IDEM

Indiana Department of
Environmental Management

Indiana Integrated Water Monitoring and Assessment Report to the U.S. EPA

2016

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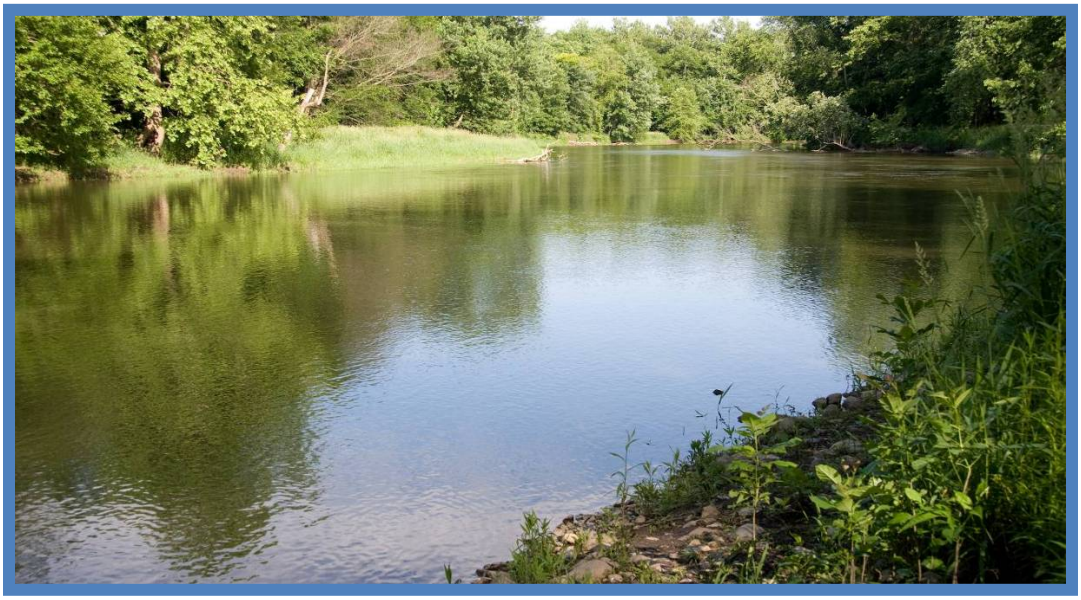

EXECUTIVE SUMMARY

Section 305(b) of the federal Clean Water Act (CWA) requires states to prepare and submit a water quality assessment report of state water resources to the U.S. Environmental Protection Agency (U.S. EPA) every two years. States are also required to develop and submit a list of impaired waters to U.S. EPA for approval under CWA Section 303(d).

IDEM used agency-collected data and other data collected by other organizations to develop this report. IDEM's solicitation, review and use of external data are described in detail in the section of this report entitled, Assessment Methodology and Summary Data. IDEM data used to develop this report were collected in accordance with IDEM's 2010 water quality monitoring strategy (WQMS), which describes a nine-year basin rotation approach to monitoring for CWA purposes. Using this strategy, one basin (approximately 10% of the state) is monitored each year, which provides a comprehensive statewide data set for assessments every nine years. The most current and readily existing available data were reviewed for the purposes of making 305(b) assessment and 303(d) listing decisions using IDEM's consolidated assessment and listing methodology (CALM).

A summary of IDEM's methods for determining support of beneficial uses is provided in the Assessment Methodology and Summary Data Section. IDEM's CALM is provided in its entirety in Appendix N. Indiana's water quality standards provide the basis for IDEM's CWA Section 305(b) water quality assessments, designating the beneficial uses that Indiana waters must support. Of the beneficial uses designated in the state's water quality standards, IDEM assesses aquatic life use support, recreational use support and drinking water for surface waters that serve as a public water supply. IDEM also assesses waterbodies for fish consumption. Although there are additional uses designated in Indiana's water quality standards, IDEM limits its assessments

to these four uses because the criteria in place to protect them are more stringent than those necessary to protect other uses. Thus, by protecting these four uses, other uses such as agricultural and industrial uses are also protected.

IDEM conducts water quality assessments using both statistical and empirical methods. Using data from its Probabilistic Monitoring Program, IDEM determines statistically for each of Indiana's nine major basins the percentage of river and stream miles that are meeting recreational and aquatic life uses and the percentage likely to be impaired. While the results from IDEM's comprehensive assessments cannot be applied to specific waterbodies, they provide important information regarding the overall water quality condition of waters in each basin. IDEM also uses the data it collects through its Probabilistic Monitoring Program and other available data to make reach-specific assessments of rivers and streams for recreational and aquatic life uses. Other empirical assessments include waterbody-specific assessments for fish consumption and public water supply.

IDEM completed its first comprehensive aquatic life use support assessments for the entire state in 2002 and reported similar information for recreational uses for the first time in 2012. IDEM published its first Integrated Report (IR) in 2002, which has been revised biennially since then. The 2016 IR provides the most recent comprehensive report on Indiana water quality to date.

Results from IDEM's comprehensive recreational and aquatic life use support assessments are provided in this report (Appendix E). Cumulative results for IDEM's stream-specific assessments are summarized in Table 1 (Appendix A). Approximately 68 percent of the 37,693 stream miles assessed for aquatic life use were found to be fully supporting. Approximately 26 percent of the 31,683 stream miles assessed support full body contact recreational use. Almost all of Indiana's 59 miles of Lake Michigan shoreline outside the Indiana Harbor fully supports aquatic life use, while only 7% of the shoreline waters support full body contact recreational use.

Causes of nonsupport (impairment) are included in this report for each waterbody type including flowing waters (rivers and streams) and non-flowing waters (lakes and reservoirs). Lake Michigan and its shoreline in Indiana are also discussed in this report. Pathogens are the top cause of stream impairments, impacting more than 23,000 miles of streams. Polychlorinated biphenyl (PCB) in fish tissue impacts more than 4,900 miles of streams while mercury in fish tissue impacts nearly 760 miles. Nearly 8,300 stream miles also have biological communities with measurable adverse response to pollutants.

Potential sources impacting Indiana waters include nonpoint sources that impact 16,040 miles of streams, while unknown sources impact almost 10,000 miles of streams. IDEM has several programs in place to address nonpoint source pollution. The Nonpoint Source Program and the Total Maximum Daily Load Program work together to facilitate restoration of impaired waters by locally-led groups committed to improving Indiana's water resources. IDEM's Watershed Specialists promote the holistic watershed approach by working closely with these groups to ensure they have the resources and information they need to succeed in their restoration efforts.

INTRODUCTION

States are required by the Clean Water Act (CWA) to prepare a water quality assessment report of state water resources and a list of impaired waters to submit to the U.S. Environmental Protection Agency (EPA) every two years. In 2002, the U.S. EPA encouraged states to combine the information that was previously submitted as two separate reports – the 305(b) water quality monitoring and assessment report and the 303(d) list of impaired waters – into one integrated report following the two-year schedule mandated in CWA Section 305(b).

The Indiana Department of Environmental Management (IDEM), Office of Water Quality (OWQ) publishes the Indiana Integrated Water Quality Monitoring and Assessment Report (IR) every two years. Using U.S. EPA's integrated format, Indiana's IR contains two lists – the Consolidated List and the 303(d) List of Impaired Waters. While they differ in purpose and scope, together they provide a comprehensive assessment of surface water quality conditions throughout the state of Indiana. The Consolidated List contains comprehensive statistical assessments for all major basins in the state, which is developed to fulfill CWA Section 305(b) requirements. The 303(d) List of Impaired Waters is a subset of the Consolidated List and identifies only those waters that are impaired and for which total maximum daily loads (TMDLs) are required per CWA Section 303(d). In accordance with U.S. EPA guidance, the IR also contains information on trends and trophic state of Indiana's lakes pursuant to CWA Section 314 as well as information pertaining to Indiana's ground water and wetland resources.

IDEM's OWQ prepared the 2016 IR following the guidelines provided by U.S. EPA (1997a, 1997b, 2005, 2006a, 2009a, 2011, 2013 & 2015). This report for 2016 meets the reporting requirements articulated in Sections 305(b), 303(d) and 314 of the CWA.

Most of the data used in this report come from IDEM's Probabilistic Monitoring Program, which employs a stratified random sampling (probabilistic) design to generate a representative set of sampling locations for each basin. IDEM uses probabilistic results to make comprehensive use support assessments, which are statistically valid statements about the overall water quality within a given watershed. The same data used to make comprehensive statistical assessments for a given basin are also applied to the specific stream or stream reach from which they were collected in order to make site-specific assessments.

In addition to data from the Probabilistic Monitoring Program, results from IDEM's targeted monitoring programs were used to make empirical, waterbody-specific assessments included in this report, including the Fixed Station Monitoring Program, the Watershed Characterization (formerly Baseline) Monitoring Program, the Fish Tissue Contaminant Program, and the Special Studies Program. Results from monitoring conducted by Indiana-University's Indiana Clean Lakes Program, which operates under a contractual agreement with funding from IDEM, were also used.

IDEM stores assessment information – decisions about water quality based on the data collected – in the Assessment Database. The Assessment Database is continually updated with new assessment information in order to facilitate the transmittal to U.S. EPA of the most up-to-date and accurate information concerning Indiana waters.

BACKGROUND

Indiana is located on the eastern edge of the North American great interior plains. The North - South continental divide traverses through northern Indiana, draining watersheds into the Great Lakes basin and the Mississippi River and Ohio River systems. Surface water in the northern one-quarter of the state flows north into the Great Lakes and then through the St. Lawrence River to the Atlantic Ocean. The southern three-quarters of the state drains into the Ohio River or Illinois River, flows into the Mississippi River and then south to the Gulf of Mexico. Indiana has approximately 63,130 miles of rivers, streams, ditches and drainage ways based on the Indiana Reach Index, which is keyed to the U.S. Geological Survey's high resolution (1:24,000 scale) National Hydrography Dataset (UGSG, 2014). State water types are described in Table 2 (Appendix A). Metadata and definitions for this report are located in Appendix C.

WATER POLLUTION CONTROL IN INDIANA

Water pollution control authority is shared by several agencies in Indiana. IDEM holds authority to carry out several Clean Water Act (CWA) programs, including Sections 305(b), 303(d), 314, and others. The Indiana State Department of Health (ISDH) has regulatory authority for septic systems, and the Office of the Indiana State Chemist (OISC) regulates pesticides and nutrients.

The State Soil Conservation Board (SSCB), Indiana State Department of Agriculture (ISDA), and the Indiana Department of Natural Resources (IDNR) – including its Lake and River Enhancement (LARE) Program and its Lake Michigan Coastal Program (LMCP) – administer voluntary and grant programs to help abate various types of nonpoint source pollution. Indiana also partners with many federal agencies and nonprofit organizations in order to accomplish its work, including assistance from the United States Geological Survey (USGS), the United States Environmental Protection Agency (USEPA), the United States Department of Agriculture (USDA), the United States Fish and Wildlife Service (USFWS), the United States Forest Service (USFS), and the National Park Service. Additional research, technical and funding assistance is provided by Purdue University and its Extension Service, Indiana University, The Nature Conservancy, the Indiana Water Monitoring Council, county soil and water conservation districts, and local non-profit and ad-hoc watershed groups.

IDEM'S WATERSHED APPROACH

IDEM employs a watershed approach in its Clean Water Act (CWA) programs. This approach is hydrologically well defined and geographically focused, providing an effective framework to address water quality issues by taking into account land, air and water stressors. Key benefits of the watershed approach are that it integrates multiple programs through coordination of public, private, and not-for-profit stakeholders and leverages limited resources to address priority concerns.

The foundation of IDEM's watershed approach is internal and external collaboration across program areas through timely and effective communication and adaptive management. IDEM's work with other state and federal agencies and other external organizations is described in more detail in later sections of this report.

Internally, IDEM's senior staff, including the commissioner, meets weekly to discuss progress on priorities as well as emerging concerns and then relays this information to IDEM's Office of Water Quality (OWQ) managers at their weekly meeting. Cross-program teams continually work to develop strategies and work plans that ensure internal resources are focused on addressing the most significant environmental issues affecting water quality.

IDEM's water quality monitoring also employs a watershed approach. IDEM adopted a statewide rotating basin approach to watershed monitoring in 1996 in order to regularly update the water quality information for the entire state. From 1996-2010, IDEM monitored watersheds throughout the state on a five-year rotation, which provided a complete update once every five years.

In 2010, IDEM revised its water monitoring strategy and began using a nine-year rotating basin approach in 2011, which will result in a comprehensive and updated data set for the entire state in 2019. The water quality assessments included in this report are cumulative and include all waterbodies that have been assessed to date in all basins of the state. Figure 1 (Appendix B) shows the monitoring locations for all of IDEM's surface water sampling programs and illustrates the sampling density achieved through IDEM's water quality monitoring strategy over

the past five years (2011-2015).

IDEM'S OFFICE OF WATER QUALITY PROGRAMS

IDEM's Clean Water Act (CWA) programs work together to protect and improve the quality of Indiana's surface waters. Indiana's water quality standards, which are developed by the Office of Water Quality (OWQ) Water Quality Standards (WQS) program, provide the foundation for implementation of many of IDEM's CWA programs. IDEM's water monitoring programs provide much of the data necessary to conduct CWA Section 305(b) water quality assessments and to support the development of Indiana's 303(d) List of Impaired Waters and total maximum daily loads (TMDLs) required under Section 303(d) of the CWA.

Nonpoint source (NPS) pollution is addressed primarily through non-regulatory watershed management planning and implementation projects funded through IDEM's NPS Program and through the development of TMDLs for impaired waters. The agency's National Pollution Discharge Elimination System (NPDES) provides a robust regulatory program to control point sources of pollution to Indiana surface waters.

IDEM also works with the Indiana Finance Authority (IFA) to issue low cost loans to communities for infrastructure improvements to their wastewater and drinking water facilities. Many of these loans go to municipalities in watersheds where water quality impairments have been identified and for which total maximum daily loads (TMDLs) have been approved by the U.S. Environmental Protection Agency (EPA). It is anticipated that in time these projects will result in measureable improvements in water quality.

Water Quality Standards Program

Indiana's WQS can be found in 327 IAC Article 2. They were first adopted into the Indiana Administrative Code (IAC) in 1986 and underwent significant revisions in 1990. At that time, Indiana adopted numeric criteria into its WQS for all pollutants for which U.S. EPA had developed ambient water quality criteria for the protection of either human health or aquatic life. Procedures for developing additional criteria were also included in these rules.

Beneficial uses, which are the uses that the waterbody should support, were also established at that time. With a few exceptions, all waters in Indiana were designated for warm water aquatic life use, full body contact recreational use, public water supply[1] (where there are drinking water

[1]There are 34 streams or stream reaches designated for limited use in 327 IAC 2-1-11(a) and 327 IAC 2-1-1.5-19(a). These waters so designated after use attainability analyses confirmed their inability to fully support aquatic life use due to natural low flow conditions throughout much of the year. In 2007, another limited use designation was added to Indiana's WQS in 327 IAC 2-1-3.1, which is applicable only to waters receiving wet weather discharges from combined sewer overflows (CSOs). Currently, no waters are so designated because to date, no communities with CSOs have completed the steps required to receive this designation. Indiana's WQS also include waters that are designated as outstanding state resources in 327 IAC 2-1.5-19(b), 327 IAC 2-1.3-3(d) and 327 IAC 2-1-11(b). Thus, all waters in the state are currently designated for uses consistent with the requirements of the CWA or U.S. EPA's implementing regulations and have criteria appropriate to determine support of these uses.

intakes from surface waters), industrial uses and agricultural uses. In addition, certain waters, where natural temperature conditions will support cold water fisheries, were designated for put-and-take (stocked) trout fishing. For those waters where multiple uses exist, the criteria that support the most stringent uses must be met. The most stringent criteria in Indiana's WQS are those established to protect aquatic life use, recreational uses for all Indiana waters and where applicable, public water supply. IDEM's water quality assessments focus primarily on these uses and are based on the narrative and numeric criteria in the WQS established to protect them.

NPDES permits are also based on Indiana's WQS. In 1993, the rules and regulations that guide the implementation of Indiana's WQS through NPDES permits were extensively revised. Although this revision resulted in significant changes to these rules, only minor changes were made to Indiana's WQS.

With the issuance of the final Great Lakes Water Quality Guidance in 1995, IDEM began the process of revising the WQS and implementation regulations for those waters in Indiana's Great Lakes system. These revisions incorporated the various criteria and procedures identified in the guidance into Indiana's WQS. As a part of this rulemaking, IDEM also developed procedures to implement the antidegradation policy for all substances discharged to waters in the Great Lakes system. These revisions adopted by the Indiana Water Pollution Control Board became effective in February, 1997 and were subsequently submitted to the U.S. Environmental Protection Agency (EPA) for approval.

Ground water quality standards became effective in March 2002. Drinking water from public water supplies is regulated through the Safe Drinking Water Act (SDWA). IDEM defines public water supplies in accordance with the SDWA and has established minimum requirements regarding the information included in consumer confidence reports, which public water suppliers must deliver to their customers annually.

WQS development is an ongoing process. For example, 2008, in order to begin using fish tissue data to make its fish consumption assessments, IDEM had to first derive a numeric criterion for polychlorinated biphenyls (PCBs) in fish tissue. IDEM used U.S. EPA guidance for calculating screening values for target analytes, which provides the basis for developing water quality criteria for the protection of human health.

In 2012, Indiana formally adopted antidegradation standards and implementation procedures applicable to all waters of the state. These rules supersede previous antidegradation rules established in 1997, which applied only to the Great Lakes Basin. And in 2013, Indiana adopted revised chloride criteria developed by the WQS Program based on hardness and sulfate concentrations.

U.S. EPA has required all states to develop numeric water quality criteria for nutrients to support CWA Assessments and permit development. The agency has also issued guidance that appears to give states flexibility in the development of nutrient criteria if the state and U.S. EPA have agreed on a plan to accomplish this goal. Indiana is actively participating in this effort and has submitted a nutrient criteria development plan to U.S. EPA that includes a schedule for the development of nutrient criteria. This plan has been approved by U.S. EPA and is kept updated.

In accordance with the approved plan, IDEM is working with U.S. EPA Region 5 and the United States Geological Survey (USGS) to develop nutrient criteria for different water body types throughout the state. IDEM has worked collaboratively with the USGS in Indianapolis over the last 14 years to collect and analyze relevant stream data from waters throughout the state. Recent analyses of these data indicate that another study is warranted, this time collecting diurnal dissolved oxygen in addition to nutrient parameters for flowing streams. For lakes and reservoirs, data analysis was completed in 2008 by LimnoTech, Inc. IDEM then performed additional analyses on the data set to refine the nutrient benchmarks developed by LimnoTech. On June 30, 2010, IDEM issued a first notice in the Indiana Register announcing a rulemaking to formally incorporate numeric nutrient water quality criteria for lakes and reservoirs into Indiana's water quality standards. IDEM also developed a non-rule policy that went into effect on 12/12/2014 to limit total phosphorus discharge to 1 mg/L for wastewater treatment plants discharging ≥1 million gallons per day.

Currently, IDEM is planning revisions to the metals criteria in the WQS for the protection of aquatic life and human health. On March 5, 2014, IDEM issued a first notice in the Indiana Register announcing a rulemaking to formally incorporate revised water quality criteria for dissolved metals into Indiana's water quality standards. More information about this rulemaking can be found on IDEM's WQS website at: http://in.gov/idem/cleanwater/2329.htm.

IDEM has also collected considerable data on the macroinvertebrate and fish communities for many Indiana waters. A 2014 evaluation of IDEM's biological monitoring program revealed a need to select reference sites that are based on quantitative descriptions of non-biological characteristics (primarily land use and landscape condition); to refine macroinvertebrate assessment techniques; to update biological indices; and to establish a biological condition gradient to characterize the state of aquatic communities in Indiana waters at a finer resolution. IDEM has begun this work through a Section 106 Monitoring Initiative grant from the U.S. EPA.

National Pollutant Discharge Elimination System Permit Program

Point source pollution in Indiana is controlled primarily through permits issued by IDEM for discharges to surface water under the National Pollutant Discharge Elimination System (NPDES) Permit Program in IDEM's Permits Branch. Regulated facilities which discharge to waters of the state must apply for and receive a NPDES permit. Limitations in each permit are determined based on water quality criteria developed to protect all designated and existing uses of the receiving water body.

The Permits Branch issues individual (municipal, semi-public and industrial) NPDES permits. The program also issues industrial wastewater pretreatment permits to industries that discharge to municipal wastewater treatment plants. In addition, the Permits Branch issues general permits for:

- Hydrostatic testing
- Non-contact cooling
- Sand and gravel operations
- Petroleum product terminals
- Groundwater petroleum remediation systems
- Coal mines

There are currently 1194 active individual NPDES permits, 180 pretreatment permits, and 300 facilities covered by general permits.

The Permits Branch is also responsible for the review and approval of long term control plans (LTCPs) submitted by communities to reduce discharges from combined sewers. All of the combined sewer overflow communities for which IDEM is the lead regulating agency are currently under one of three enforceable mechanisms (permit, agreed order or state judicial agreement). These mechanisms are in place to help implement the approved LTCP and/or to develop and implement an approvable LTCP. There are two remaining communities for which U.S. EPA is the lead regulating agency that have not yet entered into an enforceable mechanism for development and implementation of an approved LTCP. These communities are still in negotiations with U.S. EPA.

Compliance and Technical Assistance Program

The Compliance Branch in the Office of Water Quality is responsible for the following:

- Conducting routine inspections of wastewater treatment plants to evaluate operation and maintenance, as well as complaint investigations.
- Providing operator assistance and training.
- Administration of the wastewater operator continuing education and certification program.
- Entering a wide range of NPDES compliance data into the Federal ICIS data system.
- Tracking reported bypass and overflow events.
- Administration of the sewer ban and early warning program.
- Review of compliance data, including data quality assurance.
- Conducting informal enforcement actions through the issuance of violation letters, and assisting in the enforcement process.
- Oversight and auditing of municipal pretreatment programs in the 47 municipalities with U.S. EPA delegated pretreatment programs.
- Administering the laboratory proficiency program.

The Compliance Branch works closely with the Permits Branch and staff from the OWQ's Enforcement section to ensure that permit limits are adequate for protection of designated uses and dischargers remain in compliance with their permit requirements. For example, when unpermitted dischargers are identified, or when NPDES permit holders are found to be in violation of permit limitations or conditions, they may be referred to OWQ's Enforcement section for appropriate action.

Storm Water Program

Storm water run-off from urban, industrial, and rural areas contributes to water pollution in Indiana. IDEM's Stormwater Programs process permit applications and issue permits, conducts compliance inspections, and conducts audits for three program areas that together, help to mitigate the impacts of storm water to Indiana waters. These program areas target storm water discharges from construction site run-off, industrial storm water run-off, and municipal separate storm sewer systems.

Most of the activities that discharge storm water are regulated through general permits. General permits are issued through rulemaking and as such, become part of Indiana's Administrative Code. Unlike individual permits, which IDEM issues to individual permittees when needed, general permits apply universally to all entities required to operate in accordance with the rule.

Construction Site Run-off

Any activity that results in the disturbance of one acre or more of land requires a permit in accordance with 327 IAC 15-5 (commonly known as "Rule 5"). Rule 5 is intended to reduce pollutants, principally sediment, which is a result of soil erosion. Rule 5 also covers other activities associated with construction projects including, concrete washout; fueling, etc. Most construction projects in Indiana are regulated through the general Rule 5 permit. However, in cases where an adverse environmental impact from a project site is evident or if IDEM determines that the discharge will significantly lower water quality, an individual permit may be required.

Industrial Storm Water

Industrial storm water is managed through a general permit developed in accordance with 327 IAC 15-6 (commonly known as "Rule 6"). Rule 6 permits are required for certain categories of industrial activities that are exposed to storm water and where the run-off is discharged through a point source to one or more Indiana waters. There are at least 32 categories of industrial activities regulated under Rule 6. Most industrial activities in Indiana are covered by the Rule 6 general permit. However, under certain circumstances, an industrial facility may require an individual storm water permit. Individual permits are typically required only if a regulated industrial activity category has established effluent limitations under IDEM's NPDES Program or if IDEM determines the storm water discharge will significantly lower water quality.

Municipal Separate Storm Sewer Systems

Municipal separate storm sewer systems (MS4s) are entities that are required by IDEM under 327 IAC 15-13, or "Rule 13" to develop and implement a local storm water management program.

The first MS4s were designated in 1990 and included cities (and certain counties) with a population of 100,000 or more. In Indiana, the City of Indianapolis is the only designated Phase I MS4. The city has an individual storm water permit that was specifically written to address storm water quality and management.

Federal Phase II MS4 rules were complete in 1999 and designated small urbanized areas such as cities, towns, universities, colleges, correctional facilities, hospitals, conservancy districts, homeowner's associations and military bases located within urbanized areas, as delineated by the U.S. Census Bureau. Most of these MS4s are covered under a general permit and are required to develop a storm water quality management plan that must address six minimum control measures (public education, public involvement, illicit discharged detection and elimination, construction site run-off, post-construction run-off, and good housekeeping for MS4 owned and operated facilities). Indiana currently has 186 MS4 permittees implementing Storm Water Quality Management Plans under a general permit.

Wetlands Program

IDEM administers the federal Clean Water Act (CWA) Section 401 Water Quality Certification (WQC) Program and also administers Indiana's State Isolated Wetlands Law (IC 13-18-22) for those wetlands that are not under federal jurisdiction.

IDEM regulates the placement of fill materials, excavation (in certain cases) and mechanical clearing of wetlands and other waterbodies. IDEM draws its authority from the federal CWA, state law and rules for state-regulated wetlands, and from Indiana's water quality standards. IDEM regulates some activities in waterbodies in conjunction with the U.S. Army Corps of Engineers (ACOE).

Anyone who wants to place fill materials, use heavy equipment to excavate, dredge, or mechanically clear areas within a jurisdictional wetland, lake, river or stream must first apply to the ACOE for a CWA Section 404 permit. If the ACOE decides a permit is needed, then the person must also obtain a CWA Section 401 WQC from IDEM. Placement of fill into non-jurisdictional wetlands is also regulated by Indiana law (IC 13-18-22 and 327 IAC 17).

Under CWA Section 401, IDEM reviews the proposed activity to determine if it will comply with Indiana's water quality standards. The applicant may be required to avoid impacts, minimize impacts or mitigate for impacts to wetlands and other waters. IDEM will deny water quality certification if the activity will cause adverse impacts to water quality, the application is deficient, the wetland activities are not necessary, or compensatory mitigation does not offset impacts. A regulated project is not allowed to proceed until it has received a certification from

IDEM. A key goal of the program is to ensure that all activities regulated by IDEM meet the national no-net-loss of wetlands policy.

Development of Wetlands Program Plan

In March 2015, the Indiana Department of Environmental Management (IDEM), Office of Water Quality completed work on a long-term Wetlands Program Plan (WPP) for Indiana. A WPP is a voluntary plan that describes the goals a state or tribe wants to achieve related to its wetland resources over time. The WPP is not a rule-making or regulatory document, nor is it a strict commitment by the state to achieve all aspects of the plan. Rather, it serves to inform future prioritization and action. The planning effort was funded through a U.S. Environmental Protection Agency (EPA) Wetland Program Development grant and is intended to guide IDEM's wetland program activities through 2022. The WPP is available online at http://www.in.gov/idem/wetlands/files/program_plan.pdf.

In-lieu Fee Program

The Indiana Department of Natural Resources (IDNR) is developing, and seeking approval to sponsor (referred to as the "in-lieu fee program"), the Indiana Stream and Wetland Mitigation Program. The program requires the approval of the U.S. Army Corps of Engineers (USACE) and the Interagency Review Team and must meet the requirements laid out in the federal mitigation rule (33 CFR §332.8). The in-lieu program, once fully developed, will provide an additional option for permittees to meet mitigation requirements associated with a Section 404 permit from the USACE, a 401 Water Quality Certification and/or an Isolated Wetland Permit from IDEM. The IDNR hopes to have the program approved by the USACE before the end of 2016.

Integrity and Extent of Wetland Resources

Wetlands occur in and provide benefits to every county in Indiana. The lack of quantitative information on some aspects of Indiana's wetland resources is a major obstacle to improving wetland conservation efforts. The most extensive database of wetland resources in Indiana is the National Wetlands Inventory (NWI) developed by the U.S. Fish and Wildlife Service (USFWS). The original NWI maps were produced primarily from interpretation of high-altitude color infrared aerial photographs taken of Indiana during spring and fall 1980-87. These maps were updated at a much higher resolution during 2008-2009 through a grant to Ducks Unlimited. The updated maps indicate wetlands extent and type, using the Cowardin, *et al*. classification scheme (Cowardin 1979). A 2009 analysis of the state's wetlands compared with 1986 conditions indicates that:

- Indiana has experienced a net loss in the number of emergent, forested, shore, and scrub-shrub wetlands.
- Indiana has experienced a net loss in the extent (acres) of forested, scrub-shrub, and shore wetland sub-types.

The results of this study are available at http://www.fws.gov/wetlands/Data/SupMapInf/R03Y11P02.pdf.

IDEM uses the updated, higher resolution NWI inventory primarily in its Wetlands Program as a screening tool when evaluating applications for impacts to wetlands and streams and also to help identify wetland compensatory mitigation or restoration sites. It has also helped IDEM wetland staff to set priorities for complaint investigations.

Wetland Protection Activities

In addition to the review of applications for Section 401 WQC and state regulated wetland permits, IDEM's Wetlands Program works on additional projects devoted to wetland assessment and wetland protection:

- IDEM staff work closely with the ACOE, U.S. FWS, and IDNR to evaluate proposed projects to coordinate requirements for various state and federal permits related to wetlands.
- IDEM maintains a web page devoted to wetlands and water quality issues: http://www.in.gov/idem/wetlands/index.htm. This page includes information on the status of Indiana's wetlands, current laws and rules, conservation programs and links to other regulatory and non-regulatory wetland programs.
- IDEM maintains a web-based mapping tool for potential wetland restoration sites, including opportunities for compensatory mitigation and non-regulatory purposes: http://idemmaps.idem.in.gov/MitigationVolunteer/.
- Section 401 WQC Program staff conduct outreach events at various locations to promote the importance of wetlands and to educate the public on regulations protecting wetlands.
- IDEM continues to work closely with all partners in the Indiana wetland conservation plan.

Total Maximum Daily Load Program

Status of Total Maximum Daily Load Development

As of March 1, 2016, the Total maximum Daily Load (TMDL) program has developed 1224 TMDLs (individually counting each waterbody impairment that was evaluated), all of which have been approved by U.S. EPA. Appendix D provides an accounting of all TMDLs approved to date. Appendix E provides IDEM's short term TMDL schedule – those either planned or currently being developed for the 2018 cycle.

Two watersheds – the Upper Mississinewa and the South Fork Blue River – are in progress for the 2016 cycle. Previous TMDLs have focused on *E. coli* impairments. More recently, however, the TMDL program has worked to develop TMDLs to address other issues related to NPS pollution such as impaired biotic communities and nutrient impairments.

Long Term Total Maximum Daily Load Development Schedule

U.S. EPA announced its long term vision in 2013 to improve implementation of the CWA 303(d) Program through a new framework for managing program responsibilities. In order to achieve the goals of its vision, U.S. EPA required states to develop a new framework for prioritizing impaired waters for TMDL development.

IDEM developed its TMDL Program Priority Framework in 2015, which describes IDEM's methods for prioritizing waters for TMDL planning and watershed restoration and includes the agency's long term TMDL development schedule. This long term schedule identifies the watersheds in which TMDLs will be developed through the 2022 cycle (Appendix F). IDEM submitted the framework and its long term schedule to U.S. EPA on July 8, 2015. U.S. EPA has since reviewed IDEM's Priority Framework and in a letter to IDEM dated September 16, 2015, agreed that it meets the goals of its new long term vision. . IDEM's long term schedule for TMDL development can be found in Appendix F, while more detailed information on IDEM's 303(d) TMDL Program Priority Framework is provided in Appendix H, Attachment 3). The specific waterbodies identified on IDEM's long term schedule, like those identified in IDEM's short term schedule, may change based on unanticipated circumstances. Although the specific waterbodies may change, IDEM will follow the methods described in its Program Priority Framework when prioritizing impaired waters for TMDL development to help ensure ongoing consistency with U.S. EPA's long term vision.

Nonpoint Source Pollution Program

Nonpoint source (NPS) pollution in Indiana is addressed in many ways through a number of agencies and organizations in the state. IDEM's Watershed Planning and Restoration Section leads the agency's efforts to reduce nonpoint source pollution in Indiana waters in partnership with other agencies and organizations including the Natural Resources Conservation Service (NRCS), Indiana Association of Soil and Water Conservation Districts (IASWCD), Indiana State Department of Agriculture (ISDA), the Indiana Department of Natural Resources (IDNR) and the Indiana Finance Authority (IFA) State Revolving Fund (SRF) Loan Program. The Watershed Planning and Restoration Section also leads efforts to restore waters of the state that are identified on the 303(d) List of Impaired Waters. In addition to working with other state and federal agencies, IDEM employs four watershed specialists who work with local watershed groups to promote the watershed approach and assist them in their watershed planning and restoration activities.

Nonpoint Source Program Grants

The Watershed Planning and Restoration Section manages two federal pass-through grant programs aimed at improving water quality in the state – Section 205(j) and Section 319(h) – each named after the authorizing section of the CWA.

The Section 205(j) Grant Program is dedicated to water quality management planning. Funds are used to determine the nature, extent, and causes of point and nonpoint source pollution

problems and to develop plans to solve these problems. In federal fiscal year (FFY) 2014-15, U.S. EPA allocated to Indiana $681,000 in 205(j) funds. These funds were used to support five projects: three watershed management plan development projects (on the Browns-Wonder Sugar Creek, South Fork Blue River, and Upper Middle Eel River), one sampling project on the Kankakee River, and one database enhancement project.

The Section 319(h) Program is one of the primary resources for reducing NPS pollution in Indiana and receives a significantly larger allocation than that under CWA Section 205(j) (Table 3, Appendix A). In FFYs 2014 and 2015, U.S. EPA allocated $7,023,714 in Section 319(h) funds to Indiana, which funded a total of 18 projects. An additional $131,600 planning project was funded in FFY 2015 using remaining funds from FFY 2013. Several grant proposals are submitted to the program each year by eligible organizations. Proposals are reviewed internally by a committee comprised of OWQ staff and selected for funding based on the NPS Program's priorities and the quality of the proposal. Much of this funding goes to groups working to develop and/or implement a comprehensive watershed management plan which will lead to implementation of on-the-ground best management practices (BMPs) in critical areas of their watersheds.

Additional information about IDEM's 205(j) and 319(h) grant programs and their different requirements is available online at: http://www.in.gov/idem/nps/.

Nonpoint Source Program Focus

IDEM's NPS Program is built on the foundation of the Indiana State Nonpoint Source (NPS) Management Plan. The NPS management plan, required by Section 319(b) of the CWA, is a strategic document developed by state program staff and approved by U.S. EPA that identifies strategic priorities, goals, and milestones to more effectively address NPS problems in Indiana. The plan, which is updated every five years, provides the basis for funding decisions and programmatic direction for the state program and its partners. The current plan was last revised in FFY 2013 and approved by U.S. EPA on March 14, 2014.

The majority of Indiana's Section 319(h) grant funds provide for the development and implementation of watershed management plans (WMPs). Developing and implementing a comprehensive watershed management plan is an effective way to focus efforts and resources on a watershed and its particular problems and to implement solutions to those problems. In the planning process the watershed group identifies the problems, causes, sources, and critical or target areas in the watershed, then sets goals and chooses measures or best management practices (BMPs) to be implemented to achieve those goals. WMPs now under development must meet the required elements of IDEM's 2009 Watershed Management Plan Checklist before they can be implemented with CWA Section 319(h) funds. The checklist incorporates EPA's nine required components of a watershed-based plan and also provides comprehensive guidance on IDEM's Nonpoint Source Program expectations, as well as examples and direction on how to meet those expectations.

Many of the projects funded with NPS Program grants include the collection of water quality data for watershed planning and other purposes. In accordance with their grant agreements, these projects must develop a quality assurance project plan (QAPP) to ensure the data they collect will be reliable for their project needs. Once the QAPP is approved by the NPS Program, they may begin sampling and submitting their data – also a requirement for funding – to the NPS Program. These data are then entered into IDEM's Assessment Information Management System (AIMS) database. The AIMS database is continually maintained and was recently upgraded to make NPS Program data more readily available for internal and external use. In addition, the NPS Program also funded a recent project to update IDEM's Hoosier Riverwatch database in order to improve its ability to manage and display volunteer data and accept data submitted through Indiana's External Data Framework.

Nonpoint Source Program Priorities

Each year, IDEM identifies priority projects for Section 319(h) funds in order to more efficiently meet NPS Program goals, coordinate with TMDL Program efforts to identify and reduce NPS pollution, and focus more funding on impaired waters.

For FFYs 2014 and 2015, the NPS Program has focused funding on the following priorities:

- In order to continue to make measurable improvements in water quality in Indiana, and to prioritize watersheds for actions focused on reducing nutrient loading to the Gulf of Mexico in coordination with the Indiana Conservation Partnership, IDEM's Nonpoint Source Program has focused funding watershed management plan implementation projects addressing nutrients in the following watersheds:
    - White River, East Fork Basin
    - Upper Wabash River Basin
    - Lower Wabash River Basin
- In 2014 the NPS program prioritized funding to support the conditionally approved Lake Michigan Coastal Plan. Until this plan is finalized and meets the requirements of the Coastal Zone Act Reauthorization Amendments (CZARA), IDEM's NPS Program will continue to provide technical and financial assistance for watershed planning and/or implementation in the Coastal Zone Program area.
- The program has continued to prioritize funding for:
    - Watershed planning and/or implementation efforts in watersheds with one or more impaired waterbodies that have an approved TMDL.
    - Watershed planning and/or implementation in watersheds that include waterbodies in categories 5A or 4A of Indiana's Draft 2012 Integrated Report.
    - Implementation of watershed management plans that have met, or will soon meet, IDEM's Watershed Management Plan 2003 or 2009 Checklists.

In FFY 2016, the CWA Section 319(h) program tied its funding to the TMDL vision. IDEM continued in FFY 2016 to prioritize funding for implementation of watershed management plans that meet IDEM's 2009 watershed management plan checklist and in addition, targeted specific watersheds for the following three priorities in its solicitation:

- Develop a WMP or implement an IDEM approved WMP that contains a 10-digit HUC watershed with a public lake (a lake with public access) identified as having a high blue-green algae count when monitored by IDEM and/or the lake is influenced by waterbodies listed in category 5A of the then-draft 2014 303(d) List of Impaired Waters.
- Develop a WMP or implement an IDEM approved WMP in a watershed that includes waterbodies listed on the then-draft 2014 303(d) List of Impaired Waters for Impaired Biotic Communities (IBC).
- Develop a WMP or implement an IDEM approved WMP that includes a 10-digit HUC watershed with a surface water intake for public water supply and waters identified in category 5A of the then-draft 2014 303(d) List of Impaired Waters.

One important indicator of program and project success is the quantity of pollutants, such as sediment, phosphorus, nitrogen, and *E. coli*, prevented from entering waterbodies as a result of BMPs implemented. Most NPS Program projects in Indiana use the U.S. EPA Region 5 Load Estimation Model to estimate the pollutant load reductions for each BMP they implement and submit their data to IDEM. The total reported estimated pollutant load reductions in Indiana for FFY 2014 and 2015 combined are represented in Table 4 (Appendix A). Another program measure (commonly referred to as "WQ-10" or "success stories") tracks the number of waterbodies identified by states as being primarily NPS-impaired that have been partially or fully restored as a result of restoration efforts (5, Appendix A). More detail on Indiana's FFY 2014 and 2015 success stories can be found in the cost/Benefit Section of the report.

IDEM's Watershed Specialists

The NPS Program employs four watershed specialists who provide an important link between watershed groups and other interested stakeholders and OWQ programs. In 2014 and 2015, the watershed specialists assisted nearly 90 watershed groups on many levels including: meeting facilitation, reviewing draft and final watershed management plans, reviewing grant proposals, providing water quality data and watershed maps, connecting them with other local organizations and agencies to complement planning efforts, and assisting watershed coordinators with the overall watershed planning and implementation processes. The watershed specialists also work with the TMDL Program by attending TMDL public meetings to provide information on watershed planning and to build local partnerships to address water quality.

Volunteer Monitoring Programs

Hoosier Riverwatch

From 1999-2002, IDEM and IDNR worked cooperatively to develop and implement the Hoosier Riverwatch Program (HRW), a statewide volunteer stream water quality monitoring program. The mission of Hoosier Riverwatch is to involve the citizens of Indiana in becoming active stewards of Indiana's water resources through watershed education, water monitoring, and clean-up activities. The program accomplishes the first two parts of this goal by educating citizen volunteers in a variety of watershed and pollution issues, and providing them with training and equipment to conduct water quality monitoring. The HRW Program also maintains an online database which allows volunteers to enter their own data and view data collected by other volunteers. Volunteers are encouraged to enter their results into the database to make them available to other interested parties such as watershed groups, schools and IDEM technical staff for potential use in various OWQ programs. In addition to basic search functions, the visualization tools of the database also allow volunteers to view their data and that collected by others in comparison with state and watershed averages through simple graphics.

HRW resided at IDNR until late 2012, when the program moved to IDEM's OWQ to better integrate volunteer water monitoring with OWQ's watershed monitoring and planning activities. Over the past three years, HRW has become more fully integrated into the Watershed Assessment and Planning Branch within OWQ, allowing better coordination with NPS Program whose grantees commonly use HRW methods to meet the monitoring and outreach components of their funded projects and encouraging greater data sharing through OWQ's EDF. The HRW Program has also initiated planning discussions to determine how volunteer monitoring can become more fully involved in watershed planning and restoration efforts as a whole.

The move to IDEM also provides volunteer monitors more opportunities to interact with their professional counterparts. Since 2012, HRW program staff have worked with OWQ biologists and others to offer training to the program's corps of trained volunteer instructors in topics such as basic fish and advanced macroinvertebrate identification, introductions to IDEM's mobile *E. coli* van, the collection and analysis of fish tissue for consumption advisories, the use of various electrofishing gear, and the process of estimating pollutant loads using flow and concentration data.

Indiana Clean Lakes Program

The Indiana University School of Public and Environmental Affairs (IU-SPEA) has been working with IDEM's NPS Program since 1989 to administer the Indiana Clean Lakes Program (CLP). The Indiana CLP is funded through CWA Section 319(h) and provides a comprehensive, statewide public lake management program that includes public information and education, technical assistance, volunteer lake monitoring, and lake water quality assessment.

Indiana has more than 1,400 lakes, reservoirs, and ponds, many of which are under pressure from human activities such as poorly managed agriculture, suburbanization of lakeshores, boating

impacts, and septic system discharges. These activities can result in excessive nutrient concentrations reaching lakes which can lead to accelerated eutrophication and related undesirable effects including nuisance algae, excessive plant growth, murky water, odor, and fish kills.

Indiana's CLP, which is coordinated by IU-SPEA staff and students, includes the following components:

- Annual professional sampling of lakes and reservoirs.
- Training and support of a corps of volunteer lake monitors.
- Education and outreach through a quarterly newsletter
- Development of other educational materials such as brochures and fact sheets.
- Maintenance of the Indiana Clean Lakes Program website.
- Technical assistance and expertise on lake-related issues.

The Indiana CLP also participates in the annual Indiana Lake Management Conference as part of its education and outreach activities.

In 2012, IU-SPEA expanded its volunteer monitoring program to include aquatic invasive species monitoring with the goal of helping to detect the presence of invasive species early and to prevent their spread. In 2014, Zebra mussels were added to the program.

The program also holds workshops each year to help increase public understanding of the important zones of a lake that provide essential habitat and ecosystem services. Volunteers that participate in the workshops often expand their monitoring efforts becoming even better lake stewards. This program has been very well received and continues to improve with each workshop.

Volunteers enter their data on the Indiana CLP website. Volunteer data reports are available on the website for the years 1999-2011. Information regarding IDEM's use of the data collected by IU-SPEA staff and students for CWA Section 305(b) and Section 314 assessments can be found in a later section of this report.

COORDINATION WITH OTHER AGENCIES

Nonpoint source (NPS) pollution ranges from urban sources to construction and agricultural run-off which makes cooperation essential across political boundaries and disciplines. Many local, regional, state, and federal agencies play an essential part in addressing NPS pollution, especially at the watershed level. Various agencies in Indiana provide data, technical resources and grants to local watershed groups to assist with planning, infrastructure design review and implementation of best management practices (BMPs) to reduce and prevent NPS pollution. Through coordination and collaboration, IDEM and the other agencies can more effectively focus water quality protection efforts.

IDEM works closely with other state and federal agencies engaged in improving water quality. For example, IDEM serves as a member of the Indiana Conservation Partnership (ICP) – a partnership comprised of eight state and federal agencies and other organizations committed to the goal of promoting conservation.

IDEM also has four watershed specialists that act as liaisons for local, state and federal entities to integrate watershed planning into local level planning efforts. These specialists serve as Section 319(h) project managers and assist in a technical, managerial and financial advisory role for local watershed groups.

IDEM staff in the Wetlands and Storm Water Programs work cooperatively with the U.S. Army Corps of Engineers, IDNR, the U.S. Fish and Wildlife Service (USFWS), local soil and water conservation districts (SWCDs) and other agencies to provide technical assistance and to issue Clean Water Act (CWA) Section 401 water quality certifications, state permits for isolated wetlands, and construction /land disturbance permits to protect water quality.

Indiana Department of Natural Resources

Division of Reclamation, Abandoned Mine Lands Program

IDEM's total Maximum Daily Load (TMDL) and Nonpoint source (NPS) Programs work with IDNR's Abandoned Mine Lands (AML) Program on any TMDL development and potential water quality improvements in watersheds where abandoned coal mines exist. The AML Program contributes to these efforts by sharing water quality data and information regarding the costs and techniques involved in their reclamation projects. The AML Program has also helped educate IDEM's Office of Water Quality (OWQ) staff about areas impacted by acid mine drainage by touring reclamation projects with them at different points in the reclamation process.

Division of Fish and Wildlife, Lake and River Enhancement Program

The goal of the Lake and River Enhancement (LARE) Program in the IDNR Division of Fish and Wildlife is to reduce the amount of sediment and nutrients entering Indiana's lakes and rivers. Coincidental to this goal is an ongoing effort to utilize LARE-funded projects to protect and enhance aquatic habitat for fish and wildlife to ensure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities.

These goals are accomplished through the granting of funds to appropriate sponsoring entities to provide for technical and financial assistance to qualifying projects. These projects range from diagnostic studies of targeted sub-watersheds to determine the design and construction feasibility of measures to reduce erosion and sedimentation in lakes and streams. Indiana law dedicates a portion of LARE funding to the removal of sediment, logjams and other obstructions, and control of invasive aquatic species. And, the program also provides funding to county SWCDs to assist individual landowners in the use of BMPs in targeted watersheds.

In 2015, LARE grants totaled more than two million dollars to projects in numerous counties across the state. Funding for the program comes from a lake and river enhancement fee paid by boat owners annually to the Bureau of Motor Vehicles. LARE projects leverage these funds to benefit not only boaters but everyone who uses Indiana's publicly accessible lakes and streams. LARE-funded projects also help to improve aquatic habitat and reduce the amount of nutrients entering both the Great Lakes and the Mississippi River System.

Indiana Lake Michigan Coastal Program

The purpose of IDNR's Lake Michigan Coastal Program (LMCP) is to enhance the state's role in planning for and managing natural and cultural resources in the coastal region and to support partnerships between federal, state and local agencies, and other organizations.

The LMCP annually awards a variety of grants through its Coastal Grants Program to coastal municipalities, counties, nonprofit groups, and universities for projects that protect and restore natural, cultural and historic resources in Indiana's Lake Michigan coastal region. Examples of how these funds might be used include:

- Protection and restoration of significant natural and cultural resources.
- Programs to prevent the loss of life and property in coastal hazard areas.
- Improved public access for recreational purposes.
- Revitalized urban waterfronts and ports.
- Improved coordination among government agencies when making policy decisions.
- Pollution prevention initiatives, including NPS pollution into coastal water.

The Coastal Nonpoint Pollution Control Program, established in 1990 by Section 6217 of the Coastal Zone Act Reauthorization Amendments, is jointly administered by National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency (EPA). The program establishes a set of management measures for states to use in controlling runoff from six main sources: agriculture, forestry, urban areas, marinas, hydromodification (shoreline and stream channel modification), wetlands, and riparian and vegetated treatment systems. The goal is to reduce polluted runoff to coastal waters. All coastal and Great Lakes states and territories that participate in the National Coastal Zone Management Program are required to develop coastal nonpoint pollution control programs. State authorities ensure implementation.

Indiana's Coastal Nonpoint Pollution Control Program received conditional U.S. EPA/NOAA approval in 2008. The LMCP is working closely with IDEM's NPS Program and other NPS program partners to implement management measures specified by U.S. EPA to prevent and mitigate NPS pollution in Lake Michigan coastal watersheds. Documentation indicating how Indiana meets all remaining Coastal NPS Pollution Control Program conditions must be submitted to U.S. EPA/NOAA by September 30, 2019.

The Septic System Coordination Work Group established and facilitated by the LMCP is an example of how coastal partners collaborate to address the management measure for inspection of potentially failing septic systems. The Indiana State Department of Health (ISDH), county

health departments, IDEM, the Northwest Indiana Federal Urban Waters Partnership, local municipal separate storm sewer systems (MS4s), watershed groups, and regional environmental agencies and organizations meet on a regular basis to share information on local conditions and ordinance development, address failing systems, and identify innovative funding mechanisms. In 2014 and 2015 the work group spearheaded adoption and promotion of U.S. EPA's SepticSmart Week by ISDH, IDEM, IDNR, and more than 40 coastal towns, agencies, and organizations.

Indiana Conservation Partnership

IDEM is one of eight agencies and organizations that comprise the Indiana Conservation Partnership (ICP). The ICP works to provide technical, financial, and educational assistance needed to implement conservation practices that are environmentally and economically compatible and that promote good stewardship of Indiana's soil and water resources. IDEM serves on the ICP with the following agencies and organizations:

- Natural Resources Conservation Service (NRCS)
- Farm Service Agency (FSA)
- State Soil Conservation Board
- Indiana State Department of Agriculture (ISDA)
- Indiana Department of Natural Resources (IDNR)
- Indiana Association of Soil and Water Conservation Districts (IASWCD)
- Purdue University Cooperative Extension Service

The ICP meets bimonthly for partner updates, to coordinate and collaborate where possible to optimize their resources – particularly their various cost-share and grant programs – and the technical training they can provide for achieving water quality objectives. The ICP also prepares an annual work plan that defines objectives for up to four conservation focus areas and includes the actions, responsible entities and deadlines for achieving them.

The ICP sponsors a number of initiatives that have the potential to improve water quality in Indiana. One example is the Conservation Cropping Systems Initiative, which provides education on the use of a system of practices that promote soil health. These include cover crops, nutrient and pest management, continuous no-till/strip-till, and precision farming, all of which can provide water quality benefits. Many of the agencies participating in the ICP also provide funding on a continuing or limited basis to address nonpoint source (NPS) pollution such as NRCS's Regional Conservation Partnership Program and ISDA's Clean Water Indiana (CWI) program.

Indiana's State Nutrient Reduction Strategy – a collaborative effort between ISDA and IDEM with contributions from other ICP partners – was developed in 2015 to provide a framework for reducing nutrients entering Indiana waters. As part of this strategy, the ICP has committed to report load reductions of sediment, nitrogen, and phosphorus achieved by the practices installed under various funding authorities of its participating agencies. ISDA technicians were trained by

IDEM NPS staff to use the U.S. EPA Region 5 model to calculate load reductions. For calendar years 2013 and 2014, the ICP has reported the following load reductions for the Indiana:

- Sediment – 2,658,398 tons/year
- Nitrogen – 4,901,344 pounds/year
- Phosphorus – 2,607,847 pounds/year

Indiana's State Nutrient Reduction Strategy along with maps showing the locations at which these reductions were achieved are available at: http://www.in.gov/isda/2991.htm. More detail information about the ICP and its activities can be found at: http://icp.iaswcd.org/.

National Water Quality Initiative

The U.S. Department of Agriculture (USDA) annually targets Farm Bill dollars to the NRCS National Water Quality Initiative (NWQI) Monitoring Project watersheds to promote the implementation of conservation practices. IDEM worked closely with NRCS to prioritize watersheds for the NWQI using the decision criteria of watersheds with impaired waters, high risk natural resource areas, active local watershed groups or conservation interests, and baseline water quality data. As a partner on the NWQI, the U.S. EPA requires IDEM, as the state agency in Indiana charged with implementing the CWA, to contribute monitoring resources to at least one NWQI watershed.

The watershed selected for NWQI monitoring is the School Branch watershed, a small (8.4 square miles) watershed located in northeastern Hendricks County, Indiana. School Branch is nested in the Eagle Creek watershed, which is located in the larger Upper White River Watershed. Land use in the watershed is predominately agricultural with interspersed residential areas. Soil classes in the School Branch watershed are predominantly poorly drained and the watershed is extensively tile drained. School Branch eventually drains into Eagle Creek Reservoir, a primary drinking water source for Indianapolis.

School Branch, Eagle Creek, and the Upper White River watersheds are on Indiana's 303d List of Impaired Waters due to high levels of nutrients. The size of the Eagle Creek and Upper White River watersheds (163 and 2,718 square miles, respectively) and the variety in land uses at these scales has made it difficult to evaluate the effects of conservation and land management strategies. Therefore, focusing on the much smaller School Branch watershed, in which 80% of the land use is agricultural, will allow researchers to adequately isolate water quality impacts from agriculture versus other sources.

Previous attempts to document water quality improvements from agricultural conservation practices at the watershed scale have proven particularly difficult due to the number of issues that can hinder the ability to attribute improvements to specific practices. These issues include:

- Insufficient baseline data
- Incomplete separation of agricultural influences from non-agricultural sources
- Inadequate sampling duration and intensity to account for "lag time", seasonal influences, and storm events
- Insufficient adoption of complete conservation systems within watersheds

A collaboration of federal, state, local, and academic entities along with dedicated conservation-minded farmers in the School Branch watershed has provided a unique monitoring opportunity to assess the chemical, physical, and biological impacts of conservation practices at the watershed, sub-watershed, and edge-of-field scales. The project is currently measuring water quality associated with conservation cropping systems that improve soil health in predominantly corn and soybean row crop agriculture.

The data collected in this watershed will allow evaluation of how production agriculture can complement sustainable water resources. In addition, because the School Branch watershed is nested within two successively larger watersheds of similar land use and hydrology, the project is monitoring and can model impacts of conservation at multiple scales. Historical data is also available to enhance the assessment of improvements over time.

Monitoring and evaluation efforts are being conducted at different scales by IDEM, the U.S. Geological Survey (USGS), the Indiana Geological Survey (IGS), the Marion County Health Department (MCHD), USDA-NRCS, and the Center for Earth and Environmental Services (CEES) at Indiana University - Purdue University, Indianapolis.

Through this monitoring – a collaborative effort without precedent in Indiana – these agencies and organizations are measuring streamflow and groundwater levels, collecting water samples from the stream and edge-of-field surface runoff, and monitoring sub-surface flows for nitrogen, phosphorus, and suspended sediment. Groundwater is also being monitored for nitrogen and phosphorus. Soils are being monitored as well, to determine moisture levels, water-holding capacity, and nutrient content. Supplementary biological indicators will used to evaluate factors affecting water quality and nutrient source tracking from field, in-stream bed and bank, and residential sources and sediment characteristics analyses will be conducted.

Thanks to conservation-minded farmers participating in this study, the research partners collaborating on this project will be better able to distinguish between the water quality effects associated with complete conservation cropping systems from other agricultural and non-agricultural sources of sediment and nutrients.

Indiana Water Monitoring Council

The Indiana Water Monitoring Council (InWMC), is a broad-based, state-wide organization whose primary mission is to enhance the communication, collaboration and coordination of professionals, organizations, and individuals involved in water monitoring within Indiana. As a charter member, IDEM has remained actively involved with the InWMC since its formation in 2008. IDEM staff serve on the board and on a number of InWMC committees to assist with activities to:

- Provide a forum for communication among groups involved in monitoring Indiana waters.
- Promote the sharing of monitoring data and information on effective procedures and protocols for sample collection.
- Facilitate the development of collaborative monitoring strategies.

The Ag Water Monitoring Forum is one example of the type of activities IDEM supports through its work on the InWMC. On August 28, 2015, the InWMC partnered with Indiana Farm Bureau, Purdue University's Agricultural Research Department, and the NRCS to convene a meeting of several leading researchers in the state who are focusing on the effects of conservation practices on water quality.

The meeting focused on the Indiana Nutrient Management and Soil Health Strategy, a 10-year plan developed through a collaborative effort of Indiana agricultural producers to help protect Indiana's soil and water resources through the optimization of nutrient management and implementation of practices to reduce nutrient loss from fields. Researchers and producers shared updates on the strategy and gathered input on recommended protocols and study designs for its continued implementation. The meeting agenda and presentations are available at the InWMC website: http://www.inwmc.org/event-1986971. The Indiana Nutrient Management and Soil Health Strategy, which is an addendum to the Indiana's State Nutrient Reduction Strategy, is also available online at: https://inagnutrients-public.sharepoint.com/.

Multiple state, federal, and local agencies and organizations are monitoring water quality within Indiana, each with its own mandate or reason for monitoring. Although each agency and organization is collecting potentially valuable data on Indiana's water resources, the lack of coordination can lead to duplication of efforts and important information that may be overlooked from the resulting lack of data sharing.

Members of the InWMC have overwhelmingly cited the need for a shared understanding among the water resources community of existing active monitoring networks within Indiana as critical to more effective management of water resources throughout the state. Shortly after its formation, the InWMC's Coordination and Collaboration Committee responded to this need by convening the Integrated Water Monitoring Network Optimization Taskforce to begin working toward a better understanding of the monitoring efforts going on throughout the state.

Soon, the InWMC will release the first product of the taskforce – a study of ongoing monitoring networks throughout Indiana to help environmental managers, researchers, and interested citizens find data from sampling sites with long periods of record. The study will highlight the existing river and stream water quality networks that can provide data and identify new sites that may be needed to augment existing networks and/or eliminate sites that are currently being monitored by more than one group. The paper is currently in draft and is expected to be published later in 2016. In the meantime, those wanting to learn more about the InWMC can find more information about its activities as well as a number of resources online at: www.InWMC.org.

Indiana State Revolving Fund Loan Program

The Indiana State Revolving Fund (SRF) Loan Program administers two different loan programs that provide low-interest loans to Indiana communities, one for projects that improve drinking water and the other for wastewater infrastructure projects. The Indiana Finance Authority administers these programs to protect public health and the environment. Cities, towns, counties, regional sewer/water districts, and conservancy districts are eligible for the programs. Private and not-for-profit public water systems and water authorities are alsoeligible for drinking water SRF loans.

Eligible projects include those that abate water pollution problems, provide greater protection for public health or ensure compliance with either the CWA or the Safe Water Drinking Act. Wastewater projects may include wastewater treatment plant construction or improvements, sewer line extensions to existing unsewered areas, decentralized treatment systems, combined sewer overflow elimination and infiltration/inflow corrections. Drinking water projects may include treatment plant construction and improvements, water storage facilities, water distribution systems and water supply. The program provides additional financial incentives to projects to include green technology, a Brownfields Program[2] project or a sustainable infrastructure component.

Both SRF Loan Programs offer a 20-year, fixed rate loan term. Interest rates on loans through the SRF Programs use a base interest rate, which is reset on the first business day of each January, April, July, and October. The base rate is calculated by using 90 percent of the average 20-year AAA-rated, general obligation bond Municipal Market Data composite index for the most recent calendar month. The base rate is then discounted further based upon a community's median household income from 2010 census data and projected user rates. As an incentive to communities to address nonpoint source water pollution, for projects with a NPS component or green/sustainable infrastructure components, the interest rate on their loans may be reduced by up to 0.5 percent. The program has established a floor of two percent as the lowest possible interest rate, including any reductions.

[2]The Indiana Brownfields Program works in partnership with the U.S. Environmental Protection Agency and other Indiana agencies to assist communities with redevelopment of "brownfield" properties where making productive use redevelopment is complicated due to actual or potential environmental contamination.

The SRF Loan Programs coordinate with state and federal programs, including IDEM's OWQ, to identify ways it might provide assistance to Indiana communities that will ultimately help to achieve common goals. For example, the Clean Water SRF ranking and scoring gives additional points for projects that remove a pollutant source from an impaired stream. This way of scoring increases the likelihood that projects with a water quality benefit will rank high on the SRF project priority list. The funds loaned for these removal projects can be documented as a match, when applicable, for projects submitting grant proposals to the NPS Program. Projects eligible for match must provide water quality benefits to their respective communities and may include, but are not limited to, one or more of the following:

- Wetland restoration/protection
- Erosion control measures
- Groundwater remediation
- Repair or replacement of failing septic systems or connection to sewer
- Storm water BMPs
- Source water and wellhead protection
- Conservation easements
- Agricultural and waste management BMPs

The SRF Loan Programs also serve on the Indiana Rural Wastewater Task Force's Environmental Infrastructure Working Group, which allows the SRF Program the opportunity to provide input and offer financing options to communities for their drinking water and/or wastewater infrastructure needs. The SRF Loan Programs work with communities addressing combined sewer overflows, enforcement issues or those with or nearing a sewer ban.

Over the State Fiscal Years (SFYs) 2014 and 2015, one project with a NPS component saved an additional $3,314,189 over the 20-year term of their loans. While these savings are realized over the longer term, these projects are typically completed within two years and the water quality benefits are achieved much sooner than 20 years.

Annex 4 of the Great Lakes Water Quality Agreement

The 2012 amendments to the Great Lakes Water Quality Agreement (GLWQA) included Annex 4 on nutrients. The Annex 4 binational subcommittee was established in 2013 to coordinate binational actions to manage phosphorus loadings and concentrations in the Great Lakes. Indiana has been an active member of this subcommittee since its inception. The GLWQA Lake Ecosystem Objectives include the following:

- Minimize the extent of hypoxic zones in the Great Lakes due to excessive phosphorous loading with emphasis on Lake Erie.
- Maintain levels of algal biomass below nuisance level conditions.
- Maintain algal species consistent with healthy aquatic ecosystems in nearshore waters.

- Maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health.
- Maintain an oligotrophic state, relative algal biomass, and algal species consistent with healthy aquatic ecosystems in the open waters of Lakes Superior, Michigan, Huron and Ontario.
- Maintain mesotrophic conditions in the open waters of the western and central basins of Lake Erie, and oligotrophic conditions in the eastern basin of Lake Erie.

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 ecosystem objectives for each lake, starting with Lake Erie.
- 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 2018, develop a binational phosphorous reduction strategy and domestic action plans 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 phosphorous reduction targets for Lake Erie, which are noted in Table 6 (Appendix A). Indiana's Domestic Action Plan (DAP) will be led by IDEM and developed by a steering committee comprised of representatives from different stakeholder sectors. The DAP will follow an outline that includes purpose, background, goals, objectives, tactics, and measuring and reporting progress.

Indiana's portion of the Western Lake Erie Basin is comprised of the St. Joseph, Maumee, Auglaize, and St. Marys watersheds. The St. Joseph River and the St. Marys River enter Indiana from Ohio and, at their confluence, form the Maumee River. The Maumee flows eastward into Ohio and into Lake Erie. The 40 percent reduction in spring-time total phosphorus and soluble reactive phosphorus noted in Table 6 for the Maumee River translates to a flow-weighted mean concentration of 0.23 milligrams per liter total phosphorus and 0.05 milligrams per liter soluble reactive phosphorus. Progress toward these target values will be measured on the Maumee River as close to the Indiana-Ohio border as feasible. A draft of the DAP will be available by December 31, 2016.

COST/BENEFIT ASSESSMENT

Water is a vital component of the economic health of Indiana, which is diverse in its agriculture, industry, population, and environmental resources. Finding the right balance between these often competing needs promises the benefits associated with a robust economy, high quality of life, and healthy ecosystems. However, the finances available to restore, enhance, and protect our water resources is limited in comparison to the work needed to ensure that balance. The following is a discussion of some of the revenue sources available to state, regional, and local

entities to achieve the objectives of the Clean Water Act (CWA) as well as case studies that illustrate improvements in water quality and their resulting benefits.

Funding Water Quality Improvements through Better Infrastructure

Since 1992, the State Revolving Fund (SRF) Programs have provided more than $3.7 billion dollars for more than 679 wastewater (Figure 2, Appendix B) and drinking water (Figure 3, Appendix B) infrastructure improvement projects. SRF Program assistance to communities is expected to result in water quality benefits for many Indiana rivers and streams.

In state fiscal years (SFYs) 2014 and 2015, the Wastewater SRF Program closed 34 loans totaling almost $300 million. This provided an estimated savings (compared to open market interest rates) of more than $64.5 million. In SFYs 2014 and 2015, the Drinking Water SRF Program closed on 22 loans for totaling almost $40 million with savings to Indiana communities estimated at more than $19 million (Table 7, Appendix A).

Successes in Water Quality Improvement through Strategic Measures

IDEM has reported improvements in water quality in almost 220 miles of streams in 12 different watersheds since 2007 to the U.S. Environmental Protection Agency (U.S. EPA) to meet measures outlined in U.S. EPA's strategic plan (Table 5). Measure SP-12 (commonly called "Measure W") is used by U.S. EPA to track improvements in water quality conditions in impaired watersheds resulting from watershed planning and restoration activities. For the purposes of meeting this measure, improvements may be demonstrated by the removal of at least 40 percent of the impairments or impaired miles/acres in the watershed from the state's 303(d) List of Impaired Waters or by valid scientific information that indicates significant watershed-wide improvement in one or more water quality parameters associated with impairments listed on Indiana's 2002 303(d) list. WQ-10 is a performance measure that requires states to develop Nonpoint Source (NPS) Program "Success Stories" and submit them to U.S. EPA for the purposes of tracking how NPS restoration efforts are improving water quality. To meet this measure, IDEM must identify nonpoint source-impaired waters that have been improved as a result of watershed restoration efforts funded in whole or in part by IDEM's NPS Program.

In 2014 and 2015, IDEM reported water quality improvements in the Emma Creek and Indian Creek watersheds, respectively. Two additional stories will be reported in 2016. These successes and others can be found on U.S. EPA's Nonpoint Source Success Stories website.

Reducing Livestock-Induced Pollution in Emma Creek

Emma Creek is a 38.2-mile tributary to the Little Elkhart River, which flows through southeastern Lagrange County in northeastern Indiana. IDEM monitored a small, 2.3-mile tributary to Emma Creek in 2000, collecting fish community and habitat data along with water chemistry samples. Analysis of fish community data showed an Index of Biotic Integrity score of 14, well below the score necessary to be considered supportive of the biological integrity. In addition, habitat and chemistry data collected by IDEM in 2000 revealed that siltation, excess

nutrients and low dissolved oxygen (particularly during the summer months) contributed to impaired biotic communities in the stream. IDEM's analyses of water samples also showed an ammonia level much higher than the state's water quality criterion for the protection of aquatic life. These results prompted IDEM to add the stream to the 303(d) list in 2002 for impaired biotic communities (IBC) and ammonia. Suspected pollutant sources included barnyard runoff, failing septic systems, and livestock access to the stream.

The Lagrange County Soil and Water Conservation District (SWCD) developed a watershed management plan (WMP) for the Little Elkhart River in 2007 using water quality data collected from June 2005 through December 2006 to guide the efforts. As part of the WMP implementation, the SWCD conducted a paired watershed study on the upper and lower Emma Creek subwatersheds from 2009 to 2011 (Figure 4, Appendix B). In the paired study, the lower watershed was used as the control watershed while project partners implemented best management practices (BMPs) in the upper watershed – the treatment watershed.

Between 2009 and 2010, landowners installed numerous BMPs in the Little Elkhart River watershed including the upper Emma Creek treatment watershed. As a result, water quality in the Emma Creek Tributary is improving. Data collected along the impaired segment (Figure 4) show that pollutant levels decreased in 2009–2010 as compared to 2007–2008 (Table 8, Appendix A).

Key to this restoration effort was the participation of members of the Amish community, which comprises about 75 percent of the agrarian population of the Emma Creek watershed. Participation in cost-share programs by this community has been traditionally low. Outreach and education proved to be a successful strategy in convincing the community to change their management practices to protect water quality, including installing some BMPs without financial assistance.

Data collected by the SWCD at the mouth of Emma Creek showed similar improvements in water quality, indicating that the benefits realized by the BMPs implemented in the upper watershed carry through the watershed and into the Little Elkhart River. Net load reductions in the Emma Creek watershed were 42 percent for *E. coli*, 20 percent for nitrates, 58 percent for total suspended solids, 63 percent for total phosphorus, and 89 percent for ammonia. With the exception of *E. coli*, all of these parameters are associated with watershed-based improvements eventually leading to healthier biological communities.

In 2011 IDEM returned to the Emma Creek tributary to monitor for improvements in the fish community. The IBI score indicated that no significant change in biological condition has yet occurred suggesting a time-lag between BMP implementation and the habitat recovery necessary to fully support a healthy fish community. Although the SWCD data appear to show that ammonia levels are meeting water quality standards, the stream cannot be removed from the 303(d) list for ammonia until data meeting IDEM's data quality requirements for CWA Section 305(b) assessments are available. The impaired segment must remain listed as impaired for both IBC and ammonia.

These water quality improvements are the result of collaboration between the Lagrange County SWCD, IDEM, Indiana Department of Natural Resources, the Great Lakes Commission and the Natural Resources Conservation Service (NRCS). The Lagrange County SWCD sponsored the development of the WMP and coordinated the implementation of the paired watershed study with funding and assistance from IDEM. IDEM also provided more than 1.7 million in CWA Section 319(h) funding to implement BMPs. The Indiana Department of Natural Resources and Great Lakes Commission provided additional funding for watershed land treatment practices and implementation of the WMP, with contributions of $75,000 and $515,000, respectively. NRCS provided engineering design and support. And, landowners in the watershed paid $30,000 out-of-pocket to install BMPs without the added incentive of cost-share funding.

Watershed Restoration Work Improved a Section of Indian Creek

The Devils Backbone section of Indian Creek is a 21-mile reach in Harrison County, Indiana, just upstream of Indian Creek's confluence with the Ohio River (Figure 5, Appendix B). Water quality data collected from this reach by IDEM in 2000 indicated that the geometric mean of the *E. coli* samples collected as well as the individual sample results exceeded the state's water quality criteria for recreational use. In addition, four out of the six dissolved oxygen results were below the levels set in the water quality standards for the protection of aquatic life use. Given these results, IDEM added the Devils Backbone section of Indian Creek to the 303(d) list in 2002 for and *E. coli* and low dissolved oxygen.

From 1996 to 2010, numerous state and federal partners and other organizations funded watershed planning and restoration efforts in the Indian Creek watershed. As a result, water quality conditions in the Devils Backbone reach have improved.

From 1996 to 2006 The Nature Conservancy (TNC) provided $210,000 is funding for stream restoration and outreach projects in the Indian Creek watershed. Then in 2006, IDEM awarded the Harrison County Regional Sewer District a CWA Section 205(j) almost $100 thousand in grant funds to develop a watershed management plan (WMP) for the Indian Creek watershed. The resulting WMP helped to inform the installation of numerous BMPs throughout the watershed, targeting areas where they might have the greatest impact.

Project partners in the Indian Creek watershed used $687,567 in financial and technical assistance provided through the NRCS' Environmental Quality Incentives Program (EQIP) to implement numerous conservation practices between 2003 and 2010. Additional practices were also installed during this time with $55,094 in Farm Service Agency (FSA) Conservation Reserve Program (CRP) funds. Harrison County also allocated $950,000 between 2002 and 2010 toward agricultural BMPs in the county and used funding from the Clean Water Indiana state fund to install additional BMPs in the Indian Creek watershed.

In 2010, IDEM returned to monitor the Devils Backbone reach of Indian Creek and found that water quality has improved, with results meeting the state's water quality standards for *E. coli* and dissolved oxygen. Based on these results, Indiana removed the Devils Backbone section of Indian Creek from its 2014 CWA section 303(d) impaired waters list.

Grand Calumet River Indiana Harbor Ship Canal Area of Concern

Prior to strict environmental regulations industries, factories, and municipal sanitary districts commonly discharged chemicals and contaminants directly into the Grand Calumet River in northwest Indiana. The accumulation of such pollution containing oils and greases in the river sediments caused drastic harm to the ecosystem. By the 1980s, new environmental regulations changed how municipalities and industries could operate, which reduced the amount of contaminants being discharged into the river. However, even with new operational standards the impacts of legacy contaminants – those discharge prior to the change in regulations – had already caused great harm to the river. The Grand Calumet River was highly impaired for human and wildlife use and as a result, was identified by the International Joint Commission as an Area of Concern (AOC). The Grand Calumet River Indiana Harbor Ship Canal AOC is one of 43 AOCs identified by the commission in its 1978 Great Lakes Water Quality Agreement (GLWQA). The GLWQA requires that each AOC have a Remedial Action Plan (RAP) developed for it to provide a blueprint for the remediation of 14 designated beneficial use impairments (BUIs) of the waterway.

1. Restrictions on fish and wildlife consumption
2. Tainting of fish and wildlife flavor
3. Degradation of fish and wildlife populations
4. Fish tumors or other deformities
5. Bird or animal deformities or reproduction problems
6. Degradation of benthos
7. Restriction on dredging activities
8. Eutrophication or undesirable algae
9. Restrictions on drinking water consumption, or taste and odor
10. Beach closings
11. Degradation of aesthetics
12. Added costs to agriculture and industry
13. Degradation of phytoplankton and zooplankton populations
14. Loss of fish and wildlife habitat

For Indiana this meant that IDEM would take the lead in developing the RAP with the aid of the Citizens Advisory for the Remediation of the Environment (CARE) Committee – a group of individuals selected by IDEM to provide input into the RAP planning process.

The RAP identifies key projects including sediment remediation for the entire river system as well as habitat restoration on over 900 acres. Through the assistance of the Great Lakes Legacy Act (GLLA) and the Great Lakes Restoration Initiative (GLRI) as well as funding from state and local sponsors, significant progress has been made toward the RAP restoration goals. In 2011 and 2012 respectively BUI #12 and BUI #9 were removed from the list of impairments for the Grand Calumet River Indiana Harbor Ship Canal AOC. Since the early 2000s more that 3.25 million cubic yards of contaminated sediments containing heavy metals, polycyclic aromatic hydrocarbons, and polychlorinated biphenyls have been removed. An additional 14,600 cubic

yards of sediment are expected to be removed by the end of 2016. Habitat restoration has also been a priority, with GLLA projects restoring 84 acres of wetland and riverine marshes including Roxana Marsh in East Chicago, Indiana and Seidner Dune and Swale in Hammond, Indiana. In addition, the GLRI has funded the restoration of more than 800 acres throughout the AOC including key dune and swale habitats such as Clark and Pine Nature Preserve, DuPont Natural Area and Gibson Woods Nature Preserve. GLRI-funded projects are expected to conclude in 2020.

Monitoring throughout the restoration process is essential to ensure work is on track to meet restoration goals. IDEM has implemented monitoring projects to assess fish and benthic communities, water chemistry and aesthetics and provides GLRI funds to universities and federal agencies to monitor algal and plankton populations in the river and conduct microbial source tracking at AOC beaches.

SPECIAL STATE CONCERNS AND RECOMMENDATIONS

Reductions in federal and state resources for data collection and analysis coupled with increased federal directives and competing policy and program objectives continue to strain IDEM's ability to optimize its limited resources to monitor Indiana waters in order to support Office of Water Quality (OWQ) programs and emerging state priorities.

IDEM acknowledges that fiscal responsibility may necessitate reductions in funding and staffing levels. In light of these constraints, IDEM recommends the following actions:

- Increase states' flexibility to allocate the federal funding it receives to take advantage of and optimize other funding sources.
- Combine supplemental and base funding to states provided through Clean Water Act (CWA) Section 106 funds so that in lean times, maintaining current monitoring efforts may be considered by the U.S. Environmental Protection Agency (U.S. EPA) as a valid use of supplemental funds.
- Eliminate the use of states' 2002 303(d) lists as the baseline for showing CWA program successes – this is a false construct that fails to recognize that other more recently listed waters may be better candidates for restoration in the short term.
- Acknowledge the continuum of progress demonstrated by social indicators or other factors in addition to measurable water quality improvements.

SURFACE WATER MONITORING AND ASSESSMENT

IDEM conducts most of its surface water monitoring through various programs in the Watershed Assessment and Planning Branch (WAPB). This section includes a discussion of IDEM's surface water monitoring strategy, a description of the assessment methodology for classifying all surface waters according to the degree to which they meet their designated uses, and the most current assessment results available. This section also provides a description of Indiana's Wetlands Program, an analysis of surface water quality trends, and information on public health issues.

SURFACE WATER MONITORING STRATEGY

The United States Environmental Protection Agency (U.S. EPA) recommends that states develop a comprehensive monitoring program strategy for collecting the data and information needed to address its water quality management needs. IDEM developed its first IDEM's Water Quality Monitoring Strategy (WQMS) in 1995 (IDEM, 1995), which has undergone a number of revisions, most recently in 2011 (IDEM, 2010). Table 10 shows the Office of Water Quality's (OWQ's) primary water quality monitoring objectives identified in IDEM WQMS and the types of monitoring needed to meet them.

IDEM's WQMS uses a watershed approach to prioritize water quality management needs and the monitoring activities intended to meet them. Most of IDEM's surface water monitoring is conducted by the WAPB within IDEM's Office of Water Quality (OWQ). The WAPB includes several Clean Water Act (CWA) programs and conducts both targeted and probabilistic (randomized) monitoring to meet the following objectives:

- To fulfill requirements of the CWA Sections 305(b), 303(d) and 314 to assess all waters of the state to determine if they are meeting their designated uses and to identify those waters that are not.
- To support OWQ programs including WQ standards development, NPDES permitting, and compliance.
- To support public health advisories and address emerging water quality issues.
- To support watershed planning and restoration activities.
- To determine WQ trends and evaluate performance of programs.

For its Probabilistic Monitoring Program, IDEM has divided the state into nine major water management basins and employs a rotating basin strategy that targets a different basin each year (Figure 6, Appendix B). IDEM's 305(b) assessment and 303(d) listing processes also follow this rotating basin approach, which ensures that all basins in the state are assessed at least once every nine years.

Probabilistic monitoring is conducted within a given basin and the results are reviewed for quality assurance and quality control in year one. In year two, the quality-assured data are used to make water quality assessments for the basin. These assessments and any waterbody impairments identified through these assessments are reported in the next biennial integrated reporting cycle. Appendix G provides a detailed schedule of IDEM's 305(b) assessment and reporting, and 303(d) listing activities before and after the change made to the rotating basin approach.

IDEM's targeted monitoring programs select sites based on their specific program objectives. Therefore, data collected from these programs in a given year may come from anywhere in the state, which may or may not include the basin monitored by the Probabilistic Monitoring Program that year. These data are likewise quality assured and are assessed as they become available.

The following monitoring programs are employed to achieve the above objectives:

- Probabilistic monitoring in one basin/year on a nine-year rotating basin cycle.
- Fixed station monitoring at 163 sites across the state.
- Fish tissue and sediment contaminants' monitoring on a five-year rotating basin cycle.
- Targeted monitoring for TMDL reassessments and development, watershed baseline planning, and performance measures.
- Cyanobacteria monitoring of 10-12 lakes.
- Special studies such as that conducted to support hydrographically controlled release facilities.

Lakes monitoring is conducted by the Indiana Clean Lakes Program (CLP) under contract for IDEM and is discussed in later sections of this report.

Probabilistic Monitoring Program

IDEM's Probabilistic Monitoring Program samples at least 38 randomly selected sites in a given basin and is the primary source of data used in IDEM's CWA assessments. This program, which focuses specifically on rivers and streams, is designed to characterize the overall water quality in each major river basin and to identify specific waterbodies within each basin that are not fully supporting their beneficial designated uses.

IDEM uses the data collected by the Probabilistic Monitoring Program to make water quality assessments of rivers and streams at two different spatial scales, reach-specific assessments and basin-wide assessments.

Reach-specific Use Support Assessments

IDEM uses the data collected by the Watershed Monitoring Program to make use support assessments of the stream or stream reach from which they were collected and any other reaches for which the results are representative. For these assessments, the water quality data are compared to applicable water quality criteria to determine whether or not the reach or reaches represented by the data are supporting one or more of their designated uses. Results from IDEM's reach-specific assessments are summarized in the "Rivers and Streams Water Quality Assessment" section of this report. In addition to data collected through the Watershed Monitoring program, IDEM also uses data collected by the agency's other water monitoring programs to make reach-specific assessments and may use data from external sources if they meet the necessary data quality requirements.

Comprehensive Use Support Assessments

Comprehensive assessments are statistical calculations that allow IDEM to predict with reasonable certainty the percentage of Indiana's rivers and streams within a given basin that are either impaired or supporting their designated uses. Comprehensive use support assessments are

based solely on the reach-specific assessment results from data collected by the Probabilistic Monitoring Program because, unlike data collected through other IDEM monitoring programs and most external organizations, these data are collected using a probability-based sampling design, which is necessary to make statistically valid calculations.

IDEM's comprehensive use support assessments and its reach-specific assessments of designated use support provide water quality information in two very different ways, and IDEM uses both types of assessments to meet different CWA requirements. The agency's comprehensive assessments, which rely on probabilistic data, provide statistically valid statements about the overall water quality throughout Indiana on a basin level, which allows IDEM to meet the CWA requirement to assess all the waters of the state. These results are stated as the percentage of the total stream miles in each basin meeting their designated uses and the percentage that are impaired. These percentages are statistically derived and cannot be applied to specific streams or stream reaches. Given this, they do not identify where specific impairments exist, which is required by Section 303(d) of the CWA. Information regarding the location of impairments is provided by IDEM's reach-specific results, which are based on data collected from a variety of sources including IDEM's Probabilistic Monitoring Program.

This report provides comprehensive assessments for watersheds in all of Indiana's major basins (Appendix H) in addition to summaries of results from IDEM reach-specific assessments (Appendix I). This report also includes the 2016 draft 303(d) List of Impaired Waters (N), which identifies waters that are impaired for one or more designated uses.

This report builds on the water quality assessment results reported in the 2014 Integrated Report and includes revised assessments for the Patoka River monitored in 2012 and the East Fork White River monitored in 2013. This report also contains assessment information based on total maximum daily loads developed in other basins throughout Indiana.

DATA QUALITY ASSURANCE AND QUALITY CONTROL

To ensure the quality of the data used in IDEM's Clean Water Act Section 305(b) assessments, all surface water monitoring is conducted in accordance with IDEM's quality assurance project plan (QAPP) for its surface water monitoring programs. This QAPP is part of IDEM's overall quality management plan approved by the U.S. Environmental Protection Agency (EPA). IDEM's surface water monitoring QAPP was most recently revised in October 2004 and complies with the 2002 U.S. EPA guidance (U.S. EPA, 2002).

The QAPP outlines specific data quality objectives and serves as a tool for planning for the collection of environmental data to support IDEM Office of Water Quality needs. Additionally, the QAPP describes a well-defined data quality assessment process for reviewing analytical data and categorizing analytical results in one of four levels of data quality. These data quality levels are used to determine the usability of the data for water quality assessments and other decisions.

DATA MANAGEMENT

Management of Water Quality Monitoring Data

IDEM's Watershed Assessment and Planning Branch (WAPB) in the Office of Water Quality (OWQ) maintains its surface water quality data in the Assessment Information Management System (AIMS) database. The AIMS houses several types of data including surface water chemistry data, fish and macroinvertebrate community data, assessments of habitat quality, results from algal monitoring, and fish tissue and sediment contaminant data.

Water chemistry and fish community results from water quality monitoring programs which were collected prior to 2014 have been uploaded into the new U.S. Environmental Protection Agency (EPA) EnviroFacts Data Warehouse through the Water Quality Exchange (WQX). IDEM is continuing modifications to the AIMS database that will improve quality control and usability of results uploaded through the WQX.

Recent modifications to the AIMS database now allow for more efficient datasheet upload and retrieval with additional search functions for faster query building through a user-friendly interface for staff members. AIMS also now allows for storage of additional water quality data from nonpoint source (NPS) projects (including estimated load reductions) and third-party datasets for potential use in assessing waters for the integrated report. IDEM is now receiving data from NPS projects for import into the AIMS database. IDEM is working to develop and implement standard operating procedures for receiving, assessing, and importing water quality data from third-party sources to make them more readily available for potential use in IDEM's water quality assessments.

The load reduction estimates provided by the NPS project sponsors, which are housed in AIMS and reported to U.S. EPA through its Grants Reporting and Tracking System are included in this report (Table 4). The load reductions are estimated using models and are used to assist in the evaluation of water quality sampling data collected by the project sponsors and IDEM WAPB staff.

Management of Water Quality Assessment Information

IDEM's WAPB maintains IDEM's assessment database (ADB). The assessment database houses the CWA Section 305(b) assessment decisions that have been made on the basis of the results stored in the AIMS database.

In the ADB, water quality assessment information is associated with a specific waterbody assessment unit (AU), which is assigned a unique assessment unit identifier (AUID). The geographical extent and location of each AU within a given watershed based on its 12- or 14-digit hydrologic unit code (HUC)[3] is defined for mapping purposes through a process called

[3] Hydrologic unit codes (HUCs) are a numbering system used to identify watersheds at various scales. The length of the code corresponds to the relative size of the watershed with 12- or 14-digit HUCs assigned to smaller watersheds that lie within larger watersheds, which are identified by 8- or 10-digit HUCs.

reach indexing. Reach indexing uses tools that work within geographical information systems (GIS) software to associate one or more reaches of a given waterbody to a single AU and to "key" these AUs to the National Hydrography Dataset (NHD)[4]. This "key" is called the Reach Index. By associating the information in the ADB to its geographic location, the Reach Index allows IDEM to display assessment information on a map through the use of GIS software.

Indiana lakes and reservoirs, including Lake Michigan, are each treated as a single AU and assigned an AUID based on the 12- or 14-digit watershed in which they are located. Sizes are reported in acres.

Indiana's Lake Michigan shoreline is divided into five separate AUs with AUIDs based on the 8-digit HUC in which each shoreline reach is located. The shoreline is measured and reported in miles.

All flowing waters are measured and reported in miles. The Ohio River is divided into 69 AUs ranging in size between 2-14 miles and with AUIDs that are likewise associated with the 8-digit HUCs in which they are located. Other Indiana rivers and streams in the Reach Index may be divided or combined into one or more AUs, each of which is assigned an AUID based on the 12-digit HUC in which it is located. The length of a stream AU can vary, and a single AU may or may not represent the entire stream to which it is associated. For example, large rivers are commonly broken into smaller, separate AUs while smaller streams may be grouped together into a single, "catchment" AU based on hydrology and other factors that can affect water quality. More detailed information on how IDEM determines the size extent of a given AU is provided in its Consolidated Assessment and Listing Methodology (Appendix N).

IDEM's biennial Integrated Report (IR) to U.S. EPA includes the ADB. U.S. EPA extracts the data contained in the ADB for incorporation into its Assessment, TMDL Tracking and Implementation System (ATTAINS). ATTAINS is a national database U.S. EPA uses to evaluate assessment data submitted by states and to make those data available to the public online.

In 2014, U.S. EPA convened four workgroups to redesign ATTAINS. These workgroups were comprised of headquarter and regional staff along with staff from several state agencies. IDEM participated in two of these workgroups to help:

- Define the data elements needed in the redesigned ATTAINS.
- Draft an extensible markup language schema for exchanging integrated reporting information between the states and U.S. EPA.
- Develop recommendations on data exchange approaches and system design.

[4] The NHD is a database created by the U.S. EPA and the United States Geological Survey that provides a comprehensive coverage of hydrographic data for the United States. It uniquely identifies and interconnects the stream segments that comprise the nation's surface water drainage system and contains information for other common surface waterbodies such as lakes, reservoirs, estuaries, and coastlines.

The new ATTAINS became available for states to begin using in late 2015. In 2016, IDEM will begin migrating the assessment data presently housed in its ADB to the new ATTAINS online. Once this process is complete and the data verified, IDEM will begin entering its water quality assessments and other integrated reporting information directly into ATTAINS instead of sending its ADB to U.S. EPA for upload into the system.

WATER QUALITY ASSESSMENTS

Indiana's water quality standards (WQS) provide the basis for IDEM's Clean Water Act (CWA) Section 305(b) water quality assessments and are intended to protect the beneficial uses for Indiana waters. IDEM's water quality assessments determine the degree to which Indiana's waterbodies are supporting aquatic life use, recreational uses, and fishable uses. IDEM also assesses drinking water use support on surface waters that serve as a public water supply. There are additional uses for Indiana waters described in the state's WQS. However, IDEM limits its assessments to these four because the criteria in place to protect them are more stringent than those necessary to protect other uses. Thus, by protecting these uses, other uses such as agricultural and industrial uses are also protected.

Water Quality Data Used to Make Designated Use Assessments

IDEM uses all existing and readily available data to make its CWA Section 305(b) water quality assessments, including data collected by IDEM's water quality monitoring programs as well as external sources whenever possible. Internally, IDEM draws from the following Office of Water Quality (OWQ) monitoring programs:

- Probabilistic Monitoring Program
- Fixed Station Monitoring Program
- Contaminants Monitoring Program
- Performance Measure Monitoring Program
- Special Studies Program
- Watershed Characterization Program

In addition to the water quality data IDEM collects, the agency reviews data from other sources for potential use in its CWA assessments, including data collected through partnerships with other state and federal agencies and by nonpoint source grant projects, including the Indiana Clean Lakes Program (CLP).

IDEM is committed to making greater use of external data not only in its CWA Section 305(b) assessments but wherever possible in all OWQ programs. On September 23, 2015, IDEM launched its External Data Framework (EDF) to provide a systematic, transparent, and voluntary means for external organizations to share the water quality data they collect with IDEM for possible use in its CWA assessment and listing processes and other OWQ programs.

A number of organizations submitted their data sets in response to solicitations conducted by IDEM when the EDF was still under development. IDEM was able to complete its review of

these data and found that the external data sets shown in Table 11 (Appendix A) met the necessary data quality requirements for the 305(b) and 303(d) assessment and listing processes that were in place at the time they were submitted. However, with continued development of EDF, these requirements have since been revised.

In addition, the data sets in Table 11 were not standardized in any way in terms of their format or the data quality documentation provided. The time and staff resources required to review data sets from varied sources in various formats and with various levels of data quality documentation have long been significant barriers to the use of external data in the development of state 303(d) lists. The EDF will remove these barriers going forward.

For the 2016 cycle, IDEM focused its resources on completing development of the EDF rather than investing the significant time that would be required to re-evaluate data sets that may no longer be representative of current conditions. Now that the EDF is complete, IDEM will contact early EDF participants and work with them directly to submit any more current data they might have through one of the three data submittal processes built into the EDF. These processes are designed to facilitate broader solicitation and more efficient data quality review of external data going forward. In cases where the data set originally submitted are the only data available for the waterbody in question, IDEM will evaluate the data set as time allows to determine if the results are reliable for assessment despite their age.

External organizations can learn more about the EDF and how to participate on the agency's EDF website at http://in.gov/idem/cleanwater/2485.htm. Those interested in sharing their water quality data through the EDF and may begin submitting data sets to IDEM in one of three ways through the Secondary Data Portal at: http://www.hoosierriverwatch.com/portal/

Water Quality Assessment Methodology

IDEM's CWA Section 305(b) water quality assessments are conducted in accordance with its Consolidated Assessment and Listing Methodology (CALM), which is provided in Appendix N.

Water quality assessments are made for each designated use and waterbody type by comparing the available with the applicable WQS following the methods articulated in the CALM and summarized in Table 12 (Appendix A). Assessment results are then entered into IDEM's Assessment Database, which IDEM uses to compile its Consolidated List and 303(d) List of Impaired Waters.

Assessment Methods for Public Water Supply

IDEM's methods for determining support of the public water supply (previously referred to as the "Drinking Water Use") have changed very little since 2002 when IDEM published its first CALM. While these methods provide the ability to make assessments for a wide variety of potential drinking water contaminants, generally, there is very little data available for use in making such assessments. In addition, for lakes and reservoirs, IDEM's method for determining whether the source water is supporting the public water supply use relies solely on whether or

not a facility has applied for a permit to apply chemicals on the waterbody to control algae – an indirect measure of use support lacking the follow-through necessary to determine whether the chemicals were in fact applied.

Given these issues, IDEM convened an internal work group in 2015 to review the current methodology and explore ways to improve the assessment of the quality of surface waters designated as source waters for public water supplies. The result of this effort is a new set of methods for determining use support for waters that serve as a source of public water supply.

IDEM has published these methods in its notice of comment period for the draft 2016 303(d) list (Appendix L). IDEM hopes to implement these methods beginning with the 2018 integrated reporting cycle. However, further refinements may be needed based on the information received during the public comment period. In the meantime, although IDEM currently lacks the resources to support a new monitoring program dedicated to monitoring source waters for public water supplies, IDEM is continuing to explore strategies for increasing the amount of available data for source water assessments. IDEM believes that these methods, coupled with more readily available data for assessments, will result in greater protection of Indiana's public water supplies going forward.

Assessment Methods for the Ohio River

For the Ohio River, IDEM collaborates with the Ohio River Sanitation Commission (ORSANCO) to conduct water quality assessments of the river reaches that border Indiana. ORSANCO is an interstate water pollution control agency for the Ohio River established through a compact agreement between member states and approved by Congress. Under the terms of the compact, member states cooperate in the control of water pollution in the Ohio River Basin.

ORSANCO collects most of the data used to make assessments and works with the compact states to determine the degree to which the Ohio River is meeting its designated uses. Based on the results of this collaborative assessment, ORSANCO produces a CWA Section 305(b) water quality assessment report for the Ohio River every two years. Member states then incorporate those results into their individual CWA 303(d) lists in accordance with their individual 303(d) listing methods. A more detailed discussion of the Ohio River assessments can be found in IDEM's CALM (Appendix NAppendix N).

Although the assessment methodology for the Ohio River differs somewhat from the methods IDEM uses to assess other Indiana rivers and streams, the assessment results for all rivers and streams in Indiana, including the Ohio River are combined for the purposes of this report.

REPORTING WATER QUALITY ASSESSMENT RESULTS

Indiana's Consolidated List

For the purposes of CWA 305(b) reporting, IDEM employs a multi-category approach to develop the state's Consolidated List, which provides a full inventory of all Indiana waters IDEM tracks in its ADB and information regarding the degree to which they are supporting their designated uses.

With a multi-category approach, every waterbody in the ADB is placed into one of five categories (or subcategories where applicable) for each of the following designated uses: aquatic life use, recreational use, fish consumption[5], and public water supply[6].

For each use, a waterbody is assessed as fully supporting when it is found to be meeting the WQS applicable to the use. When a waterbody is not meeting one or more of the applicable standards, it is considered impaired, meaning it is not fully supporting the use. Figure 7 in Appendix B illustrates the decision-making process IDEM uses to determine the appropriate category for each use for which a waterbody is designated. A more detailed explanation of the five categories and their subcategories is provided in IDEM's CALM (Appendix N). The following provides a summary:

Category 1	The available data and/or information indicate that all designated uses are supported and no use is threatened.
Category 2	The available data/or information indicate the individual designated use is supported.
Category 3	The available data and/or other information are insufficient data to determine if the individual designated use is supported.
Category 4	The available data and/or information indicate that the individual designated use is impaired or threatened but a total maximum daily load (TMDL) is not required.
Category 5	The available data and/or information indicate the individual designated use is impaired or threatened, and a TMDL is required.

Indiana's Consolidated List for 2016 is provided in Appendix I and includes the results of all assessments of Indiana waters to date.

[5]Fish consumption is not a designated use in Indiana's WQS. IDEM assesses Indiana waters for fish consumption pursuant to current U.S. EPA policy and in keeping with CWA goals, which are reflected in Indiana's WQS (327 IAC 2-1-1.5 and 2-1.5-3.

[6]Applicable only to waters that serve as a routine or emergency source of water for a public water system.

Indiana's 303(d) List of Impaired Waters

The 303(d) List of Impaired Waters is a subset of the Consolidated List and includes only Category 5 waters – those for which a TMDL is required. Unlike the Consolidated List, which is required under CWA Section 305(b), the CWA Section 303(d) List of Impaired Waters is subject to U.S. EPA approval.

On May 8, 2013, U.S. EPA partially approved Indiana's 2010 303(d) List of Impaired Waters. U.S. EPA's partial approval is based on concerns regarding IDEM's methods for evaluating metals data for the purposes of determining impairment. More detail about these concerns and IDEM's response to them can be found online at: http://www.in.gov/idem/nps/3889.htm.

The issues delaying full approval by U.S. EPA remain unresolved. In the meantime, IDEM has continued to conduct water quality assessments and remains committed to reporting the results of its assessments to the public.

To ensure that Indiana's 303(d) list contains the most up-to-date assessment information, each 303(d) list builds upon the list developed for the previous two-year reporting cycle. Therefore, to develop its 2012 303(d) List of Impaired Waters, IDEM used the approved portion of the 2010 303(d) list as a starting point. IDEM used the same approach to develop the 2014 303(d) list and now, the draft 2016 303(d) list, building each from the list submitted for the previous cycle.

The Notice of Public Comment Period, which includes the draft 2016 Section 303(d) Impaired Waters List (Category 5 of the Consolidated List) and the Consolidated Assessment and Listing Methodology used to develop it is included in Appendix L of this report. The draft 2016 303(d) list reflects the most current information IDEM has regarding the status of impairment of Indiana's surface waters.

CLEAN WATER ACT SECTION 305(B) ASSESSMENTS

This report provides summary assessment results for designated use support for waters throughout Indiana based on waterbody type. Lakes and reservoirs are each assigned a single AUID with sizes reported in acres. Due to its large size and unique characteristics as compared to other freshwater lakes in Indiana, Lake Michigan and its shoreline are each discussed in separate sections of this report. Results for Lake Michigan reported in acres, and results for the shoreline are reported in miles. Assessment information for rivers and streams are likewise discussed in a separate section of this report with results given in miles.

Each section provides a table summarizing designated use support by individual use and total size in miles or acres. It should be noted that these values are not additive because a single waterbody is typically designated for at least three uses and sometimes four. Thus, adding the total values reported for each use would result in far more stream miles and lake acres than what actually exists in Indiana.

Summary results regarding the causes/stressors and sources of impairment are also provided for each water body type. As with the values in the summary tables for designated use support, the summary values in each table should not be added because doing so will artificially inflate the number of miles or acres actually impaired. A summary of the total number of impaired waters in Indiana waters to date is provided in Appendix O.

Causes of impairment identified in the summary tables are those pollutants or other stressors that contribute to the actual or threatened impairment of designated uses in a waterbody. In some cases, only the symptom(s) of impairment can be identified. For example, IDEM may have evidence that biotic communities in a waterbody are impaired but the data are insufficient to determine the actual pollutant or stressor causing the impairment. In these cases, the symptom – impaired biotic communities – are treated as the cause of impairment for the purposes of this report.

The sources shown in the summary tables are the activities that contribute the pollutant(s) or create other stressors that result in impairment of a designated use. For most assessments, the sources identified at the time of assessment for a given impairment are not precisely known, this is because IDEM's monitoring and assessment processes are designed to identify impairments, not specific sources.

Accurately attributing a given impairment to specific sources is difficult at best without more detailed and resource intensive sampling and analyses than and is in many cases impossible to do with a high degree of certainty. This kind of monitoring is typically conducted with watershed characterization monitoring during total maximum daily load (TMDL) development, which must identify the sources of impairment to a waterbody and develop recommended loadings to support its restoration.

The sources identified during the assessment process and summarized in the following sections represent those sources determined by IDEM staff to be the most likely sources given a variety of factors, including but not limited to:

- Land uses (as indicated by field observations and land use data from published sources such as the U.S. Geological Survey Gap Analysis Program, aerial photography, etc.).
- Field observations of potential sources such as illegal straight pipes, tillage to the stream's edge, livestock in the stream, etc.
- The presence of permitted facilities within close proximity of the impaired waterbody in cases where the impairment is something that could reasonably be expected to be associated with the discharge of those facilities.
- Naturally occurring conditions that could contribute to impairment.

IDEM believes that by using best professional judgment, scientists can distinguish the most likely sources of impairment in the watershed and provide a starting point for a TMDL, watershed planning or other activities aimed at restoring the waterbody.

Rivers and Streams Water Quality Assessment

Rivers and streams are assessed for support of aquatic life use, recreational uses, and fish consumption. Where there is sufficient data, rivers and streams that serve as a source water for a public water supply are also assessed to determine the degree to which they support such use.

The number of stream miles in Indiana that have been assessed to date, and the number of miles fully supporting and impaired are shown for each individual use in Table 13 (Appendix A).

Table 14 (Appendix A) represents the total miles of streams affected by each cause/stressor in Indiana. These tables include identified causes of impairment and symptom of other unknown causes, including impaired biotic community status. For these impairments, the fish and/or benthic macroinvertebrate communities have been found to be impaired by substances or stressors not yet identified.

Table 15 (Appendix A) includes all the potential sources driving one or more of the impairments in Table 14, and the total stream miles impaired due to each. Potential sources include agricultural sources and sources resulting from urban activities and land development. Illicit connections identify "straight pipes" from buildings in unsewered areas that flow into state waters with no or insufficient treatment. Contaminated sediments are largely due to polychlorinated biphenyls (PCBs) that correlate with elevated PCB levels in fish tissue.

Great Lakes Shoreline Water Quality Assessment

Indiana's entire portion of the Lake Michigan shoreline was last assessed in 2001 and was found to be fully supporting of aquatic life use and fully supporting its use as a public water supply for the 33 miles so designated. All 59 miles of the shoreline in Indiana were assessed as impaired for recreational use and fish consumption.

The required total maximum daily loads for the shoreline's recreational uses have been approved by U.S. EPA in 2004: http://www.in.gov/idem/nps/2856.htm. As a result, the *E. coli* impairments for which the shoreline has been assessed now appear in Category 4 of Indiana's Consolidated List while the fish consumption impairments for PCBs and mercury in fish tissue remain in Category 5 (Indiana's 303(d) list).

IDEM's assessment results are summarized in Table 16 (Appendix A). The specific causes of impairment to Indiana's Lake Michigan shoreline are reported in Table 17 (Appendix A), and the potential sources are summarized in Table 18 (Appendix A).

Lake Michigan Water Quality Assessment

Because Lake Michigan is assessed as a single unit, any impairment identified in any part of the lake is applied to all 154,176 acres of Lake Michigan. Assessments made in the Indiana waters of Lake Michigan indicate impairment for mercury and PCBs in fish tissue. Tables 19-21 in Appendix A reflect the results of these assessments.

Lake Water Quality Assessment

IDEM conducts two types of assessments on Indiana Lakes and Reservoirs. CWA Section 314 requires states to report on the trophic status and trends of all publicly owned lakes in Indiana, and CWA Section 305(b) requires states to report on the degree to which Indiana's lakes and reservoirs are supporting their designated uses. Both types of assessments and the methods with which they are conducted are described in IDEM's CALM (Appendix N).

IDEM evaluates lakes primarily for recreational uses and fish consumption for the purposes of CWA Section 305(b) assessments. While IDEM monitors several lakes and reservoirs for fish consumption, other types of monitoring for CWA Section 305(b) designated use support assessments of Indiana lakes is limited. As a result, IDEM's assessments have relied primarily on external data collected through the Indiana Clean Lakes Program for the purposes of CWA Section 314 assessments.

The monitoring conducted by the Indiana CLP provides results for all the parameters necessary to calculate an Indiana trophic state index (TSI) score, which allows IDEM to make both CWA Section 314 trophic state assessments and some CWA Section 305(b) assessments for recreational use. However, neither the individual parameter results nor the TSI scores are considered sufficient for determining the condition of biological communities for the purposes of Section 305(b) assessments for aquatic life use support.

Use support assessments of lakes and reservoirs for public water supply are also limited but for different reasons. Compared to other designated uses, which apply to all waters of the state, these assessments are made only to the relatively few lakes and reservoirs in Indiana that are used directly or indirectly as source water for public water supplies.

IDEM's assessment methods for CWA Section 305(b) assessments of lakes and reservoirs are described in more detail in its CALM (Appendix N, Attachment 1). Summary assessment results for the 2016 cycle are provided in Tables 22-24 (Appendix A).

CLEAN WATER ACT SECTION 314 ASSESSMENTS

Section 314 of the federal Clean Water Act (CWA) requires states to report on the trophic status and trends of all publicly owned lakes in Indiana. To determine the trophic state for a given lake (the amount of biomass present at the time the measurement is taken), IDEM uses Carlson's Trophic State Index (TSI), which can be calculated for three variables, each of which can be used as independent indicators of the trophic state of the lake or reservoir in question. The three indicators used are Secchi depth (SD), total phosphorus (TP), and Chlorophyll-*a* (CHL). Although any of the three could be used to determine trophic state, IDEM uses the TSI for CHL to make its trophic state assessments because CHL concentrations provide a more direct measure of phytoplankton abundance than SD or TP. Lakes are classified based on their TSI (CHL) scores. Higher scores are an indicator of nutrient enrichment, which can come from both natural sources and sources related to human activities. Details on how the TSI (CHL) scores are calculated can be found in IDEM's CALM (Appendix N).

For the purposes of this report, Indiana lakes were placed into one of four classes based on their trophic state as measured by the Carlson TSI (CHL) score. These classes are shown in Table 25 (Appendix A). A summary of the trophic status information for lakes assessed to date is presented in Table 26 (Appendix A).

Lake trends based on changes in trophic status over time as indicated by TSI scores are summarized in Table 27 (Appendix A). Approximately 19 percent of the lakes assessed to date (20 percent of the acres assessed) show some water quality improvement as measured by a reduction in their trophic scores. Forty-one percent of the lakes assessed (23 percent of the acres assessed) appear to have relatively stable trophic conditions. Thirty-six percent of the lakes assessed to date (53% of the total acres assessed) show an increase in their trophic scores indicating that the trophic conditions are degrading.

The water quality trend is fluctuating for four percent of the lakes (four percent of the acres assessed). For these lakes, the lack of detectable trend may be due to abnormal seasonal effects or changing activities in the surrounding watershed. An unknown trend is used in this report in cases where the available data are insufficient to determine a trend.

Waterbody-specific results for trend and trophic status and trends for Indiana's lakes and reservoirs statewide are provided in Appendix J.

PUBLIC HEALTH/AQUATIC LIFE CONCERNS

The release of toxic materials into the aquatic environment can produce harmful impacts:

- Contaminants present in acutely toxic amounts can directly kill fish or other aquatic organisms.
- Substances present in lesser, chronically toxic amounts can reduce densities and growth rates of aquatic organisms and/or become concentrated in their body tissues. These substances can be further passed to humans through consumption of the organism.
- Toxic materials in the water could potentially affect human health by contaminating public water supplies.

Fish Consumption

In the last several years, advances in analytical capabilities and techniques and the generation of more frequent and higher quality toxicity information on chemicals have led to an increased concern about their presence in the aquatic environment and the associated effects on human health and other organisms. Because many pollutants are likely to be found in fish tissue and bottom sediments at levels higher than in the water column, much of the data on toxic substances used for fishable use assessments in this report were obtained through IDEM's Contaminants Monitoring Program.

While not all species of fish found in Indiana lakes and streams have been tested, carp are commonly found to be contaminated with both polychlorinated biphenyls (PCBs) and mercury at levels exceeding the state's benchmark criteria for these contaminants in fish tissue. Waterbodies in which exceedances are found are considered impaired for fish consumption and placed on Indiana's 303d) List of Impaired Waters.

Fish consumption assessments are reported separately from aquatic life use in order to provide more information about each individual use. Concerns related to fish consumption should be evaluated independently by referring to the Indiana State Department of Health (ISDH) fish consumption advisories online at: http://www.in.gov/isdh/23650.htm. The 303(d) List of Impaired Waters is not designed to provide public health information whereas the fish consumption advisory is and as such is far more reliable for using in deciding how much fish might safely be consumed from a given waterbody.

Cyanobacteria and Algal Toxins

Blue-green algae (cyanobacteria) continue to be a concern in Indiana lakes and reservoirs both with respect to recreational uses and public water supply for drinking water. Blue-green algae are common constituents of algal communities in lakes and many are known to produce potent toxins, which are now recognized as a potentially serious threat to human and animal health. Microcystin is the cyanotoxin most commonly monitored. In 2010, IDEM piloted a targeted monitoring effort to support the development of an interagency process for the development of public health advisories for blue green algae and algal toxins. Monitoring is conducted statewide at 14 swimming areas owned or managed by the Indiana Department of Natural Resources (IDNR) on a monthly basis from May through August. Sampling frequency is increased to biweekly for lakes where cyanobacteria densities are found to be greater than 100,000 cells per milliliter, as recommended by the World Health Organization.

The public is kept informed of the status of the sampled swimming areas by the www.algae.IN.gov website and the IDNR site for the specific property. IDEM's website also incorporates public health information related to blue-green algae from the ISDH and the Board of Animal Health (BOAH) as well as other relevant information from government agencies and educational institutions. When the two-year grant period for the pilot project ended, IDEM incorporated a blue-green algae monitoring program as a part of its overall water monitoring strategy.

In 2010, IDEM also contracted with Indiana University's School of Public and Environmental Affairs (SPEA) to conduct a different, but related, pilot project to monitor Microcystin at all of the same lakes to be monitored for the Indiana Clean Lakes Program (CLP). Like the Microcystin monitoring conducted by IDEM, it is anticipated that the results from this monitoring will help IDEM to better understand the environmental variables associated with blue-green algal blooms and Microcystin production. However, results from the CLP Microcystin monitoring are not used to support the development of public health advisories because they are collected for a different purpose and use different methods than those used by IDEM to conduct its sampling.

IDEM does not use information collected through these monitoring programs to make 305(b) assessments because the environmental factors that influence the occurrence and production of algal toxins are still not well understood, and there are no federal drinking water standards for blue-green algae. However, algal toxins now appear on U.S. Environmental Protection Agency's (EPA's) federal drinking water contaminant candidate list (CCL 3), which is used to prioritize federal research and data collection efforts to help determine whether a specific contaminant needs to be regulated. Details regarding U.S. EPA's CCL are available online at: http://water.epa.gov/scitech/drinkingwater/dws/ccl/ccl3.cfm#microbial. It is anticipated that as more scientific information becomes available, including the development of a federal water quality criteria for algal toxins, it may be possible to develop water quality assessment methods that will allow IDEM to determine the impact that algal toxins may be having on designated uses of Indiana waters.

Fish Kills and Chemical or Other Spills

A diverse and healthy fish community is considered an indication of good water quality. Serious public concern is often raised when dead and dying fish are noted in the aquatic environment because fish kills are sometimes evidence of a severe water quality problem. Fish kills also have the potential to impair the use of the waterbody in the short or long term. A fish kill can occur as a result of:

- An accidental or intentional spill of a toxic compound or oxygen depleting substance into the aquatic environment.
- A continuous industrial or municipal discharge due to a system upset which can result releases of atypical or unusually high concentrations of pollutants.
- Natural causes such as disease, extreme drought or depletion of dissolved oxygen from extreme weather conditions.

IDEM's Office of Land Quality tracks spills and fish kills that are reported to IDEM or discovered by agency staff. The total number of calls, spills, and kills recorded from 1998 to 2015 are listed in Table 28 (Appendix A).

GROUND WATER ASSESSMENT

In order to be eligible for Clean Water Act (CWA) Section 106 grant funds, Indiana is required to have the means to monitor water quality and to annually update water quality data and include the results in their biennial Integrated Reports (IR) to U.S. Environmental Protection Agency (EPA). While the IR requirement pertains primarily to navigable waters, U.S. EPA guidance suggests that state updates should also include ground waters to the extent practicable. This section provides a summary of Indiana's ground water monitoring and protection programs, ground water/surface water interactions within Indiana, and ground water quality and ground water contamination sources.

INTRODUCTION TO INDIANA GROUND WATER

Ground water is an important resource for Indiana citizens, agriculture and industry. The majority of Indiana's population relies on ground water for drinking water and other household uses. IDEM's 2014 Annual Compliance Report for Indiana public water supply (PWS) systems is online at: http://in.gov/idem/cleanwater/files/dw_compliance_report_2014.pdf.

Major Sources of Ground Water Contamination

The major contaminant sources impacting Indiana ground water are listed by general activity types in Table 29 (Appendix A). All sources listed are a potential threat to ground water. However, the degree to which the source is a threat to ground water depends on several factors with the most significant being hydrogeologic sensitivity. Other major risk factors include location of the contaminant source relative to drinking water sources, toxicity of the contaminant and the size of the population at risk. All risk factors listed in Table 29 were considered in the selection of the 10 priority contaminant sources, and those risk factors relevant to the highest priorities are identified. Classes of contaminants commonly associated with each high priority contaminant source are also given. Due to resource constraints, this information has not been significantly updated since the 2000 305(b) report. However, anecdotal evidence indicates the same major contaminant sources are impacting Indiana ground water now as they were at that time.

Fertilizers

Nitrate is a potential contaminant from commercial fertilizer and animal manure applications to farm land, and septic systems, all of which are considered high priority sources of potential contamination to Indiana ground water. Nitrate is a highly mobile and soluble contaminant and is most frequently detected in ground water contaminant in rural areas. However, determining the specific sources of nitrates detected in ground water can be difficult and costly.

When applied at the proper rate and time, commercial fertilizer poses little threat of contamination to ground water. Purdue University Cooperative Extension Service staff, Natural Resource Conservation Service staff, and private consultants assist crop producers in developing nutrient management plans that focus on meeting crop nutrient needs.

On July 28, 2010, the Indiana rule requiring certification for distributors and users of fertilizer materials (355 IAC 7-1-1) became effective and is administered through the Office of the Indiana State Chemist (OISC). The rule was supported by a variety of agricultural groups and other stakeholders who envisioned this as an opportunity for fertilizer material applicators and distributors to demonstrate their competency to handle and apply these materials safely and effectively. In addition, the rule provides a statewide standard for applicator certification and training.

For purposes of this rule, "fertilizer material" is defined to mean both commercial fertilizer and manure from a confined feeding operation (CFO). Any person hired to apply, handle, or

transport fertilizer material for the purposes of producing an agricultural crop must be certified and licensed by OISC. Alternatively, he or she must be trained and supervised by a certified applicator and be working for a licensed fertilizer business. Any person applying manure from a CFO (in excess of 10 cubic yards or 4,000 gallons per year) to his/her own property must be certified by OISC as a private fertilizer applicator. Any person, partnership, corporation, or business that only distributes but does not use fertilizer material must obtain a fertilizer distributor business license.

Confined Feeding Operations

Livestock and poultry confined feeding operations exist throughout Indiana and are an integral component of Indiana's agricultural economy. The primary concerns associated with CFOs are the proper storage and land application of the large volumes of manure produced by these operations. The manure is applied to farmland to recycle the nutrients to fertilize crops. Manure contains ammonia-nitrogen which is converted to nitrate through biological processes in the soil. Consequently, the rate of manure application to farmland is a major concern when the application provides more nitrogen than a crop will use. Because excess nitrogen can move beyond the crop root zone and potentially into underlying aquifers, Indiana's current regulations for CFOs require the proper design and construction of manure storage structures and the application of manure to land in a manner that protects ground and surface water quality. Crop nutrients contained in manure are available at a slower rate than commercial fertilizer nutrients due to the rate of decomposition of the manure. Therefore, when applied at the proper agronomic rate, manure poses little threat of contamination to ground water.

Septic Systems

Properly constructed and maintained septic systems provide satisfactory on-site treatment of domestic wastewater in rural and unsewered suburban areas of Indiana. However, improperly constructed or poorly maintained septic systems, as well as systems operating in areas of high seasonal water tables or other ground water sensitive areas, are also of concern as a source of nitrate contamination to ground water.

Landfills and Underground Storage Tanks

Landfills and underground storage tanks are a high priority concern for ground water largely due to practices or activities that occurred prior to construction standards and legislation established for the protection of ground water. Landfills constructed after 1988 have been required to adhere to stringent construction standards. Since then, all underground storage tank registrations, upgrades, closure activities and site assessments have been closely reviewed by the IDEM's Underground Storage Tank (UST) Section.

IDEM ensures that all regulated UST system owners and operators properly registered, upgraded and/or closed existing UST systems in accordance with state requirements. Currently, IDEM inspects all USTs systems at least once every three years to ensure that systems are properly designed and operated for corrosion protection, spill and overfill protection, and leak detection in

order to prevent releases or ensure early detection of releases. UST systems that are no longer in use are inspected to ensure they are properly closed. In addition, IDEM ensures that all confirmed releases to the environment of petroleum and hazardous substances are cleaned up as necessary to protect human health, including those released into ground water.

Underground Injection Wells

Class V underground injection wells are widespread throughout the state and occur in high concentration in several areas, including some areas where ground water is highly sensitive to contamination. Most Class V wells are shallow wells that are used by business and individuals to dispose of a wide variety of waste fluids into the ground. Under current regulation, Class V wells may be used to dispose of non-hazardous fluids only. However, this was not always the case.

Prior to 2000 when the U.S. Environmental Protection Agency (EPA) passed more intensive regulations and enforcement for Class V wells, they were sometimes used to dispose of potentially hazardous fluids. These older wells create the potential for groundwater contamination if the fluids they contain are hazardous and leach into or above aquifers supplying drinking water. These wells are regulated directly through the U.S. EPA Class V Underground Injection Control Program, which targets the wells that pose the greatest environmental risk.

Industrial Activities

Several cases of ground water contamination due to industrial facilities or their ancillary operations have been documented in Indiana. Although many contamination events occurred prior to the development of regulations for the storage and handling of industrial materials, ground water contamination still occurs as a result of either accidents or intentional dumping of waste. In 1998, Indiana's Secondary Containment of Above-Ground Storage Tanks Containing Hazardous Materials Rule (327 IAC 2-10) was adopted. This rule requires that new facilities provide secondary containment for storage of 660 gallons or more of hazardous wastes if the facility is located outside an approved delineated wellhead protection area. However, if the facility is located within an approved delineated wellhead protection area, the tank requires secondary containment if 275 gallons or more of hazardous materials are stored there. The secondary containment rule, along with outreach and education programs, has helped to prevent further ground water contamination from the storage and handling of industrial materials. However, these activities continue to be a potential source of contamination to ground water in Indiana.

Road Salts

The storage and extensive use of salt as a deicing agent during the winter months can also have an impact on ground water, and contamination from road salt has been documented in Indiana. Efforts are being made by the Indiana Department of Transportation (INDOT) to build salt storage facilities in areas where ground water is not sensitive to contamination and to upgrade existing facilities to protect ground water. Currently, all INDOT salt storage facilities are covered by domes or canopies, and several new facilities were built to contain all surface runoff

on-site to reduce ground water contamination. In addition, road salt use and application rates have been significantly reduced from past years through computerized weather forecasting and roadway temperature sensors.

Spills

Ground water contamination as a result of spills can be avoided or minimized if spills are reported to IDEM, which helps to ensure that they are handled and cleaned up properly. Indiana has a law in place to ensure that spills with the potential to contaminate ground water are reported and managed in a way that minimizes their impact (327 IAC 2-6.1).

Ground Water Protection Programs

Programs that conduct monitoring to evaluate and protect ground water resources in Indiana occur at all levels of government. At the state level, several ground water protection programs and activities have been implemented or are in the process of being implemented. Table 30 (Appendix A) lists key ground water protection programs and activities in Indiana, the developmental stage of the program or activity, and the agency or agencies responsible for the program's implementation and/or enforcement.

Classification of Indiana's Ground Water Resources

Indiana's ground water quality standards became effective in March 2002. The language of the rule includes numeric standards that provides ground water protection for wells and allows for the classification of ground water. The rule states that all ground water of the state shall be classified as drinking water class ground water unless it is classified as limited class ground water or impaired drinking water class ground water. IDEM may classify ground water as limited when ground water is shown to have a yield of less than 200 gallons per day or a total dissolved solids concentration of more than 10,000 parts per million (ppm). Additionally, ground water that is in the crop root zone, in a coal mined area, or in an injection zone of a permitted Class I, II or III injection well or gas storage well may be considered limited. IDEM may classify ground water as impaired when specific conditions are also met. These conditions include, but are not limited to:

- The ground water is not in a state approved wellhead protection area established pursuant to 327 IAC 8-4.1.
- The ground water has one or more contaminant concentrations above the numeric criteria established in the rule.
- The commissioner has approved a ground water remediation, closure, cleanup or corrective action plan that describes the nature and extent of contaminants exceeding the criteria.

Source Water Assessment Program

In 2000, U.S. EPA approved Indiana's Source Water Assessment Program developed by Indiana stakeholders. IDEM has prepared source water protection plans (SWAPs) for public water systems with the exception of community water systems that instead use ground water as their primary source of water. Those community ground water systems are required by the Indiana Wellhead Protection Rule (327 IAC 8.4.1) to prepare a wellhead protection plan for each well or well field that provides water to the public. Since 2000, source water areas for more than 3,600 public water systems have been delineated. IDEM has also inventoried the potential sources of contamination of these source water areas from regulated facilities and has assessed water system susceptibility to contamination. As of the end of 2008, IDEM distributed all SWAPs for Indiana's public water systems to their owners. As a result of this effort, IDEM's Source Water Assessment Program is completely implemented and satisfies the requirements of the Source Water Assessment Program as defined by IDEM and accepted by U.S. EPA Region 5.

Wellhead Protection Program

The Indiana Wellhead Protection Rule (327 IAC 8-4.1) became effective in March 1997. IDEM's Wellhead Protection Program implements this rule to proactively protect public water supplies from contamination. The Wellhead Protection Rule outlines the minimum requirements community public water supplies must meet to comply with the Wellhead Protection Program. As of October 2009, 633 (close to 98 percent) of Indiana's community water systems using ground water as their source of drinking water have an approved wellhead protection plan. Having an approved Wellhead Protection Plan indicates that a community has met the requirements of the Indiana Wellhead Protection Rule and has developed strategies to adequately protect their community water supplies from becoming contaminated.

Other Programs Working to Protect Indiana's Ground Water Resources

In addition to regulatory programs and other structured ground water protection activities listed in Table 30, there are several educational programs conducted in Indiana that place an emphasis on ground water protection. The Purdue University Extension Service's Safe Water for the Future Program serves as an umbrella program for several other programs that provide resources on drinking water protection for individuals and communities. The Farm*A*Syst and Home*A*Syst Programs are essentially wellhead protection programs for rural and domestic private wells. A series of publications and brochures on wellhead protection are also available to assist communities working on wellhead protection. "Watershed Connections" brings together local contacts to produce a community specific publication on water resources and their protection.

The Indiana Department of Natural Resources' Project WET (Water Education for Teachers) and Purdue University Extension Service's "Water Riches" Program are two general water education programs that provide information about ground water protection. The Purdue University Cooperative Extension Service's Water Quality Program has made more than 70 publications addressing specific topics for the general public available through its website.

Ground Water Monitoring for Public Water Supplies

The Compliance Section of the Drinking Water Branch at IDEM receives ground water compliance monitoring results reported by public water systems for volatile organic compounds (VOCs), synthetic organic compounds (SOCs), inorganic compounds (IOCs), nitrates (NO_3), and radionuclides.

Radionuclide monitoring consists of analysis for gross alpha particle activity. Public water supply systems collect samples from various points within their system including after the water is treated and before it enters the distribution system. Samples can be collected from a single well or blended from two or more wells.

Other parameters monitored by public water systems depend on the type of system. There are three types of public water systems: community, non-transient non-community, and transient non-community. Compliance monitoring results reported by public water systems are considered "treated water" and may not represent "source" or "raw water" results. Information reported to IDEM from public water systems may be viewed through the Safe Drinking Water Information System at: https://myweb.in.gov/IDEM/DWW/ .

The three types of public water systems are defined below:

- A community system is defined as a system that serves water to the public and has at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents. Examples of community water systems are municipal systems, mobile home parks, nursing homes and homeowners associations. Along with regular bacteria sampling, community systems are required to test for thirty regulated SOCs, 21 VOCs, 12 regulated IOCs, sodium, and radionuclides. Sampling for these parameters is required a minimum of once every three years depending on the levels of contaminants detected. As of this report, there are 788 community systems in Indiana.
- A non-transient non-community water system is defined as a public water system that is not a community water system and which regularly serves the same 25 or more persons at least six months per year. Examples of non-transient non-community water systems could include restaurants, factories, daycares and schools. Along with regular bacteria sampling, non-community non-transient systems are required to test for 30 regulated SOCs, 21 VOCs, 11 regulated IOCs (except sodium and fluoride), and radionuclides. Sampling for these parameters is required a minimum of once every three years depending on the levels of contaminants detected. As of this report, there are 582 non-transient non-community systems in Indiana.

- A transient non-community is defined as a non-community water system that does not serve at least the same 25 people for more than six months per year. Examples of transient non-community water systems include restaurants, rest stops and gas stations. Along with regular bacteria sampling, transient non-community systems are required to test for radionuclides. As of this report, there are 2677 transient non-community systems in Indiana.

Statewide Ground Water Monitoring Network

The Ground Water Section of the Drinking Water Branch manages a statewide ground water monitoring network (GWMN) consisting of private residential wells and non-community public water supplies (PWS), including schools, daycares, churches, and businesses. Sampling for the GWMN has been conducted annually since it was established. Seven complete rounds of sampling have been conducted to date. Although many of the sampling sites were revisited during multiple sampling rounds, the number of sites sampled each year varies based on site suitability, participant interest, availability of resources, and previous sampling results. Sites sampled for the sixth round of monitoring, which occurred between May 2013 and August 2016 are shown in Figure 15 (Appendix B).

The Indiana Geological Survey (IGS) has divided the state into hydrogeologic settings to "provide a conceptual model to help interpret the occurrence, movement, and sensitivity to contamination of ground water in relation to … the surface and subsurface environment" (Fleming, 1995). The IGS has identified more than 240 individual hydrogeologic settings across the state based largely on glacial activity. IGS and IDEM scientists then grouped these hydrogeologic settings into 20 generalized settings that are common throughout Indiana.

IDEM determined based on the 20 generalized hydrogeologic settings that 398 samples are needed to accurately represent ambient ground water quality across the state for each sampling round in the GWMN. These sampling sites were proportionally distributed throughout the 20 lumped hydrogeologic settings using a weighting procedure (also known as stratified sampling) based on the percentage of located wells in that setting. The weighted number of samples in the generalized settings ranged from 1 to 154 samples. Appendix I provides the descriptions of the 20 generalized hydrogeologic settings monitored and summary results for each.

Protocols and Methods

As part of its implementation of the GWMN, IDEM's Ground Water Section staff:

- Statistically analyzed previous study designs employed in earlier iterations of the GWMN.
- Randomly selected sampling sites in each general hydrogeologic setting.
- Collected ground water samples from drinking water wells for analysis at IDEM's contract laboratories.
- Reviewed analytical sampling results.
- Distributed sampling results to GWMN participants.
- Developed a program report.

IDEM's Ground Water Section collects most samples from April to August. Samples are generally collected from outdoor spigots that have not been treated or from source water sample taps in the case of public water supplies. Samples are analyzed for more than 200 parameters; including alkalinity, anions/cations, metals, nitrogen as nitrate-nitrite (N+N), synthetic organic compounds, volatile organic compounds and pesticide degradates.

Summary of Results

Table 31 (Appendix A) shows summary statistics for the analytical parameters that were detected in the ground water samples collected during the most recent round of sampling (with the exception of disinfection byproducts and plasticizers, which are not included in this analysis). If a particular analyte was not detected, it was not included in the table. Applicable U.S. EPA Maximum Contaminant Levels (MCLs), Secondary Maximum Contaminant Levels (SMCLs), or Recommended Levels are provided where applicable.

For all samples collected in the most recent round, analytes that had the most occurrences above a MCL included arsenic and nitrogen as nitrate-nitrite (hereafter referred to as simply "nitrogen") Parameters for with there were occurrences above the SMCL or U.S. EPA Recommended Level included iron, sulfate, and strontium. Several VOCs were detected, including methyl tert-butyl ether, tetrachloroethylene, toluene, and atrazine. These VOCs occurred in one sample each, at concentrations that did not exceed or approach an MCL. Appendix K provides the descriptions of the 20 generalized hydrogeologic settings and ground water quality summary results for each.

In the most recent round of sampling, 139 samples (about 36 percent) contained detectable levels of nitrogen. Nine of those samples exceeded the MCL of 10 milligrams per liter, and the highest reported concentration was 22 milligrams per liter. The locations of the sites sampled for nitrogen are displayed with their corresponding hydrogeologic sensitivity developed by Fleming *et al* (Figure 16, Appendix B) and aquifer sensitivity developed by Letsinger (2015) (Figure 17, Appendix B). Fleming's hydrogeologic sensitivity map is qualitative based on typical characteristics for the individual hydrogeologic settings, while the Letsinger aquifer sensitivities were quantitatively calculated from factors including slope, sand thickness, surficial clay thickness, percentage clay in soil, land cover, and vegetation. In highly sensitive areas, ground

water can be rapidly recharged by surficial infiltration, allowing potential contaminants (including nitrates and pesticides) found at the ground surface or shallow subsurface to be transported into the aquifer. Summary statistics were calculated for the nitrogen data for Indiana's generalized hydrogeologic settings (Table 32, Appendix A).

Average nitrogen concentrations for each hydrogeologic setting were also calculated for different well type and depth, aquifer conditions and aquifer sensitivity (Table 33, Appendix A). Oxidizing aquifers had significantly greater nitrogen levels and higher average concentrations than reducing aquifers. Previous studies (Freeze & Cherry, 1979) have shown that the distribution and mobility of nitrogen within aquifers can be influenced by groundwater redox conditions.

Additionally, 12 of the 19 general hydrogeologic settings had their highest average nitrogen concentrations in wells less than 100 feet deep. The averages calculated for this study suggest that nitrogen concentrations tend to be higher in shallow, unconsolidated wells in highly-sensitive, oxidizing aquifers. Additional geochemical and statistical analyses are needed to evaluate the causal relationship between these parameters.

Arsenic

Arsenic is a naturally occurring element found primarily in rocks, soil, water, and plants in many areas of the United States, including Indiana. Natural events, such as infiltration of water, dissolution of minerals from clay, and erosion of rocks, can release arsenic into water. Arsenic can also be released into the environment as a byproduct of industrial activities, such as wood preservation, mining, and smelting (IDEM, 2015).

In the most recent round of sampling, 147 samples (around 38%) contained detectable levels of arsenic. Forty-three of those samples (11%) contained arsenic concentrations above the MCL (10 micrograms per liter). The highest reported concentration was 68 micrograms per liter. Figure 18 (Appendix B) shows the location of the arsenic samples by hydrogeologic setting. Table 34 (Appendix A) shows summary statistics for arsenic samples by hydrogeologic setting, and Table 35 (Appendix A) provides an intra-setting comparison.

Reducing aquifers had significantly greater arsenic levels and higher averages concentrations than oxidizing aquifers. Geochemical modeling is needed to determine the species of arsenic found in Indiana ground water, and additional geochemical and statistical analyses are needed to evaluate the causal relationship between these parameters.

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