Final
June 2002

Total Maximum Daily Load

Bernard Bayou and Industrial Seaway

For Phenol

Coastal Streams Basin

Harrison County, Mississippi

Prepared by
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FOREWORD

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. 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 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.

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	0.6463168	mg/l	ppm	1
cubic meters	gallons	264.17205	µg/l * cfs	gm/day	2.45
cubic meters	liters	1000	µg/l * MGD	gm/day	3.79
mg/L * cfs	lbs/day	5.39	mg/L * MGD	lbs/day	8.34

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

CONTENTS

TMDL INFORMATION PAGE

Listing Information

Name	ID	County	HUC	Cause	Mon/Eval
Bernard Bayou (segment 3)	MS118BBM3	Harrison	03170009	Phenol	Evaluated
Location – Near Gulfport: From Highway 49 to Industrial Seaway at Entrance at Bernard Bayou Natural Channel					
Industrial Seaway	MS118BBM5	Harrison	03170009	Phenol	Evaluated
Location – Near Gulfport: From Gulfport Lake to Mouth at Big Lake					

Water Quality Standard

Parameter	Beneficial use	Water Quality Criteria
Phenol	Aquatic Life Support	*Fresh Water* Acute: instantaneous concentration may not exceed 300 μg/l Chronic: average concentration may not exceed 102 μg/l *Salt Water* Acute: instantaneous concentration may not exceed 300 μg/l Chronic: average concentration may not exceed 58 μg/l

NPDES Facilities

NPDES ID	Facility Name	County	Receiving Water	Flow (MGD)
MS0044580	Cavenham Forest Industries	Harrison	Bernard Bayou	0.05

Total Maximum Daily Load

Type	Number	Unit	MOS Type
WLA	0.26	lbs/day phenol	
LA	0.00	lbs/day phenol	
MOS	0.14	lbs/day phenol	Explicit
TMDL	0.40	lbs/day phenol	

EXECUTIVE SUMMARY

Bernard Bayou (segment 3) and Industrial Seaway have been placed on the Mississippi 1998 Section 303(d) List of Waterbodies as impaired due to priority organics. These segments were originally listed for priority organics on the 303(d) List based on data reported in the findings of the *Pollutant Transport in Mississippi Sound* Study (Lytle and Lytle, 1985). During this study, elevated levels of phenol were measured in the sediment of the waterbodies. Prior to developing this TMDL, MDEQ modified the cause of impairment on the 303(d) List from priority organics to phenol, to reflect the original pollutant of concern. As a result, this TMDL has been prepared for phenol in Bernard Bayou (segment 3) and Industrial Seaway.

Photo 1. Bernard Bayou at Entrance to Industrial Seaway

Bernard Bayou (segment 3) is located near Gulfport, from Highway 49 to Industrial Seaway at its entrance to the natural channel of Bernard Bayou, shown in Photo 1. Industrial Seaway is a dredged channel that flows from Gulfport Lake to Big Lake. Big Lake connects with the Back Bay of Biloxi, which then flows into the Mississippi Sound. Both waterbodies are tidally influenced and are typically stratified with respect to salinity. Bernard Bayou, however, is fed by several freshwater tributaries, including Flat Branch and Turkey Creek. The headwaters of Bernard Bayou above Highway 49 also contain primarily freshwater flow.

An assessment of the point and nonpoint sources identified one NPDES permitted point source of phenol in the watershed, Cavenham Forest Industries. The existing load from this facility was used to establish the wasteload allocation for this TMDL. The existing load is less than the maximum allowable phenol load, so no reduction in the existing load is needed. However, no additional point sources of phenol will be allowed without additional monitoring of the sediment and water column for phenol concentrations in the waterbodies.

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 phenol.

According to *Toxicological Profile for Phenol* (ATSDR, 1998):

> Phenol is a colorless-to-white solid when pure; however, the commercial product, which contains some water, is a liquid. Phenol has a distinct odor that is sickeningly sweet and tarry. Phenol evaporates more slowly than water, and a moderate amount can form a solution with water. Phenol can catch on fire. Phenol is both a man-made chemical and produced naturally. It is found in nature in some foods and in human and animal wastes and decomposing organic material. The largest single use of phenol is as an intermediate in the production of phenolic resins. However, it is also used in the production of caprolactam (which is used in the manufacture of nylon 6 and other synthetic fibers) and bisphenol A (which is used in the manufacture of epoxy and other resins). Phenol is also used as a slimicide (a chemical toxic to bacteria and fungi characteristic of aqueous slimes), as a disinfectant, and in medicinal preparations such as over-the-counter treatments for sore throats. Phenol ranks in the top 50 in production volumes for chemicals produced in the United States.
>
> Following small, single releases, phenol is rapidly removed from the air; generally, half is removed in less than 1 day. It is also relatively short-lived in the soil (generally, complete removal in 2-5 days). However, it can remain in water week or more. Phenol can remain in the air, soil, and water for much longer periods of time if a large amount of it is released at one time, or if it is constantly released to the environment. Levels of phenol above those found naturally in the environment are usually found in surface waters and surrounding air contaminated by phenol released from industrial activity and from the commercial use of products containing phenol. Phenol has been detected, however, in the materials released from landfills and hazardous waste sites, and it has been found in the groundwater near these sites. The levels of phenol found in indoor environments as a part of environmental tobacco smoke (ETS) are usually below 100 ppb, although much higher levels have been reported. One ppb or less of phenol has been found in relatively unpolluted surface water and groundwater, and low levels are also found in indoor environments and are principally derived from ETS. Only low levels of phenol are found in the organisms that live in water which also contains low levels of phenol.
>
> Phenol is present in a number of consumer products which are swallowed, rubbed on, or added to various parts of the body. These include ointments, ear and nose drops, cold sore lotions, mouthwashes, gargles, toothache drops, analgesic rubs, throat lozenges, and antiseptic lotions.

Phenol has been found in drinking water, tobacco smoke, air, and certain foods, including smoked summer sausage, fried chicken, mountain cheese, and some species of fish. It is also found in urine of children and adults. The magnitude, frequency, and likelihood of exposure, and the relative contribution of each exposure route and source to total phenol exposure cannot be estimated using information currently available. Nonetheless, for persons not exposed to phenol in the workplace, possible routes of exposure include: breathing industrially contaminated air; inhaling cigarette, cigar, or pipe smoke, or ETS polluted air; drinking water from contaminated surface water or groundwater supplies; swallowing products containing phenol; changing diapers; and coming into contact with contaminated water and products containing phenol through bathing or skin application. Populations residing near phenol spills, waste disposal sites, or landfill sites may be at risk for higher exposure to phenol than other populations. If phenol is present at a waste site near homes that have wells as a source of water, it is possible that the well water could be contaminated. If phenol is spilled at a waste site, it is possible for a person, such as a child playing in dirt containing phenol, to have skin contact or to swallow soil or water contaminated with phenol. Skin contact with phenol or swallowing products containing phenol may lead to increased exposure. This type of exposure is expected to occur infrequently and generally occurs over a short time period. At the workplace, exposure to phenol can occur from breathing contaminated air. However, skin contact with phenol during its manufacture and use is considered the major route of exposure in the workplace. It has been estimated that about 584,000 people in the United States are exposed to phenol at work. Total exposure at the workplace is potentially higher than in non-workplace settings.

1.2 Available Monitoring Data

In May 2001, MDEQ conducted toxicity testing within Bernard Bayou and Industrial Seaway to determine if phenol or other toxic pollutants were present in the waterbody. A total of four samples were analyzed for toxicity, two from Bernard Bayou and two from Industrial Seaway. Analysis of the samples was conducted by EPA's Science and Ecosystems Support Division (SESD) in Athens, Georgia. The toxicity tests were performed on fathead minnows and silverside minnows following procedures outlined in the USEPA manual *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*, EPA/600/4-90/027F. The results of the toxicity tests were no mortality in all of the samples. The results of the laboratory analysis as well as other supporting data are described in a letter addressed to MDEQ from SESD dated May 14, 2001.

The previous assessment of Bernard Bayou (segment 3) and Industrial Seaway, which resulted in the phenol listing, was based on the findings of the *Pollutant Transport in Mississippi Sound* Study (Lytle and Lytle, 1985). The surface sediments of Bernard Bayou and Industrial Seaway were sampled in November of 1979 as a part of this study. Phenol was identified as elevated in the surface sediments of these waterbodies. More recent monitoring data are not available, as MDEQ does not typically sample for phenol, in the water column or sediments.

1.3 Watershed Characteristics

Bernard Bayou (segment 3) and Industrial Seaway are located in the Gulf Coast Flatwoods and Southern Lower Coastal Plain physiographic regions in the Coastal Basin. The Gulf Coast Flatwoods, which are located south of Interstate 10, are an area of low topographic relief and restricted drainage. The Southern Lower Coastal Plain is an area of rolling hills and slightly higher elevations located north of Interstate 10. The listed segments of Bernard Bayou and Industrial Seaway are in the Coastal Streams Basin, Hydrologic Unit Code (HUC) 03170009, in south Mississippi. Figure 1.1 shows the location of the watershed and waterbody segments.

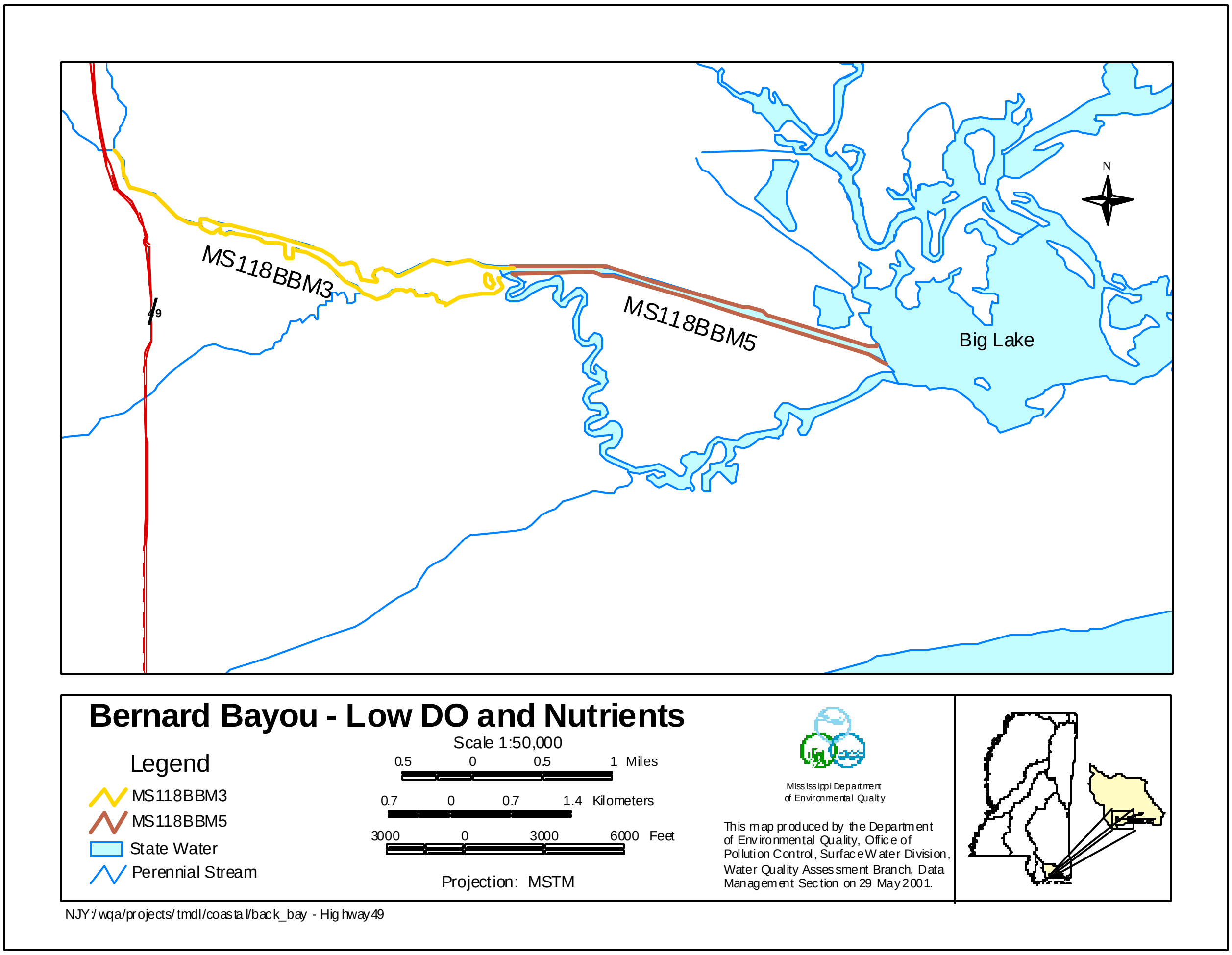

Figure 1.1 Location of 303(d) Listed Segments

The 51,000-acre drainage area of Bernard Bayou and Industrial Seaway contains many different landuse types, including urban, forest, cropland, pasture, barren, and wetlands. The landuse information is based on the State of Mississippi's Automated Resource Information System (MARIS 1997). This data set is based on Landsat Thematic Mapper digital images taken between 1992 and 1993. Figure 1.2 and Table 1.1 show the landuse distribution for the watershed. Forest and wetland areas represent the largest percentage of landuses within the watershed. However, a significant portion of the watershed is occupied by urban areas. The watershed includes the metropolitan area of Gulfport. Gulfport's major industries include fishing, seafood processing, glass making, chemicals, pharmaceuticals, steel products, iron and machine works, and aluminum extrusions. Waterborne commerce includes fertilizers, chemicals, seafood, and pulpwood products.

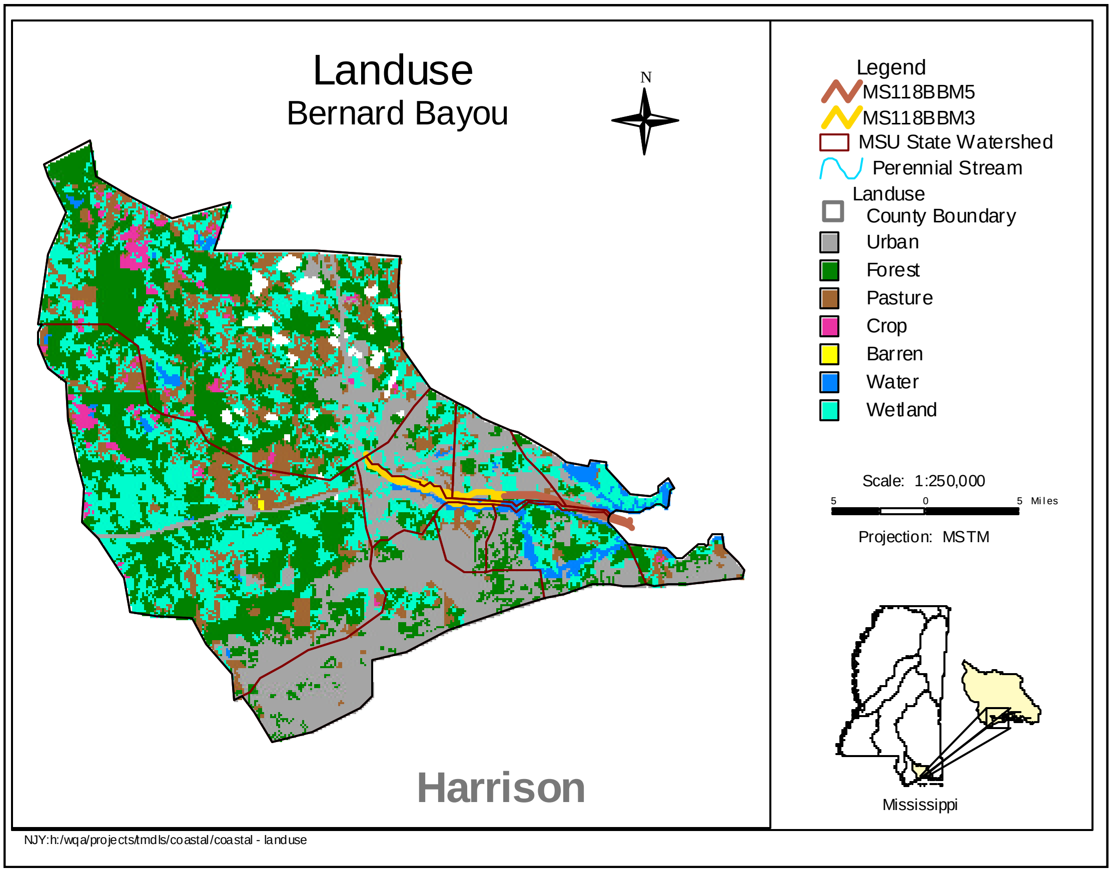

Figure 1.2. Landuse Distribution within the Bernard Bayou and Industrial Seaway Watershed

Table 1.1. Landuse Distribution in Acres for the Bernard Bayou and Industrial Seaway Watershed

	Urban	Forest	Cropland	Pasture	Barren	Water	Wetland	Total
Area (acres)	11,956	16,474	1,037	6,811	16	1,374	13,340	51,009
% Area	23%	32%	2%	13%	0%	3%	26%	100%

2.0 WATER QUALITY STANDARD AND TMDL ENDPOINT

2.1 Applicable Waterbody Segment Use

The water use classification for Bernard Bayou (segment 3) and Industrial Seaway, as established by the State of Mississippi in the *Water Quality Criteria for Intrastate, Interstate and Coastal Waters* regulation, is Fish and Wildlife Support. Waters with this classification are intended for fishing and propagation of fish, aquatic life, and wildlife. Waters that meet the Fish and Wildlife Support criteria should also be suitable for secondary contact recreation, which is defined as incidental contact with water including wading and occasional swimming.

2.2 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 state standard for phenol in saltwater is an acute criteria of 300 µg/L (0.300 mg/L) and a chronic criteria of 58 µg/L (0.058 mg/L). The saltwater criteria have been applied to Bernard Bayou and Industrial Seaway because they are tidally influenced. This water quality standard will be used to develop the targeted endpoint and to evaluate impairment in the waterbody.

2.3 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 meeting 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. The instream target used for this TMDL is a phenol concentration no greater than 0.058 mg/L. This target corresponds to the chronic water quality standard for phenol in saltwater. This standard was selected as the target for the TMDL because it is the most stringent, and thus, will be most protective of water quality.

In order to ensure the attainment of water quality standards under all possible flow conditions, the TMDL target will be applied at low-flow conditions. The low-flow condition used will be the 7Q10 flow, the lowest flow for seven consecutive days to occur within a 10-year period. The United Stated Geological Survey (USGS) has established the 7Q10 flow for many waterbodies in Mississippi based on data from their statewide network of stream gaging stations. A 7Q10 flow has not been established directly for Bernard Bayou, however, it can be estimated with the use of data from nearby monitoring stations.

An estimate of the 7Q10 flow in Bernard Bayou at the discharge point of the Cavenham Forest Industries facility was prepared by the Environmental Group of Cavenham Forest Industries in December of 1988, Attachment A. This 7Q10 estimate was prepared in order to provide a 7Q10 flow for use in calculating permit limits for the facility. The methodology used in calculating the 7Q10 estimate is acceptable. However, the USGS has updated the 7Q10 flows for nearby monitoring stations since 1988. Also, for the purposes of this TMDL, the 7Q10 flow at the upstream end of Bernard Bayou (segment 3) is needed. The upstream end of Bernard Bayou (segment 3) is located at Highway 49, while the discharge point of the Cavenham Forest Industries facility is located just east of Highway 49. Thus, the estimate needs to be recalculated at the correct point in the waterbody using the most current data available.

The flow estimate in Appendix A was calculated based on the 7Q10 flow coefficient from the Little Biloxi River watershed. The 7Q10 flow coefficient, which is calculated by dividing the 7Q10 flow by the drainage area size, is the amount of flow in cfs per square mile of drainage area expected during 7Q10 flow conditions. The reason for using the Little Biloxi River Watershed is that much of the watershed is located in the Southern Lower Coastal Plain Physiographic region. The majority of the Bernard Bayou watershed, which is above Highway 49, is also located in this region and would likely exhibit similar flow characteristics. The 7Q10 flow coefficients for several other waterbodies in the Southern Lower Coastal Plain physiographic region were also calculated, however, the flow coefficient for the Little Biloxi River watershed was used because it is the smallest, and thus provides the most conservative coefficient.

The 7Q10 flow coefficient was calculated using the most current data available for the Little Biloxi River Watershed. These data are found in *Low-Flow and Flow-Duration Characteristics of Mississippi Streams* (Telis, 1991). According to this publication, the 7Q10 flow of the Little Biloxi River near Lyman, MS, USGS Station 0241130, is 2.6 cfs. The drainage area of this station is 68.5 square miles. Thus, the 7Q10 flow coefficient is (2.6 cfs/68.5 square miles) = 0.038 cfs/square mile. The 7Q10 flow of Bernard Bayou can then be calculated by multiplying the flow coefficient by the drainage area of Bernard Bayou. The drainage area of Bernard Bayou at the upstream end of segment 3 has been estimated as 34.0 square miles based on a delineation of the watershed. Thus, the 7Q10 flow for Bernard Bayou at this point is (0.038 cfs/square mile*34.0 square miles) = 1.29 cfs. This 7Q10 flow will be used as the critical low-flow condition for the TMDL.

3.0 SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known potential sources of phenol in Bernard Bayou and Industrial Seaway. The source assessment was used as the basis of development of the TMDL. Sources were characterized with the best available information, monitoring data, literature values, and local management activities. This section documents the available information.

3.1 Assessment of Point Sources

There are several point source facilities that discharge into Bernard Bayou and Industrial Seaway. These facilities serve a variety of purposes in the watershed including municipal wastewater treatment, residential areas, and other businesses and industry. These facilities are listed in Table 3.1.

Table 3.1. Point Source Facilities

Facility	NPDES Permit Number	Flow (MGD)	Location
Harrison County WWM District/Gulfport South	MS0023345	10.50 (April – October) 16.0 (November – May))	Bernard Bayou
Bernard Bayou Industrial Park	MS0027537	0.60	Bernard Bayou
Cavenham Forest Industries	MS0044580	0.05	Bernard Bayou
Harrison County/Gulfport POTW – North #2	MS0051756	5.50	Bernard Bayou at Gulfport Lake
Homestead Trailer Village	MS0051373	0.029	Flat Branch thence Bernard Bayou
Walters Trailer Park	MS0046086	0.0015	Flat Branch thence Bernard Bayou

Only one of these facilities monitors its effluent for phenol content, Cavenham Forest Industries. The Cavenham Forest Industries facility performs site remediation as a result of contamination from wood preserving operations. The wood preserving operations, which are no longer conducted, used the preservatives creosote and pentachlorophenol. The source of the effluent produced at this facility is contaminated groundwater, sanitary wastewater, and stormwater. The effluent flow is approximately 0.05 MGD. The effluent is treated through a process that includes sedimentation, activated sludge treatment, and carbon adsorption prior to discharge. The current permit limits for this facility are given in Table 3.2.

Table 3.2. Cavenham Forest Industries

Parameter	**Monthly Average (lbs/day)**	**Daily Max (lbs/day)**	**Monthly Average**	**Daily Max**
Flow	-	-	Report (MGD)	Report (MGD)
BOD_5	6.67	10.0	16 mg/L	24 mg/L
Oil and Grease	4.17	6.3	10 mg/L	16 mg/L
Phenol, Total	0.26	0.38	0.612 mg/L	0.92 mg/L
Pentachlorophenol	0.009	0.014	0.022 mg/L	0.035 mg/L

In order to ensure that the Cavenham Forest industries is consistently meeting its permit limits for phenol, the discharge monitoring reports (DMRs) for the past two years were examined. The facility is required to submit DMRs on monthly basis. The flows and phenol concentrations measured in the effluent are shown below in Table 3.3. The abbreviation "ND" used in the table means non-detectable. Comparing the phenol loads from the DMR data and the current permit limits shows that the facility is discharging much less phenol than their permit allows.

Table 3.3. DMR Data for Cavenham Forest Industries

Date	Monthly Average Flow (MGD)	Daily Max Flow (MGD)	Phenol Monthly Average (lbs/day)	Phenol Daily Max (lbs/day)
October 1999	0.0130	0.0190	ND	ND
November 1999	0.0102	0.0137	ND	ND
December 1999	0.0110	0.0250	0.0004	0.002
January 2000	Not Reported	Not Reported	Not Reported	Not Reported
February 2000	0.0110	0.0170	0.0004	0.001
March 2000	0.0100	0.0310	0.0017	0.0104
April 2000	0.0040	0.0098	0.0007	0.0016
May 2000	0.0039	0.0095	0.0002	0.0008
June 2000	0.0045	0.0180	0.0002	0.0009
July 2000	0.0107	0.3010	0.0012	0.0050
August 2000	0.0140	0.0630	0.0020	0.0060
September 2000	0.0110	0.021	ND	ND
October 2000	0.0130	0.0260	0.0010	0.0020
November 2000	0.0130	0.0360	0.0010	0.0030
December 2000	0.0110	0.0250	0.0010	0.0020
January 2001	0.0150	0.0310	0.0020	0.0050
February 2001	0.0130	0.0240	0.0010	0.0020
March 2001	0.0170	0.0360	0.0020	0.0060
April 2001	0.0150	0.0400	0.0020	0.0070
May 2001	0.0146	0.0343	0.0006	0.0029
June 2001	0.0156	0.0436	0.0007	0.0036
July 2001	0.0118	0.0395	ND	ND
August 2001	0.0171	0.0526	0.0007	0.0044
September 2001	0.0168	0.0448	ND	ND
AVERAGE	**0.0120**	**0.0418**	**0.0010**	**0.0036**

3.2 Assessment of Nonpoint Sources

Nonpoint loading of priority organics such as phenol can result from the transport of the material into receiving waters by overland surface runoff and groundwater infiltration. Landuse activities within the drainage basin, such as industrial activities and the presence of landfills and hazardous waste sites can contribute to nonpoint source loading of phenol. The use of commercial products containing phenol can also contribute to the nonpoint source load. An additional source of phenol in the water column may be due to leaching from contaminated sediments.

For this TMDL, however, there are no data available that could be used to quantify the nonpoint source load of phenol. While it is recognized that there may be nonpoint sources present in the watershed, the nonpoint source load will be assumed to be zero due to lack of data.

4.0 ALLOCATION

The allocation for this TMDL involves a wasteload allocation (WLA) for point sources, a load allocation (LA) for nonpoint sources, and an explicit margin of safety (MOS) which will result in continued attainment of water quality standards in Bernard Bayou (segment 3) and Industrial Seaway.

4.1 Wasteload Allocation

The wasteload allocation specified in this TMDL is based on the existing load from Cavenham Forest Industries. Since this is the only point source present, the wasteload allocation was set at the daily average load of phenol allowed in the permit of the facility, 0.26 lbs/day. At the current load, water quality standards are attained and no reductions are necessary.

4.2 Load Allocations

As explained previously, the load allocation for this TMDL will be set to zero.

4.3 Incorporation of a Margin of Safety (MOS)

The two types of MOS development are to implicitly incorporate the MOS using conservative assumptions or to explicitly specify a portion of the total TMDL as the MOS. The MOS selected for this TMDL is explicit. An explicit margin of safety will be used to account for uncertainty in the calculation of the TMDL, especially in the load allocation. The explicit MOS will be calculated as the difference between the maximum daily load, which is based on the water quality standard, and the wasteload allocation.

4.4 Calculation of the TMDL

The TMDL of phenol in Bernard Bayou and Industrial Seaway was calculated using the TMDL target of 0.058 mg/L by the 7Q10 flow of Bernard Bayou. The product of the TMDL target, the 7Q10 flow, and a conversion factor is the maximum daily load of phenol in lbs/day. In order to ensure that the water quality standard is maintained at all points in the waterbody, the 7Q10 at the upstream end of Bernard Bayou (segment 3) was used in the calculation of the TMDL. As described in Section 2.3, the estimated 7Q10 flow of Bernard Bayou is 1.29 cfs. Thus, the TMDL is (1.29 cfs*0.058mg/L*5.39) = 0.40 lbs of phenol/day. The MOS was then calculated as the difference between the TMDL and the WLA (0.40 lbs/day – 0.26 lbs/day) = 0.14 lbs/day. Because they are continuous waterbodies, Bernard Bayou (segment 3) and Industrial Seaway were considered one waterbody for the purposes of developing this TMDL, given in Table 4.1. The TMDL can be expressed according to the following equation:

TMDL = WLA + LA + MOS

Where:

WLA= NPDES Permitted Facilities
LA = Nonpoint Sources
MOS = Explicit Margin of Safety

Table 4.1. Calculation of the TMDL for Bernard Bayou (segment 3) and Industrial Seaway

Parameter	WLA (lbs/day)	LA (lbs/day)	MOS (lbs/day)	TMDL (lbs/day)
Phenol (lbs/day)	0.26	0.0	0.14	**0.40**

4.5 Seasonality

This TMDL ensures that the water quality standards for phenol will be maintained during all seasons. This is because the TMDL was calculated using the 7Q10 low-flow critical condition, which represents the worst-case condition. Low flows typically occur during the late summer and early fall in Mississippi, when temperatures are extremely warm and rainfall is at its lowest level.

5.0 CONCLUSION

MDEQ developed this TMDL in order to ensure attainment of water quality standards for phenol in Bernard Bayou (segment 3) and Industrial Seaway. The TMDL incorporated the phenol load from Cavenham Forest Industries, the only NPDES permitted phenol discharger in the watershed. No reductions in the permit limit for this facility will be necessary. However, due to lack of current sediment and water column monitoring data and information on potential nonpoint sources of phenol in the watershed, no phenol additional dischargers will be allowed in Bernard Bayou and Industrial Seaway without additional study.

5.1 Future Monitoring

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 will be focused on one of the basin groups. During the next monitoring phase in the Coastal Streams Basin, the watershed may receive additional monitoring to identify any changes or improvements in water quality.

5.2 Public Participation

This TMDL will be published for a 30-day public notice. During this time, the public will be notified by publication in the statewide newspaper and a newspaper in the Gulfport area. The public will be given an opportunity to review the TMDL and submit comments. At the end of the 30-day period, MDEQ will determine the level of interest in the TMDL and make a decision on the necessity of holding a public meeting. In addition, the manager of the Cavenham Forest Industries facility has been contacted regarding this TMDL and will be given the opportunity to provide comments on the TMDL during the public notice period.

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 Linda Burrell by phone, at (601) 961-5062, or by email, at Linda_Burrell@deq.state.ms.us.

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

DEFINITIONS

Assimilative capacity: The capacity of a body of water or soil-plant system to receive wastewater effluents or sludge without violating the provisions of the State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters and Water Quality regulations.

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

Chronic toxicity: Toxicity impact that lingers or continues for a relatively long period of time, often one-tenth of an organism's life span or longer. Chronic effects could include mortality, reduced growth, or reduced reproduction.

Critical Condition: Hydrologic and atmospheric conditions in which the pollutants causing impairment of a waterbody 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: Use specified in water quality standards for each waterbody or segment regardless of actual attainment.

Discharge monitoring report: Report of effluent characteristics submitted by a NPDES permitted facility.

Effluent: Treated wastewater flowing out of the treatment facilities.

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.

Impaired Waterbody: Any waterbody that does not attain water quality standards due to an individual pollutant, multiple pollutants, pollution, or an unknown cause of impairment.

Land Surface Runoff: Water that flows into the receiving stream after application by rainfall or irrigation. It is a transport method for nonpoint source pollution from the land surface to the receiving stream.

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 direct sources and land applied fecal coliform that enter a receiving waterbody.

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

Nonpoint Source: Pollution that is in 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 Mississippi Environmental Quality Permit Board pursuant to regulations adopted by the Mississippi Commission on Environmental Quality under Mississippi Code Annotated (as amended) §§ 49-17-17 and 49-17-29 for discharges into State waters.

Point Source: 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): A waste treatment facility owned and/or operated by a public body or a privately owned treatment works which accepts discharges which would otherwise be subject to Federal Pretreatment Requirements.

Total Maximum Daily Load or TMDL: The calculated maximum permissible pollutant loading to a waterbody 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 Standards: The criteria and requirements set forth in *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. Water quality standards are standards composed of designated present and future most beneficial uses (classification of waters), the numerical and narrative criteria applied to the specific water uses or classification, and the Mississippi antidegradation policy.

Water quality criteria: Elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports the present and future most beneficial uses.

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: The area of land draining into a stream at a given location.

ABBREVIATIONS

7Q10................................Seven-Day Average Low Stream Flow with a Ten-Year Occurrence Period

ATSDR...Agency for Toxic Substances and Disease Registry

CWA ....Clean Water Act

DMR..Discharge Monitoring Report

EPA .... Environmental Protection Agency

ETS...Environmental Tobacco Smoke

HUC ....Hydrologic Unit Code

LA.. Load Allocation

MARIS .... State of Mississippi Automated Information System

MDEQ .... Mississippi Department of Environmental Quality

MOS... Margin of Safety

ND..Non-Detectable

NPDES ....National Pollution Discharge Elimination System

SESD..Science and Ecosystem Support Division

USGS...United States Geological Survey

WLA...Waste Load Allocation

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APPENDIX A:

Bernard Bayou Low Flow Estimate

BERNARD BAYOU LOW FLOW ESTIMATE

Prepared by:

Environmental Group
Cavenham Forest Industries Inc.
Gulfport, Mississippi

December, 1988

BERNARD BAYOU LOW FLOW ESTIMATE

INTRODUCTION

An estimate of the 7-day average low flow with a recurrence interval of 10 years has been determined for Bernard Bayou. This estimate of 0.74 cubic feet per second (cfs) is for the drainage area immediately upstream of the Cavenham Forest Industries Inc., Gulfport, Mississippi site. This estimate was prepared as supplementary data for Cavenham's NPDES permit application as published data are not available for this stream.

Presented below is a summary of the methodology and reasoning required to produce the estimate. Appendix A contains data used in the calculations.

METHODOLOGY

Low flow characteristics of many Mississippi streams are provided in publications by the U.S. Geological Survey (ex. Tharpe, 1975). These flow characteristics, particularly the 7-day average flows with a 10-year recurrence (7Q10) are commonly used to predict mass loading capabilities of streams with NPDES discharges. Low flow characteristics at ungaged sites may be estimated by ratioing the drainage area of an adjacent site (with known characteristics) to that of the ungaged site, assuming a similar geology and topography. The method assumes that the average flow per square mile of drainage area during periods of low flow is the same at both sites.

GEOLOGY AND TOPOGRAPHY

Two distinct physiographic divisions are apparent in the Gulfport area (Smith, 1975). One is an area of low topographic relief (essentially level) referred to as the Gulf Coast Flatwoods. The other, characterized by rolling hills at somewhat higher elevations, is referred to as the Southern Lower Coastal Plain.

The Gulf Coast Flatwoods form an east-west trending belt along the southern portion of Harrison County, generally lying along and to the south of Interstate 10. The Pamlico sand (Figure 1) which underlies this area consists of marine and estuarine deposits ranging in thickness up to 75 feet and composed of gray and tan sand, with clay and silt present in some areas (Brown and others, 1944). These lowland areas consist of a series of wet, poorly drained depressions among somewhat higher and better drained areas. Streams in this area are generally only a few feet deep, with waters flowing through poorly developed channels. Drainage is generally restricted due to the character of the land and the absence of elevation. Turkey Creek drains much of the area south of the interstate and west of Highway 49 (Figure 1 and 2).

The Southern Lower Coastal Plain physiographic province (Smith, 1975) is located generally north of Interstate 10 and extends throughout much of Harrison County. The area is considerably higher in elevation than the Gulf Coast Flatwoods and in this upland area rolling hills and gently undulating topography are common. The Soils are typically well-drained on the broad ridgetops and moderately drained on low ridges. Soils underlying this area include terrace deposits of Pleistocene age, the Citronelle Formation, and the older Graham Ferry and Pascagoula formations. The terrace deposits and Citronelle Formation consist of sands and gravels with occasional thin beds of clays. The undifferentiated Graham Ferry and Pascagoula formations are composed of gray-green and blue-gray clays, silts and sands. Drainage is well developed in this area. The two largest basins are the Wolf and Biloxi River basins which drain much of the area (Figure 1 and 2).

BERNARD BAYOU DRAINAGE BASIN

Most of the Bernard Bayou drainage basin is located north of Interstate 10 and west of Highway 49. In this area, Bernard Bayou provides drainage for the Southern Lower Coastal Plain physiographic province. To the east of Highway 49, Bernard Bayou has been dredged to form an Industrial Seaway. Upstream of the Cavenham site, drainage comes from Bernard Bayou and Flat Branch. Downstream of the Industrial Seaway, Bernard Bayou flows into Big Lake, Back Bayou and finally into Mississippi Sound.

The drainage area upstream of Cavenham was determined to be 32 square miles by planimeter. The area includes the headwaters of Bernard Bayou and Flat Creek and is bounded by the Little Biloxi River to the north, Fritz Creek to the east, Turkey Creek to the south and Wolf Creek to the west.

Figure 2 depicts low flow characteristics for streams within Harrison County. In this figure the annual 7-day average low flow with a 10-year recurrence interval was divided by the drainage area upstream of the measurement. Low flow data for streams north of Interstate 10 range from 0.021 to 0.14 cfs/sq.mi., with an average of 0.065 cfs/sq.mi. Data for the single stream south of the Interstate 10, Turkey Creek, has a value of 0.0021 cfs/sq.mi.

For determining an estimate for Bernard Bayou available low flow data were compared for neighboring streams within the Southern Lower Coastal Plain physiographic province. These

...a Wolf River (0.14 cfs/sq.mi.) and Little Biloxi River (0.023 cfs/sq.mi.). Since Turkey Creek drains an area that is within the Gulf Coast Flatwoods physiographic province this data was not used for calculating the Bernard Bayou estimate. The more conservative of the other two values (0.023 cfs/sq.mi.) is used in the calculation presented below.

BERNARD BAYOU - LOW FLOW CHARACTERISTICS

The annual 7-day average low flow with a recurrence interval of 10 years for the drainage basin upstream of the Cavenham site is estimated to be 0.74 cfs. This estimate was calculated using the following equation:

BB 7Q10 = Area X LB 7Q10/sq.mi.

BB 7Q10 = 32 sq.mi. X 0.023 cfs/sq.mi.

BB 7Q10 = 0.74 cfs

where:

BB 7Q10 = 7Q10 of Bernard Bayou immediately upstream of Cavenham site.

LB 7Q10 = 7Q10 of Little Biloxi River.

Area = Total drainage area upstream of site (32 sq.mi.)

MEAN ANNUAL FLOW appears to be 5 to 10 times 7Q10, based on gage data in 1989 USGS Water Year Book.

3

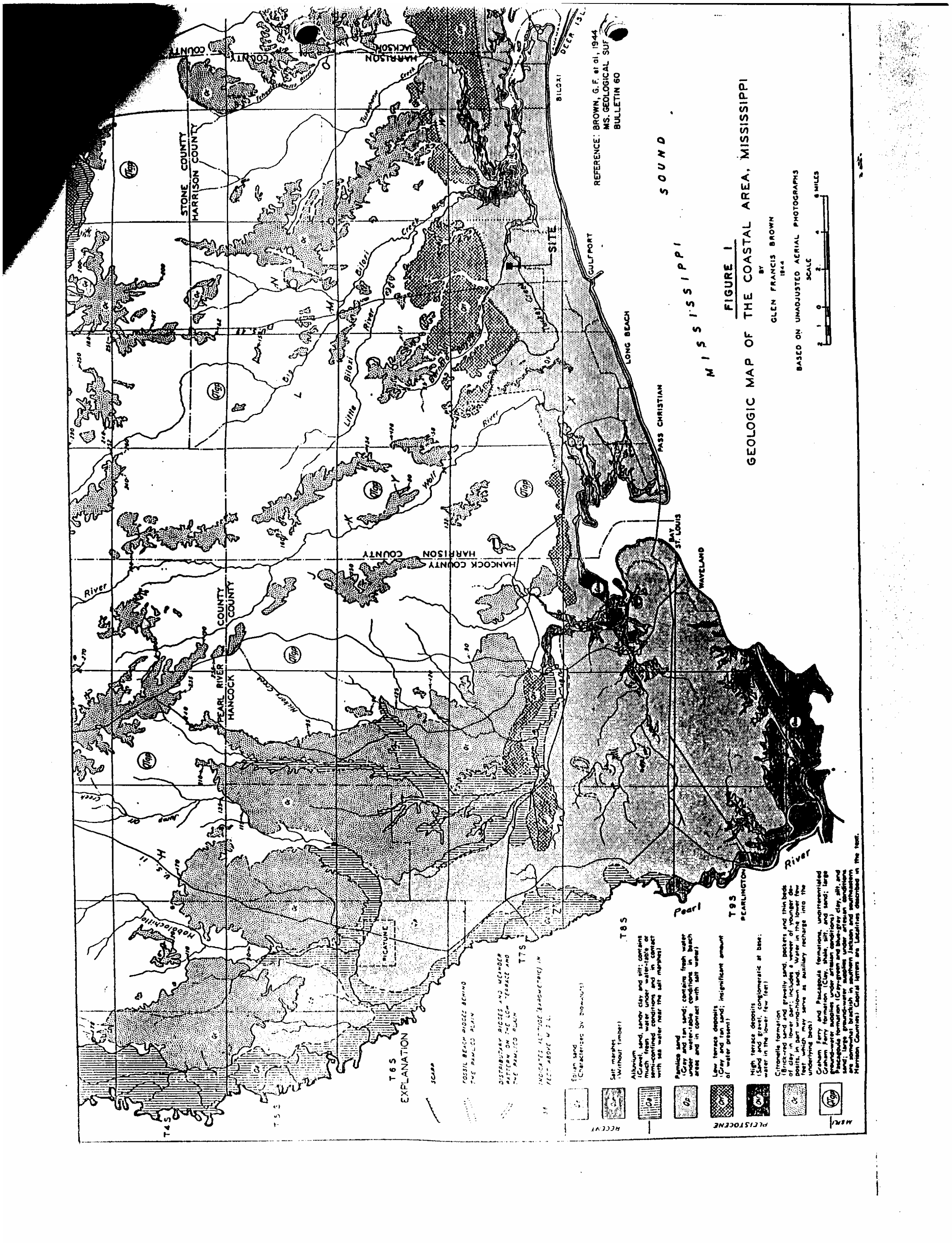
FIGURE I
GEOLOGIC MAP OF THE COASTAL AREA, MISSISSIPPI
BY
GLEN FRANCIS BROWN
1944
BASED ON UNADJUSTED AERIAL PHOTOGRAPHS
SCALE
REFERENCE: BROWN, G.F. et al, 1944
MS. GEOLOGICAL SURVEY
BULLETIN 60
MISSISSIPPI
SOUND
BILOXI
GULFPORT
SITE
LONG BEACH
PASS CHRISTIAN
BAY ST. LOUIS
WAVELAND
PEARLINGTON
STONE COUNTY
HARRISON COUNTY
HANCOCK COUNTY
PEARL RIVER COUNTY
JACKSON COUNTY
EXPLANATION

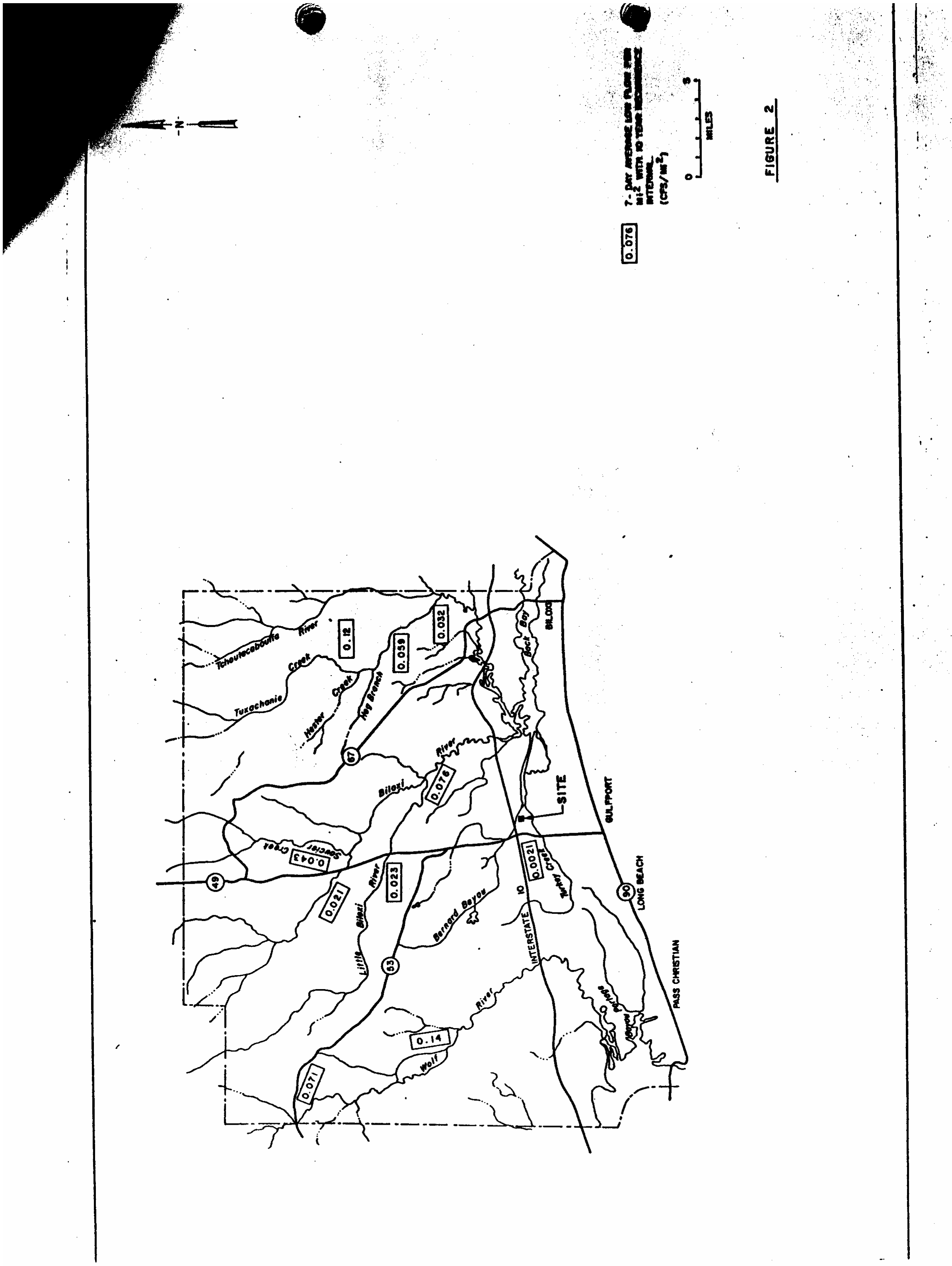
N
0.076
MILES
0
5
0.12
0.059
0.032
0.076
0.043
0.021
0.023
0.0021
0.14
0.071
Tchoutacabouffa River
Tuxachanie Creek
Hester Creek
Hog Branch
Biloxi River
Saucier Creek
Little Biloxi River
Bernard Bayou
Turkey Creek
Wolf River
Back Bay
SITE
BILOXI
GULFPORT
LONG BEACH
PASS CHRISTIAN
INTERSTATE 10
67
49
53
90

FIGURE 2

Table 1.--Continued

Station No. (prefix 0 omitted)	Station name and location within Mississippi unless otherwise indicated	Drainage area (sq mi)	Period of record (climatic years)	2-year 7-day low flow (cfs)	10-year 7-day low flow (cfs)	Minimum 7-day average flow of record (cfs) and year of occurrence
2-4780.00	Buckatunna Creek at Denham SE¼ sec.18, T.8 N., R.5 W., St. Stephens meridian, on county road, 0.3 mile east of Denham.	468	1940-49	39	25	23 (1942)
2-4785.00	Chickasawhay River at Leakesville SW¼ sec.12, T.2 N., R.6 W., St. Stephens meridian, on State Highway 63, 0.5 mile southeast of Leakesville.	[a]2,680	1940-67	383	226	166 (1964)
2-4790.00	Pascagoula River at Merrill SW¼ sec.18, T.1 S., R.7 W., St. Stephens meridian, on county road, 0.5 mile west of Merrill.	[a]6,600	1932-67	1,300	872	708 (1964)
2-4792.00	Flint Creek near Wiggins NW¼ SE¼ sec.27, T.2 S., R.11 W., St. Stephens meridian, on State Highway 26, 3.8 miles east of Wiggins.	24.8	1959-67	21	14	14.0 (1966)
2-4793.00	Red Creek at Vestry SW¼ SW¼ sec.34, T.3 S., R.8 W., St. Stephens meridian, on county road, 0.5 mile north of Vestry.	416	1960-67	160	103	90 (1964)
2-4795.00	Escatawpa River near Wilmer, Ala. NW¼ sec.19, T.2 S., R.4 W., St. Stephens meridian, on U.S. Highway 98, 4 miles northwest of Wilmer, Ala.	* 511 ~~506~~	1947-67	109	56	38 (1955)
	TCHOUTACABOUFFA RIVER BASIN					
2-4805.00	Tuxachanie Creek near Biloxi SE¼ NW¼ sec.20, T.6 S., R.9 W., St. Stephens meridian, on State Highway 15, 7 miles north of Biloxi.	92.4	1954-67	7.3	3.0	1.8 (1955)
	BILOXI RIVER BASIN					
2-4810.00	[redacted] R.11 W., St. Stephens meridian, on U.S. Highway 49, three-quarters of a mile east of Wortham.	98.3	1954-67	5.2	* 2.3 ~~2.1~~	1.3 (1964)
	WOLF RIVER BASIN					
2-4815.00	[redacted] NW¼ SW¼ sec.19, T.5 S., R.13 W., St. Stephens meridian, on State Highway 53, 15 miles northwest of Lyman.	253	1946-48 1966-67	46	18	39.4 (1966)
	PEARL RIVER BASIN					
2-4820.00	Pearl River at Edinburg [illegible] sec.13, T.11 N., R.[illegible] E., Choctaw meridian, on State Highway 16, at Edinburg.	[illegible]	1930-67	14	4.6	2.[illegible] (1[illegible])
2-4825.00	Lobutcha Creek near Carthage NE¼ sec.34, T.11 N., R.8 E., Choctaw meridian, on State Highway 16, 5 miles northeast of Carthage.	313	1940-60	14	7.9	6.3 (1944)
2-4830.00	Tuscolameta Creek at Walnut Grove NW¼ sec.34, T.9 N., R.8 E., Choctaw meridian, on State Highway 35, 0.4 mile southwest of Walnut Grove.	411	1941-67	10	4.5	3.3 (1955)

Revised by Mickey Plunkett, U.S.G.S, Jackson

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Table 2.--Continued

Station No. (prefix 0 omitted)	Station name and location within Mississippi unless otherwise indicated	Drainage area (sq mi)	Estimated 2-year 7-day low flow (cfs)	Estimated 10-year 7-day low flow (cfs)	Minimum observed instantaneous flow (cfs) and year of occurrence
2-4802.50	Bluff Creek near Vancleave SE¼ sec.6, T.6 S., R.7 W., St. Stephens meridian, on county road, 2.4 miles northwest of Vancleave.	50.7	9.8	5.2	5.66 (1952)
2-4802.60	Moungers Creek near Vancleave SE¼ sec.27, T.5 S., R.7 W., St. Stephens meridian, on county road, 3.4 miles north of Vancleave.	30.6	1.0	.4	.88 (1963)
2-4802.68	Four Mile Creek near Escatawpa NW¼ sec.32, T.6 S., R.5 W., St. Stephens meridian, on county road, 2.7 miles northeast of Escatawpa.	--	0	0	0 (1953-1955, 1960,1963)
	TCHOUTACABOUFFA RIVER BASIN				
2-4803.50	Tchoutacabouffa River near Biloxi SE¼ sec.33, T.5 S., R.9 W., St. Stephens meridian, on county road 10 miles north of Biloxi.	a57.5	7.0	3.4	9.54 (1965)
2-4804.00	Hester Creek near Biloxi SE¼ sec.2, T.6 S., R.10 W., St. Stephens meridian, on county road, 10 miles north of Biloxi.	10.5	2.5	1.3	1.60 (1953)
2-4804.50	Hog Branch near Biloxi NE¼ sec.11, T.6 S., R.10 W., St. Stephens meridian, on county road, 9 miles north of Biloxi.	8.5	1.0	.5	.59 (1953)
	BILOXI RIVER BASIN				
2-4810.50	Saucier Creek near Wortham NW¼ sec.33, T.5 S., R.11 W., St. Stephens meridian, on county road, 2.2 miles east of Wortham.	a40	3.7	1.7	3.07 (1954)
2-4811.00	Little Biloxi River near Lyman NE¼ sec.17, T.6 S., R.11 W., St. Stephens meridian, on U.S. Highway 49, 2 miles north of Lyman.	a71	5.4	2.4	3.41 (1953)
2-4811.30	Biloxi River near Lyman SE¼ SE¼ sec.25, T.6 S., R.11 W., St. Stephens meridian, on county road, 4.6 miles east of Lyman.	a250	37	19	c41.3 (1966)
	BAYOU BERNARD BASIN				
2-4812.50	Turkey Creek near Gulfport On line between secs. 21 and 28, T.7 S., R.11 W., St. Stephens meridian, on U.S. Highway 49, 2.5 miles north of Gulfport.	24.3	0.2	0.05	0.11 (1953)
	JORDAN RIVER BASIN				
2-4815.50	Hickory Creek near Kiln SE¼ sec.21, T.6 S., R.15 W., St. Stephens meridian, 8.5 miles northwest of Kiln.	a55	4.2	1.8	2.19 (1954)
2-4815.70	Catahoula Creek near Santa Rosa NW¼ sec.30, T.7 S., R.15 W., St. Stephens meridian, on county road, 7 miles southeast of Santa Rosa.	155	13	8.0	8.18 (1963)

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