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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 (USEPA) every two years. States are also required to develop and submit a list of impaired waters to USEPA for approval under CWA Section 303(d).

In 2002, USEPA encouraged states to combine the information that was previously submitted as two separate reports (the 305(b) report and 303(d) list), into one Integrated Water Monitoring and Assessment Report (IR) following the two-year schedule mandated in CWA section 305(b).

The Indiana Department of Environmental Management (IDEM), Office of Water Quality (OWQ) began using the integrated reporting format in 2002. This format calls for the development of two lists, both of which are included in this report. Indiana's Consolidated List contains assessment information for all waters of 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 a TMDL is required per CWA Section 303(d). In accordance with USEPA guidance, the IR also contains information on trends and trophic state of Indiana's lakes pursuant to CWA Section 314.

On September 26, 2007, the state's draft 2008 303(d) List of Impaired Waters was published in the Indiana Register for the 90-day public comment period required by Indiana law. In response to requests from the public, IDEM held two additional public meetings and extended the public comment period to January 31, 2008, to provide interested stakeholders additional time to submit their comments on the draft list. The IR includes only assessments conducted prior to September 26, 2007, in order to achieve consistency between the assessments reported in IDEM's Consolidated List and its 303(d) List of Impaired Waters. This approach allows Indiana to meet USEPA's reporting deadlines and minimizes inconsistencies in the information reported to USEPA and the public under different sections of the CWA.

IDEM OWQ prepared the 2008 IR following the guidelines provided by USEPA (1997a and 2005). This report for 2008 represents Indiana's fourth integrated water monitoring and assessment report and is intended to meet the reporting requirements of Sections 305(b), 303(d) and 314 of the CWA.

IDEM used data it collected and data collected by other organizations to develop this report. IDEM's solicitation, review and use of external data is described in detail in the section of this report entitled, Assessment Methodology and Summary Data. IDEM data used to develop this report was collected in accordance with IDEM's Surface Water Quality Monitoring Strategy (SWQMS), which describes a five-year basin rotation approach to monitoring for CWA purposes. Using this strategy, 1-2 basins (approximately 20% of the state) are monitored each year providing a comprehensive statewide data set for assessments every five years. These data are reviewed for the purposes of making 305(b) assessment and 303(d) listing decisions using IDEM's Consolidated Assessment and Listing Methodology (CALM).

Most of the data used in this report comes from IDEM's Watershed Monitoring Program, which employs a stratified random sampling design (probabilistic) to generate a representative sample

set for each basin. This approach allows IDEM to make assessments at two spatial scales. 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 stream-specific assessments. In addition to data from IDEM's Watershed Monitoring Program, results from other IDEM monitoring programs were used to make the water quality assessments included in this report. These programs include IDEM's Fixed Station Monitoring Program, the Source ID and Stressor ID Programs, the Fish Tissue Contaminant Program, and Special Studies Program. Results from IDEM's Lakes Monitoring Program, which operates under a contractual agreement with Indiana University, were also used.

A summary of IDEM's methods for determining support of beneficial uses is provided in the Assessment Methodology and Summary Data Section and IDEM's CALM is provided in its entirety in Appendix A of this report with Indiana's 303(d) List of Impaired Waters. Indiana's water quality standards (WQS) provide the basis for IDEM's CWA Section 305(b) water quality assessments (Appendix B), designating the beneficial uses that Indiana waters must support. Of the beneficial uses designated in the State's WQS, IDEM assesses aquatic life use support, recreational use support, and support of "fishable" uses. IDEM also assesses drinking water use support on surface waters that serve as a public water supply. Although there are additional uses designated in Indiana's WQS, 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 for these four uses, other uses such as agricultural and industrial uses are supported.

IDEM completed its first comprehensive aquatic life use support assessments for the entire state in 2002 and will report similar information for recreational uses in 2010. The 2002 IR was the state's first baseline report on water quality, which was revised in 2004 and 2006. The 2008 IR provides the most recent comprehensive report on Indiana water quality to date.

Results from IDEM's Comprehensive Use Support Assessments are provided in Appendix C of this report. Cumulative results for IDEM's stream-specific assessments are summarized in Table 1. Approximately 79 percent of the 17,535 stream miles assessed for aquatic life use were found to be fully supporting. Approximately 30 percent of the 12,073 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 almost none of the shoreline waters support full body contact recreational use.

Causes of nonsupport (impairment) are reported for each waterbody type including rivers, lakes, Lake Michigan and its shoreline in Indiana and are discussed in more detail in separate sections of this report. Pathogens are the top cause of stream impairments, affecting over 8,000 miles of streams. Polychlorinated biphenyl (PCB) in fish tissue impacts over 3,000 miles while mercury impairments impact nearly 2,000 miles of streams. Over 2,000 stream miles also have biological communities with measurable adverse response to pollutants.

Table 1: Summary of Use Support - Assessed and Reported 1998 through 2007.

Designated Use	Support	Threatened[1]	Non Support	Assessed	Not Assessed
Rivers (miles)					
Aquatic Life Use	13, 913	--	3,622	17,535	14,606
Fishable Uses	1,044	--	3,402	4,435	27,705
Drinking Water Supply[2]	--	--	1	1	101
Recreational Use (Human Health)	3,700	--	8,374	12,073	20,100
Great Lakes Shoreline (miles)					
Aquatic Life Use	59	--		59	--
Fishable Uses	--	--	59	59	--
Drinking Water Supply[2]	33	--		33	--
Recreational Use (Human Health)	--	--	59	59	--
Lake Michigan (acres)					
Fishable Uses	--	--	154,176	154,176	--
Lakes and Reservoirs (acres)					
Aquatic Life Use	3,690	--	6,625	10,315	21,826
Fishable Uses	7,820	--	63,663	71,483	5,084
Drinking Water Supply[2]	230	--	16,385	22,905	12,926
Recreational Use (Human Health)	21,922	--	983	22,905	104,662
Recreational Use (Aesthetics)	29,035	--	8,006	37,041	90,526

Source: IDEM's Assessment Database

[1]EPA recommends that states consider as threatened those waters that are currently attaining WQS, but are projected as the result of applying a valid statistical methodology to exceed WQS by the next listing cycle (every two years). IDEM recognizes the federal requirement to list waterbodies that meet U.S. EPA's definition of "threatened". However, IDEM has not determined the appropriate predictive models for the purposes of identifying future impairment. Based on this and the uncertainty associated with such models, IDEM does not assess waterbodies as "threatened" for the purposes of 303(d) listing. Waters for which there is reason to suspect a declining trend in water quality are so noted in IDEM's assessment process and in the agency's assessment database so that they may be prioritized for future monitoring when resources allow.
[2]While all waterbodies in Indiana are designated for aquatic life use, and recreational uses, not all are designated for drinking water use. There are a total of 29,541 lake acres and 132 stream miles (including 33 miles of shoreline) currently designated for drinking water in Indiana.

BACKGROUND

Introduction

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 and flows into the Mississippi River then south to the Gulf of Mexico. There are

35,673 miles of Indiana rivers, streams, ditches and drainage ways listed at the 1:100,000 scale in USEPA River Reach File 3 (RF3). State water types are described in Table 2. Metadata and definitions for this report are located in Appendix D.

Table 2: Atlas.

Description	Value	Units
Indiana population[1]	6,080,485	
Indiana surface area[2]	36,291	sq. mi.
Total miles of rivers and streams[3]	35,673	miles
Number of publicly-owned lakes/ reservoirs/ ponds[4]	575+	
Publicly-owned lakes/ reservoirs/ ponds[4]	106,205	acres
Great Lakes[4]	154,240	acres
Great Lakes shoreline[5]	59	miles
Fresh water wetlands[6]	813,000	acres

Sources: [1]U.S. Census Bureau [2]State Information Center [3]Horizon Systems Corporation 1994 [4]USEPA 1993 [5]Indiana Reach Index [6]Rolley 1991

WATER POLLUTION CONTROL PROGRAM

Water quality standards have been adopted for the Great Lakes Basin watersheds and for the non-Great Lakes Basin watersheds. National Pollutant Discharge Elimination System (NPDES) permitting is the primary point source control process used in Indiana. Nonpoint source pollution is addressed primarily through nonregulatory watershed management planning and implementation projects.

Watershed Approach

Environmental problems often cut across political jurisdictions. Consequently, environmental mitigation and protection require a comprehensive and collaborative approach that works with a multitude of programs and agencies. The watershed approach provides a framework for coordinating between multiple programs and leveraging limited resources. This approach focuses on water quality in a geographic area delineated by a watershed. In order for all of the waters of the State of Indiana to support designated uses, IDEM uses an integrated approach that includes a common information base and agreement on roles, priorities, and responsibilities for managing watershed activities. IDEM's watershed approach includes:

- Ensuring that internal resources continue to be focused on addressing the most significant water quality issues facing Indiana by conducting a semi-annual review of OWQ activities and making any necessary adjustments;
- Improving internal coordination between OWQ's TMDL, water quality assessment and watershed planning and implementation programs to facilitate an integrated watershed management approach to restoring impaired waterways; and

- Improving coordination with local watershed groups, community groups, and other state and federal agencies to better leverage OWQ efforts in ways that will achieve greater improvements in water quality.

In 2007, IDEM OWQ has created the Watershed Initiative Task Force to verify whether resources are being allocated effectively to improve water quality in Indiana. The task force is comprised of members from all programs within the OWQ and is intended to improve the communication between programs and maximize resource effectiveness.

IDEM's water quality monitoring also employs a watershed approach. A statewide rotating basin approach to watershed monitoring was adopted in 1996. The rotating basin plan makes it possible to update water quality assessments on a five-year cycle for monitored watersheds throughout the state and ensures that the information available for planning and watershed management activities is no more than five years old. 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 shows the monitoring locations for all of IDEM's sampling programs and illustrates the sampling density achieved through IDEM's water quality monitoring strategy over the past five years (2003-2007).

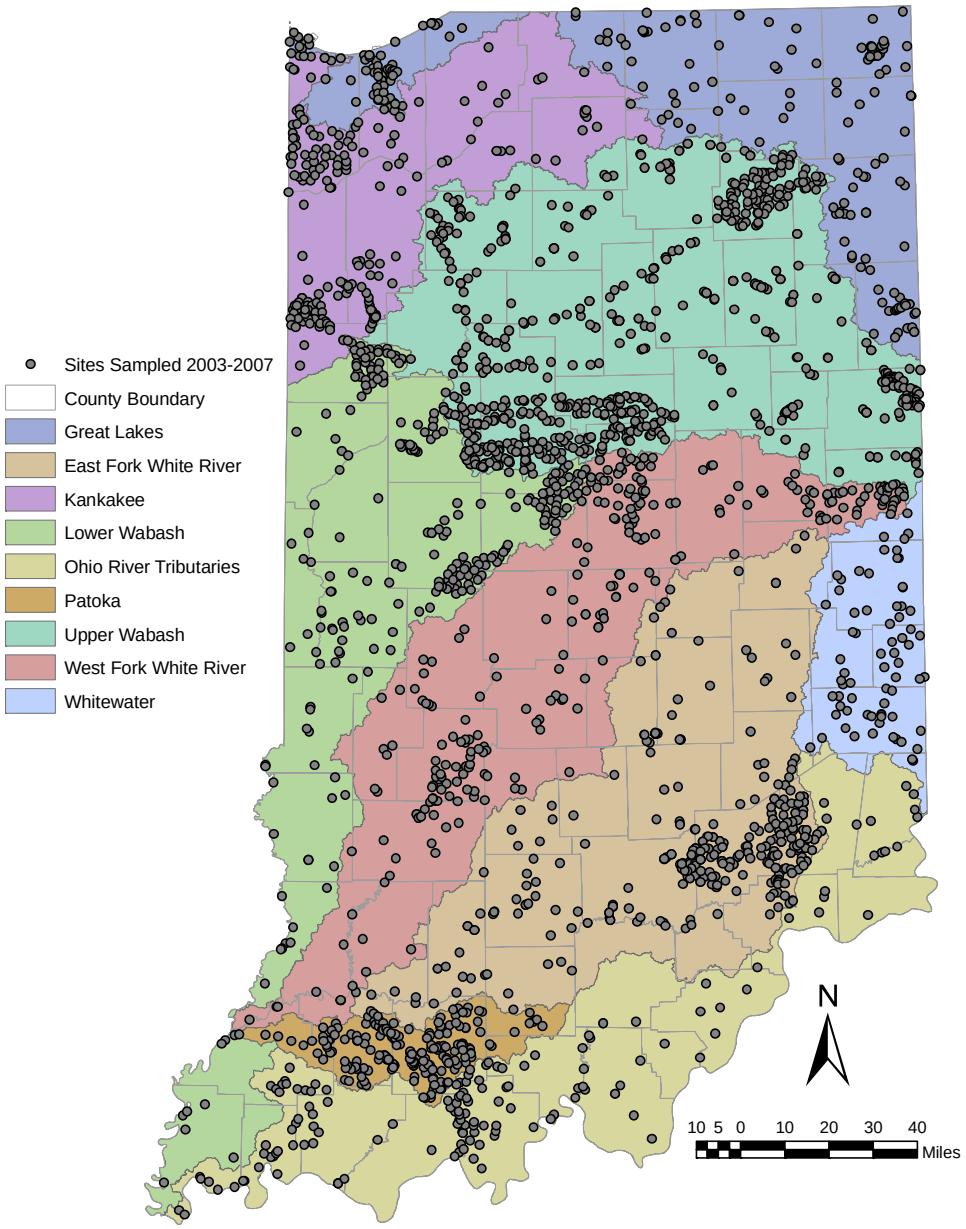

Figure 1: Monitoring Location Density

Water Quality Standards (WQS) Program

Indiana's WQS underwent significant revision in 1990. At that time, numerical criteria for all pollutants for which USEPA had developed either human health or aquatic life ambient water quality criteria were added to the standards. Procedures for developing additional criteria were also included in these rules. Additionally, all waters were designated for full body (primary) contact recreational use, and the bacteriological indicator organism was changed from fecal coliform to *E. coli* to conform to USEPA's guidance on bacteriological indicators. All waters in Indiana, with the exception of the 29 waterbodies designated in Indiana's WQS as limited use

waters[1] and the 11 waterbodies designated as exceptional use waters[2] were designated for warm water aquatic life use, full body contact recreational use, public water supply (where there are drinking water intakes from surface waters), industrial uses, and agricultural uses. Certain waters, where natural temperature conditions will support cold water fisheries, were so designated. For those waters where multiple uses exist, the criteria that support the most stringent uses must be met.

In 1993, the rules and regulations that guide the implementation of Indiana's WQS through Indiana's 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, Indiana began the process of revising the WQS and implement regulations for those waters in Indiana's Great Lakes system. This rulemaking, for the most part, had no immediate effect on Indiana's waters located outside the Great Lakes system. These revisions incorporated the various criteria and procedures (or equivalent ones) identified in the guidance into Indiana's WQS. As a part of this rulemaking, Indiana also developed procedures to implement the antidegradation policy for all substances discharged to waters in the Great Lakes system. These revisions were adopted by the Indiana Water Pollution Control Board (WPCB) effective in February 1997 and submitted to USEPA for approval. In August of 2000, USEPA formally approved these revisions with the exceptions of the sections on reasonable potential for whole effluent toxicity and variances. For these parts of the rule, USEPA promulgated the federal guidance language for Indiana.

The WPCB adopted additional changes to Indiana's WQS in 2004. The revised standards:

- changed the way metals criteria are expressed in waters outside the Great Lakes system from "total" or "acid soluble" to dissolved metals;
- changed the way cyanide is expressed from "total" cyanide to "free" cyanide in these same waters;
- changed the point of application of the dissolved solids criterion from "all waters" to the "point of water intake" for drinking or industrial water supplies in waters outside the Great Lakes system;
- changed the sulfate criterion from 250 mg/L to 1000 mg/L, which would apply outside a mixing zone;
- added provisions to allow site-specific modifications to aquatic life criteria using the "recalculation procedure" and the "water effects ratio" without having to go through a rulemaking (these procedures were incorporated into the standards) and listed several water reaches where site-specific criteria had been developed;
- made changes to the list of bio-concentrating chemicals of concern (BCCs) in waters outside the Great Lakes system so as to be consistent with the list applicable to the Great Lakes system;

[1]The 29 streams or stream reaches designated for limited use in 327 IAC 2-1-11(a) were placed in this category after use attainability analyses confirmed the inability of these streams to fully support aquatic life use due to natural low flow conditions throughout much of the year. Thus, all waters in the state are currently designated for uses consistent with the requirements of the Clean Water Act or USEPA's implementing regulations and have criteria appropriate to determine support of these uses.

[2]Exceptional use waters are identified in 327 IAC 2-1-11(b)

- made changes in definitions and narrative criteria in order to achieve more consistency between waters within and outside the Great Lakes system;
- made a number of other minor technical and grammatical changes.

These changes to the WQS were approved by USEPA in 2005 with two exceptions. USEPA is still evaluating the proposed change in the sulfate criterion and has disapproved one site-specific criterion that was proposed. With regard to the sulfate criterion, the USEPA took no action on the revised sulfate criterion submitted for approval. USEPA determined that Indiana's revised sulfate criterion is not protective of aquatic life in waters with an ambient hardness value of less than 109 mg/l, based on toxicity studies carried out by the Illinois Natural History Survey. Therefore, USEPA is requiring IDEM to revise and readopt a sulfate criterion that is protective of aquatic life in waters with an ambient hardness value of less than 109 mg/l. The revised criterion is based on hardness and chloride concentrations and is scheduled for final adoption by the WPCB in March 2008.

Indiana is currently in the process of reviewing and revising the WQS applicable to all waters of the state with regard to the development of antidegradation implementation procedures. In the future, IDEM will be considering modifications to the state's bacteriological criteria.

Other portions of the current standards are under consideration for possible updates. IDEM believes that the criteria and methodology to calculate aquatic life criteria utilized in the Great Lakes system represent the most current scientific thinking on how to incorporate existing toxicity data into aquatic life criteria. Therefore, these aquatic life criteria and the methodology for calculating criteria should replace those currently used for waters outside of the Great Lakes system. Likewise, USEPA's 2000 guidance on deriving human health-based criteria should be utilized in updating current criteria and methodology for calculating these criteria in all waters of the state.

IDEM has collected considerable data on the macroinvertebrate and fish communities for many Indiana waters. Although Indiana is not at the stage in the evaluation of these data to propose numerical bio-criteria, narrative bio-criteria language that would allow the state to better utilize the available data to assess the biological integrity of aquatic communities may be proposed in the future.

Indiana is currently working with USEPA Region 5, other Region 5 states and the United States Geological Survey (USGS) to develop nutrient criteria for different water body types throughout the region. Indiana has submitted a Nutrient Criteria Development Plan and schedule for the development of nutrient criteria to the USEPA and provides updates to the plan on an annual basis. IDEM has worked with the USGS to collect information pertinent to the development of nutrient criteria in all of our major water basins over the past five years, and USGS is currently in the process of analyzing these data. IDEM's plan currently calls for the development of nutrient criteria by the end of 2009 and for the state to put these criteria into state WQS in the following triennial review period. USEPA guidance appears to give states additional flexibility in the development of nutrient criteria, especially if the state and USEPA have agreed on a plan to accomplish this goal. Indiana is actively participating in this effort, and IDEM's plan has been approved by USEPA.

Ground water quality standards became effective in March 2002. Public water supply definitions have been formalized to be consistent with federal Safe Drinking Water Act (SDWA) definitions. IDEM has established minimum requirements for content of Consumer Confidence Reports which public water suppliers deliver to their customers annually.

Point Source Program

Point source pollution in Indiana is controlled primarily through permits issued by IDEM for discharges to surface water under the NPDES program. All facilities which discharge to waters of the State must apply for and receive a NPDES permit. Unpermitted dischargers and permittees out of compliance with their permit conditions are referred to IDEM's Office of Enforcement for corrective actions, which can include fines.

Limitations are established in each NPDES permit in order to meet both the technology-based and water quality-based requirements of the federal CWA and Indiana's state laws, which are intended to protect all designated and existing uses of the water body. In addition to issuing NPDES permits, the program includes these other activities: wastewater treatment plant inspections, operator assistance and training, compliance data review and tracking, and enforcement.

Over the past two years, the NPDES permitting program systematically identified major issues that have complicated final determinations for many NPDES permits. Based on this information, IDEM has developed a number of internal policies, procedures, and guidance documents to enhance the program's ability to issue and reissue NPDES permits. IDEM's NPDES program is pursuing additional changes within the regulatory framework to complement these efforts.

In 2003, IDEM identified and prioritized administratively extended NPDES permits and created a plan to address these permits. First, IDEM created a list of permits to issue over the next year. Second, IDEM identified its current resources and estimated additional resource needs. Third, staff worked to identify next steps for each permit, developed timeframes for each step in the process, and created schedules for issuing these permits. Over the last two years, OWQ committed to reissue 26 priority permits and exceeded that goal by reissuing 33 permits. The backlog of minor NPDES permits has also been significantly reduced.

In order to reduce untreated discharges to Indiana's surface waters, IDEM's NPDES program also issues industrial wastewater pretreatment permits to industries that discharge to municipal wastewater treatment plants and industries that were delegated to operate their own pretreatment programs, and for urban wet weather discharges. NPDES staff oversees and audits municipal pretreatment programs in 45 municipalities with industrial dischargers. In addition, storm water runoff associated with land disturbing activities of one acre or more and runoff associated with industrial activities are now regulated by permits. IDEM is now implementing its EPA approved workplan for review and approval of Long Term Control Plans (LTCPs) and has approved 49 LTCPs to date, 2 of which are in federal consent decrees.

Discharges of toxic pollutants is controlled through permit limits for specific chemicals and by whole effluent toxicity limits. Compliance is provided for by IDEM's Permit Compliance Branch and by providing facility operation technical support for wasteload allocation modeling and monitoring. These program areas work closely with the NPDES permitting program to

ensure that permit limits are adequate for protection of designated uses and dischargers remain in compliance with these limits.

Permits for dischargers within the Lake Michigan and Lake Erie basins are written to incorporate Indiana's updated water quality standards. This change was implemented as a result of the federal Great Lakes Initiative (GLI).

IDEM inspectors conduct unannounced onsite wastewater treatment plant inspections throughout the state. In addition, IDEM is increasing its focus on laboratory proficiency and proper certification of wastewater treatment plant operators. Inspectors review operation and maintenance of wastewater treatment plants permitted under the NPDES program and provide referrals for operator assistance and training. Inspectors can also initiate violation letters prior to legal action as needed, and directly refer permittees to IDEM's Office of Enforcement for corrective action.

IDEM's NPDES permits are the cornerstone of the point source control program. IDEM actively works to stay in contact with permittees through the inspection program and the permit renewal process. The programmatic efforts described in this section and the various permits issued through IDEM's NPDES program are intended to reduce untreated discharges to Indiana surface waters and to ensure that treated discharges do not cause or contribute to impairment of Indiana's surface water resources.

Nonpoint Source Control Program

Nonpoint source (NPS) pollution in Indiana is addressed in many ways by a number of agencies and organizations in the state. IDEM's efforts to reduce nonpoint source pollution to Indiana waters are led by the Nonpoint Source/Total Maximum Daily Load (NPS/TMDL) Program. These two programs previously operated as separate sections within IDEM but were merged into one section in 2005 to better coordinate efforts at controlling nps pollution. In partnership with other agencies, the NPS/TMDL Section leads efforts to restore waters of the state that do not meet WQS and are on Indiana's 303(d) List of Impaired Waters. IDEM also employs five Watershed Specialists (WSS) who assist the NPS/TMDL Section in promoting the watershed approach by working with local watershed groups.

IDEM's Nonpoint Source Program

The NPS Program administers the CWA Section 319 and 205(j) grant programs, which together provide a significant portion of funding available to address nonpoint source issues in Indiana. The NPS program currently manages more than 75 grant projects that are working towards reducing NPS pollution. In addition to numerous watershed projects, the NPS program also provides funding for the Indiana Clean Lakes Program, which addresses nps pollution issues in lakes and reservoirs throughout the state.

The NPS program conducts training and provides technical assistance on watershed management planning and implementation and has produced valuable resources for watershed planning, such as the Indiana Watershed Planning Guide and the Indiana Water Quality Atlas (IWQA).

In August 2003, the NPS program revised the Indiana Watershed Planning Guide with input from watershed coordinators throughout the state. This document is available online at:

http://www.in.gov/idem/programs/water/wsp/index.html

and provides guidance for local watershed groups to develop watershed plans that meet USEPA Section 319 nine required elements. The NPS/TMDL Section encourages local agencies and groups to use the guide to develop a watershed management plan for their watersheds through a stakeholder driven process.

The IWQA is an internet mapping and analysis tool developed for watershed coordinators and other interested parties to provide water quality data over a framework of geographic datasets for evaluation and communication of watershed data and issues. The IWQA can be used by watershed groups in their watershed planning and implementation activities and is available online at:

http://iwqa.idem.in.gov/

Updates to the IWQA are conducted annually. Currently, the IWQA is undergoing an upgrade that includes additional mapping and analysis tools such as the Watershed Delineator and the L-THIA Model developed by Purdue University and more high-resolution datasets for running the delineator and model. These upgrades and testing of the site are expected to continue through March of 2009.

Many of the projects funded with NPS program grants include the collection of water quality data for watershed planning and other purposes. Under grant agreements, projects funded by IDEM routinely submit these data to the NPS program. The NPS program has initiated a project to upgrade IDEM's Assessment Information Management System (AIMS) database in order to improve the NPS program's ability to manage these data and make them more readily available for review and potential use in other agency programs. In addition to data collected by NPS projects, the AIMS database project will provide for the storage and facilitate the review of third party datasets submitted to IDEM for potential use in making the 305(b) assessments reported in the state's IR.

In addition to providing tools to assist watershed management efforts, the NPS program has adopted a targeted approach to improving water quality in the state by focusing IDEM's Section 319 funds on impaired waters. IDEM has identified funding priorities for Section 319 grants for the last several funding cycles. For federal fiscal years 2006, 2007 and 2008, the program focused on:

- Watershed management planning and implementation in areas with approved TMDLs;
- Watershed management planning and implementation in areas with waterbodies on the 2006 Section 303(d) list; and
- Implementation of watershed management plans that meet the IDEM checklist that includes the EPA required nine elements

A Geographic Information System (GIS) map was created to identify areas that have been involved in the planning and implementation of watershed management plans and the

relationships with the TMDL development activities. The map shows the areas of Indiana where there are watersheds with nps impaired waterbodies as listed in the 2006 303(d) List of Impaired Waters. This map facilitates the use of the targeted approach to watershed management providing for coordination of TMDL, planning, and implementation efforts in areas of the state most in need of restoration. Targeting areas for watershed planning to coincide with TMDL development or where TMDLs have already been developed helps expedite the planning process and provides groups with information in the TMDL regarding watershed nps problems, sources and needed load reductions.

IDEM's Total Maximum Daily Load Program

IDEM's TMDL program focuses almost exclusively on nonpoint source related impairments and has developed 559 TMDLs to date. There are another 548 TMDLs either in progress or planned for 2008. Indiana's early TMDLs were developed primarily through the use of third party contractors. IDEM's TMDL program now develops most of its TMDLs in-house. In addition to being more cost-effective, agency development of TMDLs provides the opportunity for more effective coordination with IDEM's NPS program and other relevant water quality programs. In addition to developing TMDLs focused on *E. coli* impairments, IDEM staff are now developing TMDLs for other nps-related issues such as impaired biotic communities and nutrient impairments.

IDEM's TMDL program has been awarded considerable funding from USEPA through contractor support grants to develop additional TMDLs. In addition, IDEM's TMDL program has collaborated with both Illinois and Michigan on TMDL development for interstate waters and leads the nation in the development of TMDLs for impairments in waters that cross state lines.

IDEM's TMDL Program works closely with the NPS program and IDEM's WSS to develop TMDL reports that can be effectively used by local watershed groups and stakeholders to facilitate the restoration of impaired waters. The TMDL program also coordinates with local governmental agencies and stakeholders within the TMDL area. This coordination provides numerous opportunities for local participation in the TMDL process, which leads to positive changes in the watershed. Since 2004, the coordinated efforts of the NPS/TMDL Section and IDEM's WSS have resulted in the formation of ten new watershed groups and new grant -funded projects for planning and restoration activities in impaired watersheds.

IDEM's Watershed Specialists

IDEM's five WSS provide an important link between watershed groups and other interested stakeholders and OWQ programs. In 2007, the WSS assisted more than 80 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 WSS also work with the TMDL program by attending TMDL public meetings to provide information on watershed planning and building local partnerships to address water quality. The WSS have assisted with the formation of more than ten local watershed groups in areas with

completed TMDLs. These groups are currently developing and implementing watershed management plans to restore those impaired waters.

Coordination with Other Agencies

IDEM has working relationships with other state and federal agencies interested in improving water quality in Indiana. In addition, results of projects completed by local and regional government, university and nonprofit organizations are integrated into reporting processes whenever possible.

IDEM's efforts to address nps pollution rely heavily on the efforts of federal, state, and local partners. With the extent and variety of nps issues across Indiana, the need for cooperation across political boundaries is essential. Many local, regional, state, and federal agencies play an essential part in addressing nonpoint source pollution, especially at the watershed level. They provide information about local concerns and infrastructure and build support for the pollution control practices that are necessary to reduce and prevent nps pollution. By establishing coordination frameworks to share information and resources among agencies at different levels of government, IDEM can more effectively focus its water quality protection efforts.

Much of this coordination occurs on an ad hoc basis. However, IDEM works closely with the Natural Resources Conservation Service (NRCS), the Indiana Department of Agriculture (ISDA), the Indiana Department of Natural Resources (IDNR), and the Indiana Association of Soil and Water Conservation Districts (IASWCD). A workgroup comprised of key staff from these organizations meets on a bi-monthly basis to exchange information and work toward better coordination of programs and resources on their mutual goals to reduce nps pollution. IDEM has broadened discussions to include emerging issues on urban stormwater and wetland regulation. In addition to participating in this workgroup, IDEM also works with the IDNR Coastal Zone Program to address nps issues in the Lake Michigan watershed.

IDEM's WSS act as liaisons between federal, state and local programs and officials to ensure all interested parties are aware of pertinent watershed management activities and to promote coordination and integration of those activities with other local planning efforts. In addition to working with individual watershed groups, the WSS work with the Indiana Conservation Partnership which includes representatives from NRCS, ISDA, IDNR, IASWCD, and the Purdue University Extension Service.

IDEM staff in the Water Quality Certification program work cooperatively with several U.S. Army Corps of Engineers (ACOE) districts, IDNR, the U.S. Fish and Wildlife Service (USFWS) and other agencies to issue permits that are protective of water quality, regulating activities in wetlands and other waters pursuant to CWA Section 401.

Coordination with Indiana Department of Natural Resources

From 1999-2002, IDEM and IDNR worked cooperatively to develop and implement the Hoosier Riverwatch Program, a statewide volunteer stream water quality monitoring program. The goal of this program was to educate citizen volunteers in water quality monitoring methods and to electronically store their results to make them available to other interested parties such as watershed groups, schools and to IDEM technical staff for potential use in various OWQ programs. IDNR, Division of Fish and Wildlife staff have taken the lead in developing the program, which has trained more than 7,000 volunteer stream monitors to date. Since 2001, volunteers have registered results for nearly 1,000 sites into the Hoosier Riverwatch database. The Hoosier Riverwatch database is web-based and interactive, allowing volunteers to enter their own data and view other volunteers' data. In 2007, the program completed a three-year regional research project in cooperation with cooperative extension programs in Iowa, Ohio, Michigan, Wisconsin, and Minnesota to test the accuracy of bacteriological monitoring methods used by volunteers and the usability of their results. More details on this project can be found at:

http://www.usawaterquality.org/volunteer/EColi/

The IDNR Division of Reclamation Abandoned Mine Lands (AML) Program has worked very closely with NPS/TMDL staff on the development of a TMDL in a watershed with abandoned mines. The AML program shared water quality data, information on costs and techniques of reclamation projects, and educated NPS/TMDL staff about areas impacted by acid mine drainage by touring reclamation projects at different points in the reclamation process.

Coordination with the Indiana Association of Soil and Water Conservation Districts

The mission of the IASWCD is to represent county soil and water conservation districts (SWCD) as one voice and to assist the leadership of local soil and water conservation districts through coordination and education for the wise use and management of our natural resources.

One of the many ways the IASWCD promotes the wise use of Indiana's natural resources is by providing information and outreach in support of statewide efforts to develop and enhance Indiana's watershed program and help address NPS pollution. Section 319(h) funds are used to staff a Watershed Information Specialist (WIS) position at the IASWCD. This position serves as a liaison with IDEM OWQ staff to help promote watershed management efforts throughout the state.

- The WIS serves as a key contact for SWCDs via the IASWCD Weekly Update, developed under this contract to regularly communicate issues, events, and resources in watershed management statewide.
- Met regularly with IDEM WSS and Watershed Planning Branch Chief for communication and planning purposes. This included initiating, coordinating, and facilitating a reoccurring Watershed "Team" Meeting, inviting members of NPS/TMDL and Wetlands/Rules Sections to participate, as well as representatives from NRCS, ISDA, IDNR, and the IASWCD. These meetings served as an opportunity to update, network, and discuss current work in watershed management and water quality.
- Participated in the strategic planning process for the WSS, facilitating document development.

- Assisted in the development of watershed-based information lists. The first is a list of local contacts, including SWCD supervisors, staff, and technical partners, watershed coordinators, and agency staff, which was created and has been maintained throughout the contract term. The second list has been referred to as an 'inventory'. Identifying past and current efforts in watershed management is a comprehensive and necessary element for increasing program delivery efficiency and maximizing partner/public dollars. Discussions were initiated with Purdue University, CTIC (Conservation Technology Information Center), IDNR, NRCS, and IDEM to determine existing inventories of activities across the state. Coinciding with this activity, the WSS staff identified the need for an internal database designed to track watershed groups and group process. Working with IDEM staff, this position participated in meetings and worked with NPS/TMDL staff members to develop a database framework that can be spatially referenced in ArcGIS.

Coordination with the United States Geological Survey

The USGS has worked with NPS/TMDL staff to provide information, data, and sampling assistance for the development of TMDLs. USGS prepared a presentation and brought in specialists to discuss data collected in a watershed with a TMDL under development to assist in determining biological impacts. USGS has also provided training to NPS/TMDL staff on the new INStreamStats Model. Staff can now assist watershed groups in the use of this valuable new tool.

USGS has also been monitoring cooperatively with IDEM at randomly selected sites in each of the five major river basins that are sampled on an annual rotating basis to collect phytoplankton and algal biomass chlorophyll *a* samples as well as physical and chemical data. This information is being used in conjunction with biological (macro-invertebrate and fish community), chemical, and physical data collected by IDEM to try to determine potential cause and effect relationships between nutrient concentrations, algal responses and biological condition. These studies form one of the basic components of Indiana's nutrient criteria development plan.

The USGS National Water Quality Assessment (NAWQA) study sites in Indiana also contribute to Indiana's work in developing nutrient criteria for the state. Data gathered at these sites are providing Indiana with useful information regarding seasonal and annual trends of nutrient and algal concentrations and their potential effects on the biotic community. The USGS is also conducting fate and transport studies in the White River, West Fork and Sugar Creek watersheds, which will provide information about the fate and transport of nutrients in these waters. Results from these studies have also been incorporated into IDEM's nutrient criteria development plan.

Coordination with Indiana's State Revolving Fund Loan Program

The State Revolving Fund (SRF) Loan Programs provide low-interest loans to Indiana communities for projects to improve drinking water and wastewater infrastructure.

The SRF Loan Programs coordinate with state and federal programs, including IDEM OWQ, to identify ways the SRF Loan Programs 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 increases the likelihood of projects with a water quality benefit being high on the SRF project priority list. The SRF Loan Programs also serve on the Rural Wastewater Task

Force and the Environmental Infrastructure Work Group where they have the opportunity to provide input and offer financing options to communities. The SRF Loan Programs work with communities addressing combined sewer overflows, enforcement issues, or those with or nearing a sewer ban.

COST/BENEFIT ASSESSMENT

Cost Information

The State Revolving Fund (SRF) Loan Programs provide low-interest loans to Indiana communities for projects that improve drinking water and wastewater infrastructure. The Indiana Finance Authority administers these programs to protect public health and the environment.

Cities, towns, counties, regional sewer/water districts, conservancy districts, and water authorities are eligible for both programs. Private and not-for-profit public water systems are eligible for drinking water SRF loans. Eligible projects include those that abate water pollution problems, provide greater protection to public health or ensure compliance with either the CWA or the SDWA. Wastewater projects may include wastewater treatment plant construction or improvements, sewer line extensions to existing unsewered properties, decentralized systems, combined sewer overflow corrections and infiltration/inflow corrections. Drinking water projects may include treatment plant construction and improvements, water storage facilities, water distribution systems and water supply. There is an additional financial incentive to include green technology, a Brownfields Program project, or a sustainable infrastructure component to a project.

The SRF loan is a 20-year, fixed rate loan. To ensure a subsidized rate at the time of closing, interest rates may reset quarterly and are at or below 90% of the average 20-year AAA-rated, general obligation bond Municipal Market Data. Rates are further discounted based on the community's median household income (derived from current census data) and local user rates.

As an incentive to communities to address nonpoint source water pollution, the interest rate on their loan, for projects with a nps component, may be reduced by up to 0.5%. This results in a subsidy equal to as much as one-half the total cost of the nonpoint source project. This subsidy is realized in the form of savings through reduced loan payments over the twenty-year term of the loan. In State Fiscal year (SFY) 2006 and SFY 2007, eight projects had a NPS component and saved an additional $7,163,553.00 over the 20-year term of their loans. While these savings are realized over the longer term, these projects are typically completed within 2 years and the water quality benefits are achieved much sooner.

In state fiscal years 2006 and 2007, the Wastewater SRF Program closed 45 loans totaling approximately $383,715,000.00 and provided an estimated savings (compared to open market interest rates) of $70,742,630.00. The Drinking Water SRF Program closed on 21 loans for approximately $92,435,000.00 with an estimated savings to communities of $18,199,475.00.

Table 3: Investments in SFY 2006 and 2007

SRF Program	Number of Projects	Loan Amount	Savings Realized
Clean Water	45	$383,715,000	$70,742,630
Drinking Water	21	$92,435,000	$18,199,475

Since 1999, the SRF Programs have provided more than $1.9 billion dollars for over 375 wastewater and drinking water infrastructure improvement projects. Water quality benefits to many Indiana rivers and streams are expected as a result of the assistance to communities from the SRF Programs. Figures 2 and 3 show locations of loans closed throughout Indiana.

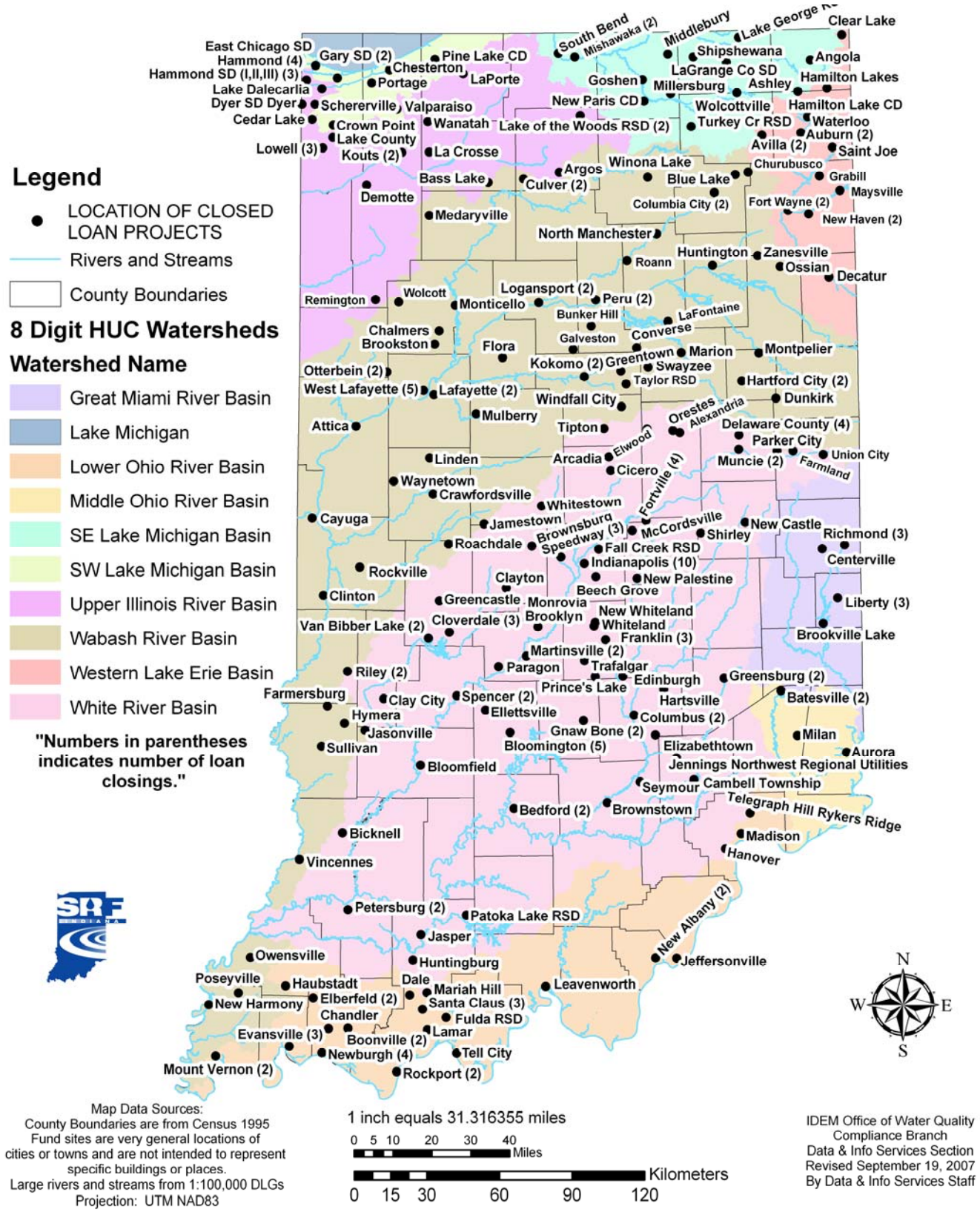

Figure 2: State Revolving Fund Clean Water Projects as of June 2007

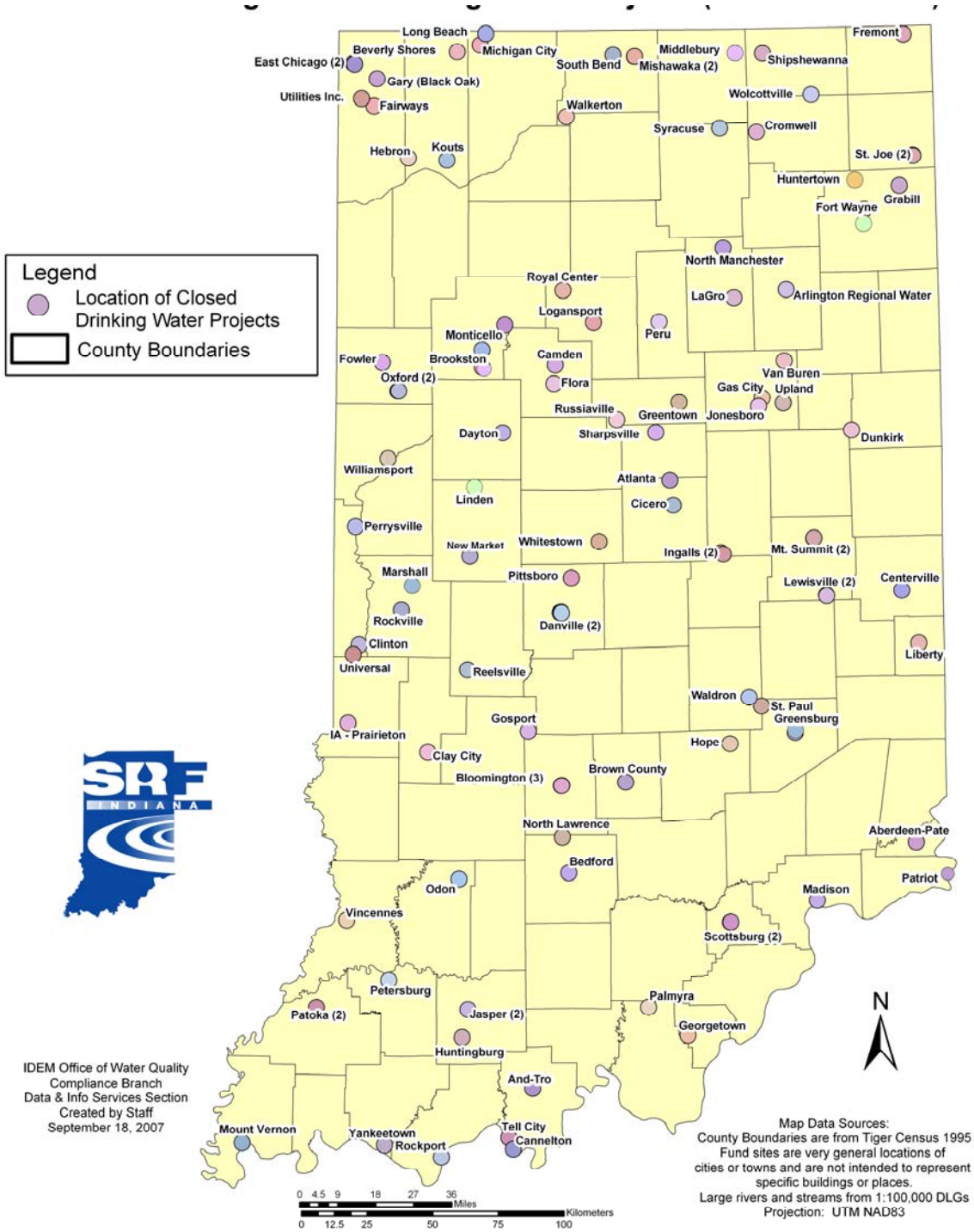

Figure 3: State Revolving Fund Drinking Water Projects as of June 2007

In addition to the SRF Program, IDEM's NPS Program awarded 205(j) grants totaling more than $1.9 million to 24 projects and awarded more than $17.6 million in Section 319 grants to 112 projects from 2003-2007. These federally funded grant projects include watershed management planning, water quality management, and nonpoint source pollution assessment, prevention, education, and restoration.

Benefit Information

According to the 2007 NPS Annual Report, the number of active watershed groups in Indiana has increased from 66 in 2005 to 82 in 2007. With the help of NPS implementation materials, the number of watershed groups that meet the USEPA nine required elements almost doubled from 25 groups in 2005 to 49 in 2007. The water quality benefits resulting from the funds that the NPS program administers include significant reductions in the amount of sediment, phosphorus, and nitrogen reaching Indiana waterways in the form of nps polluted runoff (Table 4).

Table 4: Reduction of Sediment, Phosphorus, and Nitrogen reaching Indiana Waters

Dates	Sediment Reduction (ton/year)	Phosphorus Reduction (lbs/year)	Nitrogen Reduction (lbs/year)
2000-2003	36,081	42,965	86,281
2004	18,612	22,056	44,651
2005	33,415	39,347	79,346
2006	24,765	39,445	97,187
2007	22,876	122,040	111,428
2008	4,429	8,345	22,134

Source: IDEM's Nonpoint Source Project Tracking Database

On-the-ground Improvements to Water Quality – the Pigeon Creek Story

Pigeon Creek watershed is located within Posey, Warrick, Gibson, and Vanderburgh counties in southwestern Indiana. Pigeon Creek flows south where it meets the Ohio River upstream of the drinking water intake in Evansville, Indiana. IDEM placed thirty-two miles of the mainstem of Pigeon Creek on its 1996 303(d) List of Impaired Waters for chlordane and other priority pollutants based on fish tissue data indicating concentrations of these contaminants high enough to warrant the issuance of a fish consumption advisory. These impairments persisted through the 1998 303(d) listing cycle.

These impairments resulted from the use of these chemicals on agricultural lands with poor stream buffers and high historic soil loss. The primary land use in this watershed is agriculture, and crops in this watershed were historically treated with chlordane to control insects. Even though use of chlordane was prohibited in the early 1980s, high levels of this chemical persisted in the sediments in Pigeon Creek and its tributaries. Because these chemicals bond tightly to soils, IDEM and local watershed groups identified erosion from agricultural lands as the primary source of these pollutants.

In 1997 the Citizens for the Improvement of Pigeon Creek cooperated with the NRCS and the Vanderburgh County SWCD to develop a watershed plan for the portion of Pigeon Creek in Vanderburgh County. The partners received CWA Section 319 funding to support projects on Pigeon Creek and its tributaries, including enhanced watershed planning, education, and installing best management practices (BMP) such as filter strips, grassed waterways, field buffers, and conservation tillage.

This project was supported by $171,990 from two CWA section 319 grants (awarded in 1997 and 1999). Landowners and partner agencies within the watershed contributed an additional $42,997 in matching funds, in-kind services, and materials. Partners for the CWA section 319 grants included the Vanderburgh, Warrick, Gibson, and Posey County SWCDs, as well as the Four Rivers Resource Conservation and Development office. These partners helped to select sites for BMP installation, conduct education and outreach activities, and offer technical support. Monitoring and assessment of water quality in 2002 was funded by $78,001 from a CWA section 205(j) grant to IDEM's Assessment Branch. The IDNR, through the Lake and River Enhancement program, funded planning and BMP installation projects amounting to $270,000 in state funds. The NRCS greatly assisted this project by allocating $135,000 each year for the years of 1997, 1998, and 1999 through the Environmental Quality Incentives Program.

From 1997 through 2001 the partners installed more than 50 BMPs designed to reduce soil erosion in the Pigeon Creek watershed. And, locally led efforts continue to address sediment loading to streams in the Pigeon Creek watershed.

In 2002 IDEM assessed water quality in Pigeon Creek to determine whether a TMDL was still needed to address the impairment for chlordane and other priority pollutants and collected additional samples in 2005.

The allowable threshold level of chlordane at the time that the original samples were collected was based on the U.S. Food and Drug Administration's (FDA's) action level for chlordane, which was >0.02 parts per million (ppm) as a total of all isomers. The FDA has since revised this value. The current FDA action level cited for chlordane in fish tissue in the FDA handbook entitled "*Action Levels for Poisonous or Deleterious Substances in Human Food and Animal Feed*," is 0.3 ppm.

IDEM compared the 1992 and 2005 data to the current FDA action level for chlordane (see Table 5). Using the current FDA action level for determining impairment, the results indicated that Pigeon Creek was no longer impaired for chlordane. Based on these results, all 32 miles of the mainstem of Pigeon Creek previously impaired were removed from the state's 303(d) List of Impaired Waters.

Table 5: Comparison of chlordance concentrations in fish tissue from samples collected in Pigeon Creek.

Comparison of fish tissue chlordane isomer levels taken from channel catfish sampled in Pigeon Creek at Kleymyer Park, Evansville, Indiana. The sample point was located near the lowest point of the Pigeon Creek watershed.			
Parameter	**September 1992 sample results (wet weight)**	**August 2005 sample results (wet weight)**	**Percent Reduction**
Chlordane, Alpha-	.082 ppm	.014 ppm	83%
Chlordane, Gamma-	.056 ppm	.004 ppm	93%
Nonachlor, cis-	.055 ppm	.009 ppm	84%
Nonachlor, trans-	.11 ppm	.032 ppm	71%
Oxychlordane	.012 ppm	.001 ppm	92%
Total chlordane residue	.315 ppm	.060 ppm	81%
FDA action level for chlordane*	.3 ppm		
*Maximum concentration of allowable levels of chlordane residue in edible portions of fish tissue.			

These land treatment measures significantly reduced the amount of chlordane and other organic pollutants reaching the stream, allowing the legacy sources to be covered by cleaner sediments from other points in the watershed, moved naturally, or degraded over time.

The Pigeon Creek Watershed Management Plan is now addressing other water quality impairments in addition to those associated with chlordane and priority organic pollutants. IDEM and the local watershed group plan to track the status of these other impairments to determine what further work is needed.

Special State Concerns and Recommendations

IDEM has special state concerns regarding two significant issues that affect IDEM's water quality programs and its ability to achieve specific CWA objectives.

Developing TMDLs for Waters Impaired for Mercury and/or PCBs in Fish Tissue

Mercury and polychlorinated biphenyls (PCB) in fish tissue are among the top four causes of impairment to Indiana's waters. To date, states have received little guidance from USEPA

regarding how to develop a TMDL to restore a waterbody with fish tissue impairments for mercury or PCBs. Given this, IDEM has placed all fish tissue impairments in a separate category of the consolidated and 303(d) lists (5B) because it does not believe that, at this point in time, a conventional TMDL is the appropriate approach for addressing these impairments. Until adequate guidance is available, IDEM considers it more prudent to focus its limited resources on developing TMDLs on impairments for which appropriate methods have been established. IDEM urges USEPA to continue working toward development of guidance on how to effectively address fish tissue impairments.

Conflicting Monitoring Needs

For 2002, USEPA called for full integration of CWA Section 305(b) reporting and Section 303(d) listing processes into one consolidated report. Indiana complied and submitted its first IR in 2002. Since that time, it has become evident that while integration of these two CWA objectives solves some problems, a critical issue remains in the fact that the types of water quality monitoring required to support these two programs are not compatible. Until this issue is addressed on the federal level, states will continue to struggle to meet conflicting monitoring needs.

USEPA emphasizes a probabilistic monitoring approach in order to help states meet the CWA section 305(b) goal of comprehensively monitoring all waters of the state. IDEM's probabilistic monitoring program provides IDEM with the ability to make statistical inferences regarding the extent to which waters of the state, as a whole, support or do not support designated uses based on data collected randomly throughout the state. However, these statistical results do not indicate where each specific impaired stream is located.

While the data collected through probabilistic monitoring can be used to make site-specific assessments, the randomness built into the probabilistic study design does not allow for continued monitoring of those streams where impairments have been identified. Follow-up monitoring is needed for these waters in order to determine the full extent of these impairments and the stressors and/or pollutants driving them. However, IDEM cannot direct a larger proportion of its monitoring funds to meet the targeted monitoring needs because the minimum number of samples required to maintain the statistical rigor required by IDEM's probabilistic sampling design consume most of OWQ's monitoring resources, leaving comparatively very little funding to direct toward targeted monitoring. As a result, IDEM OWQ programs struggle with conflicting monitoring needs. The resources available to conduct the targeted monitoring necessary to meet other CWA mandates and USEPA performance measures are not keeping pace.

For example, USEPA now requires states to meet performance measures aimed at quantifying improvements in water quality resulting from TMDL implementation and/or watershed planning and restoration activities funded through Section 319 grants and other OWQ programs such as SRF and 104(b)(3) projects. IDEM is most interested in providing tangible measures of success of its programs. While there is clearly an emphasis, as measured by federal resource allocations, on accountability on the federal level, there does not appear to be a corresponding emphasis on the targeted monitoring required to provide them.

Indiana's 303(d) list continues to grow as a function of probabilistic monitoring required to meet CWA 305(b) goals while the federal funding devoted to targeted monitoring needed to better characterize and address these impairments does not. IDEM continues to monitor probabilistically, which results in a large number of waters being sampled for the first time every season. As a result, IDEM continues to find previously unidentified impairments. USEPA's most recent guidance (USEPA, 2005) recommends that states develop expeditious schedules of 8 to 13 years from the date of the original listing. While IDEM continues to make great strides in TMDL development, without additional resources allocated to the types of monitoring necessary for this CWA mandate, it will become increasingly difficult for IDEM's TMDL Program to keep pace with the number of new impairments identified each year.

With this report, IDEM has completed a second full round of its five-year rotating basin monitoring providing USEPA with a comprehensive aquatic life use assessment for the entire state based on probabilistic monitoring results. IDEM agrees with the need for continued probabilistic monitoring in order to determine overall trends in water quality throughout the state and over time and to provide additional data with which to assess previously unassessed waters. However, additional resources are needed to complete the targeted monitoring necessary to meet other CWA goals and USEPA objectives.

SURFACE WATER MONITORING AND ASSESSMENT

IDEM's Surface Water Monitoring Strategy

The Assessment Branch (AB) in IDEM OWQ is responsible for monitoring the surface water quality all across Indiana pursuant to CWA Section 305(b) and pursuant to Section 303(d) helps identify those waters of the state that are impaired. To accomplish these CWA requirements, the AB developed the Indiana Water Quality Monitoring Strategy (SWQMS) in 1996. The monitoring strategy was revised most recently in 2005 and is designed to provide technical data and information in support of:

- The annual update and biennial IR;
- NPDES permitting program;
- The annual Fish Consumption Advisory (issued by the Indiana State Department of Health in cooperation with IDEM and the IDNR);
- Drinking water source assessment; and
- Identifying past and emergent water quality trends.

IDEM's monitoring strategy follows a rotating basin approach. Approximately one-fifth of the state (1-2 basins) is scheduled for monitoring each year for five years (Figure 4). Monitoring is conducted within a given basin(s) and the results are analyzed for quality assurance and quality control (QAQC) in year one. In year two, the QAQC'd data are used to make water quality assessments for the basin(s). These assessments and any waterbody impairments identified through these assessments are reported in the third year, either electronically or in a narrative report. CWA Section 305(b) requires states to submit a narrative report in even-numbered years and an electronic update in odd-numbered years. As a result, each narrative IR now contains the results for two years' worth of monitoring and assessments. A detailed schedule of IDEM's 305(b) assessment and reporting, and 303(d) listing activities is presented in Appendix E.

The principle goals of the Indiana SWQMS: 2006-2010 are to:

- Measure the physical, chemical, bacteriological, and biological quality of the aquatic environment in all river basins and identify factors responsible for impairment;
- Assess the impact of activities that occur in all river basins and the probable effects of these activities on the quality of the ecosystem and drinking water source protection;
- Identify trends through analysis of environmental data from a variety of sources and make recommendations for the protection of designated uses of the water resources of the state; and
- Provide environmental quality assessment reports to support the water quality management program in partnership with customers and stakeholders.

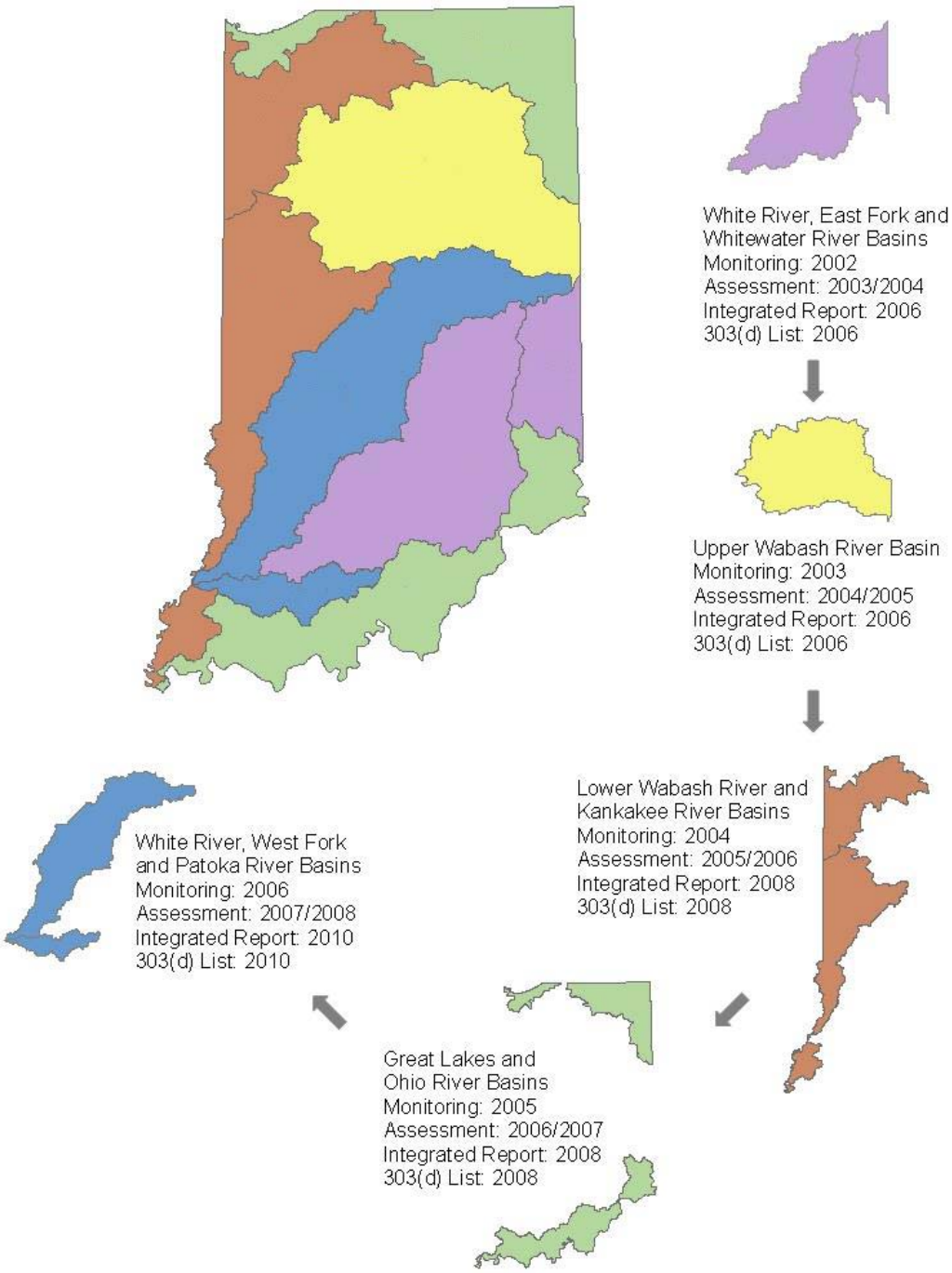

Figure 4: IDEM's Rotating Basin Monitoring, Assessment, Reporting and Listing Schedule.

The ideal monitoring program would be to sample everywhere all the time. However, such an approach would be cost-prohibitive and is unrealistic. An alternative is to sample a large number of randomly selected sites in a given watershed, which reduces bias. This is IDEM's approach. A chief component of the OWQ surface water quality monitoring strategy is the Watershed Monitoring Program, which is designed to characterize the overall environmental quality of each

major river basin and to identify those monitored waterbodies within each basin that are not fully supporting their beneficial designated uses. IDEM uses data from this program to make water quality assessments at two spatial scales:

- Comprehensive Use Support Assessments: These assessments are statistical in nature, based on the data collected by IDEM's Watershed Monitoring Program. This program employs a probability-based sampling design that allows IDEM to predict with reasonable certainty what percentage of Indiana's rivers and streams are impaired. However, it is important to note that while the data collected can be used to make statistically valid statements about the overall water quality within a watershed, these statements cannot be applied to specific stream reaches. IDEM's comprehensive aquatic life use support results are included in Appendix C of this report. IDEM began monitoring *E. coli* probabilistically in 2004, which will allow calculation and reporting of comprehensive recreational use support for all basins in Indiana by 2010 reporting cycle.
- Stream-Specific Use Support Assessments: The data used to make statistical comprehensive use support assessments are also applied to the specific stream or stream reach from which they were collected to assess its use support. Results from IDEM's stream-specific assessments are summarized in the Rivers and Streams Water Quality Assessment section of this report.

The principal advantage of the probabilistic monitoring approach is that it allows IDEM to meet the goal of providing a comprehensive statistical assessment of the overall water quality in each major basin while at the same time, providing a great deal of data that can be used to make stream-specific assessments (Figure 1). However, IDEM must continually balance the need for the probabilistic monitoring necessary to provide USEPA with comprehensive statistical assessments with the targeted monitoring necessary to achieve other CWA objectives. This is becoming increasing difficult as the number of CWA and other USEPA objectives requiring targeted monitoring increase.

This report provides comprehensive assessments for watersheds in all of Indiana's major basins in addition to summaries of results from IDEM stream-specific assessments. Watersheds that were previously reported, either in the form of an electronic update or narrative report, are included in this report.

On September 26, 2007, Indiana's draft 2008 303(d) List of Impaired Waters was published in the Indiana Register for the 90-day public comment period required by state law. In addition to the 90 days required, IDEM extended the public comment period to January 31, 2008 to provide interested stakeholders additional time to submit their comments on the draft list. To avoid adding impaired waterbodies to Indiana's 2006 303(d) List after it has been presented to the public for comment and to achieve consistency between the 305(b) report and the 303(d) list, Indiana does not include in this report the results of water quality assessments conducted after September 26, 2007. These assessments, which include the White River, West Fork and Patoka basins, will be included in the 2009 electronic update and incorporated into the narrative 2010 IR. Any streams that are assessed as impaired after September 26, 2007, will be addressed in the next draft of the 303(d) list to be included with the 2010 IR. This approach allows Indiana to meet USEPA's reporting deadlines and minimizes inconsistencies between the 305(b) report and the 303(d) list that is presented to the public in an integrated format in even-numbered years.

Data Quality Assurance and Quality Control

To ensure the quality of the data used in IDEM's 305(b) assessments, all surface water monitoring is conducted in accordance with IDEM's Quality Assurance Project Plan (QAPP) for Indiana Surface Water Quality Monitoring and Total Maximum Daily Load (TMDL) Program, which is part of the IDEM's overall Quality Management Plan (QMP), approved by USEPA. IDEM's QAPP for surface water monitoring was most recently revised in October 2004 and complies with the 2002 USEPA Guidance for Quality Assurance Project Plans (USEPA, 2002).

The QAPP outlines specific data quality objectives for environmental data and serves as a tool and provides a plan for environmental data collection for several surface water quality monitoring and TMDL programs. Additionally, the QAPP describes a well-defined data quality assessment (DQA) 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.

IDEM's Water Quality and Assessment Data Management

The IDEM AB maintains its surface water quality data in its AIMS database. AIMS houses surface water chemistry, fish community, macroinvertebrate community, habitat quality, fish tissue contaminant and sediment contaminant data. Results from the fixed station monitoring program that were collected prior to 1995 are also stored in USEPA's Storage and Retrieval system (STORET) for samples collected through 1995. Since STORET is not available for batch upload at this time, it is expected to be replaced with the new Water Quality Exchange (WQX). IDEM is currently planning modifications to the AIMS database that will allow updates of data through the WQX. This update will also provide for a more user-friendly interface, better access via the IDEM Intranet by all staff, and allow for storage of additional water quality data such as NPS project-collected data and third party datasets for potential use in assessing waters for the IR.

IDEM's Watershed Planning Branch maintains IDEM's Assessment Database (ADB). The ADB houses the CWA Section 305(b) assessment decisions that have been made on the basis of the results stored in AIMS. IDEM recently upgraded its ADB to a more recent version that better accommodates US EPA's IR format. However, the structure of the new ADB is very different than the structure of the ADB IDEM has used in previous cycles, requiring a significant amount of review to ensure that all assessment data was properly migrated. Although database maintenance is an ongoing task, it is anticipated that the review and corrections needed specifically as a result of IDEM's data migration will be complete by the 2010 cycle.

Waterbody assessment units (AU) in the IDEM ADB are assigned a unique identifier which is "keyed" to the National Hydrography Dataset (NHD) for the purposes of mapping. This "key" is called the Reach Index. When Indiana created its first Reach Index in 2002, most waterbodies in the state were assigned an assessment unit ID (AUID) based on the 14-digit watershed in which they were located. In most cases, each 14-digit watershed was assigned a single AUID regardless of how many individual streams were in the watershed. Therefore, an assessment of *any* stream would be applied to *all* the streams in the watershed regardless of where the sample was located or its relative representativeness to each stream. This problem was not preventable at the time because, while the reach indexing tool used to create Indiana's Reach Index had the capability to

split "watershed" segments into smaller AUs, the software had no built-in means for tracking changes in segmentation.

For the 2006 IR cycle, IDEM developed an administrative process for splitting stream segments into smaller AUs allowing for more accurate application of assessment data. This process has been refined somewhat for the 2008 cycle. However, the basic process for splitting AUs is the same. Changes in segmentation are considered on a case-by-case basis and are generally made either to accommodate a more accurate assessment or to correct an earlier assessment in which the data were inappropriately applied.

Segmentation changes are based on a combination of factors including primarily hydrology, similarities in land use and potential sources of impairment. Splitting AUs in this way allows IDEM to associate an identified impairment more accurately to the waterbody from which the sample was collected and to any others for which results are representative. When AUs are split, IDEM reevaluates any assessments made on the original AU along with any recent data that is available. This reassessment process ensures that the original assessment information is properly applied to the resulting new AUs. In most cases, the original assessment applies to only one or two of the resulting AUs with the remaining units are unassessed.

IDEM's methods for tracking changes in segmentation are still being refined. Per USEPA's request, IDEM now retires the original AUID for any AU that has been split to facilitate tracking.

It is important to note that while changes in segmentation – usually from one large AU to several smaller AUs – increase the number of impairments on the 303(d) list, they produce a more accurate representation of the number of stream miles impaired. IDEM recognizes the importance of accurate tracking in this regard, particularly when resegmentation results in changes to the total number of AUs and stream miles listed as impaired. A key for tracking all segmentation changes to date and the application of previous assessment information to the resulting new AUs in terms of their Consolidated Listing categories is provided in Appendix A.

In addition to splitting segments, the Reach Index must be updated to include a number of waterbodies that could not be indexed due to the spatial resolution of the NHD at the time the index was developed. At the time Indiana's Reach Index was created, the NHD was only available in 1:100,000 scale. Given this, a number of the state's first and second order streams and lakes that do not appear at this scale could not be indexed and are therefore not mappable using the current Reach Index. Today, the NHD is available in high resolution (1:24,000 scale) for the entire state of Indiana. In order to facilitate more accurate mapping of these and future assessments, IDEM has begun the ambitious process of revising its Reach Index to include all waters that appear in the high resolution NHD. Due to the complexity of this work and the enormous number of additional waterbodies that appear when mapping at high resolution, this is no small task. Once IDEM completes its revision of the Reach Index, all new AUs identified must then be incorporated into IDEM's ADB for assessment purposes.

With regard specifically to streams, in order to index new streams that appear at high resolution, the indexing for the entire watershed must be revisited. Those AUs that were originally comprised of all streams in a given watershed will necessarily have to be split into more representative reaches for assessment purposes. Once this process is complete for the entire state,

the need to split AUs on an assessment-by-assessment basis will be eliminated along with the difficulties associated with tracking such changes.

At this time, it is anticipated that IDEM's high resolution Reach Index will be completed prior to the 2010 integrated report cycle. In the meantime, IDEM has prioritized its high resolution indexing work to stay ahead of IDEM's monitoring and assessment schedule, focusing indexing efforts in those basins next in line for assessments in order to minimize the number of AUs split for assessment purposes.

Summary Data and Assessment Methodology

Summary Data

Indiana's CALM is provided in its entirety in Appendix A along with Indiana's Consolidated List. This section provides a summary of the data that supports IDEM's 305(b)/303(d) processes. IDEM draws from the following monitoring programs for data to use in making the use support determinations required under CWA Section 305(b) assessments and subsequent CWA Section 303(d) listing decisions:

- Fixed Station Monitoring Program, which provides chemistry data;
- Watershed Monitoring Program, which provides fish and benthic aquatic macroinvertebrate community data (IBI and mIBI) along with habitat evaluations, water chemistry data including information on nutrients, Chlorophyll *a* data, and *E. coli* data;
- Source ID Program, which provides chemistry data;
- Stressor ID Program, which provides fish community (IBI) data and habitat evaluations along with chemistry data collected at the same sites;
- Fish Tissue Contaminant Program, which provides fish tissue data;
- Lakes Monitoring Program, which provides chemistry data and information on nutrients, algae, secchi depth; and
- Special Studies Program which provides a variety of information for selected locations.

SWQMS and fact sheets with detailed descriptions of the monitoring programs are available on the IDEM Web site at: http://www.in.gov/idem/programs/water/quality/index.html

USEPA requires that states consider all readily available data sources in the preparation of their 303(d) lists and thus the 305(b) assessment purposes. In addition to the water quality data collected by IDEM, IDEM has cooperative agreements with the USGS to collect water quality data at the same sites sampled by IDEM to provide data for additional parameters not sampled by IDEM. In addition to providing important data for IDEM's development of its nutrient criteria, these data can also be used in 305(b) assessments and 303(d) listing decisions. IDEM also routinely solicits data generated by external parties through 319 and 205(j) grant projects for potential use in 305(b) assessments. IDEM's 305(b) coordinator also works closely with TMDL staff to determine whether data they collect for TMDL development from external parties can be used in making water quality assessments. Although these data are collected by organizations external to IDEM, most of these data sets are submitted to IDEM and housed internally making them most easily obtainable through program staff within IDEM. All data received are reviewed for usability in accordance with IDEM's Assessment Branch QAPP.

While IDEM works with external organizations to obtain water quality data for potential use in water quality assessment processes, the ability to solicit the largest possible audience and to review the data received has been hampered in past cycles by the lack of a formal process and limited staff resources. In order to address these issues, IDEM OWQ has begun developing a framework for the solicitation, review of external data for its usability in selected OWQ programs. The goals of this project include:

- Identifying IDEM processes for which external organizations would like to see their data used (e.g. education, planning, TMDL development, 305(b) assessment, 303(d) listing, etc.);
- Developing an effective data solicitation process;
- Developing a data quality ranking system and criteria specific for each type of proposed use;
- Developing a process for providing technical assistance to help organizations meet the data quality criteria necessary for the process in which they want their data considered.

In 2007, it was determined that a broad data solicitation prior to having the external data framework fully developed would provide a fuller understanding of the variety of organizations that are collecting water quality data in Indiana, the types of data they are collecting and its relative data quality. IDEM solicited data from:

- Relevant programs at every college and university in the state
- Environmental groups and interested citizens identified through various sources
- Hoosier Riverwatch - Indiana's statewide volunteer monitoring program
- Drinking water utilities
- County health departments and the ISDH
- County SWCD (via IASWCD)
- Municipal Separate Storm Sewer System (MS4) entities and Combined Sewer Overflow (CSO) communities
- Federal agencies (USGS, USFS, etc.)
- State professional organizations (Indiana Water Resources Association., Indiana Association of Cities and Towns, etc.)

Results from this solicitation have also helped to identify where IDEM should focus its solicitation and technical assistance efforts to achieve a greater response from the water quality monitoring community at large. In total, IDEM sent solicitations by email or letter to approximately 670 individual organizations that fall into one or more of the categories in the above list. A copy of this solicitation is provided in Appendix F of this report. In response to this solicitation, IDEM received more than one hundred water quality data packages and reports from forty-one individual organizations. A summary of the types of organizations that responded with data is provided below in Table 6.

Table 6: Summary of results from IDEM's external data solicitation, conducted in 2007.

Type of Organization	Number that Submitted Data
Cities and Towns	14
County Soil and Water Conservation Districts (SWCD)	8
Watershed Groups and Environmental Organizations	6
County Health Departments	5
Colleges and Universities	2
Private Drinking Water Utilities	1
County Surveyors	1
Resource Conservation and Development Areas (RC&D)	1
Regional Planning Commissions	1
Parks and Recreation Departments	1
Other State Agencies	1

The chemical and physical data sets received from the 2007 solicitation are presently being reviewed to determine their usability in IDEM's 305(b)/303(d) processes and to synthesize the information they contain relative to the development of IDEM's external data framework. IDEM is also reviewing projects conducted with funding from IDNR Lake and River Enhancement Program and projects funded through IDEM's Section 319 and 205(j) programs. Any 305(b) assessment decisions made from these data will be incorporated into IDEM's 305(b) electronic update submitted to USEPA in 2009 and will be discussed in more detail in IDEM's narrative IR submitted in 2010.

IDEM has completed its review of the biological data submitted and has determined that studies submitted by two organizations, the City of Muncie and the City of Elkhart meet IDEM's quality assurance requirements and are readily available and usable in their present form for 305(b) assessment and 303(d) Listing processes. The other studies submitted contain valuable information for IDEM biologists and were considered generally usable with respect to the data quality (Table 7). However they will require significant staff time to prepare them for assessment purpose. IDEM is highly encouraged by the results of its preliminary review and the quality of the data received. As IDEM moves forward with its External Data Framework Project, all data will be reevaluated to determine what improvements IDEM needs to make in terms of communicating its format requirements for data submissions. As with chemical data sets received, those biological data sets determined to be usable for assessment purposes will be assessed and incorporated into IDEM's 305(b) electronic update submitted to USEPA in 2009.

They will be discussed in more detail in IDEM's narrative IR submitted in 2010.

Table 7: Review results for biological data sets reviewed in response to 2007 solicitation.

Organization	Type of Data Submitted	Usability in IDEM Assessment Processes
City of Elkhart	Macroinvertebrate Community Fish Community Fish Tissue	Datasets are usable in their present format for assessment purposes. These studies were found to have high precision and taxonomic sensitivity with the survey and assessment having been conducted by a professional biologist
City of Muncie	Macroinvertebrate Community Fish Community	Datasets are usable in their present format for assessment purposes. These studies were found to have high precision and taxonomic sensitivity with the survey and assessment having been conducted by a professional biologist
Marion County Health Department	Macroinvertebrate Community	These studies appear to have high precision and taxonomic sensitivity with the survey and assessment having been conducted by a professional biologist. However, the data set is very large with no analysis provided. Due to the significant time required to work through the raw data to prepare them for assessments (mapping, evaluation and interpretation), they are not presently considered readily available for assessment purposes.
Storm Water Quality Management Plans Baseline Characterization Reports: • City of Shelbyville • City of Madison • City of Decatur • Town of Speedway	Macroinvertebrate Community	These studies were found to have high precision and taxonomic sensitivity with the survey and assessment having been conducted by a professional biologist as required by IDEM's QAPP. However, the rapid bioassessment (RBP) tool used to analyze results is different than that which IDEM uses, making it difficult to interpret. Generally these data are usable for assessment purposes. However, due to the staff time required to determine comparability, they are not presently considered readily available for assessment purposes.

It is anticipated that OWQ's external data framework will ultimately provide the guidelines and technical assistance necessary to help organizations collecting water quality data throughout Indiana who desire the opportunity to become more involved with IDEM in working toward our shared goals of protecting and restoring Indiana's water resources.

Assessment Methodology

Waterbodies in this report are identified based on watershed areas known as 14-digit hydrologic unit areas (HUAs), which in Indiana range from about 5,000 to 20,000 acres in size. The average 14-digit hydrologic unit area in Indiana is about 12,000 acres or 20 square miles. As discussed in earlier sections of this report, in Indiana's Reach Index, a waterbody AU may represent separate reaches or the whole mainstem of the larger waterbody and/or its tributaries within a 14-digit watershed. Beginning with the 2006 assessment cycle, IDEM began splitting AUs for assessment

purposes. As a result, in the basins assessed during this cycle there is an increasing number of 14-digit watersheds in which each individual stream is assigned its own unique AUID. While this practice will necessarily continue in the long term, generally, the river miles in most watersheds still appear as one waterbody. However, in watersheds containing reaches of Indiana's large rivers (i.e. rivers with more than 1,000 square miles of drainage area), these reaches were already assigned individual AUIDs and rarely require splitting for assessment purposes. The waterbody AUs for these reaches typically do not include tributaries. This approach allows IDEM to separate wadeable streams from nonwadeable streams for the purposes of assessment ensuring that issues such as sampling techniques, which might bias results, are considered within the context of stream size. All waterbody assessments for Indiana's hydrologic unit areas are now stored in the database.

Indiana's lakes and reservoirs are tracked as individual waterbodies and are reported in terms of their acreage with the hydrologic unit area in which they are located. Lake Michigan is tracked both as Great Lake shoreline miles and as a lake in acres with its own USGS cataloging unit (eight-digit hydrologic unit code). The shoreline is assigned mileage units. Lake Michigan is assigned acreage units and is not included in the lake acre assessment values in this report. Separate tracking of Lake Michigan will lead to better assessment and understanding of the water quality of this lake.

The assessment process described in Indiana's CALM (Appendix A) is summarized in Table 8 and was applied to data from various programs in IDEM's AB and to other external data meeting IDEM's QAQC requirements. Results from the assessment process are entered into IDEM's ADB. Site-specific assessments that are entered into the ADB are presented in Appendix A, which includes all assessments completed to date for each waterbody by their beneficial uses: aquatic life support, fish consumption, recreational use, and drinking water supply for those waterbodies designated for this use. Each unique waterbody AU for which data was collected received its own assessment. As discussed earlier in this report, when the assessment for a AU was not homogeneous, the AU was split into smaller AUs, each assessed separately.

Physical/chemical data for toxicants (total recoverable or dissolved metals, polynuclear aromatic hydrocarbons [PAHs], pesticides, ammonia, and cyanide), conventional water chemistry parameters (dissolved oxygen, pH, temperature, and anions), and bacteria (*E. coli*) were evaluated for exceedance of the Indiana WQS (327 IAC 2-1-6 and 327 IAC 2-1.5-8). USEPA 305(b) Guidelines were applied to sample results as indicated in Table 8 (USEPA 1997b).

Table 8: Summarized Criteria for Use Support Assessment.

Aquatic Life Use Support - Rivers and Streams		
Toxicants	Metals, pesticides, PAHs, cyanide, ammonia were evaluated on a site-by-site basis and judged according to the magnitude of the exceedance(s) of Indiana's WQS and the number of times the exceedance(s) occurred. For any one pollutant (grab or composite samples), the following assessment criteria are applied to data sets consisting of three (3) or more measurements.	
	Fully Supporting	**Not Supporting**
	≤1 exceedance of the acute criteria within a three-year period, and <1 exceedance of the chronic criteria for aquatic life within a three-year period.	>1 exceedance of the acute or chronic criteria for aquatic life within a three-year period.
Conventional inorganics	Dissolved oxygen, pH, sulfates, chlorides were evaluated for the exceedance(s) of Indiana's WQS. For any one pollutant, the following assessment criteria are applied to data sets consisting of three or more measurements.	
	Fully Supporting	**Not Supporting**
	For dissolved oxygen, one/more samples may be <4mg/L, but no more than 10% of all measurements are <5mg/L. For other conventional inorganics, criteria are exceeded in <10% of measurements.	For dissolved oxygen, one/more samples <4mg/L and more than 10% of all measurements are <5mg/L. For other conventional inorganics, criteria are exceeded in >10% of measurements.
Nutrients	Nutrient conditions were evaluated on a site by site basis using the benchmarks described below. In most cases, two or more of these conditions must be met on the same date in order to classify a waterbody as impaired. This methodology assumes a minimum of three sampling events. • Total Phosphorus: One/more measurements >0.3 mg/l • Nitrogen (measured as NO_3 + NO_2) -- One/more measurements >10.0 mg/l • Dissolved Oxygen (DO) -- Measurements below the water quality standard of 4.0 mg/l or measurements that are consistently at/close to the standard, in the range of 4.0-5.0 mg/l or values >12.0 mg/l • pH measurements -- Measurements above the water quality standard of 9.0 or measurements that are consistently at/close to the standard, in the range of 8.7- 9.0 • Algal Conditions -- Algae are described as "excessive" based on field observations by trained staff.	

	Fully Supporting	Not Supporting
Benthic aquatic macroinvertebrate Index of Biotic Integrity (mIBI) Scores (Range of possible scores is 0-8)	• mIBI ≥1.8 (for samples collected with an artificial substrate sampler) • mIBI ≥2.2 (for samples collected using kick methods)	• mIBI <1.8 (for samples collected with an artificial substrate sampler) • mIBI <2.2 (for samples collected using kick methods)
Fish community (IBI) Scores (Range of possible scores is 6-60)	IBI ≥36	IBI <36
Qualitative habitat use evaluation (QHEI) (Range of possible scores is 0-100)	The Qualitative Habitat Evaluation Index (QHEI) is not used to determine aquatic life use support. Rather, the QHEI is an index designed to evaluate the lotic habitat quality important to aquatic communities and is used in conjunction with mIBI and/or IBI data to evaluate the role that habitat plays in waterbodies where impaired biotic communities (IBC) have been identified. QHEI scores are calculated using six metrics: substrate, instream cover, channel morphology, riparian zone, pool/riffle quality, and gradient. A higher QHEI score represents a more diverse habitat for colonization of aquatic organisms. IDEM has determined that a QHEI total score of <51 indicates poor habitat. For streams where the macroinvertebrate and/or fish community (mIBI and/or IBI) scores indicate IBC, QHEI scores are evaluated to determine if habitat is the primary stressor on the aquatic communities or if there may be other stressors/pollutants causing the IBC.	
Aquatic Life Use Support – Lakes and Reservoirs		
	Fully Supporting	**Not Supporting**
Indiana Department of Natural Resources surveys of the status of sport fish communities in lakes and information on trout stocking.	Supports cold water fishery, including native cisco and stocked trout, or both.	Native cisco population is gone or lake unable to support stocked trout and lake attributes, or both, appear to contribute to warm water fishery condition.
Temperature and pH	Lakes in which thermal modifications have caused an adverse effect on aquatic life and lakes that do not meet Indiana's WQS for pH have been assessed as not supporting of aquatic life use.	
Fishable Use Support (Human Health)		
Available fish tissue data for the most recent 12 years of data collection were evaluated for 305(b)/303(d) purposes for the 2008 cycle. Only waters for which sufficient fish tissue data were available were assessed for fish consumption All samples from a given sampling reach must have results below the benchmarks for mercury and PCBs in order to be assessed as fully supporting, and all waters with a sample result exceeding the benchmark for either mercury and/or PCBs are classified as impaired.		

	Fully Supporting	Not Supporting
Mercury in Fish Tissue	Actual concentration values (including estimated values above the method detection limits) for all samples collected from sampling reach are ≤0.3 mg/kg	One or more actual concentration values (including estimated values above the method detection limits) for samples collected from sampling reach are >0.3 mg/kg
	Fully Supporting	**Not Supporting**
PCBs in Fish Tissue	Actual concentration values (including estimated values above the method detection limits) for all samples collected from sampling reach are ≤0.02 mg/kg	One or more actual concentration values (including estimated values above the method detection limits) for samples collected from sampling reach are >0.02 mg/kg

Recreational Use Support (Human Health) – All waters

IDEM has two different criteria for recreational use assessments depending on the type of data set being used in making the assessment. For data sets consisting of five equally spaced samples over a 30-day period, we apply two tests, both of which are based on USEPA's Ambient Water Quality Criteria for Bacteria - 1986 (EPA440/5-84-002), which provides the foundation for Indiana's WQS for recreational use. For data sets consisting of 10 or more grab samples where no five of which are equally spaced over a 30-day period, the 10% rule is applied. Specific criteria are provided below.

	Fully Supporting	Not Supporting
Bacteria (E. coli): at least five equally spaced samples over 30 days. (cfu = colony forming units)	Geometric mean does not exceed 125 cfu/100ml and no more than one sample >576 cfu/100ml.	Geometric mean exceeds 125 cfu/100mL.
Bacteria (E. coli): grab samples (cfu = colony forming units)	No more than 10% of measurements >576 cfu/100ml and not more than one sample >2400 cfu/100ml.	More than 10% of samples >576 cfu/100ml or more than one sample >2,400 cfu/100ml.

Drinking Water Use Support – Rivers

Rivers are designated for drinking water uses if a community water supply has a drinking water intake somewhere along the segment. When IDEM has data for a segment with a drinking water intake, those data are compared to Indiana's WQS to determine if the drinking water use is met. Different criteria are applied depending on whether the segment is located within or outside of the Great Lakes system. The appropriate water quality criteria are applied for specific substances identified in the criteria. Information regarding non-naturally occurring taste and odor producing substances not specifically identified in the criteria are reviewed within the context of a water treatment facility's ability to meet Indiana's drinking WQS using conventional treatment.

Toxicants	Metals, pesticides, PCBs, total cyanide were evaluated on a site by site basis and judged according to magnitude of the exceedance(s) of Indiana's WQS for point of water intake and the number of times exceedance(s) occurred. For any one pollutant (grab or composite samples), the following assessment criteria are applied.	
	Fully Supporting	**Not Supporting**
	No more than one exceedance of the acute or chronic criteria for human health within a three-year period.	More than one exceedance of the acute or chronic criteria for human health within a three-year period.
Conventional inorganics	Total dissolved solids, specific conductance, sulfate, chloride, nitrite-N and nitrogen (measured as NO_3 + NO_2) were evaluated for the exceedance(s) of Indiana's WQS for point of water intake and the number of times the exceedance(s) occurred. For any single pollutant (grab or composite samples), the following assessment criteria are applied to data sets consisting of three or more measurements.	
	Fully Supporting	**Not Supporting**
	No more than one exceedance of the acute or chronic criteria for human health within a three-year period.	More than one exceedance of the acute or chronic criteria for human health within a three-year period.
Taste and odor producing substances	**Fully Supporting**	**Not Supporting**
	Taste and odor substances not present in quantities sufficient to interfere with production of drinking water by conventional treatment	Taste and odor substances present in quantities requiring additional treatment by the public water supply to prevent taste and odor problems
Recreational Use Support (Aesthetics) – Lakes and Reservoirs		
Natural Lakes	**Fully Supporting**	**Not Supporting**
	No more than 10% of all TP values >54 ug/L and their associated Chla values <20ug/L	Less than 10% of all TP values are <54 ug/L but their associated Chla values are >20ug/L, and the TSI score for the lake indicates eutrophic (32-46) or hypereutrophic (>47) conditions Or More than 10% of all TP values are >54 ug/L with associated Chla values <4ug/L, but the TSI score for the lake indicates eutrophic (32-46) or hypereutrophic (>47) conditions Or More than 10% of all TP values are >54 ug/L with associated Chla values >4ug/L

	Fully Supporting	Not Supporting
Reservoirs	No more than 10% of all TP values >51 ug/L and their associated Chla values are <25ug/L	Less than 10% of all TP values are <51 ug/L but their associated Chla values are >25 ug/L and the TSI score for the lake indicates eutrophic (32-46) or hypereutrophic (>47) conditions Or More than 10% of all TP values are >51 ug/L with associated Chla values <2ug/L, but the TSI score for the lake indicates eutrophic (32-46) or hypereutrophic (>47) conditions Or More than 10% of all TP values are >51 ug/L with associated Chla values >2ug/L
Drinking Water Use Support – Lakes and Reservoirs		
Information on the application of pesticides to surface drinking water reservoirs	Reservoirs or lakes that serve as source water for public water supplies that received pesticide (algaecide) application permits for algae were classified as not supporting because additional treatment by the public water supply was required to prevent taste and odor problems.	
Other Assessments – Lakes and Reservoirs		
Indiana Trophic State Index (TSI)	Nutrients, ammonia, dissolved oxygen, light transmission and light penetration in the water column turbidity, and algae growth were used to determine TSI scores. Trophic scores were used to classify lakes according to their trophic state. Lake trends were also assessed for lakes with two or more trophic scores if at least one of the scores was less than five years old. Trophic scores and lake trends are not used to determine use support status. These assessments are conducted to fulfill Clean Water Act Section 314 reporting requirements for publicly owned lakes and reservoirs.	

In addition to the decision- making criteria show in Table 8, the need for a Coolwater Index of Biotic Integrity (IBI) has been recognized. IDEM has been working with the Aquatic Research Center of the Indiana Biological Survey (INBS) on creating an Index of Biotic Integrity for coolwater streams. A total of 283 sites were examined statewide in order to develop and calibrate an Index of Biotic Integrity for use in coolwater streams of Indiana. A coolwater temperature model was created from 34 streams that had daily temperatures less than 26 Celsius. Graphical analysis of the data from the Aquatic Research Center of the INBS enabled construction of maximum observed species lines for calibrating the Coolwater Index of Biotic Integrity for twelve metrics as modified for application to all coolwater streams and rivers in Indiana. Metrics that have been previously calibrated in ecoregions and other reports have been modified for the Coolwater IBI. By evaluating the 303(d) listed streams against the coolwater temperature model, about 18% of the failing streams actually were misclassified coolwater streams and met the revised criteria. Both the INBS and IDEM AIMS fish databases were used for the development of the new IBI. This data, while not an actual assessment, is important as it points to possible

changes needed to the water quality standards. In the future, IDEM will explore the possible addition of a cool water designation for streams, in addition to the current warm water and cold water designations.

List of Impaired Waters

IDEM OWQ began using the integrated reporting format in 2002. This format calls for the development of two lists, both of which are included in this report. Indiana's Consolidated List contains assessment information for all waters of 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 a TMDL is required per CWA Section 303(d).

A draft list for 2008 was prepared and published in the Indiana Register on September 26, 2007. Public comments were accepted through January 31, 2008, on the draft list. The draft list and public comment period notice is available on the Office of Water Quality Internet site:

http://www.in.gov/idem/programs/water/303d/index.html

The final 2008 Section 303(d) List of Impaired Waters is included in Appendix A of this report. For the development of the 2008 303(d) list, IDEM has followed, to the degree possible, the 305(b) and 303(d) reporting methods outlined in the U.S. EPA's *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act* (USEPA, 2005) and the additional guidance provided in the U.S. EPA memorandum *Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions* (USEPA, 2006b). This guidance recommends that each waterbody be placed into one of five categories (or their subcategories) depending on the degree to which it supports its designated uses. Waters in Category 5 require TMDLs and are the Section 303(d) Impaired Waters. A more detailed discussion of the consolidated listing methodology and the different categories illustrated in Figure 5 can be found in Appendix A of this report.

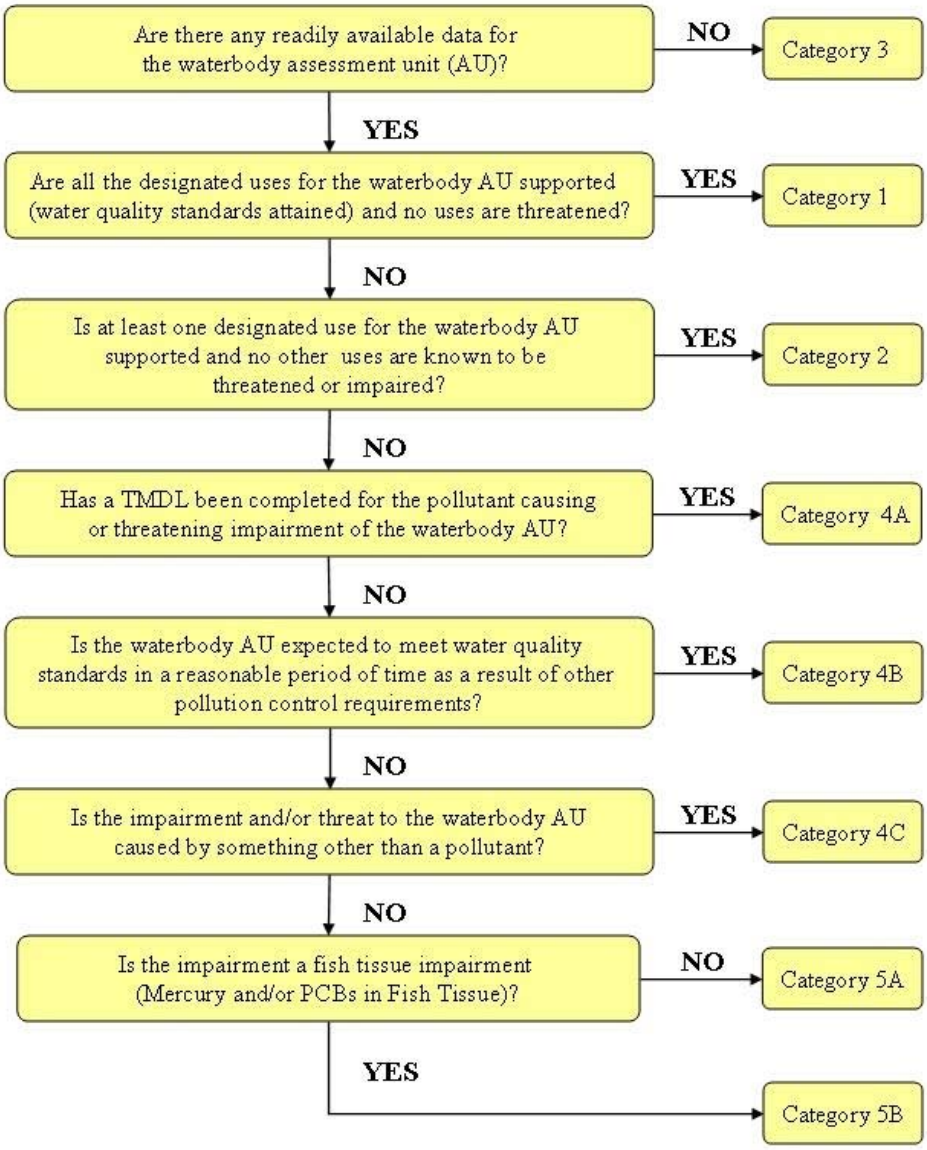

Figure 5: Consolidated Listing Logic Diagram

Rivers and Streams Water Quality Assessment

Designated Use Support

Rivers and streams in all watersheds were assessed for support of beneficial uses designated in Indiana WQS (Indiana Legislative Services Agency, 1997), which contain both narrative and numeric requirements to ensure that beneficial uses of Indiana waters are protected. Indiana's WQS provide the basis for IDEM's CWA Section 305(b) water quality assessments. Of the beneficial uses designated in the State's WQS, IDEM assesses aquatic life use support, recreational use support, support of "fishable" uses. IDEM also assesses drinking water use support on surface waters that serve as a public water supply. Although there are additional uses designated in Indiana's WQS, IDEM's 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 for these four uses, other uses such as agricultural and industrial uses are supported.

A summary of IDEM's methods for determining support of designated uses is provided in the Assessment Methodology and Summary Data Section, and IDEM's CALM is provided in its entirety in Appendix A of this report. For the 2008 cycle, IDEM began using fish tissue data directly to make assessments for PCBs and mercury in fish tissue, both of which are bioaccumulative chemicals of concern. These assessments are made in keeping with the narrative part of Indiana's WQS that are intended to protect the "fishable" uses of waterbodies throughout the state.

In previous years, IDEM relied on fish consumption advisories (FCA) published by the ISDH to assess the fishable uses of Indiana waters. Despite the fact that FCA are not tied to any numeric WQS, USEPA required their use for CWA 305(b) assessments because, at the time, the FCA provided the best information available to assess for support of fishable uses. Since then, USEPA has developed appropriate screening value calculations that allow states to relate WQS to PCB concentrations in fish tissue. USEPA has also developed a national water quality criterion for mercury in fish tissue.

The FCA are not based on WQS, which are intended to provide the underpinning for CWA 305(b) assessments and 303(d) decisions. Like the FCA, the criteria now used to make fishable use support assessments these criteria are intended to be protective of human health. Unlike the FCA, these criteria are directly related to WQS and provide a more accurate and complete assessment of where high concentrations of these contaminants are found in the aquatic environment. Because FCA are expressed only in terms of certain fish species within a given size class, they do not tell the whole story. Comparing fish tissue data directly to a numeric criterion, regardless of the species sampled or their sizes, provides a more accurate assessment of the resource and is thus more consistent with CWA goals.

IDEM's revised methodology was implemented by conducting a statewide reassessment of all lakes and streams in the state for which IDEM had sufficient fish tissue data to make an assessment. The results of this reassassement are presented in this report, stream results in this section and lakes results in the section entitled, "Lake Water Quality Assessment". This reassessment process and IDEM's revised method for fish tissue assessments and the rationale

for revising the methods are discussed in detail in IDEM's CALM provided in Appendix A of this document.

Assessed waters are those waterbodies that were monitored and classified for use support based on IDEM's assessment results. IDEM's SWQMS provides for monitoring all the state's major basins within a five-year period. Therefore, the data used in assessments generally are five years old or less. The results of IDEM's Comprehensive Use Support Assessments are provided in Appendix C.

Waterbodies are classified for designated use support as described in the Assessment Methodology Section. Support of individual designated uses for the state's waterbodies is determined by adding the stream miles assessed for each use individually. Table 9 summarizes use support for the stream miles in the state.

Table 9: Individual Use Support Summary – Streams.

Designated Beneficial Use	Total Miles Designated	Miles Assessed	Percent Assessed	Miles Fully Supporting	Miles Not Supporting
Aquatic Life Use	32,141	17,535	54.6	13,913	3,622
Fishable Uses	32,170	4,465	13.9	1,044	3,420
Drinking Water Supply	102	1	1.0	0	1
Recreational Use (Human Health)	32,173	12,073	37.5	3,700	8,374

Sources: Indiana 305(b) Assessment Database and IDEM Biological Studies Section

Causes/Stressors and Sources of Impairment of Designated Uses

Causes/stressors are those pollutants or other stressors that contribute to the actual or threatened impairment of designated uses in a waterbody. Toxic substances listed in the state water quality numeric standards and conditions such as habitat alterations, presence of exotic species, etc. are all examples of causes or stressors. The stressor inhibits the waterbody from providing a habitat that can support aquatic life or creates a situation that is hazardous to human health or animal life.

Table 10 represents the total miles of streams affected by each cause/stressor in Indiana. A waterbody may be impaired by several different causes/stressors so that the total stream miles affected may actually be less than the total number of miles listed in the table.

Biotic community status represents streams where the cause of impairment is not identified. The fish and/or benthic macroinvertebrate community at sampling sites in the watershed have responded to as yet unidentified stressors.

Table 10: Summary of National and State Causes Impairing Waters – Streams.

Cause/Stressor	Miles
Cause unknown	
Impaired Biotic Communities	2,469
Pesticides	
Atrazine	7
Toxic Organics	
PAHs	22
Dioxins	154
Bioaccumulative Chemicals of Concern	
PCBs in Fish Tissue	3,194
Mercury in Fish Tissue	1,703
Metals	
Cadmium	17
Copper	13
Lead	93
Nickel	13
Zinc	26
Aluminum	27
Toxic Inorganics (metals excluded)	
Cyanide	79
Sulfates	248
Ammonia (Un-ionized)	39
Chlorides	80
Other	
Total dissolved solids	341
Nutrient/Eutrophication Indicators	749
Organic Enrichment (Sewage) Indicators	36
pH	81
Oxygen Depletion	702
Temperature	15
Siltation	118
Flow alteration	57
Other habitat alterations	89
Pathogens (*E. coli* indicator)	8,322
Oil and grease	11
Algal Growth	123

Source: Indiana 305(b) Assessment Database

Sources are the activities that contribute pollutants or stressors to surface water resulting in impairment of designated uses in a waterbody. The structure of IDEM's Assessment Database (ADB), which was designed by USEPA for states to use in their CWA section 305(b) reporting, requires that a source be identified for each assessment made whether or not specific sources are precisely known. For most assessments, the sources identified in the ADB for a given

impairment are not proven. Rather they 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 GAP, L-Thia, areal 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 stream 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, its scientists can apply these types of information to distinguish the most likely sources of impairment in the watershed, providing a starting point for a TMDL, watershed planning or other activities aimed at restoring the stream. Within this context, the sources identified in the ADB do not identify any entities or practices known to contribute to a specific impairment.

Absent more detailed and resource-intensive sampling and analyses, accurately attributing a given impairment to specific sources is difficult at best and is, in many cases, impossible to do with a high degree of certainty. In 2004, IDEM implemented a second-year sampling strategy to address this issue. IDEM's second-year studies are aimed at providing sufficient data to more confidently attribute specific sources to impairments than previously possible.

IDEM continues to explore different approaches to determine sources of impairments. One approach involves gathering a variety of information from sources within and outside IDEM to determine extent of problem area and potential sources/stressors of the impairment. When sufficient information is gathered to characterize the impairment, all the data are analyzed to narrow down the list of potential sources/stressors and identify those contributing to the impairment. The potential of these sources to contribute to the identified impairment is then verified and a sampling plan is developed to collect any additional biological and/or chemical water quality data needed to confirm or eliminate the potential sources identified.

The activities listed in Table 11 represent the total stream miles impaired due to each potential source. Several potential sources may contribute to impairment of a single stream or stream reach, so the total miles in the table may be greater than the actual stream miles impaired reported elsewhere in this document.

Table 11 includes 45 potential sources for the use impairments shown in Table 11, including agricultural categories and additional sources resulting from urban activities and land development. Illicit connections identify "straight pipes" from buildings in unsewered areas that flow into state waters without any treatment. Contaminated sediments are largely due to PCBs that correlate with elevated PCB levels in fish tissue.

Table 11: Summary of National and State Sources Impairing Waters – Streams.

Source	Miles
Municipal Point Sources	
Package plants (small flows)	901
Combined Sewer Overflow	402
Collection System Failure	4
Agriculture	
Grazing Related Sources	1,465
Animal Feeding Operations (NPS)	1,191
Crop Production	1,473
Land Application/Waste Disposal	
Sludge Application or Disposal	1
Landfills	7
Illegal Dumps or Other Inappropriate Waste Disposal	45
Onsite Wastewater Treatment Systems (septic systems)	768
Hazardous waste	3
Hydromodification	
Channelization	179
Dam Construction	16
Upstream Impoundment	1
Flow Regulation/Modification	383
Habitat Alterations (not directly related to hydromodification)	
Loss of Riparian Habitat	549
Bank or shoreline modification/destabilization	312
Other	
Contaminated Sediments	165
Debris and Bottom deposits	18
Natural sources	132
Groundwater Loadings	6
Urban Runoff/Stormwater	430
Land Development	2
Erosion and sedimentation	3
Resource Extraction (Mining)	182
Industrial Point Sources	333
Illicit connections	165
Nonpoint Source	6,308
Source Unknown (applied to fish tissue impairments)	3,863

Source: Indiana 305(b) Assessment Database

Great Lakes Shoreline Water Quality Assessment

The Indiana portion of Lake Michigan is classified as partially supporting recreational use. The shoreline miles reported in Tables 12 through 14 represent linear shoreline miles.

With the exception of Lake Michigan, which is discussed in the next section, Indiana's lakes are assessed for support of designated uses as described in the Lake Water Quality Assessment section of this report. Indiana's entire portion of the Lake Michigan shoreline was assessed in 2001.

Table 12: Individual Use Support Summary – Great Lakes Shoreline.

Designated Beneficial Use	Total Miles Designated	Miles Assessed	Percent Assessed	Miles Fully Supporting	Miles Not Supporting
Aquatic Life Use	59	59	100	59	0
Fishable Uses	59	59	100	0	59
Drinking Water Supply	33	33	100	33	0
Recreational Use (Human Health)	59	59	100	0	59

Source: Indiana 305(b) Assessment Database

Causes/stressors are pollutants or other stressors that adversely impact the designated uses of a lake. Pathogens (*E. coli* is the indicator measured.) identify recreational use impairment for Indiana's Lake Michigan shoreline (Table 13).

Table 13: Summary of National and State Causes Impairing Great Lakes Shoreline.

Cause/Stressor	Miles
Bioaccumulative Chemicals of Concern	
PCBs in Fish Tissue	59
Mercury in Fish Tissue	59
Other	
Pathogens (*E. coli* indicator)	59

Source: Indiana 305(b) Assessment Database

Sources are the activities that contribute pollutants or stressors to lakes resulting in impairment of designated uses. Table 14 shows the activities possibly contributing to impairment of the Lake Michigan shoreline.

Table 14: Summary of National and State Sources Impairing Great Lakes Shoreline.

Source	Miles
Land Application/Waste Disposal	
Illegal Dumps or Other Inappropriate Waste Disposal	18
Onsite Wastewater Treatment Systems (septic systems)	18
Other	
Nonpoint Source	6
Source Unknown (applied to fish tissue impairments)	59

Source: Indiana 305(b) Assessment Database

Great Lake Water Quality Assessment – Lake Michigan

The Indiana waters of Lake Michigan have been assessed for mercury and PCBs in fish tissue as per IDEM's 2008 Consolidated Assessment and Listing Methodology. Tables 15 through 17 reflect the results of these assessments. Lakes are assessed as a single unit; therefore, any impairment will apply to all 154,176 acres of Lake Michigan.

Table 15: Individual Use Support Summary – Lake Michigan.

National and State Uses (acres)					
Beneficial Use	Size Assessed	Size Fully Supporting	Size Fully Supporting but Threatened	Size Not Supporting	Size Not Attainable
Aquatic Life Use					
Fishable Uses	154,176			154,176	
Drinking Water Supply					
Recreational Use (Human Health)					

Source: Indiana 305(b) Assessment Database

Table 16: Summary of National and State Causes Impairing Lake Michigan.

Cause/Stressor	Acres
Bioaccumulative Chemicals of Concern	
PCBs in Fish Tissue	154,176
Mercury in Fish Tissue	154,176

Source: Indiana 305(b) Assessment Database

Table 17: Summary of National and State Sources Impairing Lake Michigan.

Source	Acres
Source Unknown (applied to fish tissue impairments)	**154,176**

Source: Indiana 305(b) Assessment Database

Lake Water Quality Assessment

Because of the differences in the scope and nature of the data collected on Indiana's lakes as opposed to the state's rivers and streams, there is generally less information available with which to make assessments. The criteria for use support assessments for lakes and reservoirs is presented in Table 8 and discussed in more detail here and in the section on the Indiana Clean Lakes Program. Summaries of 305(b) assessment information for Indiana lakes are provided in Tables 18 through 20.

Designated Use Support

Monitoring for CWA Section 305(b) designated use support assessments of Indiana lakes has been limited in the past because the majority of State resources allocated for lakes have gone toward assessing the trophic status of lakes in the state pursuant to CWA Section 314.

IDEM uses Indiana's Trophic State Index (TSI) to make its CWA Section 314 assessments. Although TSI calculations take into account results for water quality indicators such as nutrients, dissolved oxygen, water clarity, and plankton, the TSI score alone is considered insufficient for judging the condition of biological communities such as fish, macroinvertebrates, and plant life for the purposes of Section 305(b) assessments of aquatic life use support.

IDEM has used biological indicators to determine aquatic life use support in rivers and streams for many years. However, IDEM has comparatively little biological community data for Indiana lakes. Given this, Section 305(b) aquatic life use assessments have relied on information primarily from the IDNR:

- Information regarding the presence or absence of the native cold water cisco (*Coregonus artedi*) as indicated in IDNR's surveys of sport fish communities was used to determine whether a given lake is fully supporting aquatic life use or impaired, respectively.
- In keeping with Indiana's narrative WQS, those waters stocked for the purposes of put-and-take trout fishing as indicated by IDNR's trout stocking plans were assessed as fully supporting.

In cases where temperature and pH information are available and indicate an adverse affect on the aquatic life, the lake was assessed as impaired.

Between 1999 and 2004, IDEM commissioned two studies aimed at developing indices of biological integrity for Indiana lakes. The first study focused on northern Indiana lakes and reservoirs, and the second focused on lakes in the southern part of the state. Both studies were funded under CWA Section 319 grants to the Indiana Lakes Management Society and were conducted by Dr. Thomas Simon of the INBS.

These studies resulted in the development, calibration, and subsequent validation of an IBI for northern lakes and reservoirs and an IBS (Index of Biological Sustainability) for southern lakes and oxbows. IDEM is presently reviewing the results to determine whether they can be used to assess aquatic life use in the waterbodies sampled and the extent to which the indices developed can be incorporated into IDEM's CALM.

The degree to which Indiana's lakes support their "fishable" uses as described in Indiana's narrative WQS are assessed using fish tissue contaminant data. Presently, IDEM assesses for mercury and PCBs in fish tissue. Details regarding IDEM's fish tissue assessment methodology can be found in IDEM's Consolidated Assessment and Listing Methodology in Appendix A of this report.

IDEM conducts two types of recreational use support assessments on lakes. For the 2008 cycle, IDEM developed a new methodology to assess recreational uses specifically within the context of aesthetics. This method employs benchmarks for total phosphorus concentrations for both natural lakes and reservoirs that have been found to result in significant increases in algal levels. Because excessive algae can deter use of the resource for recreational purposes, these criteria are used to make recreational use support determinations only and are made within the context of aesthetics as opposed to health risk. Details regarding the development of this methodology and how it was applied are provided in IDEM's CALM (Appendix A).

Recreational Use Support assessments within the context of human health are based on pathogen data and are made in the same manner as for rivers and streams when adequate data are available.

Drinking water use support for lakes and reservoirs is limited to those that are used directly or indirectly as drinking water supplies. Lakes and reservoirs for which water utilities have applied for pesticide application permits from IDEM's Drinking Water Branch were assessed as not supporting of their drinking water use. Conditions that require the application of pesticides to a drinking water supply to control algal levels in excess of those that are naturally occurring are considered an impairment of the Indiana's narrative WQS for taste and odor producing substances.

Blue-green algae (cyanobacteria) continue to be a concern in Indiana lakes and reservoirs both with respect to recreational uses and drinking water uses. The presence of the exotic and potentially toxic blue-green algae, *Cylindrospermopsis raciborskii* was discovered in Indiana in 2001. Late in the summer of 2007, a health advisory was issued by the ISDH limiting recreational use on Geist Reservoir based on high concentrations of another potentially toxic blue green algae, *Microcystin-LR*. It is important to note that although these species have been identified in some Indiana lakes and reservoirs, they are not present 100% of the time and it is extremely rare for them to cause toxicity. While toxicity among blue-greens is generally well known and characterized, their dynamics are not well understood.

Presently, there are no federal drinking water standards for blue-green algae. "Blue-green algae (cyanobacteria), other freshwater algae, and their toxins" appeared on USEPA's second federal Drinking Water Contaminant Candidate List (CCL), published in 2005. USEPA uses the CCL to prioritize research and data collection efforts to help determine whether a specific contaminant ought to be regulated. In 2007, USEPA determined that there was insufficient information regarding the adverse health effects of blue-green algae and their toxins, their known/likely occurrence, and whether there exist meaningful opportunities for health risk reduction to warrant development of a water quality standard for blue-green algae at this time (USEPA, 2007). Details regarding USEPA's decision and a fact sheet describing the CCL-2 are available online at:

http://www.epa.gov/safewater/ccl/reg_determine2.html#supportdocs

IDEM does not use information regarding the presence of blue-green algae to make 305(b) assessments due to the lack of a federal drinking water standard for them and because their dynamics in Indiana lakes and reservoirs is not yet well understood. However, recognizing that these species may pose a potential water quality problem, their presence when confirmed for a given lake or reservoir is noted in IDEM's ADB to facilitate tracking of these waters. More information on *Cylindrospermopsis* and other potential toxin-producing blue-green algae in Indiana waters is available from Indiana Department of Natural Resources (IDNR) at:

http://www.in.gov/dnr/fishwild/fish/cylind.htm

Table 18: Individual Use Support Summary – Lakes, Reservoirs.

Designated Beneficial Use	Total Acres Designated	Acres Assessed	Percent Assessed	Acres Fully Supporting	Acres Not Supporting
Aquatic Life Use	32,141	10,315	32.1	3,690	6,625
Fishable Uses	127,567	71,483	56.0	7,820	63,663
Drinking Water Supply	29,541	16,615	56.2	230	16,385
Recreational Use (Human Health)	127,567	22,905	18.0	21,922	983
Recreational Use (Aesthetics)	127,567	37,041	29.0	29,035	8,006

Source: Indiana 305(b) Assessment Database and IDEM Biological Studies Section.

Table 19: Summary of National and State Causes Impairing Lakes, Reservoirs.

Cause/Stressor	Acres
Cause unknown	
Impaired Biotic Communities	6,520
Bioaccumulative Chemicals of Concern	
PCBs in Fish Tissue	192,493
Mercury in Fish Tissue	198,719
Other	
Taste and Odor	16,385
Phosphorus (Total)	7,023
pH	105
Temperature	1,556
Pathogens (*E. coli* indicator)	983
Algal Growth	16,385

Source: Indiana 305(b) Assessment Database

Table 20: Summary of National and State Sources Impairing Lakes, Reservoirs.

Source	Acres
Municipal Point Sources	
Combined Sewer Overflow	30
Agriculture	
Grazing Related Sources	30
Animal Feeding Operations (NPS)	30
Crop Production	30
Other	
Urban Runoff/Stormwater	30
Resource Extraction (Mining)	105
Industrial Point Sources	1,556
Nonpoint Source	7,054
Source Unknown (applied to fish tissue impairments)	219,410

Source: Indiana 305(b) Assessment Database

Indiana Clean Lakes Program

CWA Section 314 Assessments of Lake Trends and Trophic Status

IDEM bases its Section 314 assessments of trend and trophic state of Indiana's lakes on data collected by staff and students at Indiana University's School of Public and Environmental Affairs (SPEA) through the Clean Lakes Program (CLP). Indiana's CLP is funded through a CWA Section 319 grant. Lake assessments are included in this report (Appendix G).

CLP monitoring and IDEM's Section 314 assessments follow a five-year basin rotation strategy. This strategy differs somewhat from that which is used for river and stream sampling because lakes are not as equally distributed across the Indiana landscape as rivers. While some basins contain very few lakes, others contain more than can feasibly be sampled in a given year. In addition, new lakes created in reclaimed coal mine areas have added another year, at least, to the previous sampling cycle rotation. As a result, it now takes nearly six years instead of five to complete a sampling rotation of the lakes and reservoirs in all the major basins of the state.

The Indiana Trophic State Index (TSI) is used to assign points for each of ten common water quality parameters. The total of these points for a particular lake is that lake's trophic or TSI score. Scores range from 0 to 75 points, with lower numbers indicating waters with the least amount of nutrient enrichment. Details on the water quality parameters used to calculate Indiana's TSI can be found in IDEM's CALM, located in Appendix A of this report.

For the purposes of CWA Section 314 assessments, Indiana lakes were placed in one of five classes per USEPA guidelines (USEPA 1997b) based on their trophic state as measured by the Indiana TSI score. The lake classes used in this report, in order of increasing eutrophication, are shown in Table 21. A summary of the trophic status information for lakes assessed between 2000 and 2004 is presented in Table 22.

Table 21: Lake Classification Scheme for Indiana.

Trophic State		TSI Score
Increasing Eutrophication ↓	Oligotrophic	less than 15 points on the Indiana TSI scale
	Mesotrophic	16-31 TSI points
	Eutrophic	32-46 TSI points
	Hypereutrophic	greater than 47 TSI points
	Dystrophic	lakes with little plant growth despite the presence of nutrients; usually due to high humic conditions

Table 22: Trophic Status of Lakes Assessed 2000-2004.

Trophic Status	Number of Lakes	Acres
Oligotrophic	76	12,235
Mesotrophic	185	73,387
Eutrophic	100	14,040
Hypereutrophic	37	3,348
Total Number Assessed	398	103,010

Source: Indiana 305(b) Assessment Database

Indiana now has enough data collected to begin conducting some cursory trend analyses on the trophic status of lakes in the state (Table 23). Of the lakes sampled from 2000-2004, approximately 11% (5% of the acres assessed) show some water quality improvement due to decreasing nutrient levels and effects. Thirty-seven percent of the lakes (23% of the acres assessed) appear to be stable, neither losing nor gaining in levels and effects of nutrients. Eight percent of the lakes sampled during this time (12% of the acres assessed) show degraded water quality due to increasing nutrients. The water quality trend is fluctuating for 34% of the lakes (58% of the acres assessed) and unknown for approximately 10% of the lakes (2% of the acres assessed). A lack of detectable trend in the first of these two categories may be due to abnormal seasonal effects or changing activities in the surrounding watershed. An unknown trend, as used in this report, reflects having insufficient data points to determine a trend, as in the case of newly-created or never-before-sampled lake.

Table 23: Trends in the Trophic Status of Lakes Assessed 2000-2004.

Trend	Number of Lakes	Acres
Improving	44	5,480
Stable	150	23,705
Fluctuating	136	60,214
Degrading	34	11,897
Trend Unknown	39	1,907
Total Number Assessed	403	103,203

Source: Indiana 305(b) Assessment Database

These assessments have not been revised for this cycle due to a vacancy in IDEM's Lakes Coordinator position. However, IDEM has received results from the CLP for its 2005 sampling season and anticipates receiving results for the 2006 sampling season in time to complete the next round of CWA Section 314 lakes assessments by April 1, 2009, at which time the electronic update of Indiana's CWA assessment information will be submitted to USEPA.

WETLANDS ASSESSMENT

The IDEM administers the CWA Section 401 Water Quality Certification (WQC) Program. 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 WQS. IDEM regulates some activities in wetlands in conjunction with the ACOE.

Any person who wishes to place fill materials, excavate or dredge, or mechanically clear (use heavy equipment) 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 water quality certification from IDEM. Placement of fill into nonjurisdictional wetlands is regulated by Indiana's Wetlands Activity Permits rule and state law.

Under CWA Section 401, IDEM reviews the proposed activity to determine if it will comply with Indiana's WQS. 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. No project may 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 no net loss of wetlands policy. Table 24 provides information regarding historical and present estimates of wetland resources in Indiana.

Table 24: General Wetland information.

Statistic	Amount
Total surface area of the state of Indiana	23,310,000 acres
Estimate of wetland acreage in Indiana circa 1700	5,600,000 acres
Wetland acreage in Indiana circa 1986 (National Wetland Inventory)	813,000 acres
Percent of surface area of Indiana covered by wetlands circa 1700	24.1%
Percent of surface area of Indiana covered by wetlands circa 1986	3.5%
Percent of total area of wetlands that are wholly or partially contained within managed lands (state, local, federal and private areas)	14%
Percent of Indiana's total wetlands that are 0.25 acres or less in size	11.6%
Percent of Indiana's total wetlands that are 0.50 acres or less in size	29.5%
Percent of Indiana's total wetlands that are 1.00 acres or less in size	46.9%
Percent of Indiana's total wetlands that are 5.00 acres or less in size	80.2%

Development of Wetland Water Quality Standards

Draft wetland water quality standards were preliminarily adopted by the WPCB February 13, 2002. However, with the passage of isolated wetland legislation, IDEM is not pursuing final adoption of these standards.

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 developed by the USFWS. Indiana's National Wetlands Inventory maps were produced primarily from interpretation of high-altitude color infrared aerial photographs (scale of 1:58,000) taken of Indiana during spring and fall 1980-87. The maps indicate wetlands type, using the Cowardin *et al*. classification scheme. Very narrow wetlands in river corridors and wetlands under cultivation at the time of mapping are generally not depicted. Forested wetlands are poorly described. IDEM has recently entered into a partnership with Ducks Unlimited to update the palustrine wetlands mapped in Indiana. This effort is scheduled for completion in 2009 and will become an update to the National Wetland Inventory.

The IDNR conducted the most recent and complete analysis of this database in 1991. According to the report, Indiana had approximately 813,000 acres of wetland habitat in the mid-1980s when the data were collected (Table 25). Wetland loss or gain since then is not known at this time (Rolley 1991).

Table 25: Type and Extent of Indiana's Wetlands.

Wetland Type (Cowardin Classification)	Historical Extent (acres)	Extent as of mid-1980s (acres)
Palustrine scrub/shrub (PSS)		42,000
Palustrine forested (PFO)		504,000
Palustrine emergent (PEMB)		55,000
Palustrine emergent seasonally flooded (PEMC)		68,000
Palustrine emergent semi-permanently flooded (PEMF)		21,000
Palustrine open water (POW)		99,000
Lacustrine limnetic open water (L10W)		141,000
Riverine (R)		53,000
Total wetland resources	5,600,000	813,000

Source: Rolley, 1991

Wetland Protection Activities

In addition to the review of applications for Section 401 Water Quality Certification and state regulated wetland permits, the program works on additional projects devoted to wetland assessment and wetland protection:

- IDEM staff work closely with the ACOE, USFWS, and IDNR to evaluate projects in planning and to coordinate requirements for various state and federal permits related to wetlands;
- IDEM maintains a web page devoted to wetlands and water quality issues. 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. The Water Quality Certification 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; and

The wetlands section merged with the Rule 5 and Rule 13 storm water sections this year. More information about these programs can be found at:

http://www.in.gov/idem/permits/water/wastewater/wetwthr/storm/rule5.html
http://www.in.gov/idem/permits/water/wastewater/wetwthr/storm/rule13.html

PUBLIC HEALTH/AQUATIC LIFE CONCERNS

The release of toxic materials into the aquatic environment can produce effects in several ways:

- Contaminants present in acutely toxic amounts may kill fish or other aquatic organisms directly;
- 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 on to humans through consumption of the organism; and
- Toxic materials in the water could potentially affect human health by contaminating public water supplies. However, at this time IDEM has no data to indicate that there have been any adverse human health effects due to toxic substances in surface water supplies.

In the last several years, advances in analytical capabilities and techniques and the generation of more and better 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, much of the data on toxic substances used for fishable use assessments in this report were obtained through the fish tissue and surficial aquatic sediment contaminants monitoring program.

While not all species of fish found in Indiana lakes and streams nor all waters have been tested, carp are commonly found to be contaminated with both polychlorinated biphenyls and mercury at levels exceeding the state's benchmark criteria for these contaminants in fish tissue.

Fishable use assessments are reported separately from aquatic life use in order to provide more information about each individual designated use. Concerns related to fish consumption can be evaluated independently by referring to the ISDH and FCA online at:

http://www.in.gov/isdh/fca/

It is expected that as more lakes and streams are monitored, toxicants will be found at levels of concern in the new samples (i.e., mercury and/or PCBs).

A diverse and healthy fish community is considered an indication of good water quality. Serious public concern is generated when dead and dying fish are noted in the aquatic environment since this is sometimes evidence of a severe water quality problem and may indicate the long term loss of use of affected water as a fishery. A fish kill can result from:

- The accidental or intentional spill of a toxic compound or oxygen-depleting substance into the aquatic environment;
- Continuous industrial or municipal discharge which may release, due to a system upset, an atypical effluent containing high concentrations of pollutants; and
- Natural causes such as disease, extreme draught, 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 each recorded from 1998 to 2007 are listed in Table 26.

Table 26: Calls, Spills and Fish Kills Reported in 1998 to 2007.

Year	Calls	Spills	Fish Kills
1998	2649	1393	28
1999	2507	1246	41
2000	2930	1491	43
2001	3093	1591	51
2002	3043	1666	55
2003	3026	1551	30
2004	2829	1406	37
2005	3319	1271	40
2006	3319	1368	31
2007	2852	1354	36

Source: ULCERS Database

GROUND WATER ASSESSMENT

INTRODUCTION TO INDIANA GROUND WATER

Ground water is an important resource for Indiana citizens, agriculture, and industry. The majority of the state's population use ground water for drinking water and other household uses. IDEM's 2006 Annual Compliance Report for Indiana Public Water Supply (PWS) Systems is online at:

http://www.in.gov/idem/compliance/water/drinkingwater/compeval/2006acr.pdf

During the growing season, ground water is withdrawn at an average rate of 282.9 million gallons per day (mgd) for crop and turf irrigation (based on a 90-day season). Industry withdraws an average 98.6 mgd of ground water, and 31.3 mgd is used for energy production (Ralph Spaeth, Indiana Department of Natural Resources, *written communication*, 2000). Since December 2000, no statewide ground water monitoring studies have been conducted due to budgetary and staffing constraints. However, a statewide ground water monitoring network is scheduled to begin spring of 2008.

Major Sources of Ground Water Contamination

The major contaminant sources impacting Indiana ground water as of 1998 are listed by general activity types in Table 27. 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, 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 27 were considered in selection of the ten priority contaminant sources, and those risk factors relevant to the highest priorities are identified. Classes of contaminants commonly associated with each highest priority contaminant source are also given. Due to resource constraints, the information in Table 27 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 in 2008 as they were in 1997 and 1998.

Table 27: Major Sources of Ground Water Contamination.

Contaminant Source	Highest Priority	Risk Factors[1]	Type of Contaminant[2]
Agricultural Activities			
Agricultural chemical facilities		A,C,H,I	5
Commercial fertilizer applications	X	A, C, D, E	5
Confined animal feeding operations	X	A, D, E	5, 9
Farmstead agricultural mixing and loading procedures			
Irrigation practices		A,C,H,I	1,2,5,8,9
Manure applications	X	A,C,H,I	5, 9
Pesticide applications		A,C,H,I	1,2
Storage and Treatment Activities			
Land application		A,C,H,I	5,9
Domestic and industrial residual applications		A,C,H,I	5,9
Material stockpiles		A,C,H,I	5,9
Storage tanks (above ground)		A,C,H,I	
Storage tanks (underground)	X	A, B, C, D, E, F	2, 3, 4
Surface impoundments	X	A, C, D, E, F	1, 2, 3, 4, 5, 6, 7, 9
Waste piles		A,C,H,I	5,9
Disposal Activities			
Deep injection wells			
Landfills (constructed prior to 1989)	X	A, B, C, D, E, F	1, 2, 3, 4, 5, 6, 7, 8, 9
Permitted landfills (constructed 1989- present)			
Septic systems	X	A, C, D, E, F, G	1, 2, 3, 4, 5, 7, 9

Shallow (Class V) injection wells	X	A, B, C, D, E, I	1, 2, 3, 4, 5, 7, 9
Other			
Hazardous waste generators		A	
Hazardous waste sites		A	
Industrial facilities	X	A, B, C, D, E, F	1, 2, 3, 4, 5, 7, 8, 9
Liquid transport pipelines (including sewer)		A	8
Materials spills (including during transport)	X	A, B, C, D, E, F	1, 2, 3, 4, 5, 7, 8, 9
Material transfer operations		A	
Small-scale manufacturing and repair shops		A, I	8
Mining and mine drainage		A	7,8
Salt storage (state and nonstate facilities) and road salting	X	A, C, D, E, F	6
Urban runoff		A, C, H, I	1, 2, 4, 5, 7, 8, 9

Source: USEPA 2006a; 2007

[1]Factors considered in selecting the contaminant source: (A) human health and/or environmental risk (toxicity); (B) size of the population at risk; (C) location of source relative to drinking water source; (D) number and/or size of contaminant sources; (E) hydrogeologic sensitivity; (F) documented state findings, other findings; (G) high to very high priority in localized areas, but not over majority of Indiana; (H) geographic distribution/occurrence; (I) lack of information

[2] Classes of contaminants associated with contamination source: (1) Inorganic pesticides; (2) Organic pesticides; (3) Halogenated solvents; (4) Petroleum compounds; (5) Nitrate; (6) Salinity/ brine; (7) Metals; (8) Radionuclides; (9) Bacteria, Protozoa and Viruses

Nitrate is a potential contaminant from the following high priority sources listed in Table 27: commercial fertilizer applications, concentrated animal feeding operations (CAFOs), and septic systems. Nitrate, a highly mobile and soluble contaminant, is the most frequently detected ground water contaminant in rural areas. However, determining the source of nitrates detected in ground water can be difficult and costly.

For the 1999 and 2000 crop production season, 537 million tons and 970 million tons, respectively, of commercial fertilizer containing nitrogen were sold in Indiana for application on some 12 million acres of cropland, most of which was applied to nearly 6 million acres of corn (Indiana Agricultural Statistics Service 1999-2000). Unlike pesticides, the purchase and application of commercial fertilizer is not regulated by the Office of the Indiana State Chemist. When applied at the proper rate and time, commercial fertilizer poses little threat of contamination to ground water. Purdue University Cooperative Extension Service staff, United States U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) staff and private consultants assist crop producers in developing nutrient management plans that focus on meeting crop nutrient needs based on realistic goals.

Confined feeding operations and larger concentrated animal feeding operations exist throughout Indiana as an integral component of Indiana's agricultural economy. In 2001, the Indiana WPCB adopted new confined feeding operation (CFO) regulations (327 IAC 16), as required by IC 13-18-10, that provides design, construction and operational performance standards for all state-

regulated CFOs. This is not to be confused with the NPDES permit program that regulates CAFOs. The WPCB adopted new NPDES regulations for CAFOs in January of 2004. These regulations mirror the federal regulations for animal feeding operations and include the recent amendments to the federal regulations. The NPDES regulations for the issuance of individual NPDES permits for CAFOs are found at 327 IAC 5-4-3 and the regulations for the issuance of NPDES general permits for CAFOs are found at 327 AIC 15-15-5. Additionally, the USDA-NRCS also works closely with livestock producers who request financial and technical assistance for building livestock waste storage facilities and to install or implement conservation practices that serve to reduce soil erosion and nutrient loss. The primary concerns associated with CAFOs are the proper storage and land application of the large volumes of ammonia-containing manure produced by these operations. The ammonia form of nitrogen 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 allowing excess nitrogen to move into underlying aquifers. The new regulations also address the need to consider the phosphorous content of manure in determining the agronomic rates for land application.

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 are a high priority ground water contamination concern 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 1988, underground storage tank registration, upgrading, closure activity and site assessment have been closely reviewed by the IDEM Underground Storage Tank (UST) Section. In accordance with federal and state mandates underground storage tanks installed prior to December 22, 1988, were to be either properly protected against spills, overflows and corrosion, or properly closed.

Class V underground injection wells (UIWs) are widespread throughout the state and occur in high concentration in several areas including some in which ground water is highly sensitive to contamination. Class V wells release a wide variety of contaminants into or above aquifers supplying drinking water. The large number and diversity of Class V wells combined with lack of information regarding effects of these wells on ground water pose a significant potential threat to ground water. Indiana Class V wells are regulated by the USEPA. The USEPA targeted those Class V wells that pose the greatest environmental risk and in 2000 implemented more intensive regulations and enforcement for large capacity cesspools and motor vehicle waste disposal wells.

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 Aboveground 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. The rule is more

protective if the facility is located within an approved delineated wellhead protection and 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 alleviated a number of problems. However, these activities continue to be a potential source of contamination to ground water in Indiana.

The storage and extensive use of salt as a deicing agent during the winter months has an impact on ground water. Ground water 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 usage and application rates have been significantly reduced from past years through computerized weather forecasting and roadway temperature sensors.

Ground water contamination as a result of spills can be avoided or minimized if spills are properly handled and cleaned up. Unreported spills may contribute to ground water contamination. Spill handling and clean up, when not properly executed, create a concern for ground water contamination. Indiana's Spills; Reporting, Containment and Response Rule (327 IAC 2-6.1) ensures that spills are reported, properly handled and cleaned up.

Ground Water Protection Programs

Programs to monitor, 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 28 lists the state's ground water protection programs and activities, developmental stage of the program or activity, and IDEM or agencies responsible for the program's implementation and/or enforcement.

Table 28: Summary of State Ground Water Protection Programs through 2007.

Program or Activity	Status	State Agency/Organization
Active SARA Title III Program	Fully established	IDEM-OLQ[1]
Ambient ground water monitoring program	Under development	IDEM-OWQ
Aquifer sensitivity assessment	Fully established	IDEM-OWQ, IDNR, IGS[2], OISC[3]
Aquifer mapping/basin studies	Under development	IDNR, IDEM-OWQ
Aquifer/ hydrogeologic setting characterization	Fully established	IGS, IDEM-OWQ, IDNR
Bulk storage program for agricultural chemicals	Fully established	OISC
Comprehensive data management system	Under development	IDEM-OWQ
Complaint response program for private wells	Fully established	IDEM-OWQ
Confined animal feeding program	Fully established	IDEM-OWQ
Ground water discharge permits for constructed wetlands	Under development	IDEM-OWQ
Ground water Best Management Practices	Under development	OISC*, IDEM-OWQ
Ground water legislation	Fully established	IDEM, IDNR, OISC, ISDH
Ground water classification	Fully established	IDEM-OWQ
Ground water quality standards	Fully established	IDEM-OWQ
Land application of domestic and industrial residuals	Fully established	IDEM-OLQ
Nonpoint source controls	Under development	IDEM-OWQ
Oil and Gas	Fully established	IDNR
Pesticide State Management Plan	Pending	OISC*, IDEM-OWQ, IDNR, IGS
Pollution Prevention Program	Fully established	IDEM-OPPTA[4]
Reclamation	Fully established	IDNR
Resource Conservation and Recovery Act (RCRA) Primacy	Fully established	IDEM-OLQ
Sensitivity assessment for drinking water/ wellhead protection	Fully established	IGS, IDEM-OWQ
Spill Monitoring	Fully established	IDEM-OWQ
State Superfund	Fully established	IDEM-OLQ
State RCRA Program incorporating more stringent requirements than RCRA primacy	Fully established	IDEM-OLQ
State septic system regulations	Fully established	ISDH

Program or Activity	Status	State Agency/Organization
Underground storage tank installation requirements	Fully established	IDEM-OLQ
Underground Storage Tank Remediation Fund	Fully established	IDEM-OLQ
Underground Storage Tank Permit Program	Fully established	IDEM-OLQ
Underground Injection Control Program	Fully established for Class II wells	IDNR
Well abandonment regulations	Fully established	IDNR
Wellhead Protection Program	Fully established	IDEM-OWQ
Well installation regulations	Fully established	IDNR

*indicates lead agency involved in enforcement or implementation
"Pending" is used to describe those programs that have a written draft policy "under development" is used to describe those programs still in the planning stage.
[1]OLQ Office of Land Quality; [2]IGS Indiana Geological Survey; [3]OISC Office of the Indiana State Chemist; [4]OPPTA Office of Pollution Prevention and Technical Assistance (IDEM);

Indiana's Ground Water Quality Standards became effective in March 2002. The language of the rule, which includes numeric standards, provides ground water protection to 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. Basically, 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 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 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.

In addition, IDEM's commissioner may deny a request to classify ground water as impaired drinking water class if the exceedance of the contaminant was caused by an illegal action of the person seeking the change in classification.

In 2000, USEPA approved Indiana's Source Water Assessment Plan developed by Indiana stakeholders. IDEM made the decision to prepare Source Water Protection Plans (SWAPs) for public water systems with the exception of community water systems that utilize ground water as their primary source of water. Community 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 wellfield that provides water to the public. IDEM contracted the majority of field work and the preparation of the SWAPs. Since 2000, the contractors have identified the source water areas for

approximately 3,600 public water systems and the watersheds for surface water systems. In the delineated source water areas, IDEM contractors have inventoried the potential sources of contamination from regulated facilities and assessed water system susceptibility to contamination. As of the end of 2007, all SWAPs for the 3,600 public water systems surveyed by IDEM's contractors and final reports were distributed by IDEM to the owners of the public water system. As a result of this effort, IDEM's source water protection program is completely implemented and satisfies the requirements of substantial implementation of the Source Water Protection Program as defined by IDEM and accepted by USEPA Region 5.

In March of 1997 the Indiana Wellhead Protection Rule (327 IAC 8-4.1) became effective. The Wellhead Protection Program is a proactive program that protects 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. The Wellhead Protection Program is a part of the Source Water Protection Program. As of the end of 2005, 649 wellhead protection plans had been submitted to IDEM for review and 614 plans have been approved for those communities. An approved plan signifies 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.

In addition to regulatory programs and other structured ground water protection activities listed in Table 28, there are several educational programs conducted in Indiana that place an emphasis on ground water protection. The Purdue University Extension program "Safe Water for the Future" is an umbrella for several 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. Indiana Project WET (Water Education for Teachers) and Indiana's Water Riches are two general water education programs that provide information about ground water protection. The Purdue Extension Water Quality Program has available through their website more than 70 Purdue Extension publications addresses specific topics for the general public. For example, the Purdue Pesticide Programs publication "Nitrate and Indiana's Ground Water" describes the occurrences of nitrate across the state, potential causes of contamination, health risks associated with nitrates and types of available treatment technology if nitrates are found in ground water.

Ground Water for Drinking Water Monitoring Data

In 1998, a project was conducted to assess the ambient ground water conditions in the state. The project was the ground water monitoring network component of the Pesticide State Management Plan. The ground water monitoring network was established to provide a statistical evaluation of possible trends in pesticide occurrences and concentrations in major hydrogeologic settings of the state. Of the 230 hydrogeologic settings identified by the Indiana Geological Survey, approximately 60 were grouped into 22 "type" hydrogeologic settings that represent the state (Figure 6). Quarterly sampling of nearly 400 wells selected from the 22 hydrogeologic settings was initiated in 1998. Wells were sampled every 3-4 months for seven consecutive periods ending in December 2000. As presented in the 2002 Integrated Water Quality Monitoring and Assessment Report, sampling results indicate no clear or statistically significant detections of

pesticides or VOC's in sampled wells. During the effort (in 1998), wells in each of the 22 hydrogeologic settings were also sampled for nitrates. Nitrate levels of three ppm or lower are assumed to be naturally occurring. The hydrogeologic settings indicating nitrate levels above 3 ppm were the Topeka Fan, Brighton Fan, East Fork White River, Wabash River Valley, and the Mitchell Plain Karst region. Since December 2000, no subsequent statewide ground water monitoring efforts have been conducted due to budgetary and staffing constraints.

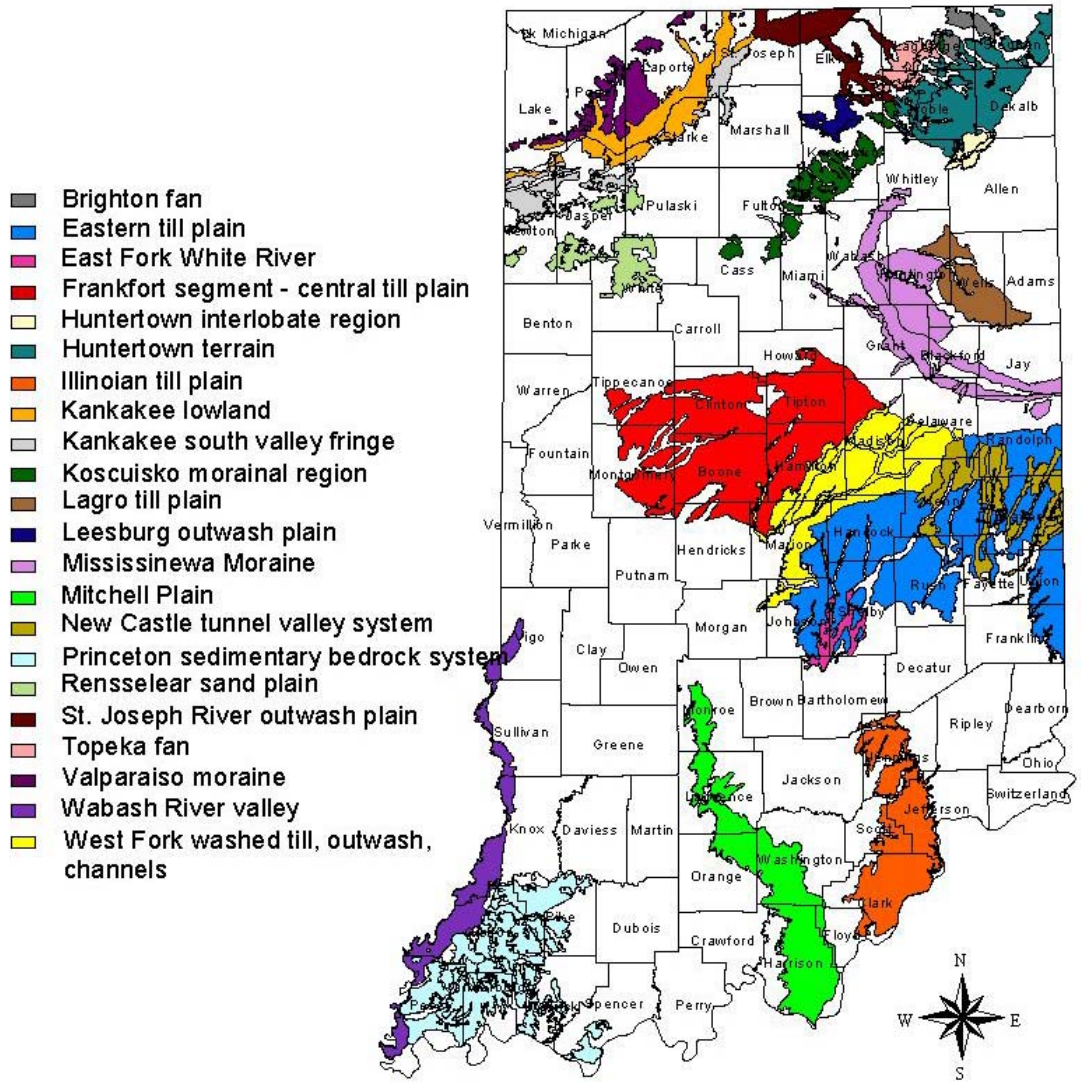

Figure 6: Representative Hydrogeologic Setting Monitoring Networks

The IDEM Drinking Water Branch PWS Compliance Section receives ground water compliance monitoring results reported by PWS for volatile organic compounds (VOCs), synthetic organic compounds (SOCs), inorganic compounds (IOCs), nitrates (NO_3), and radionuclides. Public water systems include community, nontransient noncommunity and transient noncommunity systems. 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. A nontransient noncommunity water system is defined as a public water system that is not a community water system which regularly serves the same 25 or more persons at least six months per year. Examples of nontransient noncommunity water systems could include restaurants, factories, daycares and schools. A transient noncommunity is defined as a noncommunity water system that does not serve at least the same 25 people over six months per year. Examples of transient noncommunity water systems include restaurants, rest-stops, and gas stations.

Community and Noncommunity nontransient systems are required to test for thirty regulated SOCs, and 21 VOCs. Community systems monitor for 12 regulated IOCs and sodium (a special monitoring requirement). Nontransient noncommunity systems monitor for eleven regulated IOCs (excluding sodium and fluoride). All PWS systems including transient noncommunity are required to test for nitrates. Only community systems are required to monitor for radionuclides. Radionuclide monitoring consists of analysis for gross alpha particle activity. Samples collected by PWS are from entry points, which occur after treatment and before the distribution system. Entry point data can be from a single well or blended from two or more wells. For PWS data, the reporting period was dependent on sampling frequency requirements for the parameter group. For VOC, SOC, and IOC data, community and nontransient noncommunity systems are required to sample a minimum of once every three years or more frequently if certain levels of contaminants are detected.

All PWS systems are required to test for nitrate. Nitrate concentrations were utilized in Figures 7 through 9 to illustrate general ground water quality trends across the state. The ground water quality data information used in this analysis were compliance monitoring values reported to the IDEM Drinking Water Branch PWS Compliance Section by PWS systems. The presentation of this data is a representation of quality of water after treatment by PWS and not the quality of the ambient conditions of ground water prior to being pumped from the ground itself. The finished water quality information was used due to the availability and quantity of data. Although these data do not represent ambient conditions, finished water quality data provides information that can be analyzed in order to help in prioritizing future ambient ground water monitoring efforts. Reported nitrate data from 2000 through 2007 were utilized to determine the relative occurrences of nitrate as well as the spatial distribution of nitrate concentrations. It is generally accepted that nitrate concentrations of three ppm or less can be considered to be naturally occurring in ground water. Figure 7 illustrates the distribution of sampling points across the state.

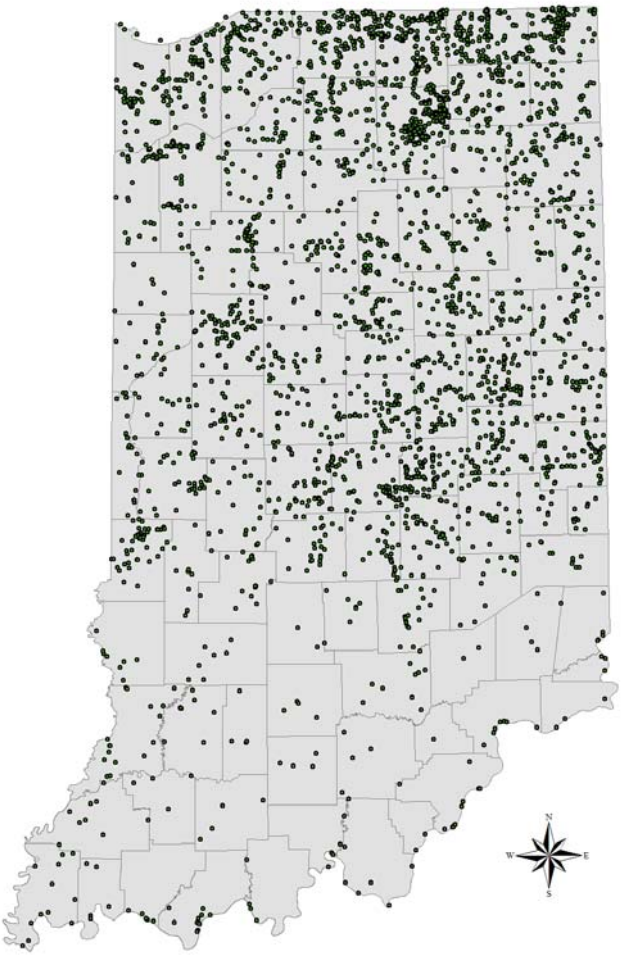

Figure 7: General Nitrate Sample Point Distribution.

All the reported nitrate data received by the IDEM Drinking Water Branch PWS Compliance Section IDEM between the years 2005 to the end of 2007 was filtered at five ppm, which is half of the maximum contaminant level (MCL) for nitrate (ten ppm). Figure 8 shows, by year, the occurrence of at least one reported value of five ppm or greater during any compliance monitoring sampling event during that year. Figure 8 does not necessarily represent values of non-compliance of drinking water standards or violations exceeding drinking water quality MCL (the drinking water standard is based on the MCL of ten ppm). Figure 8 is provided to illustrate the locations of areas that may be more vulnerable to ground water contamination.

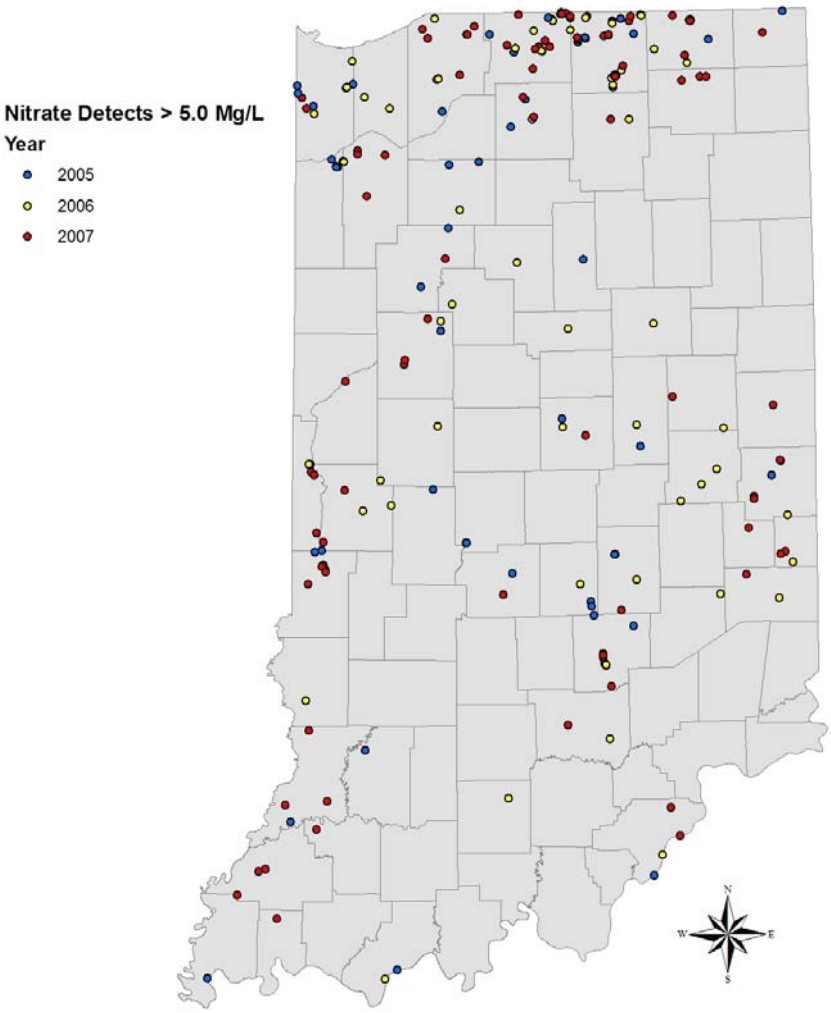

Figure 8: Nitrate Sample Results Greater than 5 ppm.

Statewide Ground Water Monitioring Network.

A Statewide Ground Water Monitoring Network (SGWMN) is scheduled to begin in the spring of 2008. Sampling locations will consist of 300 drinking water wells across Indiana. Sites selected for the SGWMN are illustrated on Figure 11. Sampling locations consist of 200 public water supply wells and 100 private (residential) wells. Sites will be sampled for volatile organic compounds (VOCs), synthetic organic compounds (SOCs), inorganic compounds (IOCs) and nitrates (NO_3). Subsequent reports shall integrate the SGWMN information as it is collected and analyzed.

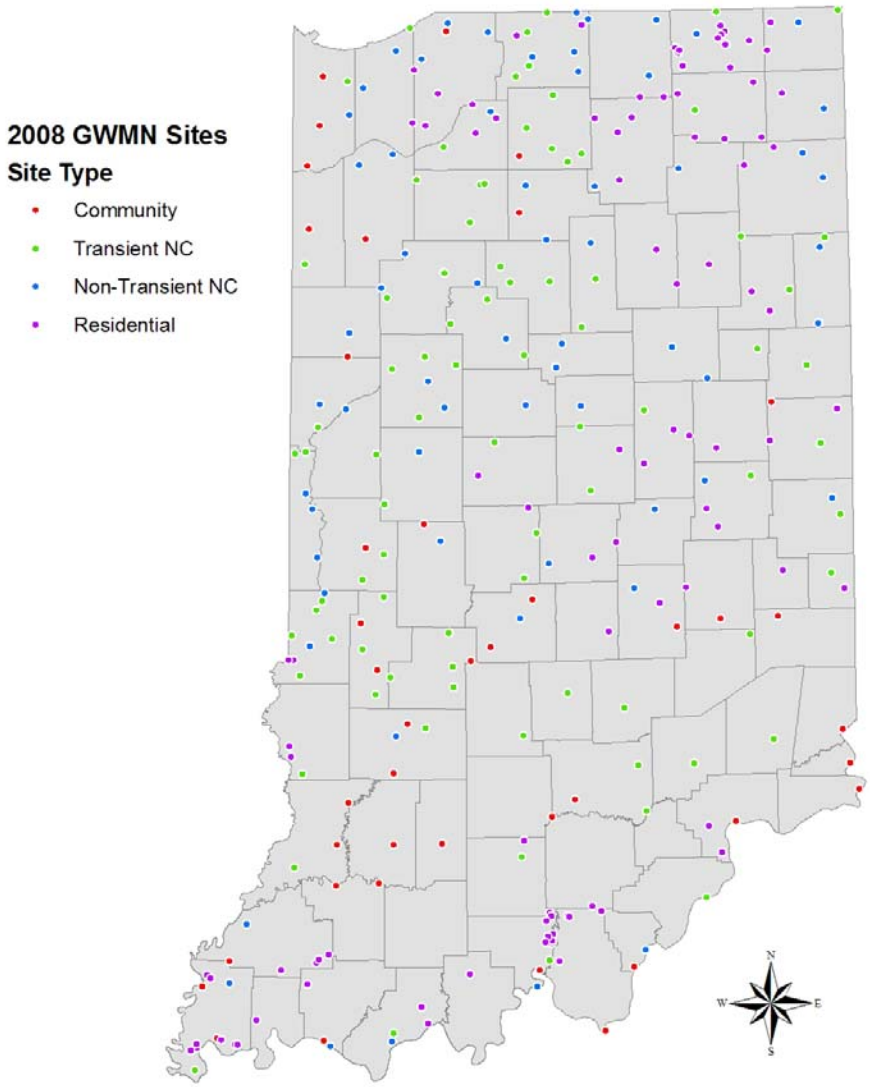

Figure 9: Statewide Ground Water Monitoring Network.

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