

MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY'S SURFACE WATER MONITORING PROGRAM

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ABSTRACT

The Mississippi Department of Environmental Quality's Surface Water Division (SWD) is responsible for the conservation of the quality of the surface water of Mississippi for public use by the citizens of the state of Mississippi. This responsibility coupled with legislative mandates set forth by the Mississippi Water Pollution Control Act and the Federal Clean Water Act serve as the main purpose for development and implementation of the Surface Water Monitoring Program (SWMP). The purpose of this paper is to outline the elements of MDEQ's SWMP. The key elements include clearly defined objectives and an outline of the overall strategy to be used to meet these objectives. A conceptual model of the Program involves two major components: Ambient Monitoring Networks and Program Support Monitoring Activities. The former component addresses general water quality assessment of status and trends and the later component addresses specific monitoring and assessment needs of other SWD programs (i.e. Total Maximum Daily Load Program, Standards Program, Non-point Source Program, etc.). Ecological indicators used in the SWMP consist of a suite of physical, chemical and biological parameters. Data collected for the SWMP are housed in an internal database and will in the future be available to the public through MDEQ's Surface Water Information Management System (SWIMS) and U.S. EPA's Storage and Retrieval System (STORET). Routine water quality assessments are made on these data by SWD personnel and are reported in the State's 305(b) Water Quality Report to Congress every two years. In addition, internal reports are generated and are available to the public.

KEYWORDS

Management and Planning, Methods, Surface Water, Water Quality

INTRODUCTION

The Mississippi Department of Environmental Quality's (MDEQ) Office of Pollution Control (OPC) is the State agency responsible for the conservation of the quality of the natural resources of Mississippi for public use. This responsibility coupled with legislative mandates set forth by the Mississippi Air and Water Pollution Control Act (citation) and the Federal Clean Water Act (citation) serve as the main purpose for development and implementation of the Surface Water Monitoring Program (SWMP).

In order to successfully develop, implement and maintain a surface water-monitoring program, a strategy for the program was derived. The purpose of this strategy is to:

- Outline the elements and establish the overall goals and objectives of the SWMP
- Achieve mandates set forth by the Mississippi Air and Water Pollution Control Act and the Federal Clean Water Act
- Protect, maintain and improve the physical, chemical and biological integrity of our inland and near-coastal waters

The quality of the State's surface waters has a profound effect upon the health and welfare of Mississippi's citizens, and the State's wildlife, fish and other aquatic life. The quality of Mississippi's waters also significantly affects domestic, agricultural, industrial and recreational water use activities. To support the goal of protecting, maintaining and improving water quality to ensure fishable and swimmable waters, as set forth in the Clean Water Act (CWA), the agency's SWMP is designed to provide the water quality information necessary for State and Federal water quality management decision-making and for reporting on the overall status of the State's surface waters.

ELEMENTS OF MDEQ's SWMP

The key elements include clearly defined

objectives and an outline of the overall strategy to be used to meet these objectives.

Objectives

The objectives of the SWMP are:

- Meet requirements of legislative mandate (Section 106 of CWA)
- Monitor, assess and report overall status and trends of surface water quality in Mississippi (Section 305(b) of CWA)
- Identify impaired waterbodies (Section 303(d) of CWA) and determine causes and sources of impairment
- Determine effectiveness of other OPC Surface Water Division (SWD) Programs
- Support monitoring and assessment activities of other OPC SWD Programs
- Address surface water quality issues and economic development interests of public concern
- Determine better ways of monitoring and assessing surface waters

In order to accomplish these objectives, the OPC carries out a broad range of monitoring activities before and after implementing pollution controls. These multi-faceted activities consist of the actual measurement of water quality parameters in State waters followed by the investigation and evaluation of factors determining these water quality findings. Finally, the monitoring process culminates with an overall assessment of the specific effects of such quality upon the beneficial uses of State waters.

Strategy

A comprehensive monitoring program strategy should address all water quality management needs and all waters of the state (Yoder 1997). MDEQ's SWMP strategy is geared to address several monitoring elements outlined below:

- Quality Assurance
- Outline of Management Questions
- Conceptual Monitoring Design
- Core Indicators
- Data Acquisition/Sharing With Other Monitoring Agencies
- Data Management
- Data Analysis/Assessment
- Reporting

This monitoring strategy addresses the range of water quality management decisions that require monitoring data, including how the five components of the State's required Section 305(b) Water Quality Report to Congress (40 CFR 130.8) will be achieved. The five components of the 305(b) Report are:

- An assessment of the water quality status of all waters
- An estimate of the extent to which MDEQ surface water programs have improved water quality
- An estimate of the costs and benefits needed to achieve CWA objectives
- A description of the nature and extent of nonpoint source pollution
- An assessment of the water quality status of all publicly owned lakes

Quality Assurance

In order to evaluate and report the quality of environmental data, MDEQ has developed a Quality Assurance/Quality Control (QA/QC) Program to complement all SWMP components. The objectives of the QA/QC Program are:

- Structure the framework and design of SWMP activities so that MDEQ can minimize, isolate, identify and correct problems in either process or design that produce error and increase data variability.
- Evaluate and report the quality of all data as well as the type and amount of uncertainty associated with all data.

Structuring the framework and design of SWMP activities includes the generation and implementation of quality assurance project plans (QAPPs) and standard operating procedures (SOPs). Quality Assurance Program/Project Plans are developed, maintained and reviewed to ensure the scientific defensibility of monitoring and laboratory activities, and to ensure that the quality of all reported data are known and reported in a comprehensive and consistent manner. These plans outline the level of data quality that is appropriate for the specific uses of the data. EPA Order 5360.1 requires EPA-approved QAPPs for all projects and activities involving the collection and analysis of environmental data (40CFR 31.45). The requirements for QAPPs are given in EPA 2001.

The QAPP includes detailed descriptions of:

- Project Management
- Data Generation and Acquisition
- Assessment and Oversight
- Data Validation and Usability

In addition to QAPPs, standard operating procedures (SOPs) have been developed, reviewed, and maintained for all data collection and analysis activities including field and laboratory SOPs.

Evaluation of data quality involves establishing data quality objectives (DQOs), evaluating program design for whether the objectives can be met, and establishing assessment and measurement performance criteria that are used to evaluate the quality of the data. To evaluate data quality, the following indicators are used:

- Accuracy
- Precision
- Representativeness
- Completeness
- Comparability

To measure these indicators, quality control activities are used during each step of the monitoring and assessment process. Quality control activities include:

- System and Performance Audits of Field and Laboratory Activities
- Inspection and Calibration of Equipment
- Duplicate and Repeat Sampling
- Laboratory Blanks and Spiked Samples
- Sorted Biological Sample Re-checks
- Taxonomic Re-identifications
- Data Entry and Analysis Rechecks

The implementation of MDEQ's QA/QC Program as well as the development and use of QAPPs and SOPs will result in generation of scientifically defensible data capable of supporting MDEQ management decisions.

Outline of Management Questions to be Answered by the SWMP

The structure and design of the SWMP is reliant on the questions that are to be answered by the end users of the data. By outlining the questions to be addressed, MDEQ was able to design an

appropriate monitoring program needed to obtain answers to these questions. Questions to be answered by SWMP activities are:

1. What is the general water quality status of Mississippi surface waters?
2. What are the general water quality trends of MS surface waters?
3. What is the water quality status of specific waterbodies of public concern?
4. What waterbodies in MS are impaired or of concern?
5. What are the causes and sources of impairment of MS surface waters?
6. Are MDEQ Surface Water Division Programs effective?
7. What are better ways of monitoring and assessing surface WQ?

Conceptual Monitoring Design

As stated above, program objectives, or more specifically the questions that are to be answered, drive the conceptual monitoring design. Similar to the SWMP objectives and questions, the conceptual monitoring design is multifaceted. The design incorporates several approaches for site selection, indicators used, intensity levels of monitoring, magnitude and frequency of data collection, and monitoring schedules.

To ensure that the design is clearly understood and represented in an organized fashion, the structure of the design is presented as tiered model. The tiered model is structured mainly to group monitoring activities that mutually address questions to be answered. The tiered model includes primary, secondary and tertiary tiers. The Primary tier is the broadest grouping of activities and the tertiary tier is the narrowest grouping. All three tiers of the SWMP are shown in Figure 1. The primary tier of the SWMP model includes two major types of monitoring activities:

- Status and Trends Ambient Monitoring Networks
- MDEQ Program Support Monitoring Activities

Status and Trends Ambient Monitoring Networks.

The common thread of activities in this primary tier is that they are designed to mainly address

comprehensive water quality status and trends management questions (i.e. what percentage of waterbodies are meeting their designated uses) and are continuous in duration. Data collected from these networks can also be used to make general statements about specific broad scale questions (i.e. what are the main causes and sources of impairment of MS waters).

The secondary tier under Status and Trends Ambient Monitoring Networks includes a Statewide Network and a rotating Basin Network. The main difference between these two networks is the reason and approach used for selecting sites. The Statewide Network is mainly composed of historical fixed stations that were targeted for long-term routine monitoring for a specific reason and are monitored on a static yearly schedule (Figure 2). The rotating Basin Network is mainly composed of random sites that were selected using a probabilistic approach in each of five basin groups and are monitored on a rotating five-year basin schedule according to MDEQ's Basin Management Approach. Figure 3 shows the five groupings of basins and their order in the cycle. In each basin group, a different set of random sites monitored as part of the Basin Network are chosen at the beginning of each five-year cycle. However, there is a component of fixed and random site selection used in both networks. The tertiary tier is groupings of waterbody types that are monitored using similar methods, indicators and frequencies.

MDEQ Program Support Monitoring Activities.

For this primary tier component, the common thread of activities is that they are designed to address immediate and specific water quality monitoring and assessment questions (i.e. what is the cause and source of impairment of a specific waterbody) usually dictated by other MDEQ Programs (i.e. TMDL, Standards, Non-point Source Pollution, Permitting). These monitoring activities usually involve a short term monitoring strategy and are narrow in their scope, usually designed for answering specific questions.

The secondary tier under MDEQ Program Support Activities includes two groups, Statewide Activities and Basin Activities. The main difference between these two groups is in scale. Statewide Activities are designed to address large-scale questions (i.e. what is an appropriate biological index to use for assessing statewide biological integrity) of a

specific nature and can be implemented any time. Basin Activities are designed to address small-scale questions (i.e. are the proposed NPDES limits for a specific wastewater facility appropriate for maintaining the goals of the Clean Water Act) of a specific nature and are usually implemented on the basin rotation five-year schedule. Generally, site selection for all of these activities are targeted in nature, but may involve the use of probabilistic site selection when appropriate. The tertiary tier is groupings of activities by Program type (i.e. TMDL, Standards, 303(d), WLAs) that generally involve similar objectives.

Core Indicators

To assess the overall health of waterbodies and to answer specific water quality questions, the SWMP utilizes a suite of water quality indicators. Each indicator or parameter is designed to either measure a general or specific cause of pollution (i.e. nutrients, DDT) or measure a general or specific response to pollution (biological integrity, fish kill). The SWMP includes a core group of indicators that is used to represent each applicable designated use of a waterbody (aquatic life support, contact recreation, fish consumption, and drinking water supply) and a supplemental group that is used on a site or project specific basis. Table 1 presents the core group of indicators used in MDEQ's SWMP.

Data Acquisition/Sharing with Other Monitoring Agencies

In addition to the previous ambient monitoring components outlined in this strategy and implemented by MDEQ, other government agencies and institutions throughout Mississippi perform extensive monitoring. A considerable effort has been made by MDEQ to identify, obtain information from, and work with the many other organizations collecting water quality data. This provides additional monitoring data for use in assessing state waterbodies, and also reduces, if not eliminates, replication of services and ensures efficient use of MDEQ's limited surface water monitoring resources. These other monitoring organizations include state and federal agencies such as the United States Geological Survey (USGS), United States Army Corps of Engineers (USACE), Tennessee Valley Authority (TVA), United States Environmental Protection Agency (USEPA), National Oceanic and Atmospheric

Administration (NOAA), Mississippi Department of Marine Resources (MDMR), Gulf Coast Research Laboratory (GCRL), United States Department of Agriculture (USDA), Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) as well as other federal, state and local agencies, research institutions and universities.

Data Management

The dissemination of accurate information is a major objective of a monitoring program. To meet this need, the Water Quality Assessment Branch (WQAB) serves as the clearinghouse for information on all MDEQ SWMP activities. In this capacity, the WQAB routinely compiles all SWMP data as well as data from outside sources and centralizes these data in one location for ready access and to facilitate data entry into and retrieval from computer databases. With a central repository for monitoring data, information can be more easily supplied to MDEQ staff, federal and state agencies and the public. Water quality monitoring assessments can also be more easily conducted and water quality summary reports generated. Two such reports are the state's Section 305(b) Water Quality Report to Congress which involves the reporting and evaluation of all surface water monitoring data collected in the state and the Section 303(d) priority list of impaired waters identified through the 305(b) assessment process.

All physical, chemical, and biological data collected under the SWMP are entered on surface water monitoring forms as analyses are completed in the field and in the laboratory. These forms are specifically designed to capture all necessary information and to facilitate accurate database entry. These forms are then screened, checked for accuracy and completeness, validated, and sorted.

All persons performing sampling and/or analysis keep copies of the original form as completed in the field and the lab. All surface water data are then entered into MDEQ databases:

- Laboratory Information Management System (LIMS) – used to track MDEQ chemical laboratory samples through the sample handling and analysis phase
- Surface Water Information Management System (SWIMS) – application for displaying all MDEQ data and sampling locations through a single Geographic Information System (GIS)

based platform, user friendly and comprehensive for agency and future public use

- Water Assessment Data Entry System (WADES) – permanent storage and retrieval system for all SWMP data
- Ecological Data Application System (EDAS) – application for storage, analyses and assessment of biological data
- Assessment Data Base (ADB) – application for 305(b) assessment and reporting

MDEQ surface water data are also routinely transferred to EPA's data storage and retrieval system (STORET) as specified in the data handling agreement executed between the EPA Regional Administrator and the Head of the Office.

Data Analysis/Assessment

Historically, an assessment methodology was developed and used by MDEQ to analyze and assess all SWMP data. This methodology, based on EPA Section 305(b) Report guidance involved determining if a waterbody was fully supporting its designated use or uses, as measured by attainment of water quality criteria. The methodology is described and outlined in MDEQ's latest 305(b) Report.

MDEQ is in the process of revising its assessment methodology, however the components of designated use support and water quality criteria will remain. The main revision will be the incorporation of 303(d) List development and maintenance into the assessment methodology.

Surface waters in Mississippi are classified and assigned various use classifications based on existing utilization of the waterbody along with any expected future uses. The use classifications used by the State of Mississippi are as follows:

- Public Water Supply
- Recreation
- Fish and Wildlife
- Shellfish Harvesting
- Ephemeral

Most of Mississippi's waters are classified as Fish and Wildlife but there are several waters that fall under classifications in addition to or other than Fish and Wildlife. For each of the use classifications listed above, there are various water quality criteria or standards that apply to those waterbody uses and which are used in the

assessment process. A complete description of the Mississippi's waterbody use classifications and water quality standards can be found in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 1995).

Reporting

MDEQ's main reporting avenue for SWMP data is through the biennial Section 305b Report. The purpose of the 305(b) report is for each state to describe the status of the quality of the state's surface and ground waters for EPA, Congress, and the public. Through compilation and summarization of the reports submitted from the states, EPA can summarize the status of the quality of the Nation's waters for Congress. The 305(b) Report is required by Section 305(b) of the Federal Clean Water Act and the Mississippi Department of Environmental Quality (MDEQ) is the state agency responsible for generating this report.

In addition to the 305(b) Report, MDEQ provides a list of all impaired waterbodies, required pursuant to Section 303(d) of the CWA. The 303(d) List is a prioritized listing of waterbody use impairment along with the causes of the impairment. Upon being reported on the 303(d) List, a Total Maximum Daily Load (TMDL) is developed for the cause/s and strategies for restoring the waterbody back to fully supporting its designated use/s are developed. When the TMDL has been completed or monitoring data show that the waterbody is no longer impaired, the waterbody is taken off the 303(d) List.

For the purpose of stakeholder outreach and education, MDEQ reports on SWMP activities and water quality issues through various formats such as, technical reports, brochures, posters, oral presentation, newspaper articles, and the Internet (www.deq.state.ms.us).

SUMMARY

In order to meet the primary goal of the Clean Water Act, which is for all waters to be fishable and swimmable, the Mississippi Department of Environmental Quality (MDEQ) has developed and implemented a Surface Water Monitoring Program (SWMP) to monitor and assess the status of all waters. Through this program, MDEQ strives to help conserve the quality of the natural resources of Mississippi for public use and to identify waters that

need attention so that they can be restored to optimal health. The SWMP is composed of an organized strategy to collect, analyze and assess water quality data so that meaningful statements and management decisions can be made. Steps in developing this strategy included: identifying assessment questions, developing a conceptual model, selecting indicators to be measured, establish data quality objectives, develop sampling design, developing sample collection procedures, developing laboratory sample analysis procedures, identifying data analysis procedures, and developing a mechanism for dissemination of information. By developing and implementing this organized SWMP, MDEQ seeks to ensure the quality of the State's surface waters and protect the health and welfare of Mississippi's citizens, and the State's wildlife, fish and other aquatic life.

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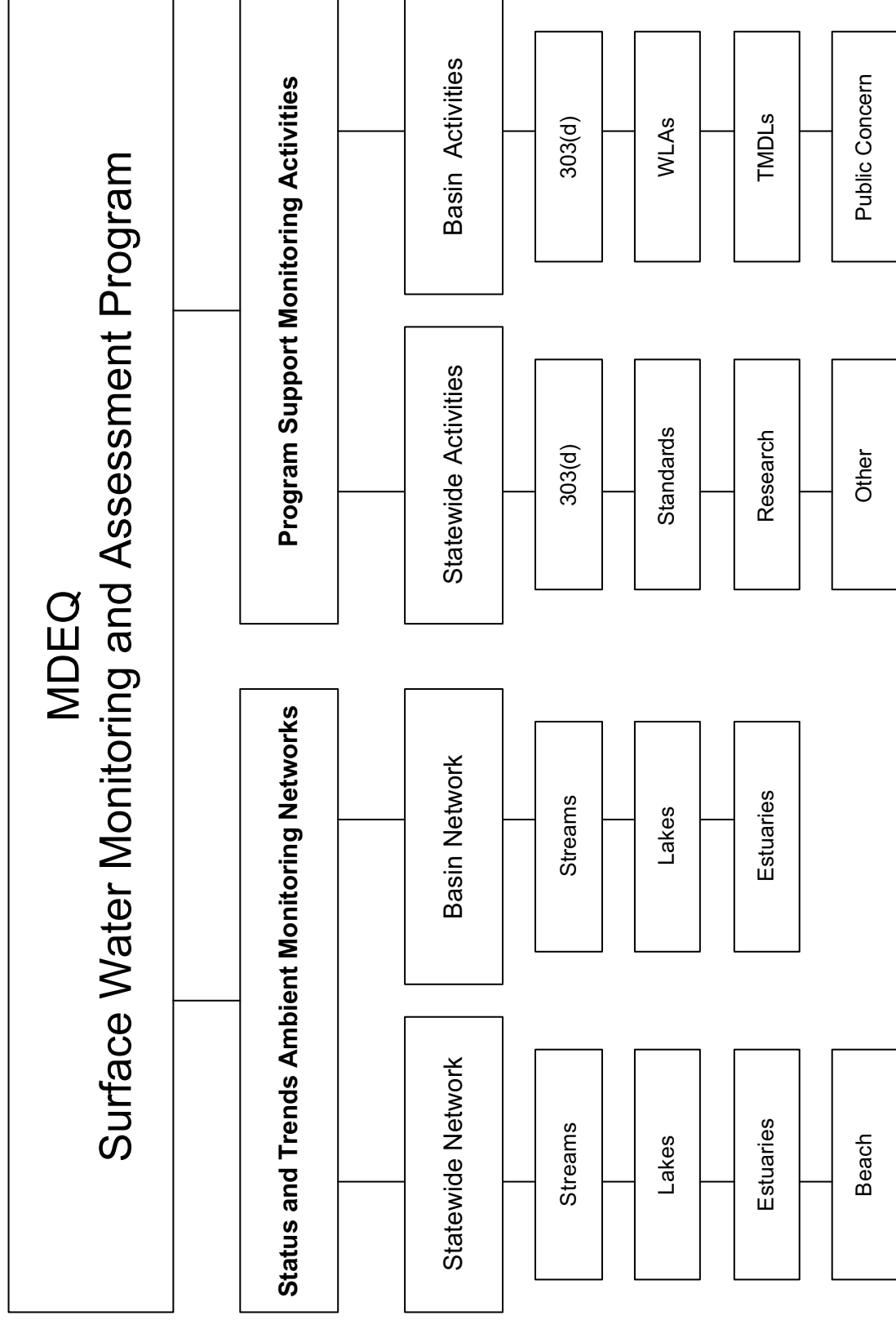


Figure 1. Tiered Surface Water Monitoring Program Design

Ambient Monitoring Stations



Legend

- Ambient Monitoring Station
- River or Stream
- Waterbody



Mississippi Department
of Environmental Quality

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Scale 1:2,500,000



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Figure 2. Map of Statewide Ambient Monitoring Network

Group	Basin
I	Big Black, Tombigbee, and Tennessee River Basins
II	Yazoo River and North Independent Streams Basins, And adjacent tributaries of the Mississippi River
III	Pearl River and South Independent Streams Basins, And adjacent tributaries of the Mississippi River
IV	Pascagoula River Basin
V	Coastal Streams Basin



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Scale 1:2,500,000



Figure 3. Map showing Basin Groups

Table 1. List of Core Indicators Used in the SWMP

Physical/Chemical		Biological	
General	Water Temperature	Pathogens	Fecal Coliform
	pH	Fish Tissue	Hexachlorobenzene
	Alkalinity		alpha BHC
	Hardness		gamma BHC
Oxygen Demand	Total Organic Carbon		Aldrin
	Biological Oxygen Demand		Dieldrin
	Chemical Oxygen Demand		Endrin
			Total DDT
Dissolved Oxygen	Dissolved Oxygen		o,p-DDE
			p,p-DDE
Water Clarity	Turbidity		o,p-DDD
	Total Suspended Solids		p,p-DDD
	Transparency		o,p-DDT
			p,p-DDT
Dissolved Substances	Specific Conductance		Toxaphene
	Total Dissolved Solids		Methoxychlor
	Salinity		Total PCB's
	Chlorides		PCB 1221
Nutrients	Nitrate + Nitrite		PCB 1232
	TKN		PCB 1248
	Ammonia		PCB 1254
	Total Phosphorus		PCB 1260
Toxics	Aluminum		PCB 1262
	Arsenic		PCB 1016/1242
	Cadmium		Chlordane
	Chromium		Pentachlorophenol
	Copper		Cadmium
	Lead		Chromium
	Manganese		Copper
	Mercury		Lead
	Nickel		Arsenic
	Selenium		Mercury
	Zinc	Biological	Macroinvertebrates
	Phenols	Nutrient Response	Chlorophyll <i>a</i>
Hydrological	Flow		
Habitat	Habitat Assessment		
	Sediment Particle Size		