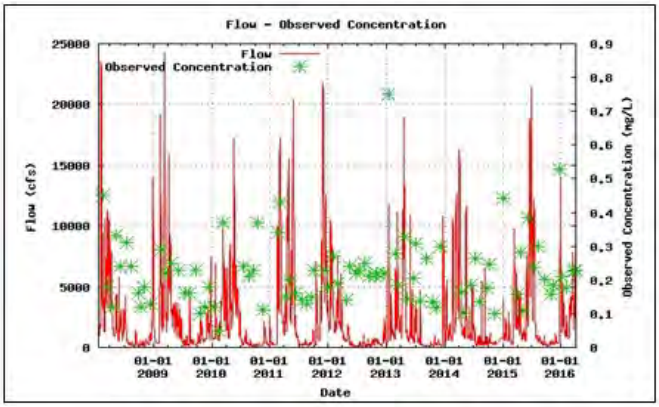

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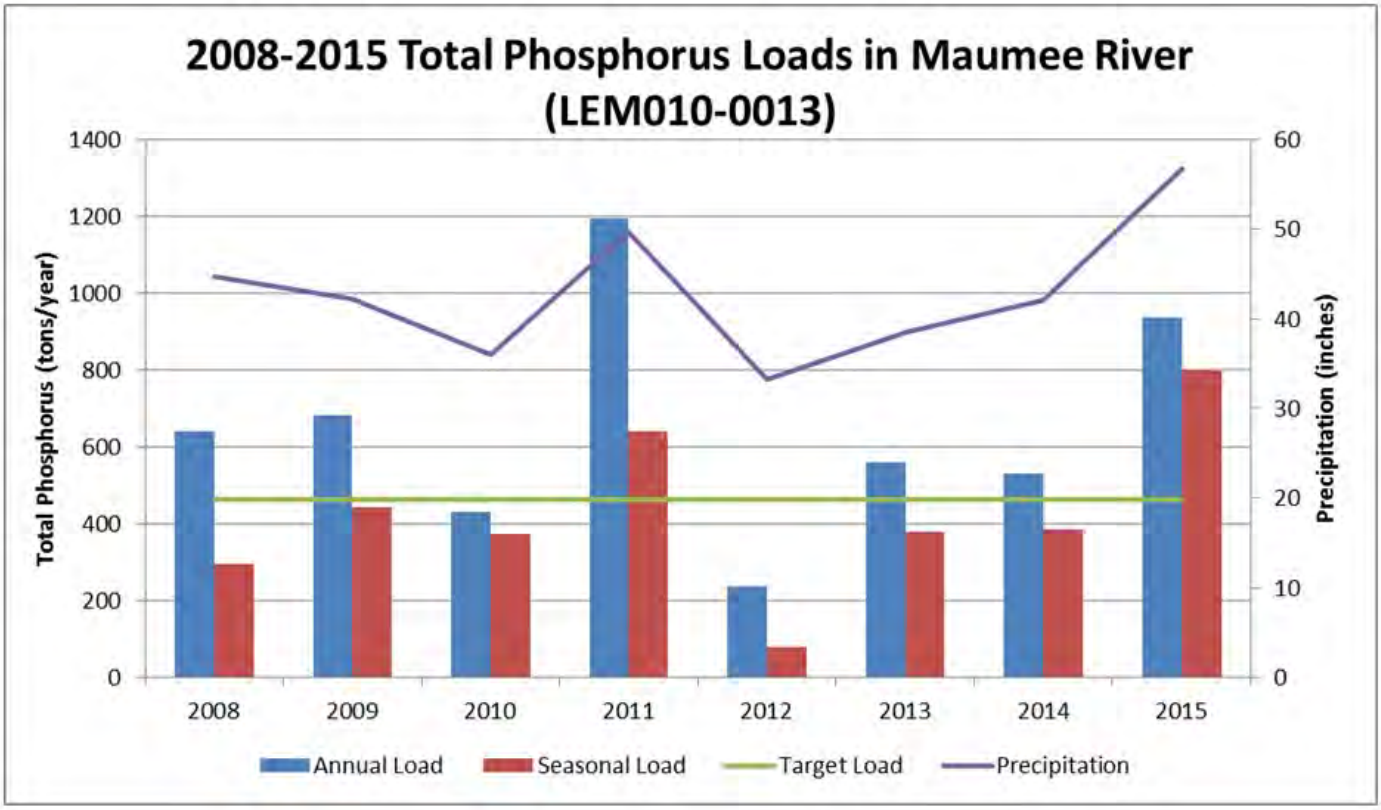

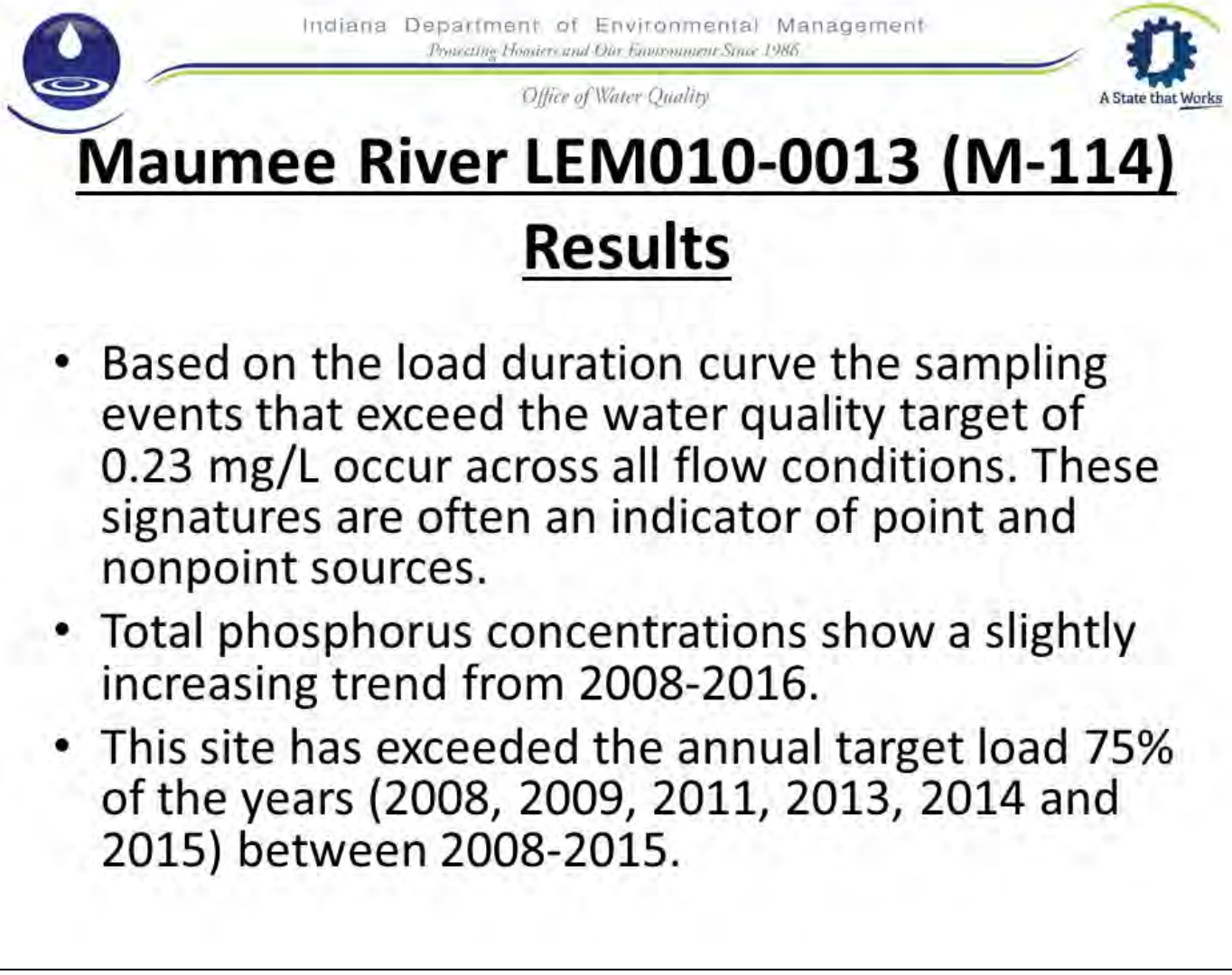
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Maumee River LEM010-0013 (M-114)
Results
• Based on the load duration curve the sampling events that exceed the water quality target of 0.23 mg/L occur across all flow conditions. These signatures are often an indicator of point and nonpoint sources.
• Total phosphorus concentrations show a slightly increasing trend from 2008-2016.
• This site has exceeded the annual target load 75% of the years (2008, 2009, 2011, 2013, 2014 and 2015) between 2008-2015.

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Fish Creek at SR 427
LEJ050-0006 (FSH-18)

- This site is along Fish Creek upstream of the Fish Creek Gage (04177720)
- USGS stream gage on Fish Creek near Hamilton, IN (04177720) used in the analysis of this site. Drainage Area ratio is 1.11.

LOADEST Results

	Beginning Date	Ending Date
FlowData	1969 – 10 – 01	2016 – 06 – 26
Water Quality Data	2008- 01 – 02	2016 – 03 – 01
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	22,002	0.83
Maximum Annual Load to Meet Target	17,906	0.68
Load Reduction Needed to Meet Target	4,095	0.15
Average Annual Seasonal Load	15,240	

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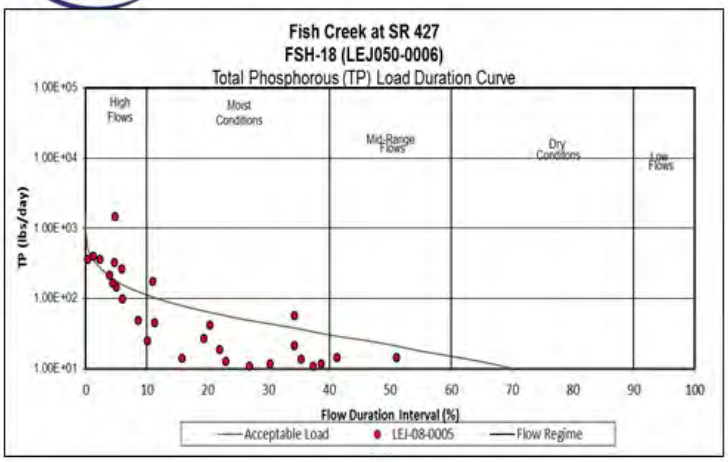

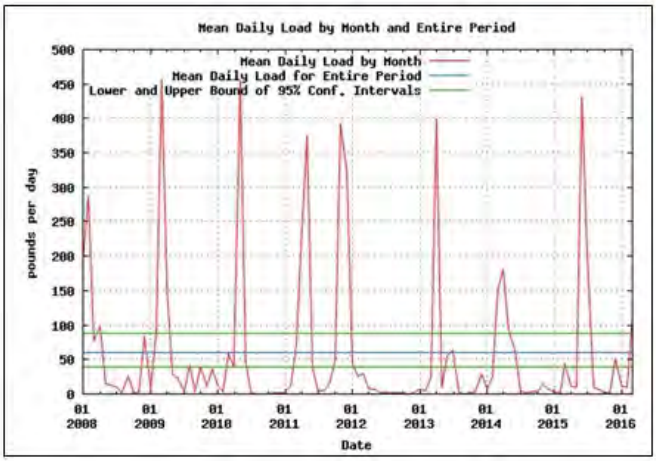

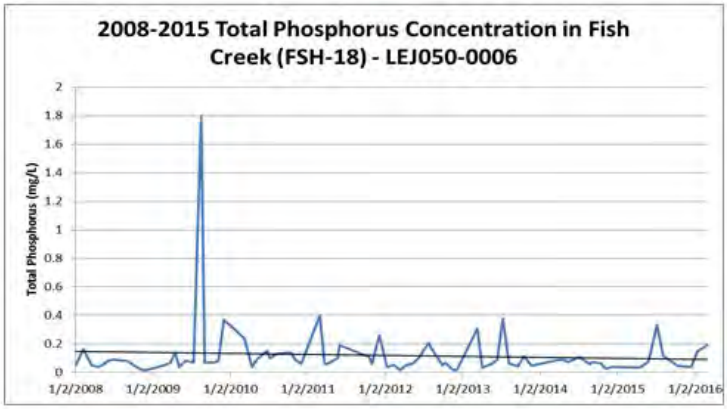

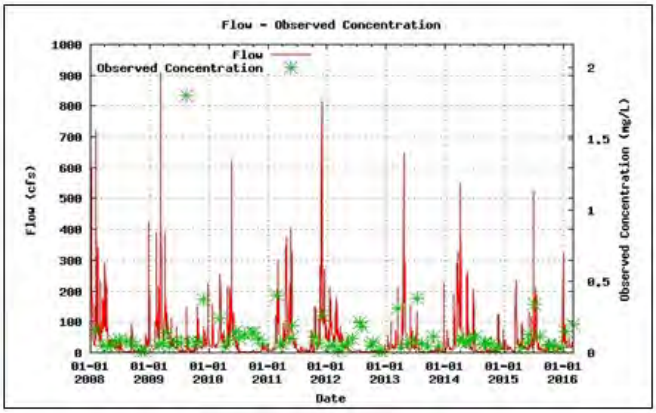

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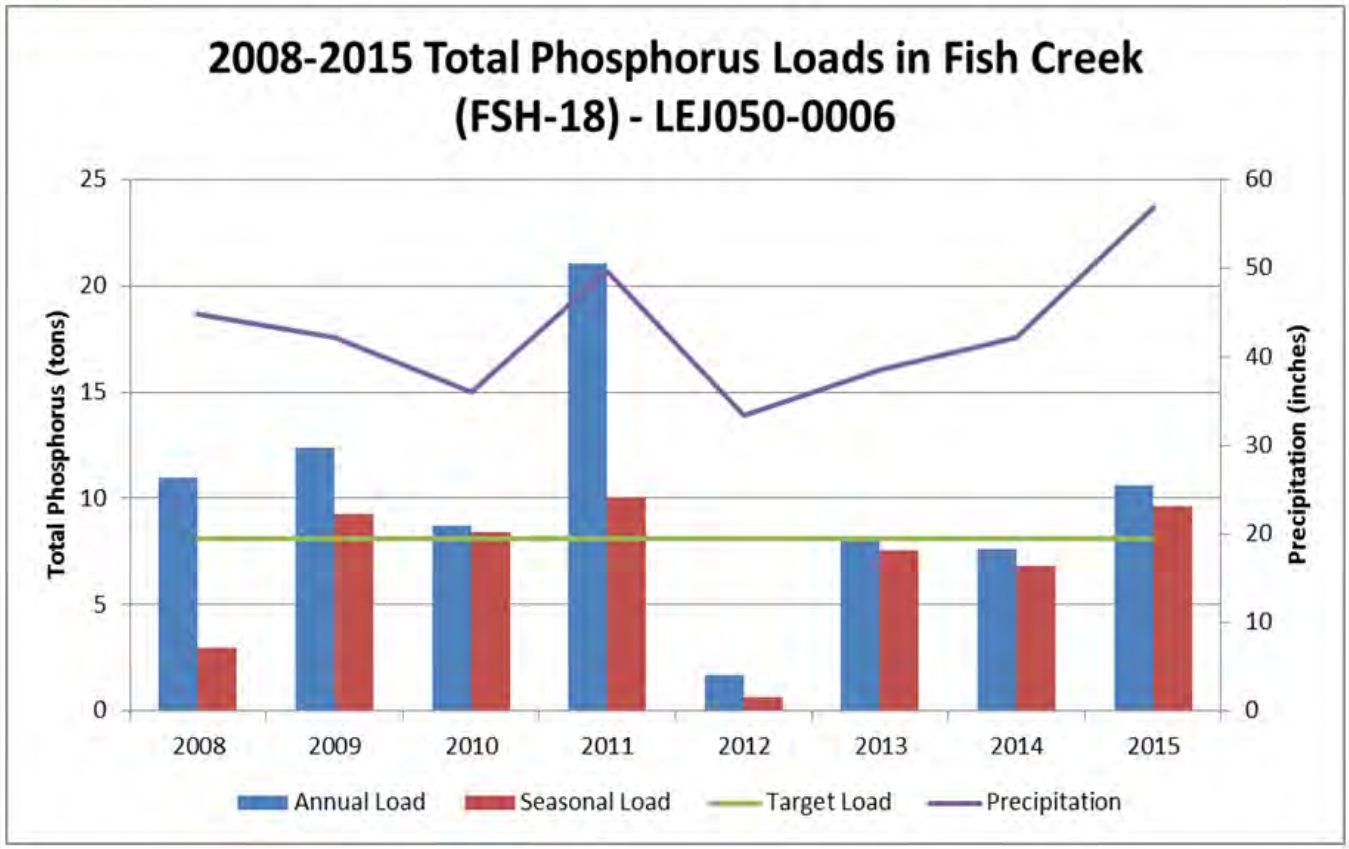

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Fish Creek LEJ050-0006 (FSH-18)

Results

- Based on the load duration curve the sampling events that exceed the water quality target of 0.23 mg/L occur at very high flows. These signatures are often an indicator of nonpoint sources.
- Total phosphorus concentrations show relatively constant trend from 2008-2016.
- This site has exceeded the annual target load 62.5% of the years (2008, 2009, 2010, 2011, 2015) between 2008-2015.

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Fish Creek at CR 79
LEJ050-0007 (FSH-5)

- Flows into the Cedar Creek downstream of site LEJ050-0007 the site is located near the town of Hamilton, IN.
- USGS stream gage on Fish Creek near Hamilton, IN (04177720) used in the analysis of this site. Drainage Area ratio is 1 (100%).

LOADEST Results

	Beginning Date	Ending Date
FlowData	1969 – 10 – 01	2016 – 06 – 26
Water Quality Data		
	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	29,561	0.47
Maximum Annual Load to Meet Target	36,667	0.58
Load Reduction Needed to Meet Target	0	0
Average Annual Seasonal Load	20,662	

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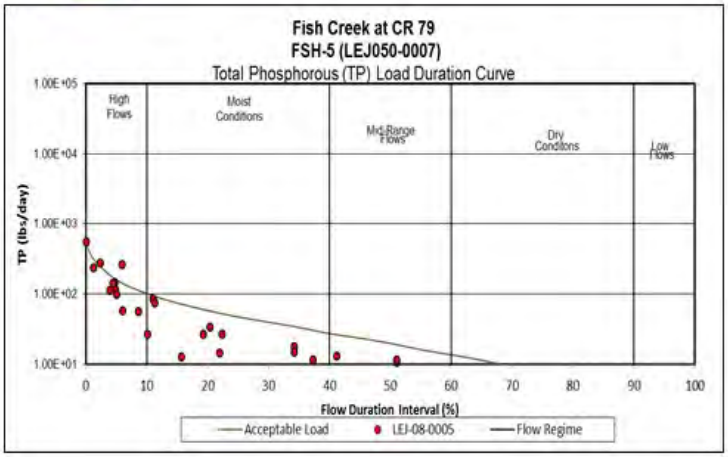

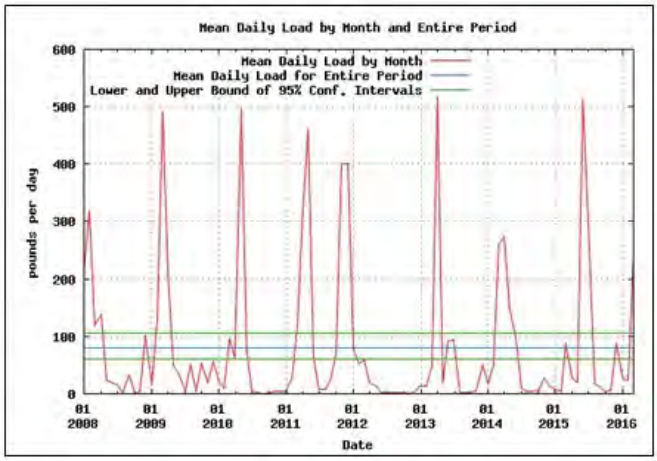

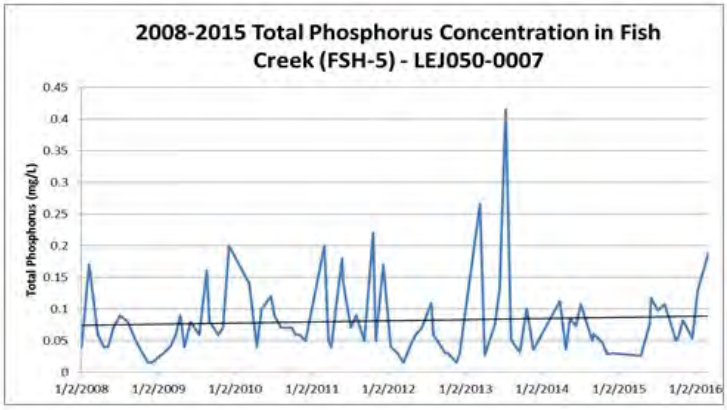

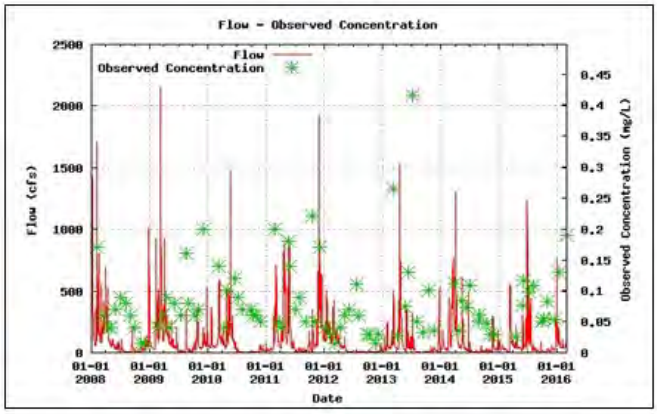

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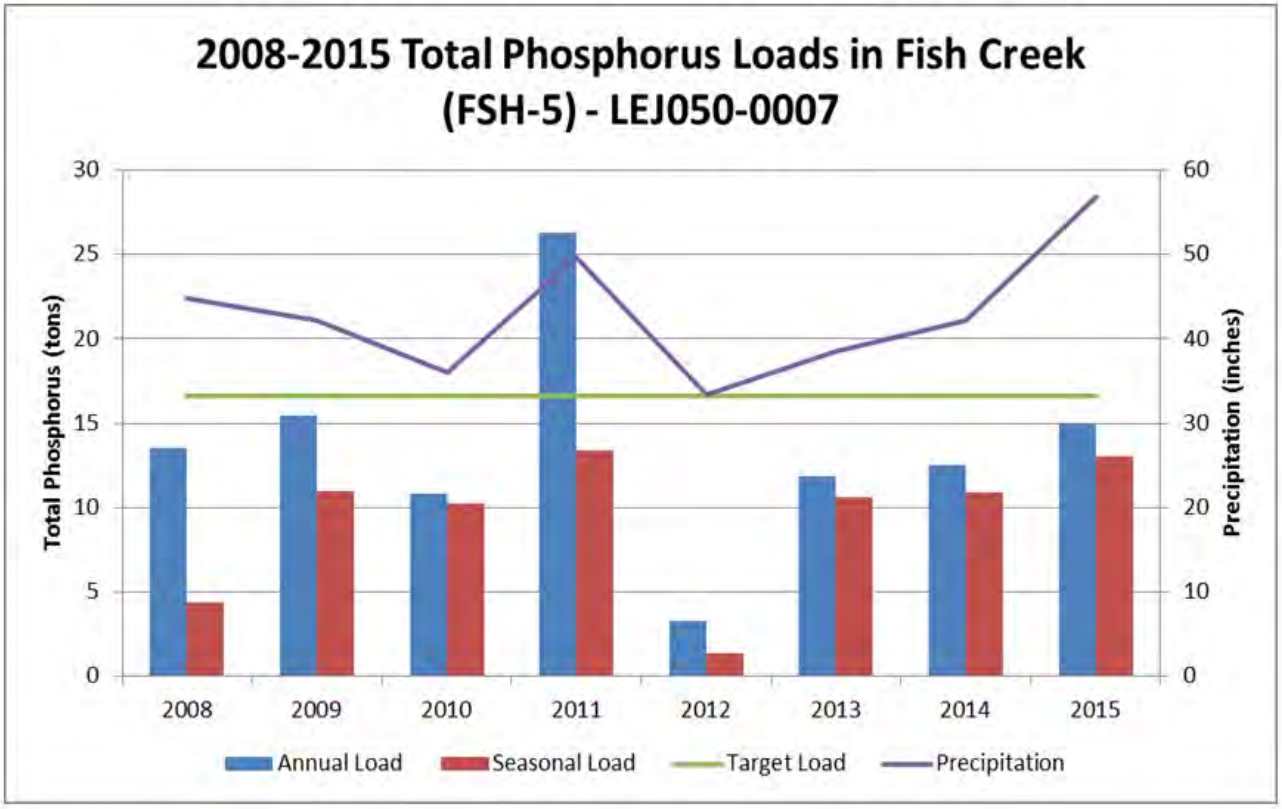

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Fish Creek LEJ050-0007 (FSH-5)

Results

- Based on the load duration curve the sampling events that exceed the water quality target of 0.23 mg/L occur at very high flows. These signatures are often an indicator of nonpoint sources.
- Total phosphorus concentrations show a slightly increasing trend from 2008-2016.
- This site has exceeded the annual target load once (2011) during the 8 year study period from 2008-2015.

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Blue Creek at IN State Rd 124 SWCD Site 204

- This site along Blue Creek just upstream of IDEM Fixed Station site LES040-0007. It represents the water quality that is flowing into the St. Mary's River from Blue Creek.
- USGS stream gage on St Mary's River near Decatur, IN (04181500) used in the analysis of this site. Drainage Area ratio is 0.13 (13%).

LOADEST Results

	TP	TP	DRP	DRP
	Beginning Date	Ending Date	Beginning Date	Ending Date
FlowData	1946 - 04 - 01	2016 - 12 - 31	1946 - 04 - 01	2016 - 12 - 31
Water Quality Data	2012 - 05 - 24	2016 - 10 - 25	2014 - 11 - 12	2016 – 5 - 17
	Total (lb/yr)	Per Acre (lb/ac/yr)	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	83,544	1.6	69,711	1.4
Maximum Annual Load to Meet Target	33,508	0.7	8,422	0.2
Load Reduction Needed to Meet Target	50,035	1.0	61,288	1.2
Average Annual Seasonal Load	55,581	1.1	31,700	0.6

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Black Creek at Ward Road SWCD Site 304

- This site along Bac Creek just upstream of IDEM Fixed Station site LES040-0007. It represents the water quality that is flowing into the St. Mary's River from Blue Creek.
- USGS stream gage on Cedar Creek near Cedarville, IN (04180000) used in the analysis of this site. Drainage Area ratio is 0.07 (7%).

LOADEST Results

	TP	TP	DRP	DRP
	Beginning Date	Ending Date	Beginning Date	Ending Date
FlowData	1946 - 11 - 21	2016 - 12 - 31	1946 - 11 - 21	2016 - 12 - 31
Water Quality Data	2012 - 05 - 25	2016 - 10 - 25	2014 - 11 - 12	2016 – 5 - 17
	Total (lb/yr)	Per Acre (lb/ac/yr)	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	10,249	0.8	6,288	0.5
Maximum Annual Load to Meet Target	6,536	0.5	1,519	0.1
Load Reduction Needed to Meet Target	3,712	0.3	4,769	0.4
Average Annual Seasonal Load	8,354	0.7	3,611	0.3

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Flatrock Creek at IN-OH State Line SWCD Site 401

- This site along Flatrock Creek along the Indiana Ohio border represents the water quality that is flowing into Ohio from Indiana.
- USGS stream gage on St Mary's River near Decatur, IN (04181500) used in the analysis of this site. Drainage Area ratio is 0.16 (16%).

LOADEST Results

	TP	TP	DRP	DRP
	Beginning Date	Ending Date	Beginning Date	Ending Date
FlowData	1946 - 04 - 01	2016 - 12 - 31	1946 - 04 - 01	2016 - 12 - 31
Water Quality Data	2014 - 05 - 22	2016 - 10 - 25	2014 - 11 - 12	2016 – 5 - 17
	Total (lb/yr)	Per Acre (lb/ac/yr)	Total (lb/yr)	Per Acre (lb/ac/yr)
Estimated Annual Load	65,714	1.0	55,052	0.8
Maximum Annual Load to Meet Target	44,229	0.7	10,661	0.2
Load Reduction Needed to Meet Target	21,484	0.3	44,391	0.7
Average Annual Seasonal Load	58,901	0.9	30,879	0.5

APPENDIX 3

RESPONSE to SUMMARIZED

PUBLIC COMMENTS

Climate/Weather

PC: Farmers are doing a better job of managing their fertilizer, but the climate and lack of winters seem to be making the issues worse than what the farmers are doing.

The DAP's failure to mention climate change, which is expected to increase rain amounts in the critical March-July period, is a regrettable, politically motivated decision, which undercuts the DAP's claim to be a scientifically based proposal. The DAP should address this key issue.

Climate scientists predict increased frequency of intense storms for the Midwest. Does the DAP take into account predicted changes in spring run-off?

R: The DAP was revised to include the challenge posed by climate change.

Unregulated/Nontraditional Farmers

PC: Voluntary measures by farmers are not working to reduce phosphorus and nitrogen loadings. Regulatory controls are needed on agriculture.

Regulatory controls on Agriculture backed by better enforcement.

R: The DAP endorses rigorous enforcement of existing regulations and, at this time, is not proposing additional regulatory controls on agriculture. While there are dissenting views, the consensus of the DAP Advisory Committee is that adoption of conservation practices by farmers in the WLEB is increasing and that those practices along with the modelled nutrient load reductions associated with them will be tracked annually to determine trends. At the sub-watershed scale (12-digit HUC) where these practices are installed, additional water quality monitoring will be conducted over the next few years to determine if water quality is improving. Edge-of-field monitoring will enhance our knowledge of the efficacy of different suites of conservation practices and will help refine our models. Based on these findings, the DAP acknowledges that additional regulatory controls may be warranted in the future. Adaptive management is an underpinning of the DAP.

There should be fair and consistent enforcement of the Fertilizer and CFO rules and enforcement should be pro-active rather than triggered when there is a complaint. There should be un-announced inspections during time of year when application is expected with consequences for violations.

R: The CFO program conducts approximately 600 inspections annually which includes complaints. Because of the strict bio-security restriction, the large universe of farms, and the limited number of inspectors, it would be difficult to reach every farm during the land application season. Should a complaint be received regarding a land application, complaint staff would investigate the complaint at the application area and then contact the farm to review land application records. For example, in 2017 there were 112 complaints received. Only 24 complaints regarding land application were at farms that are regulated under the CFO regulations. No violations were determined for these 24 inspections. Another forty-nine inspections for land application at non-CFO facilities were referred to the Indiana Office of the State Chemist to investigate.

PC: There were several comments regarding nontraditional landowners and the perception that they are exempted from regulations regarding septic systems and the application and disposal of animal waste.

R: Nontraditional landowners are not exempt from regulation.

There are numerous livestock operations under the threshold for regulation by the CFO rule. The DAP should address these numbers as well as the acres for spreading manure because of them. The DAP should also enumerate the number of acres onto which commercial fertilizer is spread.

R: The DAP was revised to include language on unregulated livestock operations and nontraditional farmers. It includes as a future endeavor (2018-2019) to document the numbers and density of these operations as well as the number of acres for land applying the manure generated from them. The revised DAP does not enumerate the number of acres onto which commercial fertilizer is spread but includes as a future endeavor to investigate this.

Drainage maintenance/invasive species

PC: Drainage boards are key and many regulated drains/ditches/streams are devoid of vegetation.

Drainage boards, county surveyors and SWCDs should neither increase erosion and nutrient pollution, nor conflict with natural streambank protection & revitalization when working on ditch maintenance. Counties should use BMPs to selectively remove invasive species & protect riparian buffer areas.

Employ the practices in the *Indiana Drainage Handbook* such as working from 1 side of the stream and only removing vegetation (if necessary) from the side where machinery must be staged, and mitigate in-stream and streambank habitat loss.

R: One of the DAP's guiding principles is to restore more natural hydrology and ecological functions by promoting drainage water management and mitigating modified hydrology. Based on these public comments, the DAP has been revised to include the reference to the *Indiana Drainage Handbook*. Additionally, WLEB county surveyors have been invited to participate on the Advisory Committee.

PC: There were comments regarding urban sprawl, stopping the sale of invasive (plant) species and removing them so that native species will return, and providing more oversight on the sale and application of chemicals that contain P and herbicides that contain an added surfactant.

R: These concerns have been added to the DAP section on future endeavors.

The Public Comment Process

PC: Requiring the Survey Monkey form was a disservice to those who may have wished to provide extensive comments.

R: The Advisory Committee apologizes for any inconvenience. It made the decision to use Survey Monkey in anticipation of numerous comments with sorting functions available that the committee thought would make responding easier. The additional comment box allowed for more extensive comments and attachments. If the Advisory Committee seeks public comments again, that will be made clearer.

Additional participants with DAP

PC: PU Extension

Co. Surveyors, drainage boards

Save Maumee Grassroots Organization

R: Invitations have been extended.

Significant Challenges

PC: Reaching 40% P reduction with voluntary agricultural practices.

Chief concern with DAP is its reliance on existing programs and voluntary measures.

The Lake Erie nutrient problem will continue indefinitely. It cannot be addressed with temporary projects among a minority of producers. We need to make comprehensive and enduring changes in nutrient and drainage management.

R: The DAP emphasizes that reaching the target loads in the WLEB is a complex, multi-faceted problem caused by point and nonpoint sources across all sectors of our community. To successfully address this problem, a multi-faceted approach is required that includes using existent regulatory instruments and implementing a strong system of enduring voluntary best management practices (BMPs).

Single Comments

PC: Goals for each sector. Obtainable Point Sources, row crop agriculture, CFO's, instream, and etc. (this comment regarding the question "Does the DAP address the topics necessary to achieve Indiana's goal of reducing P to the WLEB?"

R: At this time, there is not enough baseline data for the various nonpoint sources to set specific targets.

PC: All producers of P runoff need to address not just the selected priority watersheds.

R: The DAP states this.

PC: Fish Creek does not flow into Cedar Creek as stated on page 49. It flows into the St. Joseph River.

R: Thank you for catching this; it has been corrected.