State of Mississippi

Water Quality Assessment

2012 Section 305 (b) Report

MISSISSIPPI DEPARTMENT OF
ENVIRONMENTAL QUALITY

State of Mississippi
Water Quality Assessment
2012 Section 305(b) Report

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 2012 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 2012 §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.

ACKNOWLEDGEMENTS

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Table of Contents

Table of Figures

Table of Tables

List of Acronyms

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

SOP	Standard Operating Procedures
STORET	STOrage and RETrevial System
SWMP	Surface Water Monitoring Program
TB	Tombigbee Basin
TDS	Total Dissolved Solids
TMDL	Total Daily Maximum Load
TN	Total Nitrogen
TSI	Trophic State Index
TVA	Tennessee Valley Authority
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
USM	University of Southern Mississippi
USNPS	US National Park Service
WADES	Water Assessment Data entry System
WQS	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.

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 Ambient Monitoring Networks, Program Support Monitoring Network, 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 2012 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 2012 §305(b) report is a comprehensive statewide report of surface water quality based on data collected from January 2006-December 2010. This report presents a compilation and summary of data collected statewide; only data collected within the reporting window are used for assessment. Beginning in 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.

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^{o}F in the north to 43^{o}F on the coast. Summer temperatures throughout Mississippi average 90^{o}F with frequent excursions above 100^{o}F especially in the south.

Mississippi has a population in excess of 2,910,540 (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 82,000 miles. Of these miles, 32% are perennial characterized by flowing water throughout the year. Intermittent streams which flow during rainy seasons but are dry during summer months represent 65% 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 260,000 acres. According to landuse 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	2,938,618
State surface area (square miles)	47,689
Number of river basins	10
Total number of river and stream miles*	82,154
- Number of perennial river miles (subset)*	26,379
- Number of intermittent stream miles (subset)*	53,351
- Number of ditch and canal miles	2,424
Number of lakes/reservoirs/ponds (>25 acres)	1,251
Acres of lakes/reservoirs/ponds (>25 acres)	259,533
Square miles of estuaries/harbors/bays	755
Number of coastal miles	84
- Number of Public Recreational Beach Miles	42
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

	Total Size According to Classification			
Classified Use	**Rivers (miles)**	**Lakes (acres)**	**Estuaries (sq. miles)**	**Coastal Shoreline (miles)**
Fish & Wildlife[a]	**82,154**	**140,627**		
Public Water Supply[ab]	**87**	**13,597**		
Recreation[b]	**1,043**	**93,159**	**728**	**84**
P. Water Supply & Rec.[ab]		**22,577**		
Shellfish Harvesting[bc]			**6**	
Recreation/Shellfish[b]			**32**	
Ephemeral	**113**			

[a] Also suitable for Secondary Contact Recreation
[b] Also suitable for Fish and Wildlife
[c] 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, 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 2012 Section 303(d) List of Impaired Water Bodies (MDEQ 2012) 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 2012 assessment but also allowed states flexibility and the option of using previous §305(b) guidance for water quality assessment purposes. For the Mississippi 2012 assessment, MDEQ has developed a document entitled Mississippi Consolidated Assessment and Listing Methodology (CALM) 2012 Assessment and Listing Cycle (MDEQ 2012) which can be provided upon request or found at www.deq.state.ms.us. The purpose of this document is to specify MDEQ's data requirements and assessment guidelines for the 2012 §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 (www.mdeq.state.ms.us)

Mississippi 2012 §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 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.

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, when 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. For the 2012 §305(b) report, this data window is from 2006-2010.

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 2012 §305(b) assessment, bacteriological data identified as meeting Mississippi CALM requirements were provided by the MDEQ Beach Monitoring Program and MDEQ Recreational Monitoring Network. 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 toxicants. 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 rigor 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 that do not have adequate data quality information or documented SOPs or procedures will not be assessed.

Water Body Use Support Determination

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 2012 §305(b) Assessment and §303(d) Listing process will be 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, 2012.

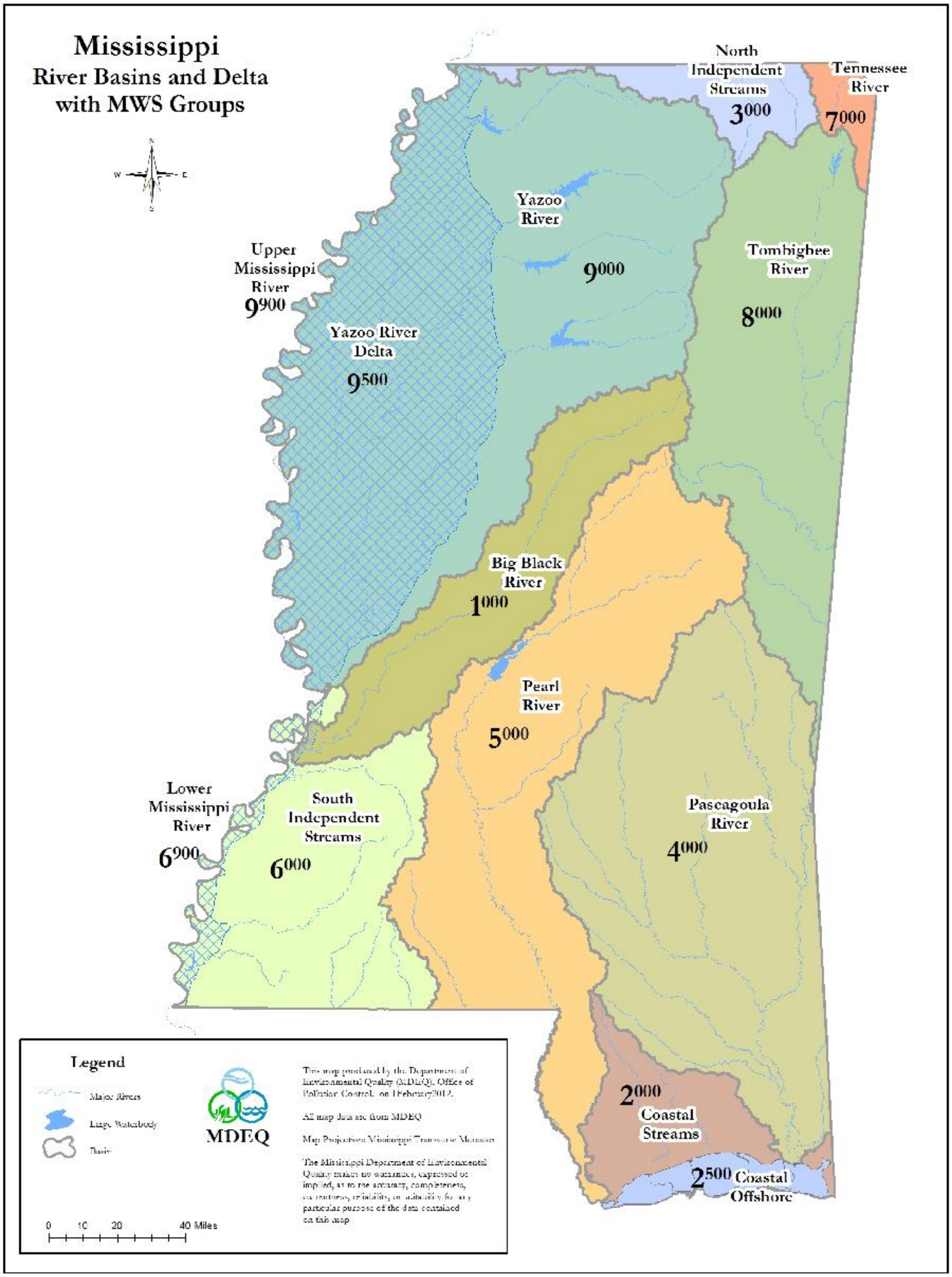

Figure 1: Mississippi River Basins and Delta

Statewide Assessment Summary

Designated Use Support-Rivers and Streams

For the 2012 §305(b) Water Quality Assessment Report, MDEQ assessed approximately 13% (3,534 miles) of Mississippi's total 26,379 miles of perennial streams and rivers for one or more uses. The status of water quality on the remaining 87% (22,849 miles) of the state's perennial rivers and streams is unknown. MDEQ collected monitoring data at more than 415 sites in the state (Figure 2).

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. 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 82,154 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. In 2008, MDEQ re-focused monitoring efforts and significantly increased routine monitoring through the Ambient Networks and Program Support Monitoring. Data from these efforts will be available for the 2012 §305(b) assessment.

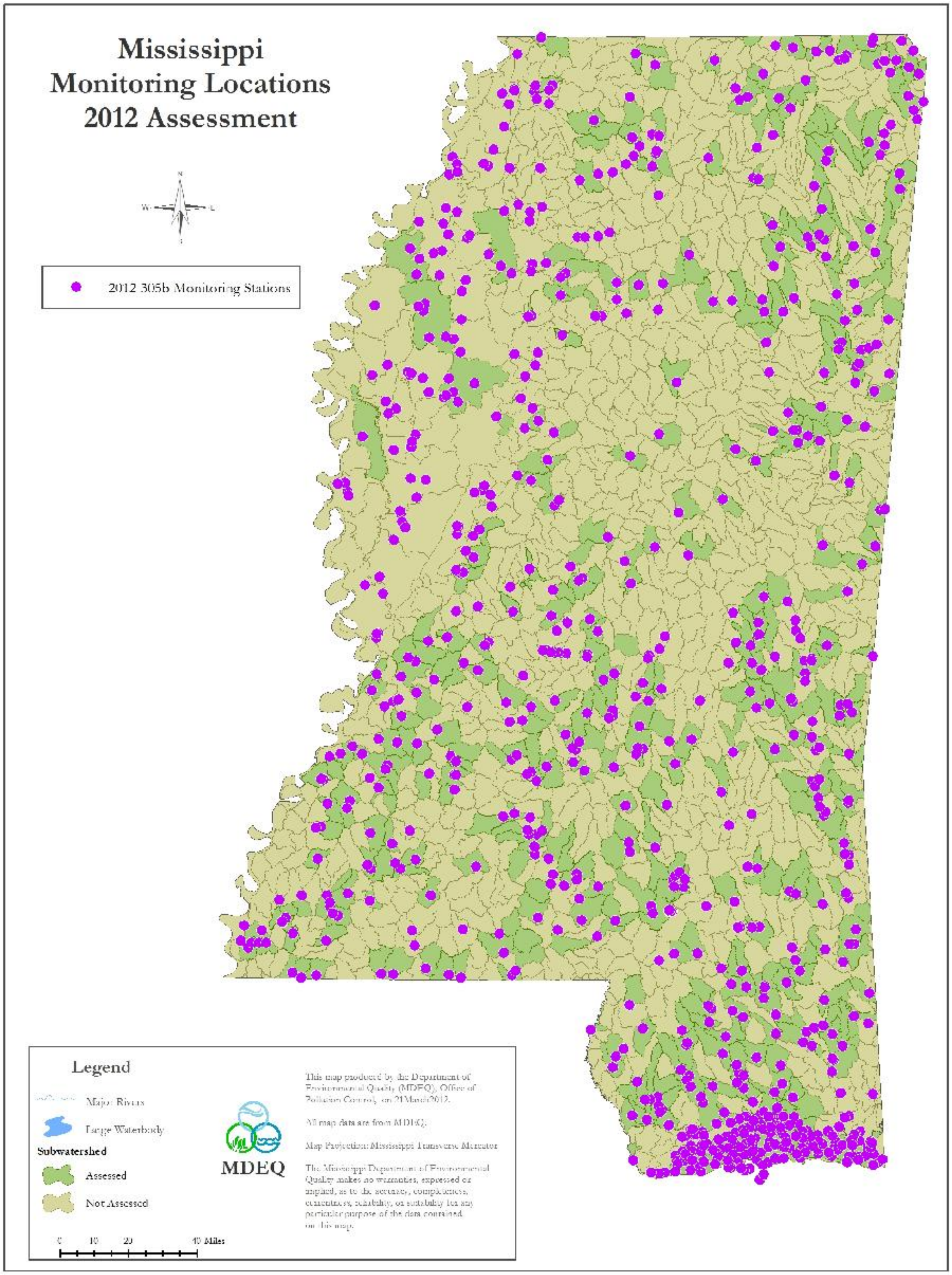

Figure 2: Monitoring Locations in Mississippi

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 26,379 total perennial stream and river miles, approximately 13% (3,534 miles) were assessed (Figure 3).

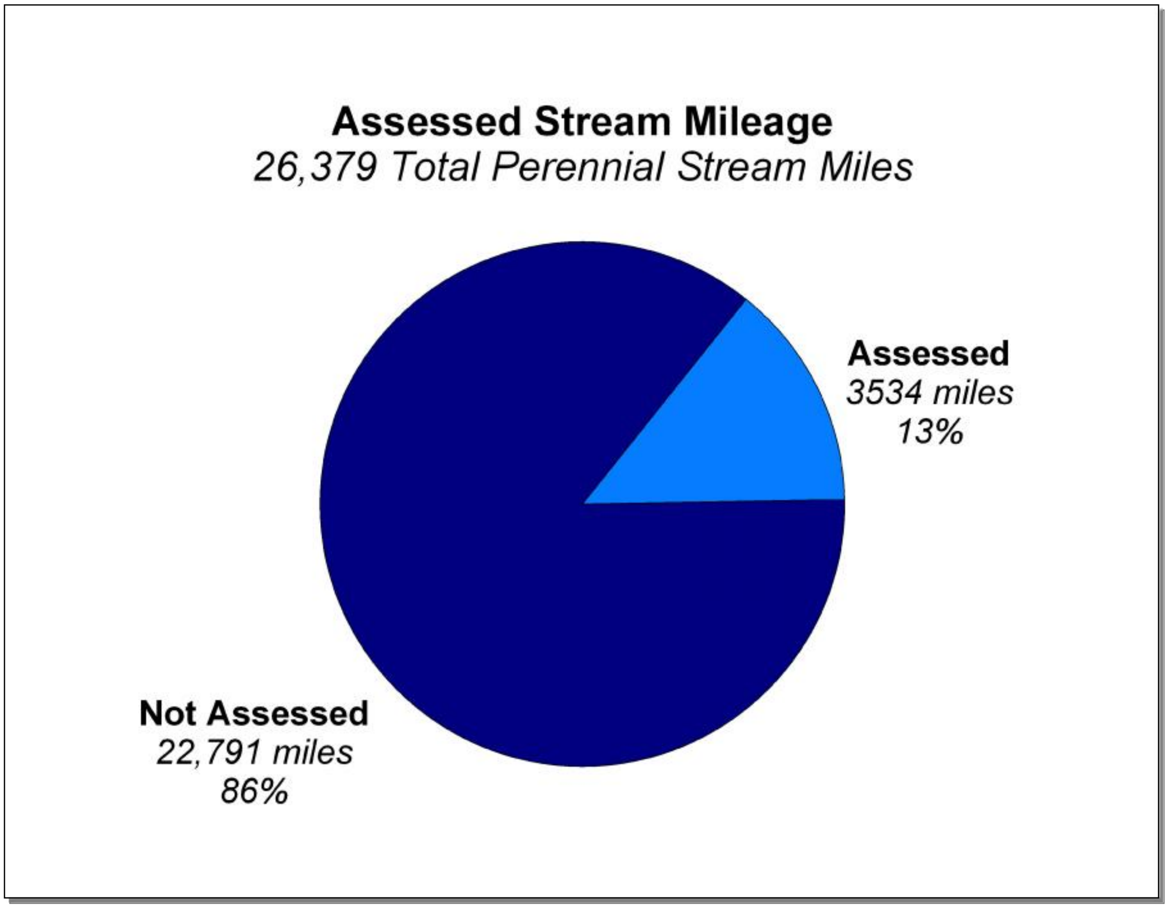

Figure 3. Assessed Stream Mileage Perennial Rivers and Streams

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. The largest percentage (33%) of miles of assessed water bodies not meeting their designated uses are categorized as biologically impaired. 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. Twenty-four percent of impairments are caused by sediment. Most of these impairments were determined during the stressor identification process. Pathogens are indicated as the cause of impairment in nine percent of the non-attaining water bodies. Other impairments were attributed to pH, nutrients, organic enrichment/low dissolved oxygen, conductivity, 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.

The largest percentage of impairment is 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	3
Conductivity	7
pH	133
Organic Enrichment/Low DO	185
Sedimentation/Siltation	373
Nutrients	339
Other (Biological Impairment)**	1,390
Pathogens	396
Total***	2,826

**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

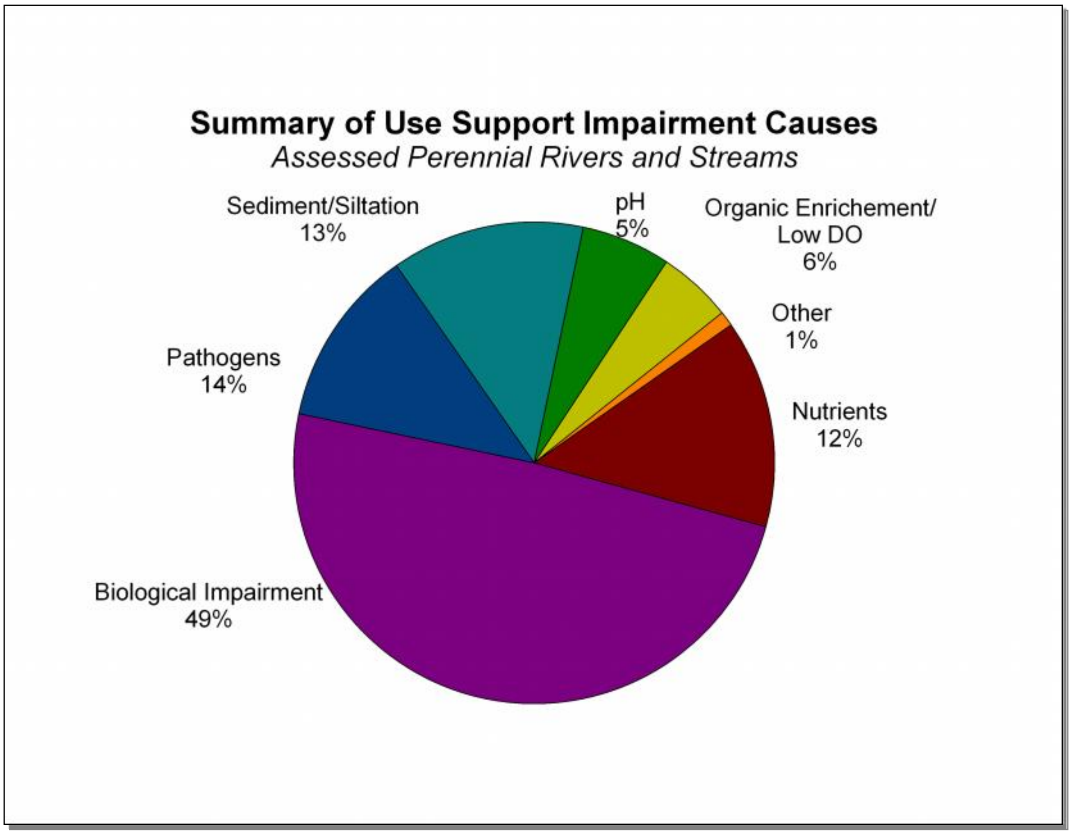

Figure 4: Summary of Use Support Impairment Causes: Rivers and Streams

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 attainment 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	1,683
Unknown	22,791
Total Not Attaining	1,995
TMDL not needed	818
TMDL needed	1176
Total Perennial Miles	26,379

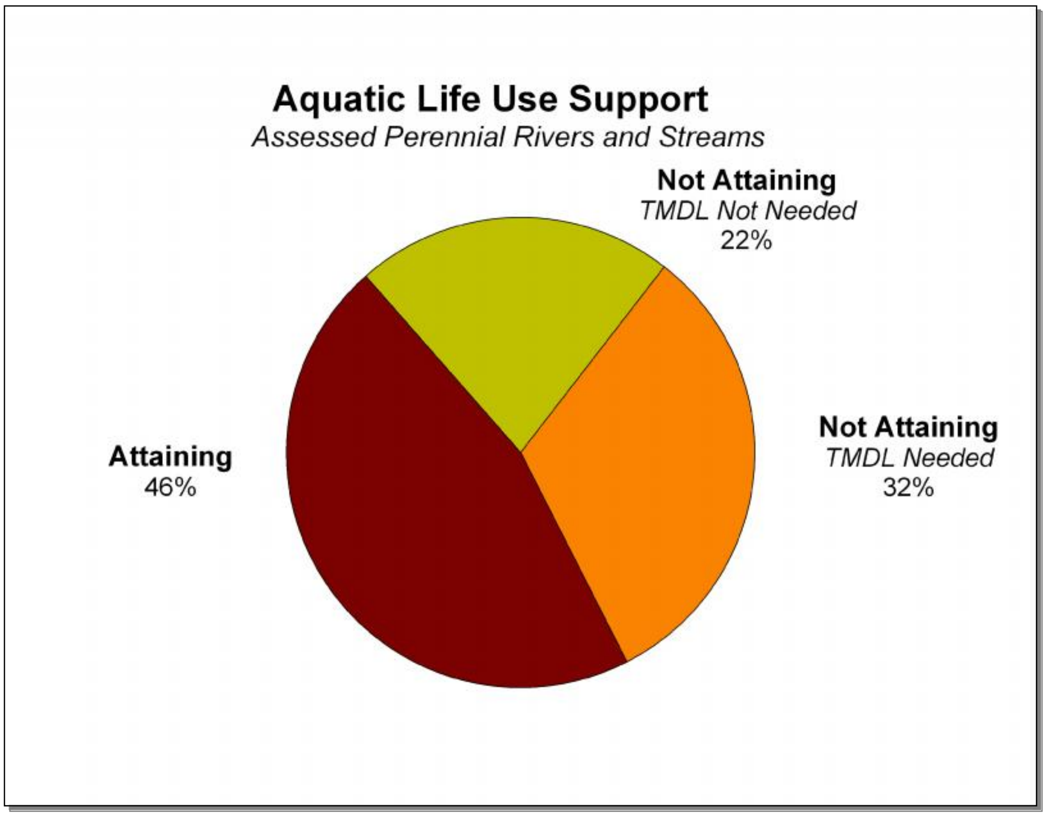

Figure 5: Aquatic Life Use Support Summary

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

Status	Miles
Attaining	255
Unknown	25,954
Total Not Attaining	170
TMDL not needed	154
TMDL needed	16
Total Perennial Miles	26,379

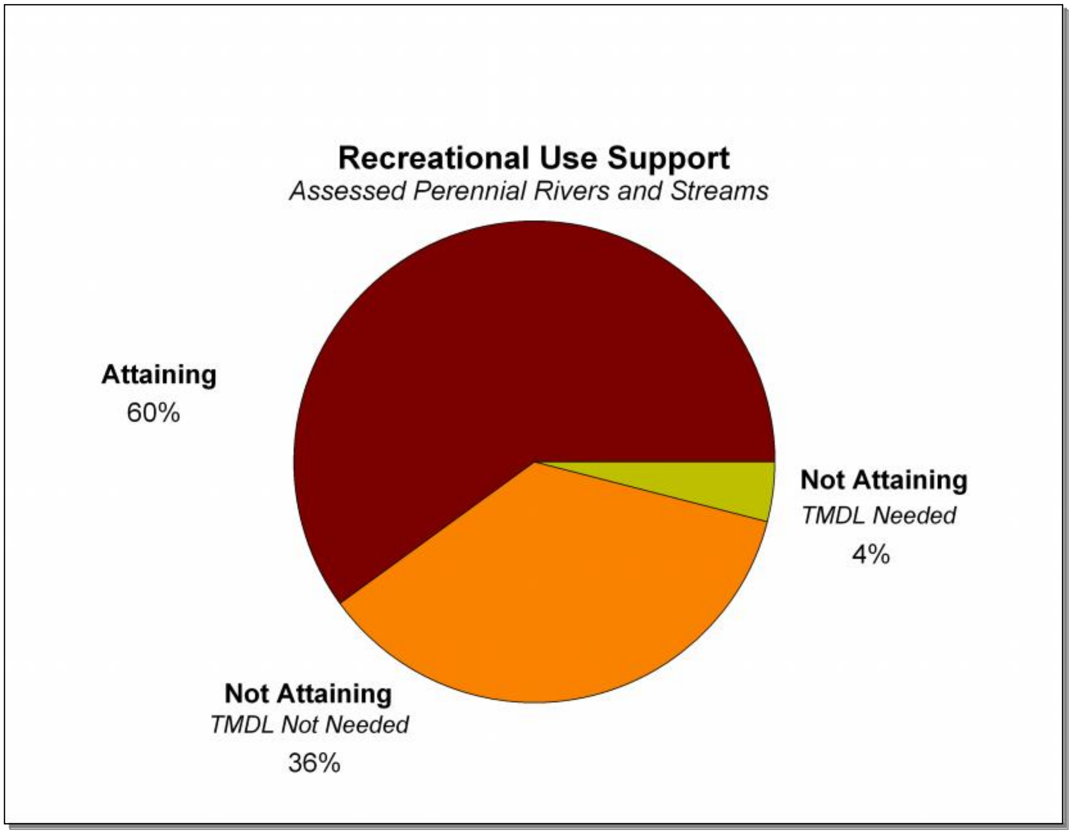

Figure 6: Recreation Use Support Summary

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.

For the 2012 §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. In addition to assessment of ALUS, MDEQ also assessed the recreation use for Mississippi's public beaches using data provided by the MDEQ Coastal Beach Monitoring Program. Shellfish consumption use was not assessed for the shellfish harvesting reefs due current efforts to replenish shellfish beds damaged by Hurricane Katrina, and bed closures in response to the MC 252 Deepwater Horizon oil spill event in 2010.
Aquatic Life Use Support (ALUS) Assessment

Through the establishment of the Mississippi Coastal Assessment Program (MCA), MDEQ has continued to coordinate the sampling effort that was initiated as part of USEPA's National Coastal Assessment (NCA) monitoring. This monitoring builds upon the data generated through NCA by using the same probabilistic station selection process and collecting data at 25 sites annually. MDEQ's MCA program monitors the core ecological indicators established by the NCA program. Information and data analysis from the MCA program pertinent to aquatic life use assessment are now available and are used in Mississippi's 2012 §305(b) report development.

Each year, a new set of 25 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 two different strata: large estuaries and small estuaries. Probabilistic site selection is provided by USEPA-Gulf Breeze. For the 2012 §305(b) reporting window a total of 125 monitoring sites were available for assessment purposes. Due to the confidential nature of the National Resource Damage Assessment (NRDA) associated with the 2010 MC 252 Deepwater Horizon Incident, MDEQ did not include 2010 estuarine data in this assessment. The data collected in response to the oil spill will be available for assessment in the 2014 report.

Assessments were based on three conventional parameters: dissolved oxygen, pH, and temperature. These data were used to assess ALUS attainment. Based on MCA data analysis, approximately 97% 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: MCA Conventional Parameter Summary – All MS Coastal Waters

Classification	Dissolved Oxygen		Temperature		pH	
All Mississippi Coastal Waters	Attaining	98%	Attaining	97%	Attaining	100%
	Not Attaining	2%	Not Attaining	3%	Not Attaining	0%

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

Classification	Dissolved Oxygen		Temperature		pH	
Large Estuaries	Attaining	99%	Attaining	98%	Attaining	100%
	Not Attaining	1%	Not Attaining	2%	Not Attaining	0%
Small Estuaries	Attaining	94%	Attaining	89%	Attaining	100%
	Not Attaining	6%	Not Attaining	11%	Not Attaining	0%

The larger percentage of low dissolved oxygen in small estuaries 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.

Recreation Use Support Assessment

For the 2012 §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 monitoring program can be found in Part IV: Coastal Beach Monitoring Network.

Of the 42 miles of Mississippi's public beaches, 25.7 miles were assessed using the MDEQ Beach Monitoring Program data. Based on these data, 24.3 miles or 54 % of the beaches in Mississippi were attaining the recreation use while 1.4 miles (3.3%) 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 and the Beach Monitoring Website (http://www.usm.edu/gcrl/msbeach/index.cgi)

MC-252 Deepwater Horizon Event and Water Quality Monitoring

April 29, 2010, the Deepwater Horizon oil rig exploded in the Gulf of Mexico. In response to this event, MDEQ, state and federal partners began an unprecedented response and data collection exercise. Data were collected to determine baseline conditions of the Mississippi Gulf Coast prior to arrival of any oiling, determine when and if oiling had reached our jurisdictional waters and water quality monitoring continues until the present to determine the impact from the spill. Data are available from NOAA for review, but the full impact of the spill has not been determined at this time. Due to the continuance of data collection and interpretation, MDEQ will not make a statement on impact to the coastal waters at this time. Data collected will be reviewed as part of the NRDA, and should be available for review for the 2014 §305(b) cycle

Lakes: Statewide Assessment Summary

Lake Water Quality

Mississippi is covered with hundreds of publicly owned lakes, reservoirs, and ponds totaling approximately 260,000 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.

Lake Lee Washington County MS. Photo taken by Charles E. Sullivan

Use Support Determinations

For the 2012 §305(b) Water Quality Assessment report, MDEQ assessed approximately 55% of Mississippi's total 259,533 lake acres for trophic status (see discussion under Section 314 reporting). 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. All the lakes were selected based on recommendations made by the Lakes Subcommittee of the MDEQ Nutrient Criteria Task Force.

In 2009, MDEQ re-established the Ambient Lakes Monitoring Program as part of the Statewide Ambient Network. As part of the lakes monitoring, MDEQ will initially focus on monitoring public lakes and reservoirs. MDEQ will collect samples from approximately 20 public lakes (greater than 100 acres in size) annually. Lakes will be monitored for traditional physical, chemical, and biological water quality parameters using the protocol that was developed for nutrient criteria development. A list of these lakes can be found in Table 8. Due to resource constraints in response to the MC 252 Deepwater Horizon incident, the program was suspended for 2010, and limited in 2011. MDEQ plans to reinstate the program in 2012. Data generated from this monitoring program will be available for assessment in the 2014 §305(b) Report.

Table 8: Ambient Lakes Monitoring Network

Lake or Reservoir	Type	County
Aberdeen Lake (Tenn-Tom Waterway)	Reservoir	Monroe
Aliceville Lake (Tenn-Tom Waterway)	Reservoir	Noxubee
Anchor Lake	Reservoir	Pearl River
Archusa Creek Water Park	Reservoir	Clarke
Arkabutla Lake	Large Reservoir	Tate, Desoto
Artonish Lake	Oxbow	Wilkinson
Bailey Lake	Reservoir	Lauderdale
Bailey Lake	Reservoir	Carroll
Bay Springs Lake	Large Reservoir	Prentiss, Tishomingo
Beaver Lake	Reservoir	Lamar
Beaver Lake	Reservoir	Smith
Beaverdam Lake	Oxbow	Tunica
Bee Lake	Oxbow	Holmes
Big Lake	Oxbow	Wilkinson
Big Snow Lake	Reservoir	Benton
Bluff Lake	Reservoir	Noxubee
Bonita Reservoir	Reservoir	Lauderdale
Butler Lake	Reservoir	Adams
Buzzard Bayou Lake	Oxbow	Tallahatchie
Chewalla Reservoir	Reservoir	Marshall
Chiwapa Reservoir	Reservoir	Pontotoc
Clarks Lake	Reservoir	Lincoln
Columbus Lake	Reservoir	Lowndes
Crystal Lake	Cut-off of Pearl River	Rankin
Cypress Lake	Oxbow	Issaquena
Cypress Lake	Oxbow	Warren
Dalewood Shore Lake	Reservoir	Lauderdale
Dawson, Lake	Oxbow	Sunflower
Deer Lake	Oxbow	Washington
Desoto Lake	Oxbow	Coahoma
Dixie Springs Lake	Reservoir	Pike
Dump Lake	Oxbow	Yazoo
Eagle Lake	Oxbow	Warren
Enid Lake	Large Reservoir	Yalobusha
Fields Lake	Oxbow	Adams
Fitler Lake	Oxbow	Issaquena
Fivemile Lake	Oxbow	Issaquena
Flatland Lake	Lake	Jefferson
Flint Creek Reservoir	Reservoir	Stone
Flower Lake	Oxbow	Tunica

Table 8: Ambient Lakes Monitoring Network continued		
Lake or Reservoir	**Type**	**County**
Gee Lake	Reservoir	Carroll
Gilliard Lake	Lake	Wilkinson
Grassy Lake	Oxbow	Tallahatchie
Grenada Lake	Large Reservoir	Grenada
Halpino Lake	Oxbow	Warren
Hampton Lake	Oxbow	Tallahatchie
Hard Cash Lake	Oxbow	Humphreys
Hennington Lake	Reservoir	Lamar
Henry, Lake	Oxbow	Leflore
Holmes Lake	Oxbow	Jefferson
Horn Lake	Oxbow	Desoto
Horseshoe Lake	Oxbow	Holmes
Horseshoe Lake	Oxbow	Coahoma
Hurricane Lake	Reservoir	Lincoln
Lake Beulah	Oxbow	Bolivar
Lake Bogue Homo	Reservoir	Jones
Lake Bolivar	Oxbow	Bolivar
Lake Cavalier	Reservoir	Madison
Lake Charlie Capps	Reservoir	Bolivar
Lake Chotard	Oxbow	Warren, Issaquena
Lake Copiah	Reservoir	Copiah
Lake Ferguson	Oxbow	Washington
Lake George	Oxbow	Yazoo
Lake Hide-A-Way	Reservoir	Pearl River
Lake Jackson	Oxbow	Washington
Lake LaRue	Reservoir	Hinds
Lake Lee	Oxbow	Washington
Lake Lorman	Reservoir	Madison
Lake Mary	Oxbow	Wilkinson
Lake Mohawk	Reservoir	Tippah
Lake Washington	Oxbow	Washington
Lake Whittington	Oxbow	Bolivar
Little Black Creek Reservoir	Reservoir	Lamar
Little Eagle Lake	Oxbow	Humphreys
Little Snow Lake	Reservoir	Benton
Loakfoma Lake	Reservoir	Noxubee
Long Brake	Oxbow	Tallahatchie
Long Creek Reservoir	Reservoir	Lauderdale
Long Lake	Oxbow	Sunflower
Lower Lake	Lake	Panola
Maynor Creek Water Park	Reservoir	Wayne
Moon Lake	Oxbow	Coahoma

Table 8: Ambient Lakes Monitoring Network continued		
Lake or Reservoir	**Type**	**County**
Mossy Lake	Oxbow	Leflore
Okatibbee Lake	Large Reservoir	Lauderdale
Oktibbeha County Lake	Reservoir	Oktibbeha
Pickwick Lake	Large Reservoir	Tishomingo
Pinchback Lake	Oxbow	Holmes
Pool A (Tenn-Tom Waterway)	Reservoir	Monroe
Pool B (Tenn-Tom Waterway)	Reservoir	Monroe, Itawamba
Pool C (Tenn Tom Waterway)	Reservoir	Itawamba
Pool D (Tenn-Tom Waterway)	Reservoir	Itawamba
Pool E (Tenn-Tom Waterway)	Reservoir	Prentiss
Roebuck Lake	Oxbow	Leflore
Ross Barnett Reservoir	Large Reservoir	Madison, Rankin
Sanders Lake	Reservoir	Carroll
Sardis Lake	Large Reservoir	Panola
Sixmile Lake	Oxbow	Leflore, Sunflower
Sixmile Lake	Oxbow	Tunica
Sixmile Lake (Upper Sixmile Lake)	Oxbow	Leflore
Sky Lake	Oxbow	Humphreys
Square Lake	Lake	Coahoma
Suffer Brake	Oxbow	Tallahatchie
Swan Lake	Oxbow	Coahoma
Swan Lake	Oxbow	Tallahatchie
Tchula Lake	Oxbow	Holmes
Tennessee Lake	Oxbow	Issaquena
Thornburg Lake	Oxbow	Adams
Tunica Cutoff	Oxbow	Tunica
Walnut Lake	Oxbow	Tunica
Wasp Lake	Oxbow	Humphreys
Wolf Lake/Broad Lake	Oxbow	Yazoo, Humphreys
Woodland Lake	Reservoir	DeSoto

Section 314 Reporting-Trophic Status

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.

These requirements 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 Secchi depth (meters)]

Chlorophyll a:
TSI = [9.81 ln Chlorophyll a (ppb)]+ 30.6

Total Phosphorus:
TSI = [14.42 ln 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 a**	**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 in 2004. During this period, all the public lakes in Mississippi greater than 500 acres in size were sampled. The lakes were sampled six times, 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 a	Total Phosphorus (ppb)	TSI Secchi Depth	TSI Chlorophyll a	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

Lake	Secchi Depth (m)	Chlorophyll a	Total Phosphorus (ppb)	TSI Secchi Depth	TSI Chlorophyll a	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	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-	0.55	4.9	0.04	68.5	46.1	25.4	Eutrophic
Pool B (Tenn-	0.58	4.39	0.04	67.7	45.1	24.2	Eutrophic
Pool C (Tenn-	0.86	3.35	0.02	62.1	42.4	19.3	Eutrophic
Pool D (Tenn-	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 lake

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 efforts by MDEQ and 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

One of the goals of the CWA is to maintain fishable waters and ensure attainment of the fish consumption use. This is consistent with MDEQ's mission to "..protect human health and the environment…" and makes fish tissue monitoring and assessment a high priority for MDEQ's water quality management activities. MDEQ is currently investigating two major fish contaminant issues: DDT and toxaphene in the Yazoo Basin (Delta Region) and mercury in waters across the state. To help address these issues and to monitor the general status and trends in contaminants in fish, MDEQ maintains a fish tissue monitoring program.

Ambient fish tissue sampling through the Ambient Monitoring Network occurs annually approximately 25 stations across the state. These sites are rotated among the different water body types. Additional tissue sampling for fish kill investigations, monitoring of fish advisory areas, and for special studies is also conducted. A distribution of the tissue sampling occurring at MDEQ for this §305(b) reporting period is shown in Table 11.

Table 11: MDEQ Tissue Samples Collected from 2004-2010

Type of Study	Number of Samples	Number of Fish
Ambient	231	734
Mercury	238	540
Dioxin	33	128
PCB's	6	17
Pesticides	39	113
Special Studies*	146	496
Metals*	44	534
Total:	585	2038

*includes shrimp, crab, and shellfish

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 7.

Table 12. Fish Tissue Advisories in Mississippi

MISSISSIPPI FISH ADVISORIES & COMMERCIAL FISHING BANS
August 2011

WATERBODY	CHEMICAL	DATE ISSUED	ACTION
Little Conehoma Creek and Yockanookany River in Attala and Leake Counties. From Hwy 35 near Kosciusko, downstream to Hwy 429 near Thomastown	PCB's	June 1987	Consumption Advisory All Species Commercial Fishing Ban
Lake Susie, Oxbow Lake of Old Tallahatchie River in Panola County west of Batesville.	PCB's	Nov. 1989	Same as above
Escatawpa River from the Alabama state line to I-10.	Mercury	May 1995	Limit Consumption Advisory for largemouth bass and large catfish (>27 in.)*
Bogue Chitto River, entire length in Mississippi.	Mercury	May 1995	Same as above
Yockanookany River, entire length.	Mercury	May 1995	Same as above
Pearl River from Hwy 25 near Carthage, downstream to the Leake County Water Park.	Mercury	June 2001	Same as above
Enid Reservoir	Mercury	May 1995	Same as above
Yocona River from Enid Reservoir downstream to the confluence with the Tallahatchie River.	Mercury	Sept. 1996	Same as above
Pascagoula River, entire length.	Mercury	Sept. 1996	Same as above
Archusa Creek Water Park	Mercury	Sept. 1996	Same as above
Grenada Lake and Yalobusha River from the dam downstream to Holcomb.	Mercury	June 2001	Same as above
Pearl River from Hwy 25 near Carthage, downstream to the Leake County Water Park.	Mercury	June 2001	Same as above
Mississippi Delta -All waters from the mainline Mississippi River Levee on the West to the Bluff hills on the East except for the waters listed below.	DDT, Toxaphene	Issued June 2001	Limit Consumption Advisory for carp, buffalo, gar, and large catfish (>22 in.)**
Mississippi Delta – The 2001 advisory described above remains in effect, but the waters listed below have been removed from the Delta Fish Advisory: • Steele Bayou (Issaquena, Sharkey, Warren, and Washington Counties) • Black Bayou (Washington County) • Bee Lake (Holmes County) • Recon Lake (or Rainey's Lake - Bolivar County) • Charlie Capps Lake (Bolivar County)		Modified July 2011	There are no restrictions on eating fish from these waters.
Gulf of Mexico	Mercury	May 1998	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.

****** The Mississippi Department of Health recommends that people limit their consumption of carp, gar, buffalo and large catfish (longer than 22 inches) to no more than one meal every two weeks.

******* 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.

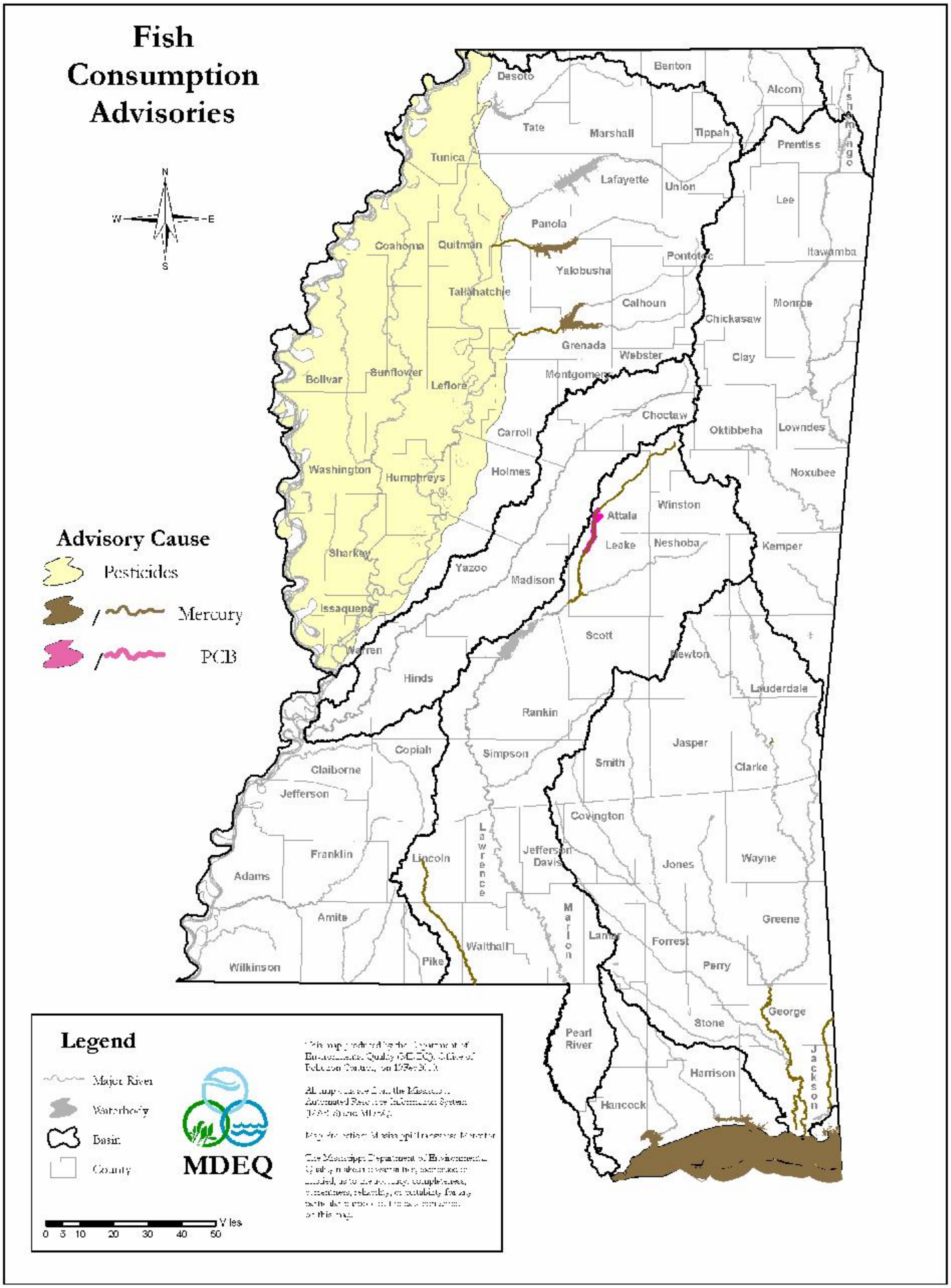

Figure 7: Map of Fish Advisories in Mississippi

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 11 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.

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 continues to monitor fish tissue for mercury contamination in this Reservoir.

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 United States in 1972; and, although DDT concentrations in fish tissue remain above the stat's advisory criteria, continue to decline in many Delta waters.

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 8), 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, which is still in effect today, 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).

Advisory Update

In August of 2011, the Fish Advisory Task Force modified the Delta Fish Tissue Advisory. The following waterbodies were removed from the Delta Fish Advisory.

- Steele Bayou (Issequena, Sharkey, Warren and Washington Counties)
- Black Bayou (Washington County)
- Bee Lake (Holmes County)
- Recon Lake (or Rainey’s Lake- Bolivar County)
- Lake Charlie Capps (Bolivar County)

The decline in pesticide concentrations in Steele Bayou, Black Bayou and Bee lake are likely due to several factors including the continued breakdown of the banned pesticides and increased usage of best management practices on agricultural lands which reduces the soil and associated contaminates from entering the waters via runoff.

Recon Lake and Lake Charlie Capps were removed from the advisory because they are surrounded by levees and do not receive run off and no elevated levels of pesticides have been measured in these lakes. The no consumption advisory for buffalo was removed from Roebuck Lake, but it remains under the regional Delta Advisory, recommending no more than two meals per month of carp, gar, buffalo and large catfish (>22" in length).

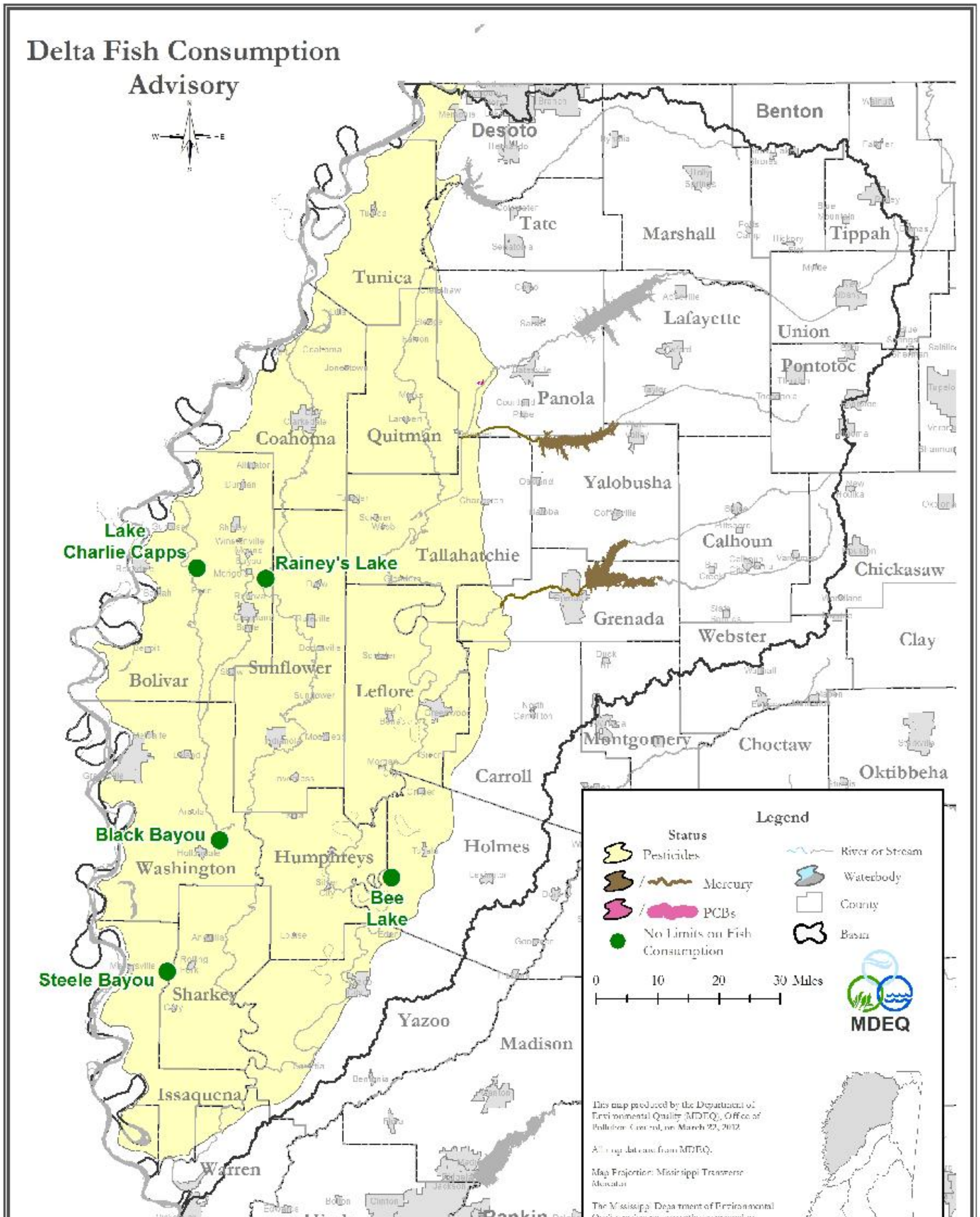

Figure 8: Advisory Area for Delta Region of Mississippi

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 2006 through December 2010, the MDEQ investigated 100 fish kills (Figure 9). Fifty-eight percent of these were associated with low dissolved oxygen levels and other natural causes (Figure 10). In 24% percent of the investigations the cause could not be determined. Twelve percent were those related to nutrient overloads, sewage spills or un-permitted discharges.

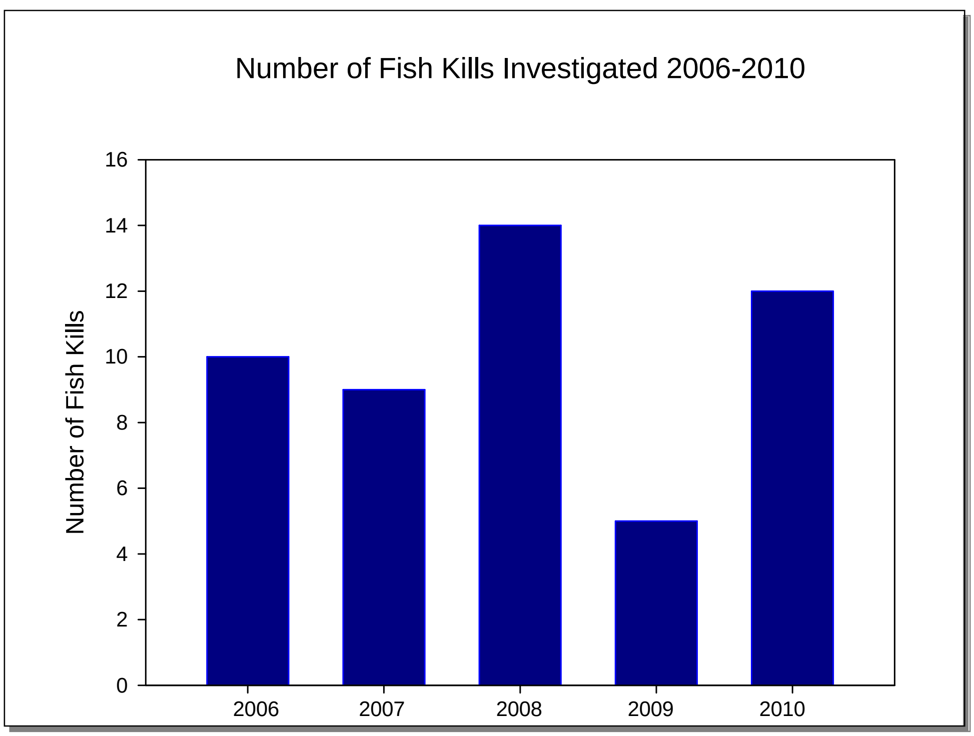

Figure 9: Annual Number of Fish Kills Investigated from 2006-2010

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 Hurricane Gustav in 2008 there were numerous fish kills. These fish kills were concentrated in the Pascagoula River Basin and Mississippi Delta respectively. 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.

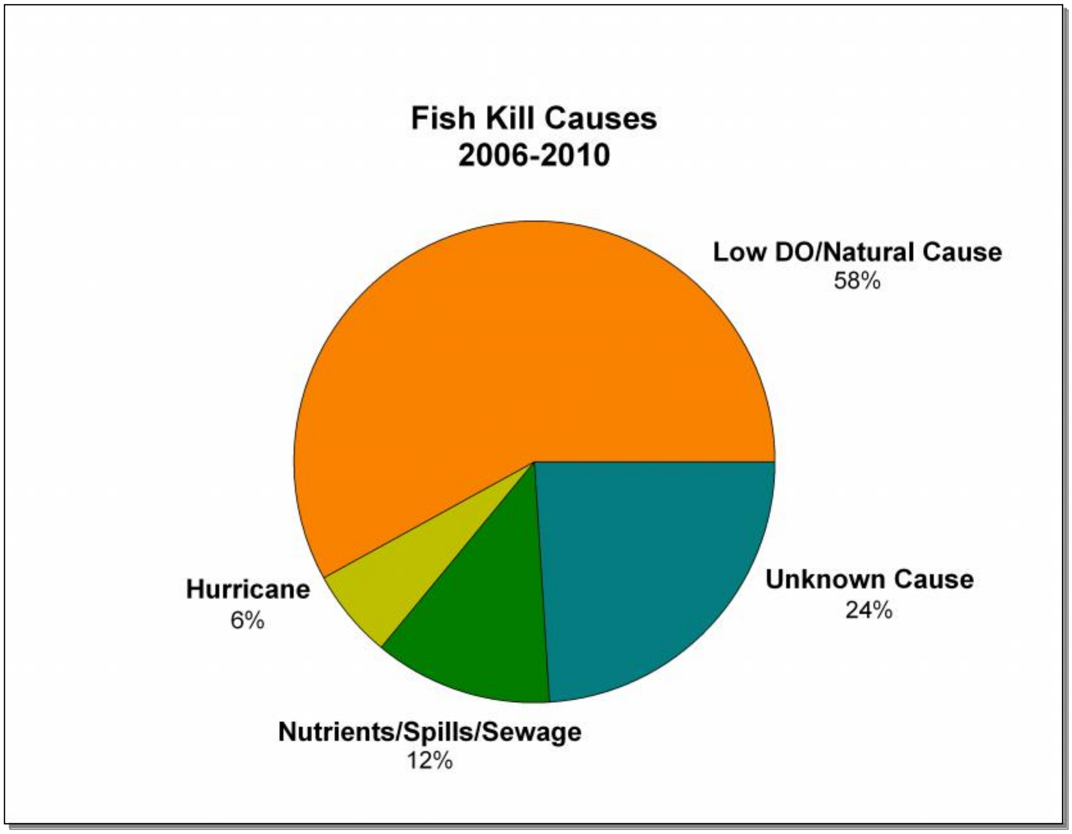

Figure 10: Distribution of Fish Kill Causes from 2006-2010

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).

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. In 2010, shellfish beds were closed in response to potential oiling from the MC-252 Deepwater Horizon incident. The Shellfish Harvesting Use was not assessed for this report due to the shellfish bed replenishment underway after the destruction of beds caused by Hurricane Katrina, as well as closures in response to the oil spill.

Beach Advisories

Sampling for 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) or by accessing the USM web site (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 2006 – 2010, the Mississippi Beach Monitoring Task Force issued 112 advisories resulting from high bacteria levels. The cause of most of these advisories was urban runoff following storm events; however, five were caused by sewer leaks, spills or breaks.

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. These activities are integrated by basin and result in watershed management plans and implementation strategies that 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 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 nine major drainage areas or basins. These nine basins are the Big Black River Basin, Coastal Streams Basin, North Independent Streams 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 11.

Through this approach, Mississippi's nine 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 12 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 ambient monitoring 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.

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. These monitoring efforts involve sampling of multiple parameters (water chemistry, bacteria, algae, fish, benthic macroinvertebrates and/or sediment) needed to address watershed data collection needs.

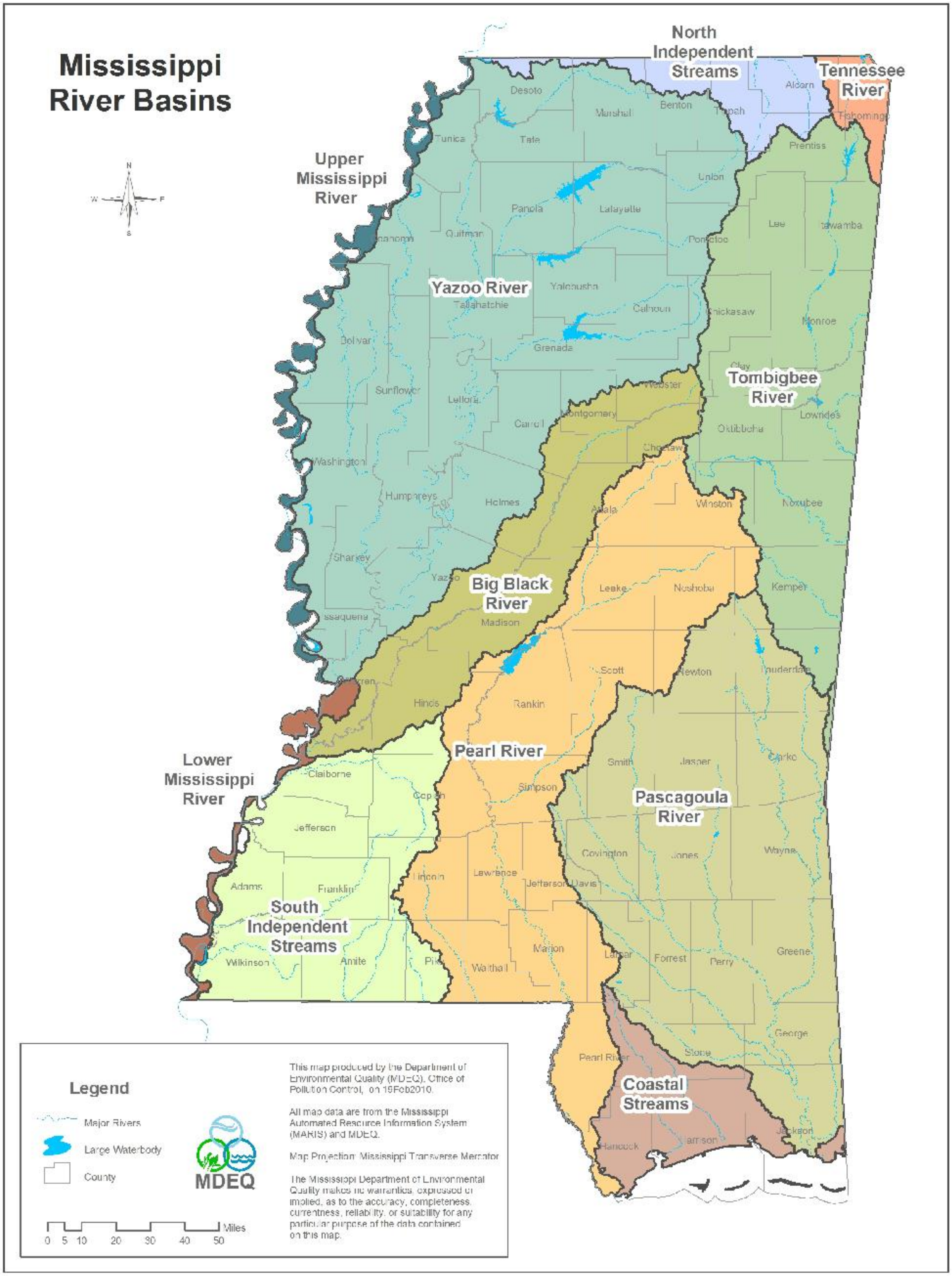

Figure 11: Mississippi's Nine Major Drainage Basins

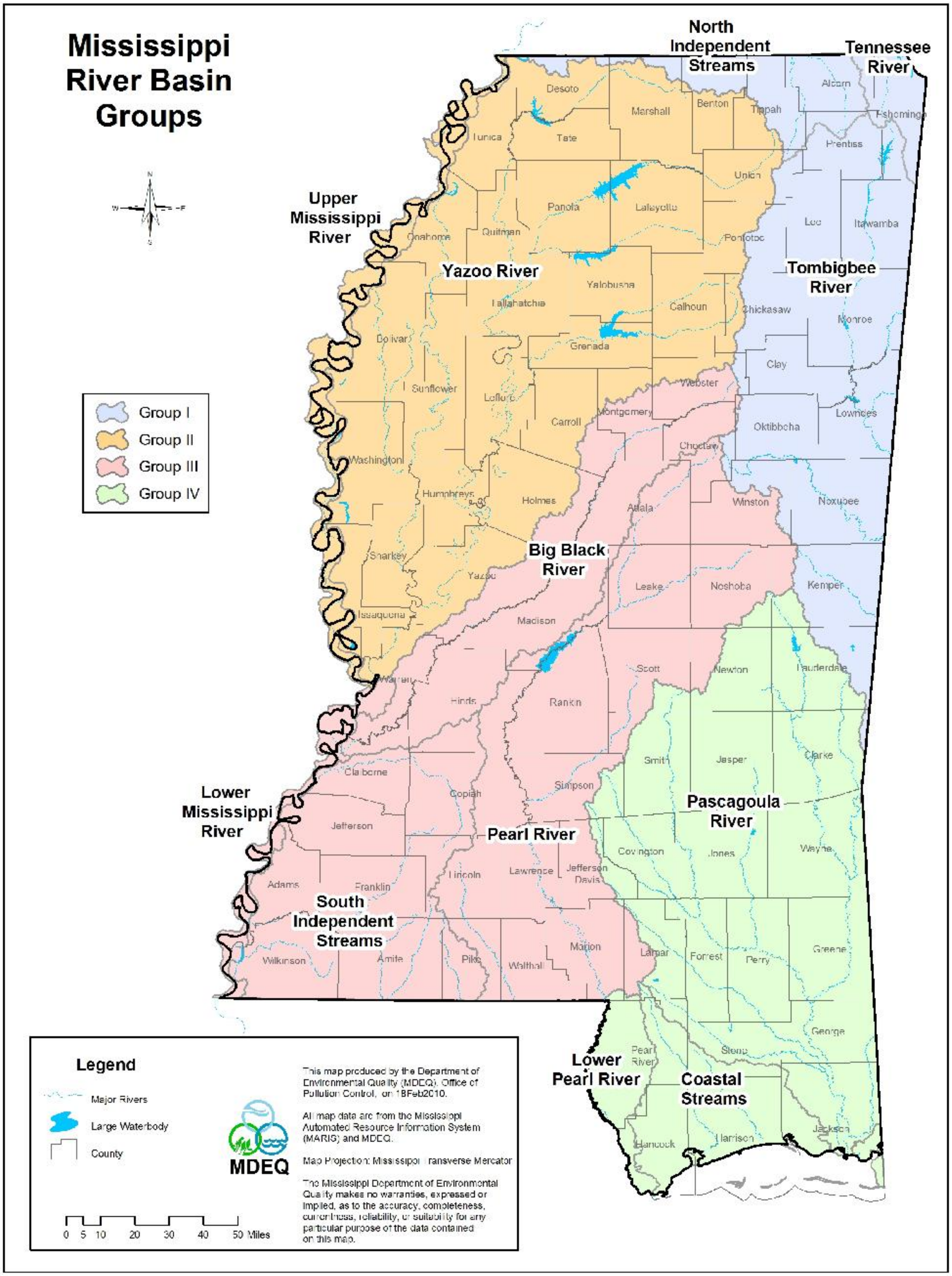

Figure 12: Mississippi's Basin Groups

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, *State of Mississippi Surface Water Monitoring Program Strategy for Fiscal Years 2012-2014* (MDEQ 2011) 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. 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 attaining 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 2012 §303(d) List is also available from the MDEQ web site (www.deq.state.ms.us).

MDEQ also reports on SWMP activities and water quality issues through various other EPA-required reports. These 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). 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. 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 February 6, 2004, revised in July 2007 and revised again in July 2010. The purpose of this plan was to provide EPA with a better understanding of Mississippi's approach to numeric nutrient criteria development. The focus of this strategy will be to develop nutrient criteria based primarily on the linkage between nutrient concentrations and the 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. The causative variables may include phosphorus and/or nitrogen and response variables may include chlorophyll *a* and turbidity. While Mississippi may derive criteria based upon a reference condition approach, this approach has 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) wadeable streams, 3) non-wadeable streams, 4) coasts/estuaries, and 5) delta waters. Currently, MDEQ continues with sample collection in support of an effects-based approach to nutrient criteria development. Some preliminary data analyses have been performed on the current data available. Recent data and information collected will be incorporated into upcoming analyses to determine appropriate and protective numeric nutrient criteria for Mississippi's waters.

Description of MDEQ Sampling Networks

Monitoring information from multiple programs is needed to fully achieve a comprehensive understanding of water quality in Mississippi's surface waters. Routine ambient, program support, 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 ambient monitoring networks serve as the foundation for the statewide water quality assessment process.

Status & Trends Ambient Monitoring Networks

In Mississippi, ambient 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. Ambient 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.

Ambient Monitoring Network stations are distributed throughout the northern, central, and southern regions of the state in streams, rivers, bayous and estuaries. These stations are located to establish baseline conditions and in 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).

To be included in Ambient Monitoring Networks, each station not only must meet the monitoring objectives of the program but also must meet specific selection criteria for station locations. The specific criteria utilized for the location and establishment of ambient stations are: major perennial stream, major lake or estuary; at or close to a hydrological recording station (required for most physical/chemical stations); strategic watershed location (lower end of watershed, confluence of major streams, mouth of major tributary, maximum spatial coverage, etc.); high recreational activity or designated use; interstate waters; 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 Bridge Network

The Ambient Bridge 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 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 scientists from each of three regional offices (northern, central, and southern regions). Each office is responsible for the stations in its region and there are currently 10 stations per region for a total of 30 stations statewide. Laboratory analyses for the samples are carried out by MDEQ's laboratory located in Pearl, Mississippi. Several stations in the sampling network are historical stations that have monitoring dating back to the 1970's. Figure 13 shows the locations of the bridge stations.

Ambient Fish Tissue Monitoring Networks

Ambient Fish Tissue Monitoring Network consists of sampling at a minimum of 25 stations annually across the state. These stations are rotated through the different water body types. Fish tissue sampling for fish kill investigations, monitoring of fish advisory areas, and special studies requires more resources and results in more intensive 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.

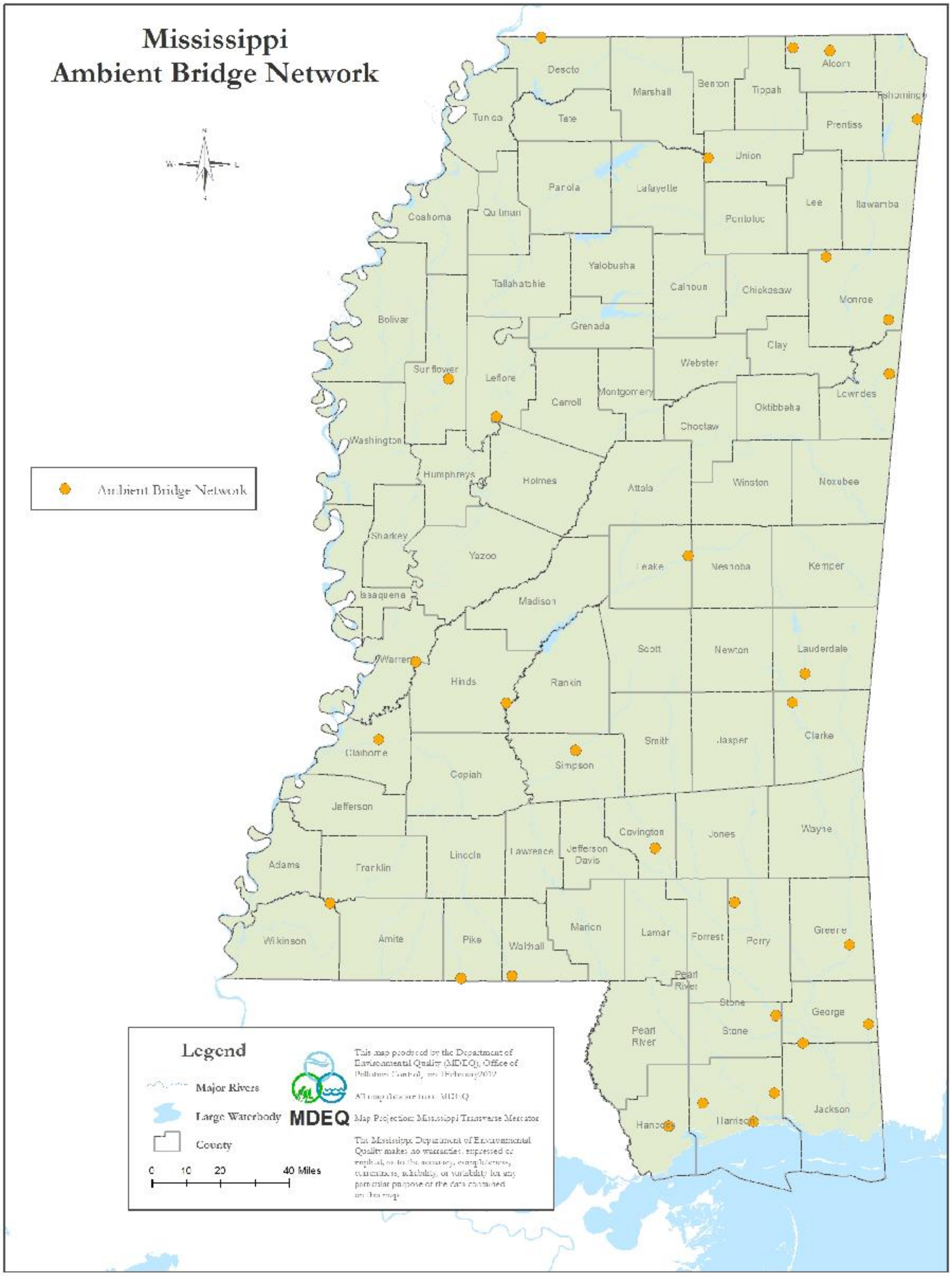

Figure 13: Ambient Bridge Network

Ambient Biological Network

In addition to extensive water chemistry and fish tissue analyses, the MDEQ relys 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 collects benthic macroinvertebrate community surveys in wadeable freshwater streams; and chlorophyll a levels in lentic, marine and estuarine waters.

In 2001, MDEQ updated the 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 MDEQ statewide Ambient Monitoring Network. In 2008, the M-BISQ was recalibrated using data and information collected 2001-2006. The recalibration report, *Evaluation and Recalibration of the Mississippi Benthic Index of Stream Quality (M-BISQ)* (MDEQ 2008), is available upon request. Figure 14 shows the M-BISQ where data were collect 2006-2010.

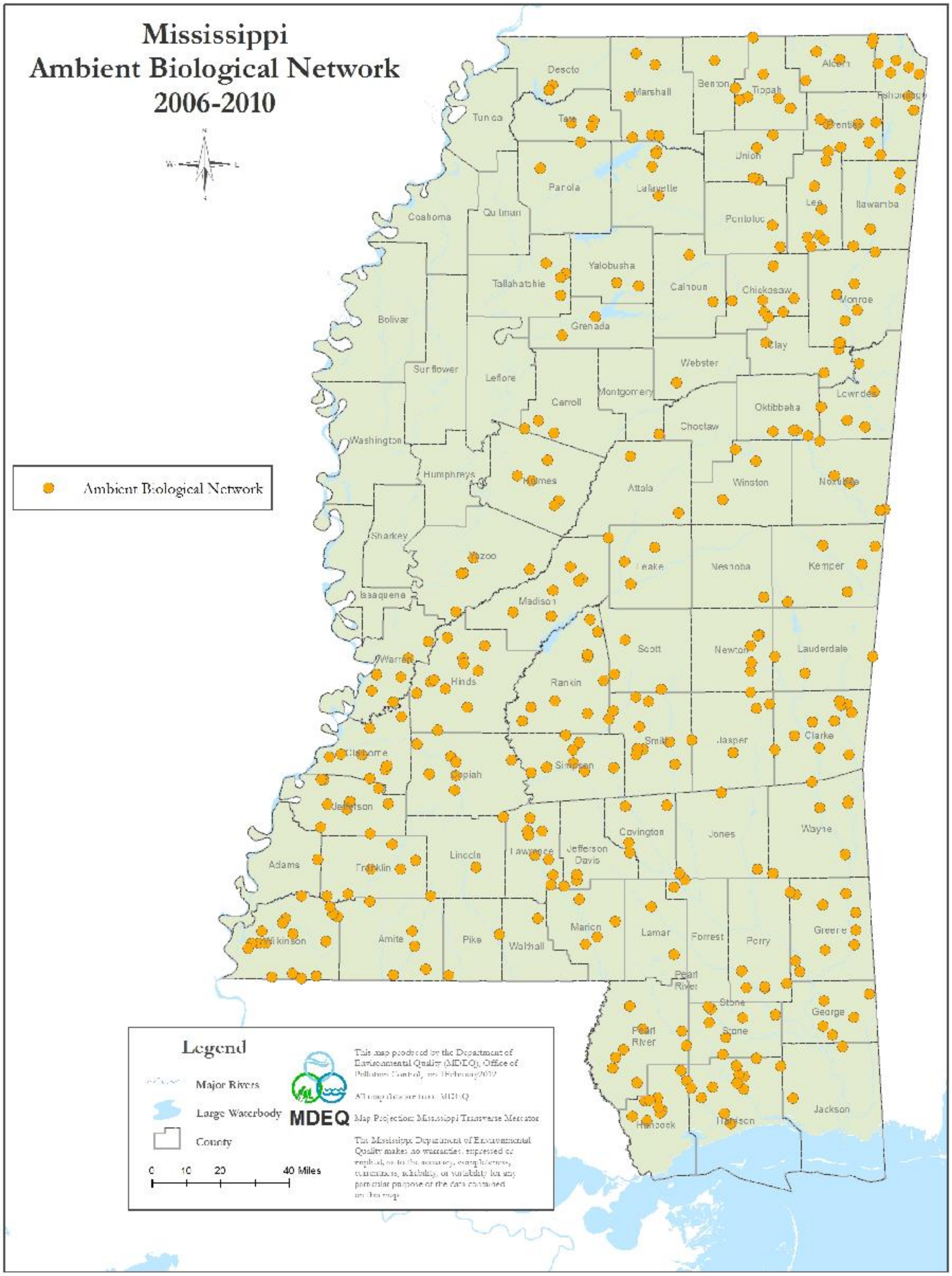

Figure 14: Ambient Biological Network

Ambient Recreational Monitoring Network

MDEQ maintains a monitoring network for flowing waters in the state that are used for primary contact recreation. A listing of these waters can be found in Mississippi's WQS. These sites are located on the recreational water bodies to monitor fecal coliform for the safety of Mississippi citizens that use these waters for recreational purposes. Monitoring at these locations entails the collection of five samples within a 30-day period. This sample frequency allows for the calculation of a geometric mean for the fecal coliform data. Each location is monitored in both the contact (May-October) and non-contact (November-April) seasons. Figure 15 shows these monitoring locations.

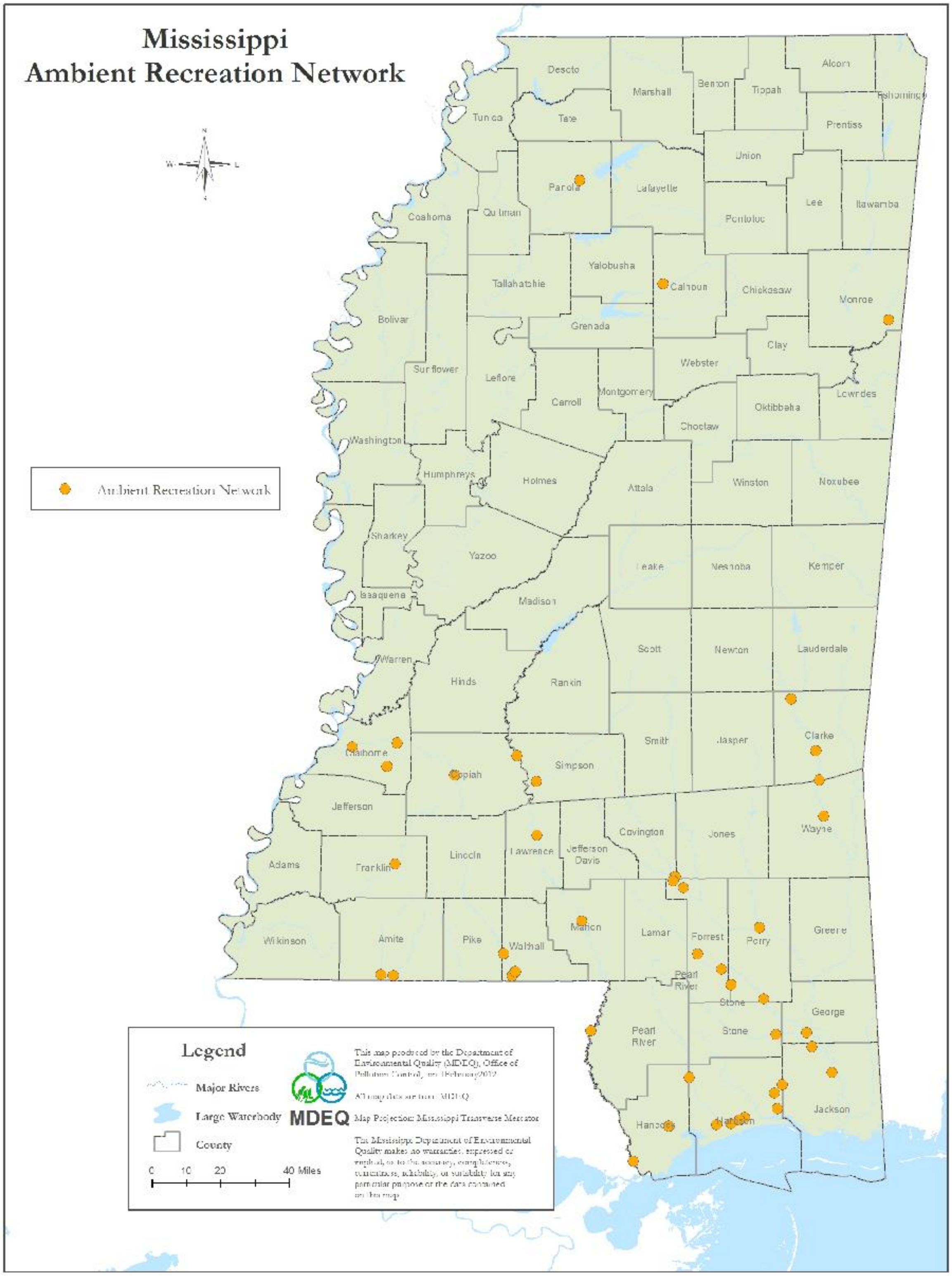

Figure 15: Ambient Recreational Monitoring Network

Ambient Beach Monitoring Network

MDEQ's Ambient 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 16). 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 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 *Enterococcus* 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). This web site contains beach advisory status, location of monitored sites, data associated with those monitored locations, and a history of beach advisories.

From 2006-2008, there were 16 core stations were sampled ten times a month during the recreational season. There are also 6 non-core stations sampled weekly during the recreational season (May – October). Beginning in 2009, all stations were sampled weekly. Any station is re-sampled if *Enterococcus* levels exceed 104 colonies/100ml.

Mississippi Coastal Assessment Program

Through the establishment of the Mississippi Coastal Assessment Program (MCA), MDEQ has continued to coordinate the sampling effort that was initiated as part of USEPA's National Coastal Assessment (NCA) monitoring. This monitoring builds upon the data generated through NCA by using the same probabilistic station selection process and collecting data at 25 sites annually. MDEQ's MCA program monitors the core ecological indicators established by the NCA program. Figure 17 depicts all of the monitoring locations that have been sampled 2006-2009

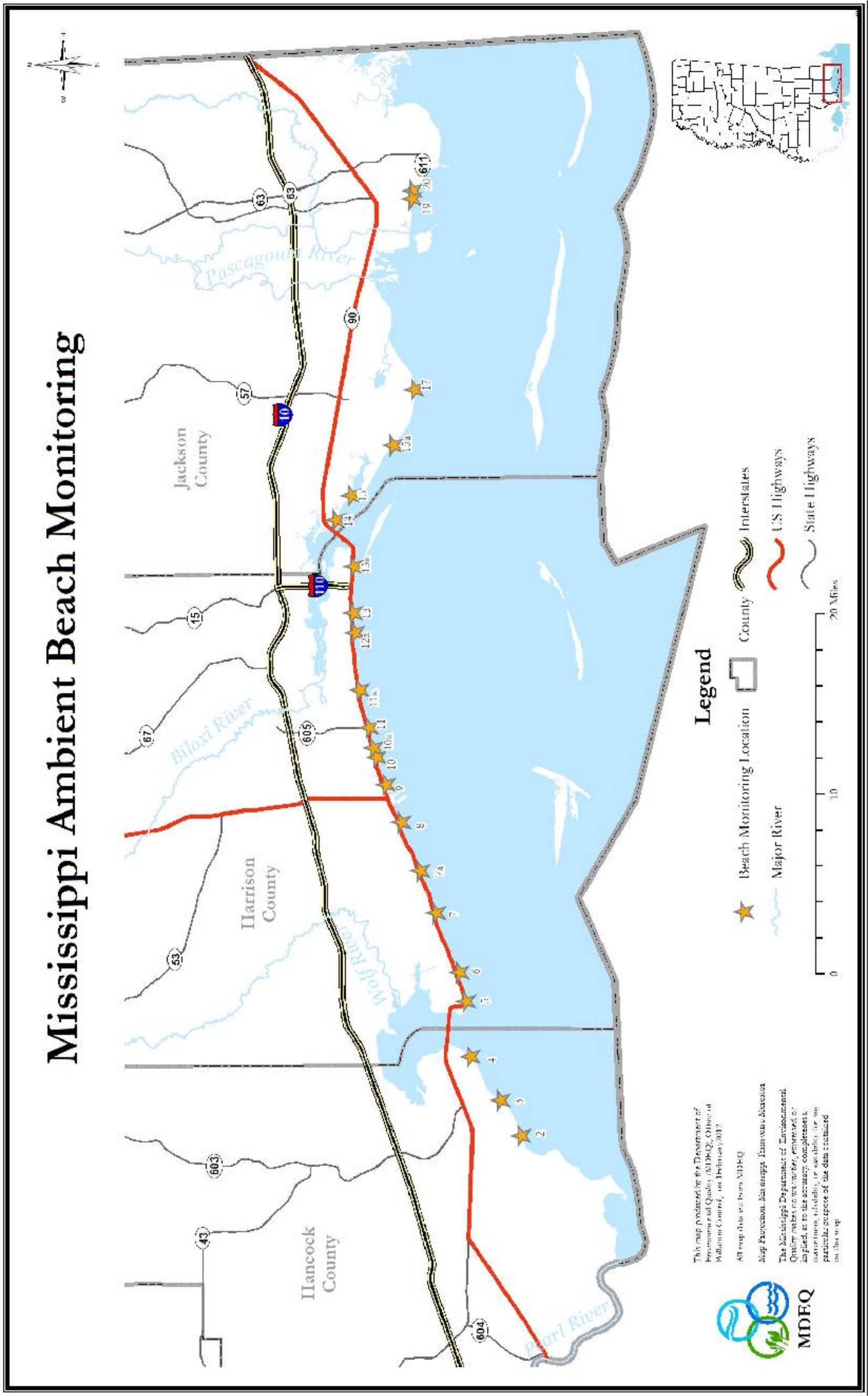

Figure 16: Ambient Beach Monitoring Network

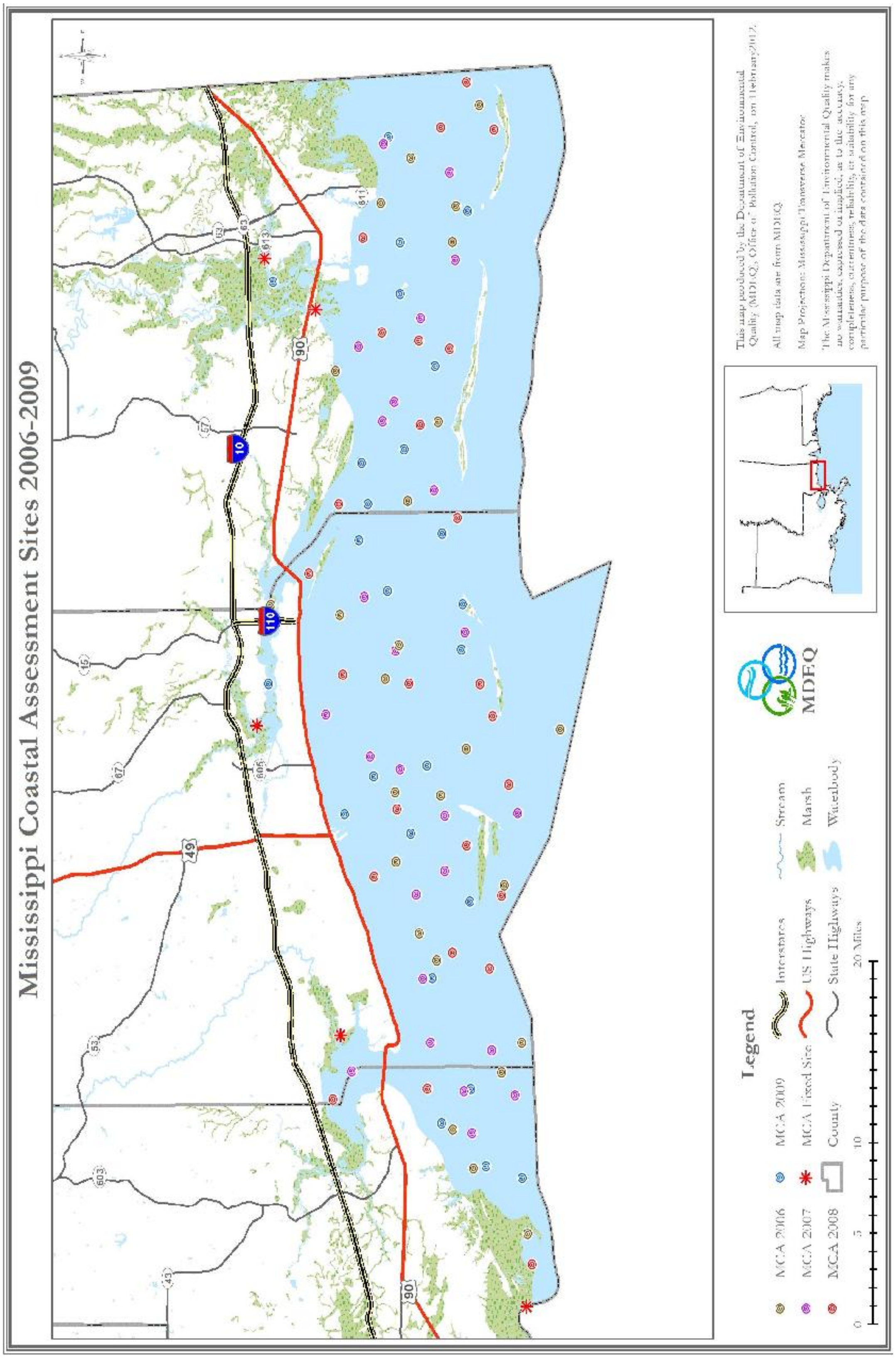

Figure 17: Mississippi Coastal Assessment 2006-2009

LITERATURE CITED

Addy, K. and L Green. 1996. Phosphorus and lake aging. Natural Resources Facts, Fact sheet No. 96-2. University of Rhode Island.

Brezonik, P.L. 1984. Trophic state indices: rational for multivariate approaches. Pages 441-445 in Lake and Reservoir Management, October 18-23, Knoxville, TN. EPA 440/5-84-001 US EPA Washington D.C.

Carlson, R.E. 1977. A trophic state index for lakes. Limnology and Oceanography, 22:361-369.

Carlson, R.E. and J. Simpson. 1996. A Coordinator's Guide to Volunteer Lake Monitoring Methods. North American Lake Management Society. 96 pp.

Greenwood, N.N. and A. Earnshaw. 2002. Chemistry of the Elements. Butterworth Heinmann, NY.

(MDEQ) Mississippi Department of Environmental Quality. 1999a. Laboratory Quality Assurance Manual/Standard Operating Procedures. November 1999. Mississippi Department of Environmental Quality, Jackson, MS.

(MDEQ) Mississippi Department of Environmental Quality. 2001a. Mississippi Delta Fish Tissue Study 2000, Final Report. October 2001. Mississippi Department of Environmental Quality, Jackson, MS.

(MDEQ) Mississippi Department of Environmental Quality. 2002a. Quality Assurance Project Plan For Water Quality Sampling and Analysis for Fecal Coliform at Targeted Pathogen TMDL Locations in the Coastal, Pascagoula, Pearl, Tombigbee, Big Black, Tennessee and Northern Independent Stream Basins. April 16, 2002. Prepared by Mississippi Department of Environmental Quality, Jackson, MS.

(MDEQ) Mississippi Department of Environmental Quality. 2002b. Quality Assurance Manual, Revision 2. August 2002. Mississippi Department of Environmental Quality, Jackson, MS.

(MDEQ) Mississippi Department of Environmental Quality. 2003a. Development and Application of the Mississippi Benthic Index of Stream Quality (M-BISQ). June 2003. Mississippi Department of Environmental Quality, Jackson, MS.

(MDEQ) Mississippi Department of Environmental Quality. 2007b. State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters. August 2007. Mississippi Department of Environmental Quality, Jackson, MS.

(MDEQ) Mississippi Department of Environmental Quality. 2008. Quality Assurance Project Plan for the §106 Monitoring Network in the State Surface Water Monitoring and Assessment Program. February 2008. Mississippi Department of Environmental Quality, Jackson, MS.

(MDEQ) Mississippi Department of Environmental Quality. 2008. Evaluation and Recalibration of Mississippi Benthic Index of Stream Quality (M-BISQ). February 2008. Mississippi Department of Environmental Quality, Jackson, MS.

(MDEQ) Mississippi Department of Environmental Quality. 2011. State of Mississippi Surface Water Monitoring Program Strategy for Fiscal Years 2012-2014. May 2009. Mississippi Department of Environmental Quality, Jackson, MS.

(MDEQ) Mississippi Department of Environmental Quality. 2012. Mississippi 2010 Section 303(d) List of Impaired Water Bodies. April 2012. Mississippi Department of Environmental Quality, Jackson, MS.

(MDEQ) Mississippi Department of Environmental Quality. 2012. Mississippi CALM (Consolidated Assessment and Listing Methodology) 2012 Assessment and Listing Cycle Data Requirements and Assessment and Listing Methodology to Fulfill the Requirements of Sections 305(b) and 303(d) of the Clean Water Act (CWA). April 2012. Mississippi Department of Environmental Quality, Jackson, MS.

Mississippi Fish Advisory Task Force. 2001. Fish Advisory Criteria For Organochlorine Compounds. February 2001. Mississippi Department of Environmental Quality, Jackson, MS.

Oldham, L. 2003. Phosphorus in Mississippi Soils. Information Sheet 871. http://msucares.com/pubs/infosheets/is0871.pdf

Reicke, D. Mississippi Wildlife Forums. 24 February 2005. http://www.mdwfp.com/forums/topic.asp?TOPIC_ID=8155 Liming and Fertilization.

(USEPA) U.S. Environmental Protection Agency. 1997. Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates: Report Contents. September 1997. U.S. Environmental Protection Agency. Office of Water. Washington, D.C. EPA-841-B-97-0002A.

(USEPA) U.S. Environmental Protection Agency. 2000. Stressor Identification Guidance Document. December 2000. U.S. Environmental Protection Agency. Office of Water. Washington, D.C. EPA/822/B-00/025

(USEPA) U.S. Environmental Protection Agency. 2001. EPA Requirements for Quality

Assurance Project Plans. March 2001. U.S. Environmental Protection Agency. Office of Environmental Information. Washington, D.C. EPA/240/B-01/003

(USEPA) U.S. Environmental Protection Agency. 2002. Consolidated Assessment and Listing Methodology Toward a Compendium of Best Practices. First Edition. July 2002. U.S. Environmental Protection Agency. Office of Wetlands, Oceans, and Watersheds. Washington, D.C.

(USEPA) U.S. Environmental Protection Agency. 2 February 2006. http://www.epa.gov/bioiweb1/aquatic/carlson.html. Carlson's Trophic State Index. Aquatic Biodiversity