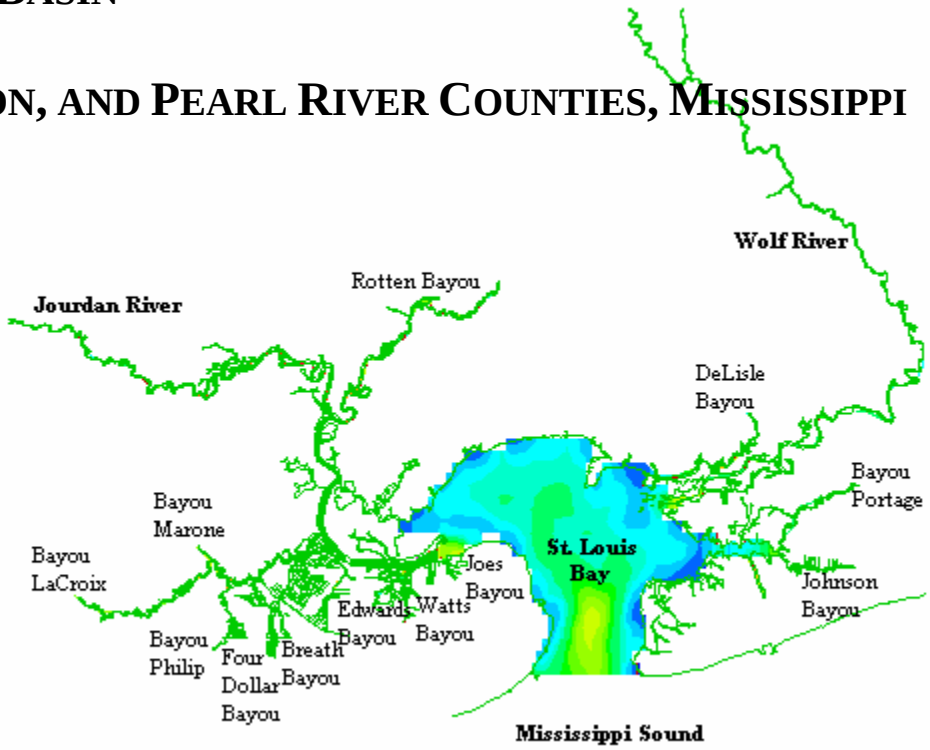
FINAL REPORT
July 2, 2001
ID: 201070201

FECAL COLIFORM TMDL FOR

ST. LOUIS BAY, JOURDAN RIVER (PHASE TWO), AND WOLF RIVER (PHASE TWO)

COASTAL STREAMS BASIN

HANCOCK, HARRISON, AND PEARL RIVER COUNTIES, MISSISSIPPI



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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. The report contains one or more Total Maximum Daily Loads (TMDLs) for waterbody segments found on Mississippi's 1996 Section 303(d) List of Impaired Waterbodies. 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, 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	0.0015625	Days	Seconds	86400
Cubic feet	Cu. Meter	0.028316847	Feet	Meters	0.3048
Cubic feet	Gallons	7.4805195	Gallons	Cu feet	0.133680555
Cubic feet	Liters	28.316847	Hectares	Acres	2.4710538
cfs	Gal/min	448.83117	Miles	Meters	1609.344
cfs	MGD	.6463168	Mg/l	ppm	1
Cubic meters	Gallons	264.17205	μg/l * cfs	Gm/day	2.45

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MONITORED SEGMENT MSSTLUBAYM IDENTIFICATION

Name:	St. Louis Bay
Waterbody ID:	MSSTLUBAYM
Location:	At Bay St. Louis: From inland boundary to Highway 90 bridge
County:	Hancock and Harrison Counties, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	114
Length:	15 miles
Use Impairment:	Shellfish Harvesting and Contact Recreation*
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
Priority Rank:	7
NPDES Permits:	There are 12 NPDES Permits issued for facilities that potentially discharge fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	Median fecal coliform MPN (most probable number) colony counts shall not exceed 14 per 100 ml, nor shall more than ten percent of the samples examined ordinarily exceed an MPN colony count of 43 per 100 ml in those portions or areas most probably exposed to fecal contamination during most unfavorable hydrographic and pollutional conditions
Waste Load Allocation:	3.07E+12 MPN/15 days (all dischargers must meet water quality standards for disinfection)
Load Allocation:	6.85E+14 MPN/15 days
Margin of Safety:	Implicit modeling assumptions
Total Maximum Daily Load (TMDL):	6.88E+14 MPN/15 days

* For MSSTLUBAYM the controlling standard is that for shellfish harvesting, which is the most stringent. MDEQ intends to delist the contact recreation use.

MONITORED SEGMENT MS115CO4M IDENTIFICATION

Name:	St. Louis Bay Coastline
Waterbody ID:	MS115CO4M
Location:	At Bay St. Louis: From Highway 90 bridge to Jourdan River
County:	Hancock and Harrison Counties, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	130
Length:	4 miles
Use Impairment:	Shellfish Harvesting and Contact Recreation*
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
Priority Rank:	1
NPDES Permits:	There are 12 NPDES Permits issued for facilities that potentially discharge fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	Fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml

* It is illegal to harvest shellfish within 750 yards of a coastline, therefore the contact recreation use controls for MS115CO4M.

MONITORED SEGMENT MS114CO1M IDENTIFICATION

Name:	St. Louis Bay Coastline near Delisle
Waterbody ID:	MS114CO1M
Location:	Near Delisle: From Jourdan River to Wolf River
County:	Hancock and Harrison Counties, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	120
Length:	14 miles
Use Impairment:	Shellfish Harvesting and Contact Recreation*
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
Priority Rank:	2
NPDES Permits:	There are 12 NPDES Permits issued for facilities that potentially discharge fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	Fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml

* It is illegal to harvest shellfish within 750 yards of a coastline, therefore the contact recreation use controls for MS114CO1M.

MONITORED SEGMENT MS118CO1M IDENTIFICATION

Name:	St. Louis Bay Coastline near Pass Christian
Waterbody ID:	MS118CO1M
Location:	At Pass Christian: From Wolf River to Highway 90 bridge
County:	Harrison County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	160
Length:	9 miles
Use Impairment:	Shellfish Harvesting and Contact Recreation*
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
Priority Rank:	3
NPDES Permits:	There are 12 NPDES Permits issued for facilities that potentially discharge fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	Fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml

* It is illegal to harvest shellfish within 750 yards of a coastline, therefore the contact recreation use controls for MS118CO1M.

MONITORED SEGMENT MS112M1 IDENTIFICATION

Name:	Jourdan River
Waterbody ID:	MS112M1
Location:	Near Kiln: From confluence of Catahoula Creek and Bayou Bacon to confluence with Rotten Bayou
County:	Hancock County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	100
Length:	13 miles
Use Impairment:	Contact Recreation
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
Priority Rank:	78
NPDES Permits:	There is 1 NPDES Permit issued for a facility that potentially discharges fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	Fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml
Waste Load Allocation:	5.68E+9 MPN/15 days (all dischargers must meet water quality standards for disinfection)
Load Allocation:	6.09E+13 MPN/15 days
Margin of Safety:	Implicit modeling assumptions
Total Maximum Daily Load (TMDL):	6.10E+13 MPN/15 days

The loads provided above are based on the same 15 day critical period as the loads provided for MSSTLUBAYM and represent the portion of the MSSTLUBAYM loads that are discharged directly into both the freshwater and saltwater portions of MS112M1. The loads provided above shall replace the narrative loads provided in Phase One.

MONITORED SEGMENT MS111M1 IDENTIFICATION

Name:	Wolf River
Waterbody ID:	MS111M1
Location:	Near Lizana (Landon): From county road at Sellers to the mouth at St. Louis Bay
County:	Harrison County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	090
Length:	31 miles
Use Impairment:	Contact Recreation
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
Priority Rank:	30
NPDES Permits:	There is 1 NPDES Permit issued for a facility that potentially discharges fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	Fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml
Waste Load Allocation:	9.09E+8 MPN/15 days (all dischargers must meet water quality standards for disinfection)
Load Allocation:	4.22E+13 MPN/15 days
Margin of Safety:	Implicit modeling assumptions
Total Maximum Daily Load (TMDL):	4.22E+13 MPN/15 days

The loads provided above are based on the same 15 day critical period as the loads provided for MSSTLUBAYM and represent the portion of the MSSTLUBAYM loads that are discharged directly into both the freshwater and saltwater portions of MS111M1. The loads provided above shall replace the narrative loads provided in Phase One.

EVALUATED WATERBODY MS114DLE IDENTIFICATION

Name:	Bayou Delisle
Waterbody ID:	MS114DLE
Location:	Near Delisle
County:	Harrison County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	120
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
NPDES Permits:	There is 1 NPDES Permit issued for a facility that potentially discharges fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	May through October - geometric mean colony count of 200 per 100 ml and less than 10 percent may exceed 400 per 100 ml November through April - geometric mean of 2000 per 100 ml, and less than 10 percent may exceed 4000 per 100 ml

EVALUATED WATERBODY MS115BLCE IDENTIFICATION

Name:	Bayou La Croix
Waterbody ID:	MS115BLCE
Location:	Near Waveland
County:	Hancock County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	130
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
NPDES Permits:	There are 0 NPDES Permits issued for facilities that potentially discharge fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	May through October - geometric mean colony count of 200 per 100 ml and less than 10 percent may exceed 400 per 100 ml November through April - geometric mean of 2000 per 100 ml, and less than 10 percent may exceed 4000 per 100 ml

EVALUATED WATERBODY MS115EBE IDENTIFICATION

Name:	Edwards Bayou
Waterbody ID:	MS115EBE
Location:	At Waveland
County:	Hancock County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	130
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
NPDES Permits:	There is 1 NPDES Permit issued for a facility that potentially discharges fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	May through October - geometric mean colony count of 200 per 100 ml and less than 10 percent may exceed 400 per 100 ml November through April - geometric mean of 2000 per 100 ml, and less than 10 percent may exceed 4000 per 100 ml

EVALUATED WATERBODY MS115JOBE IDENTIFICATION

Name:	Joes Bayou
Waterbody ID:	MS115JOBE
Location:	Near Bay St. Louis
County:	Hancock County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	130
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
NPDES Permits:	There are 0 NPDES Permits issued for facilities that potentially discharge fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	May through October - geometric mean colony count of 200 per 100 ml and less than 10 percent may exceed 400 per 100 ml November through April - geometric mean of 2000 per 100 ml, and less than 10 percent may exceed 4000 per 100 ml

EVALUATED SEGMENT MS115M1 IDENTIFICATION

Name:	Jourdan River
Waterbody ID:	MS115M1
Location:	Near Kiln: From 115J Boundary near Edwards Bayou to mouth at St. Louis Bay
County:	Hancock County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	130
Use Impairment:	Contact Recreation
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
NPDES Permits:	There are 2 NPDES Permits issued for facilities that potentially discharge fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	Fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml
Waste Load Allocation:	5.62E+11 MPN/15 days (all dischargers must meet water quality standards for disinfection)
Load Allocation:	1.52E+14 MPN/15 days
Margin of Safety:	Implicit modeling assumptions
Total Maximum Daily Load (TMDL):	1.52E+14 MPN/15 days

The loads provided above are based on the same 15 day critical period as the loads provided for MSSTLUBAYM and represent the portion of the MSSTLUBAYM loads that are discharged directly into both the freshwater and saltwater portions of MS115M1. The loads provided above shall replace the narrative loads provided in Phase One.

EVALUATED WATERBODY MS113JE IDENTIFICATION

Name:	Rotten Bayou
Waterbody ID:	MS113JE
Location:	Near Kiln
County:	Hancock County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	110
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
NPDES Permits:	There is 1 NPDES Permit issued for a facility that potentially discharges fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	May through October - geometric mean colony count of 200 per 100 ml and less than 10 percent may exceed 400 per 100 ml November through April - geometric mean of 2000 per 100 ml, and less than 10 percent may exceed 4000 per 100 ml

EVALUATED WATERBODY MS114JE IDENTIFICATION

Name:	Cutoff Bayou
Waterbody ID:	MS114JE
Location:	Near Kiln
County:	Hancock County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	120
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
NPDES Permits:	There are 0 NPDES Permits issued for facilities that potentially discharge fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	May through October - geometric mean colony count of 200 per 100 ml and less than 10 percent may exceed 400 per 100 ml November through April - geometric mean of 2000 per 100 ml, and less than 10 percent may exceed 4000 per 100 ml

EVALUATED SEGMENT MS115JM1 IDENTIFICATION

Name:	Jourdan River
Waterbody ID:	MS115JM1
Location:	Near Kiln: From Confluence of Rotten Bayou to boundary of 115J near Edwards Bayou
County:	Hancock County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	130
Use Impairment:	Contact Recreation
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
NPDES Permits:	There is 1 NPDES Permit issued for a facility that potentially discharges fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	Fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml
Waste Load Allocation:	5.68E+9 MPN/15 days (all dischargers must meet water quality standards for disinfection)
Load Allocation:	1.18E+14 MPN/15 days
Margin of Safety:	Implicit modeling assumptions
Total Maximum Daily Load (TMDL):	1.18E+14 MPN/15 days

The loads provided above are based on the same 15 day critical period as the loads provided for MSSTLUBAYM and represent the portion of the MSSTLUBAYM loads that are discharged directly into both the freshwater and saltwater portions of MS115JM1. The loads provided above shall replace the narrative loads provided in Phase One.

EVALUATED WATERBODY MS118MBE IDENTIFICATION

Name:	Mallini Bayou
Waterbody ID:	MS118MBE
Location:	At Pass Christian
County:	Harrison County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	160
Use Impairment:	Shellfishing
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
NPDES Permits:	There are 0 NPDES Permits issued for facilities that potentially discharge fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	Median fecal coliform MPN (most probable number) colony counts shall not exceed 14 per 100 ml, nor shall more than ten percent of the samples examined ordinarily exceed an MPN colony count of 43 per 100 ml in those portions or areas most probably exposed to fecal contamination during most unfavorable hydrographic and pollutional conditions

EVALUATED WATERBODY MS115WBE IDENTIFICATION

Name:	Watts Bayou
Waterbody ID:	MS115WBE
Location:	Near Waveland
County:	Hancock County, Mississippi
USGS HUC Code:	03170009
NRCS Watershed:	130
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an Indicator for the Presence of Pathogens
NPDES Permits:	There are 0 NPDES Permits issued for facilities that potentially discharge fecal coliform in the watershed (Table 3.1)
Standards Variance:	None
Pollutant Standard:	May through October - geometric mean colony count of 200 per 100 ml and less than 10 percent may exceed 400 per 100 ml November through April - geometric mean of 2000 per 100 ml, and less than 10 percent may exceed 4000 per 100 ml

EXECUTIVE SUMMARY

Several waterbody segments in the St. Louis Bay watershed are on the Mississippi 1998 Section 303(d) List of Waterbodies as impaired due to pathogens, which are indicated by the presence of fecal coliform bacteria. The TMDLs for these waterbodies were developed through one monitoring and modeling project. However, the TMDLs are being presented in two phases due to the diversity of the systems and processes involved. Phase One was comprised of TMDLs for the portion of the Wolf River and the Jourdan River watersheds that drain to freshwater. The Wolf River and the Jourdan River are the primary fresh water sources for St. Louis Bay. The results from Phase One for the freshwater portion of the Wolf River and Jourdan River watersheds were used as input at the appropriate boundaries for Phase Two, which includes the remaining portion of the Wolf River and Jourdan River watersheds that drain to saltwater. This report includes TMDLs for the Bay, it's coastlines, the near shore watersheds, which drain directly to the saltwater portion of the Bay, and the Phase Two portion of the Wolf River and Jourdan River TMDLs. The phased approach is beneficial not only because different models were used to represent the saltwater and the freshwater systems, but also because the different systems have different end point targets.

St. Louis Bay is a vital waterbody in the Mississippi Gulf Coast Region with designated uses of shellfish harvesting and primary contact recreation. The western half of the Coastal Streams Hydrologic Unit Code, HUC, 03170009, drains into St. Louis Bay. The total area of the St. Louis Bay Watershed is approximately 800 square miles. The Phase One Jourdan River and Wolf River TMDLs covered 217 and 345 square miles, respectively. The remaining portion of the St. Louis Bay Watershed drains directly to the Bay or other tidally influenced portions of the system and is covered in this Phase Two document.

The modeling to support the development of this TMDL report was conducted by the Civil Engineering Department at Mississippi State University. The modeling system selected for this study, which includes the BASINS Nonpoint Source Model (NPSM) and the Environmental Fluid Dynamics Code (EFDC), combined the hydrology, in-stream hydrodynamic, and environmental quality of the estuary system while considering both point source and nonpoint source loadings. The Mississippi Department of Environmental Quality (MDEQ) and the Environmental Protection Agency (EPA) have conducted intensive field data acquisition projects to provide additional data to facilitate better understanding of this complex estuarine system and to provide data for model calibration and validation. Intensive surveys during July 1998 and April 1999 were used for model calibration and verification.

The models accounted for seasonal variations in hydrology, climatic conditions, and watershed activities. The use of the continuous simulation models allowed for consideration of the seasonal aspects of rainfall and temperature patterns within the watershed. Calculation of the fecal coliform accumulation parameters and source contributions on a monthly basis accounted for seasonal variations in urban runoff and watershed activities such as livestock grazing and land application of manure.

The weather data used for this model were collected at several locations in the study area. The representative hydrologic period used for this modeling project was a wet year, 1995, and a dry year, 1968, as determined by an analysis of mean annual rainfall distributions at several stations including Poplarville, Gulfport, Picayune, and Bay St. Louis.

The water quality data available were not sufficient for assessment. However, the violation of the shellfish harvesting and contact recreation uses was based upon harvesting classification restrictions. The prohibited classification was not reflective of water quality, but due to proximity to a waste source. The existence of new guidance and additional water quality for the areas where the classifications are reflective of water quality could allow for upward classification of areas of St. Louis Bay where appropriate.

Fecal coliform loadings from nonpoint sources in the Jourdan River and Wolf River Watersheds were calculated based upon wildlife populations, livestock populations, information on livestock and manure management practices, and urban development for the Phase One TMDLs. However, for the small watersheds surrounding St. Louis Bay, the fecal coliform loadings from nonpoint sources were estimated based on literature values and calibration. The estimated fecal coliform production and accumulation rates due to nonpoint sources that would runoff from the watersheds were incorporated into the model. Pollutant loadings from the major rivers and small bayous are simulated as input into the Bay model. There are 12 NPDES Permitted discharges included as point sources in the model.

Under existing, or baseline, conditions output from the model indicates a violation of the median fecal coliform standard for shellfish harvesting and the geometric mean fecal coliform standard for contact recreation due to both nonpoint and point sources. After applying a TMDL reduction scenario, there were no significant violations of the standard according to the model.

The Phase One TMDL scenarios for reduction of the fecal coliform loads from the Jourdan River and Wolf River Watersheds were represented in the scenario for Phase Two, which invloves a reduction in the total fecal coliform load of approximately 27 percent. Because over 99 percent of the allocated load is due to nonpoint sources, those were focused on for reductions. Also, the permitted dischargers in the watershed are currently required to disinfect and to discharge at levels equivalent to the contact recreation water quality standard. The 27 percent reduction could be achieved through many different scenarios, which might include addressing urban nonpoint source issues in the small watersheds around the Bay and addressing other issues in the Phase One Jourdan River and Phase One Wolf River TMDLs. The categories of loads that may be reduced include those that contribute to surface runoff and those that reach the stream directly. The waters of St. Louis Bay are in various stages of restriction for shellfish harvesting and one of the goals of this TMDL is to improve water quality to allow for upward classification of the waters to once again allow shellfish harvesting where appropriate. Additional stakeholder input should be sought to develop an appropriate implementation plan for this watershed.

1.0 INTRODUCTION

1.1 Background

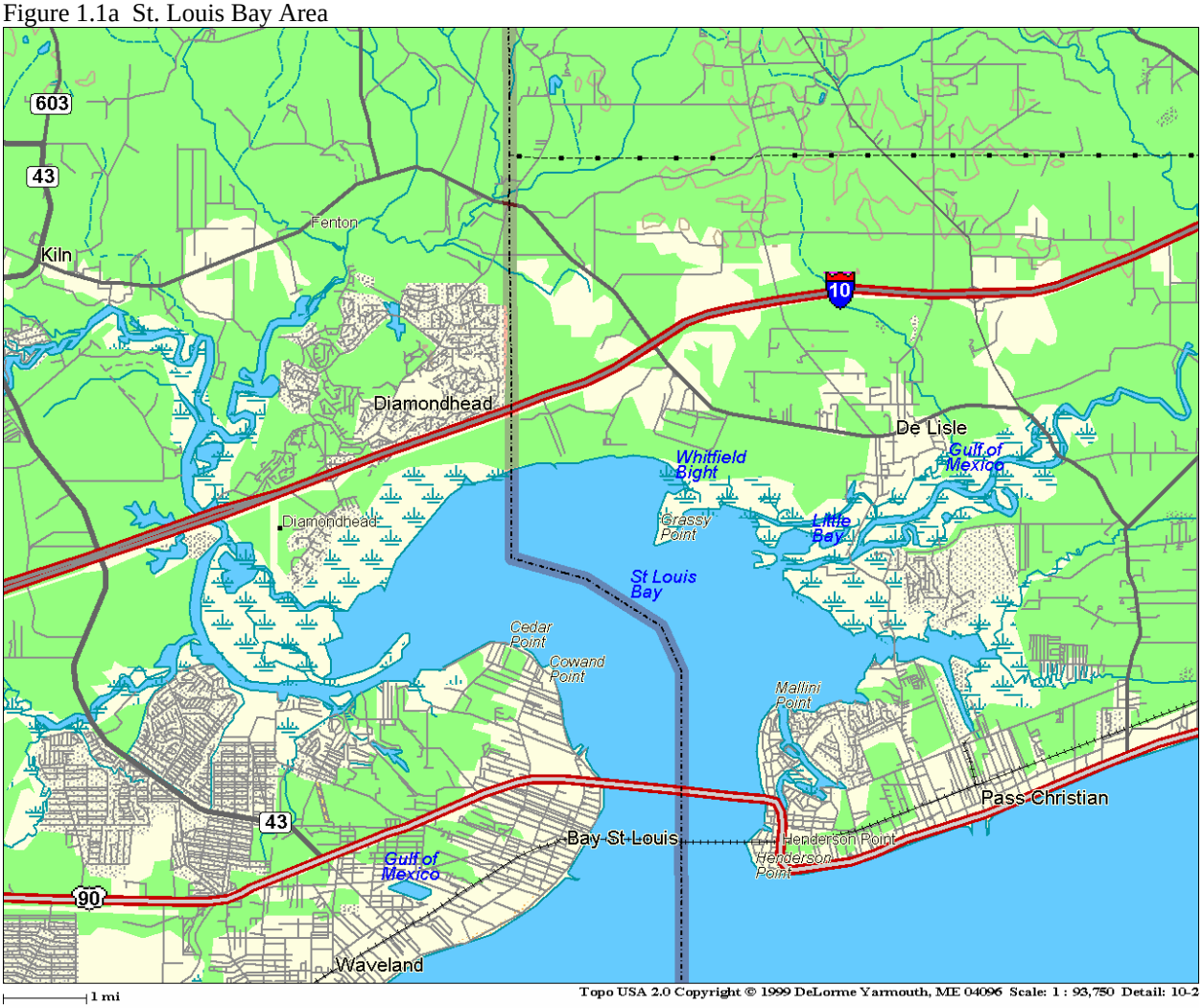
The identification of waterbodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those waterbodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR part 130). The TMDL process is designed to restore and maintain the quality of those impaired waterbodies through the establishment of pollutant specific allowable loads. The pollutant of concern for this TMDL is pathogens. Fecal coliform bacteria are used as indicator organisms for pathogens. They are readily identifiable and indicate the possible presence of other pathogenic organisms in the waterbody. The TMDL process can be used to establish water quality based controls to reduce pollution from both point and nonpoint sources, and restore and maintain the quality of water resources.

The Mississippi Department of Environmental Quality (MDEQ) has identified St. Louis Bay as being impaired by fecal coliform bacteria as reported in the Mississippi 1998 Section 303(d) List of Waterbodies. The St. Louis Bay coastline, which has been split into three segments, has also been identified as being impaired by fecal coliform bacteria. The aforementioned four segments are listed on the monitored portion of the Mississippi 1998 Section 303(d) List of Waterbodies. Phase Two of the monitored portions of the Jourdan River and Wolf River are also included in this TMDL. In addition, this TMDL includes 10 waterbody segments in the St. Louis Bay Watershed that are on the evaluated portion of the Mississippi 1998 Section 303(d) List of Waterbodies for pathogens. The 10 evaluated segments are: Bayou Delisle, Bayou LaCroix, Edwards Bayou, Joes Bayou, Jourdan River from Edwards Bayou to mouth, Rotten Bayou, Cutoff Bayou, Jourdan River from Rotten Bayou to Near Edwards Bayou, Mallini Bayou at Pass Christian, and Watts Bayou. The St. Louis Bay area is shown in Figure 1.1a.

The listing of the segments was influenced by several factors, including shellfish classifications, water quality data, and anecdotal evidence. The St. Louis Bay and it's coastlines were automatically listed as impaired for shellfish harvesting due to the prohibited and restricted classification of the shellfish beds in the Bay by MDMR. While the prohibited classification was possibly due to proximity to a NPDES point source discharge, the restricted classification was more likely water quality related. The monitored segments of the Jourdan River and the Wolf River were listed due to water quality data, which is presented in their Phase One TMDL reports. The evaluated segments were listed due to anecdotal evidence. All segments included in this report are shown in Figure 1.1b.

According to the U.S. Fish and Wildlife Service there are no threatened or endangered species that occur in the waters in the St. Louis Bay Watershed.

Figure 1.1a St. Louis Bay Area



St. Louis Bay and the other impaired segments addressed in this TMDL are in the Coastal Streams Basin Hydrologic Unit Code (HUC) 03170009 in southwest Mississippi. The area of the entire St. Louis Bay Watershed is approximately 800 square miles. As shown in Figure 1.1c the St. Louis Bay Watershed area lies within portions of Pearl River, Hancock, Harrison, Stone, and Lamar Counties. Figure 1.1c also shows the portion of the watershed in the Phase One Jourdan River TMDL in green, the portion of the watershed in the Phase One Wolf River TMDL in yellow, and the remaining portion of the watershed in blue, which is covered in this TMDL. The Jourdan and Wolf watersheds are predominately forested and rural, containing the majority of the agricultural activities. Detailed descriptions of their landuse distributions are provided in those TMDLs. However, the majority of the urban area in the St. Louis Bay Watershed is included in the area covered in this TMDL. The land use distribution for the entire St. Louis Bay Watershed is shown in Table 1.1.

Table 1.1 Landuse Distribution in Acres for the St. Louis Bay Watershed

	Urban	Forest	Cropland	Pasture	Barren	Wetland	Total
Area (Acres)	11,726	303,729	14,319	45,541	874	132,609	522,593
% Area	2	58	3	9	0	25	100

Figure 1.1b St. Louis Bay Waterbody Segments

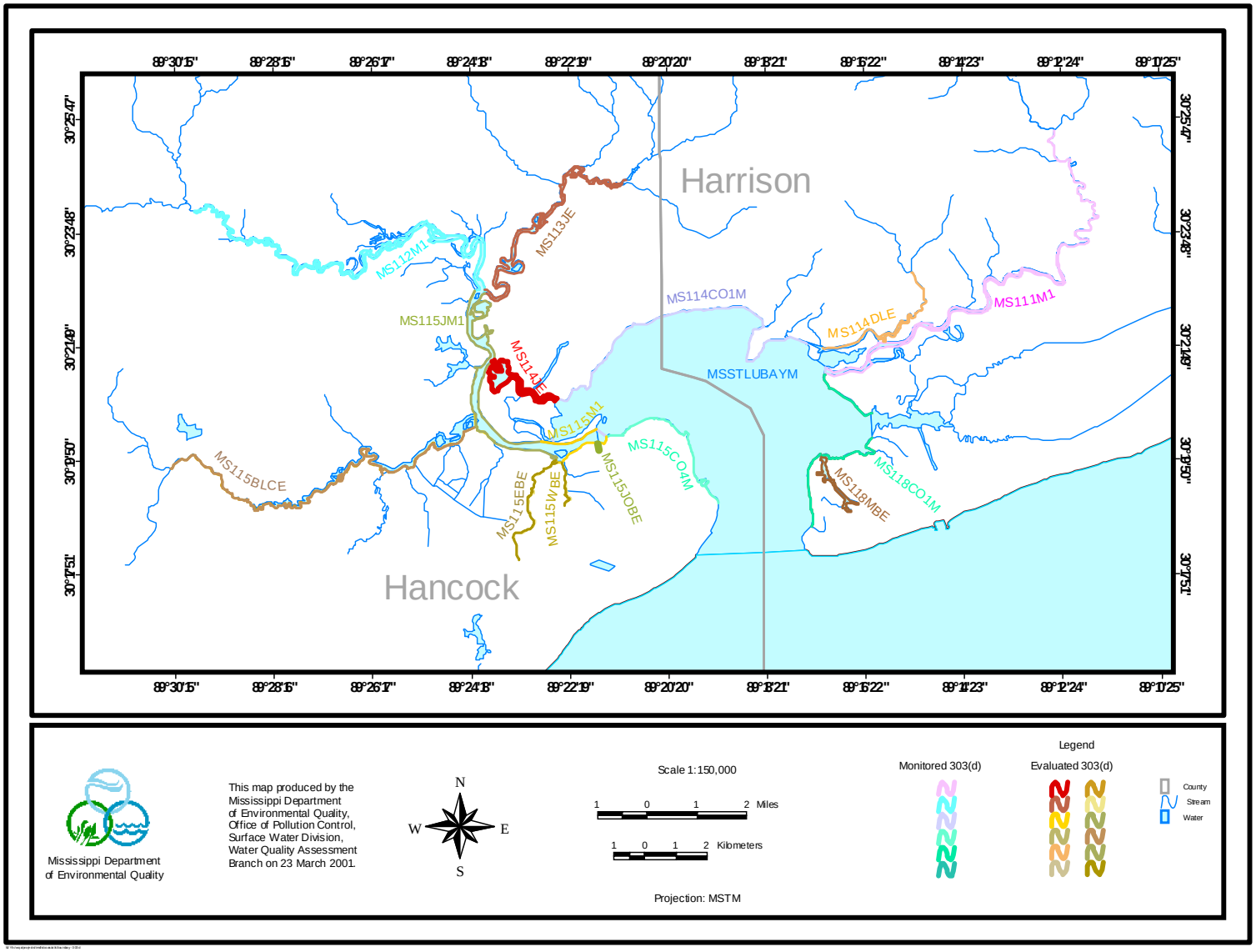
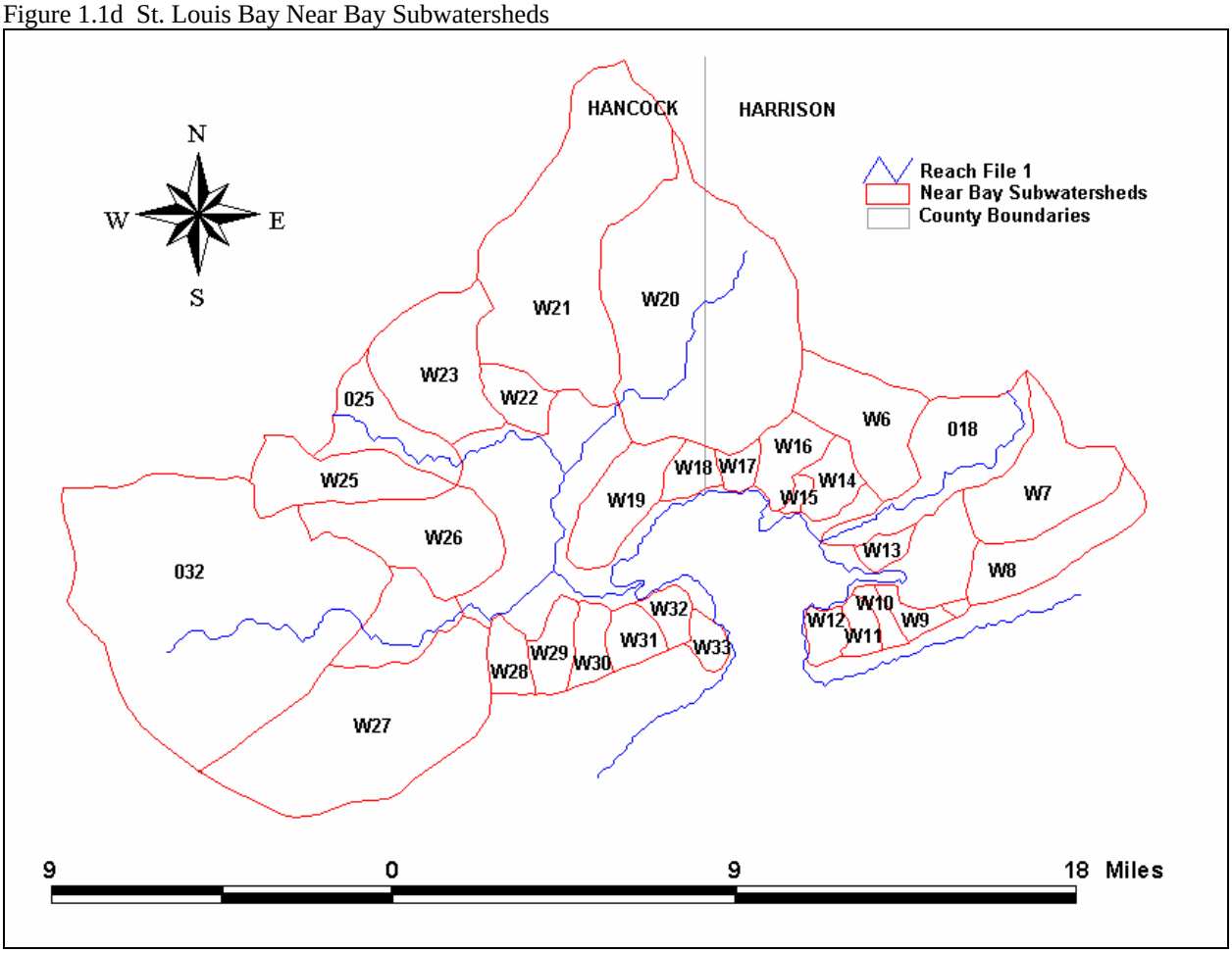


Figure 1.1d St. Louis Bay Near Bay Subwatersheds



1.2 Applicable Waterbody Segment Use

The water use classification for St. Louis Bay, as established by the State of Mississippi in the *Water Quality Criteria for Intrastate, Interstate and Coastal Waters* regulation, is Shellfish Harvesting. Because the regulations state that "waters that meet the Shellfish Harvesting Area Criteria shall also be suitable for recreational purposes," St. Louis Bay and it's coastlines have the designated beneficial uses of both, Shellfish Harvesting and Contact Recreation. The water use classification for the other monitored waterbodies is Recreation, which means they have the designated beneficial use of Contact Recreation. The evaluated waterbodies have the water use classification of Fish and Wildlife with a designated beneficial use of Secondary Contact Recreation related to pathogens.

The classification of the St. Louis Bay waters for shellfish harvesting is shown in Figure 1.2a. These classifications are determined by the Mississippi Department of Marine Resources (MDMR) and are fully explained in the National Shellfish Sanitation Program (NSSP) Model Ordinance which is available on the Interstate Shellfish Sanitation Conference (ISSC) website, http://www.issc.org/. Figure 1.2b shows the location of the reefs in St. Louis Bay. The waters of St. Louis Bay are in various stages of restriction and the goal is to improve water quality to allow for upward classification where appropriate.

Figure 1.2a Shellfish Harvesting Classifications in St. Louis Bay (MDMR)

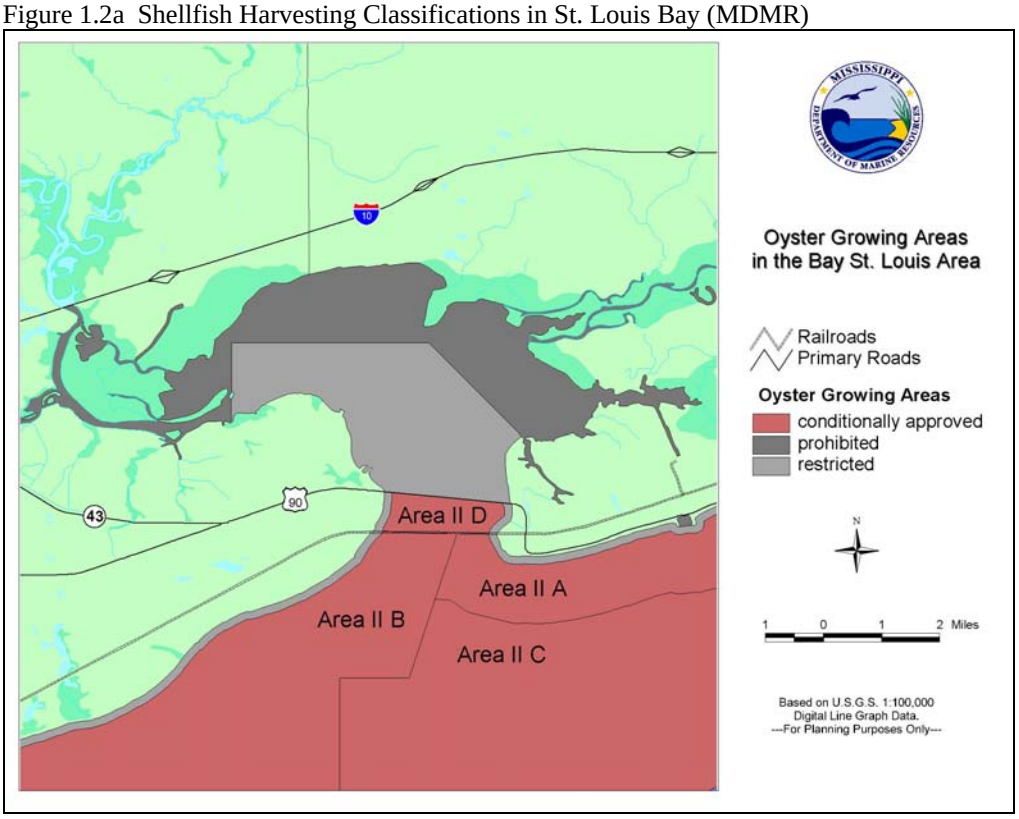
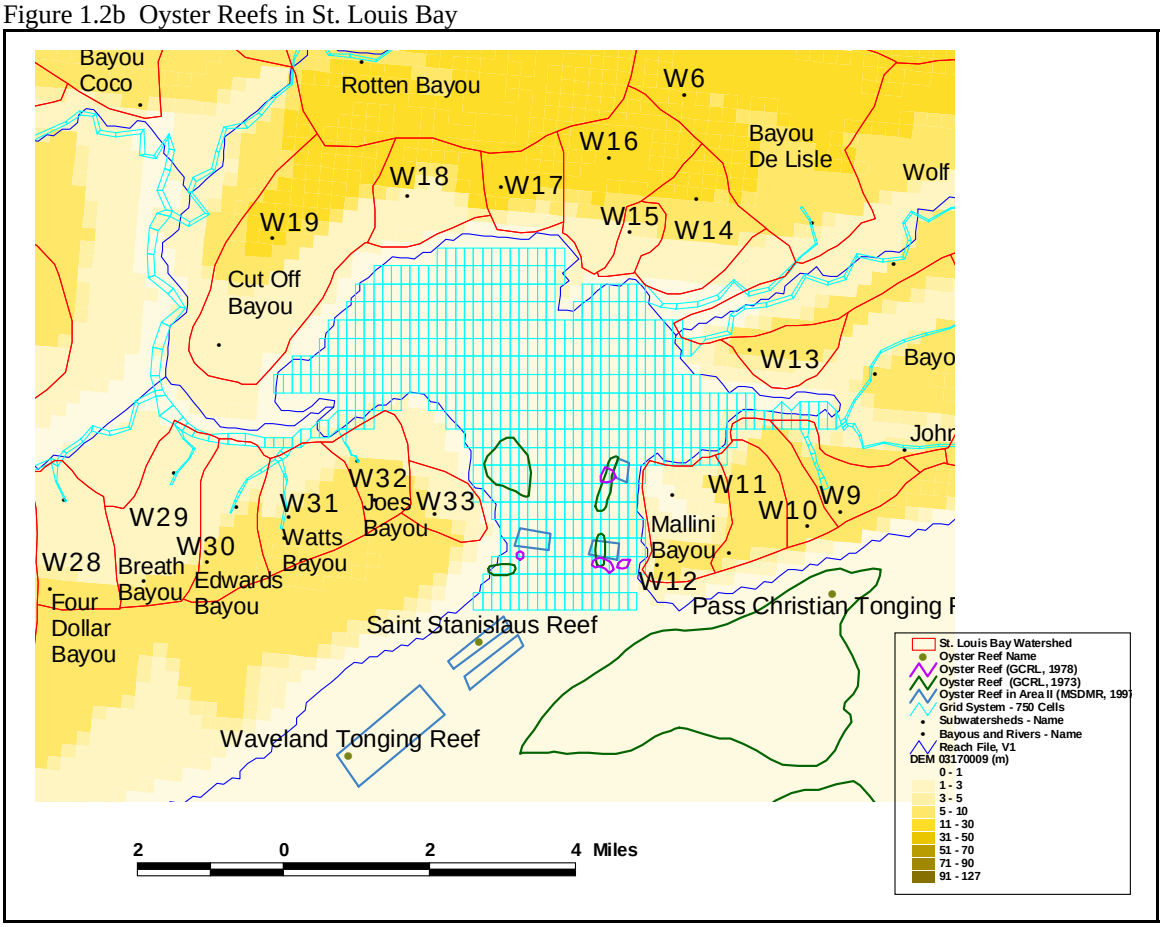


Figure 1.2b Oyster Reefs in St. Louis Bay



1.3 Applicable Waterbody Segment Standard

The water quality standard applicable to the use of the waterbody and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. The standards are shown in Table 1.3. These water quality standards will be used as targeted endpoints to evaluate impairments and to establish this TMDL.

Table 1.3 Water Quality Standards

Water Use	**Purpose**	**Water Standards**
Shellfishing Harvesting	Waters for this use are for propagation and harvesting shellfish for sale or use as a food product.	The median fecal coliform most probable number (MPN) of the water shall not exceed 14 per 100 ml, and not more than ten percent (10%) of the samples shall ordinarily exceed an MPN of 43 per 100 ml in those portions or areas most probably exposed to fecal contamination during most unfavorable hydrographic and pollutional conditions.
Recreation	The quality of waters in this classification is to be suitable for recreational purposes, including such water contact activities as swimming and water skiing.	Fecal coliform shall not exceed a geometric mean of 200 per 100 ml nor shall more than ten percent (10%) of the samples examined during any month exceed 400 per 100 ml.
Fish and Wildlife	Waters in this classification are intended for fishing and for propagation of fish, aquatic life, and wildlife. Waters that meet Fish and Wildlife Criteria shall also be suitable for secondary contact recreation. Secondary contact recreation is defined as incidental contact with the water, including wading and occasional swimming.	For the months of May through October, when water contact recreation activities may be expected to occur, fecal coliform shall not exceed a geometric mean of 200 per 100 ml nor shall more than 10 percent (10%) of the samples examined during any month exceed 400 per 100 ml. For the months of November through April, when incidental recreational contact is not likely, fecal coliform shall not exceed geometric mean of 2000 per 100 ml, nor shall more than ten percent (10%) of the samples examined during any month exceed 4000 per 100 ml.

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 that are to be achieved by implementing the load and waste load allocations specified in the TMDL. The endpoints allow for a comparison between observed instream conditions and conditions that are expected to restore designated uses. While there are various designated uses in the St. Louis Bay system, the use with the most stringent standards is that for shellfish harvesting, which requires an instream fecal coliform target of a median of 14 MPN counts per 100 ml. Reductions utilized to meet this target should be sufficient to meet all other standards.

Because fecal coliform may be attributed to both sources that are runoff dependent and sources that are constantly discharging to the stream, the critical condition must account for both high and low flow conditions. Critical conditions for waters impaired by nonpoint sources that are runoff related generally occur during periods of wet-weather and high surface runoff. But, critical conditions for nonpoint and point sources that continually discharge generally occur during low-flow, low-dilution conditions. While the models were run for a full eleven year period to capture various high and low flow situations, most of the modeling was done using a wet year and a dry year that were determined to be representative through the evaluation of precipitation records for the period of record of several stations in the area. The wet year has been determined to be the most critical for the fecal coliform water quality in the Bay.

2.2 Discussion of Instream Water Quality

According to the State's 1998 Section 305(b) Water Quality Assessment Report, St. Louis Bay is partially supporting the uses of Shellfish Harvesting and Contact Recreation. MDEQ had limited data available to support this assessment. However, in the past guidance dictated that any water classified as restricted or prohibited for shellfish harvesting by the NSSP and MDMR must be listed as impaired. Figure 1.2a shows that the northern portion of St. Louis Bay is classified as prohibited, the southern half is classified as restricted, and the portion between the bridges at the mouth is classified as conditionally approved. New guidance from EPA is now available that states "Prohibited" classifications set as a precautionary measure due to the proximity of wastewater discharges are not appropriate to consider in the listing of impaired waterbodies (Grubbs and Wayland Letter, October, 2000). The new guidance along with verification with water quality samples may provide for the opportunity to upwardly classify more of the St. Louis Bay shellfish growing areas to conditionally approved so that shellfish can be transported and used as seed oysters or possibly harvested and processed. Seasonal conditionally approved classifications are also a possibility if the water quality is determined by MDMR to be consistently adequate during certain portions of the year.

2.2.1 Inventory of Available Water Quality Monitoring Data

Monitoring for flow and fecal coliform was performed on a bimonthly basis (six per year) at station 02481510 on the Wolf River and at station 02481660 on the Jourdan River through MDEQ's Ambient Monitoring Program. Then in 1997 the monitoring frequency at that station

was increased to a monthly basis. These data along with even more recent data, including that from the Wolf River Conservation Society, are displayed in their respective Phase One reports.

Historically only one station in Bayou Portage, a tributary to St. Louis Bay, was monitored through the Ambient Monitoring Program. While three stations were added in 1997 in St. Louis Bay, the data are only collected quarterly and therefore not of sufficient frequency to assess for fecal coliform. However, that data is provided below in Table 2.2b, while Table 2.2a provides a description of the station names and locations for the stations in Table 2.2b and Table 2.2c.

Through the development of a Data Compendium for St. Louis Bay some additional historical water quality data sources were identified and evaluated. Two intensive surveys were also conducted for the St. Louis Bay Fecal Coliform TMDL Project. The results from those intensive surveys were used for model calibration, and even though the frequency is still insufficient for assessment the data is provided in Table 2.2c.

Mississippi Department of Marine Resources (MDMR) collects data extensively in shellfish growing areas. MDEQ is using MDMR data for the 2000 assessment of meeting the contact recreation designated use.

Table 2.2a Station Locations

Station ID	Waterbody Name	Station Location
BB1	BREATHS BAYOU	OFF OF JOURDAN RIVER
BLC1	BAYOU LA CROIX	NEAR MOUTH AT JOURDAN RIVER
BLC2	BAYOU LA CROIX	COUNTY ROAD WEST OF HWY 43
BLT1	BAYOU LA TERRE	COUNTY ROAD EAST OF KILN, NEAR MOUTH, SEC 37
BP1	BAYOU PORTAGE	COUNTY ROAD NEAR PASS CHRISTIAN
BP2	BAYOU PORTAGE	COUNTY ROAD (MENGE AVE) AT CUEVAS
CB1	CUTOFF BAYOU	NEAR DIAMONDHEAD MARINA
CC1	CATAHOULA CREEK	CROSSING NEAR SANTA ROSA, SEC 30
DLB1	DE LISLE BAYOU	AT CHANNEL CUT TO WOLF RIVER
DLB2	DE LISLE BAYOU	COUNTY ROAD AT DELISLE
EB1	EDWARDS BAYOU	OFF OF JOURDAN RIVER
FDB1	FOUR DOLLAR BAYOU	OFF OF BAYOU LA CROIX
JB1	JOES BAYOU	OFF OF JOURDAN RIVER
JNB1	JOHNSON BAYOU	NEAR MOUTH AT BAYOU PORTAGE
JR1	JOURDAN RIVER	MOUTH AT ST LOUIS BAY
JR2	JOURDAN RIVER	AT INTERSTATE 10
JR3	JOURDAN RIVER	HWY 43/603 AT KILN
MB1	MALLINI BAYOU	NORTHERN END NEAR MALLINI POINT
MS1	MISSISSIPPI SOUND	CHANNEL MARKER RED 4 SOUTH OF RR BRIDGE
RB1	ROTTEN BAYOU	NEAR MOUTH AT JOURDAN RIVER, ABOVE I-10
SLB1	ST LOUIS BAY	HWY 90 BRIDGE
SLB2	ST LOUIS BAY	CHANNEL MARKER GREEN 5 OFF MALLINI POINT
SLB3	ST LOUIS BAY	CHANNEL MARKER GREEN 3 OFF COWAND POINT
SLB4	ST LOUIS BAY	CHANNEL MARKER GREEN 5 OFF WOLF RIVER
SLB5	ST LOUIS BAY	OFF CEDAR POINT, NEAR JOURDAN RIVER
SLB6	ST LOUIS BAY	WEST OF GRASSY POINT NEAR DUPONT
SLB7	ST LOUIS BAY	NORTHEAST OF CUTOFF BAYOU
WB1	WATTS BAYOU	OFF OF JOURDAN RIVER
WR1	WOLF RIVER	ROUSE BRIDGE NEAR CUEVAS
WR2	WOLF RIVER	COUNTY ROAD NEAR LANDON

Table 2.2b Ambient Program Fecal Coliform Data (MPN/100 ml)

WR1		SLB1		SLB2		SLB3		MS1	
Date	FC	Date	FC	Date	FC	Date	FC	Date	FC
3/3/1998	46	8/19/1998	1.8	4/16/1997	5	4/16/1997	17	4/16/1997	7.8
8/3/1998	350			7/15/1997	49	7/5/1997	11	7/15/1997	2
				10/9/1997	2	10/9/1997	2	10/9/1997	2
				1/28/1998	540	1/28/1998	920	1/28/1998	49
				4/6/1998	13	4/6/1998	33	4/6/1998	2
				8/19/1998	1.8	8/19/1998	13	8/19/1998	1.8
				10/26/1998	4.5	10/26/1998	4.5		

Table 2.2c Intensive Study Fecal Coliform Data (MPN/100 ml)

Station ID	July 1998 Study				April 1999 Study		
	7/14/1998 Afternoon	7/15/1998 Midday	7/15/1998 Midnight	7/16/1998 Midday	4/19/1999 Afternoon	4/21/1999 Morning	4/22/1999 Afternoon
BB1	79	350	49		110	240	220
BLC1	33	79	13		4.5	33	33
BLC2	540	540		33	13	23	22
BLT1	920	920		350	46	110	350
BP1	240	23	7.8		33	17	7.8
BP2	1600	1600		540	79	49	33
CB1		49	23		22	49	4.5
CC1	79	240		11	13	46	17
DLB1	350	49			740		1600
DLB2		920		540	49	79	240
EB1	1600	140	540		49	920	1600
FDB1		70	23		140		350
JB1	360	130			70	350	79
JNB1	1600	170			140		13
JR1		79	23		7.8	6.8	17
JR2		23	23		13	33	33
JR3	350	240		33	23	7.8	46
MB1	540	33	23		22	170	130
MS1		1.8	1.8		1.8	4.5	2
RB1	130	33	130		13	4	23
SLB1		1.8	1.8		2	6.8	7.8
SLB2		14	1.8		2	79	7.8
SLB3		1.8	1.8		4.5	11	4
SLB4		1.8	1.8		4.5	110	4.5
SLB5		2	2		7.8	17	13
SLB6		2	1.8		2	79	79
SLB7		13	1.8		11	23	21
WB1	540	920	170		79	160	540
WR1	130	350		350	33	23	79
WR2	1600	350		110	7.8	6.8	13

2.2.2 Analysis of Instream Water Quality Monitoring Data

Because the St. Louis Bay 303(d) Listings were due to guidance and not the data provided above, no statistical summaries are provided.

3.0 SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known potential fecal coliform sources in the St. Louis Bay Watershed. The source assessment was used as the basis of development for the model and ultimate analysis of the TMDL allocation options. In evaluation of the sources, loads were characterized by the best available information, monitoring data, literature values, and local management activities. This section documents the available information and interpretation for the analysis. The representation of the following sources in the model is discussed in Section 4.0, Modeling Procedure: Linking the Sources to the Endpoint.

3.1 Assessment of Point Sources

Typically, point sources of fecal coliform bacteria have their greatest potential impact on water quality during periods of low flow. There are 12 facilities permitted to discharge fecal coliform included in the St. Louis Bay model. The 12 facilities serve a variety of activities including residential subdivisions, schools, industries, and municipalities. Marinas and shipyards located in the study area were considered to be discharging to the municipalities.

Samples were collected at the point sources during the July 1998 calibration study and again in the April 1999 verification study. Flow and fecal coliform values from the July 1998 study were used as input into the Bay model for calibration. For subsequent application runs of the model the maximum permitted limits were used for each facility. Every facility included in the model is listed in Table 3.1.

Table 3.1 shows the existing dischargers. However, the Gulf of Mexico Program Office (GMPO) is facilitating efforts to evaluate options for future wastewater treatment needs in Hancock County (URS, 2001). Recommendations include consolidating the wastewater treatment in the county under one authority, Southern Regional Wastewater Management District (SRWWMD) and building collection and transport systems for rural parts of the county. The consolidated facility might utilize innovative treatment and disposal approaches including land application, which would remove the discharge from the waterbody altogether. Similar efforts may be undertaken by Harrison and Jackson counties.

Table 3.1 Inventory of Point Source Dischargers

Name of Facility	NPDES #	Receiving Stream	Flow (MGD)	Permit Limit (mg/L)
Waveland Regional Wastewater Mgt. Dist.	MS0027847	Edwards Bayou	4.900	200
Diamondhead Water/Sewer Dist.	MS0046078	St. Louis Bay	0.180	200
Long Beach/Pass Christian Sewage Treatment Plant	MS0043141	Bayou Portage	1.560	200
Coast Episcopal High School	MS0028321	Canal No. 3	0.008	200
DeLisle Elem. School	MS0022799	Bayou Delisle	0.008	200
Discovery Bay	MS0021865	Bayou Portage	0.015	200
Dupont Outfall: 1N (Process WW)	MS0027294	St. Louis Bay	4.200	200
Dupont Outfall: 2A (Sanitary)	MS0027294	St. Louis Bay	0.034	200
Dupont Outfall: 3A (Storm)	MS0027294	St. Louis Bay	10.300	200
Five-Star Resort	MS0035131	Wolf River	0.008	200
Jourdan River Shores	MS0022870	Jourdan River	0.050	200
Long Beach Industrial Park	MS0022373	Canal No. 1	0.250	200

3.2 Assessment of Nonpoint Sources

There are many potential nonpoint sources of fecal coliform bacteria in the St. Louis Bay Watershed, including:

- Failing septic systems
- Wildlife
- Land application of hog and cattle manure
- Grazing animals
- Land application of poultry litter
- Other Direct Inputs
- Urban development
- Domestic Pets
- Boat Pumpout

The 523,000 acre drainage area of St. Louis Bay contains many different landuse types, including urban, forest, cropland, pasture, barren, and wetlands. The sources of failing septic systems, wildlife, land application of hog and cattle manure, grazing animals, land application of poultry litter, and other direct inputs are addressed in detail in the Phase One Jourdan River and Phase One Wolf River TMDLs. Because the Jourdan River and Wolf River drain into St. Louis Bay those sources could potentially impact the Bay. However, the area near the Bay is primarily urban and residential, including the activities of domestic pets, wildlife, septic systems, illicit connections, and landfills. Because St. Louis Bay supports both recreational and commercial boating, waste from those boats is also considered a likely source in the Bay.

The modeled landuse information for the watershed is based on two different data sets which are representative of different time periods. Geographic Information Retrieval and Analysis System (GIRAS) land use data from the 1970s, which is available on the EPA BASINS web site, was used for this project. The BASINS default land use data, originally obtained from USGS, uses the Anderson Level I and Level II classifications. These data were applied to simulations for the period 1965 through 1985. Updated land use data from 1992-1993 were obtained from the Mississippi Automated Resources Information System (MARIS) data set and merged with the BASINS data by using the EPA Watershed Characterization System (WCS) utility program. This landuse information is based on data collected by the State of Mississippi's Automated Information System. This dataset is based on Landsat Thematic Mapper digital images taken between 1992 and 1993. The MARIS dataset is classified on a modified Anderson level I and II system. The MARIS landuse dataset was used for the hydrologic calibration period of 1987 through 1999. Figure 3.2 and Table 3.2 show the landuse distribution for the watershed.

Figure 3.2 Landuse Distribution

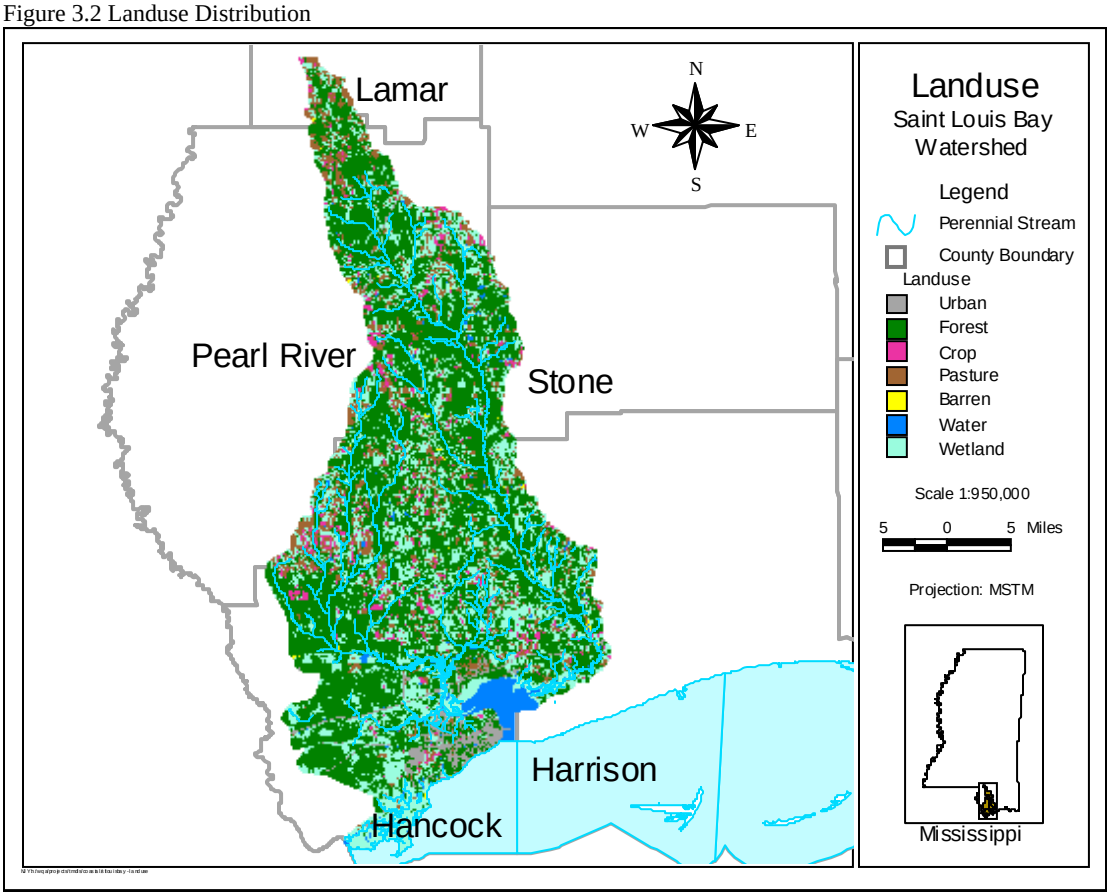


Table 3.2 Landuse Distribution in Acres for the St. Louis Bay Watershed

	Urban	Forest	Cropland	Pasture	Barren	Wetland	Total
Area (Acres)	11,726	303,729	14,319	45,541	874	132,609	522,593
% Area	2	58	3	9	0	25	100

For Jourdan River and Wolf River Watershed modeling purposes the landuse categories were grouped into the categories of urban, forest, cropland, pasture, barren, and wetlands. The contributions of each of these land types to the fecal coliform loading of the Jourdan River and Wolf River was considered on a subwatershed basis. The nonpoint fecal coliform contribution from each landuse was estimated using the latest information available. The MARIS landuse data for Mississippi was utilized by the WCS to extract landuse sizes, populations, and agriculture census data. Several agencies were contacted and the watershed was visited to refine the assumptions made in determining the fecal coliform loading. The GAP Study provided information on wildlife density in the Wolf River Watershed. The Mississippi State Department of Health was contacted regarding the failure rate of septic tank systems in this portion of the state. Mississippi State University researchers provided information on manure application practices and loading rates for hog farms and cattle operations. The Natural Resources Conservation Service also provided information on manure treatment practices and land application of manure. The output from the watershed models was input into the Bay model in order to account for watershed activities.

In the smaller watersheds near the Bay the watershed model was used only to simulate stormwater runoff. Through calibration, water quality simulation from the watershed model was found to be inadequate for the urban runoff loads entering the Bay. Event mean concentrations (EMCs) from the literature were found to be more accurate.