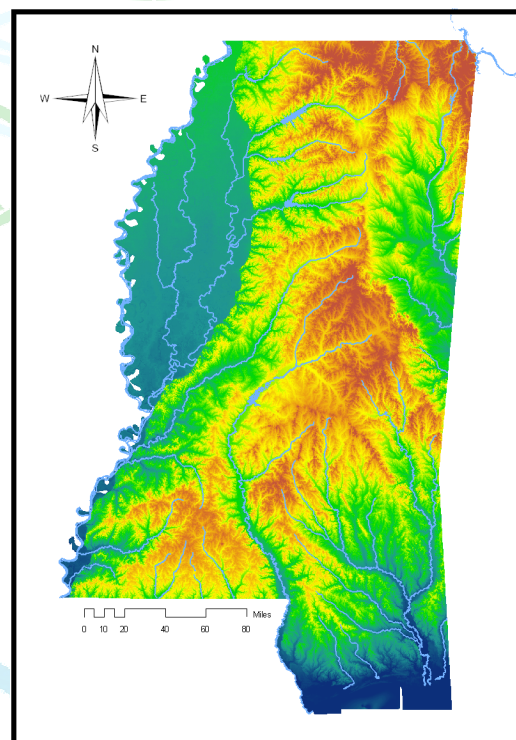
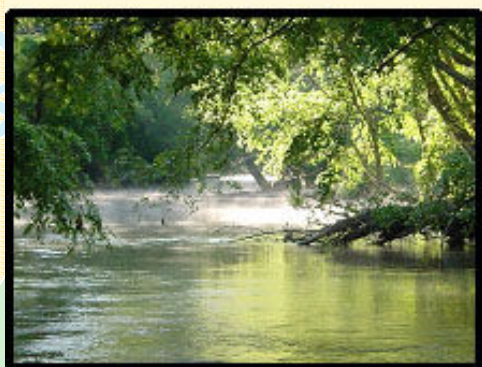
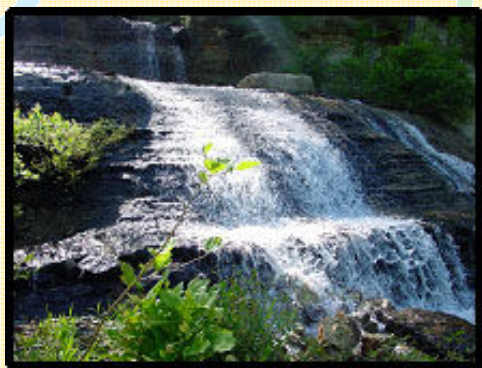


# State of Mississippi Water Quality Assessment 2008 Section 305 (b) Report



Department of Environmental Quality



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**Department of Environmental Quality**

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## **ABSTRACT**

Section 305(b) of the Federal Clean Water Act (CWA) requires each state to describe the quality of its water resources in a report for the United States Environmental Protection Agency (USEPA), Congress, and the public on a biennial basis. The Mississippi Department of Environmental Quality (MDEQ), as the lead agency for environmental protection in Mississippi, is the state agency responsible for generating this report. The purpose of Mississippi's 2008 Water Quality Assessment §305(b) Report is to comprehensively describe for USEPA, Congress, and the public the status of the quality of the state's waters. This 2008 §305(b) report fulfills all reporting requirements under §305(b) of the CWA. Along with the water quality assessment information, the report also describes the state's assessment methodology and gives the causes, where known, for those waters identified as impaired. Additionally, Mississippi's water quality monitoring program is described in this report.



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## List of Acronyms

<b>ADB</b>	Assessment Database
<b>ALUS</b>	Aquatic Life Use Support
<b>AU</b>	Assessment Unit
<b>BEACH</b>	Beaches Environmental Assessment and Coastal Health
<b>BOD</b>	Biological Oxygen Demand
<b>CALM</b>	Consolidated Assessment and Listing Methodology
<b>CWA</b>	Clean Water Act
<b>DDT</b>	Dichloro-Diphenyl-Trichloroethane
<b>DO</b>	Dissolved oxygen
<b>EMAP</b>	Environmental Monitoring and Assessment Program
<b>FDA</b>	US Food and Drug Administration
<b>FSD</b>	Field Services Division
<b>GCRL</b>	University of Southern Mississippi Gulf Coast Research Laboratory
<b>GIS</b>	Geographic Information Systems
<b>M-BISQ</b>	Mississippi Benthic Index of Stream Quality
<b>MDEQ</b>	Mississippi Department of Environmental Quality
<b>MDMR</b>	Mississippi Department of Marine Resources
<b>MDWFP</b>	Mississippi Department of Wildlife Fisheries and Parks
<b>NCA</b>	National Coastal Assessment
<b>NCTF</b>	Nutrient Criteria Task Force
<b>NHD</b>	National Hydrography Dataset
<b>NHEERL</b>	USEPA Gulf Ecology Division National Health and Environmental Effects Research Laboratory
<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>NPDES</b>	National Pollutant Discharge Elimination System
<b>NPS</b>	Non Point Source
<b>NRCS</b>	National Resource Conservation Service
<b>NSSP</b>	National Shellfish Sanitation Program
<b>OPC</b>	Office of Pollution Control
<b>ORD</b>	US EPA Office of Research and Development
<b>PCBs</b>	Polychlorinated biphenyls
<b>QAPP</b>	Quality Assurance Project Plans
<b>QC</b>	Quality Control
<b>RU</b>	Reporting Unit
<b>SI</b>	Stressor Identification
<b>SOP</b>	Standard Operating Procedures
<b>STORET</b>	STOrage and RETreival System
<b>SWMP</b>	Surface Water Monitoring Program

<b>TDS</b>	Total Dissolved Solids
<b>TMDL</b>	Total Daily Maximum Load
<b>TSI</b>	Trophic State Index
<b>TVA</b>	Tennessee Valley Authority
<b>USACE</b>	United States Army Corps of Engineers
<b>USDA</b>	United States Department of Agriculture
<b>USEPA</b>	US Environmental Protection Agency
<b>USFWS</b>	US Fish and Wildlife Service
<b>USGS</b>	US Geological Survey
<b>USM</b>	University of Southern Mississippi
<b>USNPS</b>	US National Park Service
<b>WADES</b>	Water Assessment Data entry System
<b>WQS</b>	Water Quality Standards



# **PART I**

## **INTRODUCTION**



# Introduction

## Background and Purpose

According to the Federal Clean Water Act (CWA), §305(b) requires each state to describe the quality of their water resources, both surface water and ground water, in a report for the United States Environmental Protection Agency (USEPA), Congress, and the public on a biennial basis. The Mississippi Department of Environmental Quality (MDEQ), as the lead agency for environmental protection in Mississippi, is the state agency responsible for generating this report. MDEQ is committed to ensuring that everyone, regardless of race, culture, or income enjoys a healthy environment in which to live, learn, and work. For more information on the agency's mission, organizational structure, programs, and contacts, visit MDEQ's web site at [www.deq.state.ms.us](http://www.deq.state.ms.us).

Historically, §305(b) reporting has involved comprehensive statewide assessments every two years since CWA was passed in 1972. Section 305(b) ground water assessments are updated separately. This report is designed to be comprehensive in nature, based upon the most current updated information applicable for statewide assessment of Mississippi's surface waters.

For §305(b) assessment, surface water quality data and other environmental information collected on the state's streams, rivers, lakes, estuaries, and coastal waters are compiled, summarized, and analyzed. In addition, ground water data and information are also assessed for the aquifers in the state. Monitoring data are routinely collected by MDEQ statewide through several different monitoring activities. These activities include an Ambient Fixed Station Monitoring Network, Basin Monitoring Networks, intensive surveys, and other special water quality studies. Data are used for many varied purposes, and are collectively analyzed and considered for assessment as part of the §305(b) water quality assessment process. In order to provide a thorough assessment, data are also solicited from and provided by other agencies, institutions, and private entities that conduct monitoring activities in the state.

The purpose of Mississippi's 2008 Water Quality Assessment §305(b) Report is therefore to comprehensively describe for USEPA, Congress, and the public the status of the quality of the state's waters. Along with the water quality assessment information, the report also describes the state's assessment methodology and gives the causes for those waters identified as impaired.

This 2008 §305(b) report is a comprehensive statewide report of surface water quality based on data collected from January 2001-December 2006. This report presents a compilation and summary of data collected statewide; only data collected within the reporting window are used for assessment. In general, since 2001, more rigorous data quality and quantity requirements have been employed by MDEQ to ensure only scientifically-defensible data are used in the §305(b) assessment process. The use of more rigorous data quantity and quality requirements resulted in a reduction in the amount of data available for use in §305(b) assessment but confidence, reliability, and accuracy in assessments and corresponding §303(d) listing decisions for impaired waters is greatly enhanced.

For the §305(b) report, all data and information are considered for assessment but only water quality data that meet data quantity and quality requirements according to the state's Consolidated Assessment and Listing Methodology (CALM) are assessed. Assessment involves analysis of monitoring data and information to determine if a water body meets its designated use or uses. Water bodies are assigned one or more designated use(s) based on water body classifications as outlined in *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ 2007). Designated uses assessed are: aquatic life support, water contact recreation, fish/shellfish consumption, and/or drinking water supply. Waters assessed as not attaining their use(s) in the §305(b) assessment process become candidates for listing on Mississippi's §303(d) list.

## Mississippi's Surface Waters

Mississippi lies predominantly within the East Gulf Coastal Plain physiographic region except for a small part of northeastern Mississippi which is part of the Interior Low Plateaus Province. The state is characterized with low to moderate topographic elevations, and slopes generally from the north southward to the Gulf of Mexico. The climate of the state is humid and subtropical with climatic variations influenced by the large land mass to the north and the Gulf of Mexico to the south. Mean annual precipitation ranges from 50 inches in the north to 65 inches near the coast. Most rainfall occurs in the spring for the majority of the state; but on the coast, July, August and September often have more rainfall. Fall is the driest season statewide with streams and rivers generally reaching their lowest stage for the year during October. Temperatures in the state vary with latitude and in the winter average from 31°F in the north to 43°F on the coast. Summer temperatures throughout Mississippi average 90°F with frequent excursions above 100°F especially in the south.

Mississippi has a population in excess of 2,910,000 (US Census Bureau 2006 Projection) and covers a surface area of 47,689 square miles. The state is divided into ten major river basins with a total length of streams in excess of 83,500 miles. Of these miles, 33% are perennial characterized by flowing water throughout the year. Intermittent streams which flow during rainy seasons but are dry during summer months represent 64% of Mississippi's total stream mileage. There are over 2,400 miles of man-made ditches and canals in the state. The Mississippi River (approximately 400 miles) and the Pearl River (approximately 80 miles) form Mississippi's border with Arkansas and Louisiana on the west side of the state. The state is covered with hundreds of publicly owned lakes, reservoirs and ponds covering a combined area of approximately 270,000 acres. According to land use information, wetlands cover an estimated 2,728,000 acres with tidal marsh comprising approximately 53,000 acres of this total. The southern edge of Mississippi's contiguous land mass borders the Mississippi Sound with the coastline along the Mississippi Sound totaling approximately 84 miles. The total area of estuarine waters is approximately 758 square miles. This area includes the St. Louis Bay, Back Bay of Biloxi, Pascagoula Bay, Mississippi Sound, and the portion of the Gulf of Mexico that extends three miles south of the Barrier Islands. A tabular summary of the information given above can be found in Table 1.

**Table 1: Mississippi Atlas**

State Population.....	2,910,540
State surface area (square miles).....	47,689
Number of river basins.....	10
Total number of river and stream miles* .....	83,674
- Number of perennial river miles (subset)* .....	27,463
- Number of intermittent stream miles (subset)* .....	53,754
- Number of ditch and canal miles .....	2,457
Number of lakes/reservoirs/ponds (>25 acres).....	1,239
Acres of lakes/reservoirs/ponds (>25 acres) .....	269,960
Square miles of estuaries/harbors/bays .....	758
Number of coastal miles.....	84
- Number of Public Recreational Beach Miles.....	40
Acres of freshwater wetlands .....	2,728,072
Acres of tidal wetlands .....	52,875

\*From USEPA NHD estimates

All waters of the state are classified for uses consistent with the goals of the Clean Water Act. Waters are classified according to one or more of the following classifications: Public Water Supply; Shellfish Harvesting; Recreation; Fish and Wildlife; and Ephemeral Stream. These classifications are explained fully in the state's water quality standards (MDEQ 2007b) available on MDEQ's web site. A summary of classified uses of state waters is found in Table 2.

**Table 2: Total Sizes of Waters According to Use Classification**

Classified Use	Total Size According to Classification			
	Rivers (miles)	Lakes (acres)	Estuaries (sq. miles)	Coastal Shoreline (miles)
Fish & Wildlife <sup>a</sup>	82,431	140,627		
Public Water Supply <sup>ab</sup>	87	13,597		
Recreation <sup>b</sup>	1,043	93,159	728	84
P. Water Supply & Rec. <sup>ab</sup>		22,577		
Shellfish Harvesting <sup>bc</sup>			6	
Recreation/Shellfish <sup>b</sup>			32	
Ephemeral	113			
<b>Total:</b>	83,674	269,960	758	84

<sup>a</sup> Also suitable for Secondary Contact Recreation

<sup>b</sup> Also suitable for Fish and Wildlife

<sup>c</sup> Also suitable for Recreation





## **PART II**

# **SURFACE WATER ASSESSMENT METHODOLOGY AND STATEWIDE ASSESSMENT SUMMARY**



# Assessment Methodology

## Introduction

Surface water quality assessments are technical reviews of physical, chemical, bacteriological, biological, and/or toxicological monitoring data as well as other information to determine the quality of surface water resources. A primary goal of surface water quality assessments, as required by §305(b), is to determine if the state's surface waters are meeting the fishable and swimmable goals of the CWA. A secondary goal of the §305(b) assessment process is to provide the necessary information on water body impairment for use in the development of the state's §303(d) list.

Surface water quality assessments are general characterizations of water body health and involve comparing data to the state's Water Quality Standards (WQS). Mississippi's WQS specify the appropriate levels for which various water quality parameters or indicators support a water body's designated use(s). Each use assessed for a water body is determined to be either "Attaining" or "Not Attaining" in accordance with the applicable water quality standards and USEPA guidelines for assessments pursuant to §305(b). A water body's use is said to be impaired when, based on current and reliable site-specific data of sufficient quantity, quality, and frequency of collection, it is not attaining its designated use(s). Where data and information of appropriate quality and quantity indicate non-attainment of a designated use or uses for an assessed water body, the water body will be placed on the *Mississippi 2008 Section 303(d) List of Impaired Water Bodies* (MDEQ 2008) and be subject to further monitoring and/or Total Maximum Daily Load (TMDL) development. Assessments are necessary to answer basic questions like:

*Does this water body support a healthy and diverse aquatic life for fish and other aquatic organisms?*

*Is this water body safe for swimming?*

*Are fish caught in this water body safe to eat?*

To achieve the goals of the CWA, it is necessary to have requirements and guidelines for how water quality data are collected, analyzed, and assessed. A consistent and scientifically-defensible assessment methodology provides the mechanism to enable and support sound decision-making. The USEPA has developed, with state and public input, a national guidance document for the §305(b) assessment and §303(d) listing process. This Consolidated Assessment and Listing Methodology (CALM), finalized by USEPA in 2002, provides a framework for states to document and report how they collect and use water quality data and information for their §305(b) reporting and §303(d) listing process. USEPA recommended the use of the CALM guidance for the 2008 assessment but also allowed states flexibility and the option of using previous §305(b) guidance for water quality assessment purposes. For the Mississippi 2008 assessment, MDEQ has developed a document entitled *Mississippi Consolidated Assessment and Listing*

*Methodology (CALM) 2008 Assessment and Listing Cycle* (MDEQ 2008) which can be provided upon request or found at [www.deq.state.ms.us](http://www.deq.state.ms.us). The purpose of this document is to specify MDEQ's data requirements and assessment guidelines for the 2008 §305(b) assessment and §303(d) listing cycle. Mississippi's CALM document primarily reflects USEPA CALM recommendations but also retains some elements of previous §305(b) guidance.

## Water Quality Standards

Surface waters in Mississippi are used for a number of purposes. Waters are used for drinking and food processing, shellfishing, recreation, fishing, and aquatic life support. Water bodies are classified and assigned various use classifications by MDEQ in the state's Water Quality Standards based on the use of the water body identified by the public and other entities. The use classifications and associated USEPA designated uses for water quality assessment purposes recognized by the State of Mississippi are as follows:

Use Classification	USEPA Associated Designated Use
Public Water Supply	Drinking Water Supply
Recreation	Contact Recreation
Fish and Wildlife	Aquatic Life Use, Fish Consumption, Secondary Contact Recreation
Shellfish Harvesting	Shellfish Consumption

Most of Mississippi's waters are classified as Fish and Wildlife. For each of the use classifications listed above, there are various water quality criteria or standards that apply to those water body uses. These criteria are used in the assessment process. A water body (part or all of a stream, river, lake, estuary or coastline) should support one or more of these uses. A complete description of Mississippi's water body use classifications and water quality standards can be found in the state's WQS.

## Mississippi 2008 §305(b) Assessment Methodology

Water quality data and information can take many different forms, from simple observations to routine fixed network monitoring and intensive surveys with extensive water chemistry, biology, and physical data sampling. For §305(b) Water Quality Assessment Reports, MDEQ assesses the state's streams, rivers, lakes, and estuaries by considering all existing and readily available information. This process is not limited to data collected only by MDEQ. MDEQ solicits available water quality data and information from various state, federal, public, and private sources. Data solicitation is facilitated through Mississippi's Basin Management Approach. The public may also

submit water quality data for consideration at any time. This broad spectrum of available data is considered when making water quality assessments.

## **Data Representativeness**

Previous USEPA §305(b) guidance, *Guidelines for Preparation of the Comprehensive State Water Quality Assessments (§305(b) Reports) and Electronic Updates: Supplement* (USEPA 1997), promoted the use of two types of assessments: “evaluated” and “monitored”. MDEQ historically used evaluated and monitored assessments to make broader water quality statements to compensate for limited monitoring coverage. A water body assessed using evaluated data is defined as one for which the use support decision is based on information other than site-specific monitoring data. Such information includes land use surveys, incidents of pollution spills/fish kills, point source discharge data, and monitoring data greater than 5 years old. These data generally have a greater degree of uncertainty in characterizing in-stream water quality condition than assessments based upon site-specific in-stream monitoring data. Prior to 2002, this evaluated information was used in the assessment process as specified by USEPA §305(b) guidance. Recognizing the varying uncertainty of data and information used by states in the assessment process, §305(b) guidance recommended assigning a rating for the quality of information, or data confidence, used in the assessment. MDEQ reported these evaluated waters in the state’s 1996, 1998, and 2000 §305(b) reports as having a low confidence rating due to the lack of substantiated information supporting these assessments. However, according to the USEPA Region IV interpretation, any water quality impairments identified in §305(b), regardless of the confidence in the data, are still subject to §303(d) listing.

Data previously used for evaluated assessments will still be considered and used as screening information in the §305(b)/§303(d) assessment and listing process. However, for 2008, as in 2002, 2004, and 2006 MDEQ, as a general rule, will only use site-specific monitoring data of sufficient quality and quantity for making final water quality §305(b) assessments and §303(d) listing decisions. Any remaining information and monitoring data not meeting CALM requirements for data sufficiency will be used for a non-attainment assessment decision when those data and information demonstrate compelling evidence of water quality degradation of the overall condition of a water body, as defined in Mississippi’s CALM document, and data quality documentation is available. If there is no documented data quality information, data do not meet data quality objectives, and/or data demonstrate potential impairment but at a lesser degree, the water body will be placed on a targeted monitoring list to confirm the actual water quality condition.

Section 305(b) water quality assessments are based on one or more different types of monitoring data that have been grouped together by water body and then analyzed collectively in order to determine the water quality status or condition of the water body. Monitoring data used for §305(b) assessments primarily consist of one or more of the following data types: physical/chemical, biological, habitat, bacteriological, and/or toxicological. Current site-specific ambient monitoring data are considered to most accurately portray water quality conditions. A water body is classified as monitored if

sufficient (both in quantity and quality) physical, chemical, biological, bacteriological, and/or fish tissue data were collected on the water body at any time within the data window established for the §305(b) reporting period. Data used in §305(b) assessments are considered representative if the data are collected within the reporting period prior to the assessment. For the 2008 §305(b) report, this data window is from 2001-2006.

Physical and chemical data include parameters such as pH, temperature, dissolved oxygen, nutrients, suspended solids, turbidity, specific conductance, and certain water column toxicants. Chemical monitoring data are compared to applicable numeric water quality criteria as found in MDEQ's most current version of the WQS document (MDEQ 2007b). This allows MDEQ to determine which pollutant specific numeric criteria are violated. These criteria are used for aquatic life, recreation, shellfish consumption, and drinking water use assessment.

Biological data may include the community structure of aquatic insects and other benthic macroinvertebrates, fish, or algae as well as the condition of biological habitat in the water body. The biota of a water body reflect the physical, chemical, and biological integrity of the system and are considered to be direct indicators of Aquatic Life Use Support (ALUS). For Mississippi §305(b) assessments, benthic macroinvertebrate community data are the biological indicator primarily used to determine ALUS. Biological data collected as part of the Mississippi Benthic Index of Stream Quality (M-BISQ), MDEQ's biological monitoring network for Wadeable streams, have been the primary source of data for ALUS assessments in Mississippi waters, due to rigorous project data quality objectives and a robust data set.

Bacteriological data include water column surveys for fecal coliform bacteria or other bacteriological indicators (i.e., enterococci). These data are used to assess the recreation use for waters to protect the public in swimming and other water related activities. For the 2008 §305(b) assessment, bacteriological data identified as meeting Mississippi CALM requirements were provided by the MDEQ Beach Monitoring Program and MDEQ special project sampling to address statewide §303(d) listed waters with pathogens indicated as the cause of impairment. Fecal coliform data are also used indirectly for assessment of the Shellfish Consumption use. Shellfish Consumption use assessment is accomplished through the review of the current shellfish harvesting classification of Mississippi coastal waters established by the National Shellfish Sanitation Program (NSSP) in Mississippi. The NSSP is administered by the Mississippi Department of Marine Resources (MDMR), and classifies coastal waters in Mississippi as either approved, conditionally approved, restricted or prohibited, based on results of fecal coliform monitoring conducted by MDMR.

Fish tissue data include the analyses of fish flesh for the presence of toxic organic chemicals and metals. For this report, the Fish Consumption Use is assessed only for non-attainment based on whether MDEQ and the Mississippi Department of Health have issued a Fish Tissue Advisory for a water body in the state. If an advisory for "restricted" or no consumption is in place and is supported by water body-specific fish tissue monitoring, the water body is assessed as not attaining this use.



The length of record of the data, the type of data and the frequency of data collection are considered when making use support determinations. According to the Mississippi CALM, at least 20 data points within a five-year period are required for conventional parameters and 10 data points within three years are required for assessment of metals. For bacteria data, not including data from the MDEQ Beach Monitoring Program, a minimum of five fecal coliform samples collected over a 30-day period in each season (summer and winter) over two years are necessary for bacteriological assessment. For MDEQ beach monitoring data, a total of 20 enterococci samples are needed in each season over a period of two years to meet CALM requirements.

In general, data utilized in §305(b) assessments are collected, analyzed, and interpreted in a manner consistent with state and USEPA guidelines.

### **Data Quality**

The ability to make meaningful and scientifically defensible statements about the overall status of a water body depends directly on the vigor and quality under which the data are collected, analyzed, and reported. Data generated by MDEQ, other agencies, and individuals should be of the quality and quantity necessary to make credible and realistic assessment decisions on the condition of the state's waters. Whenever possible, data need to be of the highest quality and developed using sampling and analytical protocols and standard operating procedures recognized by state and USEPA quality assurance (QA) program plans. Data will not be assessed from data-reporting entities that do not provide data quality information or documented SOPs or procedures to support the data.

### **Water Body Use Support Determination**

In accordance with recommendations from USEPA's Consolidated §305(b) Assessment and §303(d) Listing guidance document, *Consolidated Assessment and Listing Methodology, Toward a Compendium of Best Practices* (USEPA 2002), MDEQ began using more rigorous data sufficiency requirements for the §305(b) assessment process. Although all data are considered for assessment, once a data set is reviewed, it may be determined that all data and information collection activities do not meet the rigorous quality, quantity, and sampling frequency requirements given in Mississippi's CALM. However, these data and information collection activities still serve a useful purpose and MDEQ will not disregard these data in the §305(b) assessment process. Data and information that do not meet the requirements stated in the CALM methodology will be used for a listing decision when those data demonstrate compelling evidence of the condition of a water body and the data are supported by data quality documentation.

Use support decisions are made based on a cumulative evaluation of all the monitoring data coupled with any other existing and readily available information for an individual water body. A detailed description of the assessment methodology used by MDEQ for the 2008 §305(b) Assessment and §303(d) Listing process is provided upon request. The Mississippi CALM describes the minimum data quantity and quality needed to meet data

sufficiency requirements for assessment. Decision-making criteria for attainment and non-attainment of each designated use are also presented in that document. These guidelines apply, as appropriate, to rivers, streams, lakes, estuaries, and coastal waters.

Within the water quality assessment process, a certain degree of uncertainty is inherent for any assessment decision made. The correctness of data analysis is directly dependent on study design, data quantity, data quality, and the accuracy and rigor of the methods used in collection, laboratory analysis, and the assessment process itself. All data used to make formal assessments of the quality of the state's waters, regardless of its source, will be evaluated in keeping with the requirements and guidelines contained in Mississippi's CALM document.

### **Assessment Database (ADB)**

All information collected during the assessment process is placed in Mississippi's version of USEPA's Assessment Database (ADB), which has been customized to facilitate Mississippi's assessment and reporting needs. The ADB is useful for maintaining the quality and consistency of water body assessments. Information placed in ADB for each water body includes location and description, designated use, assessment types, assessment category (1-5 according to USEPA's Integrated Listing protocol), use support determinations, causes of impairment, and sources of impairment. The ADB allows for the linking of impairment causes and sources with different uses for the same water body and is used to generate the various required summary tables for each water body type. Electronic ADB files for the §305(b) assessment are submitted to USEPA for compilation with data from the other states.

All water bodies cataloged in the ADB are also geo-referenced. Using Arc Info software, in conjunction with the National Hydrography Dataset (NHD) coverage, all water body assessments are assigned a unique identifier or assessment unit (AU) that is designated according to where the water body is located within a 12-digit subwatershed. The 12-digit subwatershed is referred to as the reporting unit (RU). The combination of the RU and the AU results in a 6 digit unique identifier that is cataloged in the ADB to store and track assessment information. The first number identifies the basin in which the water body is located. The major basins in the state are numbered 1 through 9 in alphabetical order (e.g. 1 is the Big Black River basin, and 9 is the Yazoo River Basin (Figure 1)). The next three digits in the identifier refer to the specific 12 digit subwatershed within the basin, starting with 001 (e.g. 146 located in the Big Black Basin would be 1146). The final two digits in the identifier refer to a specific stream segment within the subwatershed beginning with 11. For instance, Beaver Creek, with waterbody ID 521413 is stream segment 13 in subwatershed 214 in the Pearl River Basin. An exception to this system is found in the Yazoo River Basin. In the Yazoo, subwatersheds in the Hills region begin with 001, while subwatersheds in the Mississippi Delta begin with 500.

All geo-referenced information is provided to USEPA electronically. In addition, individual segment assessment information, similar to what is provided to USEPA

Region IV via electronic data files, can be found in Appendix A. These assessments reflect the attainment status and corresponding category designation as of April 1, 2008.

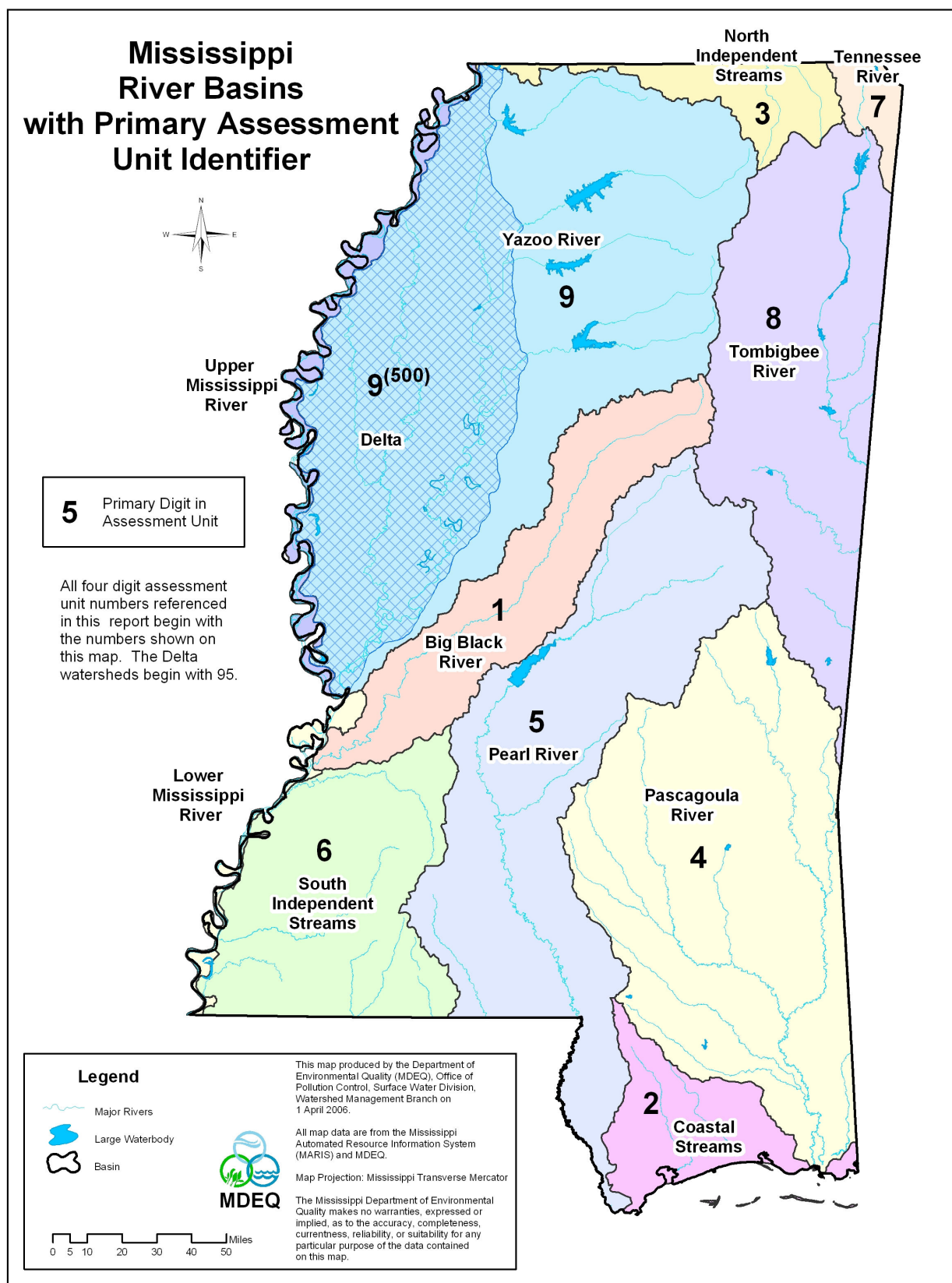


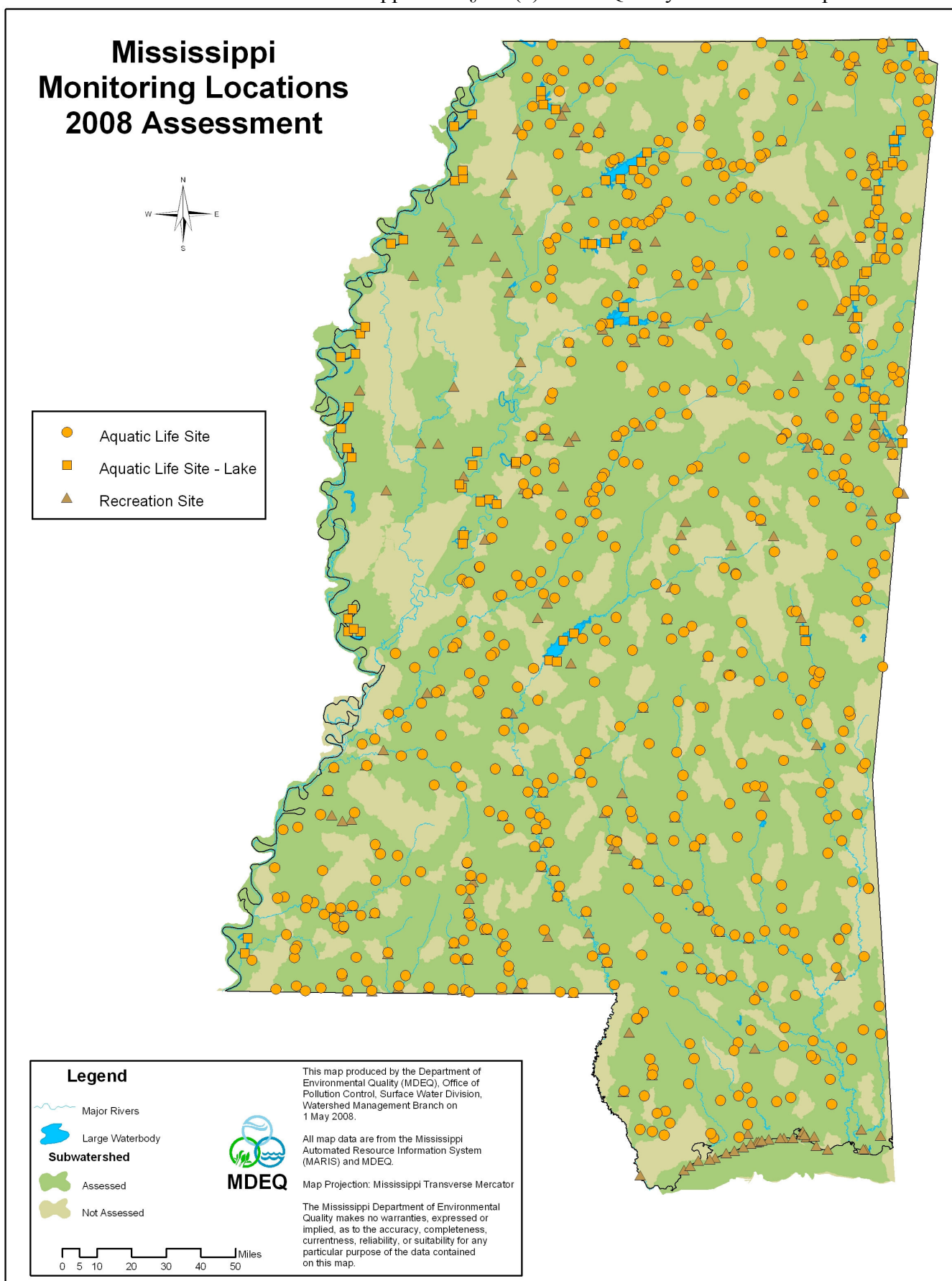
Figure 1: Mississippi River Basins and Delta

# **Statewide Assessment Summary**

## **Designated Use Support-Rivers and Streams**

For the 2008 §305(b) Water Quality Assessment Report, MDEQ assessed approximately 30% (8,172 miles) of Mississippi's total 27,463 miles of perennial streams and rivers for one or more uses. The status of water quality on the remaining 70% (19,264 miles) of the state's perennial rivers and streams is unknown.

The low percentage of assessed waters relative to the total stream and river mileage in the state is not an indication of MDEQ's lack of monitoring efforts. In fact, for this reporting period, MDEQ monitored 71% of the state's 1,292 12-digit watersheds. These monitoring efforts entailed data collected at more than 895 sites in the state (Figure 2). However, the mathematical calculation of miles monitored/assessed is surprisingly low when compared to the total miles of water resources in the state. The resulting assessed mileage is not an accurate depiction of the amount of importance MDEQ places on monitoring the state's surface water resources. It is more a factor of the amount of water resources in the state, available resources, and limitations recommended by USEPA §305(b) guidance on assigning assessed mileage to a monitoring station. As Mississippi's situation attests, it is not practical for a state to monitor all waters for a comprehensive assessment when the state has 83,674 miles of streams and rivers. MDEQ recognizes the need for a combination of monitoring and assessment approaches to address this situation in future assessments. One such tool is probability-based monitoring surveys. This is a more cost-effective and efficient way to produce a statistical estimate, of known confidence, describing the condition of a resource based on a random sampling design. Recommended by USEPA for §305(b) assessments, a state can assess 100% of its waters utilizing a probabilistic approach. MDEQ is currently using this methodology as part of the Mississippi Coastal Assessment Program and is planning to expand the probabilistic approach to the state's freshwater resources.



**Figure 2: Monitoring Locations in Mississippi**



For water bodies with multiple uses assessed, the ADB automatically assigns the water body mileages according to the Integrated Reporting category system. This categorization system assigns a water body use into one of five categories:

**Category 1:** Attaining all uses

**Category 2:** Attaining some uses but insufficient information for assessment of other uses

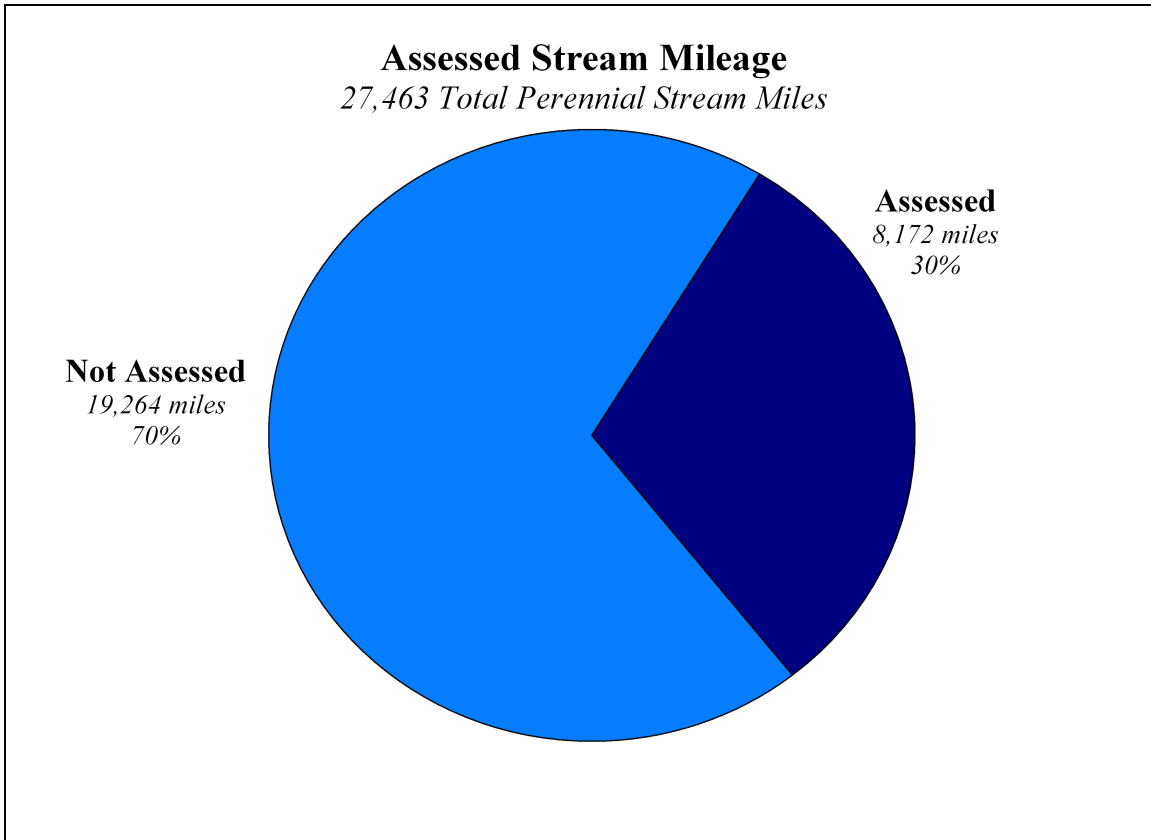
**Category 3:** Insufficient information to assess any use

**Category 4:** Not attaining a use but a TMDL is not necessary

**Category 5:** Not attaining a use and a TMDL is needed

USEPA defines a Category 1 water as having sufficient data to prove there is no impairment for any potential designated use of that water body. Mississippi currently has no water bodies assigned to Category 1 due to USEPA requirements that all uses be assessed. Mississippi's assessments are placed in categories 2-5.

Of Mississippi's 27,463 total perennial stream and river miles, approximately 30% (8,172 miles) were assessed (Figure 3).



**Figure 3: Assessed Stream Mileage: Perennial Rivers and Streams**

## **Causes and Sources of Impairment of Designated Uses- Rivers and Streams**

Causes and sources of impairment were assigned for streams and rivers having one or more uses impaired. Total assessed sizes of streams and rivers affected by various cause categories are given in Table 3 and depicted in Figure 4. For the largest percentage (28%) of miles of assessed water bodies not meeting their designated uses, impairment is caused by sediment and siltation. As Mississippi does not have sediment criteria, most of these impairment causes are identified through the Stressor Identification process. Twenty six percent of impairments are caused by unknown pollutants or other factors contributing to biological impairment. In these latter cases, actual monitoring has detected biological impairment, but the exact pollutant cause is undetermined. Pathogens were indicated as the cause of impairment in 23% of the non-attaining water bodies. Other impairments were attributed to mercury, nutrients, organic enrichment/low dissolved oxygen, salinity/TDS/chlorides, PCB's and pesticides. All of the stream miles determined to be impaired by mercury and PCB's are the result of fish consumption advisories. For the biologically impaired waters, the next step in the water quality management process is to conduct stressor identification analyses to identify the stressor(s) causing the impairment. Once the stressor(s) are identified, the TMDL process, where applicable, can proceed. For stressors identified that are attributed to pollution (i.e., a dam or levee) where TMDLs cannot be generated, other water quality management actions will be considered through the Basin Management Approach.

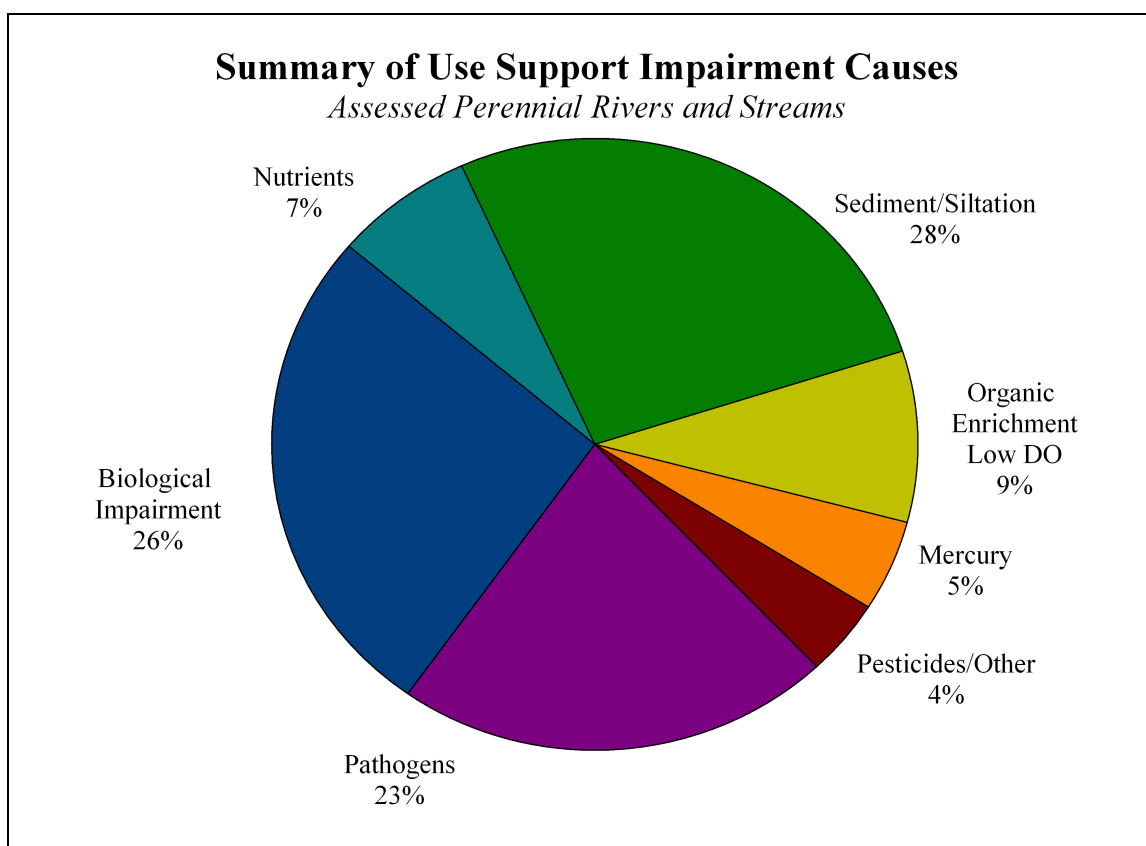
The second largest percentage of impairment was identified as biological, and the specific sources of the impairment are yet to be determined. As a result, unknown sources contribute to the majority of river miles assessed as not attaining one or more uses. To a lesser extent, pollutants are contributed by contaminated sediments, unspecified nonpoint source activities (i.e., urban, agricultural, silvicultural, and/or industrial runoff), and other smaller sources. As stated above, stressor identification analyses will be conducted for biologically impaired waters to identify sources of pollution contributing to impairment.

**Table 3: Summary of Use Support Impairment Causes for Rivers and Streams**

Cause Categories	Total Size Miles
DDT/Toxaphene	129
Mercury	277
PCBs	51
Organic Enrichment/Low DO	513
Sedimentation/Siltation	1640
Nutrients	425
Other (Biological Impairment)**	1,530
Pathogens	1,359
Salinity/TDS/Chlorides	5
pH	8
Total***	5,937

\*\*Definitive cause identification is not possible at the time of assessment. Designation used to report on waters where biological indicators (macroinvertebrates) were used and impairment was indicated but further investigation needed to identify the cause of the impairment.

\*\*\*Total exceeds number of actual impaired miles due to presence of multiple impairment cause(s) per assessed water body

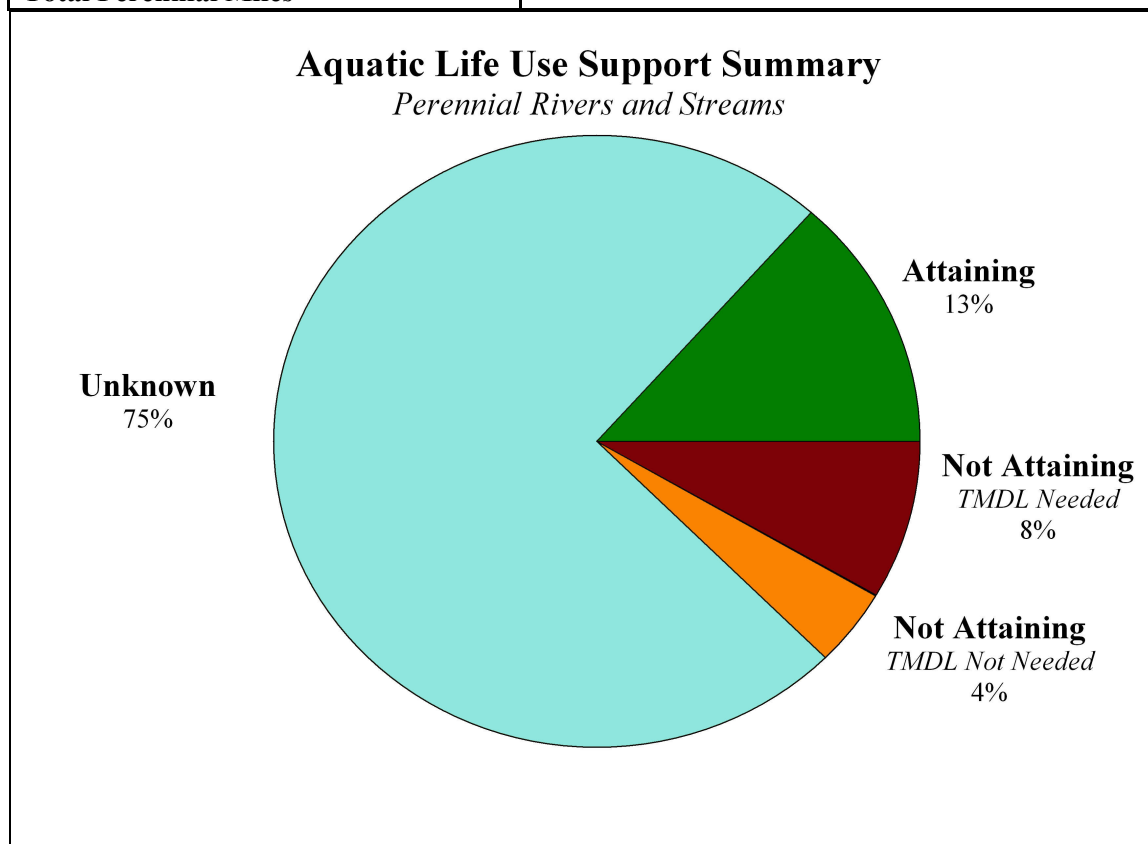
**Figure 4: Summary of Use Support Impairment Causes: Rivers and Streams**

## Assessment Summary for ALUS and Recreation

Assessments for miles of perennial rivers and streams are cataloged by use. A water body may have several different uses assessed. Therefore, numbers represented in Tables 4 and 5 are different from the mileages presented earlier in this chapter. The following tables and figures provide the assessment summaries for Aquatic Life Use Support and Recreation Use Support. Fish Consumption use has also been assessed and can be found in Part III of this report. These mileages represent the assessment status assessed for a specific use. Figures 5 and 6 give a summary of use support according to the individual uses assessed.

**Table 4: Aquatic Life Use Support Summary for Perennial Rivers and Streams**

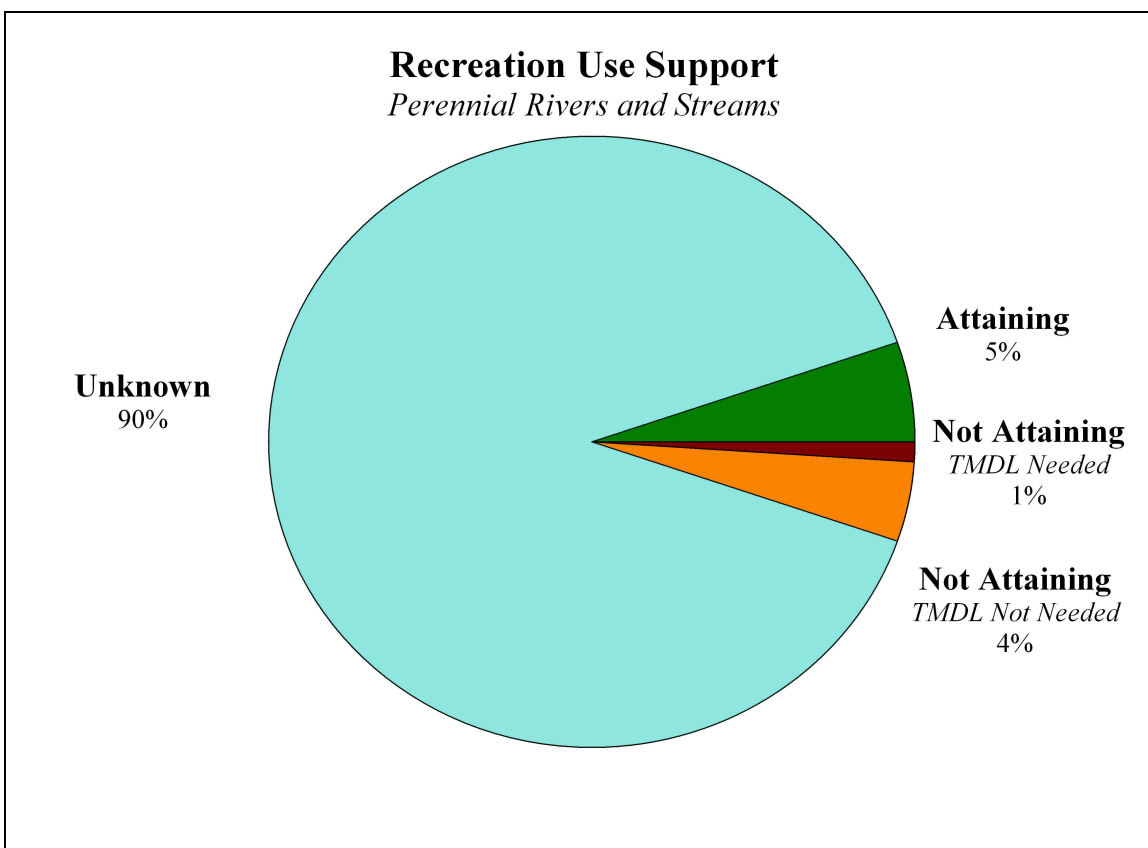
Status	Miles
Attaining	3,673
Unknown	21,402
Total Not Attaining	3,388
TMDL not needed	1,166
TMDL needed	2,222
<b>Total Perennial Miles</b>	<b>27,463</b>



**Figure 5: Aquatic Life Use Support Summary**

**Table 5: Recreation Use Support Summary for Perennial Rivers and Streams**

Status	Miles
Attaining	1,620
Unknown	23,125
Total Not Attaining	1,359
TMDL not needed	1,020
TMDL needed	339
<b>Total Perennial Miles</b>	<b>27,463</b>

**Figure 6: Recreation Use Support Summary**

## **Designated Use Support – Estuaries and Coastal Waters**

Mississippi has approximately 84 miles of coastal shoreline between the Alabama/Louisiana state boundaries and 758 square miles of coastal waters including large estuaries, smaller bays and tidal rivers, creeks, and bayous. Inland or bay type estuaries include St. Louis Bay, Back Bay of Biloxi, and Pascagoula Bay. The state's largest estuary (550 square miles) is the Mississippi Sound which extends from the southern edge of the state's contiguous land mass to the Gulf of Mexico and a chain of barrier islands (Cat, Ship, Horn, and Petit Bois Islands) located approximately 11 miles offshore. The state also classifies the Gulf of Mexico as an estuary within Mississippi waters to the state boundary located three miles south of the barrier islands.

During this §305(b) reporting period, extensive environmental monitoring was carried out by MDEQ and other State and Federal agencies and institutions in Mississippi estuaries and coastal waters through a combination of ambient fixed station trend monitoring and special studies. Rigorous CALM requirements for §305(b)/303(d) reporting, though, render part of these data unusable for §305(b) assessment due to various deficiencies in the data meeting the CALM quantity and/or quality requirements. However, all available estuarine and coastal data submitted to and/or compiled by MDEQ for the §305(b) assessment were reviewed for compelling evidence of impairment as specified by CALM. If potential impairment was noted, the water body was either assessed in this §305(b) report or assigned to a future monitoring list for follow-up sampling to confirm any impairment.

For the 2008 §305(b) report, MDEQ was able to assess 100% of the total 758 square miles of estuaries for aquatic life use. This was accomplished primarily through the use of an estuarine probability-based (random sampling) monitoring design developed by USEPA Gulf Ecology Division, National Health and Environmental Effects Research Laboratory (NHEERL), located in Gulf Breeze, Florida. This was made possible through MDEQ's participation in the National Coastal Assessment (NCA), a component of USEPA Environmental Monitoring and Assessment Program (EMAP). Additional data meeting CALM requirements for ALUS assessment in Mississippi coastal waters included intensive study data collected by MDEQ in Bayou Casotte at Pascagoula as part of a special water quality study. In addition to assessment of ALUS, MDEQ also assessed the recreation use for 57% of Mississippi's public beaches using data provided by the MDEQ Coastal Beach Monitoring Program. Shellfish consumption use was not assessed for 37 sq. miles of shellfish harvesting reefs due to damage and loss of data at MDMR from Hurricane Katrina, which drastically affected the Mississippi Gulf Coast with its August 29, 2005, landfall.

## Aquatic Life Use Support (ALUS) Assessment

Since 2000, MDEQ has been participating in USEPA's National Coastal Assessment (NCA) Program whose probabilistic design allows for assessment of 100% of the nation's estuarine and coastal resources at various geographic scales. This type of survey design consists of sampling a population of interest in a manner that allows statistically-valid statements to be made at a known confidence level about the entire population as a whole based on a sub-sample. The results of the analysis from the NCA program provide an unbiased estimate of the condition of estuarine and coastal resources and allow comprehensive assessments to be made at state, regional, bio-geographical and national levels to summarize the ecological health of coastal waters. Information and data analysis from the NCA program pertinent to aquatic life use assessment are now available and are used in Mississippi's 2008 §305(b) report development.

Each year, a new set of 30-50 randomly selected sites are sampled from July – September by MDEQ in cooperation with the University of Southern Mississippi Gulf Coast Research Laboratory (GCRL) in the state's estuaries representing three different strata: large estuaries, small estuaries, and tidal creeks and bayous. Probabilistic site selection is provided by USEPA-Gulf Breeze. For the 2008 §305(b) reporting window a total of 235 NCA monitoring sites were available for assessment purposes. Data from sites sampled in 2005 and 2006 are not available for assessment due to pending data analysis.

Assessments were based on three conventional parameters: dissolved oxygen, pH, and temperature. These data were used to assess ALUS attainment. Based on NCA data analysis, approximately 98% of all Mississippi coastal waters fully support aquatic life use for these three parameters (Table 6). Results can be further broken down by water body type and are provided in Table 7.

**Table 6: NCA Conventional Parameter Summary – All MS Coastal Waters**

Classification	Dissolved Oxygen		Temperature		pH	
All Mississippi Coastal Waters	Attaining	96.1%	Attaining	98.7%	Attaining	98.7%
	Nonattaining	3.0%	Nonattaining	0.4%	Nonattaining	0.4%
	Unknown	0.9%	Unknown	0.9%	Unknown	0.9%

**Table 7: NCA Conventional Parameter Summary – MS Coastal Waters by Strata**

<b>Classification</b>	<b>Dissolved Oxygen</b>		<b>Temperature</b>		<b>pH</b>	
<b>Large Estuaries</b>	Attaining	95.8%	Attaining	99.2%	Attaining	99.2%
	Nonattaining	3.3%	Nonattaining	0%	Nonattaining	0%
	Unknown	0.8%	Unknown	0.8%	Unknown	0.8%
<b>Small Estuaries</b>	Attaining	98.9%	Attaining	97.8%	Attaining	98.9%
	Nonattaining	0%	Nonattaining	1.1%	Nonattaining	0%
	Unknown	1.1%	Unknown	1.1%	Unknown	1.1%
<b>Tidal Creeks and Bayous</b>	Attaining	84.2%	Attaining	100%	Attaining	94.7%
	Nonattaining	15.8%	Nonattaining	0%	Nonattaining	5.3%
	Unknown	0%	Unknown	0%	Unknown	0%

The larger percentage of low dissolved oxygen in Mississippi tidal creeks and bayous is due to several factors. Low dissolved oxygen conditions are common in constricted coastal waters such as estuarine creeks and bayous with most of these conditions naturally occurring during the summer months. Although localized dissolved oxygen problems due to anthropogenic pollution sources can and do occur, high water temperatures, saline/freshwater stratification, and salt marsh interactions are prevalent in Mississippi estuarine waters and frequently combine to cause periods of low dissolved oxygen during this time of year.

The other data that met CALM requirements were collected by MDEQ during an intensive water quality study of Bayou Casotte located at Pascagoula. Conducted in August – October 2002, this study involved diel monitoring over a three month period to assess the impacts of an industrial facility discharge into the bayou. This heavily industrialized bayou has been the subject of chronic water quality complaints. Based on these data, Bayou Casotte was assessed as nonattaining of the aquatic life use for the upper portion of the bayou above the Bayou Casotte Turning Basin/Shipping Channel. The cause of the nonattainment is attributed to low dissolved oxygen and unionized ammonia.



## **Recreation Use Support Assessment**

For the 2008 §305(b) assessment, data from the MDEQ Coastal Beach Monitoring Program were used to assess recreation use support in Mississippi estuarine and coastal shoreline waters. MDEQ, in conjunction with the GCRL, conducts routine bacteria and water chemistry sampling activities at 22 beach stations located along Mississippi's Gulf Coast. The bacterial indicator used for recreation use support assessment purposes in marine and estuarine waters is enterococci. Further information on this fixed network monitoring program can be found in Part IV: Coastal Beach Monitoring Network.

Of the 40 miles of Mississippi's public beaches, 23 miles were assessed using the MDEQ Beach Monitoring Program data. Based on these data, 14.5 miles or 36 % of the beaches in Mississippi were attaining the recreation use while 8.6 miles (21 %) were found to be not attaining for primary contact recreation. These elevated bacterial concentrations resulted in occasional beach closures, due primarily to urban runoff from unspecified nonpoint sources. It should be noted that this assessment represents a five-year reporting period. Beaches are routinely monitored and are safe for swimming unless a beach advisory is in effect. To learn more about Mississippi's beach advisories, see Part III of this report.

## **Hurricane Katrina Water Quality Impact Monitoring**

On August 29, 2005, Hurricane Katrina slammed into the Louisiana and Mississippi coasts inflicting catastrophic damage of historical proportions to both states. In Mississippi, the tidal surge devastated the Mississippi Gulf Coast shoreline and inland bay areas. Following the storms, numerous federal and state agencies including the USEPA, the National Oceanic and Atmospheric Administration (NOAA), the US Food and Drug Administration (FDA), the U.S. Geological Survey (USGS), GCRL, MDMR, and MDEQ collaborated to conduct intensive monitoring of water, sediment, and fish and seafood tissue along the Mississippi Coast.

The agencies coordinated monitoring activities utilizing the strengths of each agency. This coordination provided maximum coverage with minimal overlap in a manner that maximized data comparability from site to site and from state to state across the Gulf.

- NOAA collected fish, shrimp, and oysters from the mouth of the Mississippi River to Mobile Bay, beginning September 12-13, 2005, and analyzed these samples for contaminants.
- USEPA Region 4 and MDEQ sampled 30 sites in the bays and estuaries. They analyzed water and sediment for a broad range of chemical contaminants and bacteria.
- USEPA Office of Research and Development, with assistance from MDEQ sampled 30 randomly selected sites in Mississippi Sound for water, sediment, and benthic community structure. These data can be compared to historical data from the National Coastal Assessment Program.

## Mississippi 2008 §305(b) Water Quality Assessment Report

- USGS sampled the freshwater inflows to the bays and estuaries for contaminants.
- USGS and MDEQ sampled bacteria in the sound, bays and rivers beginning on September 19, 2005. USGS set up a temporary lab at Stennis Space Center, and sampled weekly at 45 sites.
- USEPA Region 4 sampled soil and sediment around eight high priority facilities in Mississippi to evaluate potential contamination from industrial sources.
- USEPA Region 4 sampled soil, sediment and groundwater at five National Priority List (NPL) or superfund sites in the Katrina affected area in Mississippi.
- FDA, MDEQ, MDMR, and GCRL cooperated to collect and analyze fish, shrimp and crabs from 16 sampling sites along the coast.

Reports are available from this analysis. Most of the data indicate generally good water and sediment quality following the storm, and no increase in fish tissue contamination as a result of the storm. The few problem areas that have been seen appear to be specific, isolated issues.

The USEPA Bay/Estuary report is available at <http://www.epa.gov/region4/sesd/>.

The USEPA Report on the five NPL facilities is available at:  
<http://www.epa.gov/region4/sesd/>.

Detailed results of these and other Katrina related monitoring activities by USEPA can be found at the USEPA's web site, <http://www.epa.gov/katrina/index.html>.

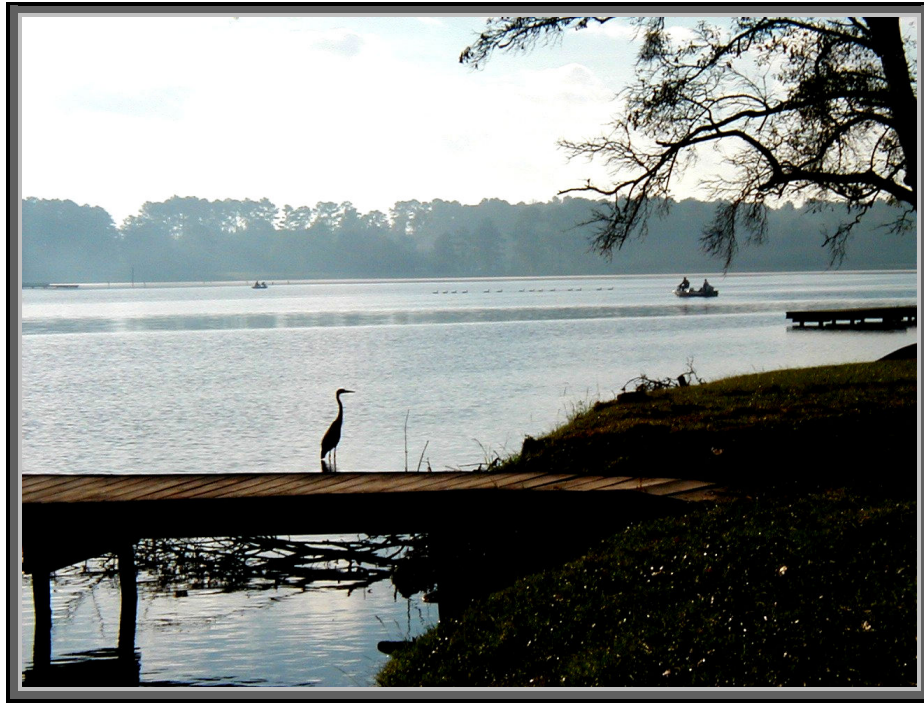
Testing results by state, county or testing site can be viewed by using EnviroMapper at:  
[www.epa.gov/enviro/katrina/emkatrina.html](http://www.epa.gov/enviro/katrina/emkatrina.html).

NOAA Monitoring Results are available at:  
[http://www.st.nmfs.noaa.gov/hurricane\\_katrina/water\\_sediment\\_survey.html](http://www.st.nmfs.noaa.gov/hurricane_katrina/water_sediment_survey.html).

# Lakes: Statewide Assessment Summary

## Lake Water Quality

Mississippi is covered with hundreds of publicly owned lakes, reservoirs, and ponds totaling approximately 270,000 acres. The largest lakes in Mississippi are man-made reservoirs. Grenada Reservoir, Enid Reservoir, Sardis Reservoir and Arkabutla Reservoir in the Yazoo River Basin are used for flood control. The Ross Barnett Reservoir (Pearl River Basin) is used as a source of drinking water for the City of Jackson. All of these large reservoirs support numerous other recreational activities. Pickwick Lake, in the state's northeast corner, is an impoundment of the Tennessee River and is shared with Alabama and Tennessee.



## Use Support Determinations

For the 2008 §305(b) Water Quality Assessment report, MDEQ assessed approximately 55% of Mississippi's total 269,960 lake acres for trophic status (see discussion under Section 314 reporting) and for basic chemical parameters indicative of aquatic life use support (ALUS) attainment status. No lakes data were available for recreation use support assessment. Fish consumption use support assessment for lakes can be found in Part III of this report. In an effort to use historical data, certain lakes and sites previously sampled by MDEQ were again used as sampling sites. At those lakes where there had been no historical sampling, sites were located near the outlet and near significant drainages into a lake. All the lakes were selected based on recommendations made by the Lakes Subcommittee of the Nutrient Criteria Task Force. Twenty-eight large lakes were assessed during the 2008 §305(b) reporting period as part of a lakes nutrient study. For the purpose of this report, large lakes were those with at least 500 acres of surface area.

## Assessment Summary for ALUS Determinations

Aquatic life use support determinations for all lakes assessed for the 2008 §305(b) report were based upon comparison of measurements of specific chemical parameters (temperature, pH, dissolved oxygen, specific conductivity and total dissolved solids) to water quality standard values presented in the Assessment Methodology section of CALM. Attainment status was based primarily upon these parameters and the 28 lakes assessed were determined to be attaining this use (Table 8). Monitoring locations can be found in Figure 7.

**Table 8: Assessed Lakes**

<b>PASCAGOULA RIVER BASIN</b>		<b>YAZOO RIVER BASIN</b>	
OKATIBEE LAKE	4,243 acres	ARKABUTLA LAKE	9,653 acres
<b>PEARL RIVER BASIN</b>		BEE LAKE	1,357 acres
ROSS BARNETT	26,221 acres	BEULAH LAKE	994 acres
<b>SOUTHERN INDEPENDENT STREAMS BASIN</b>		DESOTO LAKE	1,432 acres
LAKE MARY	2,765 acres	EAGLE LAKE	4,476 acres
<b>TOMBIGBEE RIVER BASIN</b>		ENID LAKE	14,641 acres
ABERDEEN LAKE	1,769 acres	GRENADA LAKE	19,946 acres
ALICEVILLE POOL	1,291 acres	HARD CASH LAKE	84 acres
BAY SPRINGS LAKE	6,194 acres	HORSESHOE LAKE	713 acres
COLUMBUS LAKE	2,693 acres	LAKE CHOTARD	187 acres
TENN TOM POOL B	2,437 acres	LAKE FERGERSON	1,888 acres
TENN TOM POOL C	1,367 acres	LAKE WHITTINGTON	2,135 acres
TENN TOM POOL D	1,884 acres	LEE LAKE	1,793 acres
<b>TENNESSEE RIVER BASIN</b>		MOON LAKE	2,343 acres
PICKWICK LAKE	2,948 acres	SARDIS LAKE	30,777 acres
		WASP LAKE	505 acres
		WOLF/BROAD LAKE	1,030 acres

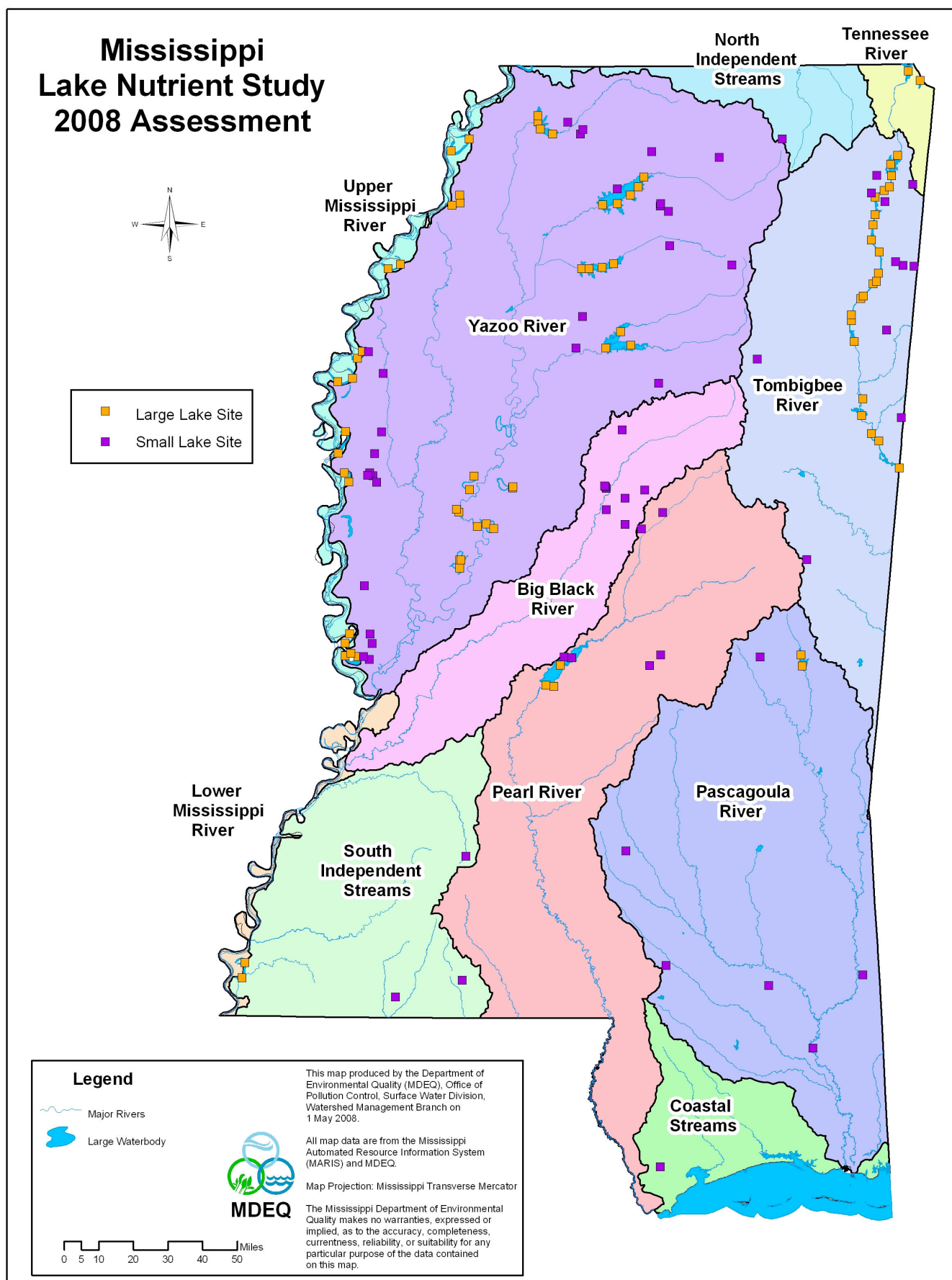


Figure 7: Statewide Lake Monitoring Station

## **Section 314 Reporting**

Mississippi initiated its Clean Lakes Program during the summer of 1982 by conducting a Clean Lakes Classification Survey on 34 public lakes. Subsequent to the passage of the 1987 amendments to the Clean Water Act, the state completed three Phase I and one Phase II Diagnostic Feasibility Studies on large lakes in the Yazoo River Basin. Through 1996, the state maintained and benefited from a Lake Water Quality Assessment (LWQA) Program, which was supported by Section 314 grants. From 1991-1996, many of the original lakes studied in the 1982 Clean Lakes Study were re-monitored, and twenty (20) were targeted for characterization of trophic level and water quality status. Results were reported in the 1996 and 1998 water quality assessments. Since that time routine lake monitoring has continued as part of ambient and special study monitoring.

## **Reporting Requirements**

Section 314 of the Clean Water Act directs each state to prepare or establish: an identification and classification according to eutrophic conditions of all publicly-owned lakes in such state; a description of procedures, processes, and methods (including land use requirements), to control sources of pollution of such lakes; a description of methods and procedures, in conjunction with appropriate federal agencies, to restore the quality of such lakes; methods and procedures to mitigate the harmful effects of high acidity; a list and description of lakes for which uses are known to be impaired and an assessment of the status and trends of water quality in lakes.

For the 2008 §305(b) Report, lake monitoring was carried out by MDEQ through a combination of ambient fixed station monitoring and special studies. In addition to routine water quality monitoring, MDEQ conducted extensive monitoring to develop nutrient criteria for Mississippi lakes.

## **Trophic Status**

Section 314 of the Clean Water Act requires that all publicly owned lakes of each state be classified according to their trophic condition. The CWA also requires within §305b that each state provide a report with an analysis of the extent to which all navigable waters of a state provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water. Requirements such as these have led to the development of various indices that enable researchers to classify water bodies based on the amount of biological production that is occurring within that water body (Brezonik 1984, Carlson 1977). These indices vary in approach with respect to variables and their classification index range, but they are based on the same concepts: that the trophic state of a lake is an important component in determining the productivity of a water body; that an index can be useful in determining the trophic state of a water body; and indicating whether it is suitable for fishing or swimming.

Trophic state is not synonymous with water quality. Although the terms are related, they should not be used interchangeably. Trophic state is a scale that describes the condition

of a water body based on its productivity. The trophic scale is a division of variables used in the definition of trophic state and is not subject to change because of the attitude or biases of the observer (Carlson and Simpson 1996).

The most widely used index for classifying lake trophic status is Carlson's Trophic State Index (USEPA 2006). This index is based on the relationship that changes in nutrient levels cause changes in algal biomass which results in changes in lake clarity. Simply, it is a measure of a lake's trophic state from oligotrophy (very clear water, nutrient poor and with high dissolved oxygen year round) to eutrophy (more productive, more plant biomass and high nutrient level) (Carlson and Simpson 1996). Three variables are commonly used to calculate Carlson's Trophic State Index (TSI) for a lake: Secchi Depth; Chlorophyll *a*; and Total Phosphorus.

The TSI for each parameter is calculated according to the following formulas:

Secchi Depth:

$$TSI = 60 - [14.41 \ln \text{Secchi depth (meters)}]$$

Chlorophyll *a*:

$$TSI = [9.81 \ln \text{Chlorophyll } a \text{ (ppb)}] + 30.6$$

Total Phosphorus:

$$TSI = [14.42 \ln \text{Total Phosphorus (ppb)}] + 4.15$$

Table 9 shows the typical ranges of TSI scores and water quality parameters associated with the three trophic states of a lake.

**Table 9: Carlson's Trophic State Index (Adapted from Addy and Green 1996).**

	TSI	Secchi Depth (m)	Chlorophyll <i>a</i>	Total Phosphorus (ppb)
Oligotrophic	<39	>4	<2.6 ppb	<12 ppb
Mesotrophic	40- 50	2-4m	2.6-7.2 ppb	12-24 ppb
Eutrophic	50- 110	<2m	>7.2 ppb	>24 ppb

Carlson's index was developed to be used with lakes that have few rooted aquatic plants and little non-algal turbidity.

Based on these assumptions, this index is not ideally suited for the majority of Mississippi lakes. However a literature review indicated that Carlson's index is the most commonly used trophic state assessment tool in the Southeast, and it appears to be the most appropriate index currently available.

These trophic assessments are based on data collected over a two year span (2003-2004). During this period, all the public lakes in Mississippi greater than 500 acres in size were sampled. The lakes were sampled six times per year, once in the spring, once in the fall and four times during the summer. To facilitate comparisons, data from the summer growing season (June through September) were given primary focus.

Based on these data, the Carlson Index indicated that all but one of the lakes sampled were eutrophic. Bay Springs Lake on the Tennessee-Tombigbee Waterway was classified as mesotrophic. The TSI based on secchi depth seems to provide the best assessment of trophic status for Mississippi lakes. This could be due to the fact that nutrients in Mississippi often enter water bodies along with soil particles from agricultural fields or other runoff. Therefore, low secchi depth may also be correlated with increased nutrients and productivity. For example, lakes may be muddy during the spring and early summer months with limited light penetration preventing significant algal growth. However, as water clears later in the summer and fall, the available nutrients can cause rapid phytoplankton growth. The trophic status for each lake is provided in Table 10.

Clay, turbidity, and pH also affect the bio-availability of phosphorus. Low pH reduces the solubility while phosphorus binds onto the clay preventing it from dissolving efficiently into the water column (Reicke 2005, Oldham 2003, Greenwood and Earnshaw 2002). Thus, TSI for phosphorus may not be an appropriate variable to measure in Mississippi for use in this index.

Oligotrophy vs. mesotrophy vs. eutrophy is not a reflection of whether a water body is “good,” “fair,” or “poor” as different trophic states are suitable for different activities. An oligotrophic lake may be more desirable for swimming, whereas a eutrophic lake may be more desirable for fishing (Addy and Green 1996). An oligotrophic or a eutrophic lake has attributes of production that remain constant regardless of the use of the water or where the lake is located (Carlson and Simpson 1996). Some lakes are naturally eutrophic, because trophic state is a reflection of a lake’s physical condition. Size and shape of the lake, residence time, geology, soils and size of the watershed all play a role in trophic state. Additionally, man-made reservoirs tend to become eutrophic more rapidly than natural lakes, since there is a tendency for these reservoirs to revert back to their original states, typically a stream system or marsh. Natural eutrophication occurs over thousands of years; but human activities can accelerate the process by introducing fertilizers, pesticides and sediments (Addy and Green 1996).



Table 10: Trophic Status of Lakes

Lake	Secchi Depth (m)	Chlorophyll <i>a</i>	Total Phosphorus (ppb)	TSI Secchi Depth	TSI Chlorophyll <i>a</i>	TSI Total Phosphorus	Classification
Aberdeen Lake	0.36	9.24	0.07	74.7	52.4	32.8	Eutrophic
Arkabutla Lake	0.44	6.37	1.1	71.7	48.7	38.3	Eutrophic
Aliceville Pool	0.39	8.6	0.09	73.6	51.7	36.4	Eutrophic
Bay Springs Lake	2.17	3.18	0.03	48.7	41.9	19.9	Mesotrophic
Bee Lake	0.35	25.0	0.11	74.8	62.2	39.7	Eutrophic
Beulah Lake	0.36	30.6	0.15	74.4	64.1	43.5	Eutrophic
Bluff Lake	0.57	12.3	0.83	68.0	55.2	34.7	Eutrophic
Lake Bogue Homo	1.04	5.81	0.04	59.3	47.8	26.9	Eutrophic
Lake Bolivar	0.18	45.4	0.33	84.2	68.0	54.7	Eutrophic
Lake Chotard	0.57	31.6	0.11	67.9	64.4	39.5	Eutrophic
Columbus Lake	0.4	10.3	0.09	73.2	53.4	36.8	Eutrophic
Dalewood Shores Lake	0.98	10.0	0.03	60.1	53.2	22.2	Eutrophic
Desoto Lake	0.62	22.6	0.07	66.7	61.2	32.4	Eutrophic
Eagle Lake	0.39	41.9	0.15	73.4	67.2	43.8	Eutrophic
Elvis Presley Lake	1.39	3.4	0.02	55.1	42.6	15.8	Eutrophic
Enid Reservoir	0.8	5.97	0.06	63.1	48.1	30.6	Eutrophic
Lake Ferguson	0.74	17.2	NA	51.9	45.1	NA	Eutrophic
Flint Creek	1.75	5.9	0.02	51.8	48.0	14.1	Eutrophic
Geiger Lake	0.93	17.5	0.05	60.9	58.7	27.3	Eutrophic
Grenada Reservoir	0.52	6.39	0.06	68.8	48.8	29.9	Eutrophic
Hard Cash Lake	0.49	10.0	0.05	70	53.2	28.5	Eutrophic
Horseshoe Lake	0.49	26.1	0.13	70.1	62.6	41.8	Eutrophic
Horn Lake	0.44	31.6	0.15	71.6	64.4	43.4	Eutrophic
Kemper County Lake	1.1	7.9	0.04	58.6	50.8	25.8	Eutrophic
Lake Lamar Bruce	0.93	11.6	0.03	61.0	54.6	22.7	Eutrophic
Little Black Creek	1.29	7.45	0.02	56.3	50.3	18.9	Eutrophic

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Lake	Secchi Depth (m)	Chlorophyll <i>a</i>	Total Phosphorus (ppb)	TSI Secchi Depth	TSI Chlorophyll <i>a</i>	TSI Total Phosphorus	Classification
Lake Lee	0.58	21.0	0.1	67.6	60.5	38.1	Eutrophic
Lake Lincoln	0.91	10.1	0.03	61.2	53.3	22.7	Eutrophic
Lake Mary	0.8	14.6	0.05	63.1	56.9	29.2	Eutrophic
Lake Whittington	0.68	23.0	0.08	65.4	61.3	35.6	Eutrophic
Moon Lake	0.54	8.57	0.15	68.8	51.6	44.0	Eutrophic
Natchez State Lake	0.99	13.4	0.04	60.0	56.1	24.8	Eutrophic
Okatibbee Reservoir	0.62	8.6	0.04	66.7	51.7	26.9	Eutrophic
Pickwick Reservoir	1.14	8.86	0.04	58.0	52	27.1	Eutrophic
Pool A (Tenn-Tom)	0.55	4.9	0.04	68.5	46.1	25.4	Eutrophic
Pool B (Tenn-Tom)	0.58	4.39	0.04	67.7	45.1	24.2	Eutrophic
Pool C (Tenn-Tom)	0.86	3.35	0.02	62.1	42.4	19.3	Eutrophic
Pool D (Tenn-Tom)	1.01	3.03	0.02	59.7	41.4	15.8	Eutrophic
Pool E (Tenn-Tom)	0.85	2.84	0.06	62.2	40.8	30.7	Eutrophic
Ross Barnett	0.44	11.5	0.1	71.6	54.6	37.9	Eutrophic
Roebuck Lake	0.19	13.2	0.18	83.8	55.9	46.5	Eutrophic
Sardis Reservoir	1.38	4.86	0.04	55.3	46.1	26.9	Eutrophic
Lake Tangipahoa	1.28	12.5	0.05	56.3	55.3	28.4	Eutrophic
Lake Tchula	NA	12.1	0.13	NA	55.1	41.8	Eutrophic
Tunica Cutoff	0.61	20.6	0.07	67.1	60.2	33.8	Eutrophic
Trace State Lake	0.71	9.75	0.04	64.8	52.9	26.6	Eutrophic
Turkey Fork	0.89	15.7	0.06	61.6	57.6	30.3	Eutrophic
Wolf/Broad	0.35	18.2	0.16	74.8	59.0	44.5	Eutrophic
Lake Washington	0.29	57.9	0.23	77.7	70.4	49.5	Eutrophic
Wasp Lake	0.17	21.4	0.16	85.2	60.6	44.5	Eutrophic

## **Lake Pollution Control Methods**

Sources polluting lakes in Mississippi are controlled through several state and local programs. Point sources are regulated by MDEQ through issuance and enforcement of NPDES permits ensuring that lake water quality complies with Mississippi's water quality standards. If an existing or proposed point source discharge is found to be detrimental to a lake's water quality, alternative discharge sites are investigated.

Nonpoint source pollution is by far the major source of pollution to Mississippi's lakes. Several lakes have been targeted for demonstration projects in the Nonpoint Source (NPS) Program. Mississippi's NPS Program has identified control measures to address nonpoint source problems and is working with the agencies and groups which will implement the measures.

Local units of government can play an important role in protecting lakes. Counties or municipalities may adopt land use ordinances or regulations that can be more effective than statewide programs in protecting lakes.

MDEQ's Wetlands Program also plays a role in protecting lakes. Wetlands serve as valuable fish and wildlife habitat, and as effective natural filters of pollutants entering streams and lakes. MDEQ strives to minimize wetlands losses around lakes. In addition, the creation or restoration of wetland acres is a measure to control NPS pollution entering lakes.



## **PART III**

# **PUBLIC HEALTH CONCERNS AND ADVISORIES**



## Public Health Concerns and Advisories

### Introduction

Toxic pollutants and pathogenic organisms in our environment are a widespread and growing public concern. As MDEQ turns its attention more toward risk assessment and public health, levels of toxic pollutants and pathogens in water, sediment and fish tissue become increasingly important.

Monitoring for toxins and bacteriological indicators of pathogens in surface waters is accomplished through several data collection activities by MDEQ as well as other state and federal agencies. MDEQ monitoring activities for toxicants and bacteria include water column, sediment, and/or fish tissue sampling from: ambient fixed station network program monitoring, emergency response to pollutant spills or discharges, hazardous waste program investigations, and special monitoring studies for pollutants of state, regional, or national environmental concern (e.g., mercury, dioxin).



Results from these monitoring activities may lead MDEQ and/or other partnering state agencies to issue public health advisories or restrictions on the use of affected water bodies when unsafe levels of pollutants are detected. In some cases, a “blanket” public health advisory may be issued as a general precaution for

areas where the pollutant(s) may impact a broad area, is pervasive, and/or the pollutant source is not readily controllable (i.e., atmospheric deposition of mercury). Monitoring of the affected geographic area is continued and expanded as necessary to ensure the public health advisory is maintained as long as warranted.

## Fish Tissue Contamination

Most of the water bodies in Mississippi with elevated levels of toxicants have some form of the toxicant present in fish tissue. In addition, with one of the CWA goals being to maintain fishable waters and ensure attainment of fish consumption use, fish tissue monitoring and assessment are of primary importance in water quality management activities. Major fish toxicant issues currently under investigation by MDEQ include continued concern over pesticides in the Yazoo River Basin (Delta region) and mercury contamination in several areas of the state. To address these issues, as well as to monitor general status and trends in fish tissue contaminants, MDEQ maintains a comprehensive fish tissue monitoring program.

Ambient fish tissue sampling through the Status and Trends Network of the MDEQ Surface Water Monitoring Program occurs annually at 25 primary fixed stations across the state and at selected basin network sites. Additional fish tissue sampling for fish kill investigations, monitoring of fish advisory areas, and for special studies is also conducted. A distribution of the fish tissue sampling occurring at MDEQ for this §305(b) reporting period is shown in Table 11.

**Table 11: MDEQ Fish Samples Collected from 2001-2006**

<b>Type of Study</b>	<b>Number of Samples</b>	<b>Number of Fish</b>
Ambient	258	852
Mercury	254	574
Dioxin	56	188
PCB's	31	96
Pesticides	294	903
Special Studies	8	34
<b>Total:</b>	<b>901</b>	<b>2647</b>

## Fish Consumption Advisories and Fishing Bans

The fish consumption advisories and commercial fishing bans presently in effect are listed in Table 12 and shown in Figure 8.



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**Table 12: Fish Tissue Advisories in Mississippi**

<b>MISSISSIPPI'S FISH TISSUE ADVISORIES AND COMMERCIAL FISHING BANS AUGUST 2001</b>			
<b>WATERBODY</b>	<b>CHEMICAL</b>	<b>DATE ISSUED</b>	<b>ACTION</b>
Little Conehoma Creek and Yockanookany River in Attala and Leake Counties. From Hwy 35 near Kosciusko, downstream to Hwy 429 near Thomastown	<b>PCB's</b>	<b>June 1987</b>	Consumption Advisory All Species Commercial Fishing Ban
Lake Susie, Oxbow Lake of Old Tallahatchie River in Panola County west of Batesville.	<b>PCB's</b>	<b>Nov. 1989</b>	Same as above
Escatawpa River from the Alabama state line to I-10.	<b>Mercury</b>	<b>May 1995</b>	Limit Consumption Advisory for largemouth bass and large catfish (>27 in.)*
Bogue Chitto River, entire length in MS.	<b>Mercury</b>	<b>May 1995</b>	Same as above
Yockanookany River, entire length.	<b>Mercury</b>	<b>May 1995</b>	Same as above
Pearl River from Hwy 25 near Carthage, downstream to the Leake County Water Park.	<b>Mercury</b>	<b>June 2001</b>	Same as above
Enid Reservoir	<b>Mercury</b>	<b>May 1995</b>	Same as above
Yocona River from Enid Reservoir downstream to the confluence with the Tallahatchie River.	<b>Mercury</b>	<b>Sept. 1996</b>	Same as above
Pascagoula River, entire length.	<b>Mercury</b>	<b>Sept. 1996</b>	Same as above
Archusa Creek Water Park	<b>Mercury</b>	<b>Sept. 1996</b>	Same as above
Grenada Lake and Yalobusha River from the dam downstream to Holcomb.	<b>Mercury</b>	<b>June 2001</b>	Same as above
Mississippi Delta - all waters from the mainline Mississippi River Levee on the West to the Bluff hills on the East.	<b>DDT, Toxaphene</b>	<b>June 2001</b>	Limit Consumption Advisory for carp, buffalo, gar, and large catfish (>22 in.)****
Roebuck Lake, LeFlore County	<b>DDT, Toxaphene</b>	<b>June 2001</b>	Limit Consumption Advisory for carp, gar, and large catfish (>22 in.)**** No Consumption of Buffalo. Commercial Fishing Ban
Yazoo National Wildlife Refuge (all waters)	<b>DDT, Toxaphene</b>	<b>1975</b>	Closed to fishing**
Gulf of Mexico	<b>Mercury</b>	<b>May 1998</b>	King Mackerel <33" - no limit, 33-39" limit consumption***, >39" - do not eat
* The Mississippi State Health Department recommends that people limit the amount of bass and large catfish that they eat from these areas, because of high levels of mercury in the fish. Children under seven and women of child bearing age should eat no more than one meal of these fish every two months. Other adults should eat no more than one meal of these fish every two weeks.			
** Precautionary advisory issued by U.S. Fish and Wildlife Service			
*** The Mississippi State Health Department recommends that people limit the amount of 33-39" King Mackerel they eat from the Mississippi Gulf Coast. Children under seven and women of child bearing age should eat no more than one meal of these fish every two months. Other adults should eat no more than one meal of these fish every two weeks.			

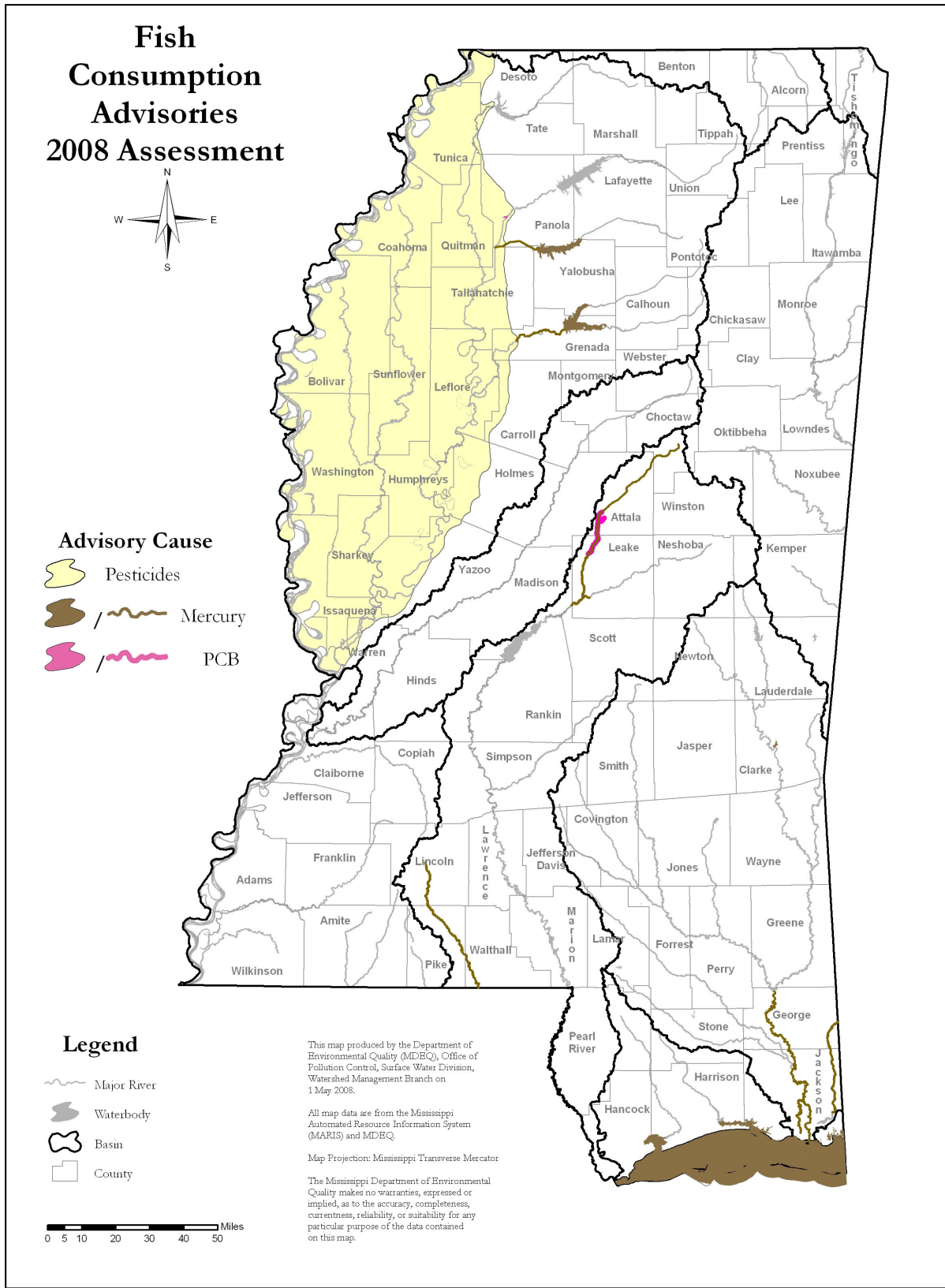


Figure 8: Map of Fish Advisories in Mississippi

## **Mercury Contamination in Fish Tissue**

The presence of mercury in fish tissue continues to be an issue of concern to MDEQ. The agency continues to commit resources to determining the status of mercury contamination in Mississippi's waters. Mississippi currently has 14 water bodies under fish consumption advisories for mercury including the Gulf of Mexico. The advisories are for the larger predator species such as largemouth bass and large catfish in freshwater systems and king mackerel in the Gulf. Advisories issued during this reporting period include Grenada Reservoir and the Yalobusha River and the upper portion of the Pearl River.

Current monitoring efforts are targeting additional species of different trophic levels within existing advisory areas. This includes species such as bluegill, crappie, buffalo and smaller catfish. Additional marine species are also being sampled.

The information gained from additional species is important because historical monitoring efforts have focused on the predator species which were known to have the highest concentrations. However, new health effects studies indicate that mercury may be harmful at lower levels than previously believed, so additional data on species with lower mercury concentrations are now critical. Additional data on marine species are important for the same reasons. Most of the existing data are for king mackerel.

Several other efforts are underway in Mississippi to address the issue of mercury in fish. The Pat Harrison Waterway District is liming Archusa Creek Reservoir in an effort to improve the water quality for fish production and to evaluate its effectiveness in reducing mercury levels. MDEQ FSD is analyzing fish and sediment samples in support of the project. Also mercury TMDLs for the Escatawpa and Bogue Chitto Rivers and for Enid Reservoir and the Yocona River have been completed.

## **DDT Contamination in the Delta**

DDT contamination in the Mississippi Delta has been a concern ever since the harmful effects of pesticide contamination first became a national issue. DDT was banned for use in Mississippi in 1972; and, although DDT concentrations in fish tissue have decreased ten-fold since that time, levels remain among the highest in the nation.

The Mississippi Fish Advisory Task Force was convened in 2000 to address the protection of those who routinely consume fish from the Delta. The task force consisted of scientists, engineers, and medical doctors from MDEQ, Mississippi Department of Health, Mississippi Department of Agriculture and Commerce, Mississippi Department of Wildlife, Fisheries and Parks, and Mississippi Department of Marine Resources. This group is charged with developing criteria for issuing fish consumption advisories for Mississippi. With input from a Technical Advisory Group made up of experts outside of state government in the fields of toxicology and aquatic biology, the Task Force developed new risk based criteria for DDT, toxaphene and PCB's. A complete report on

the process is provided in the document *Fish Advisory Criteria For Organochlorine Compounds* (Mississippi Fish Advisory Task Force, 2001).

Concurrent with this criteria development, MDEQ began collecting new fish tissue data from the Delta. MDEQ collected fish tissue samples from ten sites located on four lakes and five rivers or bayous in the Mississippi Delta Region of Mississippi. The data from the 2000 study were evaluated along with existing fish tissue data from MDEQ's 1999 Ambient Monitoring Program to determine the need for advisories in the Delta. The data indicated that all ten sites and all nine water bodies sampled in the study warranted some type of advisory. Based on this information, the task force recommended a regional advisory for the Delta (Figure 9), rather than a patchwork of discrete advisories for each of the ten sites. The data from this study support previous data collected by MDEQ and other agencies, which indicate that these pesticide concentrations were common for this part of the state.

On June 26, 2001, MDEQ issued an advisory for the Delta region of Mississippi. This advisory recommended that people limit the amount of carp, buffalo, gar, and large catfish (catfish larger than 22") they eat to no more than two meals per month. This advisory applies to the entire Delta from Memphis to Vicksburg, from the Mississippi River Levee on the west to the bluff hills on the east. The advisory includes all natural waters including lakes, rivers, bayous and sloughs.

In addition, for Roebuck Lake in Leflore County, the advisory recommends that people do not eat buffalo from this water body. In August 2001, MDWFP issued a commercial fishing ban for Roebuck Lake.

The Delta advisory does not apply to the Mississippi River or the river-connected oxbow lakes located west of the Mississippi River Levee. These lakes rise and fall each year with the Mississippi River and are flushed out regularly. Perhaps more importantly, the periodic flooding of these areas has made them less desirable for row cropping and therefore there has been less historical application of these now banned pesticides. The advisory also does not apply to bass, bream, crappie, freshwater drum and smaller catfish (catfish < 22" in length), nor does it apply to farm raised catfish. A complete report on this study is available in the document *Mississippi Delta Fish Tissue Study 2000, Final Report* (MDEQ 2001).

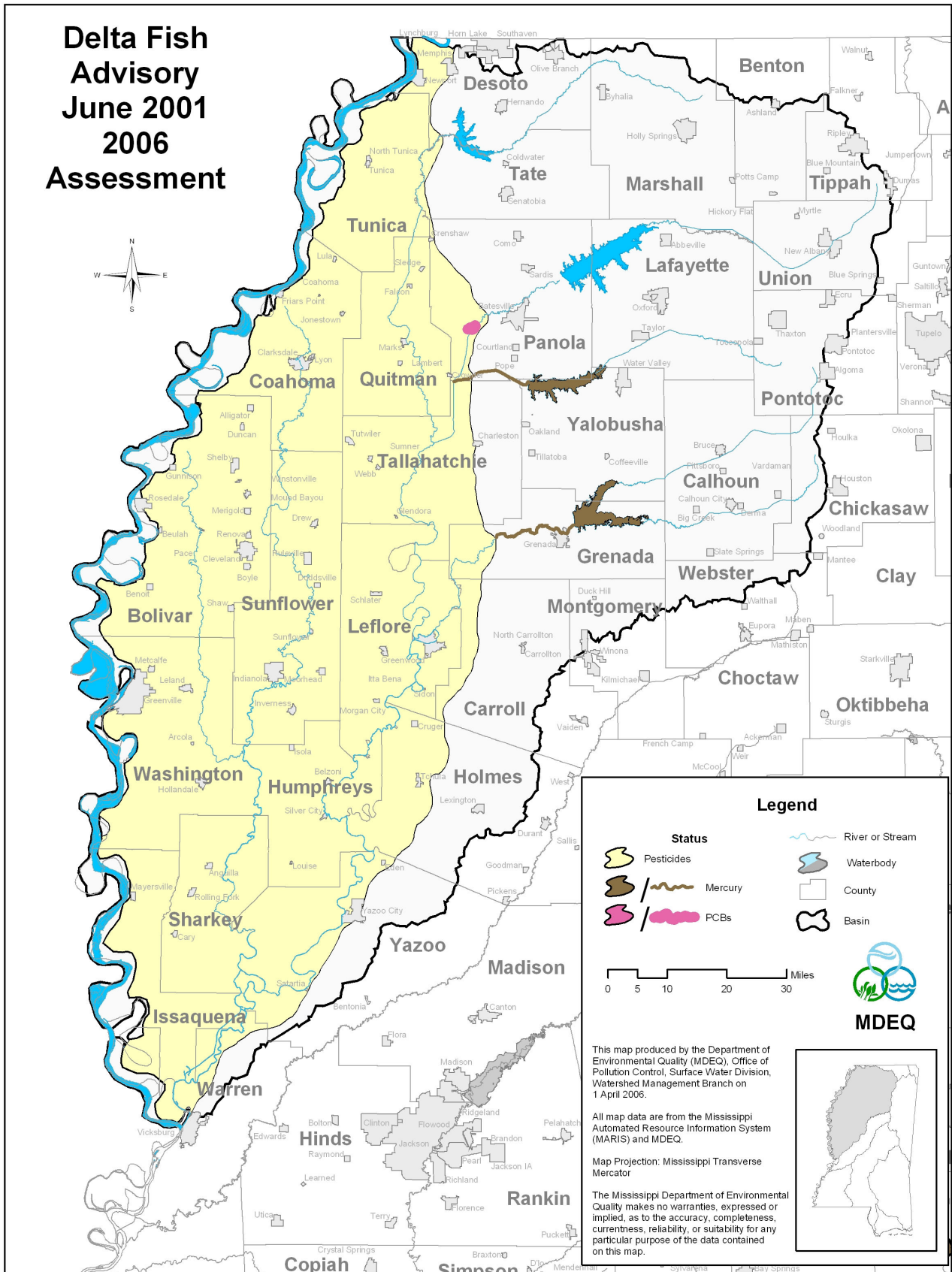


Figure 9: Advisory Area for Delta Region of Mississippi

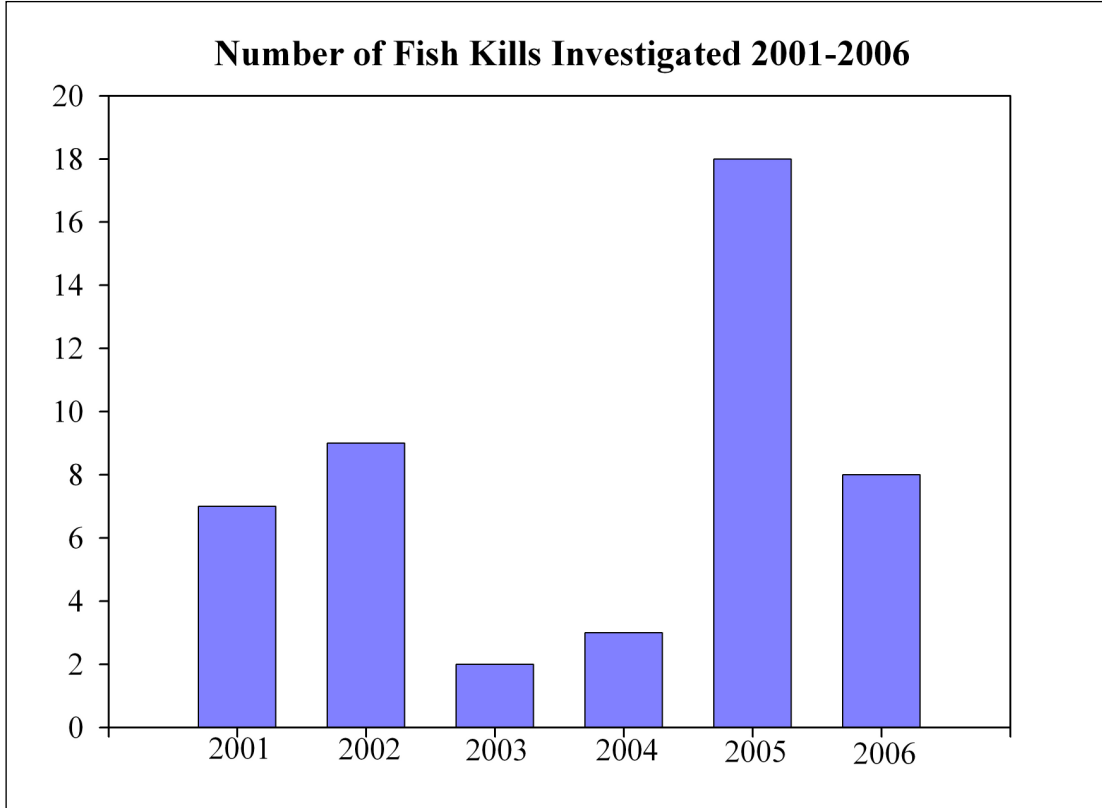
## **Other Toxicants in Fish Tissue**

In addition to the pesticides, mercury and ambient monitoring described above, MDEQ investigated several additional water bodies for contaminants in fish. The two primary chemicals of concern have been PCBs and dioxin. Dioxin concentrations in Mississippi fish have declined markedly over the last decade, primarily as a result of changes in the bleaching process in the paper industry. The dioxin advisory on the Leaf River, which originated in 1989, was removed in 1995. Dioxin concentrations in the Escatawpa River declined as well, and the Limit Consumption Advisory for fish was removed in 1996. MDEQ continues to monitor fish from the Leaf River near New Augusta and the Tenn-Tom Waterway near Columbus to confirm that these concentrations remain low. In addition, in 2001, MDEQ removed the fish advisory on Country Club Lake near Hattiesburg, originally issued in 1990, after multiple samplings showed dioxin levels declined in that water body.

PCBs continue to be a concern in industrial areas and around natural gas compressor stations. MDEQ continues to sample fish in the vicinity of existing advisories on the Yockanookany River in Attala County and Lake Susie in Panola County, and these advisories remain in effect.

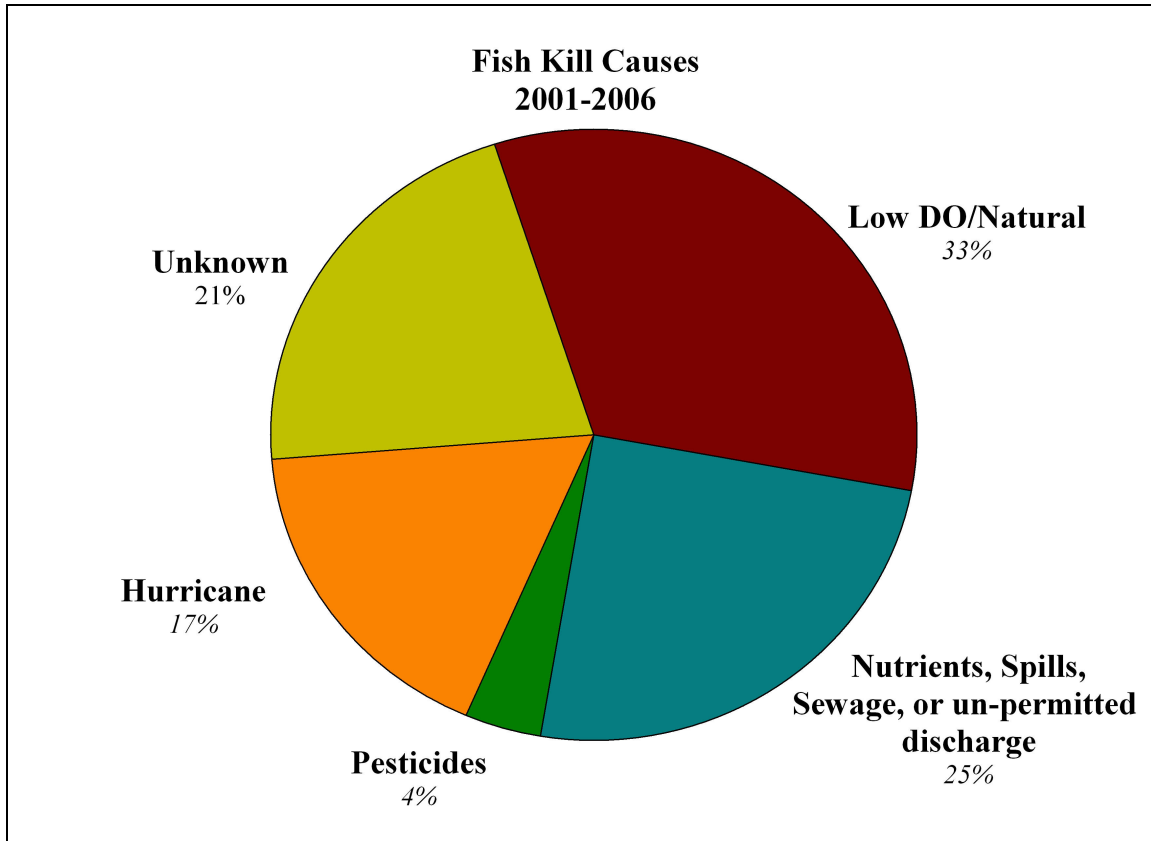
## **Fish Kills**

From January 2001 through December 2006, the MDEQ investigated 49 fish kills (Figure 10). Thirty-three percent of these were associated with low dissolved oxygen levels and other natural causes (Figure 11). In 21% percent of the investigations the cause could not be determined and four percent were associated with pesticides. Twenty-five percent were those related to nutrient overloads, sewage spills or un-permitted discharges.



**Figure 10: Annual Number of Fish Kills Investigated from 2001 – 2006**

The leading cause of kills was attributed to natural causes such as low dissolved oxygen, in those cases the cause was listed as “low D.O./natural”. In some of the fish kills investigated the fish had deteriorated to the point that the cause was difficult or impossible to discern. When the cause could not be determined the kill was categorized as “unknown”. Following Hurricanes Katrina and Rita in 2005, there were numerous fish kills. These fish kills were concentrated in the Pascagoula River Basin and Mississippi Delta respectively. These kills comprised 17% of the total investigations in the data window. The most probable cause was oxygen depletion due to thermal turnover caused by heavy rainfall combined with increased biological oxygen demand (BOD) from allocthonous material (i.e., leaves, limbs, or crop residue) washed or blown into the stream.



**Figure 11: Distribution of Fish Kill Causes from 2001 – 2006**

## Shellfish Restrictions

The National Shellfish Sanitation Program (NSSP), administered by MDMR, opens and closes shellfish harvesting areas according to a classification system for the coastal waters of Mississippi. For current status of the classifications and maps of these waters, visit the MDMR web site ([www.dmr.state.ms.us](http://www.dmr.state.ms.us)).

Most of the major shellfish harvesting areas in Mississippi waters are routinely classified as either “conditionally approved” or “restricted”. The restrictions are due primarily to the effects of nonpoint source pollution from urban runoff and unsewered communities. Studies by MDMR of fecal coliform data, the indicator utilized by the NSSP, have historically shown wide fluctuations in fecal counts (MPN) due to rainfall and/or high river stages. This continues despite significant improvements in wastewater treatment and collection systems in the coastal area. These fluctuations are likely a result of private septic systems and other nonpoint pollution sources located in watersheds that drain into these waters. When coliform levels exceed water quality standards, oyster harvesting is halted by MDMR until approved conditions are met.



For some coastal waters, the restriction or prohibition classification is based solely on geographic location (i.e., proximity to a shoreline or NPDES-permitted wastewater discharge points where human contamination of shellfish beds is more likely) regardless of the fecal coliform levels measured. Due to this “semi-permanent” condition unrelated to actual water quality data, according to the MDEQ CALM, these water bodies will not be assessed. For the 37 sq. miles of shellfish harvesting areas, TMDLs have already been developed for 28 sq. miles that were assessed as not attaining the shellfish harvesting use in 2004. These estuarine water bodies are periodically impacted by urban nonpoint source runoff and failing septic tanks.

Because of hurricane damage sustained in 2005, all shellfish beds were closed for 2006. The Shellfish Harvesting Use was not assessed for this report due to data loss at MDMR during Hurricane Katrina.

## **Beach Advisories**

Sampling for fecal coliform bacteria, enterococci bacteria, and chemical water quality parameters occurs weekly to monthly along the entire length of Mississippi’s Gulf Coast public beaches at a total of 22 stations. Results from the sampling and information on the program are readily available to the public on a web site developed for the program. The web site is accessible through MDEQ’s web site ([www.deq.state.ms.us](http://www.deq.state.ms.us)) or by accessing the USM web site ([www.usm.edu/gcrl/msbeach/index.cgi](http://www.usm.edu/gcrl/msbeach/index.cgi)).

In 2000, USEPA amended the Clean Water Act through the BEACH (Beaches Environmental Assessment and Coastal Health) Act to require all states to add more stringent sampling and public notification requirements to their water quality programs. MDEQ’s Beach Program already met the federal requirements with the exception of the formal adoption of enterococci bacteria as the new bacterial indicator in the state’s water quality standards (WQS). MDEQ implemented the new enterococci criteria during 2005. The new enterococci criteria were adopted into the Mississippi WQS in 2007.

For the period 2004 – 2006, 12 of the 22 beaches experienced a total of 25 advisories resulting from high bacteria levels. The cause of most of these advisories was urban runoff following storm events; however, seven advisories were caused by sewer leaks.



## **PART IV**

# **SURFACE WATER MONITORING AND ASSESSMENT PROGRAM SUMMARY**



## **Basin Management Approach**

Mississippi's plan for achieving comprehensive, statewide assessment of its surface waters involves coordination of various levels of MDEQ surface water monitoring activities and data sharing with other monitoring agencies using the agency's Basin Management Approach. Mississippi's Basin Management Approach is a process to conduct comprehensive water quality planning and to foster implementation of practices that will result in water quality protection on a basinwide scale. This approach recognizes the interdependence of water quality on the many related activities that occur in a drainage basin. Some of these activities include monitoring, assessment, problem identification, problem prioritization, planning, permitting, water use, and land use. In Mississippi's Basin Management Approach, these activities and their associated information are integrated by basin and result in watershed management plans and implementation strategies that will serve to focus water quality protection efforts.

The purpose of Mississippi's Basin Management Approach is to restore and protect the quality of Mississippi's water resources by developing and implementing effective management strategies that address water quality issues while fostering sound economic growth. The majority of water quality management activities in Mississippi are now based on a repeating multi-year management cycle.

MDEQ initiated a rotating basin cycle in 1997 to manage its water programs on a basinwide scale. These basins serve as the hydrological boundaries that guide MDEQ's water quality activities. The waters of Mississippi are divided into ten major drainage areas or basins. These ten basins are the Big Black River Basin, Coastal Streams Basin, North Independent Streams Basin, Mississippi River Basin, Pascagoula River Basin, Pearl River Basin, South Independent Streams Basin, Tennessee River Basin, Tombigbee River Basin and Yazoo River Basin. The boundaries for each basin are shown in Figure 12.

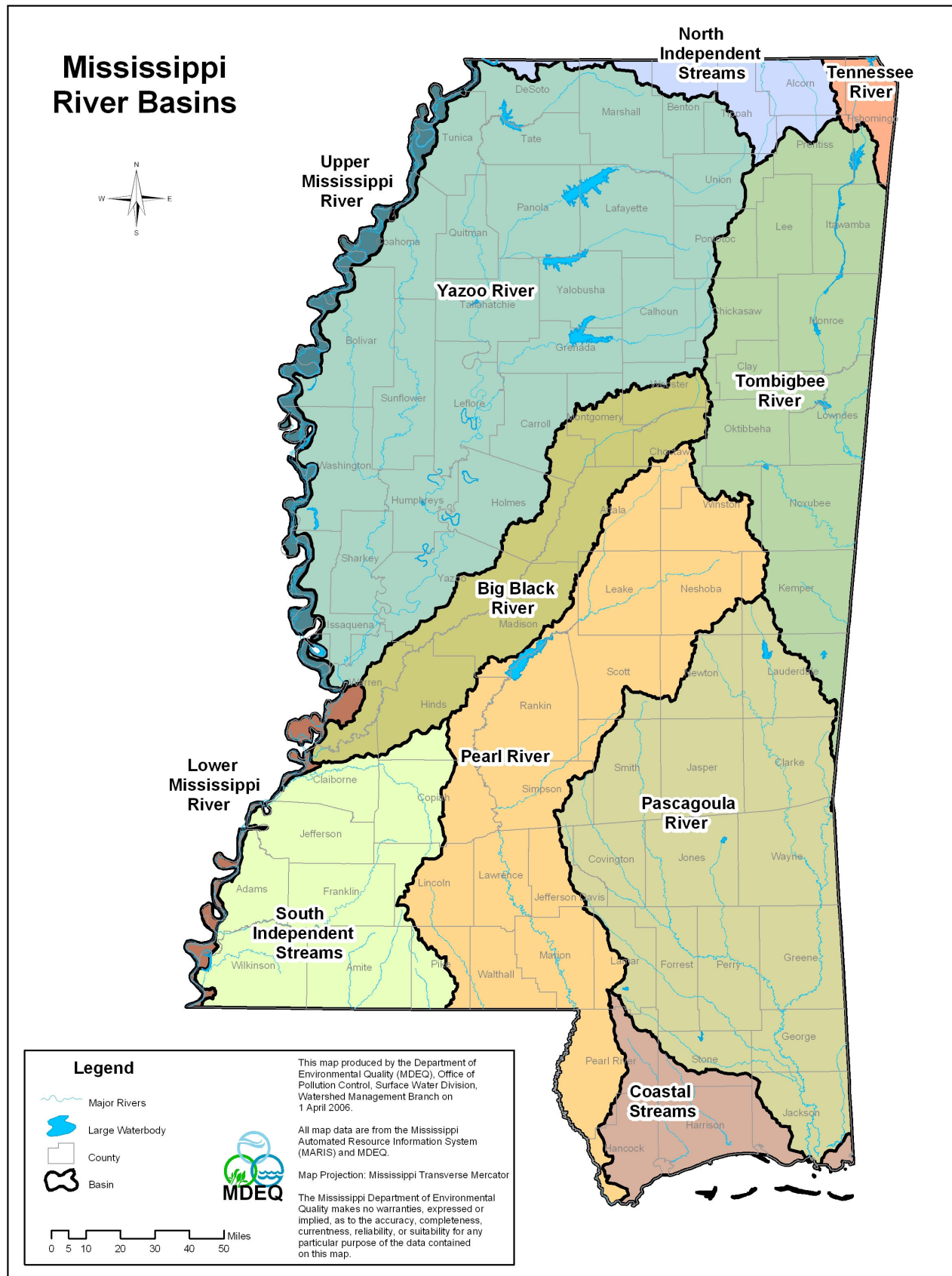


Figure 12: Mississippi's Ten Major Drainage Basins

Through this approach, Mississippi's ten drainage basins have been placed into four basin groups, allowing all of the basins to receive equal focus. Each of these basin groups is configured to represent approximately one-fourth of the state. Figure 13 depicts the four basin groups. The Basin Management Approach strategy is supported by various water quality monitoring activities that take place as part of the program support monitoring conducted by MDEQ and other resource partners that augments the statewide primary ambient fixed station network with supplemental monitoring sites in the large drainage basins. One objective of program support monitoring is to increase the total coverage of waters monitored in Mississippi and fill data gaps identified in the planning phase of the basin cycle. Concentrating monitoring and assessment resources in specific drainage basins maximizes sampling efficiency to achieve this objective and enhances collaboration among participating resource agencies. Another short-term major objective of program support monitoring is to verify the actual quality of waters historically assessed as "potentially impaired" in the §305(b) process. These assessments were based on evaluations rather than actual monitoring data. Such verification by monitoring ultimately confirms the accuracy of the state's list of impaired water bodies that is required pursuant to §303(d) of the Clean Water Act.

Supplemental watershed monitoring takes place during the data gathering phase of the basin management cycle and during pre and post-implementation monitoring associated with §319 Nonpoint Source funded watershed implementation projects. The predominant sampling tool used by MDEQ for program support sampling is biological monitoring for benthic macroinvertebrates. In addition, these monitoring efforts involve sampling of multiple parameters (water chemistry, bacteria, algae, fish and/or sediment) needed to address watershed data collection needs. For 2001-2006, in lieu of statewide historical ambient fixed network and discrete program support monitoring, MDEQ focused resources to conduct a statewide biological monitoring project to verify §303(d) evaluated impairments and developed an Index of Biological Integrity for wadeable streams. This is known as the Mississippi Benthic Index of Stream Quality (M-BISQ). Data collected as part of this monitoring effort were used in the development of this 2008 §305(b) Water Quality Assessment Report and the 2008 §303(d) list.

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# **MDEQ Surface Water Monitoring Program**

## **Introduction**

Surface water monitoring activities provide the foundation for assessment of the water quality condition in the Mississippi's waters. Without monitoring data and information, the state's water quality management and regulatory programs cannot accurately and effectively report on the status of the state's water resources, identify and solve problems, characterize water pollution causes and effects, and/or evaluate the overall effectiveness of state management regulatory actions.

MDEQ's Office of Pollution Control (OPC) is the state agency responsible for the conservation of the quality of the natural resources of Mississippi and has primary responsibility for providing an effective statewide surface water monitoring and assessment program. This responsibility, coupled with legislative mandates set forth by the Mississippi Air and Water Pollution Control Law (Sections 49-17-1 to 49-17-43) and the Federal Clean Water Act (Sections 106, 204, 303, 305, and 314), serves as the main purpose for development and implementation of the Surface Water Monitoring Program (SWMP). Other state and federal government agencies and public/private groups are also involved in monitoring surface water quality. These other monitoring organizations include 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), Mississippi Band of Choctaw Indians, University of Southern Mississippi Gulf Coast Research Laboratory (GCRL), United States Department of Agriculture (USDA) National Sedimentation Laboratory, USDA Forest Service, USDA Natural Resource and Conservation Service, United States Fish and Wildlife Service (USFWS), Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP), as well as other federal, state and local agencies, research institutions, universities, and private groups. MDEQ actively solicits their contribution of information to the evaluation and assessment of Mississippi waters. This is accomplished through the use of the agency's Basin Management Approach in which the various state, federal, and private representatives partner with MDEQ in this water management planning process.

## **Surface Water Monitoring Strategy**

In order to successfully develop, implement and maintain a surface water monitoring program, a strategy is necessary to steer and guide the broad range of multi-faceted monitoring activities carried out in support of program objectives. MDEQ's SWMP strategy, *Mississippi Department of Environmental Quality's Surface Water Monitoring Program* (MDEQ 2004) can be provided upon request.

MDEQ's main reporting avenue for SWMP data is through the §305(b) Water Quality Assessment Report. In addition to the §305(b) Report, MDEQ provides a list of all impaired water bodies without TMDLs required under §303(d) of the CWA. The §303(d) List is a listing of water body 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 water body back to fully supporting its designated use(s) are developed. When the TMDL has been completed or monitoring data show that the water body is no longer impaired, the water body is taken off the §303(d) list. The State's 2008 §303(d) List is also available from the MDEQ web site ([www.deq.state.ms.us](http://www.deq.state.ms.us)).

Since 2002, the State has been moving closer towards integrated §305(b)/§303(d) reporting as recommended by EPA in their guidance document, *2002 Integrated Water Quality Monitoring and Assessment Report Guidance* (EPA 2001). MDEQ will continue to support consistency in the development and submission of §305(b) reports and §303(d) Lists.

Besides the §305(b) and §303(d) reporting processes, MDEQ also reports on SWMP activities and water quality issues through various other EPA-required reports. These other reports include annual reporting of summary activities and individual projects for various EPA CWA grants, (i.e., §104(b), §106(e), §205(j), §319, §406(b), and surface water programs (i.e., WQS, TMDL, NPDES, Basin Approach, Beach Monitoring). Mississippi's Basin Management Approach strategy is supported by various water quality monitoring activities. These are a component of a basin fixed-station monitoring network and augment the statewide primary ambient fixed station network with supplemental monitoring sites in the large drainage basins. Data is updated annually producing a status report/management plan. Likewise, these reports help prioritize stakeholder agendas and plans of action. Reporting formats are presented in project/program-specific technical reports, brochures, posters, oral presentation, newspaper articles and MDEQ Internet access. In addition, data generated are uploaded to National databases (i.e., EPA STORET/WQX) for the purpose of stakeholder outreach, education, public information, and to meet other federal grant and/or state legislative requirements.

Mississippi is moving toward providing water quality data through the Water Quality Exchange (WQX) Network/Node. Likewise, BEACH (Beaches Environmental Assessment and Coastal Health) data is required as a component of the BEACH Act of 2000 and is also provided to USEPA through WQX. Additionally, MDEQ responds to individual requests from phone, web, or personal inquiries for water quality data and information.

Mississippi's Plan for Nutrient Criteria Development was submitted to EPA Region IV in February 6, 2004 and was revised in 2007. The purpose of this plan was to provide EPA with a better understanding of Mississippi's approach to nutrient criteria development. The focus of this strategy will be to develop nutrient criteria based primarily on the linkage between nutrient concentrations and impairment of designated uses.

Conceptually, three forms of nutrient criteria are defined and include: 1) causal and/or response variables expressed as numerical concentrations and/or mass quantities or loadings; 2) causal and/or response variables expressed as narrative statements with a translator mechanism to derive or calculate numerical concentrations and/or mass quantities or loadings; and 3) causal and/or response variables expressed as narrative statements only. Within this concept, the causative variables will include phosphorus and nitrogen and response variables, chlorophyll *a* and turbidity. While Mississippi may derive criteria based upon a reference condition approach, this approach has its limitations in that it does not provide a definite link between nutrient concentrations and impairment. An effects-based approach may be more appropriate since derived values are neither under/over-protective. Cause/effect relationships between nutrients and impairments will be the primary approach with the reference-based approach utilized as a “fallback”. This will be done for 1) lakes/reservoirs, 2) streams/rivers, and 3) coasts/estuaries. The schedule for development of nutrient criteria began in 2003 with sampling in the designated water body types. Currently, MDEQ continues with sample collection in estuaries and has begun the data analysis phase in lakes and rivers/streams. Data and information resulting from this process will be used to develop appropriate nutrient criteria for the state.

## **Description of MDEQ Fixed Sampling Networks**

Monitoring information from multiple programs is needed to fully achieve a comprehensive understanding of water quality in Mississippi's surface waters. Both routine ambient and special project monitoring activities administered by MDEQ contribute information for the evaluation and assessment of water quality in Mississippi. While all of these monitoring efforts contribute information for use in the §305(b) Water Quality Assessment Report, the fixed station ambient monitoring networks serve as the foundation for the statewide water quality assessment process.

## **Status & Trends Ambient Monitoring Networks**

In Mississippi, ambient fixed station monitoring is designed to characterize and assess statewide water quality status and trends in the state's streams, lakes, estuaries and coastal waters for general reporting in the §305(b) Water Quality Assessment report. Subsequently, waters identified as impaired are placed on the state's §303(d) list. Fixed station monitoring also supports the design and implementation of MDEQ's surface water management programs including NPDES, non-point source, water quality standards, TMDL development, basin initiatives and water quality planning/management. This type of monitoring is also used by MDEQ to evaluate program effectiveness and to address economic development interests and concerns.

Since 1997, additional regional ambient monitoring efforts have been added to MDEQ's Surface Water Monitoring Plan (SWMP) activities. To provide better information for assessment and public health issues along Mississippi's coastal beaches, a new revamped Coastal Beach Monitoring Network was established in 1999 as a third tier of MDEQ's SWMP Ambient Fixed Monitoring Network system. In 2000, EPA instituted the five-year National Coastal Assessment Program and the MDEQ SWMP incorporated annual monitoring using a probabilistic design of coastal waters in support of this project.

In 2002, the SWMP adjusted monitoring activities to collect additional water quality data needed to address high priority management issues. These issues included monitoring to support development of regional biological (M-BISQ) assessment criteria for §305(b)/§303(d) decision making, monitoring to support nutrient water quality criteria development for Mississippi water bodies, monitoring to determine if waters on the §303(d) list were actually impaired, and monitoring to provide data for site specific §303(d) issues (i.e., fecal coliform impairment confirmation, stressor identification, TMDL model development) to ensure that the state could meet TMDL development deadlines. Work also began to establish appropriate biological indicators and assessment methodologies specific to the Mississippi Delta and Non-Wadeable streams and rivers in the state.

With this redirection, the Status & Trends Surface Water Monitoring Network, which included routine sampling of a statewide Ambient Fixed Station Network and the rotating Basin Network, was suspended in 2000. In its place, MDEQ has dedicated sampling resources (staff and funding) to comply with EPA's court ordered TMDL deadlines and conducted special project monitoring (i.e., M-BISQ) to address other critical data collection needs. The statewide fish tissue monitoring portion of the Status & Trends Network, the Coastal Beach Monitoring Network, and the National Coastal Assessment (NCA) monitoring, are the only parts of the Status & Trends Surface Water Monitoring Network that have been continuously monitored since 2000.

### **Statewide Fixed Station Monitoring Network**

Primary fixed network stations are distributed throughout the northern, central, and southern regions of the state in streams, rivers, bayous and estuaries. This network consists of unpolluted streams to establish baseline conditions and streams below critical discharges to establish long-term trends and/or observe improvements where pollution control measures are implemented. Streams representing a composite of a large watershed allow broad evaluations of overall abatement programs and waters of general concern (i.e., major streams entering or leaving the state and near-coastal waters). Several stations in the sampling network are historical stations that have monitoring dating back to the 1970's.

The Statewide Fixed Monitoring Network design is conventional (i.e., targeted). Each station is required to meet the monitoring objectives and selection criteria for station locations. The network of statewide ambient primary fixed stations was established for systematic water quality sampling at regular intervals and for uniform parametric coverage to monitor water quality status and trends over a long-term period. Sampling is carried out by MDEQ FSD biologists from each of three regional offices (northern, central, and southern regions). Each office is responsible for the stations in its region. Laboratory analyses for water and biological samples are carried out by MDEQ's laboratory located in Pearl, Mississippi.

To be included in the Statewide Fixed Monitoring Network, each station not only had to meet the monitoring objectives of the program but also had to meet specific selection criteria for station locations. The specific criteria utilized for the location and establishment of Statewide Fixed Stations are:

Major perennial stream, major lake or estuary; at or close to a hydrological recording station (required for most physical/chemical stations); strategic basin location (lower end of basin, confluence of major streams, mouth of major tributary, maximum spatial coverage, etc.); high recreational activity or designated use; interstate waters; of some ecological, public health or economic significance (below major pollution sources, fish advisory area, ecoregional reference site, high quality waters, endangered/threatened species, high economic interest, etc.); other logistical and administrative criteria (safety, accessibility, multi-agency coordination, historical data record).

Ambient fish tissue sampling occurs annually at 25 primary fixed stations across the state and at selected basin network sites. Fish tissue sampling for fish kill investigations, monitoring of fish advisory areas, and special studies requires more resources and results in more monitoring than ambient fixed station network sampling. Fish samples are normally collected from early spring through fall depending on ambient conditions. Target species include one predator or



carnivore such as flathead catfish or largemouth bass, and one bottom feeder or omnivorous species such as channel catfish or smallmouth buffalo. Ideally, fillet composite samples consisting of five individuals are analyzed where all fish in the composite are at least 75% of the weight of the largest fish in the composite. The MDEQ laboratory has the capability to analyze fish tissue samples for approximately 36 organic compounds, PCBs, PCP and seven heavy metals.

In addition to extensive water chemistry and fish tissue analyses, the MDEQ Status and Trends Ambient Monitoring Network rely heavily on the use of biological indicators. The purpose of ambient biological monitoring is to assess the health or biological integrity of the aquatic community as a long-term indicator of stream water quality. The MDEQ ambient biological monitoring program uses benthic macroinvertebrate community surveys in wadeable freshwater streams; and chlorophyll a levels in lentic, marine and estuarine waters.



In 1996, the entire historical biological ambient monitoring network was re-evaluated and modified. As a result, approximately 40 fixed sites were established as macroinvertebrate monitoring sites for the new MDEQ Surface Water Monitoring Program. Sampling at these Primary Fixed Station Network macroinvertebrate sites began in 1997. Sites were sampled on an annual basis using modified EPA rapid bioassessment techniques and habitat assessments were performed. In 2001, MDEQ changed biological monitoring

methodology in response to §303(d) issues and workloads. This initiative led to the development of a Mississippi-calibrated Index of Biological Integrity (IBI) *Development and Application of the Mississippi Benthic Index of Stream Quality (M-BISQ)* (MDEQ 2003b) for use in assessment of wadeable streams in Mississippi and resulted in monitoring efforts that have greatly increased the number of biological assessments conducted on state waters. The Mississippi Benthic Index of Stream Quality (M-BISQ) and the established sampling and analytical methodology contained therein now serves as the foundation for routine biological monitoring in the MDEQ statewide Status and Trends Ambient Monitoring Network.

Since 1997, a significant increase in phytoplankton assessments has occurred in the SWMP. Determination of chlorophyll *a* levels is now a routine part of the water quality assessments done on lentic systems. Phytoplankton is routinely sampled in 24 lakes and reservoirs in the statewide Ambient Monitoring Network on a quarterly basis for chlorophyll *a* analysis. Also, quarterly collections of phytoplankton at nine estuarine and marine sites are used for chlorophyll *a* analysis in coastal waters. In 2007, MDEQ re-instituted a 30 station Fixed Monitoring Network and implemented a statewide Recreational Monitoring Network. Data generated from these stations will be used to develop the 2010 §305(b) assessment. More detailed information on MDEQ's monitoring programs can be found in *Mississippi Department of Environmental Quality Quality Assurance Project Plan for the §106 Monitoring Network* (MDEQ 2008).

## **Basin Monitoring Network**

The MDEQ Basin Approach to Water Quality Management strategy is supported by a basin fixed station monitoring network which augments the statewide primary fixed station network by adding monitoring sites in specific drainage basins or watersheds. There are several fundamental differences between the basin fixed station monitoring network and the primary fixed station network. The primary fixed station network is static with a rigid set of parameters, routine sampling intervals, and is designed to study long-term water quality trends across the entire state. In contrast, the basin network is dynamic, sampling is relatively short-term and the monitoring is basin/watershed specific. Due to its dynamic nature, the basin network is subject to more variation in station selection, parameters sampled and sampling frequency.

One objective of the basin monitoring network is to increase the total spatial coverage of waters monitored in Mississippi. This objective is achieved by concentrating monitoring and assessment resources in specific drainage basins thereby maximizing sampling efficiency. Another major objective of the basin network is to provide specific information on a program by program basis to fill data gaps identified by MDEQ regulatory and management programs. As a consequence, basin management plans and implementation strategies are developed.

To date, basin network stations have been of a conventional (i.e. targeted) design in streams, rivers, and coastal waters with station selection criteria dictated by the program

requesting the monitoring. Generally, the specific criteria utilized for the location and establishment of basin fixed stations have been:

1. Perennial streams, significant lakes and estuaries;
2. Most downstream access to main stem of the Natural Resources Conservation Service (NRCS) watershed units in the basin representing the effluent from the watershed unit;
3. Waterbody on §303(d) list of impaired waters or State's waters of concern list;
4. Strategic watershed location (maximum spatial coverage, major land use change within watershed unit, etc.); and
5. Areas with same selection criteria as applied to primary statewide network stations but unmonitored:
  - A. High recreational activity or designated use;
  - B. Interstate waters;
  - C. Of some ecological, public health or economic significance (below point and nonpoint pollution sources, fish advisory areas, ecoregional reference sites, high quality waters, endangered/threatened species, high economic interest, etc.); and
  - D. Other logistical and administrative criteria (safety, accessibility, multi-agency coordination, historical data record).

Monitoring of basin network stations is conducted through a coordinated effort between the FSD regional office biologists and OPC Laboratory biologists and chemists. Parametric coverage for these stations generally includes biological/habitat assessments in combination with chemical/physical, bacteriological, algal, fish tissue and/or sediment monitoring. Similar to the statewide network, the Basin Monitoring Network has also been suspended since 2001 to focus monitoring resources on other high priority statewide environmental issues. In the interim, Basin priorities have been monitored through special studies/project monitoring or with support from other monitoring agencies.

### **Coastal Beach Monitoring Network**

MDEQ's Coastal Beach Monitoring Program, operated in conjunction with the University of Southern Mississippi's Gulf Coast Research Laboratory (GCRL), conducts routine bacteria and water chemistry sampling at 22 beach stations located along Mississippi's Gulf Coast (Figure 14). MDEQ is just one partner within a multi-agency Beach Monitoring Task Force composed of EPA Gulf of Mexico Program, Mississippi Department of Marine Resources, and the Mississippi State Department of Health. This Beach Monitoring Task Force oversees the program and actually issues beach advisories when needed.

MDEQ and the Beach Monitoring Task Force rely on data collected under this program to assess health safety issues for users of Mississippi's recreational beaches. When enterococci bacteria concentrations reach unsafe levels, beach advisories are issued. In



addition, the monitoring data provide information concerning the seasonal water quality conditions of the immediately accessible waters along the public bathing beaches. Beach water quality conditions are made available to the public via a Beach Monitoring Web page developed by GCRL that can be accessed via the MDEQ Homepage ([www.deq.state.ms.us](http://www.deq.state.ms.us)). This web site contains beach advisory status, location of monitored sites, data associated with those monitored locations, and a history of beach advisories.

There are sixteen core stations that are sampled approximately ten times a month during the recreational season. Non-core stations are sampled weekly during the recreational season (May – October). Any station is re-sampled if enterococci bacteria levels exceed 104 colonies/100ml. For a complete list of parameters monitored as part of this program, see Table 13 below

**Table 13: MDEQ Beach Monitoring Parameters**

Water Quality Indicators	
Water Profiles	Water Samples
Temperature	Enterococci counts (MF)
Salinity	Stage of river nearest station
Dissolved Oxygen	Rainfall and /or cloud cover
pH	Tide Stage
Turbidity	

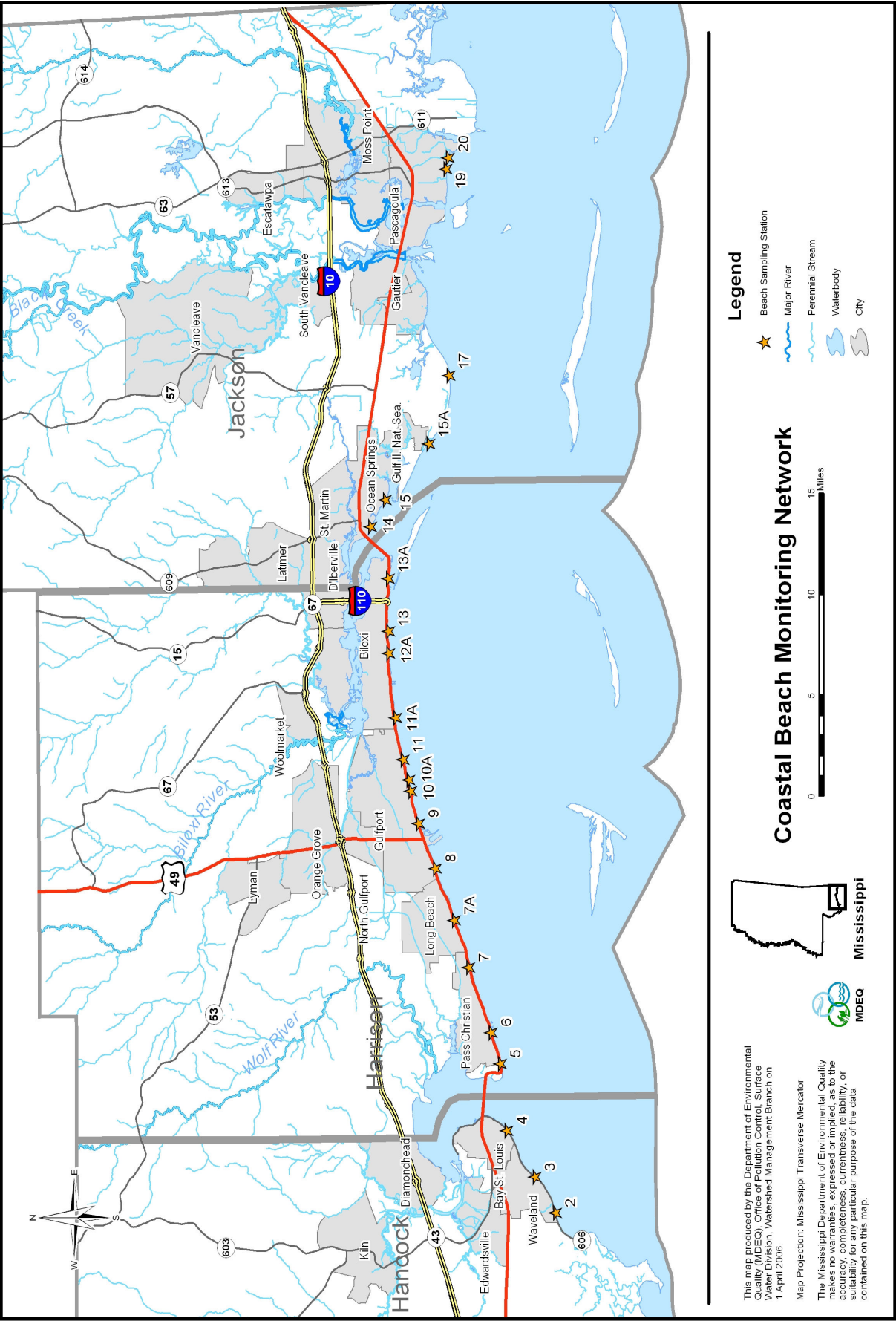


Figure 14: Coast Beach Monitoring Network

### EPA National Coastal Assessment Program

MDEQ has continued to coordinate the sampling effort for NCA in Mississippi's coastal waters. This monitoring involved the random selection of 30-50 sites annually from 2000-2004 (Figure 15). Beginning in 2005 the number of sites was cut in half but MDEQ continued to sample the core ecological indicators established by the NCA program (Table 14). Unfortunately much of the 2005 sampling effort was destroyed by Hurricane Katrina. All that remains of the 2005 effort are physical and chemical results.



**Table 14: List of Core Ecological Indicators Measured by NCA.**

Water Quality Indicators		Sediment Quality	Biota		Habitat
Water Profile	Water Samples	Composited Surficial Sediment	Fish/Shellfish	Benthos	
Dissolved Oxygen (DO)	Total Nutrients	Sediment Contaminants	Community Structure	Community Structure	Submerged Aquatic Vegetation
pH	Dissolved Nutrients	Sediment Toxicity	Tissue Contaminates		Type (tidal, open water, harbor, etc.)
Salinity	Chlorophyll- <i>a</i>	Percent Silt/Clay	Presence of External Pathology		Presence of Marine Debris
Temperature	TSS				
Depth					
Light Attenuation					
Secchi Depth					

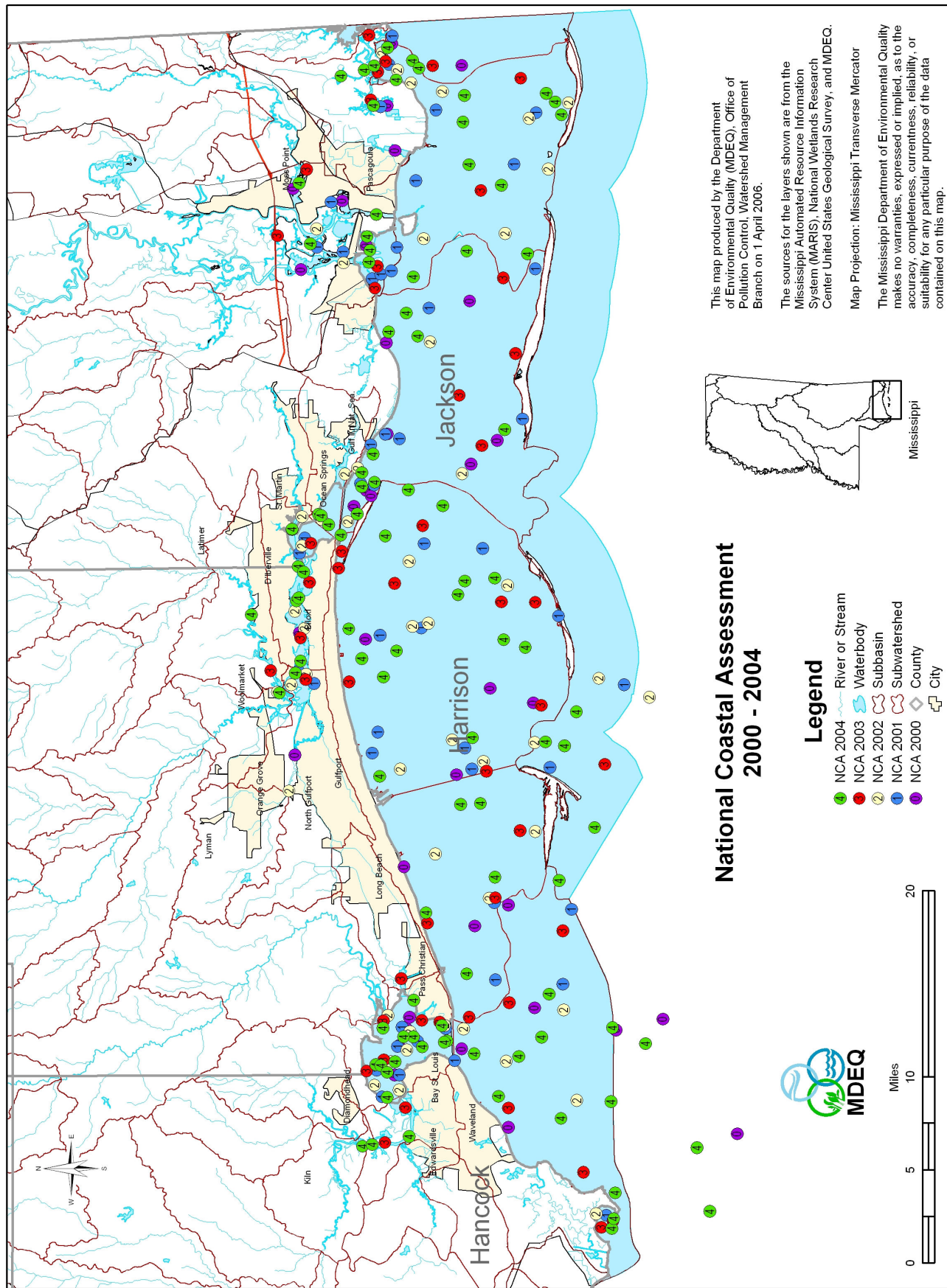


Figure 15: National Coast Assessment 2000-2004



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