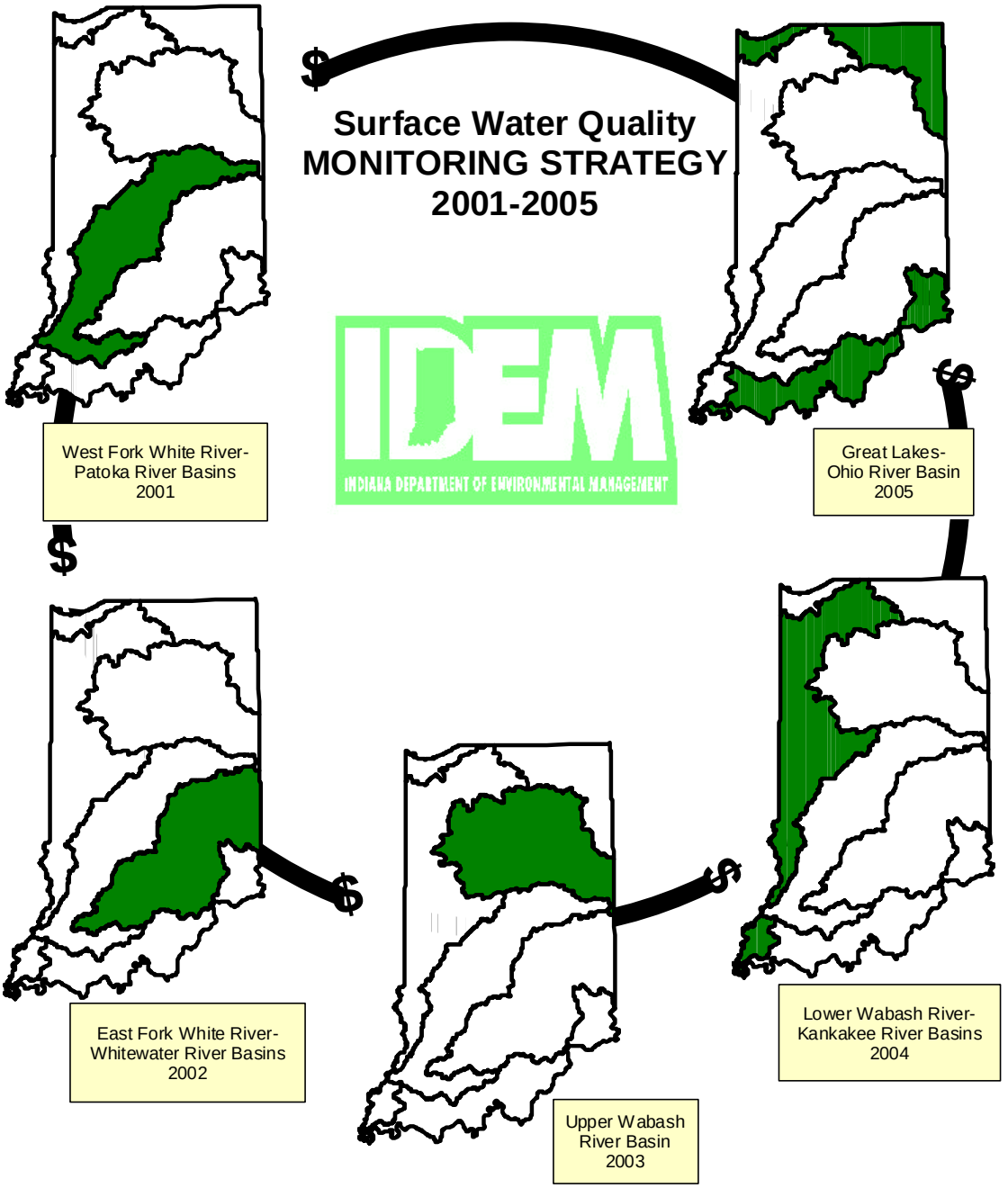
Surface Water Quality MONITORING STRATEGY 2001-2005



Assessment Branch
Office of Water Quality
Indiana Department of Environmental Management

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EXECUTIVE SUMMARY

The purpose of the Surface Water Quality Monitoring Strategy (*Strategy)* is to direct the water quality assessment of Indiana's rivers, streams, and lakes for designated uses. The *Strategy* focuses on a watershed approach for addressing water quality issues and uses a five-year rotating study cycle of all major river basins in the State.

Since the *Strategy* was implemented in 1996, all of the State's major river basins have been assessed and it can be predicted with reasonable certainty what percentage of our rivers, streams, and lakes are impaired. The *Strategy* was revised in 1998 due to limited resources and it now has been updated and modified to reflect current status after careful consideration of mandates and user needs. Coordination of all watershed activities is imperative to achieving success in reducing pollutants from entering our State's waters.

Challenges in successfully implementing the *Strategy* include establishing the Total Maximum Daily Load (TMDL) Program, bridging the information gap between the 305(b) report and the 303(d) list of impaired waters, implementing the Assessment Information Management System (AIMS) database, and obtaining sufficient personnel to adequately staff priorities.

Considerable time has been devoted to exploring ways to achieve the *Strategy's* goals by reviewing mandates and examining alternatives. Three major alternatives were examined during the review process and each alternative contains merits worthy of implementation. All examined alternatives, however, require additional staff regardless of option or approach. Determining the right mix of each proposal and what results might be realized over the long term is not easy. The most important ingredient in accomplishing the *Strategy's* goals is recruitment and retention of good scientists and treating them well.

Several suggestions for future actions were proposed as part of the *Strategy* review process. These suggestions are actions or studies that would enhance or improve existing programs. Some of these include: perform follow-up TMDL sampling to obtain data for load reductions to achieve water quality standards; prepare a new memorandum of understanding for laboratory services between Indiana State Department of Health (ISDH) and the Indiana Department of Environmental Management (IDEM) for the Fixed Station Monitoring Program; develop a comprehensive lakes database; increase emphasis on sampling of surface water supplies for drinking water protection; and conduct sampling at confined feeding, land application, and construction sites to assess water quality impacts.

The United States Environmental Protection Agency (EPA) released a draft of requirements for an adequate state water monitoring program in mid-March 2001 (USEPA 2001). The stated purpose of its release was to better define elements of an adequate state ambient water quality monitoring program in the Clean Water Act. Ten requirements were identified. Except for including groundwater and wetlands as monitoring objectives and examination of core indicators and programmatic evaluation, this *Strategy* fulfills EPA's draft model. Indiana must submit to EPA a water quality monitoring program strategy that addresses the ten elements by September 30, 2002. IDEM-OWQ plans to revise this *Strategy* to meet the newer requirements by fall 2002.

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I. Introduction

The IDEM originally developed the Surface Water Quality Monitoring Strategy (hereinafter referred to as the *Strategy*) in 1995 (IDEM 1995). The Office of Water Quality (OWQ)-Assessment Branch revised it in 1998 (IDEM 1998). After completing the first rotation of watershed monitoring during the 1996-2000 time period, the *Strategy* has been re-evaluated, modified, and updated to accomplish the established goals with available resources. This document provides basic information on how the IDEM continues to examine the surface waters of the State. This strategy consists of:

- Dividing the State's river basins into major sampling units;
- Field sampling and monitoring for each of the sampling units; and
- Data analysis and assessment of water quality.

The *Strategy* is composed of the planning, sampling, and reporting strategies, which are discussed in Section II (Strategy Components). Additionally, information about the Assessment Branch's resources is provided in Section III (Resources). A discussion of the *Strategy* goals, and objectives are summarized in Section IV (Discussion and Summary).

- **Vision**

Provide water quality information and develop the environmental indicators that provide information necessary to protect human health and the environment in Indiana.

- **Mission**

Implement a surface water quality monitoring strategy that assesses the quality of Indiana surface water, the ability to support designated uses, and effectively communicate this information to internal and external customers.

- **Goals**

1) *Measure the physical, chemical, bacteriological, and biological quality of the aquatic environment in all river basins and identify factors responsible for impairment.*

2) *Assess the impact of human or other activities that occur in all river basins and the probable effects of these activities on the quality of the dynamic ecosystem and drinking water source protection.*

3) *Identify trends through the analysis of environmental data from a variety of sources and make recommendations for the protection of designated uses of the surface water resources of the State.*

4) *Provide environmental quality assessment to support the water quality management program in partnership with customers and stakeholders.*

A. BACKGROUND AND HISTORY

Indiana has a long history of concern for the environment, particularly in the area of surface water quality. The Industrial Age has brought significant changes to the surface water quality in Indiana. Concern for surface water quality in the State was initially driven by public health concerns. In the early 1960s this concern was primarily driven by the obvious need for industries and municipalities to install wastewater treatment facilities to clean up significant point source pollution problems in Indiana rivers, streams, and lakes. Current water quality standards and regulations are addressing these major point source water quality problems. The role of regulatory agencies such as IDEM has become one of pollution prevention, planning, monitoring, assessment, evaluation, permitting, compliance, and enforcement.

As major point source improvements have been achieved in Indiana and across the nation, it has become apparent that if the goals of the Clean Water Act and Indiana Water Quality Standards are to be achieved, more subtle and diffuse sources of pollution, such as nonpoint source pollution, must also be addressed. Recent efforts on the part of the IDEM and the EPA have focused on attempting to better assess nonpoint source pollution. Conducting water quality surveys will do this; the results of which will be used for developing water quality models. These models will be used to determine total maximum daily loads (TMDLs). In the TMDL program load allocations will be distributed between both nonpoint source pollution as well as point source pollution sources so that water quality standards and the designated beneficial uses can be attained in the waterbody.

The 1995 Monitoring Strategy (IDEM 1995) was developed as a proactive monitoring program for the surface waters of Indiana. This 1995 Monitoring Strategy, in support of the 1994 IDEM Strategic Plan, provided guidance and direction in achieving the major goal of enhanced surface water quality in the State. The 1998 report focused on surface water quality only; the Drinking Water Branch of OWQ is developing the monitoring strategy for groundwater. IDEM's Strategic Plan has been superceded by the Agency's Environmental Performance Partnership Agreement (EnPPA) with EPA.

Key elements of the 1995 Monitoring Strategy included strategies for planning, sampling, reporting, and volunteer monitoring. The 1995 Monitoring Strategy was well received throughout the Agency and endorsed by the EPA Region 5 Water Division as being forward thinking and responsive to meeting the State's water quality objectives. The 1995 Monitoring Strategy was developed based upon the advice from IDEM's senior management that adequate staff would be available after the OWQ's 1995 reorganization plan was implemented. However, for unforeseen reasons the OWQ's 1995-reorganization plan was not fully implemented in 1996 and 1997. In 1996 and 1997 only enough staff were available to complete the first year of assessment sampling. Of the 43 full-time positions approved for the Assessment Branch in the OWQ's approved reorganization plan, only 28 were allowed to be filled. The first year general overview (synoptic) surveys were conducted in the West Fork White River-Patoka River basins (1996) and the East Fork White River-Whitewater River basins (1997). The second year of intensive physical, chemical, and bacteriological field monitoring work was designed to identify pollution sources of impaired streams identified in the first year assessment program. The second year of source identification could not be done due to inadequate human and fiscal

resources. Consequently, the 1995 Monitoring Strategy was revised in 1998 in order to accomplish as many of the original goals as possible with the then available resources.

There were other reasons for revising the *Strategy* that have become apparent since its development. The 1995 Strategy did not provide all the data required for the development of wasteload allocations for the NPDES permitting program, and staff was not available to gather the additional data. This need had been intensified with IDEM's commitment to process approximately 700 backlogged municipal and industrial permits by June 30, 1999.

Additionally, IDEM committed to begin a Total Maximum Daily Load process in 1998. This required existing staff and analytical contract fiscal resources to identify sources of impairment, to provide data for modeling and in some cases to monitor water quality after new control measures have been implemented. The 1995 Monitoring Strategy only allocated resources to identify sources of impairment found in the first year work.

The TMDL program is the product of various ongoing statewide water quality monitoring activities. Section 303(d) of Clean Water Act (CWA) requires the development of TMDLs for waters of the State that have been identified as being impaired for violations of water quality standards. Consequently, the main objective of the TMDL program is to develop and implement TMDLs for impaired waterbodies to attain and maintain the applicable water quality standards for physical, chemical and biological integrity for designated uses. According to the Indiana 1998 303(d) List of Impaired Waterbodies, IDEM has identified 208 waterbodies as impaired for approximately 378 parameters of concern, and has developed a 15-year schedule to develop and implement the TMDLs for these impaired waters.

The amended Safe Drinking Water Act (SDWA) of 1996 provided that source water protection be emphasized in all watershed planning activities. Thus, when a drinking water intake is located in an area to be sampled, consideration will be given to sampling parameters regulated by the SDWA. This would give an indication of both the current state of the water supply and the susceptibility of the stream for use as a drinking water source in the future.

Finally, the 1995 Monitoring Strategy did not allocate resources for special work that occasionally arises and requires the expertise of the Assessment Branch. One such need in 1998 was the Trace Metals Pilot Project which supported the Great Lakes Initiative and Triennial Review.

With these reasons in mind, the 1995 Monitoring Strategy was revised in 1998 to eliminate the first year synoptic sampling program for microbiological and chemical parameters. The resources dedicated to this program in 1996-97 were utilized to expand the fixed station monitoring program and to create a Special Projects group in the Surveys Section. This group was responsible for identifying impairment sources and activities, providing permit and TMDL support, and conducting special projects. While data needs were greater than resources could provide, the 1998 Monitoring Strategy gave the Surveys Section the flexibility to manage a number of important special projects while still providing watershed assessments.

B. RIVER BASIN MONITORING CYCLE

The five-year rotating river basin monitoring cycle begun in 1996, will continue to be the basis for Indiana's Surface Water Quality Monitoring Strategy. The state of Indiana has been divided geographically into major hydrological groupings or sampling units for the purpose of sampling, analysis and assessment. The goal to conduct a spatially complete surface water quality survey of the State has been accomplished for one monitoring cycle. The five-year monitoring cycle listed below will accomplish the second spatially complete surface water quality survey of the State.

Major River Basin	Sampling Year
West Fork White River and Patoka River Basins	2001
East Fork White River and Whitewater River Basins	2002
Upper Wabash River Basin	2003
Lower Wabash River and Kankakee River Basins	2004
Great Lakes and Ohio River Basins	2005

C. SUPPORT ACTIVITIES

The vision, mission and goals statements in the Introduction identify the guiding principles for the *Strategy*. The data will be collected, analyzed, assessed and published in multiple formats and used by a wide variety of customers. Internally, the OWQ will use the data for program support activities, such as; permitting, CWA Section 305(b) Assessments, CWA Section 303(d) Listing, TMDL determinations, and drinking water source protection activities. IDEM will also use the information produced for agency-wide initiatives/priorities, such as: the IDEM-EPA Environmental Performance Partnership Agreement (EnPPA), the Northwest Indiana Remedial Action Plan (RAP), and the Wildcat Creek Watershed Pilot Project. Additionally, the data, information, and reports produced will be made accessible to the public through the IDEM web site and via requests for information.

II. Strategy Components

A. PLANNING

The purpose of the planning component of this strategy is to set forth a general conceptual framework from which the OWQ Assessment Branch programs are developed and function. The programmatic model, as shown in Figure 1, provides the conceptual framework of branch activities relative to the study of ecological stressors and the surface water aquatic ecosystem.

The planning process is a dynamic process of seeking answers to the questions: Where are we? Where do we want to be? How are we going to get there? The Planning process provides the framework that allows the systematic development of a comprehensive water quality monitoring program in which water quality conditions are defined. It is a process that characterizes the existing and emerging problems by type, magnitude, and geographical extent. It provides the basis for designing and operating pollution prevention, abatement, and resource management programs. It also provides the basis for evaluating compliance and the effectiveness of programs. The monitoring activities defined in this strategy are intended to raise the awareness of managers to surface water quality problems. The information gathered will allow decision makers to analyze options, choose courses of action, design and implement programs, evaluate program effectiveness and make adjustments. A proper conceptual model is fundamental within any monitoring program. The planning process allows this all to occur and the Conceptual Model (Figure 1) provides a “road map” for this process.

Historically, the OWQ has directed its data collection efforts towards point source control and regulation. This has resulted in gaps in the assessment of the ambient condition of surface waters of the state. IDEM has embarked on a proactive approach using the *Strategy*, which will fill in these data gaps and provide a unified framework from which assessment of the surface waters can be achieved or undertaken. The ecological assessments conducted by the OWQ Assessment Branch involve ongoing measurements of the chemical, physical, bacteriological, and biological systems to determine the ecological integrity of the surface waters of the state.

The OWQ Assessment Branch staff collect field and laboratory data which are interpreted through the use of various descriptive analytical techniques and developed into environmental indicators. These assessments provide the data and the information which are delivered to numerous customers and stakeholders. The Assessment Branch program areas responsible for this process are the Biological Studies Section, Surveys Section, and the TMDL group in the Toxicology and Chemistry Section. The chemistry component of the Toxicology and Chemistry Section supports these programs through development of quality assurance and quality control procedures for sampling, laboratory analysis, and data handling.

The Biological Studies Section (BSS) conducts ecological assessments of Indiana surface waters, providing its customers direct measurement of environmental quality and information on any changes over time of this quality. The assessment of environmental quality involves the direct and indirect measurements of numerous parameters within several media of the environment

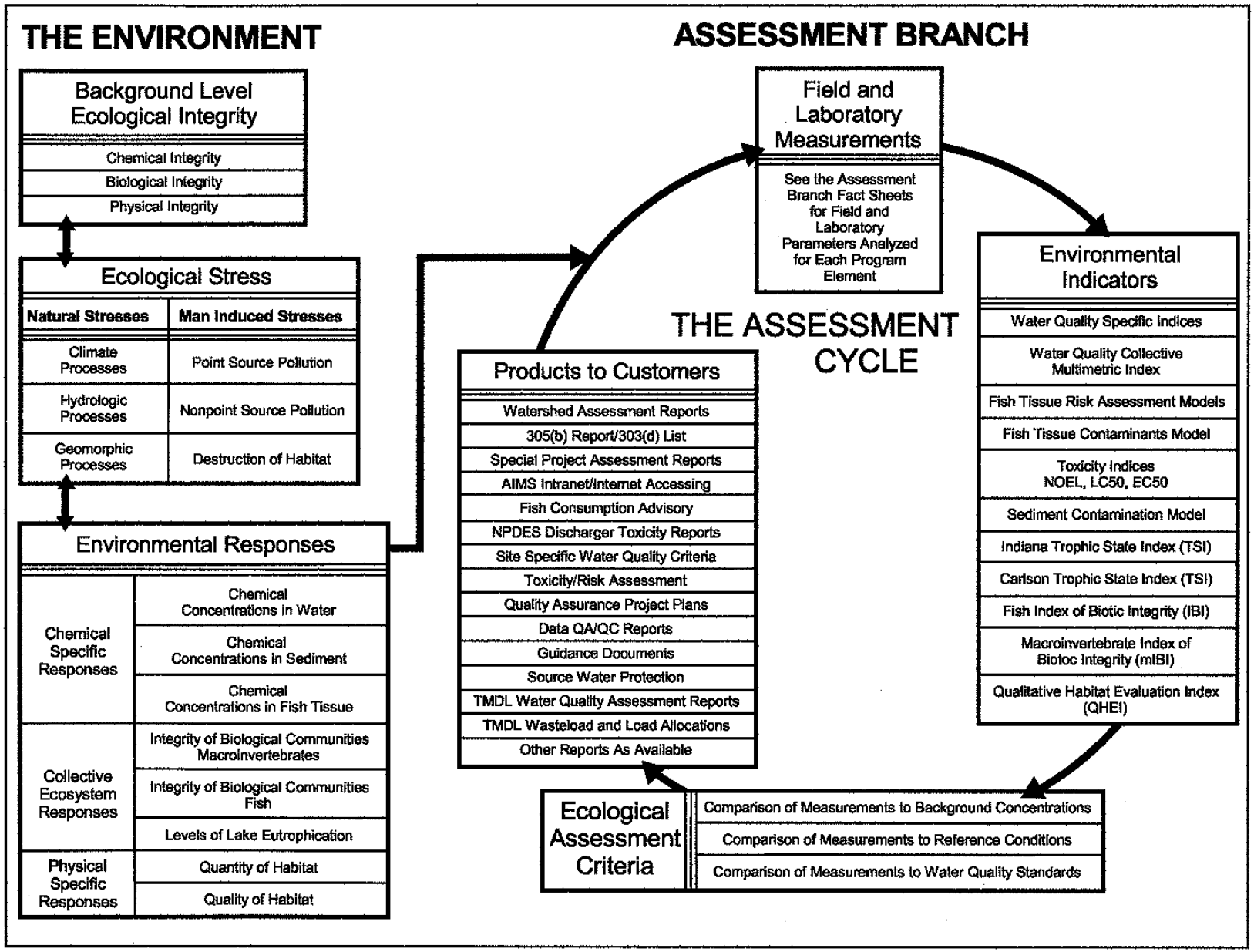
including: chemical analysis of specific water quality parameters, chemical analysis of surficial aquatic sediments, measurement of fish tissue contamination, aquatic habitat quality, fish community impairment, invertebrate community impairment, and lake eutrophication levels.

The Surveys Section provides surface water quality and hydrological data for assessment of Indiana's surface water and varying customer needs. Specific programs include the Watershed Monitoring Program, which utilizes randomly selected sampling sites for making assessments and statistically valid statements about all waters in the major drainage basins. The Fixed Station Monitoring Program provides basic information that reveals water quality trends and provides data for the many existing and prospective users of surface water in Indiana. This is achieved by monthly sampling of targeted fixed station sites statewide. The Special Projects Program addresses permit support issues and special pollution investigations. The *E. coli* Monitoring Program determines ambient concentrations of bacterial contamination in surface waters which is an important tool for determining the safety of swimming and wading in Indiana's streams and lakes. Finally, the current Pesticide Monitoring Program determines the ambient concentrations of pesticides in the surface waters and calculates their loadings based on flow data obtained from U.S. Geological Survey (USGS) gaging stations.

The TMDL group is vested with the responsibility of implementing Section 303(d) of the Clean Water Act, which requires each State to develop Total Maximum Daily Loads, and to establish priorities for their development. A Total Maximum Daily Load, or TMDL, is the total pollutant loads that a waterbody can assimilate and still meet water quality standards. A TMDL consists of wasteload allocations (WLA) from point sources of pollution, load allocations (LA) from nonpoint sources of pollution, and a Margin of Safety (MOS). The MOS accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water. The Allocation for Future Growth may include a reserved loading amount for the expansion of current National Pollutant Discharge Elimination System (NPDES) dischargers, the construction of new NPDES dischargers, or in anticipation of other activities in the watershed that may contribute to an increased pollution load to the waterbody. A successful TMDL study will need a high degree of quantitative and qualitative analytical effort to gather the desired information, and if needed, to model surface water quality under critical flow conditions. This program requirement dictates the need for water quality sampling to determine current conditions, the pollutant types and quantity, and sources of pollution, and their impact on the watershed.

By providing a conceptual framework, a comprehensive monitoring strategy can be designed and effectively implemented which will maximize and coordinate the various Assessment Branch programs. This *Strategy* will provide the comprehensive surface water quality assessments needed for management decisions, made in partnership with the citizens of Indiana, to protect designated uses of Indiana waters.

Figure 1. Programmatic Conceptual Model for the Surface Water Monitoring Strategy



B. SAMPLING PROGRAMS

The Sampling component of the *Strategy* includes the sampling and analysis of each river basin to be conducted once every five years according to the *Strategy* planning schedule. Two main objectives are addressed. The first is to describe the overall environmental quality of the surface water resource in the major river basins. The second is to identify parts of the river basins that are impaired or do not meet surface water quality standards. The Sampling component of the *Strategy* is designed to meet these objectives and to provide data for the needs of the major priorities of the Office of Water Quality (OWQ). The major OWQ priorities include the 305(b) watershed assessments, the 303(d) list of impaired waterbodies, development of TMDLs, NPDES permitting, source water protection and the fish consumption advisory.

Results of biological, chemical, and physical data collections will be used to evaluate each river basin separately. Program effectiveness will continue to be evaluated to maximize the utilization of available resources to meet the objectives stated above. The challenge is to communicate technical information in a timely and accurate way for use in policy making, regulation, and public awareness. The *Strategy* is an integration of all of the water body sampling, analysis and interpretation programs of IDEM, OWQ and the Assessment Branch with the above objectives in mind. Most components will be carried out only in the basins when they are targeted every fifth year, while some components will be performed throughout the five-year cycle.

The 305(b) watershed assessments utilize physical, chemical and bacteriological water quality data, biological and habitat assessments and fish tissue and sediment data to characterize the overall health of the surface water resources in each river basin. The statewide and rotating basin monitoring provide data for these assessments. The parameters chosen for analysis of water quality include both field-analyzed parameters and laboratory analyzed parameters. It is not practical, given resource limitations, to test for all analytes which have surface Water Quality Standards, so parameters have been chosen to provide the best indication of pollution and impaired surface water quality. Water chemistry, biological indices, and habitat assessments are evaluated to gain a picture of the overall health of the surface water resources in each major river basin. When a drinking water intake is located in an area to be sampled, consideration will be given to sampling parameters regulated by the Safe Drinking Water Act.

While the 305(b) watershed assessments require water quality data to characterize the overall health of the river basin, the 303(d) listing process requires data to list specific stream segments as being impaired for a designated use. Examples of reasons for listing a water body include violations of water quality standards for chemicals, impaired biological communities, and the issuance of a Fish Consumption Advisory (FCA). The statewide and rotating basin monitoring provide data for making 303(d) listing determinations. After a waterbody has been placed on the 303(d) list, sampling is performed to develop the TMDL. This includes a reassessment of the waterbody and the collection of data for modeling purposes. Follow-up monitoring may also be required as part of the TMDL implementation plan. The TMDL sampling has expanded since the 1998 revision of the *Strategy* with OWQ devoting more resources to the development of TMDLs.

NPDES permitting requires water quality data to determine the background concentrations of various parameters in water bodies. The statewide monitoring is currently the major source of data for determining background concentrations. However, the Trace Metals Project beginning in 2001 will provide low level dissolved and total recoverable metals data at 24 selected sites around the state. NPDES permitting also requires site-specific studies on occasion for modeling purposes. The Sampling component of the *Strategy* accounts for this need and an effort will be made to allocate resources as needed.

The FCA requires information on chemical contaminants that may be accumulating in fish tissue. Fish tissue data to be used for the FCA are collected during the rotating basin monitoring.

In addition to the major priorities listed above, the sampling resources and expertise of the OWQ Assessment Branch are also needed on occasion to support special needs of OWQ program areas.

Data collection efforts can be divided into the following categories:

- **Statewide Monitoring**: Sampling of the Lake Michigan shoreline and selected rivers on a monthly basis each year.
- **Rotating Basin Monitoring**: Probabilistic sampling of each basin once every five years according to the *Strategy* planning schedule; limited follow-up monitoring to identify sources of impairment; *E. coli* at targeted recreational sites; pesticides at targeted USGS gaging sites through 2001.
- **TMDL**: Sampling of waterbodies on the 303(d) list.
- **Other OWQ Program Support**: Special sampling projects to assist OWQ program areas.

A table of the sampling programs showing the four data collection categories is provided in Table 1. Appendix A includes site maps for these programs. In addition, Appendix B includes sampling program fact sheets that describe the objectives, participants, and products of each program. The following text gives a synopsis of each sampling program that is part of the Sampling component of the *Strategy*.

- **Fixed Station Monitoring Program**

This program is currently comprised of 160 targeted sampling sites statewide. There are many objectives for the data obtained from these locations. Each site is sampled once per month for a variety of parameters depending on the nature and history of the site. This frequency of sampling provides for a comprehensive data set for valid statistical trend analyses at each site. Since the focus of the Fixed Station Program is on the major rivers of the state, it is logical to continue to use these sites as targeted locations, particularly since a wealth of historical data exists from many of these sites. Samples are taken during a variety of stream conditions: high flow, low flow, before agricultural activity, after fertilizer/pesticide application, and after the leaves fall. On some of the larger rivers, sites are located spatially with a high enough frequency so as to give a good representation of each of these rivers from up to downstream. In other areas, where the sites are still sparse, the data are still useful to provide general ambient data for use in planning and modeling for NPDES permits. They are also useful as representative data for the

Table 1: Summary of Existing Surface Water Quality Monitoring Strategy Programs

Program	Locations	Assessment
Statewide Monitoring		
Fixed Station Monitoring Program	Sample at main stems of major rivers throughout the State, and Lake Michigan drinking water intakes.	Stream conditions at high flow, low flow, before agricultural activity, after fertilizer/pesticide application, and seasonal variability. Data used for historical information and trends.
Rotating Basin Monitoring		
Pesticide Monitoring Program[1]	USGS gaging stations within the targeted river basin.	Determine ambient concentrations of pesticides and calculate loadings.
Bacteriological Sampling Program	Site selection based on information provided by conservation officers and county health departments within the targeted river basin.	Study used as indicator to show the ability of a water body to support recreational uses for full body contact.
Watershed Monitoring Program[2]	Sample at probabilistic sites within the targeted river basin.	Water chemistry, fish tissue and fish community, macroinvertebrate community, and habitat assessments.
Fish Community Assessment Program	Sample at probabilistic sites within the targeted river basin.	Monitor biological integrity of streams.
Fish Tissue Contaminant Monitoring Program	Sample at CORE sites. Additional monitoring efforts at Watershed Monitoring Program sites.	Study accumulation of chemical contaminants in fish tissues.
Sediment Contaminant Monitoring Program	Sample at sites where fish tissue is collected within the targeted river basin.	Study accumulation of chemical contaminants in the sediments of streams, rivers and lakes.
Macroinvertebrate Community Assessment Program	Sample at probabilistic sites within the targeted river basin. Revisiting reference site locations selected from 1990 through 1996 and historical locations of impairment within targeted basin. Additional monitoring efforts at Watershed Monitoring Program sites.	Monitor biological integrity of streams.
Lake Water Quality Assessment Program	Sample at public lakes and reservoirs within the targeted river basin.	Physical, chemical, and biological data gathered on each lake are combined into a multi-metric index
Source Identification Program	Selected waterbodies identified as being impaired in the prior year.	Identification of sources of impairment in water body with water quality standard violations.
TMDL		
TMDL Development	Targeted waterbodies on the 303(d) list.	Reassess the impaired waterbody and collect data for modeling purposes.
TMDL Follow-up Monitoring	Waterbodies with established TMDLs.	Sample the waterbody in accordance with the follow-up monitoring schedule for the TMDL.
Other OWQ Program Support		
Permits Support	NPDES permitted facilities.	Site-specific sampling and data collection to develop wasteload allocations for NPDES permits.
Trace Metals	Sample at 24 sites statewide at USGS gaging stations.	Collect dissolved and total recoverable metals data using clean sampling techniques.
Fish Consumption Advisory Program	Sample statewide at selected stations.	Provide the recreational fisher with information as to the risks associated with the consumption of potentially contaminated fish.
QAPP & QA/QC Program	Water, sediment and biological samples analyzed by Contract and State analytical laboratories.	Quality guide for Contract and State analytical laboratory staff charged with the analysis of environmental samples.

[1]This program will be discontinued after the 2001-sampling season. Limited pesticide sampling will be included in the Fixed Station Program starting in 2002. [2]Formerly referred to as Probabilistic Sampling Program.

particular type of land use upstream of the site. Some of these data are useful for drinking water source monitoring. The data from these sites complement the data from the Watershed Monitoring Program to help give an overall view of the chemical and physical surface water quality for the study area.

- **Pesticide Monitoring Program**

The main objective of this project is to determine the ambient concentrations of pesticides throughout the major watersheds of Indiana. Loading calculations are done based on flow data obtained from each site. Sampling sites are selected to focus on main stems of the major watersheds. All sites are located at U.S. Geological Survey gaging stations. Sampling is performed during the pre-emergent and post-emergent application periods for pesticides during the year. This process will show the seasonal trends associated with non-point source runoff. The results of this project will contribute to the Indiana 305(b) report, 303(d) list of impaired waters, basin assessment reports, and the 319 non-point source priority watershed list. The current program will complete the five year cycle after the West Fork White River and Patoka River Basins are monitored in 2001. Beginning in 2002, pesticide monitoring will be reduced with limited sampling conducted within the Fixed Station Monitoring Program.

- **Bacteriological Sampling Program**

The bacteriological indicator used for this project is *Escherichia coli (E. coli)*. The main purpose for using this parameter is that it is an indicator which shows the ability of a waterbody to support recreational uses for full body contact according to Indiana Water Quality Standards. Sampling sites for *E. coli* will be selected within the targeted basin based on information acquired from conservation officers, county health departments, and others, including other offices within IDEM, that have conducted previous surveys and have identified non-point sources of fecal contamination. The results of this program contribute to the Indiana 305(b) Report and subsequent 303(d) list of impaired streams.

- **Watershed Monitoring Program**

This program is a combination of different monitoring programs and is operated through the cooperative sampling efforts of the Surveys and Biological Studies Sections. The objective of this program is to provide a comprehensive, unbiased assessment of all streams for their ability to support aquatic communities and designated aquatic use, using probability based sampling of sites throughout major river basins to assess and characterize the overall water quality and biological integrity. Site selection will focus on all streams within the targeted river basin. Sampling for water chemistry will be performed three times under different flow regimes during spring, summer, and fall (May-October). Biological sampling and habitat assessments will be performed during the seasonal low-flow time frame (July-October). Data to be collected and assessed are: water samples for laboratory analysis, in-situ water chemistry, channel morphology data, fish community assessments, and habitat assessments. The results of this program will further contribute to the Indiana 305(b) Report and subsequent section 303(d) list of impaired streams, the Indiana Fish Consumption Advisory, as well as provide for support of the Environmental Performance Partnership Agreement (EnPPA), the Unified Watershed Assessments (UWA) and the development of biocriteria for Indiana surface waters.

- **Source Identification Program**

According to EPA advisement, all 305(b) assessments at the waterbody level should include causes/stressors and sources contributing to impairment of designated uses. When the original monitoring strategy was formulated, there was a recognition that follow up studies, i.e. second year studies, were needed to identify sources and magnitude of impairments. The source identification component of the monitoring strategy became unattainable due to a staffing shortfall which coincided with the beginning of the first five year rotating cycle. As a step towards addressing this monitoring need, a Source Identification Program was initiated in 2000. This program evaluates data produced by the watershed monitoring program in the prior year in an effort to determine impaired water quality locations. These impaired locations are evaluated and prioritized according to the degree and type of stressor for the purpose of conducting individual follow up source identification studies. The number and type of studies that can be conducted each field season is limited due to the current staffing shortfall.

- **Fish Community Assessment Program**

The objective of this program is to assess water quality using resident fish communities as a tool for monitoring the biological integrity of streams. This type of monitoring aids in the classification of streams that exhibit very poor to excellent water quality conditions as well as habitat availability and quality. Because most fish have a life span of greater than three years, fish community monitoring can detect areas of degradation that have occurred over an extended period of time. These data provide the information needed to assess changes in Indiana ecosystems that affect aquatic life. Assessments will be done in conjunction with the watershed monitoring program using probability based sampling.

- **Fish Tissue Contaminant Monitoring Program**

The objective of this program is to provide information on chemical contaminants that may be accumulating in the tissues and edible portions of fish tissue. This type of monitoring helps to locate sources of contaminants whose concentrations in water or sediments may be too low to be easily found with normal sampling and laboratory procedures. See Table 2 for a listing of national CORE network stations in Indiana that provide baseline fish tissue data. The Fish Tissue Contaminant Monitoring Program provides the majority of data used for the FCA. The FCA is developed for the protection of sport and subsistence fishermen. The data are also used for wildlife health risk assessment and information needed to develop models to assess changes in Indiana waters that affect aquatic life and human health. Additional monitoring efforts are also being done in conjunction with the Watershed Monitoring Program.

Table 2: Fish Tissue Sampling Schedule for CORE Network Stations.

Site Name Description	Stream Name	14-Digit HUC	County	Latitude	Longitude
LEM010-0025 Johnny Appleseed Park	ST Joseph River	4100003100040	Allen	41 5 56	--85 6 58
LEM010-0026 N of New Haven, IN	Maumee River	4100005010040	Allen	41 4 49	--85 1 58
LES060-0011 Ft Miamis Park, Fort Wayne	ST Mary's River	4100004060060	Allen	41 4 58	--85 9 4
LMJ120-0020 Dickey Rd, E Chicago	Indiana Harbor Canal	4040001020010	Lake	41 39 8	--87 27 47
LMM010-0003 West	Lake Michigan	4040001020010	Lake	41 41 13	--87 28 55
LMG060-0007 U/S Lefty's Coho Landing	Burns Ditch	4040001060040	Porter	41 37 6	--87 10 35
LMM010-0004 East	Lake Michigan	4040001070030	Laporte	41 44 36	--86 55 25
LMG070-0026 Michigan City, IN	Trail Cr	4040001070030	Laporte	41 43 6	--86 53 11
LMJ130-0002 Bristol, IN	ST Joseph River	4050001150010	Elkhart	41 43 40	--85 48 50
LMJ240-0024 Downstream South Bend, IN	ST Joseph River	4050001240060	St. Joseph	41 44 57	--86 16 17
UMK030-0019 Kingsbury FWA	Kankakee River	7120001030030	Laporte	41 29 25	--86 34 51
UMK120-0009 LaSalle FWA	Kankakee River	7120001110020	Newton	41 9 59	--87 31 32
WBU040-0009 U/S Fairbanks Park, Terre Haute, IN	Wabash River	5120111040050	Vigo	39 28 31	--87 25 12
WBU090-0002 Darwin Ferry	Wabash River	5120111100050	Vigo	39 17 3	--87 36 33
WLV010-0009 Mascouten Park	Wabash River	5120105070030	Tippecanoe	40 26 31	--86 53 43
WEL100-0006 Williams Dam, Williams, IN	E Fk White River	5120208100030	Lawrence	38 47 44	--86 38 30
WLV030-0013 Ft Quiatenon	Wabash River	5120108030030	Tippecanoe	40 24 17	--86 57 54
WLW100-0002 New Harmony, IN	Wabash River	5120113100010	Posey	38 8 26	--87 56 6
WUW070-0008 E of Bluffton, IN	Wabash River	5120101070010	Wells	40 43 43	--85 8 14
WWL100-0016 Petersburg, IN	White River	5120202100020	Pike	38 30 43	--87 17 16
WWU010-0029 E of Winchester, IN	White River	5120201010020	Randolph	40 11 0	--84 58 15
WWU090-0024 Broad Ripple Park, IN	Indianapolis Waterway Canal	5120201090080	Marion	39 52 20	--86 7 58
WWU140-0002 Henderson Ford, CR 390 E	White River	5120201140130	Morgan	39 29 57	--86 21 19

* *These 23 stations are sampled for fish tissue in conjunction with US EPA's CORE monitoring network of national stations. Sampling is performed once in five years, as a minimum, based on the rotating river basin schedule.*

***Samples collected by the Indiana Department of Natural Resources*

- **Sediment Contaminant Monitoring Program**

The objective of this program is to provide information on chemical contaminants that may be accumulating in the sediments of Indiana's streams, rivers, and lakes. Sediment monitoring can be an important tool for detecting pollutants in streams and lakes. This type of monitoring helps to locate sources of contaminants whose concentrations in water may be too low to be easily found with routine sampling procedures. The sediment contaminant monitoring program provides supportive information for the fish tissue contaminant monitoring program, wildlife health risk assessments, and for possible future development of models to assess changes in Indiana waters that affect aquatic life and human health. Sediment samples will be collected at sites where fish tissue is collected.

- **Macroinvertebrate Community Assessment Program**

The objective of this program is to assess water quality using aquatic benthic macroinvertebrate communities as a tool for monitoring the biological integrity of streams. Macroinvertebrate community assessment data has been established to evaluate the compositional, structural and functional integrity of the community. Concurrent aquatic habitat assessments are conducted to determine if either site specific habitat degradation or water quality causes can be determined. Monitoring has been conducted through "revisiting" randomly-selected site locations which were sampled from 1990 through 1996. Additional monitoring efforts are also being performed in conjunction with the watershed monitoring. These data provide the information needed to develop models to assess changes in Indiana ecosystems that affect aquatic life and human health.

- **Lake Water Quality Assessment Program**

The objective of this program is to provide basic information on the status and trends of the eutrophication (nutrient enrichment) levels of Indiana public lakes and reservoirs. Physical, chemical, and biological data gathered on each lake are combined into a multi-metric index. This program is currently being funded with a federal grant administered by IDEM's Office of Water Quality. Since 1989, the sampling and analytical efforts for this program have been conducted by staff and students of Indiana University's School of Public and Environmental Affairs (IU/SPEA), in addition to a corps of trained volunteer monitors.

IDEM's Lake Water Quality Assessment Program contractor, Indiana University, shifted the rotating sampling schedule in 1998 to more closely resemble that used by the *Strategy*. Such a sampling scheme is not without its problems, however, since a) lakes are not distributed as equally around the state as rivers and streams, and b) locational data had not been gathered on all previously sampled lakes.

After further study and evaluation it may prove more expedient for IDEM's contractor to not sample lakes by river basin (which range from as few as 29 to as many as 251 public lakes within a given basin). This approach should be re-evaluated in time for the 2003 sampling season, if not sooner. The year 2002 marks the end of the current 5-year cycle that began on lakes in 1998. The timing of, and parameters included in, statewide lake assessments may come under additional scrutiny in light of pending development of nutrient criteria.

Since 1997, Indiana University has been collecting location data from each sampled lake. This should prove helpful in linking lake water quality information with that of rivers and streams within the same watershed. This would be further assisted by the development of a much-needed agency-wide or statewide database to hold lake information (AIMS, EPA's STORET, or another). This would then allow analysis of lakes data in conjunction with data from surrounding waterbodies. The need for this is twofold. While lakes sometimes act as 'sinks', removing and storing various pollutants from flowing waters; they can also act as 'sources' when these stored contaminants are recycled within the water column and/or released to downstream waters. Further understanding of this connection between the quality of flowing versus standing waters is vital to improving the Agency's long term ability to properly assess, protect, and improve the state's water resources.

- **Fish Consumption Advisory Program (FCA)**

One of the objectives of Indiana's fish tissue monitoring program is to provide the recreational fishermen with information as to the risks associated with the consumption of potentially contaminated fish. The FCA helps consumers to make personal decisions regarding the size and type of fish and how often to eat freshwater fish.

Each year, members from the Indiana State Department of Health (ISDH), Department of Environmental Management (IDEM) and Department of Natural Resources (IDNR) meet to discuss the findings of recent fish monitoring data and to develop the new statewide fish consumption advisory. Indiana's fish consumption advisories are issued by ISDH. IDEM collects and manages about 98% of the data used to make decisions on fish advisories for the State. IDNR has been instrumental in the collection of fish tissue samples from Lake Michigan and a number of inland lakes where their special studies are occurring.

The 2000 advisory was based on levels of polychlorinated biphenyls (PCBs) and mercury found in fish tissue. Across the last two decades more than 2300 fish tissue samples have been analyzed for PCBs, pesticides, and heavy metals of concern. Of those, the majority contained at least some mercury. However, not all fish tissue samples had mercury at levels considered harmful to human health.

Because of past widespread agricultural and industrial use of these materials, their great stability, persistence in the environment, and the potential for bioaccumulation, it is not surprising that concentrations exceeding safe levels have been found in some species and in some places. Criteria for the statewide 2000 Indiana FCA were developed from recommendations by the Great Lakes Sport Fish Advisory Task Force (1993).

- **NPDES Permits Support**

This activity provides site specific data needed to develop wasteload allocations for NPDES permits. Other permit support work may be conducted as needed. The data for wasteload allocations may include background concentrations, time-of-travel measurements, sediment oxygen demand and other sampling or measurements as required.

- **Total Maximum Daily Load (TMDL) Program**

The main objective of this program is to assess the water quality of waterbodies that have been placed on Indiana's 303(d) List of Impaired Waterbodies, and to perform TMDL evaluations of those not meeting water quality standards. OWQ has developed a set of guidelines and a separate strategy for this program. The TMDL process for each impaired waterbody will take 2-3 years and will be completed in 3 phases of planning, sampling and data collection, model development, and implementation. The schedule for developing the TMDLs is expected to follow, to the extent possible, the rotating basin plan for the surface water quality monitoring projects. Water and/or sediment samples and hydrologic measurements will be collected from each impaired waterbody. At a minimum, each waterbody impaired for conventional chemical parameters will be sampled three times through the spring to fall seasons. Waterbodies impaired for *E. coli* will be sampled during the recreational season between April 1 and October 31. These waterbodies will be sampled 5 times evenly spaced within a 30 day time period to calculate the geometric mean. Additional sampling may be needed in order to identify all the various sources of the substance(s) causing the impairment. Also, for impairments identified through biological assessments, additional sampling may be needed to identify the substance(s) or other causes of these impairments and their sources. Conversely, where potential sources are known or suspected, additional samples may need to be collected to confirm the impairment. Efforts will be made to characterize loading from point and nonpoint sources. Additional sampling may also be required for TMDL evaluations for waste load allocations and load allocations, modeling and implementation purposes. For waterbodies with TMDL implementation plans, follow-up sampling will be conducted for a period of three consecutive years after implementation. Continued monitoring of the waterbodies will then follow the rotating basin schedule.

Monitoring of surface waters in each major river basin is also expected to result in identification of additional impaired waterbodies and in developing a new 303(d) list every 4 years. Sampling of impaired waterbodies each year for the purpose of TMDL development could also result in identifying waterbodies that are no longer impaired for the listed parameters which would provide a basis for delisiting them from the 303(d) list.

- **Trace Metals Program**

The Trace Metals Sampling Project is expected to begin in 2001 with the selection of an outside contractor. Recently, Indiana adopted the Great Lakes Initiative (GLI) water quality standards for watersheds in the Great Lakes Basin. Data showing low level dissolved metals are required to assess these waters and historically only total recoverable metals have been monitored. This project will develop the clean sampling techniques for acquiring surface water samples for trace metals and provide both dissolved and total recoverable metals data at nanogram per liter levels. Twenty-four strategically selected sites will be sampled quarterly equaling 8 sites a month statewide. All sampling sites will be near USGS gaging station**.**

- **QAPP and QA/QC Program**

The Environmental Toxicology and Chemistry Section develops and maintains the Quality Assurance Project Plan (QAPP) for Indiana Surface Water Quality Monitoring Programs. This QAPP serves as a guide to both Contract and State analytical laboratory staff charged with the analysis of environmental samples (water, sediments, and biological) and QA/QC review in

order to provide results that will meet the data quality objectives for the individual water quality monitoring projects. The QAPP is updated every three years or when required by significant changes in projects or procedures. The Toxicology and Chemistry Section also provides QA/QC reviews of laboratory data reports detailing chemical analyses of samples collected by the Assessment Branch. These QA/QC reviews assign levels of confidence and Data Quality Assessment Levels to the laboratory data reports, and determine laboratory compliance to USEPA methods and QA/QC procedures as prescribed in the QAPP for individual parameters. Successful collection of precise, accurate, and complete environmental data provides IDEM and USEPA Region 5 with good quality data, which could be used for regulatory decisions and to implement programs to improve and maintain clean waters in the State of Indiana.

C. REPORTING

The OWQ Assessment Branch has defined ***reporting*** as:

> *The component of the monitoring strategy which is the result of the sampling process and includes data management (data entry, maintenance, data documentation, and database access), interpretation, publication, and the communication of data and information products* (IDEM 1998).

All communication depends upon a complete, comprehensive and scientifically defensible information base. The data should meet known and designated data quality objectives for each project and facilitate data evaluation, data sharing, and information publication.

- **Data Management**

A data management system called AIMS (Assessment Information Management System) has been developed to assist the Assessment Branch in data analysis and reporting. AIMS is a centralized data storage and retrieval system that provides an efficient and easily accessible data base of surface water resources information to serve the needs of IDEM and stakeholders.

In addition to efficient data storage and retrieval, a number of steps identified by staff demonstrate a commitment to producing quality end products for Assessment Branch programs. These steps will be fully incorporated into the information management process and integrated, where possible, with AIMS. Included in this process is the development of procedures and formats for:

- Data entry and standards for quality checks for overall data quality assessment;
- Data quality assessment (DQA) to define precision and accuracy of results;
- Data and information dissemination and related documentation;
- Data reduction (scores and other metrics as environmental indicators); and
- Standards for use of data in reports (using known DQA for each project).

The Assessment Branch will continue to provide data for entry into STORET (Storage & Retrieval). STORET is an electronic database system maintained in conjunction with US EPA that serves as a central repository for water quality data collected by contributing agencies and organizations. This national water quality database provides analysts opportunities to examine

temporal changes in water chemistry for a wide range of parameters throughout the nation's watersheds. IDEM Fixed Station Monitoring Program data up to 1995 are available for statistical analyses using STORET. STORET assists IDEM in compliance with reporting requirements of PL 92-500 CWA (Clean Water Act) and IDEM's EnPPA with EPA.

- **Interpretation**

Data collected by the water quality assessment programs will be interpreted to meet the goals of the *Strategy*. The goals of the *Strategy* are to measure the physical, chemical, bacteriological, and biological quality of the aquatic environment, assess the impact of human or other activities on the aquatic ecosystem, analyze water quality trends, and develop environmental indicators. By meeting the goals of the *Strategy* and providing data to IDEM and stakeholders, adverse environmental impacts can be corrected and exceptional water quality resources protected.

To aid in data interpretation, specialized equipment and software have been acquired. These include the use of Geographic Information Systems (GIS), Geographic Positioning Systems (GPS), and statistical tools. The GIS and GPS tools make it easier to link our sampling data to geographic coordinates using IDEM and national standards for geographic accuracy and precision. Through the use of GIS and GPS, the Assessment Branch can provide better information to end-users in a format that is easily communicated (e.g., multi-layer data maps). Statistical software and spreadsheets will assist in the identification of trends, ecological assessments, and modeling for total maximum daily loads (TMDLs).

- **Publication**

Technical reports will be published to communicate the results of Assessment Branch water quality monitoring efforts. Reports published by the Assessment Branch using data produced by the monitoring strategy programs will adhere to the Standard Operating Procedure (SOP) for Documentation. In addition to formatting guidelines, the SOP will include a review and distribution process for reports and a detailed filing system. The format and style of the manuscript should follow standards established in the CBE Style Manual (CBE Style Manual Committee 1994). Documents will include at a minimum a standardized format for the following: a Signatory Page authorizing printing and distribution, an Information Page, and a Distribution List.

- **Communication**

Reporting is identified as one of the major components for an effective monitoring program. The reporting component of the *Strategy* provides products that include but are not limited to:

- Data for CWA Section 305(b) Water Quality Reports;
- Data for CWA Section 303(d) List of Impaired Waterbodies;
- Technical surface water quality reports;
- Data & Interpretation for NPDES permit support;
- Environmental indicators in support of EnPPA Strategic Goals;
- Inter- and intra- governmental data transfer;
- Technical Data Sets for Consultants/Researchers
- Spatial and mapping data using Geographical Information System (GIS) tools;
- Submissions and peer review for technical and informational publications;

- Public outreach information sharing including the Internet; and
- Presentations at professional, scientific, citizen, and school group meetings.

Fact Sheets (Appendix B) have been developed for Assessment Branch Programs, which support the *Strategy*. These provide program specific information including objectives, participants, description, specific products, technical notes, and contact information. Fact Sheets will be updated annually as the Assessment Branch continues to explore the tools and media available for information development and communication. These currently include but are not limited to hard copy and electronic publications, public presentations, and the Internet.

In summary, the *Strategy* calls for ambient surface water quality monitoring using a five-year cycle to conduct sampling in the major river basins. It also requires a commitment to improving capabilities in data management and information access. This includes data and information sharing at many different levels including the review of raw data; data analysis and assessment; and recommendations to management for policy decision making. The success of the *Strategy's* data management and reporting is critical to achieving the goals of the monitoring strategy.

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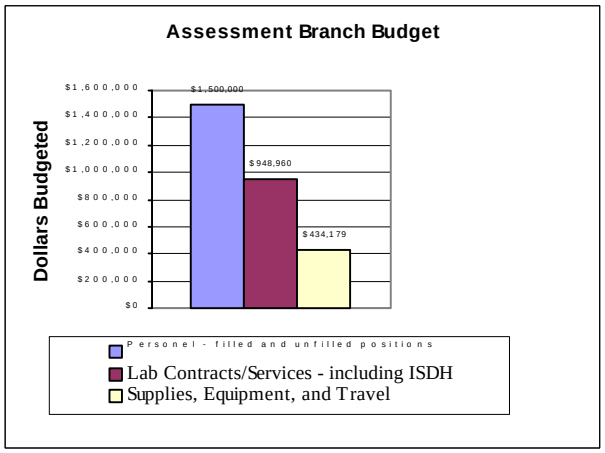
III. Resources

A. STAFF AND FINANCIAL RESOURCES

When the 1995 Surface Water Quality Monitoring Strategy was prepared, the Assessment Branch had 24 staff, consisting of 20 full-time employees and 4 temporary employees. The staffing resource proposed to implement the *Strategy* at that time were 43 permanent staff.



Currently 41 full-time positions in the Branch are funded by EPA grants and water permits fees. Ten positions from the Governor's Public Service Summer Internship Program are scheduled for use from May through August 2001 to assist with the summer sampling workload. The Assessment Branch also utilizes two 180-day temporary Laboratory Technicians and two college students as temporary part-time Environmental Scientists to augment permanent staff.

It may appear that the staffing resources are approaching the level necessary to fully implement the *Strategy*. However, this is not the case. Eight positions are assigned to the Total Maximum Daily Load (TMDL) work group, an entirely new program initiated in 1998. This workgroup was not envisioned as part of the original 1995 *Strategy*. Additionally, other new programs have been initiated and have been prioritized for six staff. These programs are E. *coli* Program, Pesticide Program, GIS Program, Database Maintenance, and Report and Data Distribution and Coordination. While these programs do support the *Strategy*, the staff assigned to these programs is not available for direct fieldwork and report writing. It can be argued that the impact of these positions equals the equivalent of three full time positions that support the *Strategy*. The balance of these resources supports public outreach, report and Internet data retrieval development, and database maintenance. Therefore, the Assessment Branch is 13 field positions short of fully supporting the *Strategy*.

As shown in Figure 2, the proposed budget for contractual services and payments in 2001 for the surface water quality and biological sampling analysis program is a total of $1,710,000. Of this, $176,000 of contract funds are for fish tissue and sediment contaminant analyses; $230,000 in contract funds for surface water and effluent chemical analyses; $179,000 for pesticide sampling analysis; $113,000 for flow gaging station support; and $170,000 for low level (trace) metals analysis using ultra clean sampling techniques.

Bacteriological and chemistry analysis for the Fixed Station and TMDL Programs are currently performed by the Indiana State Department of Health(ISDH) at no cost to IDEM. Based upon 2000 estimates, the value of the laboratory services performed by the Indiana State Department of Health is approximately $590,000. There is also a $65,000 per year contract (nonpoint source

funds) with Indiana University for operating the Clean Lakes Program which includes the sampling of 75 public lakes per year for a variety of water quality parameters and coordinating the Indiana Volunteer Lake Monitoring Program. The remaining funds are for Special Projects.

In summary, the current field personnel and funding including laboratory services support the 2001-2005 *Strategy* at a very minimal level.

B. REVIEW AND PLANNING PROCESS PROPOSALS

Throughout the review and planning process of the five-year rotating-basin monitoring approach, various proposals and suggestions were offered as a means of improving and enhancing the current strategy. Much deliberation and consideration was given to each of the proposals as to how they would positively benefit or negatively impact the monitoring strategy. The intent was to seek better ways to serve both internal and external IDEM customers as well as address some remaining needs in the current mode of operation. Much of this effort was devoted to discussion of allocating resources to accomplish these proposals either in part or entirety. The obvious conclusion of this review process is that not enough staffing resources are currently available to achieve all the monitoring needs or proposed improvements to the monitoring strategy. These proposals warrant serious consideration and should be noted as suggestions for redirecting current resource efforts or implemented as additional studies should resources become available. Following is a brief description of the major strategy change proposals presented during this review process.

- The probabilistic sampling design is a very efficient and effective use of limited human resources and for statistically determining the number of miles of impaired streams within a basin. Without an increase in human and analytical resources, the spatial coverage of sample sites is resource limited and therefore provides inadequate information to identify the exact location of every individual mile of impairment. The resource limitation creates a perceived problem between the 305(b) program, the 303(d) listing process and the resulting TMDL program in that many of the miles are not spatially identified well enough to be included on the 303(d) list. As time goes on and more statewide 5-year monitoring cycles are completed there will be an increase in the number of the impaired reaches that can be identified, while maintaining the inherent advantages of a probabilistic sampling design.

- *Intensive Spatial Networking Based on 14-Digit Hydrologic Units for Monitoring and Assessing Rotating Basins* is a systematic approach for making observations and sampling each of the 14-digit hydrologic units at three or four spatially critical targeted locations within each of these small watershed units.

- *Expanded Probabilistic Option* would redirect resources into increasing the number of probabilistic sites to increase spatial and temporal density of data within the watershed. The design would include monthly sampling of randomly selected sites within the watershed.

- *Semi-Rotating Targeted Stations* would redirect some of the current resources of the Fixed Station Program so that additional targeted and/or probabilistic sites could be placed in the rotating basins. Of the current 160 sites, 60 sampling sites would be left as a core fixed

station group to be monitored statewide. The remaining 100 sites would be placed in the rotating basins to provide additional water quality information and more complete waterbody coverage

- The *1999 Paired Study, Lower Wabash River Basin, Indiana* (Christensen 1999) was conducted to determine if water quality parameters changed as water flowed from probabilistically selected sites to the nearest downstream access point. The results of the study did not indicate any statistically significant differences for most parameters and field measurements (28 parameters). Staff has explored the applicability of the results and suggests that future studies be conducted to verify the conclusions.

When the first monitoring strategy was formulated in 1995, many of the goals of an adequate monitoring and assessment program were accounted for as set forth by the Intergovernmental Task Force on Monitoring Water Quality (ITFM). A staffing shortfall necessarily left a gap between the original monitoring strategy goals and what could be realistically achieved. Much of the content of the above proposals would serve to assuage the shortfall of the original monitoring strategy. The addition of staffing resources, however, could facilitate the return to the original monitoring strategy goals and indeed alleviate many of the issues and concerns of the alternative proposals.

The Assessment Branch of the Office of Water Quality has an important role to play in the collection of needed water quality data. These data are needed to assess status and trends, to identify and prioritize existing and emerging problems, to develop and implement management and regulatory programs and to evaluate compliance with environmental requirements and the effectiveness of programs and projects. The *Strategy* provides a comprehensive plan to achieve effective collection, interpretation, and presentation of water-quality data and to improve the availability of information for decision making at all levels of government given the level of manpower and sampling resources available to the Agency at this time.

C. SUGGESTIONS FOR FUTURE STUDIES AND ACTIONS

Specific suggestions for future actions were also proposed as part of the *Strategy* review process. These suggestions are studies or actions that would enhance or improve established Assessment Branch programs or in some cases satisfy recent EPA initiatives. These suggestions are listed below and should be considered when making future updates to the *Strategy*.

- Follow-up sampling of TMDLs is essential in attaining valuable data necessary to determine if load reductions required by a TMDL lead to attainment of the water quality standard. Three consecutive years of sampling and collecting data should be necessary to be reasonably assured that the impaired waterbody meets water quality standards.

- Write and sign a new Memorandum of Understanding for laboratory services performed by the Indiana State Department of Health for the Fixed Station Sampling Program.

- Better incorporation of studies of lakes, reservoirs, and other lentic waterbodies with information gathered from tributaries and outflows where appropriate. Key to accomplishing this is the development of a comprehensive database of lake information.

- Begin assessing water quality of wetlands and/or incorporating wetland assessments done by other entities.

- Increase emphasis on sampling of surface water supplies for source water protection.

- Expand pesticide-monitoring program from the one-year basin study area to a statewide network of sampling sites.

- Conduct sampling at confined feeding, land application, and construction sites to assess the surface water quality impacts of these activities.

- Increase coordination and collaboration with other programs in the Office of Water Quality.

- Improve upon the identification of nonpoint source (NPS) stream impairments for the purpose of targeting Section 319 funding toward specific water quality concerns and reduction of NPS pollutants.

These suggestions will be given careful consideration when updating and integrating new components to current Assessment Branch programs. Even the best and most dynamic monitoring program would have difficulty assessing all aspects of aquatic environments. Scientists and ecologists are continually adding to our knowledge of these diverse systems; meanwhile, agency resources must be effectively scrutinized to ensure all forms of pollution are adequately monitored and addressed. Future success in making adequate judgements about the quality of Indiana's surface waters depends on proper application and coordination of staff and equipment and the financial and technical resources available to support the assessment process. These water quality assessments are crucial to the protection and restoration of Indiana's vital water resources.

D. VOLUNTEER MONITORING

In *Volunteer Water Monitoring: A Guide For State Managers* (USEPA 1990), the U.S. Environmental Protection Agency (EPA) makes a strong case for utilizing and supporting citizen volunteer monitoring programs. They are quick to point out that citizens have become increasingly involved in monitoring the quality of our Nation's waters. They also commend those States with the foresight to recognize the value of working with such citizen volunteers; not only for the information gained via data collected, but also in having people educated and involved as good stewards of the state's precious water resources.

In 1995, Assessment Branch staff likewise recognized that the numbers, location, and availability of citizen volunteer monitors had great potential for enhancing IDEM's monitoring and assessment efforts, and that use of volunteer or third-party data could prove invaluable for filling gaps in the *Strategy* they were designing. The variety and flexibility of such groups offers much toward meeting the State's goals of identifying problems, assessing trends, and characterizing the state's rivers, streams, lakes, and wetlands. These efforts lend great insight into targeting precious Agency resources in the investigation of water quality problems and restorative actions, whether regulatory or voluntary in nature. EPA not only encourages such

interactions to occur, but has provided the guidance and often the funding necessary to support partnerships between States and citizen volunteer groups—especially those that promote public education and participation.

The crux of using volunteer-collected data, of course, has always been the question of its credibility. Many would-be data users are often skeptical about the quality of such data, though EPA and experienced States are quick to point out that even screening level data has its uses and steps can be taken to ensure that data of known quality is being produced by these programs. The manual listed above, as well as additional resources published by EPA (USEPA 1996, USEPA 1997), point out the need for agencies to understand the strengths and drawbacks of all volunteer programs; whether State-sponsored or private. They also outline the resources, roles, and responsibilities which States should expect to provide in support of volunteer monitoring efforts.

The EPA documents listed here cover several basic ingredients necessary for successful partnering between State agencies and volunteer monitoring programs. The main 'ingredient' is getting agencies to recognize that, while volunteer monitoring is cost-effective, it is not free. Agencies need to be willing to provide upfront coordination to oversee and manage State-sponsored volunteer monitoring efforts or to work in a cooperative and meaningful way with other existing programs. Either option requires sufficient agency investment in office administration, data management, and analytical support necessary to carry said monitoring programs through to "demonstrable use of the data". Agency support should begin at the planning table where technical, decision-making, and lay personnel meet to state the needs and objectives for their data collecting project or program. In the course of generating credible data, this will ideally lead to developing and adhering to a clearly designed sampling and quality assurance plan that meets all data collecting objectives.

After the planning stage is completed, agencies might expect to assist with thoroughly training and re-training volunteer monitors; as well as providing consistent feedback in terms of open communication, recognition of accomplishments, and gradually increasing responsibilities. As EPA stated in the volume above, such feedback is the "psychological equivalent" of a paycheck. A critical and often overlooked step in this process is actually using the data that the volunteers collect. Simple analysis and attractive display of high quality volunteer data not only educates people about water quality issues; it also encourages continued participation in addressing these issues. Therein lies the ultimate value of a well-planned and implemented volunteer monitoring program. An investment of time and resources into organizing and maintaining such programs results in a corps of citizen stewards who have the enthusiasm, expertise, and commitment to not only monitor, but also protect, the water resources that are vital to everyone.

Shortly after the development of the original Monitoring Strategy, many of Indiana's approximately 70 organizations and citizen groups interested in water quality joined efforts to form an alliance called the Collaborative Resource Alliance for Water Quality Data and Development (CRAWDAD). This alliance fostered the necessary collaboration among groups to reduce duplication of efforts and encourage the success of each program; regardless of affiliation or scope. Stated goals of CRAWDAD included promotion of water education, coordination of water quality data collection and distribution; and analysis and interpretation of volunteer data.

Accomplishments to date include standardizing data collection forms used by some participants, and developing a web-accessible database for entering and storing volunteer data. Education and outreach efforts of this alliance led to conducting a joint-student congress dealing with water quality issues, and culminated in the production of an informative, recruitment-type video on the state's volunteer water monitoring activities.

Unfortunately, due to promotion and attrition, the volunteer monitoring alliance known as CRAWDAD has become inactive in Indiana. Likewise, IDEM's loss of a dedicated Volunteer Coordinator position also impedes the Agency's taking full advantage of the use of volunteer monitoring data; even though such monitoring efforts continue to grow in Indiana. Other barriers that exist to prevent IDEM from making the best possible use of volunteer data have to do with the data quality issue mentioned earlier. While some volunteer groups have excellent quality assurance/quality control (QA/QC) programs and highly skilled and trained people; other groups do not. Still, the fact that so many of these groups exist in our state and are collecting data has the potential to relieve some of the pressure IDEM experiences in attempting to "assess all waters of the State at all times". The key is for IDEM, in light of its continued shortage of internal resources, to find a way to tap into these valuable external resources; and to do so in such a way that supports the collection and use of data of known quality, in keeping with Agency standards.

IDEM's approach to using data generated by volunteer monitoring groups should be twofold. First, identify those groups collecting data of known quality and qualify/rank this data to be plugged into the varied data needs of the Agency. Were there a platform for storing volunteer data along with its documented QA/QC procedures, various data users within the Agency would be able to choose the data most useful to their programs. Secondly, IDEM could coordinate with volunteer groups to begin educating them about the need for incorporating QA/QC into their methods, as well as find ways to facilitate efforts to do so. This could have the combined effect of improving the quality of data generated by volunteer groups, in addition to letting them know that their efforts are important to IDEM. Examples of how this might be achieved include notifying volunteer monitors when IDEM staff will be sampling in their area, in order to gain insight from said volunteers and perhaps have the opportunity to demonstrate and motivate good sampling techniques. IDEM staff could also, as suggested earlier, assist in training volunteers and discuss/illustrate the incorporation of good QA/QC methods into their sampling regimes.

Both of these approaches, conducted in tandem, could help overcome many barriers that have kept IDEM from making the best possible use of the extensive volunteer monitoring efforts already in existence around the state, and would build bridges of collaboration between the Agency and the public it serves. As pointed out earlier, the benefits to be gained by using external data and promoting stewardship are worthy endeavors warranting the investment of resources on the part of IDEM. As resources become available in the future, the items outlined here should receive the greatest consideration by staff in order for volunteer monitoring data to be successfully incorporated into IDEM's monitoring, assessment, and other programs. Stated again, these include working to update volunteer monitoring protocols; create better coverage; improve the quality of volunteer-collected data; better analyze, report, and display volunteer data; and continue efforts to build rapport with various groups and the public as a whole. This could feasibly be accomplished by providing technical and financial assistance, acting as a

clearinghouse for data and information, conducting or assisting with meetings and training, loaning equipment, and providing feedback and recognition.

Indiana has already shown that volunteer monitoring programs can collect and report data of the quality required for use by the State. Since 1989 IDEM has been financially supporting, receiving, assessing, and reporting on data collected by citizens in the Indiana Volunteer Lake Monitoring Program. Begun as an effort to educate lake homeowners and users, and allow for trend analysis and an early warning system to lake water quality problems, this data may now prove valuable in understanding and properly incorporating EPA's newly-released nutrient criteria into the State's water quality standards.

The Indiana Department of Natural Resources (IDNR) is beginning to have the same success with its Hoosier Riverwatch stream-monitoring program. Both of these State-sponsored programs benefited from the combined rapport-building, education-promoting, and data-enhancing efforts that occurred during staff involvement with the afore-mentioned CRAWDAD alliance.

In summary, while no single entity could ever expect to have all of the resources needed to fully tackle the environmental needs around it, an outlay of even one staff person benefited IDEM. Devoting even minimal resources towards enhancing volunteer monitoring programs could be expected to provide even greater payoffs in terms of better assessing and targeting efforts towards the state's water resources. The same could be said of incorporating and using third party data (that collected by IDNR, USGS, USACE, and local agencies like Muncie's Bureau of Water Quality). IDEM could better target its investigative, restorative, and protective resources by relying on high quality data collected by other professional water quality agencies. Such collaborative efforts may someday be the rule rather than the exception when it comes to fulfilling the Agency's mandate to assess State waters.

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IV. Discussion and Summary

The purpose of the *Strategy* is to direct the surface water quality assessment of Indiana's rivers, streams, and lakes for designated uses. Implementation of the *Strategy* is used as a tool to accomplish the overarching goal of improving the services provided by the Office of Water Quality. Many staff meetings and discussions have been held during the period of December 2000 – February 2001 to improve staff coordination within the Office of Water Quality.

The *Strategy* focuses on a holistic watershed approach for addressing and prioritizing water quality issues. The watershed approach was used in the original monitoring strategy that was implemented in 1996 and it was formally recognized by OWQ in 1998 as the best and most appropriate way of doing business. Since then, a process of evaluating program elements in a watershed manner was implemented so that the various program areas collaborate with each other in support of the federal and state mandates. These mandates include the 305(b) water quality report to Congress, 303(d) TMDL Program, National Pollutant Discharge Elimination System (NPDES) permitting program, annual Fish Consumption Advisory, and drinking water source protection of the SWDA (1996).

At the heart of the *Strategy* is the utilization of a five-year rotation study cycle of all major river basins in the state. Why use a rotation strategy? Five years after implementing our *Strategy*, nearly 100% (less the Ohio River and Lake Michigan) of the State's surface waters have been assessed, and it can be predicted with reasonable certainty what percentage of our rivers and streams are impaired. All counties and watersheds have been visited and the collected data can be used to make statistically valid statements about the water quality. Furthermore, by using a probabilistic method to determine what waters are sampled, future predictions on whether the water quality is improving or not improving can be made. This, indeed, is a strong statement.

The rationale for revising our basic strategy in 1998 was lack of adequate staff resources. The original strategy assumed that there would be 43 positions to implement the proposed strategy. When this did not occur by 1997, the SWQMS was modified to fit what could be done with available staff. Other reasons for revising the strategy were: 1) the need to develop more wasteload allocations for the NPDES permitting program in reducing the huge backlog of municipal and industrial permits; 2) establishment of the TMDL Program; 3) source water protection considerations for the amended SDWA; and 4) special investigative work in support of compliance activities.

Coordination of all watershed activities is imperative to achieving success in reducing pollutants that enter our state's waters. Extra efforts have recently been made to work closer with OWQ's Watershed Management Section, Water Quality Standards Section, Municipal & Industrial Permitting Sections, and the Drinking Water Branch.

Challenges facing the Assessment Branch in successfully implementing this *Strategy* include establishing and ramping up the TMDL Program, bridging the data gap for 305(b) report and the 303(d) list of impaired waters, implementing the Assessment Information Management System (AIMS), and finding sufficient personnel to adequately staff priorities.

The TMDL Program has 8 personnel and relies on contractors to do the bulk of TMDL development. Last year (2000), the size of the staff was increased from 2 to 8; and, as with any start up, considerable time was devoted to training staff and acquiring supplies, equipment, and vehicles. The TMDL program is off to a good start, having submitted and received U.S. EPA approval for the first effort, the Kokomo Creek TMDL.

The AIMS database is in developmental stages and will be implemented as data are imported from old, existing databases. It is hoped that this project will be successfully implemented and debugged in late 2001. When this project is complete, much of our data will be electronically entered into the database system and our dependence on using paper records and standalone systems will diminish substantially.

Exploring ways to bridge the data gap from probabilistic sampling for 305(b) water quality report to developing the 303(d) impaired waters list requires added personnel above the current staffing levels. Several alternatives were discussed to obtain sufficient data to better answer questions and supply site-specific locations for TMDL preparation. All examined alternatives require additional staff regardless of option or approach.

The ideal program, of course, would be able to sample everywhere all the time, but this would be mismanagement as well as cost prohibitive. Because this is not feasible, a program that would yield general information about all waters in a watershed and also reveal specific information about as many selected sites as feasible would be the next best alternative. A large number of probabilistically (random and unbiased) located sampling sites within a watershed would provide the desired information. To this end, a pilot project for source identification was conducted with great promise in 2000 and will be continued on a limited basis in 2001 and beyond. Another pilot project seeking site-specific data at the 14-digit HUC level will be tested when adequate staff resources are available. In addition, results of the Paired Study (randomly selected site with a nearby bridge) appear to produce a savings in time which translates into being able to sample more watershed sites. These alternatives plus others will be used in the future to help bridge the data gap for the 305(b) water quality report and the 303(d) list of impaired waters.

On March 13, 2001, the US EPA released a preliminary draft of requirements of an adequate state ambient water monitoring program. The purpose of this document is to better define the elements of an adequate state water monitoring program for purposes of Section 106(e)(1) of the Clean Water Act. Ten required elements were identified. Except for including groundwater and wetlands as monitoring objectives and examination of core indicators plus programmatic evaluation (i.e., how results are to be reported to customers), this *Strategy* fulfills US EPA's draft model. Indiana must submit to Region 5 a monitoring program strategy that addresses the ten elements no later than September 30, 2002. Thus, the intent of IDEM-OWQ is to adopt this *Strategy* and to begin work revising it to meet the new US EPA guidelines by fall 2002.

V. References

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VI. Acknowledgements

Planning and preparation of this SWQMS document involved the work and cooperation of many individuals. Sub-committee members are staff assigned to the Water Quality Assessment Branch unless otherwise noted. Listed below are the SWQMS Sub-committee Assignments and names of those who participated in the preparation and production of this document.

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Appendix A

Maps of Sampling Programs

Biological Studies Section

Fish Community Monitoring Program
Fish Tissue Contaminant Monitoring Program
Macroinvertebrate Community Assessment Program

Environmental Toxicology and Chemistry Section

TMDL Program

Surveys Section

Watershed Monitoring Program
Pesticides Monitoring Program
Fixed Station Surface Water Quality Program
Synoptic Program & Source ID Program
E. coli Monitoring Program
Special Sampling Projects

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Appendix A

Biological Studies Section Maps

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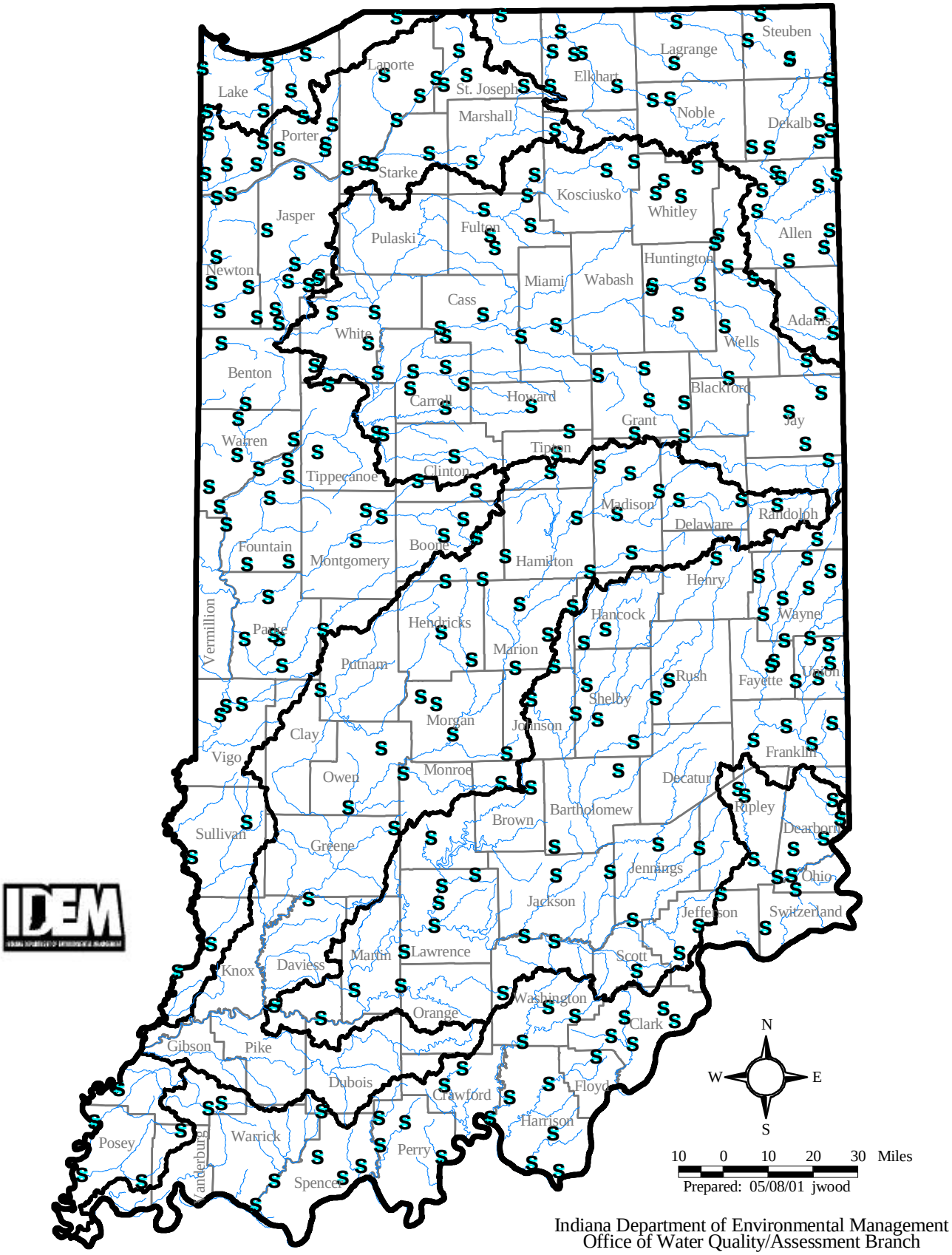
Fish Community Monitoring Program

1996 - 2000



Indiana Department of Environmental Management
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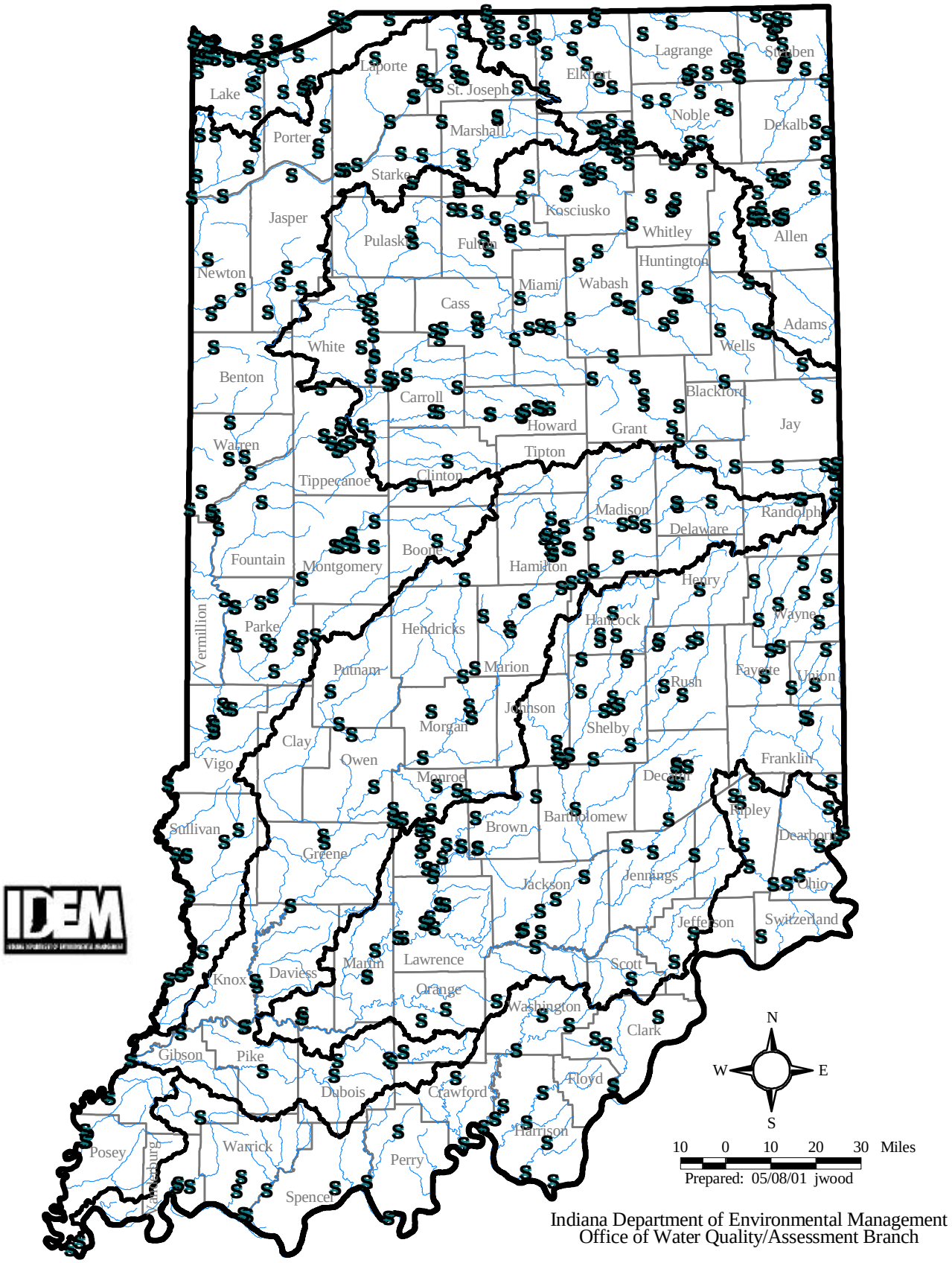
Fish Tissue Contaminant Monitoring Program

1983 - 2000



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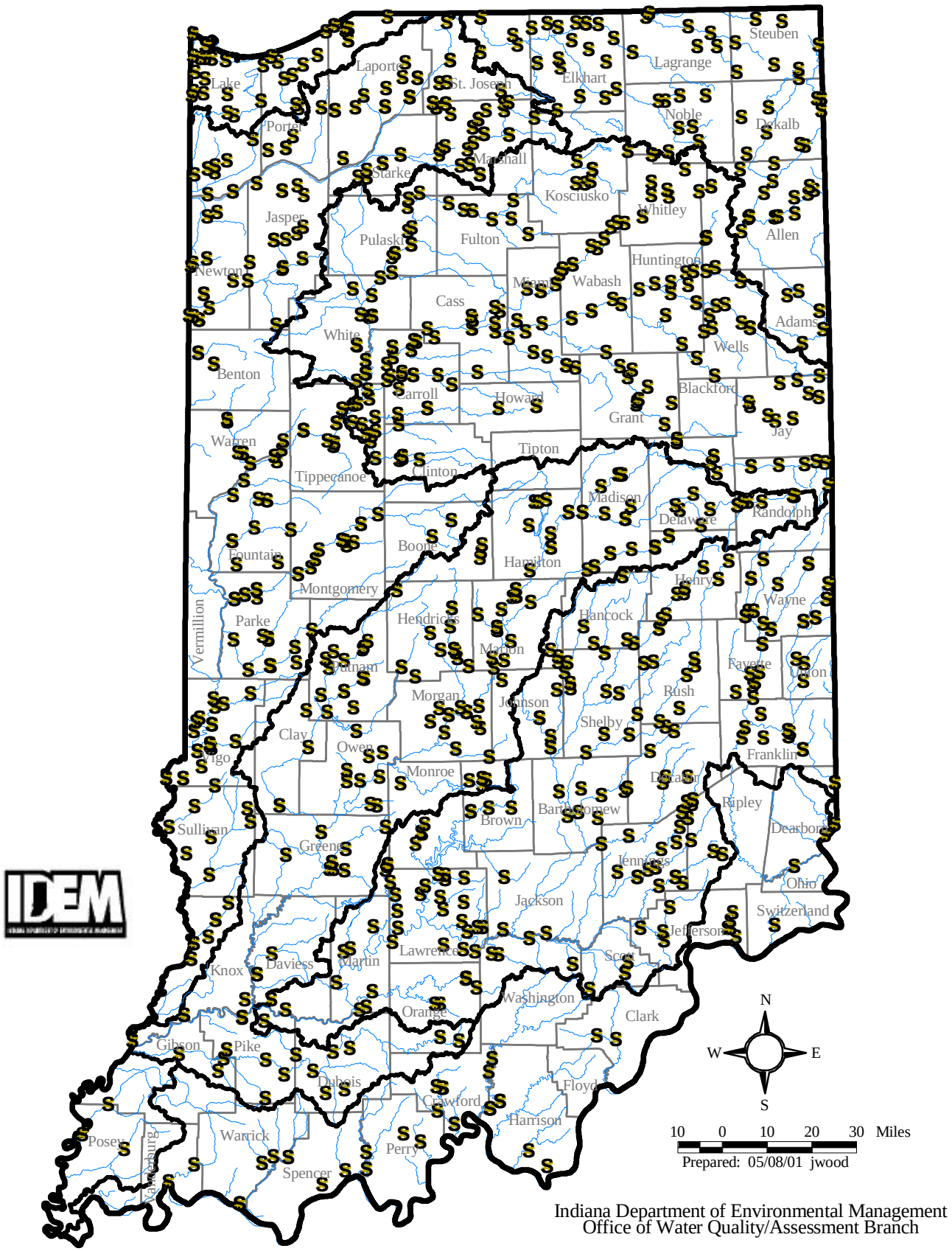
Macroinvertebrate Community Assessment Program

1990 - 2000



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Appendix A

Environmental Toxicology and Chemistry Section Maps

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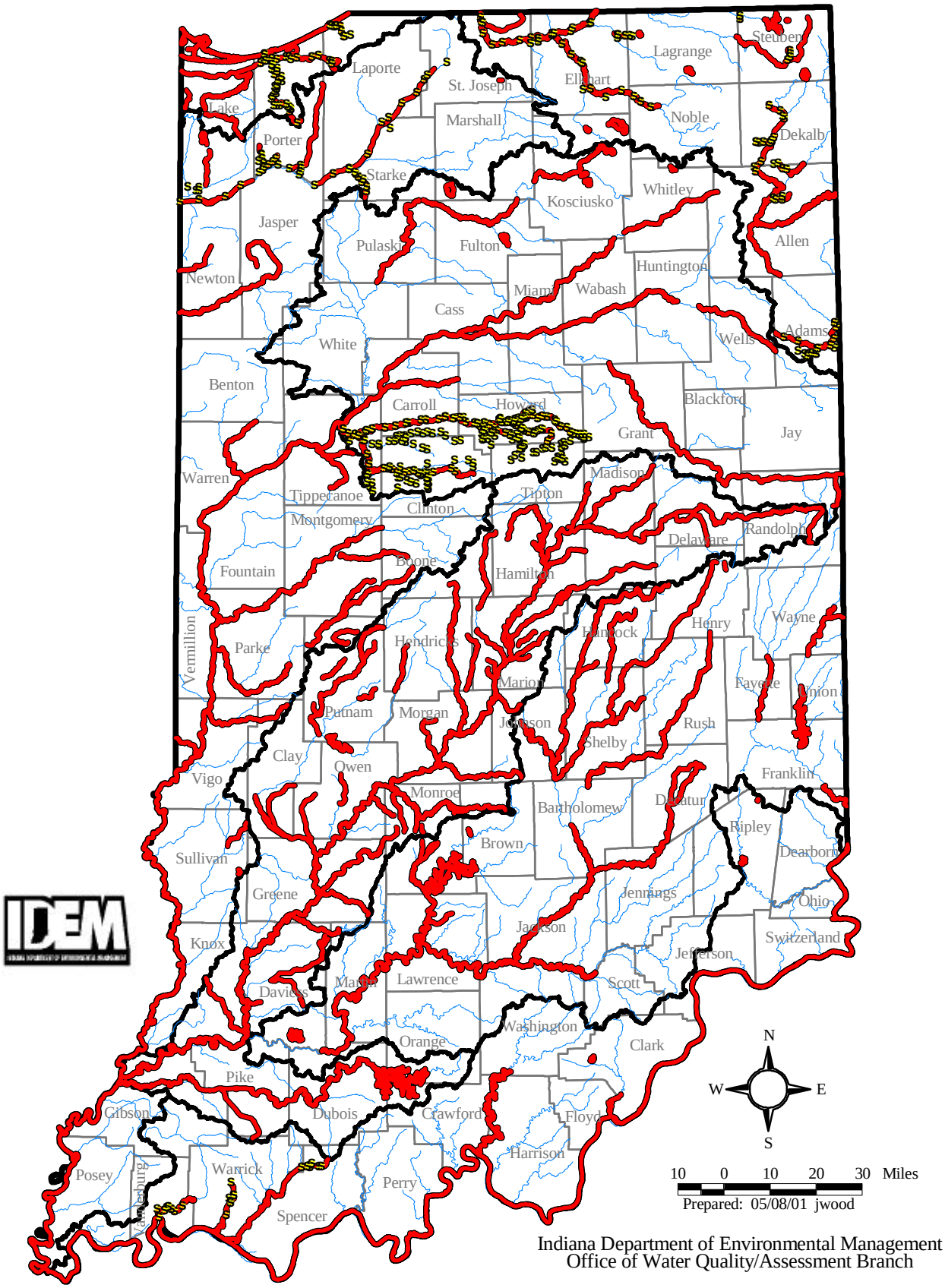
TMDL Program

1998 303(d) List of Impaired Water Bodies
Sampling Activities from Wildcat Creek Pilot Project and Year 2000 of 5-Year Cycle



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Appendix A

Surveys Section Maps

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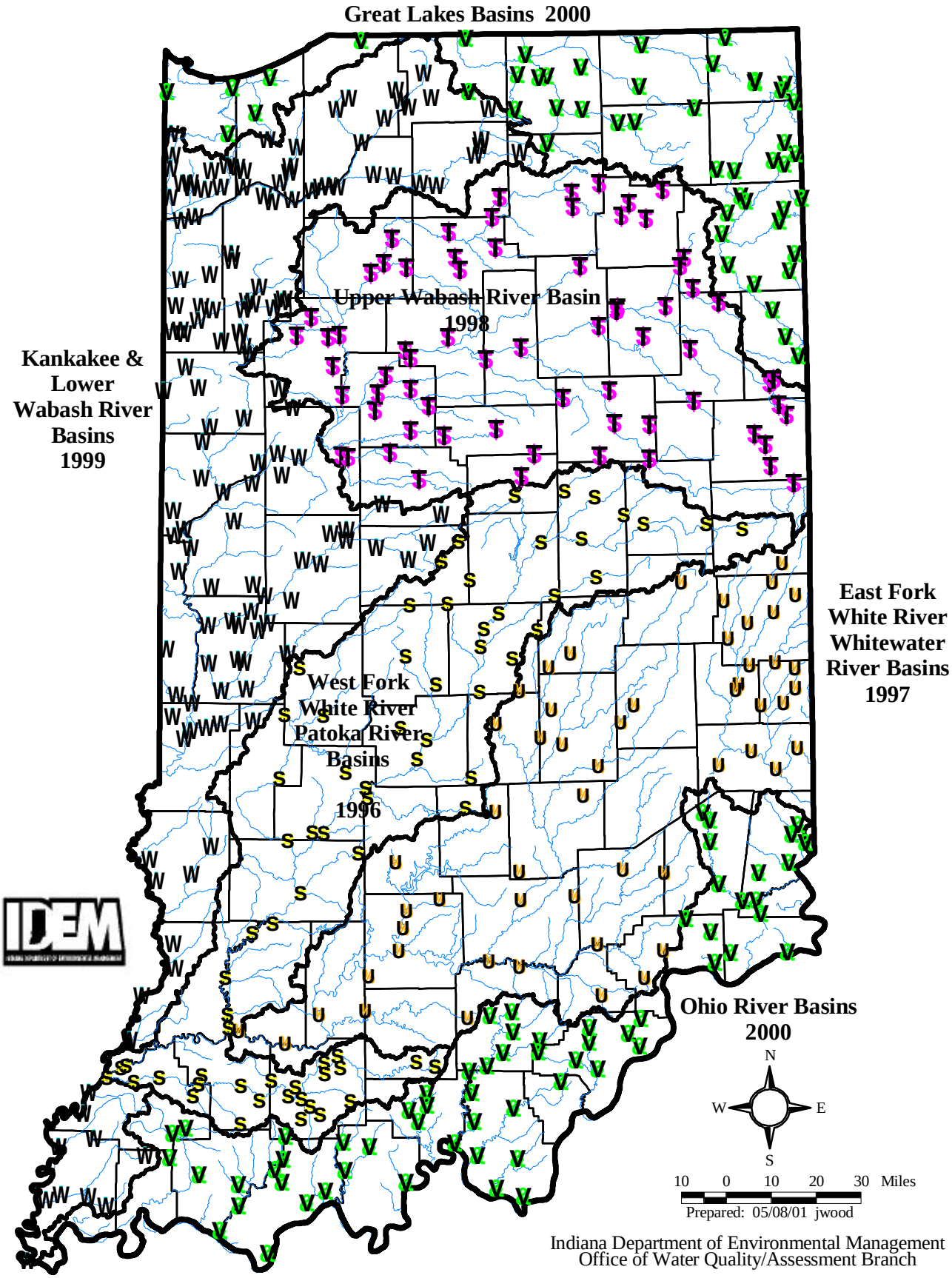
Watershed Monitoring Program



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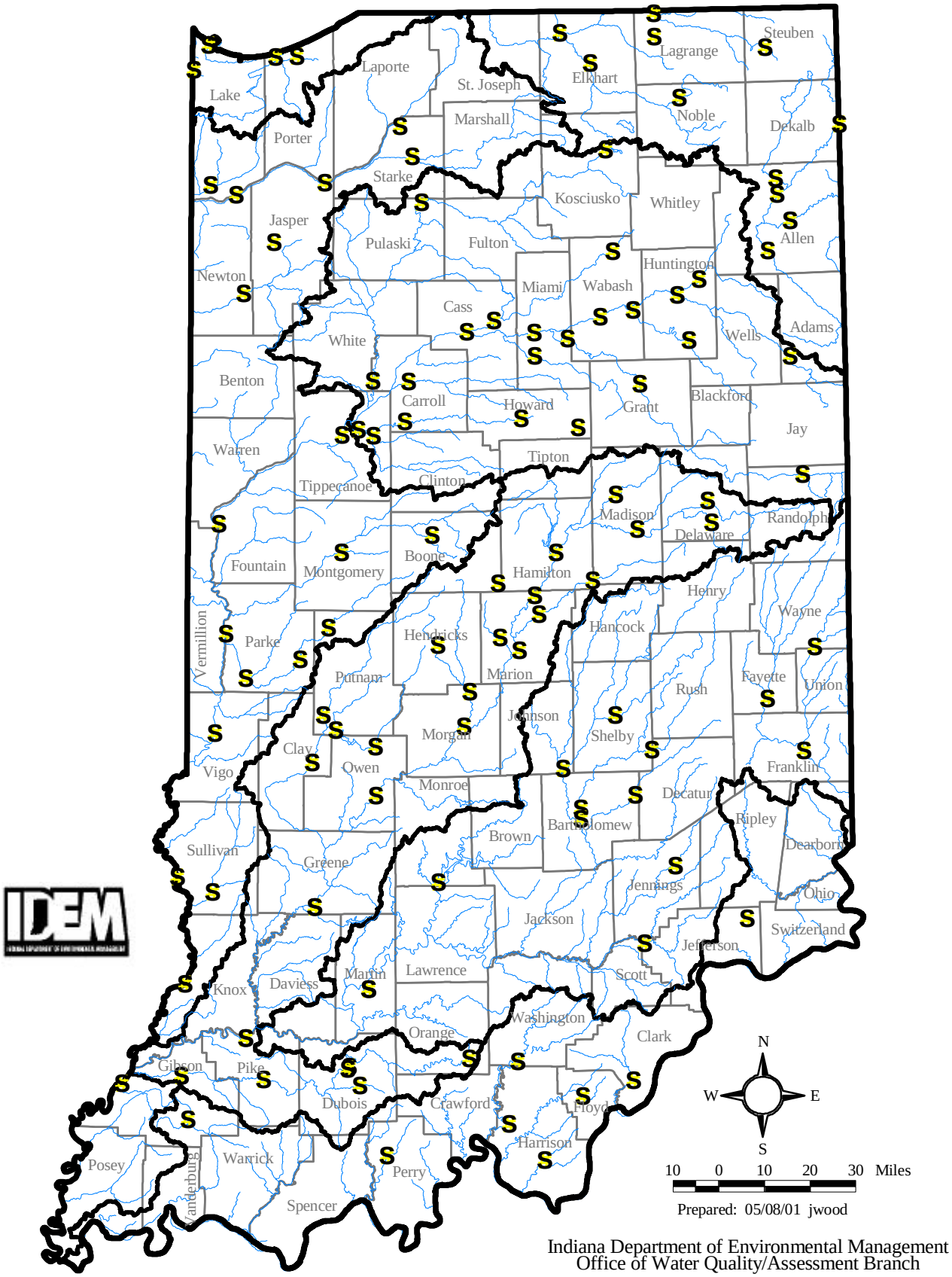
Pesticides Monitoring Program

1997 - 2001



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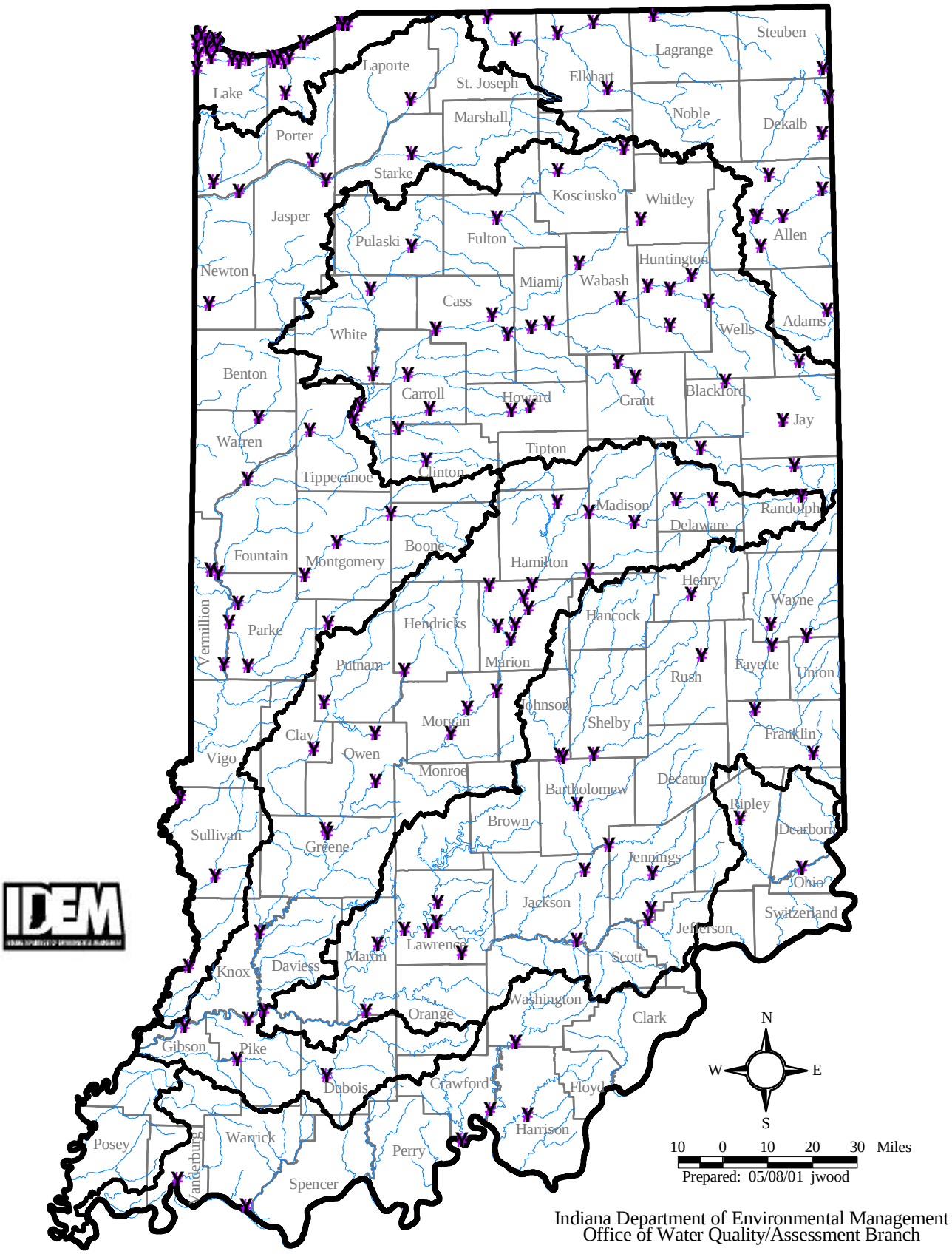
Fixed Station Surface Water Quality Program

Monthly Monitoring Sites 1999 To Present



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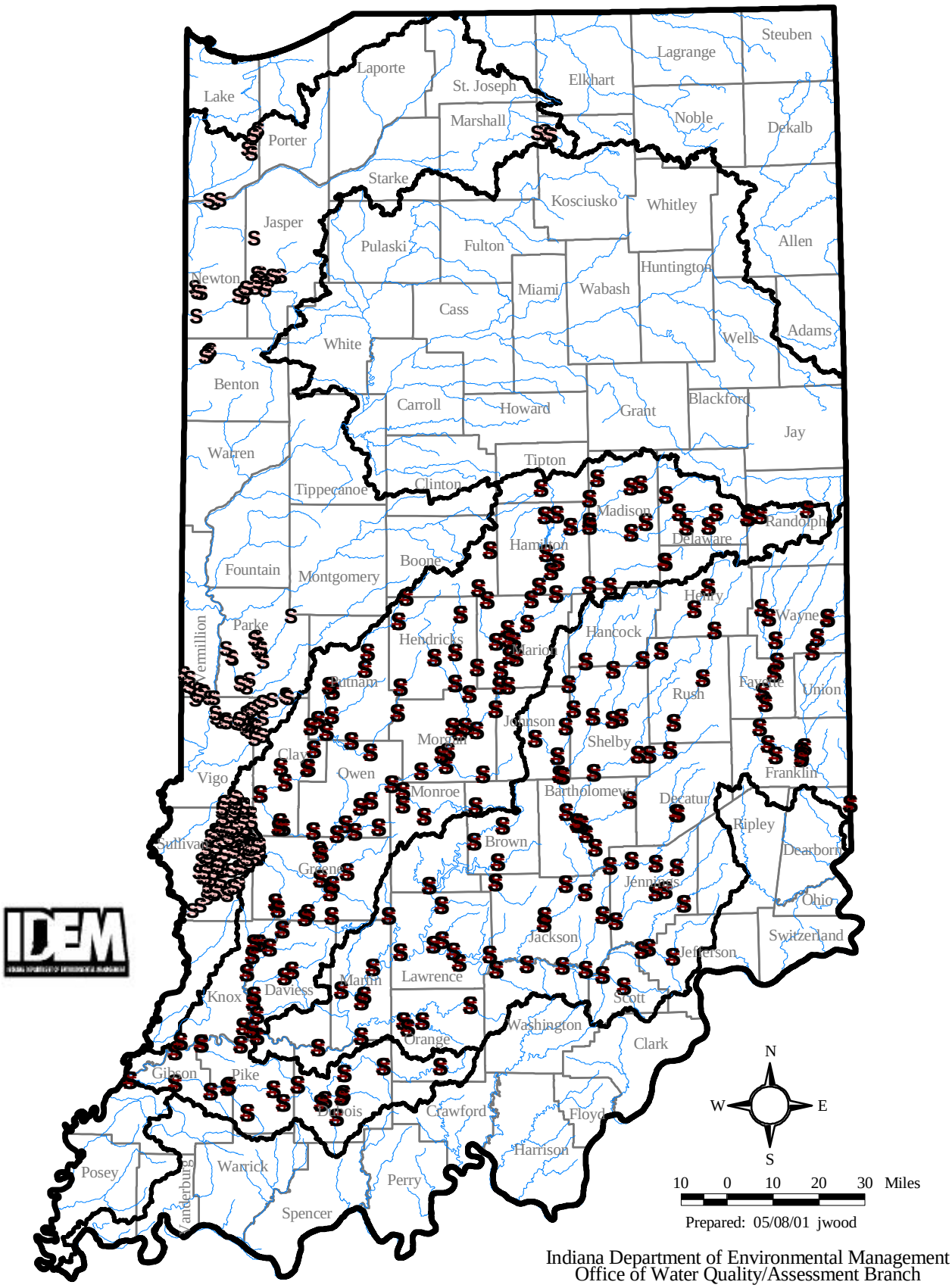
Synoptic Program & Source ID Activities

Synoptic Sampling 1996 - 1997 & Source ID 2000



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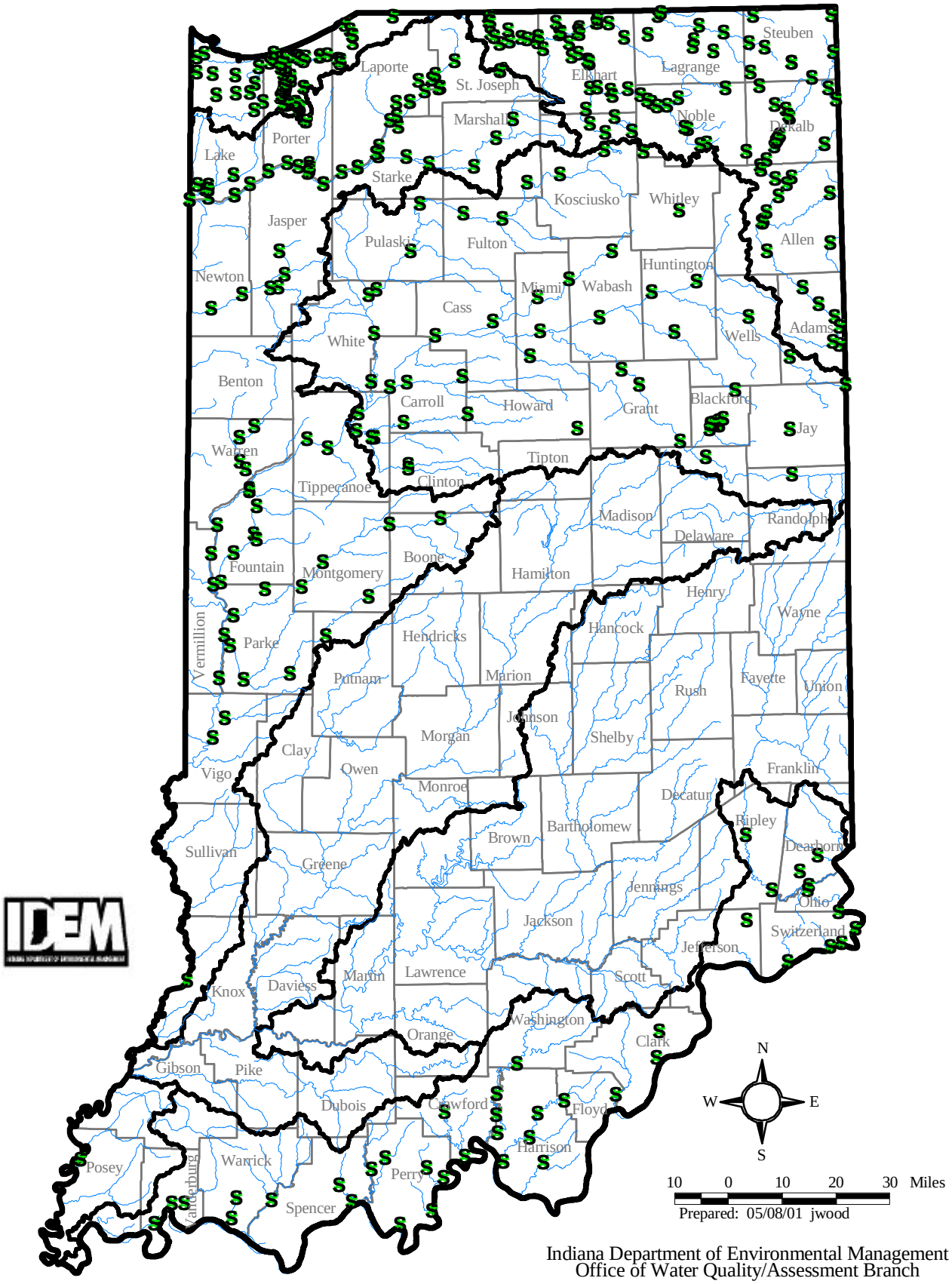
E. coli Monitoring Program

1998 - 2000



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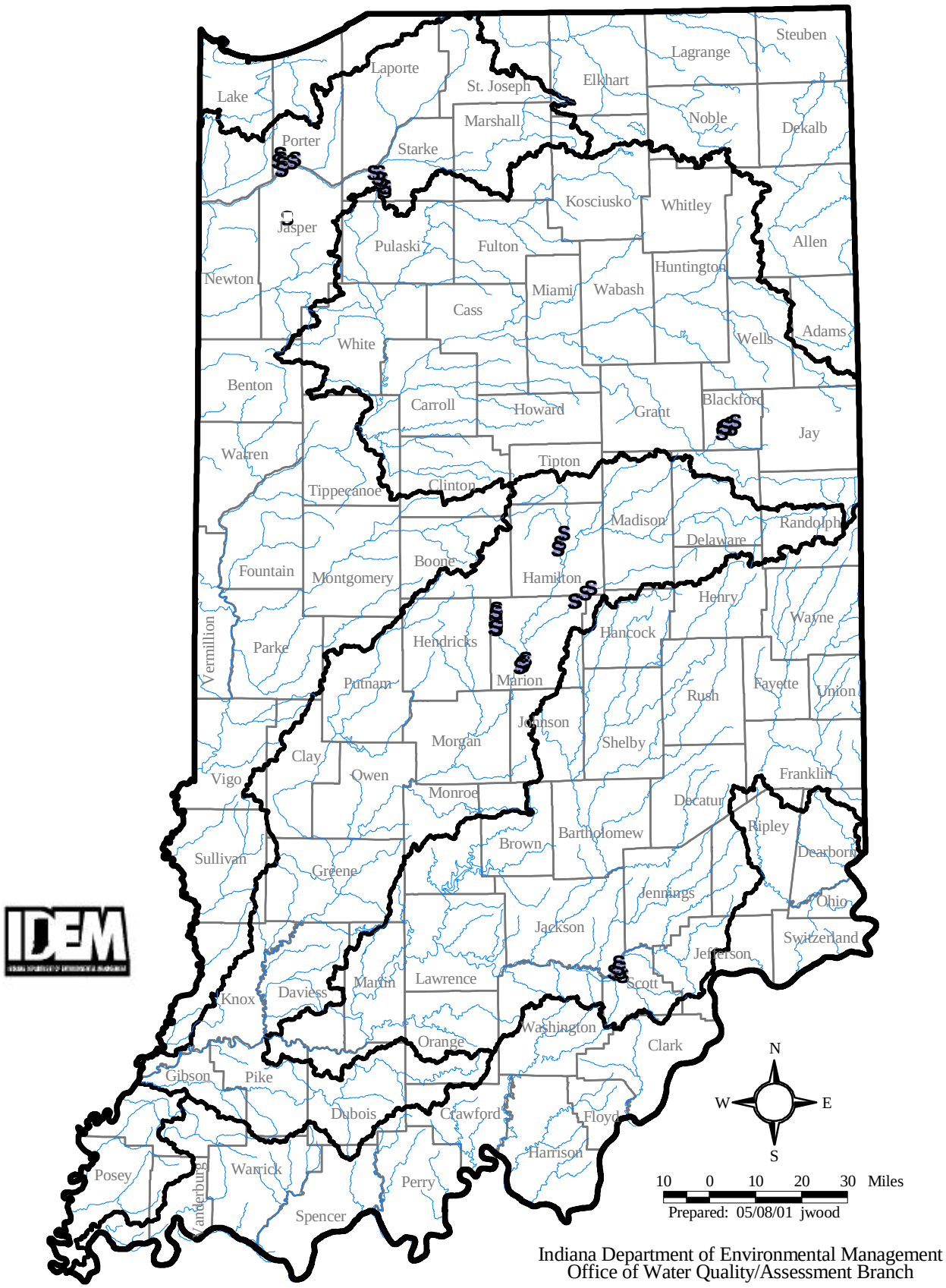
Special Sampling Projects



Indiana Department of Environmental Management
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Appendix B

Fact Sheets

Assessment Branch

Surface Water Quality Monitoring Strategy	IDEM 32/01/016/1998	Rev March 2001

Biological Studies Section

Fish Community Sampling Program	IDEM 32/01/004/1998	Rev January 2001
Fish Tissue Contaminant Monitoring Program	IDEM 32/01/005/1998	Rev April 2001
Biological Studies Section	IDEM 32/01/006/1998	Rev March 2001
Macroinvertebrate Community Assessment Program	IDEM 32/01/007/1998	Rev March 2001
Sediment Contaminant Monitoring Program	IDEM 32/01/008/1998	Rev March 2001
Lake Water Quality Assessment	IDEM 32/01/009/1998	Rev February 2001
Fish Tissue Contaminant Monitoring Program	IDEM 32/01/021/2001	April 2001
Fish Consumption Risk Assessment	IDEM 32/01/024/2001	April 2001

Environmental Toxicology and Chemistry Section

Environmental Toxicology and Chemistry Section	IDEM 32/01/003/1998	Rev March 2001
TMDL Program	IDEM 32/01/018/1999	Rev March 2001
Quality Assurance Project Plan for Indiana Surface Water Programs	IDEM 32/01/023/2001	February 2001

Surveys Section

Watershed Monitoring Program	IDEM 32/01/001/1998	Rev February 2001
Pesticide Monitoring Program	IDEM 32/01/002/1998	Rev February 2001
Fixed Station (Ambient) Monitoring Program	IDEM 32/01/012/1998	Rev March 2001
Surveys Section	IDEM 31/01/015/1999	Rev February 2001
Synoptic Sampling Program	IDEM 32/01/017/1998	Rev March 2001
E coli Monitoring Program	IDEM 32/01/019/1999	Rev March 2001
Source Identification Monitoring Program	IDEM 32/01/020/2001	February 2001
Trace Metals	IDEM 32/01/022/2001	March 2001

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Appendix B

Assessment Branch Fact Sheets

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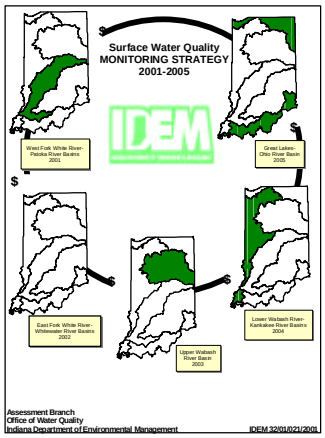
IDEM=s Surface Water Quality Assessment Program

Surface Water Quality Monitoring Strategy

Program Objective

The purpose of Office of Water Quality's (OWQ) Surface Water Quality Monitoring Strategy (the *Strategy*) is to direct the assessment of the quality of surface waters of Indiana=s rivers, streams, and lakes for designated water uses. The strategy is designed to provide technical data and information in support of the biennial 305(b) Water Quality Report, National Pollutant Discharge Elimination System (NPDES) permitting program, and the annual Fish Consumption Advisory. In addition, the implemented strategy provides water quality information to identify activities responsible for impairment, analyze water quality trends, and develop environmental indicators.



The State is divided geographically into major units for environmental sampling, analysis, and assessment with the goal of completing an initial survey of the State during the five year period of 2001-2005:

- West Fork White River and Patoka River Basins in 2001;
- East Fork White River and Whitewater River Basins in 2002;
- Upper Wabash River Basin in 2003;
- Lower Wabash River and Kankakee River Basins in 2004; and
- Great Lakes and Ohio River Basins in 2005.

Data collected from field sampling is analyzed for physical, chemical, and biological factors. For example, specific physical properties of water sampled may indicate a decrease in quality or quantity of habitat in the event of an environmental stress. Specific chemical responses to stress may imply elevated concentrations in fish tissue and sediment. Specific ecosystem factors may result in impaired biological communities.

The Office of Water Management=s (OWM) field sampling strategy is designed to describe the overall environmental quality of each basin and to identify impaired water bodies that do not meet water quality standards. Elements of the sampling program include: fixed station monitoring; sampling from statistically selected sites; fish community, fish tissue, and sediment contaminant sampling programs; pesticide monitoring; bacteriological (*E. coli)* sampling; macroinvertebrate sampling; site specific sampling in support of NPDES permitting program; and special projects such as trace metals, Total Maximum Daily Loads (TMDL) sampling, Wildcat Creek Pilot Project, and monitoring of the White River in Marion County.

College students from the Governor=s Public Service Internship Program are used each summer to assist the Assessment Branch in field sampling operations. Volunteer monitoring will be employed to supplement existing IDEM staff whenever applicable.

The water quality data will be collected, analyzed, and assessed with information published in multiple formats to be used by a variety of customers. OWM=s internal program support activities include: 305 (b) Water Quality Report; 303 (d) Impaired Water Bodies List; TMDL determinations; and NPDES permits. External uses of monitoring data and information include: the annual Fish Consumption Advisory; the IDEM-U.S. EPA Environmental Performance Partnership Agreement; Northwest Indiana Remedial Action Plan; and the Wildcat Creek Watershed Pilot Project. Access to collected data and information will be provided to the public upon request and via the Internet.

Program Participants

This program is operated through the efforts of the OWM Assessment Branch with collaboration with the staff from the Watershed Planning Section (formerly known as the Nonpoint Source Section) and the Permitting Branch. The Fish Consumption Advisory is produced in conjunction with the Indiana Department of Health and the Indiana Department of Natural Resources.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	See fact sheets listed in Program Products section
Sampling Sites:	See fact sheets listed in Program Products section
Sampling Frequency:	See fact sheets listed in Program Products section
Data Collected:	See fact sheets listed in Program Products section

Program Product(s)

- Report: *Surface Water Quality Monitoring Strategy* - revised, IDEM 32/01/013/1998 rev. 2001
- Fact Sheet: *Assessment Branch*, IDEM 32/01/014/1998 rev. 2001

Biological Studies Section

- Fact Sheet: *Biological Studies Section*, IDEM 32/01/006/1998 rev. 2001
- Fact Sheet: *Fish Community Sampling Program*, IDEM 32/01/004/1998 rev. 2001
- Fact Sheet: *Fish Tissue Contaminant Monitoring Program*, IDEM 32/01/005/1998 rev 2001
- Fact Sheet: *Macroinvertebrate Community Assessment Program*, IDEM 32/01/007/1998 rev.2001
- Fact Sheet: *Sediment Contaminant Monitoring Program*, IDEM 32/01/008/1998 rev 2/2001
- Fact Sheet: *Lake Water Quality Assessment*, IDEM 32/01/009/1998 rev 2/2001

Environmental Toxicology and Chemistry Section

- Fact Sheet: *Environmental Toxicology and Chemistry Section*, IDEM 32/01/003/1998 rev. 2001
- Fact Sheet: *TMDL Monitoring Program*, IDEM 32/01/018/1999 rev. 2001

Program Product(s) B continued

Surveys Section

- Fact Sheet: *Watershed Monitoring Program*, IDEM 32/01/001/1998 rev. 2001
- Fact Sheet: *Pesticide Monitoring Program*. IDEM 32/01/002/1998 rev. 2001
- Fact Sheet: *Fixed Station Sampling Program*, IDEM 32/01/012/1998 rev. 2001
- Fact Sheet: *Surveys Section*, IDEM 32/01/015/1998 rev. 2001
- Fact Sheet: *Synoptic Sampling Program*, IDEM 32/01/017/1998 rev. 2001
- Fact Sheet: *E. coli Monitoring Program*, IDEM 32/01/019/1999 rev. 2001
- Fact Sheet: *Source Identification Program*, IDEM 032/01/02/2001
- Fact Sheet: *Trace Metals Project*, IDEM 032/01/022/2001

Technical Notes

Please read the fact sheets listed in the Program Products section.

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Appendix B

Biological Studies Section Fact Sheets

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IDEM=s Surface Water Quality Assessment Program

Fish Community Sampling Program

Program Objective

The objective of this program is to assess water quality using resident fish communities as a tool to monitor the biological integrity of a stream. This type of monitoring aids in the classification of streams that exhibit very poor to excellent water quality conditions as well as habitat availability and quality. Because most fish have a life span of greater than three years fish community monitoring can detect areas of degradation that have occurred over an extended period of time. Fish community sampling is an integral part of the Watershed Based Monitoring Program (see the *Watershed Monitoring Program* fact sheet, IDEM 32/01/001/1998 for details on this program).

Program Participants

This program is operated through the efforts of the Biological Studies Section with the aid of citizens, local governments, the Indiana Department of Natural Resources, U.S. Fish and Wildlife Service, and U.S. Environmental Protection Agency (USEPA) Region 5, Chicago, Illinois, and USEPA National Health and Environmental Effects Research Laboratory, Corvallis, Oregon.

Program Description

Media:	Surface waters; rivers and streams
Study Area:	Statewide
Site Selection Type:	Various methods; Historically, from bridges that offered easy access to the sampling locations. Areas with obvious degradation were avoided if possible. The focus of study was based on Ecoregions (Omernik and Gallant 1988). Currently, sites are selected randomly (probabilistic design) from within major watershed boundaries. An attempt is made to sample all sites within the watershed regardless of degradation. The focus of study is based on major watersheds delineated by U.S. Geological Survey, Hydrologic Unit Codes.
Sampling Sites:	30-50 sampling sites per watershed, one or two watersheds per year.
Sampling Frequency:	Once per site, 10 percent (approximately 3-5) of the sites per watershed basin are sampled again within the same year to account for field technique accuracy.
Data Collected:	Fish community Index of Biotic Integrity (IBI), habitat information using the Ohio Environmental Protection Agency's Qualitative Habitat Evaluation Index (QHEI), and in-situ water chemistry.

Program Product(s)

- Provide information for the Section 305(b) report
- Support for Section 303(d), list of impaired waters
- Technical reports on fish community trends and assessments
- Aid in the development of criteria for biological integrity
- Support the Environmental Performance Partnership Agreement (EnPPA)
- Cooperation and corroboration with program participants on issues of scientific importance

Technical Notes

The Index of Biotic Integrity (IBI) is used to calculate the results of fish community data. The IBI is composed of 12 metrics that assess the communities species and trophic composition (feeding and reproductive guilds) and fish condition and health. The total IBI score, integrity class and attributes help define fish community characteristics (see chart below). When fish community data (IBI) is plotted against habitat data (QHEI) areas of impairment, as well as areas with excellent water quality and habitat, become clear.

Total IBI Score	Integrity Class	Attributes
58-60	Excellent	Comparable to pristine conditions, exceptional assemblage of species.
48-52	Good	Decreased species richness, intolerant species in particular: sensitive species present.
40-44	Fair	Intolerant and sensitive species absent; skewed trophic structure.
28-34	Poor	Top carnivores and many expected species absent or rare: omnivores and tolerant species dominant.
12-22	Very Poor	Few species and individuals present; tolerant species dominant; diseased fish frequent.
	No fish	Repeated sampling finds no fish.

Karr et al., 1986.

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IDEM=s Surface Water Quality Assessment Program

Fish Tissue Contaminant Monitoring Program

Program Objective

The object of this program is to provide information on chemical contaminants that may be accumulating in the tissues of fish. This type of monitoring helps to locate sources of contaminants whose concentrations in other environmental media (such as water) are often too low to be easily found with routine sampling and laboratory procedures. The fish tissue contaminant monitoring program provides the majority of data used for Indiana's Fish Consumption Advisories (FCA) for the protection of consumers of sport caught fish. In addition this information can be used for wildlife health risk assessments for fish-eating birds and mammals; and to provide information needed to develop models to assess changes in Indiana waters that affect aquatic life and human health.

Program Participants

The Biological Studies Section of the Assessment Branch, Office of Water Quality, operates this program. Contract laboratory services are utilized for contaminant levels determination. Decisions on fish consumption advisories are made through an Interagency Workgroup consisting of participants from IDEM, the Indiana State Department of Health (ISDH), and the Indiana Department of Natural Resources (IDNR). Fish consumption advisories are issued through the ISDH.

Program Description

Media:	Fish from the surface water of rivers, streams, reservoirs and lakes
Study Area:	Statewide
Site Selection Type:	Historically, a targeted site selection based on need for information, follow-up monitoring, or regular biennial revisits. Program is also now implementing a fish tissue collection portion into the stratified probability based sampling program of the Surface Water Quality Monitoring Strategy (see Fact Sheet *Watershed Monitoring Program)* to better understand basin wide and regional contaminant levels and trends.
Sampling Sites:	Continued targeting of sites on rivers, lakes, and reservoirs; emerging problem areas of the state; and water bodies never before monitored; regular revisit to 20 designated CORE river locations and near shore Lake Michigan; based on a probabilistic draw in wadable streams (see Fact Sheet *Watershed Monitoring Program)*.
	Sampling Frequency: 5 year basin rotations for entire State (see : ***http://www.state.in.us/idem/owm/assessbr/master_swqms7.pdf***)
Data Collected:	Chemical contaminant levels in fish flesh

As a member of the Ohio River Valley Water Sanitation Commission (ORSANCO), Indiana contributes in giving ORSANCO the responsibility of monitoring fish tissue contaminants in the Ohio River.

As a Great Lakes State, Indiana also participates in the annual Great Lakes Fish (tissue) Monitoring Survey in southern Lake Michigan sponsored by the Great Lakes National Program Office (GLNPO) U.S. Environmental Protection Agency (U.S. EPA). This is the 21st year of Indiana=s participation in this program. In alternating years coho and chinook tissue samples are collected by IDNR for tissue contaminant analysis. A lab selected by GLNPO analyzes these samples. The results are reported by GLNPO to the participating states.

Indiana continues to participate in a four year National Study of Chemical Residues in Lake Fish Tissue. The U.S. EPA Office of Science and Technology (OST) is coordinating this national effort. It utilizes a probability based survey design (random selection) to select lakes for sampling. Its objective is to estimate the national distribution and extent of the average levels of some of our most common persistent bioaccumulative chemicals in fish tissue from lakes and reservoirs of the continental United States. The design to be used in this study is based on designs developed by the Environmental Monitoring and Assessment Program (EMAP) of U.S. EPA (see: ***http://www.epa.gov/emap/***). A number of specific questions will be addressed in the sample design. Field collections for this project are expected to take four years. Indiana has eleven lakes identified for sampling, which will be spread over the four years as determined by the sampling design. The U.S. EPA will pay all laboratory costs.

Program Product(s)

- *Indiana=s Fish Consumption Advisory*.
- Use support designations of Indiana waters for Section 305(b) Report
- Assessments for Section 303(d) List of Impaired Waters in Indiana.
- Periodic technical reports on contaminant levels and trends.
- Support of the Environmental Performance Partnership Agreement (EnPPA) between Indiana and U.S. EPA.
- Support of Indiana=s Remedial Action Plan for the Northwest Indiana Area of Concern.
- Support of the Lake Michigan Lakewide Area Management Plan.

Technical Notes

Contaminants analyzed for includes a number of metals (23) including cadmium, lead, and mercury, organochlorine pesticides (27) such as DDT, chlordane, and dieldrin, and total polychorinated biphenyls (PCBs). Additional contaminants such as polycyclic aromatic hydrocarbons (PAHs) (18), semivolatile (47), volatile (33) compounds, congeners of PCBs and dioxins, and tributyl tin may be analyzed for when industrial, municipal, and/or other source pollution is suspected.

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IDEM=s Surface Water Quality Assessment Program

Biological Studies Section

Program Objective

The Biological Studies Section (BSS) conducts ecological assessments of Indiana surface waters, providing its customers direct measurement of environmental quality and information on any changes over time of this quality. The assessment of environmental quality involves the direct and indirect measurements of numerous parameters within several media of the environment including: chemical analysis of specific water quality parameters, chemical analysis of surficial aquatic sediments, measurement of fish tissue contamination, acute and chronic toxicity of National Pollution Discharge and Elimination System (NPDES) effluents, aquatic habitat quality, fish community impairment, invertebrate community impairment, and lake eutrophication levels. The role of the BSS relative to these environmental media and the environmental indicators that we provide our customers are outlined in Table I.

The Biological Studies Section conducts studies of fish and macroinvertebrate communities, as well as stream habitats, to establish biological criteria to which all other streams may be compared in order to identify impaired streams or watersheds. This Section also conducts fish tissue and sediment sampling to monitor sources of toxic and bioconcentrating substances whose concentrations are often too low to be detected in other environmental media. Fish tissue data serve as the basis for fish consumption advisories which are issued to protect the health of those who consume fish caught in Indiana waters. Fish tissue data are also useful for wildlife health risk assessments for fish-eating birds and mammals, and for providing the information needed to develop models for assessing changes in the quality of Indiana ecosystems.

The BSS is responsible for determining the biological integrity of aquatic communities of Indiana streams and lakes. This is accomplished through a variety of field and laboratory studies that involve several different forms of aquatic life. These data are used to determine compliance with the existing narrative biological criteria in Indiana's current water quality standards, to determine the extent of ecological harm, and to make correlations to physical and/or chemical impairments which may occur.

The Section also oversees lake monitoring efforts conducted under contract by staff and students of the Indiana University School of Public and Environmental Affairs, as well as by a corps of trained volunteer monitors. Both programs include the monitoring of physical, chemical and/or biological parameters useful in assessing the impacts of nutrients in Indiana lakes and reservoirs.

The BSS participates in the review of requests for site-specific water quality criteria for waters influenced by NPDES discharges. In the course of its various monitoring and assessment field activities the staff finds point- and nonpoint source-related problems which are then referred to the appropriate IDEM programs. The Section also cooperates in monitoring and assessment of the Ohio River in conjunction with the Ohio River Valley Water Sanitation Commission (ORSANCO), and other state and federal agencies.

Table I. Role of the Biological Studies Section Relative to Media and Ecological Data Collected and Expressed in Terms of Environmental Stressors, Responses and Indicators

Chemical, Physical and Biological Stresses	Environmental Responses	Environmental Indicators Used to Assess Impairment
Point Source Pollution and Nonpoint Source Pollution	Elevated Pollutants in Water	Water Chemical Specific Concentrations and Loadings
	Elevated Pollutants in Aquatic Sediments	Sediment Chemical Specific Concentrations and Loadings
	Elevated Pollutants in Fish Tissue	Contaminant Bioconcentration in Fish Tissue, Fish Consumption Advisories
	Acute and Chronic Toxicity	Effluent Toxicity Tests
Destructive Habitat Alterations	Decreased Aquatic Habitat Quality	Aquatic Habitat Evaluation Index
Collective Ecosystem Level Responses to Environmental Stress	Fish Community Impairment	Fish Community Index of Biotic Integrity (IBI)
	Invertebrate Community Impairment	Macroinvertebrate Index of Biotic Integrity (mIBI)
	Lake Eutrophication	Indiana Trophic State Index
		Carlson Trophic State Index

Program Participants

The Section works directly with the other sections of the Assessment Branch including the Surveys Section and the Environmental, Toxicology and Chemistry Section. Work is conducted cooperatively with the Indiana Department of Natural Resources, Indiana State Department of Health, U.S.EPA, U.S. Geological Survey, U.S. Fish & Wildlife Service, U.S. Army Corps of Engineers, ORSANCO, local regulatory agencies, Indiana public and private school students and faculty, and staff and students of numerous state universities and colleges. Internal customers include various programs within IDEM=s Offices of Land and Water Quality (OLQ and OWQ, respectively). Ultimate customers are the citizens and of Indiana.

Technical Notes

Please see the technical notes for the fact sheets listed in the Program Products section below.

Program Descriptions

Media:	Surface water; rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	*see fact sheets listed in Program Products section*
Sampling Sites:	*see fact sheets listed in Program Products section*
Sampling Frequency:	*see fact sheets listed in Program Products section*
Data Collected:	*see fact sheets listed in Program Products section*

Program Products

- Fact Sheet: *Fish Community Sampling Program* B IDEM 32/01/004/1998 rev. 2001
- Fact Sheet: *Fish Tissue Contaminant Monitoring Program* B IDEM 32/01/005/1998 rev. 2001
- Fact Sheet: *Sediment Contaminant Monitoring Program* B IDEM 32/01/008/1998 rev 2001
- Fact Sheet: *Macroinvertebrate Community Assessment Program* B IDEM 32/01/007/199 rev.2001
- Fact Sheet: *Lake Monitoring Program* - IDEM 32/01/009/1998 rev 2001

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IDEM=s Surface Water Quality Assessment Program

Macroinvertebrate Community Assessment Program

Program Objective

The Biological Studies Section (BSS) conducts biological community assessments of Indiana rivers and streams through the collection, study and assessment of macroinvertebrate communities (animals without a backbone that can be seen with the naked eye, such as aquatic insects, snails, crayfish, mussels, etc.). Any biological community assessment is a measurement of a collective ecosystem level response to environmental stress and gives an annual picture of the worst conditions, which have been imposed on the ecosystem at the point being assessed. When conducted in conjunction with chemical analysis of specific water quality parameters and aquatic habitat quality, they provide a more complete and comprehensive picture of ecological quality of the watershed.

The Biological Studies Section uses these macroinvertebrate and habitat studies to establish biological references to which all 35,673 miles of Indiana streams may be compared in order to identify impaired streams or watersheds. These data are used to determine compliance with the existing narrative biological criteria in the Indiana water quality standards, determine the extent of ecological harm, and make correlation to physical and/or chemical impairments that may occur. These data provide the information needed to develop models to assess changes in Indiana ecosystems that affect aquatic life.

In the course of its various monitoring and assessment field activities the staff finds obvious biological impairment due to point and non-point source related problems which are immediately referred to the appropriate IDEM programs. The Biological Studies Section also participates in evaluating macroinvertebrate monitoring and assessment programs on the Ohio River with the Ohio River Valley Water Sanitation Commission (ORSANCO).

Program Participants

The staff of the Biological Studies Section of the Assessment Branch conducts this particular monitoring program. No contractual laboratory services are needed as field samples collected in the field are returned to the BSS Laboratory for enumeration and identification. Data reduction is conducted during the winter months by the section's staff and data are maintained in a sample tracking and relational database format.

Program Description

Media:	Surface water; rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	Presently 780 different sites on 470 different rivers and streams in Indiana have been sampled. These sites include sites sampled in 86 of the states 92 counties (over 94% of the state). These data represent riffle communities at wadeable stream and rivers sites and were derived from a study to establish reference conditions.
Sampling Frequency:	Sampling is limited to July-October each year. The fixed station CORE sites are sampled on a rotational basis as part of the OWQ Surface Water Monitoring Strategy.
Data Collected:	Benthic macroinvertebrate community assessment samples are collected by several methods from Indiana rivers and streams. Biological samples are museum currated and maintained for the state. Macroinvertebrate community assessment data evaluating the compositional, structural and functional integrity of the biological community is being established. Concurrent aquatic habitat assessments are conducted to determine if either site specific habitat degradation or water quality causes can be determined. These data are used in determining the baseline reference condition for the calibration of a state wide macroinvertebrate index of biotic integrity (mIBI) and this is in turn being used in the surface water quality monitoring strategy of the Office of Water Quality.

As a member of the ORSANCO, Indiana contributes in giving the ORSANCO the responsibility of monitoring the Macroinvertebrate communities of the Ohio River and the lower reaches of its major tributaries (including the Wabash River). The ORSANCO has subcontracted some of these studies to the Ohio Biological Survey and to Universities.

Universities and consulting companies employed by dischargers periodically conduct site or watershed specific Macroinvertebrate community assessments within Indiana lakes, rivers and streams.

Program Products

- Contribution to Indiana's biennial 305b Report
- Support for 303(d) List of impaired waters in Indiana.
- Biological Impairment Reports to Inspectors
- Periodic technical reports on biological watershed assessments and trends
- Environmental Indicators development to measure success of environmental objectives in support of the Environmental Performance Partnership Agreement (EnPPA) between Indiana and U.S. EPA.
- Support of Indiana's Remedial Action Plan for the Northwest Indiana Area of Concern.
- Support the Triennial Review of Indiana Water Quality Standards

Technical Notes

A rapid bioassessment collection is reduced, using a 100 organism sub-sampling method. The sample is then enumerated and identifications of the organisms found within the sample are reduced to ten family level metrics, evaluating the condition of the biological community. These data are in turn reduced to an average multi-metric score for the site and compared to a reference condition.

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IDEM=s Surface Water Quality Assessment Program

Sediment Contaminant Monitoring Program

Program Objective

The object of this program is to provide information on chemical contaminants that may be accumulating in the sediments of Indiana=s streams, rivers, and lakes . Sediment monitoring can be an important tool for detecting pollutants in streams and lakes. This type of monitoring helps to locate sources of contaminants whose concentrations in other environmental media (such as water) are often too low to be easily found with routine sampling procedures. The sediment contaminant monitoring program provides supportive information for the fish contaminant monitoring program, wildlife health risk assessments, and for possible future development of models to assess changes in Indiana waters that affect aquatic life and human health.

Program Participants

This program is operated through the sampling efforts by the Biological Studies and Surveys Section of the Assessment Branch. Contract laboratory services are utilized for contaminant levels determination.

Program Description

Media:	Surface water; rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	Historically, a targeted site selection based on need for information, follow-up monitoring, or regular biennial revisits. Collection of sediment samples generally occurs in parallel with the Fish Tissue Contaminant Monitoring Program.
Sampling Sites:	Continued targeting of sites on rivers, lakes, and reservoirs.
Sampling Frequency:	5 year basin rotations for entire State (see: ***http://www.state.in.us/idem/owm/assessbr/master_swqms7.pdf***)
Data Collected:	Chemical contaminant levels in composite grabs of surficial aquatic sediments from river, stream, reservoir and lake sediments. Many of the contaminants analyzed for may bioaccumulate in fish.

Program Product(s)

- Use support designations of Indiana waters for 305(b) Report
- Assessments for 303(d) List of Impaired Waters in Indiana.
- Impairment reports to Inspectors.
- Periodic technical reports on contaminant levels and trends.
- Environmental Indicators development in support of the Environmental Performance Partnership Agreement (EnPPA) between Indiana and U.S. EPA.
- Support of Indiana=s Remedial Action Plan for the Northwest Indiana Area of Concern.

- Support of the Lake Michigan Lakewide Area Management Plan.
- Support the Triennial Review of Indiana Water Quality Standards

Technical Notes

Contaminants that may be analyzed for includes a number of metals (23) including cadmium, chromium, copper, lead, mercury, nickel, and zinc; organochlorine pesticides (27) such as DDT, chlordane, and dieldrin; and aroclors of polychorinated biphenyls (PCBs) (8 aroclors). Additional contaminants such as polycyclic aromatic hydrocarbons (PAHs) (18), semivolatile (47), volatile (33) organic compounds, congeners of PCBs and dioxins, and tributyl tin may be analyzed for when industrial, municipal, and/or other source pollution is suspected. Other measurements and analyses include particle size distribution, percent moisture, total organic carbon, total ammonia, and acid volatile sulfide content.

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IDEM=s Surface Water Quality Assessment Program

Lake Water Quality Assessment

Program Objective

The objective of this program is to provide basic information on the status and trends of the trophic state (enrichment levels) of Indiana=s public inland lakes and reservoirs. Eutrophication is a natural process of lake aging; the rate of which can be adversely increased by man=s activities. Physical, chemical, and biological data gathered on each lake are combined into a multi-metric index known today as the Indiana Trophic State Index (ITSI); a modified version of the BonHomme Index developed for Indiana in 1972. Eutrophy points are assigned to each parameter, then totaled for a final ITSI score ranging from 0 to 75. The lower the score, the lower the levels and effects of nutrients.

A complementary effort of monitoring lakes in Indiana is provided by a corps of citizen volunteers. Volunteers are trained to monitor water clarity, as well as collect samples for the analysis of total phosphorus and chlorophyll *a*. While volunteers do not sample as intensively as the State does during a single sampling event, they do collect data on a regular basis, season after season. Such consistent data gathering can be quite useful in detecting changes in water quality.

Program Participants

This program is currently being funded primarily by a federal grant administered by IDEM=s Office of Water Quality. The lake surveys described here were originally conducted by scientists with the Indiana State Department of Health, who later were transferred to the Indiana Department of Environmental Managementwhen it was created in 1986. Since 1989 the sampling and analytical efforts for this program have been conducted for IDEM by the staff and students of Indiana University=s School of Public and Environmental Affairs (IU/SPEA). Citizens enrolled in the Volunteer Lake Monitoring Program typically take transparency/clarity readings on their lakes every other week from April through October, as well as collect monthly water samples for analysis at the IU/SPEA laboratory during the summer.

Program Description

Media:	Surface water; natural lakes and manmade reservoirs
Study Area:	Statewide
Site Selection Type:	State - Deepest point in boat-accessible, public lakes
	Volunteers - Deepest point in public or private lakes
Sampling Sites:	State - More than 600
	Volunteers - Approximately 100 for Secchi readings and 30 for water samples
Sampling Frequency:	State - Approximately 20% are sampled July and August of each year
	Volunteers - Nearly 100 % of lakes are sampled regularly from April to October of each year
Data Collected:	Physical, chemical, and biological (plankton) data and samples

Program Products

- Reported in: *Indiana's 305(b) Water Quality Report to EPA*
  (Produced every two years with electronic updates annually)

- Publications: *Indiana Lake Classification System and Management Plan* (Published 1980 & 1986)
  Indiana Lake Water Quality Update: 1989-93 (Printed 1996)
  Indiana Volunteer Lake Monitoring Program Results for 1989, -1990-91, and *-1992-93*
  (Printed 1990, 1992, & 1994, respectively)

- Newsletter: *Water Column* (Published quarterly since Fall 1988)

Technical Notes

The parameters listed below are collected during most sampling events by the State. Those in **bold** type are used in calculating the Indiana Trophic State Index. Citizens involved with the volunteer monitoring program also monitor the three parameters marked below with an asterisk (*).

WATER QUALITY PARAMETERS		
PHYSICAL	**CHEMICAL**	**BIOLOGICAL**
Light Penetration: via Secchi disk *	**Total Phosphorous ***	**Total Plankton Count**
Light Transmission: % at 3 foot depth (via photocell)	**Soluble Reactive Phosphorous**	**% Blue-Green Algae**
1% Light Level	**Organic Nitrogen**	Chlorophyll *a* *
Temperature Profile	**Nitrate-Nitrogen**	
Alkalinity	**Ammonia-Nitrogen**	
Conductivity	**Dissolved Oxygen: % saturation at 5 foot depth**	
Land Use	**Dissolved Oxygen: % of water column with at least .1 ppm**	
	Dissolved Oxygen Profile	
	pH	

In addition to the efforts listed above, staff with IDEM's Biological Studies Section collect and analyze fish tissue and sediment samples from a handful of Indiana lakes and reservoirs each year. For more information on these programs please see fact sheet numbers IDEM 32/01/005/1998 and IDEM 32/01/008/1998, respectively.

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IDEM=s Surface Water Quality Assessment Program

Indiana's Participation in the National Study of Chemical Residues in Lake Fish Tissue

(U.S. EPA Office of Science and Technology)

Background and Project Description

The U.S. Environmental Protection Agency (U.S. EPA) Office of Water conducted a national screening-level investigation in 1987 to determine the prevalence of selected bioaccumulative pollutants in fish and to correlate elevated fish tissue contaminant levels with pollutant sources. Gamefish and bottom-dwelling fishes were collected from 314 locations across the country thought to be influenced by various point and nonpoint sources. These fish tissue samples were analyzed to determine levels of 60 target analytes, including dioxins and furans, PCBs, pesticides, mercury, and several other organic compounds. Results of the 1987 study indicated that target analytes were present in fish tissue at many of the sampling sites and some of the contaminants (e.g., PCBs, dieldrin, mirex, and combined chlordane) occurred at levels posing potential human health risks.

The Office of Water has initiated work on a new four-year national study of chemical residues in fish tissue, which is designed to expand the scope of the 1987 study. This contemporary study is statistically designed and will provide screening-level data on fish tissue contaminants from a greater number of waterbodies than were sampled in 1987.

This study broadens the scope of the 1987 study, which focused on chemical residues in fish tissue near point source discharges. The new study will:

- Provide information on the national distribution of selected **persistent, bioaccumulative, and toxic (PBT)** chemical residues in gamefish and bottom-dwelling fish in lakes and reservoirs of the coterminous United States (excluding the Great Lakes),

- Include lakes and reservoirs selected according to a probability design,

- Involve the collection of fish from those randomly selected lakes and reservoirs over a four-year survey period (2000-2003),

- Not be used to set fish consumption advisories; however, states and Native American Tribes may choose to initiate a detailed fish study in a particular lake based on the screening contaminant concentrations provided by the national study, and

- Include the analysis of fish tissue for PBT chemicals selected from U.S. EPA's multimedia candidate PBT list of 451 chemicals and from a list of 130 chemicals from several contemporary fish and bioaccumulation studies. A final target analyte list of 87 PBT

chemicals was compiled based on input from study design workshop participants and a review team of analytical experts convened in October 1998 and March 1999, respectively.

Lakes and reservoirs were chosen as the target population because they:

- Are accumulative environments where contamination is detectable,
- Provide important sport fisheries nationwide,
- Offer other recreational (nonfishing) access and opportunities, and
- Occur in agricultural, urban, and less-developed areas, so that associations with each primary use may be determined.

Lakes and reservoirs are the focus of this study rather than other waterbody types because:

- Fish consumption advisories represent 16.5% of the Nation's total lake acres (plus 100% of the Great Lakes), compared to 8.2% of the Nation's total river miles (USEPA 1998b). [**Note:** The Great Lakes is not included in this study because substantial fish tissue contaminant information is available and continues to be collected in ongoing Great Lakes monitoring programs.]
- Estuaries are currently being studied by U.S. EPA's Environmental Monitoring and Assessment Program (EMAP). EMAP has sampled fish from East and Gulf Coast estuaries, and will include fish contamination in its Year 2000 initiative on West Coast estuaries.

The specific objective of the new National Fish Tissue Study is to ***estimate the national distribution of the mean levels of selected persistent, bioaccumulative, and toxic chemical residues in fish tissue from lakes and reservoirs of the coterminous United States.***

In so doing, the study will provide the following types of information:

- Information to meet objectives of the President's Clean Water Action Plan (CWAP) and to specifically respond to the following action item:

  CWAP Key Action: USEPA and NOAA will conduct a national survey of mercury and other contaminants in fish and shellfish throughout the country, and will coordinate the effort with states and tribes to maximize geographic coverage. The shellfish survey will be based on the data obtained by NOAA's ongoing Mussel Watch Project.

  Information about persistent, bioaccumulative, and toxic chemicals (PBTs) for the U.S. EPA's PBT Initiative that addresses the following objective:

  The PBT Initiative seeks to identify areas of concern for human and/or ecological health. Study of fish tissue may reveal where PBTs not previously considered a problem are present at levels of concern.

- Data to answer important questions concerning the regional occurrence of fish tissue contamination, such as the following:

What is the national extent of selected chemical contaminants in fish from lakes of the coterminous United States (excluding the Great Lakes)?

What chemical residues are found in fish from lakes located in agricultural and nonagricultural areas of the United States?

Are contaminant levels in fish high enough to warrant further investigation?

What are the benefits to the State of Indiana, IDEM and tie-in to ongoing programs?

The Biological Studies Section in the Office of Water Quality (IDEM) is the primary collector and curator of data that supports the Indiana Fish Consumption Advisory (FCA) issued by the Indiana State Department of Health. Results from this National Lakes Fish Contaminants study will directly benefit our efforts to further contribute data in support of the FCA. The Biological Studies Section has over 24 years of experience toward understanding biological tissue contamination, bioaccumulation of potentially toxic compounds and risks to humans and wildlife from consumption of fish containing contaminants.

The Office of Water Quality (OWQ) Assessment Branch is responsible for assessing the quality of Indiana's surface waters. This includes obtaining data on, and furthering our knowledge on the fate of bioaccumulating contaminants in the biota that occupy Indiana waterbodies. Information from this National study will also aid our efforts to develop indicators of environmental successes and failures through long term trend monitoring based on a scientifically sound sampling design in support of EnPPA goals (for example mercury reduction programs).

Where will we be sampling?

The national study has stratified the selection of lakes to be sampled into 6 size classes. The selection of lakes has also been stratified by region of the country.

Number of lakes selected for sampling by size category and year for coterminous United States.

Lake area (ha)	2000	2001	2002	2003	All Years	Weighting Factor
>1-5	39	41	47	47	174	938.84
>5-10	44	40	47	46	177	261.61
>10-50	32	47	46	25	150	256.51
>50-500	34	37	29	34	134	85.06
>500-5000	36	30	31	41	138	11.36
>5000	40	30	25	32	127	2.21
Total	**225**	**225**	**225**	**225**	**900**	

For Indiana, eleven lakes were originally selected by the stratified random design for sampling over the four years of the project. The following table lists all of the lakes chosen for the study that were located in Indiana. Several of these were later determined to be nontarget or unacceptable for sampling given the criteria that U.S. EPA listed for inclusion/exclusion of a waterbody. The U.S. EPA River Reach File 3 (RF 3) was used to generate the random list of lakes. The RF3 provided the best known Geographical Information System (GIS) coverage for lakes.

Randomly Selected# List of Target Lakes.

Lake Name	County	Lake Area (ha)	Year	Completed?	Latitude			Longitude		
					Deg	Min	Sec	Deg	Min	Sec
Baire Lake	Putnam	3	2000	2000	39	43	58.8	-86	45	17.6
Unnamed	Huntington	102	2000	Nontarget*	40	43	47.3	-85	33	10.8
Unnamed	Brown	59	2000	Nontarget*	39	5	58.6	-86	19	34.3
Winona Lake	Kosciusko	216	2001		41	13	22.4	-85	50	1.0
Turtle Creek Reservoir	Sullivan	606	2001		39	4	1.9	-87	31	43.0
Geist Reservoir	Hamilton	683	2001		39	55	41.5	-85	56	33.0
Round Lake	Greene	8	2002	Nontarget*	39	2	6.0	-87	14	6.7
Hardy Lake	Scott	316	2002		38	46	21.4	-85	41	20.0
Gravel pit	St. Joseph	18	2003		41	36	40.3	-86	20	17.5
Fox Lake	Steuben	53	2003		41	37	36.5	-85	1	25.0
Unnamed	Montgomery	5	2003		40	2	5.6	-86	57	10.8

#=Waterbodies were selected by a randomized design utilizing U.S. EPA Reach File 3. The inclusion probability was determined by the goal of obtaining approximately an equal number of lakes to sample in each size category.

Nontarget*=Waterbody did not meet U.S. EPA criteria for sampling.

What will we be sampling?

Two distinct trophic groups of fish, bottom-dwellers and predators, will be included as target fishes for this study. This permits monitoring of a wide variety of habitats, feeding strategies, and physiological factors that might result in differences in bioaccumulation of contaminants. Suggested target species are listed in the following table in order of preference. IDEM staff will make an effort to collect one composite sample containing five individual whole fish for each of these categories. Every effort will be made to collect the desired species and number of fish; however, the outcome of field sampling efforts will ultimately depend on the natural diversity and abundance of fish in the study lakes.

What are we analyzing for?

An analytical methods workgroup selected 87 target analytes for analysis. These include compounds found in the following groups:

- Organohalide pesticides
- Organophosphorus pesticides
- Dioxins/furans
- Toxic PCBs
- Hydrocarbons, Phenols
- PAHs
- Total mercury
- Arsenic

Recommended Target Species for Inland Freshwaters (Presented in Order of Preference).

	Family name	Common name	Scientific name
Predator Species *(in order of preference)*	*Centrarchidae*	Largemouth bass	***Micropterus salmoides***
		Smallmouth bass	***Micropterus dolomieu***
		Black crappie	***Pomoxis nigromaculatus***
		White crappie	***Pomoxis annularis***
	Percidae	Walleye	***Stizostedion vitreum***
		Yellow perch	***Perca flavescens***
	Percichthyidae	White bass	***Morone chrysops***
	Esocidae	Northern pike	***Esox lucius***
	Salmonidae	Lake trout	***Salvelinus namaycush***
		Brown trout	***Salmo trutta***
		Rainbow trout	***Oncorhynchus mykiss***
		Brook trout	***Salvelinus fontinalis***
Bottom-dwelling Species *(in order of preference)*	***Cyprinidae***	Common carp	***Cyprinus carpio***
	Ictaluridae	Channel catfish	***Ictalurus punctatus***
		Blue catfish	***Ictalurus furcatus***
		Brown bullhead	***Ameiurus nebulosus***
		Yellow bullhead	***Ameiurus natalis***
	Catostomidae	White sucker	***Catostomus commersoni***

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IDEM=s Surface Water Quality Assessment Program

Fish Consumption Risk Assessment

Program Objective

The recreational sport of fishing as well as subsistence fishing are common and economically important activities in Indiana. Health studies have shown fish to be good for people to eat being high in protein and low in saturated fats. However, fish accumulate contaminants from the water they=re in and from the foods they eat. Some of these contaminants can actually build-up in the edible portion of fish such as the muscle and fat tissue. Exposure to these contaminants through fish consumption can cause build-up of the contaminants in humans and fish eating wildlife.

Fish contaminant monitoring is a widely used method of assessing environmental contaminants and their bioavailability. Concentrations of some contaminants may be greater in tissues than in water or sediments because of bioaccumulation. Tissue contaminant monitoring provides a tool to measure contaminants in Indiana=s environment that may not be easily measured in water or air. It also provides information on the availability of contaminants that are capable of bioaccumulating. The fish tissue contaminant monitoring program (see Fact Sheet: *Fish Contaminants Monitoring Program*) provides the vast majority of data used to support Indiana=s Fish Consumption Advisories (FCA) for the protection of sport and subsistence anglers.

Health risks from eating contaminated fish cannot be predicted with certainty. However, the weight-of-evidence from epidemiological studies can be extrapolated to determine at what level of contaminant exposure a consumer may be increasing his or her risk for adverse health affects over a lifetime. The major contaminants of concern for which FCAs are being issued on Indiana rivers, streams and lakes at this time are polychlorinated biphenyls (PCBs) and mercury. In order for scientists to standardize assessing the risk level from exposure to contaminants such as PCBs and mercury certain assumptions are made in applying quantitative methods of risk assessment.

In the assessment of PCB contaminant levels a weight-of-evidence derived individual Health Protection Value (HPV) of 0.05 micrograms per kilogram of body weight per day (ug/kg-day) for total PCB residue ingested from fish tissue is used (Anderson *et al.* 1993). The HPV is intended to encompass acceptable cancer and reproductive/developmental risk. In the assessment of mercury contaminant levels a reference dose (RfD) of 0.3 ug/kg/day for mercury ingested from fish tissue for general populations (adult men, and women who don=t plan on having children) is used (Shubat *et al*. 1995). Both of these exposure rates are not to be exceeded in the utilization of a standard meal size, consumption frequency, and reduction rate with cooking (PCBs only) over time. For example, in order to eat fish in an unlimited fashion the contaminant level in fish fillets would have to be less than a specified concentration in order for the consumer to not exceed that dose rate over the course of his or her lifetime. For the Indiana Fish Consumption Advisory the standards for calculating the potential exposure or exceedance of this dose rate is based on consuming an eight ounce serving (227 grams) per meal for a 154 pound (70 kilogram) adult with unlimited consumption being 225 meals per year (Anderson *et al*. 1993). In addition, the Advisory makes a recommendation of subtracting or adding one ounce of fish for every 20 pounds of body weight in order to follow the consumption rate advise.

Since PCBs concentrate in the fatty tissue proper cooking can reduce the amount of contaminant in the final product consumed after cooking. A fifty- percent reduction factor is included in the model for skin-on scaleless fillet preparation (such as largemouth bass or pan fish) and proper cooking. A thirty- percent reduction factor is included for skin-off fillets (such as catfish). In contrast to PCBs, cooking will not reduce the amount of mercury in a fish meal. Therefore, in calculating the consumption groupings for mercury, no reduction for preparation and cooking is factored. The only way to reduce mercury exposure when eating sport

caught fish is to reduce one's overall consumption.

Grouping Categories of the Indiana Fish Consumption Advisory:

Total PCB

Group	*Skin-On Scaleless Fillets*	*Skin-Off Fillets*
1	*0 - 0.05 ppm*	*0 - 0.036 ppm*
2	*0.06 – 0.2 ppm*	*0.037 – 0.156 ppm*
3	*0.2 – 1.0 ppm*	*0.157 – 0.676 ppm*
4	*1.1 – 1.9 ppm*	*0.667 – 1.35 ppm*
5	*>1.9 ppm*	*>1.36 ppm*

ppm=parts per million (mg/kg) wet weight

Mercury

Group	
1	*<0.16 ppm*
2	*0.16 - 0.65 ppm*
3	*0.66 - 2.80 ppm*
4	*2.81 - 4.5 ppm*
5	*>4.5 ppm*

Advisory Groups of the Indiana Fish Consumption Advisory:

Group 1 Unrestricted consumption. **One meal per week for women who are pregnant or breast-feeding, women who plan to have children, and children under the age of 15.**

Group 2 Limit to one meal per week (52 meals per year) for adult males and females. **One meal per month for women who are pregnant or breast-feeding, women who plan to have children, and children under the age of 15.**

Group 3 Limit to one meal per month (12 meals per year) for adult males and females. **Women who are pregnant or breast-feeding, women who plan to have children, and children under the age of 15 do not eat.**

Group 4 Limit to one meal every two months (6 meals per year) for adult males and females. **Women who are pregnant or breast-feeding, women who plan to have children, and children under the age of 15 do not eat.**

Group 5 No consumption (DO NOT EAT)

Program Participants

Decisions on fish consumption advisories are made through the **Indiana Interagency Fish Consumption Advisory Workgroup** consisting of participants from IDEM, the Indiana State Department of Health (ISDH), and the Indiana Department of Natural Resources (IDNR). The Indiana Fish Consumption Advisory (FCA) booklet is issued annually through the ISDH.

The Indiana FCA may also be found on the Internet: ***http://www.state.in.us/isdh/dataandstats/fish/***

Program Description

Media: Contaminant monitoring results of fish tissue samples from surface waters including rivers, streams and lakes
Study Area: Statewide
Site Selection : see Fact Sheets: *Watershed Monitoring Program*, and *Fish Contaminants Monitoring Program*.
Sampling Frequency: see *Surface Water Quality Monitoring Strategy 2001-2005*, revised 2001
Data Collected: Chemical contaminant levels in fish flesh

As a member State of the Ohio River Valley Water Sanitation Commission (ORSANCO), Indiana gives ORSANCO the responsibility of monitoring fish tissue contaminants in the Ohio River. As a Great Lakes State, Indiana participates in the annual Great Lakes Fish (tissue) Monitoring Survey sponsored and coordinated by the U.S. Environmental Protection Agency (U.S. EPA) Great Lakes National Program Office. In alternating years coho and chinook tissue samples are collected by IDNR for tissue contaminant analysis. A lab selected by GLNPO analyzes these samples. The results are reported by GLNPO to the participating states.. The IDNR Division of Fish and Wildlife annually collects non salmonid fish tissue samples from Lake Michigan for IDEM to determine contaminant levels. IDEM is a participant in the 4 year U.S. EPA National Study of Chemical Residues in Lake Fish Tissue (see Fact Sheet: *Indiana's Participation in the National Study of Chemical Residues in Lake Fish Tissue*).

Program Product(s)

- A*Indiana=s Fish Consumption Advisory*@ issued by the ISDH
- Use support designations of Indiana waters for Section 305(b) Report
- Assessments for Section 303(d) List of Impaired Waters in Indiana.
- Periodic technical reports on contaminant levels and trends.
- Support of the Environmental Performance Partnership Agreement (EnPPA) between Indiana and U.S. EPA.
- Support of Indiana=s Remedial Action Plan for the Northwest Indiana Area of Concern.
- Support of the Lake Michigan Lakewide Area Management Plan.

References

Anderson, Henry A. MD, James R. Amrheim, Pam Shubat, John Hesse. 1993. Protocol For a Uniform Great Lakes Sport Fish Consumption Advisory. Great Lakes Fish Advisory Task Force Protocol Drafting Committee.

Shubat, Pamela, Mark Staba, and Hillary Carpenter. 1995. Criteria Used to Issue Fish Consumption Advice: 1995 Minnesota Fish Consumption Advisory. Section of Health Risk Assessment, Minnesota Department of Health. HRA Series FSH-95-001.

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Appendix B

Environmental Toxicology and Chemistry Fact Sheets

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IDEM=s Surface Water Quality Assessment Program

Environmental Toxicology and Chemistry Section

Program Objective

The Environmental Toxicology and Chemistry Section (ETCS) provides technical and liaison services within the Office of Water Quality (OWQ) in the areas of general and environmental toxicology, toxicity evaluation and risk assessment analysis, quality assurance of environmental sampling and analytical data results from analysis of environmental samples. The Section as part of the Assessment Branch Water Quality Monitoring activities, also leads efforts on developing TMDLs (Total Maximum Daily Loads) for Impaired Waterbodies that are on the 303(d) List. Broadly speaking, the ETCS staff provides information regarding the current and future impact of various pollutants and toxic substances on aquatic life, human health and the environment. Quality assurance support is provided to various programs within the Assessment Branch and across OWQ for analytical data collected to meet individual project objectives. The main mission and objectives of the ETCS are:

- Assure that State Water Quality Criteria (WQC) or standards are implemented through the NPDES (National Pollutant Discharge Elimination System) permit limit compliance monitoring program to improve and maintain surface water quality and its designated uses. Regular and timely review of the pollutant monitoring data and toxicity biomonitoring reports submitted by the regulated community serves as a basis to accomplish this goal.

- Assess the potential for exposure and toxic effects of chemical pollutants or toxicants from environmental media (water, soil, sediments and fish tissue) and their release into the environment through point or nonpoint source discharges. This information is made available to management and other customers, both within and outside IDEM, to prevent environmental pollution and improve both water quality and the environment.

- The TMDL development is required of the impaired waterbodies that do not meet the water quality standards. The TMDL work involves characterization and identification of the target parameters and their risk to human health or aquatic life, identifying sources of pollution and quantification of loading, and calculation of Load Allocation (LA) and Waste Load Allocation (WLA) for the non-point and point sources. Implementation of TMDL through point and non-point source programs is expected to achieve an overall improvement in water quality of an impaired waterbody in a particular Watershed.

- Provide quality assurance support to Assessment Branch data collection efforts and analysis of environmental samples (water, sediments, and fish tissue) through compliance with the integrated Quality Assurance Project Plan (QAPP) prepared for surface water toxics monitoring programs. This work is performed not only to ascertain quality and accuracy of environmental data collected but to ensure that the analytical data gathered are of high quality and can be used with confidence in assessing surface water quality.

Program Participants

This program provides technical support to the sampling efforts of the Office of Water Quality=s Assessment Branch (Biological Studies, Environmental Toxicology and Chemistry, and Survey Sections), the Permitting Branch (NPDES program), and the Operations Branch (Data Management Section). Also coordinates with the Indiana Department of Health (ISDH) Environmental Lab and Contract Laboratories for laboratory analysis of environmental samples, data collection and data review process.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	Statewide
Sampling Sites:	Statewide
Sampling Frequency:	Statewide
Data Collected:	Conduct reviews of water chemistry, bacteriological lab data and reports received from regulated community and contract analytical laboratories. Additionally, collects field data, water chemistry data and bacteriological (E. *coli*) data for the TMDL Program.

Program Product(s)

- *Quality Assurance Project Plan (QAPP) for Indiana Surface Water Programs*
- *General Guidance for Conducting Biomonitoring Toxicity Tests for Indiana NPDES Permits*
- *General Procedures for Aquatic Toxicity Testing and Guidelines to Develop Site-Specific Water Quality Criteria*
- *General Procedures and Guidance for Developing a Metal Translator*
- *1998 303(d) List of Impaired Waterbodies and 15 year Schedule for TMDL Development*
- *QA/QC and Toxicity Biomonitoring Review Reports*
- *Sampling and Analysis Work Plans for the TMDL Program.*
- *Technical Review Proposals for Analytical Test Methods*
- *Broad Agency Announcements (BAA) for Water Quality Monitoring Projects*

Technical Notes

- Evaluate toxicity biomonitoring reports received from National Pollutant Discharge and Elimination System (NPDES) permittees for Whole Effluent Toxicity Testing (WETT) and prepare the Biomonitoring Review Reports.

- Evaluate toxic chemicals and/or new products for toxicity and risks to Aquatic Life and Human Health and to recommend for approval or disapproval of their use as pesticides or biocides in Indiana.

- Develop Water Quality Criteria for the NDPES program for chemicals which have no standards at state or national levels for outside the Great Lakes Basin.

- Evaluate site-specific study plans and site-specific water quality criteria proposed and developed by the permittees to assure correct water quality criteria are implemented through the NPDES program to protect the Designated Uses of Surface Waters.

- Evaluate site-specific Dissolved to Total Metal Ratios (Metal Translators) developed and proposed by the NPDES permittees and to recommend approval or disapproval of their use in Permit Limit Calculations.

- Evaluate sediments analysis data, sediments toxicity data and develop Interim Sediment Quality Criteria for evaluation and/or remediation of contaminated sediments.

- Inspect Whole Effluent Toxicity Testing (WETT) Laboratories and Analytical Laboratories for Quality Assurance/Quality Control (QA/QC) compliance.

- Evaluate analytical contract lab proposals for analysis of environmental samples and make recommendations for selection of contract lab.

- Prepare and implement Work Plans for conducting sampling, and analysis of water samples for physical, chemical or biological target parameters for the TMDL work.

- Identify data sources for the existing data for the Impaired Waterbodies that are on the 303(d) List and gather all the existing data from water, fish tissues and sediments from appropriate Watersheds for developing the appropriate TMDLs.

- Prepare presentations for the education and participation of Public and Stakeholders orientation on TMDL development and implementation.

- Develop TMDLs, both in-house and through contract services, for the non-point and point source discharges using appropriate TMDL models.

- Conduct quality assurance of analytical data generated from analysis of environmental samples (water, sediments and fish tissue samples) and prepare the QA/QC review reports.

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IDEM=s Surface Water Quality Assessment Program

Total Maximum Daily Load (TMDL) Program

Program Objective

The objective of this program is to develop and implement Total Maximum Daily Loads (TMDLs) to achieve state water quality standards. Section 303(d) of the Clean Water Act requires the development of TMDLs for waters that the State has identified as being impaired. These TMDLs must be established at levels necessary to attain and maintain the applicable water quality standards for designated uses. To accomplish this, TMDLs will set Waste Load Allocations (WLAs) for point source discharges and a set of specific requirements and best management practices for non-point source abatement of toxic pollutants. In order to implement the TMDL Program, IDEM will characterize parameters of concern and the extent and magnitude of the impairment in a waterbody, develop TMDLs that will ensure the attainment of water quality standards in these impaired waters, and finally implement the TMDLs through point and non-point source programs. The TMDL process for each impaired waterbody will take two to three years and will involve three major steps: Planning, Sampling/Data Collection, Modeling and Implementation. The data collection process will include the compilation and review of existing data, and collection and analysis of additional new data necessary for modeling. The next steps include developing the appropriate models, and implementing the strategies necessary to reduce the pollutant loading from point and non-point sources to achieve water quality standards for designated uses. It is anticipated that the first year will be used in planning and sampling/data collection, the second year for modeling the TMDLs and writing the required reports, and the third year for implementation. Throughout the process, identification of stakeholders, public participation and outreach activities will be important to the successful implementation of the TMDL.

Program Participants

The TMDL Program is operated through the efforts of the Toxicology and Chemistry, Surveys, and Biological Studies Sections of the Assessment Branch in coordination with staff from the Watershed Management and Water Quality Standards Sections of the Planning and Restoration Branch, and with support from the Permit Branch. Primarily, the Assessment Branch will be responsible for the Planning, Sampling/Data Collection and Modeling aspects of TMDLs, whereas the Permit Compliance Branch and the Planning and Restoration Branch will direct the Implementation aspects through point and non-point source programs. Initially, contractor support will be used for the development of the first TMDLs with the possibility of augmenting future program activities. TMDL development will also be conducted cooperatively with the U.S. Army Corps of Engineers (USACOE) and the Ohio River Valley Water Sanitation Commission (ORSANCO). Laboratory support comes from the Indiana State Department of Health (ISDH), the U.S. Geological Survey (USGS) as well as the Office of Water Quality private contract laboratories.

Program Description

Media:	Surface Water and Sediments: rivers, streams and lakes.
Study Area:	Statewide, select impaired waterbodies and watersheds in a major river basin.
Site Selection Type:	Impaired waterbodies from the 303(d) list. As of 1998, 208 impaired waterbodies in 5 major river basins have been identified for TMDL development.
Sampling Sites:	To be determined by the specific parameter of impairment and locations of impaired waterbodies in a watershed.
Sampling Frequency:	To be determined by the specific parameter of impairment and locations of impaired waterbodies in a watershed. Sampling will be limited to the July through October field season.
Data Collected:	Field Data: pH, temperature, dissolved oxygen, conductivity, turbidity, etc. Water Chemistry Data: Parameter of concern in each watershed. Bacteriological Data: E. coli

Program Product(s)

- Watershed Characterization Report selected for TMDLs.
- Periodic Interim Technical Reports on development of TMDLs.
- TMDL Final Reports for each impaired waterbody on the 303(d) list.

Technical Notes

- Contributions to the Indiana Biennial 305(b) Report.
- Development of the 303(d) List of Impaired Waterbodies.
- Development of appropriate steady-state and dynamic models for TMDL development.

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IDEM's Surface Water Quality Assessment Program

Quality Assurance Project Plan (QAPP) for Indiana Surface Water Quality Monitoring Programs

Program Objective

The Toxicology and Chemistry Section develops and maintains the Quality Assurance Project Plan (QAPP) for Indiana Surface Water Quality Monitoring Programs. This QAPP serves as a guide to both Contract and State analytical laboratory staff charged with the analysis of environmental samples (water, sediments, and biological) in order to provide results that will meet the data quality objectives for the individual water quality monitoring project. This QAPP satisfies USEPA requirements for environmental data collection projects that are funded in whole or in part by USEPA grants. Successful collection of precise, accurate, and complete data provides IDEM and USEPA Region 5 with good quality data, which could be used for regulatory decisions and to implement programs to improve and maintain clean waters in the State of Indiana.

The QAPP consists of sixteen elements and provides guidance in several major areas: Project Management; Measurement and Data Acquisition; Project Assessment and Data Oversight; and Environmental Data Validation/Usability. It is specific to the following Assessment Branch Water Quality Monitoring Projects:

- Fixed Station Monitoring Program
- Watershed Monitoring Program
- Pesticides Monitoring Project
- Stream Reach Monitoring Program
- Compliance Evaluations Inspections
- Fish Tissues and Sediments Monitoring Program
- Total Maximum Daily Load (TMDL) Program

Project Management Guidance in the QAPP covers the following areas:

- Project Descriptions
- Project Organization and Responsibility
- Quality Assurance Objectives for Measurement Data

Measurement and Data Acquisition covers:

- Sampling Procedures
- Custody Procedures
- Calibration Procedures and Frequency
- Analytical Procedures

Project and Data Assessment Oversight covers:

- Internal Quality Control Checks
- Performance and Systems Audits
- Preventive Maintenance

Environmental Data Validation and Usability covers the following areas:

- Data Reduction, Validation, and Reporting
- Data Quality Assessment Levels (1-4) with categories and guidelines
- Corrective Action Procedures
- Quality Assurance Reports to Management

Program Participants

This program provides technical support for the sampling efforts of Biological Studies, Surveys, and the Environmental Toxicology and Chemistry Sections from Water Quality's Assessment Branch, the Permitting Branch (NPDES Program), and the Operations Branch (Data Management Section). Also coordinates with the Indiana Department of Health (ISDH) Environmental Lab and Contract Laboratories for laboratory analysis of environmental samples, data collection, and data review process for quality assurance and quality control.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	Statewide / Major River Basins
Sampling Sites:	Statewide / Major River Basins
Sampling Frequency:	Varied
Data Collected:	Conduct reviews of water chemistry, bacteriological lab data and reports received from regulated community and contract analytical laboratories.

Program Product(s)

- *Quality Assurance Project Plan (QAPP) for Indiana Surface Water Programs*
- *QA/QC Review Reports*
- *Broad Agency Announcements (BAAs)*
- *Sampling and Analysis Work Plans for the TMDL Work*
- *Technical Review of Proposals for Analytical Test Methods*

Technical Notes

- Inspect Analytical Laboratories for Quality Assurance/Quality Control (QA/QC) compliance.
- Evaluate analytical contract lab proposals for analysis of environmental samples and make recommendations for selection of contract lab.
- Prepare and implement Work Plans for conducting sampling and analysis of water samples for physical, chemical, or biological target parameters for the TMDL work.
- Conduct quality assurance of analytical data generated from analysis of environmental samples (water, sediments and fish tissue samples) and prepare the QA/QC review reports.

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Appendix B

Surveys Section Fact Sheets

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IDEM=s Surface Water Quality Assessment Program

Watershed Monitoring Program

Program Objective

The objective of this program is to provide a comprehensive, unbiased assessment of all streams for their ability to support aquatic life and designated aquatic use. This is accomplished by the use of randomly selected sampling sites throughout the major river basins to assess and characterize the overall water quality and biological integrity. Site selection is conducted by the National Health and Environmental Effects Research Laboratory (NHEERL) in Corvallis Oregon and focuses on all streams within the targeted river basins. Sampling for water chemistry is performed under different flow regimes during three distinct time frames from May to October. These sample event periods are May through June, July through August, and September through October. Fish community assessments, macroinvertebrate community assessments, fish tissue contaminant monitoring, and habitat assessments will be performed during the seasonal low-flow time frame (July-October). Data to be collected and assessed are: water and fish tissue samples for laboratory analysis, in-situ water chemistry, channel morphology data, fish community assessments, macroinvertebrate community assessments, and habitat assessments. The results of this program will further contribute to the Indiana 305(b) Report and subsequent section 303(d) list of impaired streams, the Indiana Fish Consumption Advisory, as well as provide for support of the Environmental Performance Partnership Agreement (EnPPA), the Unified Watershed Assessments (UWA) and the development of biocriteria for Indiana's surface waters.

Program Participants

This program will be achieved by the sampling efforts of the Surveys and Biological Studies Sections of the Assessment Branch, and through support of the National Health and Environmental Effects Research Laboratory in Corvallis, Oregon.

Program Description

Media:	Surface Water; rivers and streams
Study Area:	Statewide (in targeted basins based on a five year rotating basin cycle)
Site Selection Type:	Probability-based sampling sites are selected by a representative stratified random draw according to stream order.
Sampling Sites:	Water chemistry will be collected at 50 sites within each of the targeted basins. Biological data will be collected at 42 sites within the West Fork White River Basin and 30 sites within the Patoka River Basin.
Sampling Frequency:	Water chemistry to be sampled three times during sampling time frames. Biological sites to be sampled once during sampling time frame.
Data Collected:	Water Chemistry, Fish Tissue, Fish Community Assessment, and Habitat Evaluations

Program Product(s)

- Report: Statistical Analysis by Basin and Ecoregions of the Water Chemistry Analytes in the West Fork White River and Patoka River Basins

- Report: Assessment of the Fish Communities of the West Fork White River and Patoka River Basins.

Technical Notes

WATER CHEMISTRY PARAMETERS		
PRIORITY METALS	**ANIONS/PHYSICAL**	**NUTRIENTS/ORGANICS**
Arsenic	Alkalinity	TKN
Cadmium	Total Solids	Ammonia-N
Chrome(III)	Suspended Solids	Nitrate-Nitrite-N
Copper	Dissolved Solids	Total Phosphorus
Lead	Sulfate	TOC
Mercury	Chloride	Cyanide-Total
Nickel	Hardness	Cyanide-Free
Selenium		COD
Zinc		

FISH TISSUE PARAMETERS			
GENERAL	**PESTICIDES**	**PCB'S**	**METALS**
% Moisture	Pesticides	Total PCB's	Mercury
% Lipids			Cadmium
			Lead

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IDEM=s Surface Water Quality Assessment Program

Pesticide Monitoring Program

Program Objective

The objective of this project is to determine the ambient concentrations of pesticides in the surface waters in Indiana. Loadings are also calculated based on flow data obtained from U.S. Geological Survey (USGS) gaging stations. This data will provide benchmark information for long-term trend analysis along with a broad scale overview of water quality. IDEM will gain a better understanding of pesticide concentration loads each watershed contributes to each major water basin.

Program Participants

This program is operated through the sampling efforts of the Office of Water Quality's Assessment Branch and the lab analyses of Environmental Health Laboratory (EHL) located in South Bend, Indiana.

Program Description

Media: Surface Water: rivers, streams and lakes
Study Area: Statewide by the year 2001
Site Selection Type: Sites selected at USGS gaging stations
Sampling Sites: 28 sites in the West Fork White River and Patoka River Watersheds.
Sampling Frequency: Preliminary survey in early March, then 15 consecutive weeks during April-August
Data Collected: Pesticides

Program Product(s)

- Report: *Survey of Pesticides in the West Fork White River and Patoka River Basins*

Technical Notes

- Test for 226 water soluble herbicides, pesticides and semi-volatile compounds using the EPA Method 525.2 and 547 at Data Quality Assessment 3. List of pesticides tested available upon request.
- Collect field results for temperature, pH, dissolved oxygen, conductivity, and turbidity.

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IDEM=s Surface Water Quality Assessment Program

Fixed Station (Ambient) Monitoring Program

Program Objective

The objective of this program is to provide basic information that will reveal water quality trends and provide data for the many existing and prospective users of surface water in Indiana. The program was developed to determine chemical, physical, bacteriological, and biological characteristics of Indiana water under changing conditions. The information has been used in determining background data for certain types of pollutants, such as chlorides and phosphorous. The information also assists in the development of wasteload allocations and NPDES permits for wastewater treatment plants; for other municipal, industrial, agricultural, and recreational uses. Additionally, the information is collected for future pollution abatement activities such as from review of non-point source effects; and in procuring data useful and necessary for securing public action toward the preservation of streams for all beneficial uses.

Program Participants

This program is operated through the sampling efforts by the Survey Section of the Indiana Department of Environmental Management's Office of Water Quality (OWQ) at the Assessment Branch. Laboratory analyses are performed at the Indiana State Department of Health (ISDH) Laboratory.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	Network established in 1957
Sampling Sites:	160 fixed stations
Sampling Frequency:	Monthly
Data Collected:	Water Chemistry, Bacteriological and Field Analytical Data

Program Product(s)

- Report: Indiana Water Quality Monitor Station Records: Rivers and Streams
- Data available in the U.S. EPA **STORET** database

Technical Notes B Parameters vary for each site

Water Chemistry Parameters			
Priority Metals	**Secondary Metals**	**Anions Physical**	**Others**
Arsenic	Calcium	Alkalinity	TKN
Cadmium	Iron	Total Solids	Ammonia
Chromium	Magnesium	Suspended Solids	Nitrate-Nitrite
Chromium (Cr^{+6})	Manganese	Dissolved Solids	Total Phosphorus
Total Chromium	Sodium	Flouride	TOC
Copper	Dissolved Iron	Sulfate	Cyanide
Lead	Dissolved Manganese	Chloride	ROD
Mercury	Dissolved Copper	Hardness	COD
Selenium	Dissolved Lead	Dissolved Oxygen	E. coli
Nickel	Dissolved Zinc	PH	Dissolved reactive silica
Zinc		Specific Conductance	Phenols
Barium			
Silver			

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IDEM=s Surface Water Quality Assessment Program

Surveys Section

Program Objective

The objective of this program is to provide surface water quality and hydrological data required for the assessment of Indiana's surface waters. As part of the *Surface Water Quality Monitoring Strategy*, the Surveys Section is conducting a five year rotating basin sampling plan of the State's ten major watershed's. Information collected will be reviewed by the Environmental Toxicology/Chemistry Section and integrated with data from Biological Studies Section. Information generated through analysis of the surface water quality data will be published in various formats and made available upon request in report form and via the internet to interested parties.

Program Participants

This program is operated by the Surveys Section of the Surface Water Quality Assessment Branch with the cooperative efforts of the Indiana State Department of Health's Water Quality Laboratory and the U.S. Environmental Protection Agency (U.S. EPA). The Surveys Section also utilizes the contract services of the U.S. Geological Survey and various commercial contract laboratories.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	see factsheets listed in Program Products section
Sampling Sites:	see factsheets listed in Program Products section
Sampling Frequency:	see factsheets listed in Program Products section
Data Collected:	see factsheets listed in Program Products section

Program Product(s)

- Fact sheet: *Watershed Monitoring Program* IDEM 32/01/001/1998(rev February 2001)
- Fact sheet: *Pesticide Monitoring Program* IDEM 32/01/002/1998(rev February 2001)
- Fact sheet: *Fixed Station Monitoring Program* IDEM 32/01/012/1998(rev February 2001)
- Fact Sheet: *E. coli Monitoring Program* IDEM 32/01/019/1999(rev February 2001)
- Fact Sheet: *Source Identification Program* IDEM 32/01/020/2001
- Fact Sheet *Trace Metals Project* IDEM 32/01/022/2001
- Report: *Great Lakes and Ohio River Tributary Source Identification 2001*
- Report: *Indiana Water Quality Fixed Station Program 2001*

Program Products – cont.

- Report: *Indiana Water Quality Fixed Station Program Trend Analysis 2001*
- Report: *West Fork White River and Patoka River E coli Survey 2001*
- Report: *Fourteen Digit Hydrologic Unit Mileage's for the West Fork White River and Patoka River Basins* IDEM 032/01/049
- Report: *West Fork White River and Patoka River Watershed Survey 2001*

Technical Notes

Please read the fact sheets listed in the Program Products section.

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IDEM=s Surface Water Quality Assessment Program

Synoptic Sampling Program

Program Objective

In 1996, the Surveys Section of the Indiana Department of Environmental Management, Office of Water Quality (OWQ), Assessment Branch initiated synoptic water quality sampling surveys in accordance with its new monitoring strategy. This strategy is described in the Office of Water Management document titled, *Monitoring Strategy 1996-2001*.[1]

One of the main objectives of these surveys was to describe the environmental water quality of the surface water resource in these basins and to identify what parts of the watersheds are impacted and exhibit signs of existing or emerging problems. This was primarily accomplished by looking at water quality stream standards and by comparing sub-watersheds to each other.

The sampling site selection criteria are: land use, stream confluences and drainage areas. The samples are collected and analyzed to identify which parts of the watershed exhibit signs of existing or emerging problems. Sampling will be done during the whole range of stream conditions: high flow, low flow; before and after agricultural activities including pesticide applications; and seasonal variations.

Field analyses, visual observations, and laboratory analyses are used to provide indications of pollution and/or impacted water quality. Biological indices and habitat assessment are included to gain a picture of the overall health of the water resource in the watershed.

Program Participants

This program is operated by the Surveys Section of the Office of Water Quality at the Assessment Branch, with laboratory support from commercial contract laboratories or the Indiana State Department of Health Water Quality Laboratory, or a combination thereof. These support facilities may vary from year to year.

[1] The first two years of the monitoring strategy (1996 and 1997) utilized the Synoptic Sampling Program; however, in 1998 the monitoring strategy was revised. This revision, entitled the *Surface Water Quality Monitoring Strategy*, describes the various sampling programs in which data is collected and used. In 1997, a random (probabilistic) based approach was studied in conjunction with the synoptic program. It was determined that a random-based site selection approach in conjunction with an expanded Fixed Station Sampling Program could yield the same types of data in a more efficient manner. Therefore, the synoptic sampling program was discontinued after 1997 in favor of the random-based approach, which is now called the Watershed Monitoring Program.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	Basin being studied, depending on year of the 5-year rotation
Site Selection Type:	Best professional judgement.
Sampling Sites:	Approximately 100 sites.
Sampling Frequency:	Six times per year **B** over all seasons and flow variations
Data Collected-	Field Data: Dissolved oxygen, water temperature, pH, turbidity, conductivity, and stream flow, weather code.
Laboratory Data:	Water Chemistry and Bacteriological.

Program Product(s)

- Fact sheet: *Watershed Monitoring Program*, IDEM 32/01/001/1998 (rev. 2001)
- Fact sheet: *Pesticide Monitoring Program*. IDEM 32/01/002/1998 (rev. 2001)
- Fact sheet: *Fixed Station Sampling Program*, IDEM 32/01/012/1998 (rev. 2001)
- Fact sheet: Surveys Section, IDEM 32/01/015/1998 (rev. 2001)
- Report: *1996 West Fork White River and Patoka River Basins General Aquatic Life and Recreational Use Water Quality Assessments for the 305(b) Report*, IDEM 32/02/014/1997(rev. 2001)
- Report: *West Fork White River and Patoka River Basin Eleven Digit Hydrologic Unit Mileages*, IDEM 32/02/015/1997
- Report: *West Fork White River **B** Patoka Watershed Atlas of Synoptic Sampling Sites for 1996*, IDEM 32/02/017/1997

Technical Notes

Sampling sites for this project were selected in such a way as to give an overall even spatial distribution coverage. Then, each site was evaluated as to its upstream land use. Sites were sampled six times over the year to give seasonal coverage. Basic water quality parameters were chosen to characterize the sites. Flow measurements were made at selected sites and data from the USGS gaging station sites were collected in order to help with the chemical data interpretation. Special sampling methods were followed which are referenced in this report. Samples were tested by contract laboratory. Results were entered in the Surveys Section database. Quality assurance and quality control guidelines were followed throughout the whole process.

Technical Notes B continued

Synoptic 1997 - Parameters and Laboratory Test Methods

General Chemistry--Water	
Parameter	**Test Method**
Alkalinity	310.2
Total Solids	160.3
Suspended Solids	160.2
Dissolved Solids	160.1
Sulfate	375.2
Chloride	325.2
Hardness	130.1

Nutrient & Organic Water Chemistry	
Parameter	**Test Method**
Total Kjeldahl Nitrogen (TKN)	351.2
Nitrate + Nitrite	353.2
Total Phosphorus	365.2
TOC	415 or SM5310

Bacteriological	
Parameter	**Test Method**
E. coli	SM9222

Metals--Water Chemistry	
Parameter	**Test Method**
Arsenic	200.9
Cadmium	
Chromium	
Copper	
Lead	
Nickel	
Iron	200.7
Zinc	
Mercury	245.2

Field Parameters	
Parameter	**Method**
Dissolved Oxygen	HydroLab™ Multi-Probe sonde, and Scout 2™ Display Unit. Calibration Checks by: Winkler field kit Hach Turbidimeter Cole-Parmer pH meter Mercury thermometer
Temperature ^{0}C	
pH	
Conductivity	
Turbidity	
Weather Codes	Sensory
Stream Flow**	USGS gage or Wading

**Designated sites only

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IDEM=s Surface Water Quality Assessment Program

E. coli Monitoring Program

Program Objective

The objective of this program is to determine the ambient concentrations of bacterial contamination in the surface waters in Indiana. *E. coli* monitoring can be an important tool for determining the safety of swimming and wading in streams and lakes. This data will provide benchmark information for long-term trend analysis along with a broad scale overview of water quality. IDEM will gain a better understanding of fecal contamination in surface waters in sampled watersheds and how that contaminant affects major water basins.

This type of monitoring helps to locate sources of contaminants, which are often diverse and widespread. The *E. coli* monitoring program provides supportive information for the Watershed Monitoring Program, (Fact Sheet IDEM 032/01/001/1998) and for development of models to assess Total Maximum Daily Loads (TMDLs, Fact Sheet IDEM 032/01/018/1999) to nonpoint sources in Indiana public and recreational waters.

The project provides for a mobile laboratory to facilitate *E. coli* testing to eliminate the necessity of transporting samples to distant contract laboratories within a six-hour holding time. A converted van provides IDEM staff with work space containing storage for samples, supplies for Colilert® testing, and equipment for collecting, preparing, incubating, reading, and disposing of up to 40 samples per day. The use of the mobile laboratory allows staff to complete the analyses in the field, thereby increasing the number of tests performed.

Program Description

Media:	Surface Water: rivers, streams and lakes
Study Area:	Statewide
Site Selection Type:	Sites selected are known recreational and public access areas. Non-point sources are surveyed from bridges.
Sampling Sites:	Site identification information from: County Health Department surveys. In 2001, 100 sites are to be surveyed by the mobile laboratory in the West Fork of the White River and Patoka River Basins.
Sampling Frequency:	Each location is sampled five times equally spaced over a 30-day period.
Data Collected:	Colony forming units of *Escherichia coli* bacteria per 100 ml of surface water. Method 9213D-SM and Method 9223-SM, Enzyme Substrate Coliform Test to derive a Most Probable Number (MPN) from charts provided by the manufacturer.

Program Participants

This program is operated through the sampling and analysis efforts of the Special Projects Work Group, Survey Section, IDEM Office of Water Quality, Assessment Branch with additional efforts by

1. Toxicology and Chemistry Section, TMDL work Group
2. Interagency Taskforce on *E. coli*
3. Indiana State Department of Health Laboratory
4. Private laboratories under contract to the State of Indiana

Program Product(s)

- Report: Concentrations of Escherichia Coli in Surface Water in the Great Lake Watersheds of Indiana, June –October 2000
- In Support of: Surface Water Quality Monitoring Strategy, The Indiana Water Quality Reports to USEPA Region 5, the TMDL program, and the Interagency Taskforce on *E. coli*.

Technical Notes

1. Test Method 9223-SM Enzyme Substrate Coliform Test at Data Quality Level 3.
2. Idexx Quanti-tray 2000 ™ MPN Method, Colilert Test® at Data Quality Level 3.
3. Temperature, pH, dissolved oxygen, conductivity, and turbidity analyzed in the field.

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IDEM=s Surface Water Quality Assessment Program

Source Identification Program

Program Objective

The Source Identification Program objective is to conduct follow-up studies to determine the sources of known stream impairments. This is carried out through evaluation of data produced by all Assessment Branch Programs during the prior year's field season. The impaired locations are reviewed and prioritized according to the degree and type of stressor. This program not only confirms causes and identifies sources of impairments, but makes the appropriate referrals for follow-up and remediation of the problems. Cause and source identification is a basic component of USEPA 305(b) guidance which encourages states to document impaired problems as part of the assessment process. The number and type of studies that can be conducted each field season is limited due to current staffing levels.

Program Participants

The Source Identification Program is carried out through the cooperative efforts of the Watershed Group and Special Projects Group of the Surveys Section, Assessment Branch.

Program Description

Media:	Surface Water; rivers and streams
Study Area:	Statewide rotating basins (follow-up in previous years targeted basins)
Site Selection Type:	Targeted sites
Sampling Sites:	As needed to adequately characterize each impairment
Sampling Frequency:	To be determined by the requirements of each study
Data Collected:	In-situ water chemistry, water chemistry and sediments for laboratory analysis, and onsite physical observations as appropriate for each study
Parameters:	To be determined by the requirements of each study

Program Product(s)

Report: Selected Source Identification Studies Conducted in the Kankakee River and Lower Wabash River Basins in 2000

Technical Notes

All Source Identification monitoring will adhere to the Assessment Branch Quality Assurance Project Plan.

Contact Information

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	For More Information on IDEM's Office of Water Quality...
IDEM Information: (317) 233-1044 or 800-451-6027 800-743-3333(TDD) toll-free for Indiana residents **EnviroLine:** (317) 232-8603 or 800-451-6027 toll-free for Indiana residents **Fax on Demand:** 800-726-8000 **Internet:** www.state.in.us/idem	**Assessment Branch** (Surface water quality: river, streams and lakes) Shadeland Office, Indianapolis (317) 308-3173 **Permitting and Compliance Branch** (NPDES permits, Inspections, operator assistance, and compliance.) Indiana Government Center North, Indianapolis (317) 232-8675 **Drinking Water Branch** (Public water supply and ground water protection) Shadeland Office, Indianapolis (317) 308-3280 **Planning Branch** (Water quality standards/rules, grants and loans) Indiana Government Center North, Indianapolis (317) 233-8488 **Financial Administrative Services Branch** (Program management, data management, rules) Indiana Government Center North, Indianapolis (317) 232-8472

IDEM=s Surface Water Quality Assessment Program

Trace Metals Project

Program Objective

Recently, under the Great Lakes Initiative (GLI), Indiana has adopted dissolved metal criteria for the Great Lakes Basin. To meet compliance to the new criteria for dissolved metals, data are required to assess surface water quality; historically, only total recoverable metals have been monitored. Therefore, there is an immediate need in the Assessment Branch for the implementation of Clean Sampling Techniques (Method 1669) in conjunction with ultra-clean low detect metals analyses (EPA Method 1638, 1636, 1631, 1630, and others). The main objective of this project is to gather trace metals data for both dissolved and total recoverable metals at nanogram levels (parts per trillion, ppt) using clean sampling and ultra-clean analytical techniques.

Program Participants

This program will be operated through the sampling efforts of the Surveys Section of the Assessment Branch and through support of the selected Contract Analytical Laboratory.

Program Description

Media:	*Surface water (rivers and streams)*
Study Area:	*Statewide targeted sampling locations*
Sampling Sites:	*Twenty- four locations*
Sampling Frequency:	*Samples will be collected quarterly, 8 locations per month time frame*
Data Collected:	*Nineteen metals, seventeen non-metals, and field parameters*

Program Product(s)

- Develop expertise in using Clean Sampling Methods.
- Collect both Total and Dissolved Metals data statewide at nanograms levels (parts per trillion, ppt).
- Identify dissolved and total mercury and methyl mercury concentrations.
- Sampling and Analysis Work Plans.
- QA/QC Review Reports.
- Yearly Report

Technical Notes

Statewide, twenty-four strategic rivers and stream sites have been selected for this project and each sampling site is near a USGS gaging station. The sampling and data collection efforts are timed to be quarterly in order to capture metals concentrations during the four seasons of the year. Both total and dissolved metals concentrations will be determined in the surface water samples.

- **Target Parameter(s)**

Metals

Aluminum	Cadmium	Lead	Selenium
Antimony	Chromium	Manganese	Silver
Arsenic	Chromium (VI)	Mercury	Thallium
Barium	Copper	Methyl Mercury	Zinc
Beryllium	Iron	Nickel	

Non-Metals

Alkalinity	Cyanide, Free	Kjeldahl Nitrogen, Total	Sulfate
Ammonia-Nitrogen	Cyanide, Total	Nitrate+Nitrite-Nitrogen	Total Dissolved Solids
Chemical Oxygen Demand	Fluoride	Organic Carbon, Total	Total Solids
Chloride	Hardness	Phosphorus, Total	Total Suspended Solids

Field Sample Measurements

Dissolved Oxygen	pH	Turbidity	Water Temperature	Specific Conductance

- **Sampling Procedures**

Field work will follow EPA Method 1669, "Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels." In this method, measures are taken to avoid exposing a sample to any possible source of metal contamination, including atmospheric deposition, by using non-metallic materials for the collection of the sample and by following a rigorous protocol for the actual sampling procedure. It requires a "clean hands and dirty hands" technique, which requires at least two or more staff for sampling.

Data received from the Contract Lab will be reviewed by IDEM staff for Quality Assurance/Quality Control.

Trace Metals Sampling Locations for 2001

Contact Information

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Appendix C

Time Line

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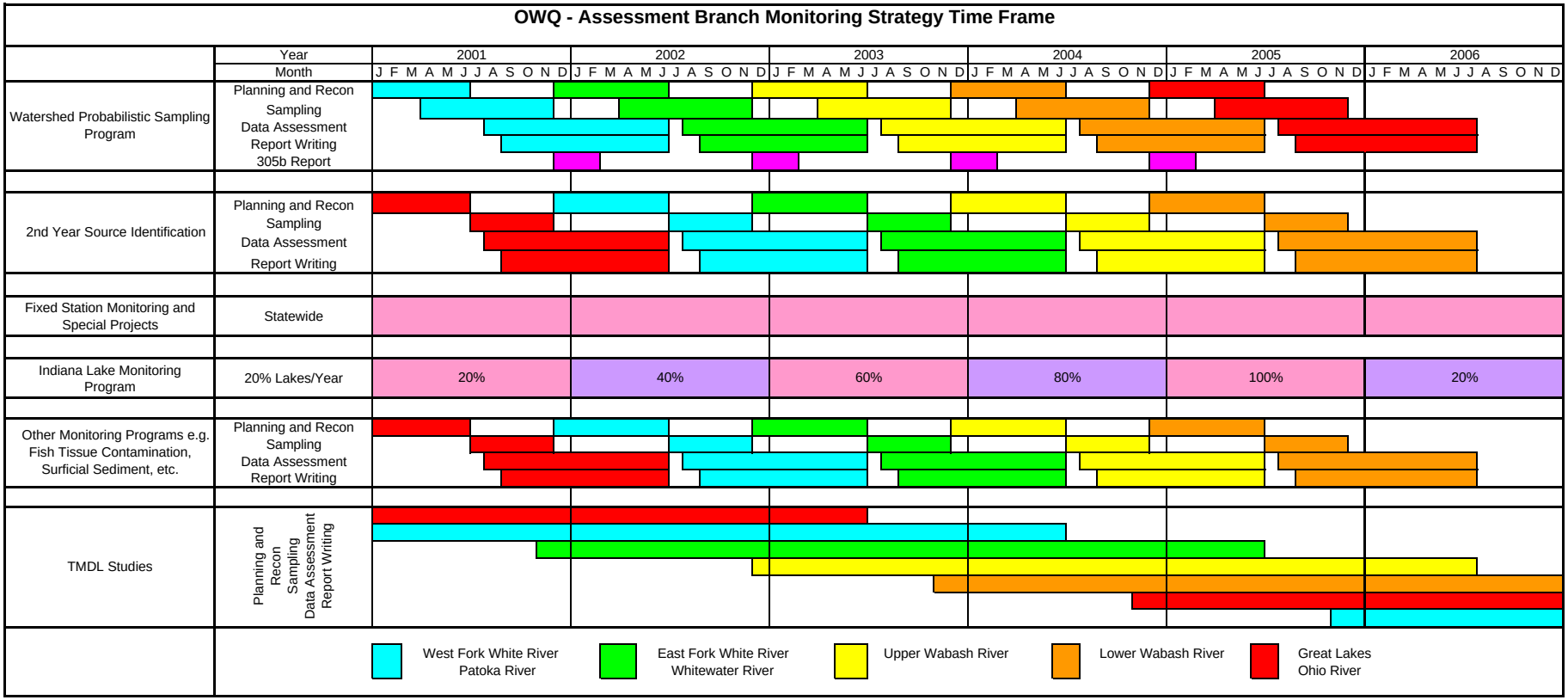
OWQ - Assessment Branch Monitoring Strategy Time Frame
Year
Month
2001
2002
2003
2004
2005
2006
J F M A M J J A S O N D
Watershed Probabilistic Sampling Program
Planning and Recon
Sampling
Data Assessment
Report Writing
305b Report
2nd Year Source Identification
Planning and Recon
Sampling
Data Assessment
Report Writing
Fixed Station Monitoring and Special Projects
Statewide
Indiana Lake Monitoring Program
20% Lakes/Year
20%
40%
60%
80%
100%
20%
Other Monitoring Programs e.g. Fish Tissue Contamination, Surficial Sediment, etc.
Planning and Recon
Sampling
Data Assessment
Report Writing
TMDL Studies
Planning and Recon
Sampling
Data Assessment
Report Writing
West Fork White River
Patoka River
East Fork White River
Whitewater River
Upper Wabash River
Lower Wabash River
Great Lakes
Ohio River

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Appendix D

Brochures

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How's the quality of Indiana's surface water?

Indiana's surface water quality varys greatly, from clean enough for fishing, swimming or for use as a drinking water supply to severely degraded by pollution. For detailed information, visit IDEM's Web site or call IDEM's Assessment Branch at (800) 451-6027, press 0 and ask for ext. 308-3198, or call (317) 308-3198.

On the Web

- **Indiana Water Quality Report**
  www.in.gov/idem/owm/planbr/wqs/quality.html
- **Indiana State of the Environment Report**
  www.in.gov/idem/soe/index.html
- **IDEM's Assessment Branch**
  www.in.gov/idem/owm/assessbr/assessindex.html
- **Water Issues Research**
  www.in.gov/idem/research.html

Water quality fact sheets are available on the Web at www.in.gov/idem/owm/assessbr/assessindex.html, or they can be ordered at (800) 451-6027, press 0 and ask for ext. 308-3206, or (317) 308-3206. They also are available through the Fax on Demand (FOD) System at (800) 726-8000.

Fact Sheets

- **Assessment Branch Fact Sheet** (FOD# 8790)
- **Surveys Section Fact Sheet** (FOD# 8827)
- **Surface Water Quality Monitoring Strategy Fact Sheet** (FOD# 8828)

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Photos by DNR photographer Richard Fields
surface water brochure.p65 3/01

***Surface water** is a natural or artificial accumulation of water on the land's surface. Indiana's surface water consists of more than 35,673 miles of rivers and streams and more than 600 publicly owned lakes and reservoirs that cover more than 106,000 acres.*

Why should you care about surface water?

Water is essential to life. Thirty-eight percent of Hoosiers get their drinking water from public water treatment plants supplied by surface water. Our rivers, streams and lakes also sustain wildlife and provide recreational opportunities such as boating, fishing, swimming, nature study and photography. Industry and commerce also rely on Indiana's surface water to make steel, electricity and other products.

Who monitors Indiana's surface water?

The Surveys Section of the Assessment Branch of the Indiana Department of Environmental Management's Office of Water Quality implements a surface water quality monitoring strategy. The strategy is designed to describe the overall environmental quality of surface waters of Indiana's rivers, streams and lakes and identify impaired water bodies that do not meet water quality standards.

How does IDEM monitor the surface water?

One element of IDEM's surface water quality monitoring strategy is the Fixed Station Monitoring Program. Under this program, IDEM scientists collect water samples and field analytical data every month from 160 "fixed stations" (sampling sites) at selected rivers, streams and lakes throughout the state. The scientists send their water samples to the Indiana State Department of Health laboratory for analysis.

What are the samples tested for?

The Indiana State Department of Health analyzes the general chemistry of the water by testing for the presence of heavy metals (e.g., copper, lead and mercury); nutrients (e.g., phosphorus, nitrates and nitrites); organic compounds (e.g., pesticides); other substances such as cyanide and arsenic; and bacteria such as *E. coli*. Each fixed station sampling site is tested for various parameters. These analyses are done in accordance with standard testing methods set by the U.S. Environmental Protection Agency and environmental rules established by the Indiana Water Pollution Control Board.

What field data are collected?

Field analytical data are the first indicators of water quality. IDEM collects data on dissolved oxygen levels, pH, temperature, specific conductance and turbidity.

Field Data

Dissolved Oxygen readings are commonly used to measure water quality and determine whether the water is able to support desirable aquatic life. The ideal dissolved oxygen levels for fish are between 7 and 9 mg/l. Most fish can't survive at levels below 3 mg/l for extended periods of time.

pH is a convenient method of expressing the acidity or alkalinity of a solution. Natural waters usually have a pH between 6.5 and 8.5, with 7.0 being neutral. Values less than 7.0 indicate acidity, and values greater than 7.0 are considered basic or alkaline.

Temperature can adversely affect water quality and aquatic life. Water temperature is usually much more stable than air temperature, so aquatic organisms tend to be poorly adapted to rapid temperature changes. Rising water temperatures can have devastating effects on sensitive organisms. Dissolved oxygen levels in water decrease as temperatures increase.

Specific Conductance is related to the type and concentration of ions in solution. It can be used for approximating the total dissolved solids content of water by testing its capacity to carry an electrical current.

Turbidity is a measure of the cloudiness of water. The term "turbid" is applied to waters containing suspended matter that interferes with the passage of light through water or in which visual depth is restricted. Turbidity may be caused by a wide variety of suspended materials, such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms. Turbidity in water has public health implications due to the possibilities of pathogenic bacteria. Turbidity also interferes with water treatment (filtration) and affects aquatic life.

What does IDEM do with the data?

The data reveal trends about the quality of Indiana's surface water under changing conditions. It is provided to the many existing and prospective users of surface water in Indiana. IDEM uses the information:

- To determine background levels for certain types of potential pollutants, such as chlorides and phosphorus;
- To develop wasteload allocations and permits for wastewater treatment plants and for other municipal, industrial, agricultural and recreational uses;
- To plan for future pollution abatement activities based on data revealing water pollution from soil erosion, agriculture, urban runoff, land development and air pollution deposits; and
- To provide data useful and necessary for securing public action toward the preservation of streams for all beneficial uses.

Visit the Surveys Section online!

www.in.gov/idem/owm/assessbr/assessindex.html

Water

is essential to all living beings. Indiana has more than 35,673 miles of rivers and streams. Many Hoosiers drink water that originates from those rivers and streams. Water also sustains wildlife, provides recreational opportunities and makes Indiana beautiful. The health of fish and macroinvertebrate communities living in Indiana's rivers and streams reflects the ecological condition of the watershed upstream. Water samples further enable IDEM to interpret overall water quality. Only with the help of landowners and property managers can IDEM effectively assess Indiana's rivers and streams.

If you have questions or concerns about this project, please call the Biological Studies Section of the Assessment Branch of IDEM's Office of Water Quality at (800) 451-6027, press 0 and ask for ext. 308-3173, or call (317) 308-3173. To correspond by computer, send e-mails to abranam@dem.state.in.us. Visit IDEM's Assessment Branch on the Web at www.in.gov/idem/owm/assessbr/assessindex.html for information ranging from OWQ's Annual Report 2000 to the Biological Studies Section's Available Report List and numerous fact sheets.

Bluegill photos by Tom Leaird
All other photos by Anthony R. Branam, IDEM

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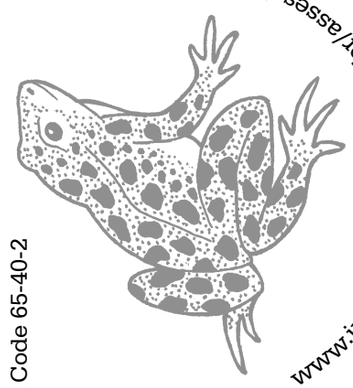

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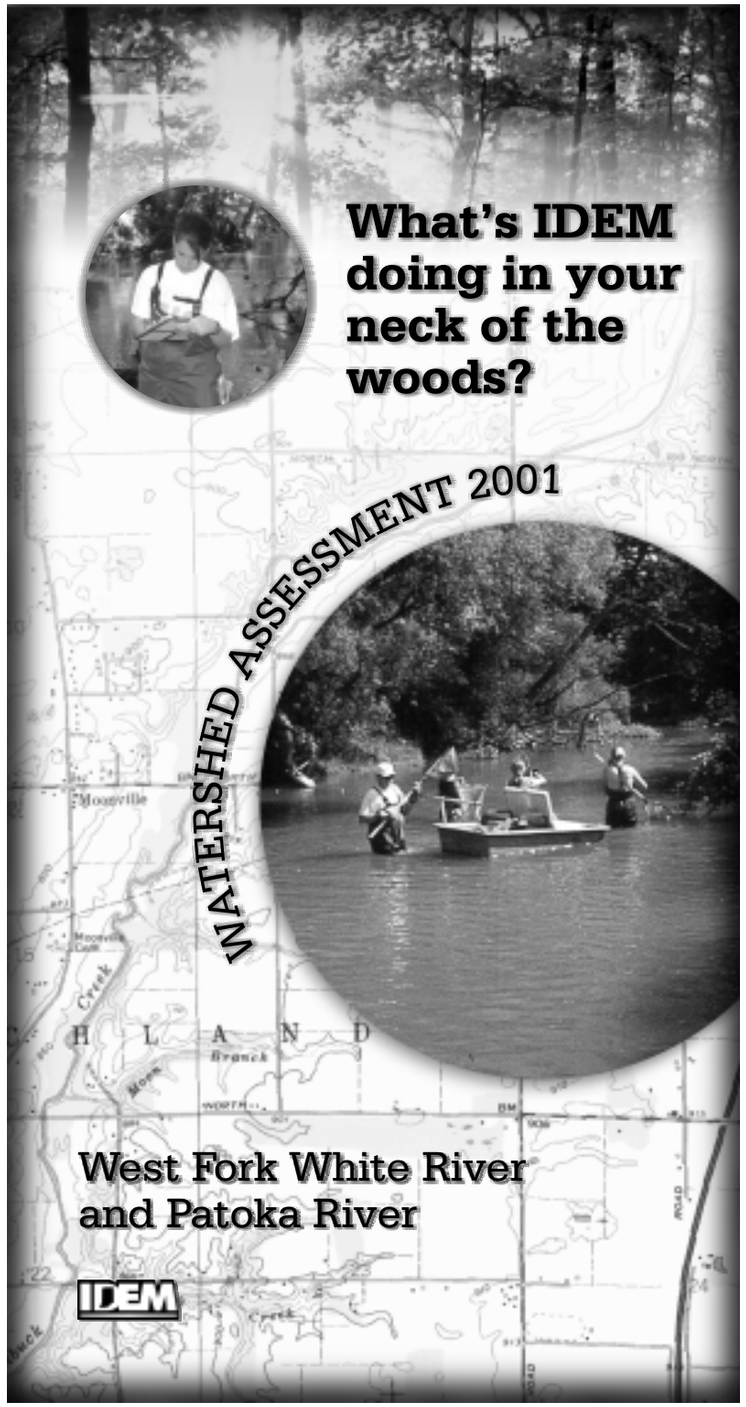
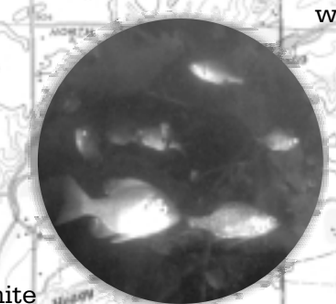


The Indiana Department of Environmental Management is studying the West Fork White River and Patoka River watersheds (drainage basins). Required by the Clean Water Act, the study will enable IDEM to determine the status and trends of overall water quality. IDEM will use the information to identify specific problem areas and impaired locations, protect exceptional rivers and streams, and improve its plans for managing and protecting Indiana's surface waters.

From May through October 2001, scientists from the Assessment Branch of IDEM's Office of Water Quality will collect water chemistry samples and fish and aquatic macroinvertebrate specimens from selected rivers and streams and locations throughout the West Fork White River and Patoka River watersheds. They will spend less than one hour at each stream sampling location collecting water samples in spring and fall, and two to four hours at each location in late summer performing macroinvertebrate and fish community surveys. They will also measure the physical characteristics of stream channels in these watersheds.



Sampling Locations

The Assessment Branch selects stream sampling locations using a computer-generated random selection (probabilistic) technique. Probabilistic selection allows information collected at one location, typically small streams and headwaters, to be generalized and applied to similar streams in the area. This method is cost effective because small field crews are able to cover a larger area, it requires fewer samples, and the information collected becomes promptly available.

Working Together

IDEM field crews usually access sampling locations from the nearest bridge. However, many locations where IDEM scientists need to collect samples and take measurements lie hundreds of feet from public road right-of-ways. In those cases, IDEM scientists contact landowners or property managers and request permission to access streams on private property. They also sometimes request the use of private boat launches to facilitate access to streams. Only with the help of landowners and property managers can IDEM effectively assess Indiana's rivers and streams.

Performing Field Work

The field work involves crews of two to four scientists merely carrying equipment to and from the stream without any threat of property damage. They collect fish specimens using electricity provided by small portable generators. This task involves moving along the stream for a given distance, between 150 to 1,000 feet, with a

small fiberglass boat, or using a backpack shocker. Once collected, the fish are promptly identified, weighed, measured and returned to the stream, with minimal stress on the fish. A few specimens of the smaller fish are preserved and returned to IDEM's laboratory for identification under a microscope. When available, selected fish species will be submitted for tissue analysis as part of IDEM's Fish Tissue Contaminant Monitoring Program, which protects people who consume fish through Indiana Fish Consumption Advisories and performs wildlife health risk assessments on fish-eating birds.

The field crews also collect aquatic macroinvertebrate specimens using netting and buckets. The specimens are preserved in a jar and returned to IDEM's lab for microscopic analysis. In addition, the crews collect water samples from the center of the stream using bottles. The water samples are placed into clean containers and sent to laboratories for physical and chemical analysis.

Reporting Findings

IDEM will report the findings of this study to Congress in the Indiana Water Quality Report - 305(b). This biennial report will describe the condition of streams, lakes and ground water in several Indiana watersheds, including the West Fork White River and Patoka River watersheds. It will be published in 2002 and made available at public libraries and on IDEM's Web site at www.in.gov/idem/owm/planbr/wqs/quality.html. Upon request, IDEM will provide information collected to landowners, property managers, special interest groups, local governments, universities, state and federal agencies, planners and policymakers.