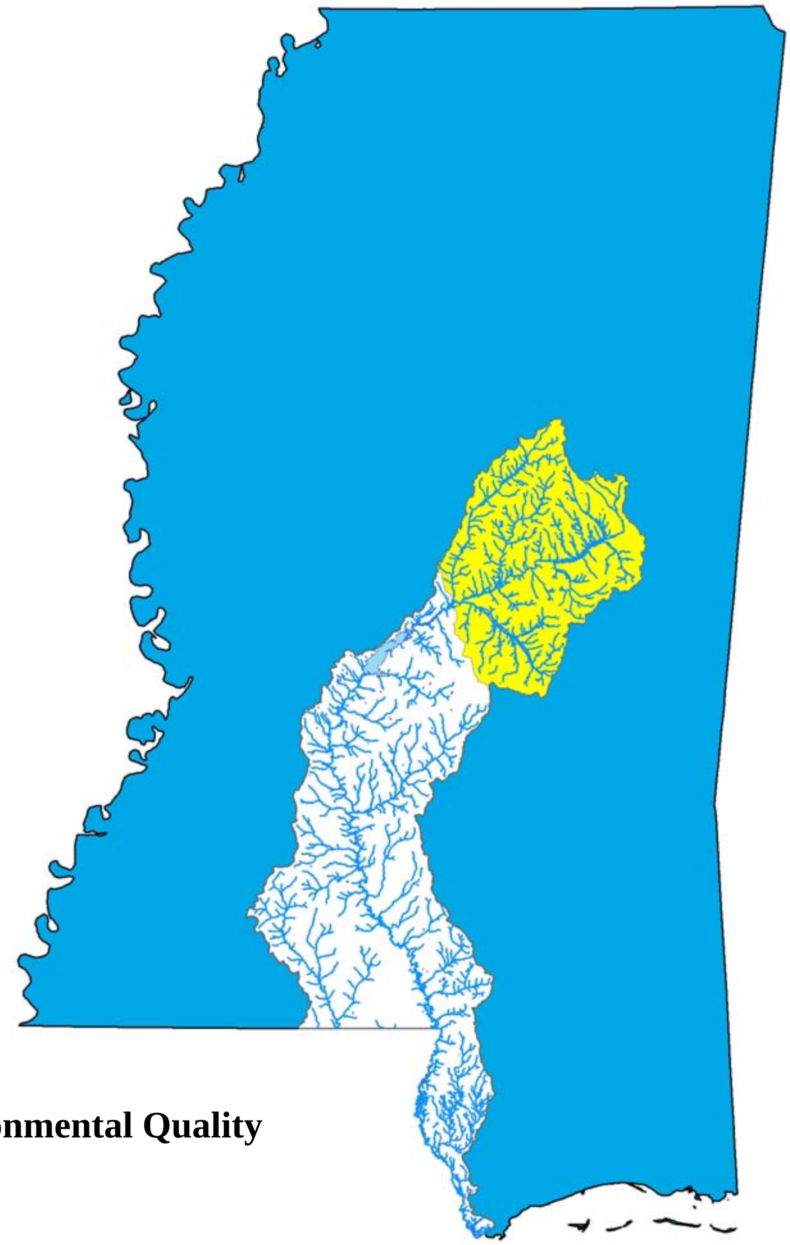
FINAL REPORT
February 2004
ID: 504021701

Pearl River and Yockanookany River Phase One Total Maximum Daily Load for Mercury

80
Hg
Mercury
200.59



Pearl River Basin

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FOREWORD

This report has been prepared in accordance with the schedule contained within the federal consent decree dated December 22, 1998. (*Sierra Club v. Hankinson, No. 97-CV-3683 (N.D. Ga.)*) The report contains one or more Total Maximum Daily Loads (TMDLs) for water body segments found on Mississippi's 1996 Section 303(d) List of Impaired Waterbodies. Because of the accelerated schedule required by the consent decree, many of these TMDLs have been prepared out of sequence with the State's rotating basin approach. The segments addressed are comprised of monitored segments that have data indicating impairment. The implementation of the TMDLs contained herein will be prioritized within Mississippi's rotating basin approach.

The amount and quality of the data on which this report is based are limited. As additional information becomes available, the TMDLs may be updated. Such additional information may include water quality and quantity data, changes in pollutant loadings, modification to state water quality criteria, or changes in landuse within the watershed. In some cases, additional water quality data may indicate that no impairment exists.

Prefixes for fractions and multiples of SI units

Fraction	Prefix	Symbol	Multiple	Prefix	Symbol
10^{-1}	deci	d	10	deka	da
10^{-2}	centi	c	10^{2}	hecto	h
10^{-3}	milli	m	10^{3}	kilo	k
10^{-6}	micro	μ	10^{6}	mega	M
10^{-9}	nano	n	10^{9}	giga	G
10^{-12}	pico	p	10^{12}	tera	T
10^{-15}	femto	f	10^{15}	peta	P
10^{-18}	atto	a	10^{18}	exa	E

Conversion Factors

To convert from	To	Multiply by	To Convert from	To	Multiply by
acres	sq. miles	0.001562	days	seconds	86400.00
cubic feet	cu. Meter	0.028316	feet	meters	0.304800
cubic feet	gallons	7.480519	gallons	cu. feet	0.133680
cubic feet	liters	28.31684	hectares	acres	2.471053
cfs	gal/min	448.8311	miles	meters	1609.344
cfs	MGD	0.646316	mg/l	ppm	1
cubic meters	gallons	264.1720	μg/l * cfs	gm/day	2.45
cubic meters	liters	1000	μg/l * MGD	gm/day	3.79

CONTENTS

TABLES

FIGURES

TMDL INFORMATION PAGE

Table i. Listing Information

Name	ID	County	HUC	Cause	Mon/Eval
Pearl River	MSUMPRLR2M	Leake	03180002	Mercury	Monitored
Near Piggtown: From Highway 25 to Leake County Water Park					
Yockanookany River	MS147M1	Attala Leake	03180001	Mercury	Monitored
Near Thomastown: From Highway 35 at Kosciusko to mouth at Pearl River					
Yockanookany River	MS146YE	Attala Choctaw	03180001	Mercury	Evaluated
Near McCool: From headwaters to the watershed 147 boundary					

Table ii. Water Quality Standard

Parameter	Beneficial use	Water Quality Criteria
Mercury (II) total dissolved Hg(II) expressed as total recoverable	Aquatic Life Support	*Fresh Water* Acute: instantaneous concentration may not exceed 2.1 µg/l Chronic: average concentration may not exceed 0.012 µg/l expressed as total recoverable *Salt Water* Acute: instantaneous concentration may not exceed 1.8 µg/l Chronic: average concentration may not exceed 0.025 µg/l expressed as total recoverable

Table iii. NPDES Facilities

NPDES ID	Facility Name	County	Receiving Water	Flow (MGD)
MS0001961	Weyerhaeuser Company	Neshoba	Unnamed Tributary to Kentawka Canal	0.0160
MS0002186	Georgia Pacific Corporation Louisville Plywood Plant	Winston	Unnamed Tributary to Hughes Creek	0.1010
MS0002615	Peco Farms of Mississippi, LLC	Scott	Sipsey Creek	0.5810
MS0020061	Carthage POTW	Leake	Town Creek thence into the Pearl River	0.9500
MS0020362	Forest POTW	Scott	Gordy Branch	4.9000
MS0020435	Weir POTW	Choctaw	Yockanookany River	0.1000
MS0020575	Ackerman POTW	Choctaw	Yockanookany River	0.2400
MS0020982	Walnut Grove POTW	Leake	Tuscolameta Creek	0.1940
MS0021156	Philadelphia POTW	Neshoba	Kentawka Canal	1.3400
MS0021628	Noxapater POTW South	Winston	Gum Branch thence into Noxapater Creek	0.0600
MS0024791	Ethel POTW	Attala	Leflore Creek	0.0900

Table iii. NPDES Facilities Cont'd

NPDES ID	Facility Name	County	Receiving Water	Flow (MGD)
MS0025194	Lake POTW	Scott	Warrior Branch thence into Warrior Creek	0.1200
MS0025241	Noxapater POTW North	Winston	Unnamed Tributary thence into Tallahaga Creek	0.0600
MS0025640	Louisville POTW East	Winston	Town Creek	0.6000
MS0025836	Louisville POTW South	Winston	Hughes Creek	0.6000
MS0026140	Choctaw Maid Farms, Inc.	Leake	Pickens Branch	0.1500
MS0026727	Sebastopol Water Association	Scott	Sipsey Creek	0.0750
MS0027774	Kosciusko POTW South	Attala	Yockanookany River	2.0480
MS0028339	MDOT Interstate 20 East Rest Area	Scott	Jones Creek	0.0150
MS0028380	Georgia Pacific Resins, Inc.	Winston	Hughes Creek	0.0270
MS0029777	Edinburg Attendance Center	Leake	Pearl River	0.0300
MS0030066	Thomastown Attendance Center	Leake	Yockanookany River	0.0200
MS0032158	Greenlee Elementary School	Attala	Yockanookany River	0.0180
MS0038393	Scott Central Attendance Center	Scott	Tallabogue Creek	0.0250
MS0038768	Louisville Municipal School District Nanih Waiya School	Winston	Nanih Waiya Creek	0.0100
MS0046043	Lofton Timber Company, LLC	Neshoba	Woodard Creek thence into the Pearl River	**
MS0046701	Raytheon Systems Company	Scott	Hontokalo Creek	0.2250
MS0046931	Central Industries, Inc.	Scott	Unnamed Tributary thence into Tallabogue Creek	1.1300
MS0047449	Texas Eastern Transmission Corporation	Attala	Little Conehoma Creek	0.0130
MS0049271	Choctaw Maid Farms, Inc.	Scott	Unnamed Tributary of Futch's Creek	0.0850
MS0051021	Southern Natural Gas Company Louisville Compressor Station	Winston	Unnamed Tributary thence into Hughes Creek	0.0010
MS0051993	Richton Tie and Timber, LLC Philadelphia Pulp Yard	Neshoba	Unnamed Tributary of Kentawka Canal	0.4630
MS0056103	Lady Forest Farms, Inc.	Scott	Little River thence into Tallabogue Creek	0.0300
MS0056286	Rives and Reynolds Lumber Co., Inc. Kosciusko Sawmill	Attala	Unnamed Tributary thence into Hurricane Branch	0.0140

Table iv. Total Maximum Daily Load

Type	Number	Unit	MOS Type
WLA	0.652	gm/day	
LA	0.553	gm/day	
MOS	1.205	gm/day	Explicit and Implicit
TMDL	2.410	gm/day	

EXECUTIVE SUMMARY

Two segments of the Yockanookany River and one segment of the Pearl River are impaired by mercury. Flathead catfish, channel catfish, largemouth bass, spotted bass, bass *sp*., freshwater drum, and bowfin caught in these water bodies have been sampled and the data show an impairment due to levels of mercury in the fish flesh, which exceed the levels derived using the 1997 Fish Advisory Guidance published by EPA.

Based on these data, the State of Mississippi issued fish consumption advisories (see Appendix B) for portions of the Pearl and Yockanookany Rivers. These advisories were issued to help protect people who regularly consume fish caught in the water bodies. The bioaccumulation of methylmercury in fish flesh is the basis for the impairment in the water bodies.

This Phase One Mercury TMDL for Pearl River and Yockanookany River has been developed prior to a complete understanding of the linkage between mercury in the water and mercury in the fish. Additionally, this Phase One Mercury TMDL is only concerned with point source contributions to the water body. Atmospheric deposition, nonpoint source contributions, and natural background will be considered in Phase Two. It is anticipated that the mercury data generated from the point source contributors during the next few years will enhance the knowledge base on this issue.

The endpoints selected for this Phase One Mercury TMDL are based on MDEQ regulations. There are several mercury criteria to evaluate. The human health criterion is currently 153 ng/l of total mercury. The aquatic life support criteria are 12 ng/l fresh water and 25 ng/l salt water of total mercury II expressed as total recoverable. Recent EPA criteria guidance has suggested that each of these numbers need to be revised. This guidance recommends that the 153 ng/l total mercury criterion be replaced with a methylmercury criterion of 0.3 mg/kg measured in fish tissue. The guidance also recommends that the aquatic life support numbers increase to a more representative value of 770 ng/l and 940 ng/l total mercury, respectively. However, these new numbers have not been adopted by the Mississippi Commission on Environmental Quality. MDEQ is therefore proposing the most protective of the currently adopted criteria, 12 ng/l. To further account for the unknowns, an additional explicit margin of safety is included in this TMDL. This explicit margin of safety is set at 50%.

The implementation plan in this Phase One TMDL calls for a moratorium on any future increase in mercury discharges in the Pearl and Yockanookany River watershed. Increased monitoring in the Pearl and Yockanookany River watershed is recommended. This TMDL also recommends pollution prevention alternatives and activities.

1.0 INTRODUCTION

1.1 BACKGROUND

The identification of water bodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those water bodies are required by Section 303(d) of the Clean Water Act. This is also a requirement of the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR Part 130). The TMDL process is designed to restore and maintain the quality of those impaired water bodies through the establishment of pollutant specific allowable loads. The pollutant of concern for this TMDL is mercury. The purpose of this TMDL is to establish water quality objectives and best management practices to reduce the mercury levels currently found in fish flesh taken from Pearl River and Yockanookany River.

Human exposure to inorganic mercury in large amounts can cause a variety of health effects. The two organ systems most likely affected are the central nervous system and the kidney. However, the most significant concerns regarding chronic exposure to low concentrations of methylmercury in fish are for neurological effects on the developing fetus and children.[1]

1.2 PHASED TMDL APPROACH

This document is Phase One of a multi-phase TMDL being developed for mercury in the Pearl River and Yockanookany River. This Phase One Mercury TMDL will determine the maximum load of mercury that should be introduced into the impaired segments based on Mississippi's water quality criteria. Phase Two of this TMDL project, to be completed at a later date, will quantify the mercury load to these water bodies that is directly related to atmospheric sources and other nonpoint sources. Phase Two will also attempt to include a fate and transport model for the water body that will better characterize aquatic mercury cycling.

1.3 WATER BODY SEGMENT LOCATION

As summarized in Table 1, segment MSUMPRLR2M of the Pearl River is located near Piggtown, Mississippi and begins at Highway 25 ends at the Leake County Water Park. Segment MS147M1 of the Yockanookany River is located near Thomastown, Mississippi and begins at Highway 35 and ends at its mouth at the Pearl River. Segment MS146YE of the Yockanookany River is located near McCool, Mississippi and begins at the headwaters of the river and ends at the watershed 147 boundary. The location of the Pearl and Yockanookany River watershed is provided in Figure 1. The locations of the 303(d) listed segments of the Pearl and Yockanookany Rivers are shown in Figure 2. Figure 3 and Table 2 provide landuse information for the watershed.

In an attempt to protect human health, Mississippi issued a Fish Consumption Advisory for portions of the Pearl and Yockanookany Rivers. This advisory was issued due to elevated levels of mercury found in fish flesh collected in these segments. See Appendix B.

Table 1. Water Body Identification for the Pearl River and Yockanookany River Phase One Mercury TMDL

Water Body Name	Water Body ID	Assessment Type	County	Listed Advisory	Advisory Cause
Pearl River	MSUMPRLR2M	Monitored	Leake	Fish Consumption Advisory	Mercury
Location – Near Piggtown: From Highway 25 to Leake County Water Park					
Yockanookany River	MS147M1	Monitored	Attala Leake	Fish Consumption Advisory	Mercury
Location – Near Thomastown: From Highway 35 at Kosciusko to mouth at Pearl River					
Yockanookany River	MS146YE	Evaluated	Attala Choctaw	Fish Consumption Advisory	Mercury
Location – Near McCool: From headwaters to the watershed 147 boundary					

Figure 1. Area Location Map

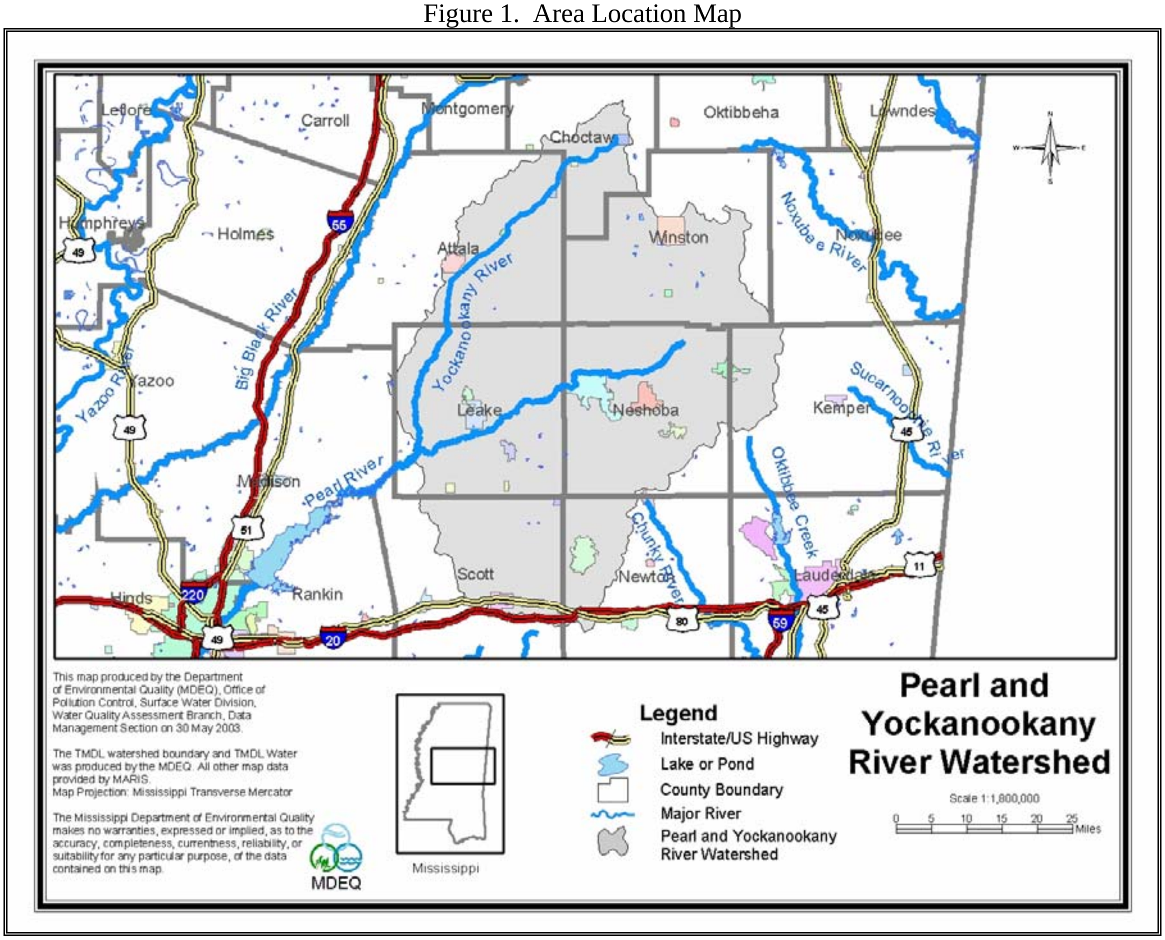

Figure 2. The Pearl River and Yockanookany River Watershed – 303(d) Segment Locations

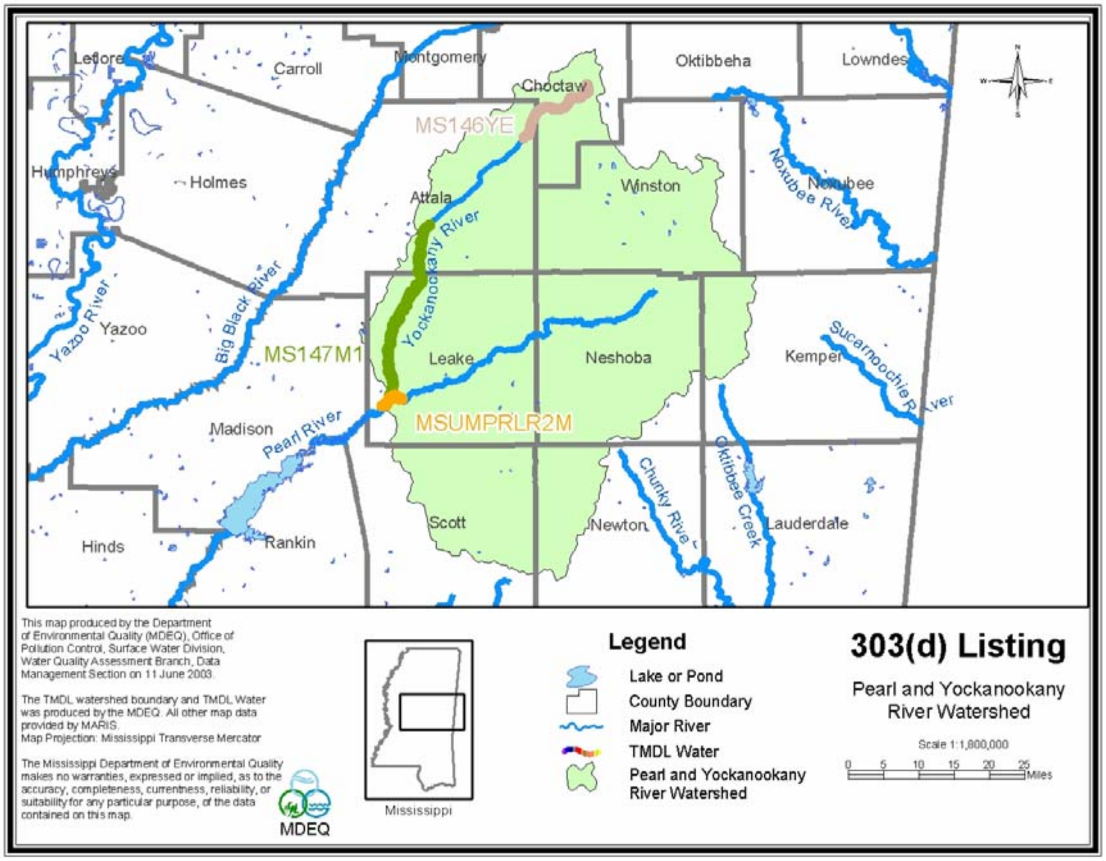

Figure 3. Landuse Distribution within the Pearl and Yockanookany River Watershed

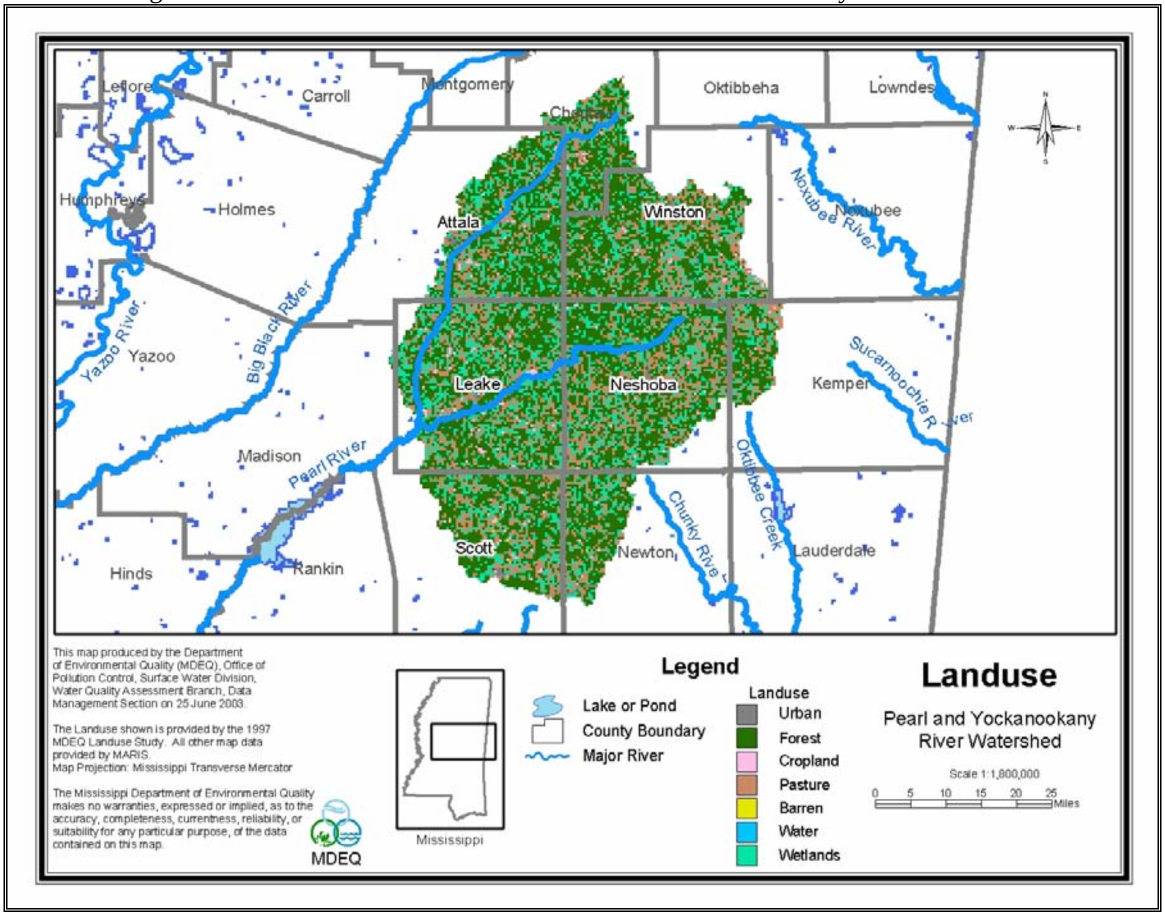

Table 2. Landuse Distribution within the Pearl and Yockanookany River Watershed (acres)

Forest	Agriculture	Urban	Wetland	Barren	Water	Total
822,540.01	395,681.11	5,489.70	346,105.98	453.94	6,034.11	1,576,304.85
52.18%	**25.10%**	**0.35%**	**21.96%**	**0.03%**	**0.38%**	**100.00%**

1.4 WATER BODY DESIGNATED USE

Designated beneficial uses and water quality standards are established by the State of Mississippi in the *Water Quality Criteria for Intrastate, Interstate and Coastal Waters* regulations. These regulations set the criteria concentrations for pollutants and methods for calculating loads based on the standards. MDEQ regulations require the use of these standards for establishing loads for Mississippi waters. The standards for the listed segments of the Pearl and Yockanookany Rivers have been established based on a designated use of Fish and Wildlife.

1.5 APPLICABLE WATER QUALITY STANDARDS

Mercury is included within MDEQ regulations as a toxic substance. The standards specifically set the numeric criteria and calculation methods for determining the loading from sources for this pollutant.

The water quality standards applicable to the uses of the water body segments and the pollutant of concern are listed in Table 3 as defined by the current *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* regulations.

Table 3. State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters

Parameter	Beneficial use	Water Quality Criteria
Total Mercury	Public Water Supply	Concentration may not exceed 0.151 µg/l
Total Mercury	Fish Consumption	Concentration may not exceed 0.153 µg/l
Mercury (II) total dissolved Hg(II) expressed as total recoverable	Aquatic Life Support	*Fresh Water* Acute: instantaneous concentration may not exceed 2.1 µg/l Chronic: average concentration may not exceed 0.012 µg/l expressed as total recoverable *Salt Water* Acute: instantaneous concentration may not exceed 1.8 µg/l Chronic: average concentration may not exceed 0.025 µg/l expressed as total recoverable

2.0 TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

2.1 SELECTION OF A TMDL ENDPOINT AND CRITICAL CONDITION

One of the major components of a TMDL is the establishment of instream numeric endpoints, which are used to evaluate the attainment of acceptable water quality. Instream numeric endpoints, therefore, represent the water quality goals specified in the TMDL. The endpoints allow for a comparison between observed instream conditions and conditions that are needed to restore designated uses. However, due to the many unknowns within the mercury cycle, there is no clearly defined linkage between water column mercury loading and bioaccumulation rates within the fish. In the Executive Summary (Vol. I, Page O-2) of its Mercury Study report to Congress, EPA states that

> *"given the current scientific understanding of the environmental fate and transport of this element, it is not possible to quantify how much of the methylmercury in fish consumed by the U.S. population is contributed by U.S. emissions relative to other sources of mercury (such as natural sources and re-emissions from the global pool). As a result, it cannot be assumed that a change in total mercury emissions will be linearly related to any resulting change in methylmercury in fish, nor over what time period these changes would occur."*[12]

2.1.1 Mercury Speciation and Chemistry

It has long been recognized that the chemical form of mercury (Hg) in air, water, and soil include elemental mercury Hg(0), inorganic ionic mercury (HgII) as soluble (HgIIs) or particulate mercury forms (HgIIp), and the organic form called monomethylmercury (MMHg or $HgCh3^{+}$). Each form has different behaviors that depend on its chemical and physical properties.[4]

The predominant source of mercury is atmospheric deposition. The atmospheric burden of mercury arises from both natural and anthropogenic sources accumulated over large periods. Both land and water environments release background mercury in the form Hg(0), except when combustion (forest and other terrestrial fires, fossil fuel combustion, waste combustion, etc.) produces the oxidized form – HgII. Hg(0) dissolves in water according to Henry's Law, and is only weakly soluble in water (about 0.006 ng/l at equilibrium with present-day air concentrations).[3] Thus, Hg(0) must oxidize to HgII, which then is the predominant form of mercury in wet or dry deposition. Hg(0) has a half-life of about 1 year in the atmosphere, while that of HgII varies between hours to months.

Only a fraction of mercury entering watersheds from deposition actually is transported into waterbodies. Values ranging from 5 to 50 percent have been reported, and a common value of 25 percent has often been quoted.[17] Most of the mercury entering the watershed remains in the soil or terrestrial biota, or is reduced to Hg(0) and transfers back to the atmosphere by evasion. Thus, direct deposition on the water body frequently overshadows delivery from the watershed in many aquatic systems studied in the northern U.S.[4]

2.1.2 Mercury Transport and Transformations

Mercury that makes its way into aquatic environments is essentially all inorganic ionic HgII. Hg(0) is only weakly soluble in water, while organic forms are usually present in trace amounts with MMHg in the typical range of 0.1 to 5 percent of the total mercury. However, higher amounts of MMHg can enter from wetland drainage.[17] Measurements of MMHg in rainwater seem to be associated with marine production of dimethylmercury, which hydrolyzes to form MMHg. Dimethylmercury does not seem to occur in fresh-water environments but only in the marine environment.[5] The ionized forms of mercury (HgII, MMHg) react rapidly and strongly with particulates. Furthermore, ionized forms react strongly with sulfide ions and somewhat strongly with organic complexes.

The production of MMHg by microorganisms and its subsequent accumulation in fish is by far the greatest concern. Part of that concern arises from MMHg's long biological half-lives in fish (1-2 years) as opposed to humans and other warm-blooded creatures that have half-lives of 1-3 months. Thus fish can accumulate MMHg to high levels, and the consumed fish – especially long-lived predatory fish – provide exposure of sensitive fish-eating organisms to MMHg.

Two competing processes affect the concentrations of MMHg, methylation produces MMHg while demethylation cleaves the methyl group and then reduces HgII to Hg(0) in a two-step process. The net MMHg produced is what scientists measure and organisms accumulate.

Microorganisms perform most of the methylation and demethylation, and sulfate reducing bacteria produce almost all of the MMHg.[2] The concentration of sulfate necessary to support production has an optimum because at higher concentrations, the produced sulfide binds HgII and can make it less available for uptake by sulfate reducing bacteria. Thus, many factors control the production of MMHg: the availability of HgII controlled largely by particulate material and dissolved organic carbon compounds; sulfide and sulfate concentrations; the presence of active sulfate reducing bacteria, and zones of sulfate production. MMHg production is often associated with sediments because most of the HgII is there and anaerobic conditions associated with reductive processes like sulfate reduction also occur there. The presence of sediments along with a ready source of biodegradable organic carbon resulting from plant production, may explain why wetlands are a major locale for production of MMHg. Circulation with surface waters may make wetland MMHg available for uptake. Emerging insects may substantially increase transfer of MMHg produced in wetlands to predatory fish.[11]

The food web has an important role in distributing MMHg into fish populations where fish consumers can then become part of the food web. The wide variability in mercury concentrations in similar sized fishes arise from the variety of local conditions of mercury bio-availability, MMHg production, and MMHg transfer among food web components.[4]

2.1.3 Mississippi Mercury Criteria (Fresh Water)

The beneficial use listed in Table 3 applicable to the listed segments of the Pearl and Yockanookany Rivers is Fish Consumption. The human health parameter for Fish Consumption is a total mercury concentration of 0.153 μg/l. The purpose of this standard is to restrict the mercury levels in fish tissue to below the 1.0 ppm FDA advisory level for human consumption. The total mercury human health standard of 0.153 μg/l in Mississippi's water quality standards was determined based on the accumulation of mercury in the types of fish that are commonly consumed in the state. Because the impaired segments are listed for partially supporting the use of Fish Consumption, the human health standard is an appropriate endpoint for Phase One of this TMDL study.[8]

However, the aquatic life criterion in fresh water, 0.012 μg/l of total Hg(II) is currently the more restrictive criterion for mercury concentration in the water column. We believe the toxicity criteria are overprotective of toxicity to aquatic life. According to *Ambient Water Quality Criteria for Mercury – 1984*, the 0.012 μg/l criterion for aquatic life was calculated based on a FDA action level of 1.0 mg/kg. This is a concentration of mercury in fish tissue of <u>edible</u> <u>fish</u>. The criterion was also based on a bioconcentration factor (BCF) of 81,700, which was the laboratory-determined ratio of the concentration of mercury in the tissue of the fathead minnow to the concentration of dissolved HgII in the lab water. The BCF of 81,700 is based on the transfer of mercury from the water to the tissue of the fathead minnow, and not directly to any species of edible fish.

In the "unused data" section of the same criteria document, BCF's ranging from 373 to 2400 were calculated for Bluegill, although the footnotes report that each BCF was not dependent on the concentration in the water. This means that there was no direct correlation between successive samples of mercury in the water and in the Bluegill fish tissue. However, a BCF was calculated in each case anyway, and they were much lower than the fathead minnow BCF. Although the criteria document states that the high BCF of the fathead minnow "might be more representative of commonly consumed warm-water fishes"; the Bluegill (which is a freshwater fish common in Mississippi) contradicts that assumption. To infer that the BCF of mercury in fathead minnows "might" be representative in light of the stated Bluegill results is an over-protective conclusion. Therefore, the use of the 0.012 μg/l of total mercury as the endpoint target for this TMDL incorporates an implicit margin of safety.

Additionally, we believe the 0.153 μg/l human health criterion is also protective of aquatic life. In *EPA's National Recommended Water Quality Criteria-Correction*, April 1999, EPA published 0.770 μg/l as the proposed freshwater aquatic life criterion. In effect, EPA has said that 0.153 μg/l is five times more protective of aquatic life than the proposed criterion. We believe 0.153 μg/l is protective of aquatic life while 0.012 μg/l is overprotective of aquatic toxicity, (a conclusion that EPA has supported by virtue of the latest proposed aquatic life criteria publication of 0.770 μg/l). If Mississippi's water quality criteria regarding mercury change, this Phase One TMDL will be revised to reflect those changes.

However, fish flesh sampling data indicate impairment of the water body's designated use. Therefore, to account for the uncertainty inherent with mercury fate and transport, this TMDL calls for a moratorium on future mercury discharges in the Pearl and Yockanookany River watershed. This is to ensure the overall mercury load from point source contributors to the system does not increase. In addition, the TMDL includes an explicit MOS set at 50% for this TMDL.

2.1.4 Mississippi Regulations on Flow Determination

In addition to the endpoint, the flow rate must be determined in order to calculate the TMDL. According to Section II.9.D(2) of the *State of Mississippi Water Quality Criteria for Intrastate, Interstate and Coastal Waters* regulations, the 7Q10 flow shall be used when applying Chronic toxicity criteria concentrations to calculations determining the load to a stream.[8] The mean annual flow for the Pearl River is estimated at 2,940 cfs. The 7Q10 flow is estimated to be 82 cfs at the most downstream point of the listed segment of the Pearl River using USGS guidance to determine flow rates. These estimates are based on the flow data from USGS Gage Station 02483500 on the Pearl River near Lena, Mississippi.

2.2 DISCUSSION OF INSTREAM WATER QUALITY

These segments of the Pearl and Yockanookany Rivers are listed because fishing advisories have been issued. The advisories have been in effect for this segment of the Pearl River since June 2001 and the Yockanookany River since May 1995. Decisions regarding these advisories were based on fish tissue data collected from the Pearl and Yockanookany Rivers. Data collected at these sites are summarized and analyzed in the following sections.

2.2.1 Inventory of Water Quality Monitoring Data

Fish tissue samples were collected by MDEQ from the Pearl and Yockanookany Rivers. Samples were collected from the Pearl River between 1995 and 1999. Samples were collected from the Yockanookany River between 1994 and 2001. These data are provided in Appendix A.

2.2.2 Analysis of Fish Tissue Data

Fish tissue data have been analyzed to identify violations requiring fish consumption advisories. Statistical summaries of methylmercury levels in fish tissue (wet weight filets) from the Pearl and Yockanookany Rivers are presented in Table 4. These summaries are based on available data from 1994 to 2001, which is listed in Appendix A.

A single sampling event could have more than one fish, so the number of samples are listed along with the number of fish collected at that site. The percent exceedance value references the number of sampling events that averaged above the 1.0 ppm FDA action level. This percentage does not represent the number of individual fish that were found to exceed the action level. The table also gives the minimum, maximum, and average methylmercury levels found for all of the samples collected at the site.

Advisories were posted for these segments of Pearl and Yockanookany Rivers because fish tissue concentrations exceeded 1.0 ppm at the sampling stations within these segments. The fish tissue data collected from these water bodies are listed in Appendix A. The Fish Advisories for these waterbodies are attached in Appendix B.

Table 4. Water Quality Station Data Analysis

Station	Sample Events	Number of Fish	Percent Exceedance*	Min ppm	Max ppm	Average ppm
Pearl River @ Confluence with Yockanookany River	11	24	67%	0.67	2.14	1.21
Pearl River @ Hwy 25	10	30	10%	0.64	1.20	0.85
Pearl River @ Leake County Water Park	3	10	67%	0.70	1.24	1.06
Yockanookany River above Pearl River Confluence	3	8	33%	0.41	1.09	0.69
Yockanookany River @ Thomastown	30	60	23%	0.16	2.40	0.87

* Percent exceedance is based on sampling events not individual fish.

3.0 SOURCE ASSESSMENT

A TMDL evaluation must examine all known potential sources of the pollutant in the subject watershed, including point sources, nonpoint sources, and background levels. The source assessment is used as the basis of development of the model and ultimate analysis of the TMDL allocation options. However, in this Phase One Mercury TMDL, only point source contributions are considered for evaluation. Phase Two of the TMDL will further study contributions from nonpoint sources and background levels in the analysis.

3.1 POTENTIAL SOURCES OF MERCURY

Mercury emissions can occur from both natural and man-made sources. The man-made sources are estimated to account for the majority of all emissions. Appendix D contains a thorough outline of mercury sources. The following are examples of mercury sources in the environment that can be controlled.[7]

- Cement and Lime Kilns
- Coal and Oil Burning
- Copper Smelting
- Crematories
- Dental Amalgam Preparation/Disposal
- Dwelling Demolition (thermostats and switches)
- Electrical Product Manufacturing and Disposal (switches, fluorescent lights, some headlights and batteries)
- Evaporation of Mercury from Landfills
- Garbage Incinerators
- Hazardous Waste Incinerators
- Industrial Waste Discharge
- Laboratories Use and Waste
- Medical Waste Incinerators
- Petroleum Refining
- Residential Boilers
- Wastewater Treatment Plants and Sewage
- Wood Burning

Many items that we are in contact with everyday contain mercury. When these items are no longer useful, care should be taken to ensure that they are kept out of the trash or drain. When products containing mercury are placed in the trash, the mercury doesn't disappear. It finds its way into the environment from waste incinerators, landfills, or wastewater treatment facilities.

Items that may contain mercury include:

- Fluorescent Lamps
- Mercury Switches
- Mercury Vapor Lamps
- Thermostat Probes
- Metal Halide Lamps
- Relays
- High Pressure Sodium Lamps
- Thermometers
- Neon Lamps
- Thermostats
- Dental Amalgam
- Manometers
- Gauges
- Laboratory Solutions

3.1.1 Fluorescent and High-Intensity Discharge Lamps

Fluorescent and high-intensity discharge (HID) lamps are used because they can use up to 50% less electricity than incandescent lighting. However, these lamps must be managed and disposed of properly because they contain mercury.[8]

3.1.2 Mercury Switches and Relays

Mercury switches are found in a variety of items ranging from chest freezers to sump pumps. Mercury containing tilt switches are found under the lids of clothes washers and chest freezers. They stop the spin cycle or turn on a light. They are also found in motion-sensitive and position-sensitive safety switches in clothes irons and space heaters. Float switches are commonly used in sump pumps and bilge pumps to turn the equipment on and off when the water is at a certain level. Automobile trunk and hood light switches often contain mercury. A variety of manufacturing processes use relays to control power to heaters or pumps. Relays that contain mercury switches activate airbags, anti-lock brakes, some seat belt systems, and some automatically adjusting suspension systems. Some agricultural equipment, military vehicles, mass transit vehicles, and fire hook and ladder equipment also contain mercury switches.[8]

3.1.3 Mercury-Containing Thermostats and Thermostat Probes

Mercury-containing tilt switches have been used in thermostats for more than 40 years. They provide accurate and reliable temperature control, require little or no maintenance, and do not require a power source. However, each switch contains approximately 3 grams of mercury. Mercury-free thermostats are available. Electronic thermostats now provide many of the same features as mercury thermostats.[8]

Mercury-containing thermostat probes may be found in several types of gas-fired appliances that have pilot lights, such as ranges, ovens, clothes dryers, water heaters, furnaces, or space heaters.

3.1.4 Mercury Thermometers

Some fever and laboratory thermometers contain mercury and should not be thrown in the trash. A typical fever thermometer contains about 0.5 grams of mercury. Larger laboratory thermometers can contain up to 3 grams of mercury. Many thermometers used to measure air and water temperature also contain mercury. They are used by homeowners, businesses, institutions, and recreational anglers. When the thermometers break outdoors, the mercury is difficult to capture. Mercury free thermometers such as digital thermometers are as accurate as mercury thermometers for most applications.[8]

3.1.5 Gauges, Manometers, Barometers, and Vacuum Gauges

Many barometers and vacuum gauges found in machinery contain mercury. Liquid mercury in the gauges responds to air pressure in a precise way that can be read on a calibrated scale. Several mercury-free alternatives are available. Some operate on the same principle as mercury gauges but use mercury-free liquids in the tube.[8]

Needle or bourdon gauges operate under a vacuum with a needle indicator. Electronic gauges can be used to measure pressure, but they must be calibrated with a mercury manometer. Equipment manufacturers recommend that service technicians use a needle or digital gauge to test the systems they are servicing, but that they calibrate the gauges they use in the field with a mercury manometer kept at their shop.[8]

3.2 POINT SOURCE ASSESSMENT

The point sources within the Pearl and Yockanookany River watershed are listed in Table 5. Point sources that are possible contributors of mercury or that have flows greater than 0.05 MGD will be recommended by this TMDL to monitor their wastewater effluent for mercury. In an attempt to control mercury levels in the water body, this Phase One TMDL will call for a moratorium on any future increase in mercury discharges into the Pearl and Yockanookany River watershed.

Table 5. Permitted Facilities in Pearl and Yockanookany River Watershed

NPDES ID	Facility Name	County	Receiving Water	Permitted Flow (MGD)
MS0001961	Weyerhaeuser Company	Neshoba	Unnamed Tributary to Kentawka Canal	0.0160
MS0002186	Georgia Pacific Corporation Louisville Plywood Plant	Winston	Unnamed Tributary to Hughes Creek	0.1010
MS0002615	Peco Farms of Mississippi, LLC	Scott	Sipsey Creek	0.5810

Table 5 Cont'd. Permitted Facilities in Pearl and Yockanookany River Watershed

NPDES ID	Facility Name	County	Receiving Water	Permitted Flow (MGD)
MS0020061	Carthage POTW	Leake	Town Creek thence into the Pearl River	0.9500
MS0020362	Forest POTW	Scott	Gordy Branch	4.9000
MS0020435	Weir POTW	Choctaw	Yockanookany River	0.1000
MS0020575	Ackerman POTW	Choctaw	Yockanookany River	0.2400
MS0020982	Walnut Grove POTW	Leake	Tuscolameta Creek	0.1940
MS0021156	Philadelphia POTW	Neshoba	Kentawka Canal	1.3400
MS0021628	Noxapater POTW South	Winston	Gum Branch thence into Noxapater Creek	0.0600
MS0024791	Ethel POTW	Attala	Leflore Creek	0.0900
MS0025194	Lake POTW	Scott	Warrior Branch thence into Warrior Creek	0.1200
MS0025241	Noxapater POTW North	Winston	Unnamed Tributary thence into Tallahaga Creek	0.0600
MS0025640	Louisville POTW East	Winston	Town Creek	0.6000
MS0025836	Louisville POTW South	Winston	Hughes Creek	0.6000
MS0026140	Choctaw Maid Farms, Inc.	Leake	Pickens Branch	0.1500
MS0026727	Sebastopol Water Association	Scott	Sipsey Creek	0.0750
MS0027774	Kosciusko POTW South	Attala	Yockanookany River	2.0480
MS0028339	MDOT Interstate 20 East Rest Area	Scott	Jones Creek	0.0150
MS0028380	Georgia Pacific Resins, Inc.	Winston	Hughes Creek	0.0270
MS0029777	Edinburg Attendance Center	Leake	Pearl River	0.0300
MS0030066	Thomastown Attendance Center	Leake	Yockanookany River	0.0200
MS0032158	Greenlee Elementary School	Attala	Yockanookany River	0.0180
MS0038393	Scott Central Attendance Center	Scott	Tallabogue Creek	0.0250
MS0038768	Louisville Municipal School District Nanih Waiya School	Winston	Nanih Waiya Creek	0.0100
MS0046043	Lofton Timber Company, LLC	Neshoba	Woodard Creek thence into the Pearl River	**
MS0046701	Raytheon Systems Company	Scott	Hontokalo Creek	0.2250
MS0046931	Central Industries, Inc.	Scott	Unnamed Tributary thence into Tallabogue Creek	1.1300
MS0047449	Texas Eastern Transmission Corporation Kosciusko Compression Station	Attala	Little Conehoma Creek	0.0130

Table 5 Cont'd. Permitted Facilities in Pearl and Yockanookany River Watershed

NPDES ID	Facility Name	County	Receiving Water	Permitted Flow (MGD)
MS0049271	Choctaw Maid Farms, Inc.	Scott	Unnamed Tributary of Futch's Creek	0.0850
MS0051021	Southern Natural Gas Company Louisville Compressor Station	Winston	Unnamed Tributary thence into Hughes Creek	0.0010
MS0051993	Richton Tie and Timber, LLC Philadelphia Pulp Yard	Neshoba	Unnamed Tributary of Kentawka Canal	0.4630
MS0056103	Lady Forest Farms, Inc.	Scott	Little River thence into Tallabogue Creek	0.0300
MS0056286	Rives and Reynolds Lumber Co., Inc. Kosciusko Sawmill	Attala	Unnamed Tributary thence into Hurricane Branch	0.0140

** Discharge from facility is rainfall driven. Facility typically has no discharge. However, timber products are recognized as potential sources of mercury. Therefore, this TMDL recommends that the facility monitor for mercury when discharge is occurring.

4.0 MODELING PROCEDURE

Establishing the relationship between the instream water quality target and the source loadings is a critical component of TMDL development. It allows for the evaluation of alternatives for possible wasteload reductions. The link for mercury in the water column and mercury in fish flesh has not been established. The discussion of mercury TMDL calculations is included in this section.

4.1 MODELING CALCULATIONS

Mass balance equations have been used to determine the mercury TMDLs in the Pearl and Yockanookany River watershed. A more complicated model is not warranted for Phase One of the TMDL analyzed because: (1) only contributions from point sources are considered, but none are known; (2) the mercury cycling processes will not be represented until Phase Two; (3) and water quality data for ambient mercury concentrations are not available to correspond to the levels of mercury found in the fish flesh for the Pearl and Yockanookany Rivers.

4.2 CALCULATION SETUP

The Pearl and Yockanookany River watershed contains all of HUC 03180001 and a small portion of HUC 03180002. The delineation of the watershed is based primarily on an analysis of the National Hydrography Dataset (NHD) stream network in the watershed. As a conservative assumption, the 7Q10 low flow condition is the flow used to calculate this TMDL. Since the Pearl River segment is the most downstream listed segment in this watershed, the TMDL was established for this segment. All upstream tributaries and point source loads are included in this total.

4.3 SOURCE REPRESENTATION

Only point sources are considered in this Phase One Mercury TMDL. Point sources that are possible contributors of mercury or that have flows greater than 0.05 MGD will be recommended by this TMDL to monitor their wastewater effluent for mercury. Table 6 lists the facilities that are recommended for mercury monitoring in the Pearl and Yockanookany River watershed.

Table 6. Facilities in the Pearl and Yockanookany River Watershed Recommended for Mercury Monitoring

Facility Name	NPDES ID
Weyerhaeuser Company	MS0001961
Georgia Pacific Corporation Louisville Plywood Plant	MS0002186
Peco Farms of Mississippi, LLC	MS0002615
Carthage POTW	MS0020061
Forest POTW	MS0020362
Weir POTW	MS0020435
Ackerman POTW	MS0020575

Table 6 Cont'd. Facilities in the Pearl and Yockanookany River Watershed Recommended for Mercury Monitoring

Facility Name	NPDES ID
Walnut Grove POTW	MS0020982
Philadelphia POTW	MS0021156
Noxapater POTW South	MS0021628
Ethel POTW	MS0024791
Lake POTW	MS0025194
Noxapater POTW North	MS0025241
Louisville POTW East	MS0025640
Louisville POTW South	MS0025836
Choctaw Maid Farms, Inc.	MS0026140
Sebastopol Water Association	MS0026727
Kosciusko POTW South	MS0027774
Lofton Timber Company, LLC	MS0046043
Raytheon Systems Company	MS0046701
Central Industries, Inc.	MS0046931
Choctaw Maid Farms, Inc.	MS0049271
Richton Tie and Timber, LLC – Philadelphia Pulp Yard	MS0051993
Rives and Reynolds Lumber Company, Inc. Kosciusko Sawmill	MS0056282

A significant amount of mercury water quality sampling data from the Pearl and Yockanookany Rivers is needed to adequately explain the relationship between mercury concentration in the water column with the concentration in fish tissue. As ambient mercury data and tools for analyzing mercury cycling become available, Phase Two of this TMDL project will be completed to accurately represent mercury sources, atmospheric deposition, and stream response.

5.0 ALLOCATION

TMDLs are composed of the sum of individual waste load allocations (ΣWLAs) for point sources, the sum of load allocations (ΣLAs) for nonpoint sources, and a margin of safety (MOS). This definition is mathematically expressed by the equation:

$$TMDL = \Sigma WLA + \Sigma LA + MOS$$

The TMDL is the amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. This TMDL represents the maximum load of mercury that can be introduced into the water body by point source discharge based on Mississippi's mercury criterion.

5.1 TMDL CALCULATION

The TMDL Calculation is based upon the conservation of mass principle, where the load can be calculated by using the following relationship:

$$Concentration = Load / Flow$$

Rearranging this equation, the load can be calculated as follows:

$$Load = Concentration * Flow$$

Load gm/day = 0.012 µg/l * 82 cfs * 2.45 (unit conversion factor) = 2.41 gm/day

The overall TMDL load for total mercury in the water body system is 2.41 grams per day. The total mercury II target of 0.012 µg/l is expressed as Total Recoverable Mercury.

Table 7. TMDL for Total Mercury II

Segment ID	Flow (cfs)	Total Hg(II) Target (µg/l)	TMDL (gm/day)
MSUMPRLR2M	82	0.012	2.41

Once the total TMDL has been calculated, the components of the equation can then be allocated.

5.2 TMDL ALLOCATIONS

The allocation for this TMDL involves a wasteload allocation for point sources and a load allocation for nonpoint sources necessary for attainment of water quality standards in the Pearl and Yockanookany River watershed. The Wasteload Allocation (WLA) for this TMDL was determined by multiplying the permitted flow of the dischargers within the Pearl and Yockanookany River watershed by the mercury criterion. Since this TMDL calls for a moratorium on any future increase in mercury discharges into the Pearl and Yockanookany River watershed, the WLA component should not increase. The Load Allocation (LA) accounts for atmospheric deposition and background.

5.2.1 Wasteload Allocations

The sum of the loads allocated to the point sources, (ΣWLAs) is determined by multiplying the permitted flow from the facility by the mercury criterion. Appendix C provides a list of permitted facilities within the watershed. Each facility's flow is multiplied by the mercury criterion and a conversion factor to give a daily load. This TMDL recommends that possible contributors of mercury or facilities with flows greater than 0.05 MGD monitor wastewater effluent for mercury.

All municipalities must complete the NPDES Form 2A Application. According to this application, supplemental information regarding effluent testing and toxicity testing must be included if one or more of the following is true: (1) the facility has a design flow rate greater than or equal to 1.0 MGD, (2) the facility is required to have a pretreatment program, or (3) the facility is otherwise required by the permitting authority to provide additional effluent information or submit the results of toxicity testing. Some facilities listed below will be required to monitor for mercury in order to meet their 2A application requirements. Minor municipal facilities not meeting any of the above requirements are not required to complete all of the 2A application are not required to monitor for mercury. In addition, the 2A application does not apply to commercial and industrial facilities. However, due to the mercury impairment in this watershed, this TMDL recommends that mercury monitoring similar to that required by a complete 2A application be required for all facilities listed in Table 8. This TMDL recommends that all facilities listed below have mercury monitoring required as part of their permitting process. If mercury is found in the facility's discharge, permit limits could be developed and a mercury minimization program would be needed.

Table 8. Facilities Recommended to Perform Mercury Effluent Monitoring

Facility Name	NPDES ID
Weyerhaeuser Company	MS0001961
Georgia Pacific Corporation Louisville Plywood Plant	MS0002186
Peco Farms of Mississippi, LLC	MS0002615
Carthage POTW	MS0020061
Forest POTW	MS0020362
Weir POTW	MS0020435

Table 8 Cont'd. Facilities Recommended to Perform Mercury Effluent Monitoring

Facility Name	NPDES ID
Ackerman POTW	MS0020575
Walnut Grove POTW	MS0020982
Philadelphia POTW	MS0021156
Noxapater POTW South	MS0021628
Ethel POTW	MS0024791
Lake POTW	MS0025194
Noxapater POTW North	MS0025241
Louisville POTW East	MS0025640
Louisville POTW South	MS0025836
Choctaw Maid Farms, Inc.	MS0026140
Sebastopol Water Association	MS0026727
Kosciusko POTW South	MS0027774
Lofton Timber Company, LLC**	MS0046043
Raytheon Systems Company	MS0046701
Central Industries, Inc.	MS0046931
Choctaw Maid Farms, Inc.	MS0049271
Richton Tie and Timber, LLC - Philadelphia Pulp Yard	MS0051993
Rives and Reynolds Lumber Company, Inc. Kosciusko Sawmill	MS0056282

** Discharge from facility is rainfall driven. Facility typically has no discharge. However, timber products are recognized as potential sources of mercury. Therefore, this TMDL recommends that the facility monitor for mercury when discharge is occurring.

5.2.2 Load Allocations

The Load Allocations (LA) for this TMDL account for mercury due to atmospheric deposition and background. Since atmospheric deposition is believed to be the primary source of mercury, a large portion of the TMDL has been set aside for this component. Phase Two of this TMDL project will explore atmospheric deposition along with local and national air-emission reduction goals.

5.3 INCORPORATION OF A MARGIN OF SAFETY

The two options for MOS development are either to implicitly incorporate the MOS using conservative assumptions or to explicitly specify a portion of the total TMDL as the MOS. A dual MOS method has been selected for this Phase One TMDL. It is implicit, based on the conservative assumptions inherent in the selection of the TMDL endpoint of 0.012 μg/l. In addition, it is explicit to account for uncertainty in the mercury linkage between fish flesh mercury levels and water-column mercury levels. The explicit MOS has been set at 50%.

Additional conservative assumptions for TMDL calculation are inherent in the development of the 0.153 μg/l human health standard. The criterion is based on the following equation:

$$C = \frac{\text{reference dose} * \text{human body weight}}{\text{fish consumption rate} * \text{bio-concentration factor}}$$

The criterion was based on a combination of fish consumption rates and bio-concentration factors for fresh water fishes, coastal organisms, and salt-water fishes. If the coastal organisms and salt-water fishes are omitted from the calculation, the criterion would be 2.22 μg/l. The fish tissue data from the Pearl and Yockanookany Rivers show elevated mercury levels in Flathead Catfish, Channel Catfish, Largemouth Bass, Spotted Bass, Bass sp., Freshwater Drum, and Bowfin. However, the BCF used in the criteria development considers four species of freshwater fish resulting in an average BCF of 5500, which is higher than that of either the bass or the catfish. Using the higher combined value in the denominator of the above equation, another conservative assumption is introduced into the calculations.

Additionally, the fresh water fish consumption rate established in the *Ambient Water Quality Criteria for Mercury* is 1.72 gm/day per person. Our regulations, however, require the use of 6.5 gm/day per person. This calculation would set the criterion at 0.587 μg/l as compared to the 0.153 μg/l in Mississippi's water quality standards. The use of a fish consumption rate of almost 3.8 times that for freshwater species alone introduces yet another conservative assumption which is already a part of the current human health standard for Mississippi.

However, there is enough uncertainty inherent to this entire process to justify the inclusion of an explicit MOS. As previously mentioned, this explicit MOS has been set at 50%.

TMDL = WLA + LA + MOS

2.41 gm/day = 0.652 gm/day WLA + 0.553 gm/day LA + 1.205 gm/day MOS

5.4 SEASONALITY

Wet deposition is greatest in the winter and spring seasons. Mercury will be expected to fluctuate based on the amount and distribution of rainfall, and variability of localized and distant atmospheric sources. While a maximum daily load is established in this TMDL, the average annual load is of greatest significance since mercury bioaccumulation and the resulting risk to human health that results from mercury consumption is a long term phenomenon. Thus, daily or weekly inputs are less meaningful than total annual loads over many years. The use of annual load allows for integration of short-term or seasonal variability. Inputs will continue to be estimated through monitoring and modeling.

Methylation of mercury is expected to be highest during the summer. High temperatures and static conditions result in hypoxic and/or conditions that promote methylation. Based on this enhanced methylation and high predator feeding activity during the summer, mercury bioaccumulation is expected to be greatest during the summer. However, based on the refractory nature of mercury, seasonal changes in body burden would be expected to be slight. Inherent variability of mercury concentrations between individual fish of the same and/or different size categories is expected to be greater than seasonal variability.[15]

5.5 IMPLEMENTATION PLAN

Implementation of this Phase One Mercury TMDL will differ from other types of TMDLs since atmospheric deposition is believed to be the primary pollutant source. This will involve MDEQ working with stakeholders to identify the most appropriate mechanisms to implement this TMDL project. MDEQ will cooperate with EPA concerning national initiatives and strategies, which will be important to implement regulatory controls on a national and international basis. Much monitoring, research, and regulation is in progress on the national level. MDEQ will consider these ongoing activities in implementing this and future phases of this TMDL project.

The ultimate reduction of mercury in the environment will take numerous years and is in line with the Bi-national Toxics Strategy, which sets a national challenge of 50% reduction of mercury releases to the air by 2006. Phase Two of this TMDL project will explore atmospheric deposition along with local and national air-emission reduction goals. Long-term monitoring of wet deposition rates and fish tissue in each of the water body segments will serve as environmental indicators to evaluate the effectiveness of the TMDLs and other parallel control measures.[15]

MDEQ also supports and encourages Pollution Prevention activities (P2 activities) as part of this implementation plan. P2 activities help alleviate costs and resources associated with controlling, removing, and managing mercury contamination in the environment. These activities include: (1) separating mercury-containing waste from the trash and save it for local household hazardous waste collection days, (2) taking mercury-containing items such as thermometers to a household hazardous waste collection facility, (3) removing mercury-containing items from households and schools (including student laboratories), and (4) conserving electricity (burning less coal and oil, which naturally contains mercury, for electricity will emit less mercury into the environment). Table 9 gives some examples of possible P2 alternatives for products containing mercury.

Table 9. Pollution Prevention (P2) Alternatives for Products Containing Mercury

Discards Known to Contain Mercury	P2 Alternatives
Thermometers	Red Bulb (Alcohol) Thermometers Digital Thermometers
Thermostats (non-electric models)	Electric Models
Batteries (old alkaline type prior to 1996)	Recharge Alkaline Batteries Mercury Free Batteries
Button Batteries	Mercury Free Button Batteries (Zinc air type)
Silver Amalgam Waste	Ask Your Dentist
Quicksilver Maze Toy	Mercury-Free Toys
Old Latex Paints (since 1990, mercury has been banned in latex paints)	New Latex Paint
Some Shoes that Light Up (L.A. Gear’s My Lil’ Lights if bought before June 1994)	Mercury-Free Shoes
Switches (some light and appliance switches)	Mechanical or Electrical Switches
Contact Lens Solution Containing Thimerosol	Mercury-Free Solution
Lights (fluorescent, high intensity discharge, and mercury vapor lamps)	Energy Efficient Fluorescent Lights (These lights still contain mercury. However, energy will be conserved thereby reducing mercury emissions from coal and oil combustion)

6.0 CONCLUSION

MDEQ will not approve any NPDES Permit application for the Pearl and Yockanookany River drainage area that does not comply with the moratorium for additional mercury discharges into these segments. In addition, this TMDL recommends all dischargers that are possible contributors of mercury or that have flows greater than 0.05 MGD to monitor for mercury using clean techniques and accurate testing methods. This TMDL also recommends and encourages Pollution Prevention Alternatives/Activities that address possible sources of mercury within the Pearl and Yockanookany River watershed.

Phase Two of this TMDL will include nonpoint sources of mercury, atmospheric deposition, and will consider the effects of mercury cycling in the water body. The TMDL calculations from Phase One may be revised in Phase Two of this TMDL since more will be known about the percentage of mercury contributions from point and nonpoint sources.

6.1 FOLLOW-UP MONITORING

Additional ambient mercury monitoring for all species of mercury will be needed for development of Phase Two. Additional information is required to facilitate the understanding of the methylmercury process and the linkage between mercury in the water column and mercury in fish flesh. Specialized monitoring approaches will also be needed to determine the atmospheric deposition contribution to mercury in the watershed.

MDEQ has adopted the Basin Approach to Water Quality Management, a plan that divides Mississippi's major drainage basins into five groups. During each yearlong cycle, MDEQ resources for water quality monitoring are focused on one of the basin groups. During the next monitoring phase in the Pearl River Basin, the Pearl River and Yockanookany River will receive additional monitoring to identify the improvements in water quality gained from the implementation of the Phase One strategy included in this TMDL.

6.2 PUBLIC PARTICIPATION

This Phase One TMDL project will be published for a 30-day public notice. During this time, the public will be notified by publication in both a statewide and local newspaper. The public will be given an opportunity to review the TMDL and submit comments. MDEQ also distributes all TMDLs at the beginning of the public notice to those members of the public who have requested to be included on a TMDL mailing list. TMDL mailing list members may request to receive the TMDL reports through either, email or the postal service. Anyone wishing to become a member of the TMDL mailing list should contact Greg Jackson at (601) 961-5098 or Greg_Jackson@deq.state.ms.us.

All comments received during the public notice period and at any public hearings become a part of the record of this TMDL. All comments will be considered in the ultimate approval of this TMDL and for submission of this TMDL to EPA Region 4 for final approval.

DEFINITIONS

Ambient stations: network of fixed monitoring stations established for systematic water quality sampling at regular intervals, and for uniform parametric coverage over a long-term period.

Assimilative capacity: the amount of contaminant load that can be discharged to a specific stream or river without violating the provisions of the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters and Water Quality* regulations. Assimilative capacity is used to define the ability of a water body to naturally absorb and use waste matter and organic materials without impairing water quality or harming aquatic life.

Atmospheric Deposition: input of chemical components from the atmosphere into natural waters through the processes of wet deposition (rain, snow) and dry deposition (particle fallout, gas-water exchange). Components can include nutrients, acidity, trace elements, and anthropogenic organics.

Background: the condition of waters in the absence of alterations based on the best scientific information available to MDEQ. The establishment of natural background for an altered water body may be based upon a similar unaltered water body or on historical least impaired data.

Best management practices: methods, measures, or practices that are determined to be reasonable and cost-effective means for a land owner to meet certain, generally nonpoint source, pollution control needs. BMPs include structural and nonstructural controls and operation and maintenance procedures.

Bioaccumulation: the net accumulation of a substance by an organism as a result of uptake from all environmental sources.

Bioaccumulation Factor (BAF): the ratio (in L/kg) of a substance's concentration in tissue of an aquatic organism to its concentration in the ambient water, in situations where both the organism and its food are exposed and the ratio does not change substantially over time.

Bioconcentration: the net accumulation of a substance by an aquatic organism as a result of uptake directly from the ambient water through gill membranes or other external body surfaces.

Bioconcentration Factor (BCF): the ratio (in L/kg) of a substance's concentration in tissue of an aquatic organism to its concentration in the ambient water, in situations where the organism is exposed through the water only and the ratio does not change substantially over time.

Calibration: testing and tuning of a model to a set of field data. Also includes minimization of deviations between measured field conditions and output of a model by selecting appropriate model coefficients.

Critical condition: hydrologic and atmospheric conditions in which the pollutants causing impairment of a water body have their greatest potential for adverse effects.

Daily discharge: the "discharge of a pollutant" measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the "daily average" is calculated as the average.

Designated Use: uses specified in water quality standards for each water body or segment regardless of actual attainment.

Discharge monitoring report: report of effluent characteristics submitted by a facility that has been granted an NPDES Permit.

Effluent standards and limitations: all State or Federal effluent standards and limitations on quantities, rates, and concentrations of chemical, physical, biological, and other constituents to which a waste or wastewater discharge may be subject under the Federal Act or the State law. This includes, but is not limited to, effluent limitations, standards of performance, toxic effluent standards and prohibitions, pretreatment standards, and schedules of compliance.

Effluent: municipal sewage or industrial or commercial liquid waste (untreated, partially treated, or completely treated).

Geometric mean: the *n*th root of the product of *n* numbers. A 30-day geometric mean is the 30th root of the product of 30 numbers.

Impairment: conditions in which the applicable state water quality standards are not met for a water body and the designated use is impaired.

Load allocation (LA): the portion of a receiving water's loading capacity attributed to or assigned to nonpoint sources (NPS) or background sources of a pollutant. The load allocation is the value assigned to the summation of all cattle and land-applied mercury that enter a receiving water body. It also contains a portion of the contribution from septic tanks.

Loading: the total amount of pollutants entering a stream from one or multiple sources.

Margin Of Safety (MOS): a required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant load and the quality of the receiving water body.

Mercury (Hg): a silver-white metal, atomic weight 200.59, which is a slightly volatile liquid at room temperature. Mercury is a naturally occurring element that is found in air, water and soil. It ranks about 67th in natural abundance among the elements in crustal rocks. Most of the mercury in the atmosphere is elemental mercury vapor (which circulates in the atmosphere for up to a year, and hence can be widely dispersed and transported thousands of miles from likely sources of emission). Most of the mercury in water, soil, sediments, or plants and animals is in the form of inorganic water-soluble salts (most commonly mercuric chloride) and organic forms of mercury (commonly methylmercury). Among the commercially important compounds of mercury are mercuric sulfide, a common antiseptic also used as the pigment vermilion; mercurous chloride, or calomel, used for electrodes, and formerly used as a cathartic; mercuric chloride, or corrosive sublimate; and medicinals such as Mercurochrome.

Mercury (elemental): mercury in a zero (0) oxidation state - referred to as mercury vapor when present in the atmosphere and as metallic mercury when present in its liquid form.

Mercury II (inorganic mercury): mercury which has been naturally oxidized to a divalent oxidation state and exhibits a wide range of acute toxicity to aquatic life. Inorganic mercury occurs in numerous forms/compounds; the most common include mercuric chloride ($HgCl_2$), mercurous chloride (Hg_2Cl_2), and mercuric oxide (Hg[O]).

Methylmercury (organic mercury): Mercury II which has been methylated in surface waters by naturally occurring bacteria and which can substantially accumulate in the food chain. Nearly all of the mercury that accumulates in fish tissue is methylmercury.

Nonpoint source pollution: pollution that is runoff from the land. Rainfall, snowmelt, and other water that does not evaporate become surface runoff and either drains into surface waters or soaks into the soil and finds its way into groundwater. This surface water may contain pollutants that come from land use activities such as agriculture, construction, silviculture, surface mining, disposal of wastewater, hydrologic modifications, and urban development.

NPDES permit: an individual or general permit issued by the MDEQ Permit Board pursuant to regulations adopted by the Commission under Mississippi Code Annotated (as amended) § 49-17-17 and § 49-17-29 for discharges into State waters.

Part per million: one millionth of a measurement. This nomenclature also applies to part per billion and part per trillion. 1 mg/kg mercury in fish flesh is one part per million. 1 μg/l liquid concentration is equivalent to one part per billion. 1 nanogram liquid concentration is equivalent to one part per trillion.

Phased TMDL Project: Under the phased approach, the TMDL has load allocations and wasteload allocations calculated with margins of safety to meet water quality standards. The allocations are based on estimates that use available data and information, but monitoring for collection of new data is required. The phased approach provides for further pollution reduction without waiting for new data collection and analysis.

Pollution Prevention (P2) Activities: Any action that avoids, eliminates, or greatly reduces the generation, amount, and toxicity of waste at the source.

Point source pollution: pollution loads discharged at a specific location from pipes, outfalls, and conveyance channels from either wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving stream.

Pollution: contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the State, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance, or leak into any waters of the State, unless in compliance with a valid permit issued by the Permit Board.

Publicly Owned Treatment Works (POTW): municipal wastewater treatment plant owned and operated by a public governmental entity such as a town or city.

Practical Bioaccumulation Factor (PBCF): - a practical approximation used in lieu of a BCF in the derivation of the human health criteria for mercury in Ambient Water Quality Criteria for Mercury. The PCBF's were calculated as the ratio of the average concentration of mercury in muscle in one species of fish to the average concentration of mercury in the body of water in which the species normally lives.

Scientific notation (exponential notation): mathematical method in which very large numbers or very small numbers are expressed in a more concise form. The notation is based on powers of ten. Numbers in scientific notation are expressed as the following: *4.16 x 10^(+b)* and *4.16 x 10^(-b) [same as 4.16E4 or4.16E-4]*. In this case, *b* is always a positive, real number. The *10^(+b)* tells us that the decimal point is *b* places to the right of where it is shown. The *10^(-b)* tells us that the decimal point is *b* places to the left of where it is shown.
For example: $2.7X10^4 = 2.7E+4 = 27000$ and $2.7X10^{-4} = 2.7E-4 = 0.00027$.

Sigma (Σ): shorthand way to express taking the sum of a series of numbers. For example, the sum or total of three amounts 24, 123, 16, ($\mathbf{d}_l$, $\mathbf{d}_2$, $\mathbf{d}_3$) respectively could be shown as:

$$\sum_{i=1}^{3} d_i = d_1+d_2+d_3 = 24+123+16 = 163$$

STORET: EPA national water quality database for STORage and RETrieval (STORET). The database includes physical, chemical, and biological data measured in waterbodies throughout the United States.

Storm runoff: rainfall that does not evaporate or infiltrate the ground because of impervious land surfaces or a soil infiltration rate than rainfall intensity, but instead flows into adjacent land or waterbodies or is routed into a drain or sewer system.

Total Maximum Daily Load (TMDL): the calculated maximum permissible pollutant loading to a water body at which water quality standards can be maintained.

Waste: sewage, industrial wastes, oil field wastes, and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any waters of the State.

Wasteload allocation (WLA): the portion of a receiving water's loading capacity attributed to or assigned to point sources of a pollutant.

Water quality criteria: water quality criteria comprise numeric and narrative criteria. Numeric criteria are scientifically derived ambient concentrations developed by EPA or states for various pollutants of concern to protect human health and aquatic life. Narrative criteria are statements that describe the desired water quality goal.

Water quality standards: a law or regulation that consists of the beneficial designated use or uses of a water body, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular water body and an antidegradation statement.

Waters of the State: all waters within the jurisdiction of this State, including all streams, lakes, ponds, wetlands, impounding reservoirs, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, situated wholly or partly within or bordering upon the State, and such coastal waters as are within the jurisdiction of the State, except lakes, ponds, or other surface waters which are wholly landlocked and privately owned, and which are not regulated under the Federal Clean Water Act (33 U.S.C.1251 et seq.).

Watershed: a part of the land area enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into a receiving water. It may also be referred to as drainage basin, river basin, or hydrologic unit.

ABBREVIATIONS

7Q10	Seven-Day Average Low Stream Flow with a Ten-Year Occurrence Period
BASINS	Better Assessment Science Integrating Point and Nonpoint Sources
BMP	Best Management Practice
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
GIS	Geographic Information System
HCR	Hydrograph Controlled Release Facility
HUC	Hydrologic Unit Code
LA	Load Allocation
MARIS	State of Mississippi Automated Resource Information System
MDEQ	Mississippi Department of Environmental Quality
MOS	Margin of Safety
NHD	National Hydrography Dataset
NRCS	National Resource Conservation Service
NPDES	National Pollution Discharge Elimination System
NPSM	Nonpoint Source Model
P2	Pollution Prevention
PCS	Permit Compliance System
PPB	Part per Billion (1 x 10^{-9}) (μg/l)
PPM	Part per Million (1 x 10^{-6}) (mg/l)
PPT	Part per Trillion (1 x 10^{-12}) (ng/l)
USGS	United States Geological Survey
WLA	Waste Load Allocation

REFERENCES

1. ATSDR. 1999. Toxicological profile for mercury (update). Agency for Toxic Substances and Disease Registry, 1999

2. Gilmour, C.C., E. A. Henry, and R. Mitchell. 1992. Sulfate Stimulation of Mercury Methylation in Freshwater Sediments. Environ. Sci. Technol. 26:2281-2287.

3. Hudson, r. J. M., S. A. Gherini, c. J. Watras, et al. 1994. Modeling the biogeochemical cycle of mercury in lakes: The mercury cycling model (MCM) and its application to the MTL study lakes. *Mercury as a Global Pollutant.* Watras C. J. and J. W. Juckabee (Eds.). Lewis Publishers. Pp 473-523.

4. J. David Dean, Kent Thornton, Randy Manning, & Donald Porcella, "Mercury Issues in the Southeastern United States." 2000, a report prepared for the TAPPI meeting.

5. Mason, R. P. and W. F. Fitzgerald. 1990. Alkylmercury species in the equatorial Pacific. *Nature*. 347:457-459.

6. Metcalf and Eddy. 1991. *Wastewater Engineering: Treatment, Disposal, Reuse*. 3rd Edition. McGraw-Hill, Inc., New York.

7. Michigan Mercury Pollution Prevention Task Force. April 1996. *Mercury Pollution Prevention in Michigan: Summary of Current Efforts and Recommendations for Future Activities.*

8. Minnesota Pollution Control Agency, Michigan Department of Environmental Quality, and Wisconsin Department of Natural Resources. *The Waste Connection: Mercury in the Environment.*

9. MDEQ. 1994. *Wastewater Regulations for National Pollutant Discharge Elimination System (NPDES) Permits, Underground Injection Control (UIC) Permits, State Permits, Water Quality Based Effluent Limitations and Water Quality Certification.* Office of Pollution Control.

10. MDEQ. 1995. *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. Office of Pollution Control.

11. MDEQ. 1998. *Mississippi List of Waterbodies, Pursuant to Section 303(d) of the Clean Water Act*. Office of Pollution Control.

12. MDEQ. 1999. *Mississippi Water Quality Assessment, Federal Clean Water Act Section 305(b) Report*. Office of Pollution Control.

13. Tremblay, A., L. Cloutier, and M. Lucotte. 1998. Total mercury and methylmercury fluxes via emerging insects in recently flooded hydroelectric reservoirs and a natural lake. Sci. Total Environ. 219:209-221.

14. USEPA. 1997. Mercury study report to congress. EPA-452/R-97-003. Office of Air Quality, Planning and Standards. Office of Research and Development. Washington, DC.

15. USEPA. 1998. *Better Assessment Science Integrating Point and Nonpoint Sources, BASINS, Version 2.0 User's Manual*. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

16. USEPA. 1986. *Quality Criteria for Water 1986.* U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

17. USEPA. Region 6. 2000. *Mercury TMDLs for Segments within Mermentau and Vermilion-Teche River Basins*. U.S. Environmental Protection Agency, Region 6, Dallas Texas.

18. Watras, C.J., K. A. Morrison, and R. C. Back. 1996. Mass balance studies of mercury and methylmercury in small, temperate/boreal lakes of the Northern Hemisphere. In" Baeyens, E., R. Ebinghaus, O. Vasiliev. (ed.) Regional and global mercury cycles: sources, fluxes and mass balances. Kluwer Academic Publ. Netherlands. Pp. 329-358.

19. Zillioux, E.J., D. B. Porcella, J. M. Benoit. 1993. Mercury cycling and effects in freshwater wetland ecosystems. Environ. Toxicol. Chem. 12:2245-2264.

APPENDIX A

Fish Flesh Mercury Data in the Pearl River

County	Site	Hg (ppm)		Species	# Fish	Min. Wt.	Max. Wt.	Mean Wt.
Leake	Pearl River @ Confluence with Yockanookany River	1.48	**	Largemouth Bass	1	5.1	5.1	5.1
Leake	Pearl River @ Confluence with Yockanookany River	1.24	**	Bass sp.	3	0.9	0.9	0.9
Leake	Pearl River @ Confluence with Yockanookany River	1.3	**	Largemouth Bass	2	3.9	4.4	4.1
Leake	Pearl River @ Confluence with Yockanookany River	1.45	**	Largemouth Bass	1	6.1	6.1	6.1
Leake	Pearl River @ Confluence with Yockanookany River	1.07	**	Flathead Catfish	2	14.1	17.1	15.6
Leake	Pearl River @ Confluence with Yockanookany River	0.77		Flathead Catfish	2	10.7	11.1	10.9
Leake	Pearl River @ Confluence with Yockanookany River	0.67		Flathead Catfish	2	5.4	5.5	5.4
Leake	Pearl River @ Confluence with Yockanookany River	2.14	**	Largemouth Bass	3	3.3	4.1	3.8
Leake	Pearl River @ Confluence with Yockanookany River	1.14	**	Largemouth Bass	3	2.2	2.5	2.4
Leake	Pearl River @ Confluence with Yockanookany River	1.24	**	Largemouth Bass	2	1.2	1.5	1.3
Leake	Pearl River @ Confluence with Yockanookany River	0.83		Largemouth Bass	3	0.7	0.9	0.8
Leake	Pearl River @ Hwy 25	0.67		Bass sp.	1	7.1	7.1	7.1
Leake	Pearl River @ Hwy 25	0.93		Bass sp.	3	1.8	2.6	2.3
Leake	Pearl River @ Hwy 25	0.78		Bass sp.	5	1.1	1.4	1.3
Leake	Pearl River @ Hwy 25	0.83		Freshwater Drum	2	1.8	2.9	2.3
Leake	Pearl River @ Hwy 25	0.92		Largemouth Bass	1	3.6	3.6	3.6
Leake	Pearl River @ Hwy 25	0.77		Largemouth Bass	1	1.9	1.9	1.9
Leake	Pearl River @ Hwy 25	0.98		Bass sp.	5	0.8	1.2	0.6
Leake	Pearl River @ Hwy 25	1.2	**	Spotted Bass	3	1.6	1.7	1.6
Leake	Pearl River @ Hwy 25	0.64		Spotted Bass	4	1.0	1.3	1.2
Leake	Pearl River @ Hwy 25	0.81		Spotted Bass	5	0.8	1.0	0.9
Leake	Pearl River @ Leake County Water Park	1.24	**	Largemouth Bass	3	1.9	2.6	2.3
Leake	Pearl River @ Leake County Water Park	0.7		Largemouth Bass	4	1.1	1.3	1.2
Leake	Pearl River @ Leake County Water Park	1.23	**	Spotted Bass	3	1.0	1.4	1.1
*** Above 1.0 (ppm)*								

Fish Flesh Mercury Data in the Yockanookany River

County	Site	Hg (ppm)		Species	# Fish	Min. Wt.	Max. Wt.	Mean Wt.
Leake	Yockanookany River above Pearl River Confluence.	0.57		Bass sp.	4	1.0	1.5	1.2
Leake	Yockanookany River above Pearl River Confluence	0.41		Largemouth Bass	2	0.8	0.8	0.8
Leake	Yockanookany River above Pearl River Confluence	1.09	**	Bowfin	2	3.5	5.4	4.5
Leake	Yockanookany River @ Thomastown	2.4	**	Bass sp.	3	0.6	1.3	1.0
Leake	Yockanookany River @ Thomastown	2.1	**	Channel Catfish	3	0.8	1.0	0.8
Leake	Yockanookany River @ Thomastown	1.7	**	Largemouth Bass	1	5.7	5.7	5.7
Leake	Yockanookany River @ Thomastown	0.93		Largemouth Bass	2	2.8	3.6	3.2
Leake	Yockanookany River @ Thomastown	0.89		Bass sp.	4	1.0	1.6	1.3
Leake	Yockanookany River @ Thomastown	1.15	**	Bass sp.	3	1.4	1.6	1.5
Leake	Yockanookany River @ Thomastown	0.75		Bass sp.	3	0.9	1.0	0.9
Leake	Yockanookany River @ Thomastown	0.86		Bowfin	3	4.6	5.5	5.0
Leake	Yockanookany River @ Thomastown	0.83		Largemouth Bass	1	1.8	1.8	1.8
Leake	Yockanookany River @ Thomastown	0.9		Largemouth Bass	1	1.3	1.3	1.3
Leake	Yockanookany River @ Thomastown	0.66		Largemouth Bass	1	1.0	1.0	1.0
Leake	Yockanookany River @ Thomastown	0.76		Largemouth Bass	1	0.7	0.7	0.7
Leake	Yockanookany River @ Thomastown	0.62		Largemouth Bass	1	0.8	0.8	0.8
Leake	Yockanookany River @ Thomastown	0.54		Largemouth Bass	1	0.6	0.6	0.6
Leake	Yockanookany River @ Thomastown	0.8		Largemouth Bass	1	0.5	0.5	0.5
Leake	Yockanookany River @ Thomastown	0.89		Largemouth Bass	1	0.5	0.5	0.5
Leake	Yockanookany River @ Thomastown	0.79		Largemouth Bass	1	0.4	0.4	0.4
Leake	Yockanookany River @ Thomastown	1.12	**	Spotted Bass	1	0.4	0.4	0.4
Leake	Yockanookany River @ Thomastown	0.54		Channel Catfish	5	1.0	1.4	1.2
Leake	Yockanookany River @ Thomastown	1.34	**	Largemouth Bass	4	1.4	2.5	1.9
*** Above 1.0 (ppm)*								

Fish Flesh Mercury Data in the Yockanookany River Cont'd

County	Site	Hg (ppm)		Species	# Fish	Min. Wt.	Max. Wt.	Mean Wt.
Leake	Yockanookany River @ Thomastown	0.16		Channel Catfish	2	0.8	1.1	0.9
Leake	Yockanookany River @ Thomastown	0.41		Bass sp.	3	0.8	1.1	1.0
Leake	Yockanookany River @ Thomastown	0.31		Channel Catfish	2	1.4	1.9	1.7
Leake	Yockanookany River @ Thomastown	0.97		Spotted Bass	1	1.1	1.1	1.1
Leake	Yockanookany River @ Thomastown	0.56		Spotted Bass	1	1.0	1.0	1.0
Leake	Yockanookany River @ Thomastown	0.52		Largemouth Bass	1	0.8	0.8	0.8
Leake	Yockanookany River @ Thomastown	1.0	**	Bass sp.	2	1.6	2.2	1.9
Leake	Yockanookany River @ Thomastown	0.3		Channel Catfish	2	0.7	0.7	0.7
Leake	Yockanookany River @ Thomastown	0.5		Channel Catfish	2	1.9	3.0	2.5
Leake	Yockanookany River @ Thomastown	0.8		Largemouth Bass	3	0.9	1.1	1.0
** *Above 1.0 (ppm)*								

APPENDIX B

MISSISSIPPI'S FISH TISSUE ADVISORIES AND COMMERCIAL FISHING BANS AUGUST 2001

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
Mississppi Delta - all waters from the mainline Mississippi River Levee on the West to the Bluff hills on the East.	DDT, Toxaphene	June 2001	Limit Consumption Advisory for carp, buffalo, gar, and large catfish (>22 in.)****
Roebuck Lake, LeFlore County	DDT, Toxaphene	June 2001	Limit Consumption Advisory for carp, gar, and large catfish (>22 in.)**** No Consumption of Buffalo. Commercial Fishing Ban
Yazoo National Wildlife Refuge (all waters)	DDT, Toxaphene	1975	Closed to fishing**
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.

** Precautionary advisory issued by U.S. Fish and Wildlife Service

*** The Mississippi State Health Department recommends that people limit the amount of 33-39" King Mackerel they eat from the Mississippi Gulf Coast. Children under seven and women of child bearing age should eat no more than one meal of these fish every two months. Other adults should eat no more than one meal of these fish every two weeks.

**** The Mississippi Department of Health recommends that people limit their consumption of these fish to no more than one meal every two weeks.

APPENDIX C: Daily Load from NPDES Permitted Facilities

NPDES ID	Facility Name	Permitted Flow (MGD)	Mercury Criterion (μg/l)	Conversion Factor	Daily Load (g/day)
MS0001961	Weyerhaeuser Company	0.0160	0.012	3.79	7.28E-04
MS0002186	Georgia Pacific Corporation Louisville Plywood Plant	0.1010	0.012	3.79	4.59E-03
MS0002615	Peco Farms of Mississippi, LLC	0.5810	0.012	3.79	2.64E-02
MS0020061	Carthage POTW	0.9500	0.012	3.79	4.32E-02
MS0020362	Forest POTW	4.9000	0.012	3.79	2.23E-01
MS0020435	Weir POTW	0.1000	0.012	3.79	4.55E-03
MS0020575	Ackerman POTW	0.2400	0.012	3.79	1.09E-02
MS0020982	Walnut Grove POTW	0.1940	0.012	3.79	8.82E-03
MS0021156	Philadelphia POTW	1.3400	0.012	3.79	6.09E-02
MS0021628	Noxapater POTW South	0.0600	0.012	3.79	2.73E-03
MS0024791	Ethel POTW	0.0900	0.012	3.79	4.09E-03
MS0025194	Lake POTW	0.1200	0.012	3.79	5.46E-03
MS0025241	Noxapater POTW North	0.0600	0.012	3.79	2.73E-03
MS0025640	Louisville POTW East	0.6000	0.012	3.79	2.73E-02
MS0025836	Louisville POTW South	0.6000	0.012	3.79	2.73E-02
MS0026140	Choctaw Maid Farms, Inc.	0.1500	0.012	3.79	6.82E-03
MS0026727	Sebastopol Water Association	0.0750	0.012	3.79	3.41E-03
MS0027774	Kosciusko POTW South	2.0480	0.012	3.79	9.31E-02
MS0028339	MDOT Interstate 20 East Rest Area	0.0150	0.012	3.79	6.82E-04
MS0028380	Georgia Pacific Resins, Inc.	0.0270	0.012	3.79	1.23E-03
MS0029777	Edinburg Attendance Center	0.0300	0.012	3.79	1.36E-03
MS0030066	Thomastown Attendance Center	0.0200	0.012	3.79	9.10E-04
MS0032158	Greenlee Elementary School	0.0180	0.012	3.79	8.19E-04
MS0038393	Scott Central Attendance Center	0.0250	0.012	3.79	1.14E-03
MS0038768	Louisville Municipal School District Nanih Waiya School	0.0100	0.012	3.79	4.55E-04
MS0046043	Lofton Timber Company, LLC	**	0.012	3.79	**
MS0046701	Raytheon Systems Company	0.2250	0.012	3.79	1.02E-02

NPDES ID	Facility Name	Permitted Flow (MGD)	Mercury Criterion (µg/l)	Conversion Factor	Daily Load (g/day)
MS0046931	Central Industries, Inc.	1.1300	0.012	3.79	5.14E-02
MS0047449	Texas Eastern Transmission Corporation Kosciusko Compression Station	0.0130	0.012	3.79	5.91E-04
MS0049271	Choctaw Maid Farms, Inc.	0.0850	0.012	3.79	3.87E-03
MS0051021	Southern Natural Gas Company Louisville Compressor Station	0.0010	0.012	3.79	4.55E-05
MS0051993	Richton Tie and Timber, LLC Philadelphia Pulp Yard	0.4630	0.012	3.79	2.11E-02
MS0056103	Lady Forest Farms, Inc.	0.0300	0.012	3.79	1.36E-03
MS0056286	Rives and Reynolds Lumber Co., Inc. Kosciusko Sawmill	0.0140	0.012	3.79	6.37E-04
				ΣWLAs	**6.52E-01**

APPENDIX D: Mercury Use Outline

Sources of Mercury

I. Deliberate Use of Mercury

A. Use of Mercury for its Physical and Electrical Properties

1. Instruments
    a. *Barometers*
    b. *Hydrometers*
    c. *Manometers*
    d. *Pyrometers*
    e. *Sphymonometers*
    f. *Thermometers*
2. Lamps
    a. *Fluorescent*
    b. *High Pressure Sodium*
    c. *Mercury Arc*
    d. *Metal Halide*
    e. *Neon*
    f. *UV disinfectant*
3. Pivots
    a. *WWTP Trickling Filter System*
    b. *Lighthouses*
4. Switches
    a. *Household Switches*
    b. *Industrial Switches*
    c. *Mercury Thermocouple*
    d. *Tilt (Motion) Switches*
5. Electrical Equipment
    a. *Rectifiers*
    b. *Batteries {Including alkaline, button (Hg – Zn) and (Hg – Cd)}*
6. Toys and Games

B. Medical, Dental, and Veterinary Use

1. Pharmaceuticals
    a. *Anesthetic*
    b. *Antiseptic*
    c. *Antineoplastic Agent*
    d. *Antisyphilitic*
    e. *Cathartic*
    f. *Diuretic*
    g. *Purgative*
2. Dental Amalgam
3. Disinfectant
    a. *Phenyl Mercuric Acetate (PMA)*
    b. *Thimerisol*
4. Diagnostic Reagents (see laboratory use)

C. Spiritist Use
   1. Ingested, Dusted, Added to Bathing Solutions and Candles
      a. *Asogue (Hg)*
      b. *Precipitado Rojo (HgO)*
      c. *Precipitado Amarillo (HgO)*
      d. *Precipitado Blanco* (Hg_2Cl_2)

D. Laboratory Use
   1. Slide Preparation
      a. *Stain*
   2. Electroanalysis
      a. *Cathode*
   3. Algae Sample Preservative
   4. Reagents (used to analyze other chemicals)
      a. *Acetic Acid*
      b. *Acetone*
      c. *Aldehyde*
      d. *Ammonia*
      e. *Arsenic*
      f. *Barbital*
      g. *Chloride*
      h. *Chlorine*
      i. *Citric Acid*
      j. *CO in gas*
      k. *Cystine*
      l. *Glucose*
      m. *HCN*
      n. *Iron*
      o. *Kjeldahl Nitrogen*
      p. *Manganese*
      q. *Mercury*
      r. *Triophene*
      s. *Vanadium*
      t. *Wine Coloring*
      u. *Zinc*

E. Mining/Metals Industry
   1. Electrolysis
      a. *Cathode*
   2. Extracting Au and Ag from Ore
   3. Extracting Au from Pb
   4. Electroplating Al
   5. Other Processes
      a. *Etching Steel/Iron*
      b. *Fire Gilding*
      c. *Blackening Brass*

F. Chlor-Alkali Industry
   1. Mercury Cell Process
      a. *Production of Chlorine, Caustic Soda, Sodium Hydroxide and Products Manufactured with These Raw Materials*

G. Fungicide/Pesticide

1. Seed Protectant
2. Golf Courses
    a. *Snow Mold Control*
3. Root Maggot Control
4. Imported Gray Goods (undyed textiles)
5. Paint and Glues
    a. *Latex Paint**
    b. *Marine Paint**
    c. *Gold Porcelain Paint*
    d. *Corrugated Cardboard Glue*

H. Preservative

1. Kyanizing Wood*
2. Anatomical Specimens
3. Embalming*
4. Tanning

I. Coloring

1. Pigment
    a. *Colored Papers*
    b. *Horn*
    c. *Inks*
    d. *Linen*
    e. *Plastics*
    f. *Rubber*
    g. *Sealing Wax*
2. Stain for Wood*
3. Mordant for Dye
    a. *Beaver and Rabbit Pelts*

J. Other Deliberate Uses

1. Plastics
    a. *Catalyst for Curing*
2. Fireworks
    a. *Pharoah's Serpents and Bengal Green Lights*
3. Photography*
    a. *Intensifier*
    b. *Magic Photograms*

II. Production/Storage

A. Mining

1. Mines with Mercury as the Primary Product
2. Mines with Secondary Production of Mercury

B. U.S. Federal Supply

C. Recycling

1. Facilities Include Fluorescent Lamp Recycling and Thermostat Recycling

III. By-Product/Contaminant

A. Combustion

1. Incineration
   a. *Municipal Solid Waste*
   b. *Medical Waste*
   c. *Sewage Sludge*
   d. *Cremation*
2. Fuel Combustion
   a. *Coal*
   b. *Oil*
   c. *Natural Gas*
   d. *Wood*

B. Vaporization

1. Landfill Gas
2. Petroleum Refining
3. Wastewater Treatment Plants
4. Mining
   a. *Smelting*
   b. *Roasting*

C. Product Contaminant

1. Chloralkali Products

IV. Natural

A. Volcanoes

B. Mineralized Bedrock

1. Cinnabar

Source: Michigan Mercury Pollution Prevention Task Force. April 1996. *Mercury Pollution Prevention in Michigan: Summary of Current Efforts and Recommendations for Future Activities.*