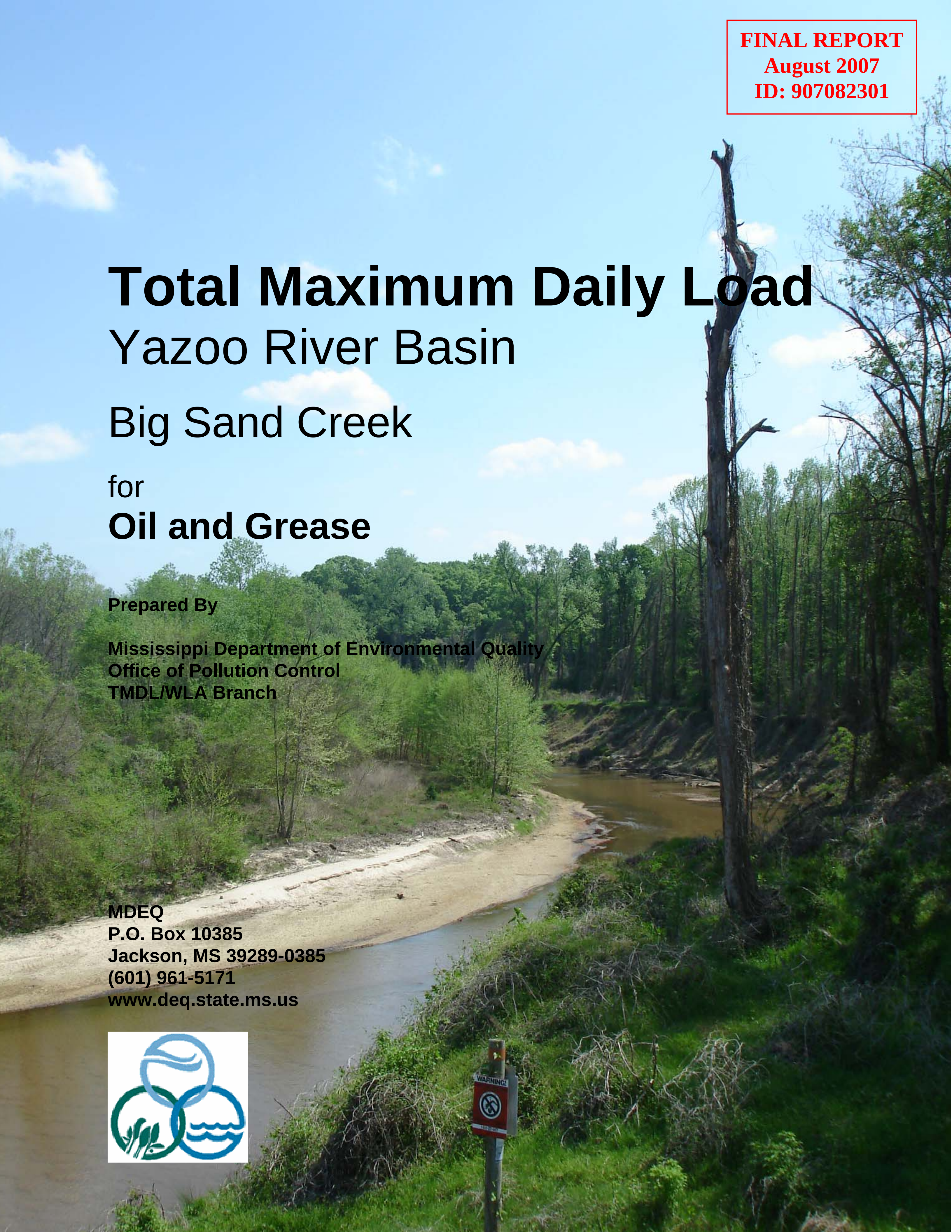

FINAL REPORT
August 2007
ID: 907082301

Total Maximum Daily Load

Yazoo River Basin

Big Sand Creek

for

Oil and Grease

Prepared By

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FOREWORD

This report contains one or more Total Maximum Daily Loads (TMDLs) for water body segments found on Mississippi's 1996 Section 303(d) List of Impaired Waterbodies. Because of the accelerated schedule required by the consent decree, many of these TMDLs have been prepared out of sequence with the State's rotating basin approach. The 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
mile^2	acre	640	acre	ft^2	43560
km^2	acre	247.1	days	seconds	86400
m^3	ft^3	35.3	meters	feet	3.28
ft^3	gallons	7.48	ft^3	gallons	7.48
ft^3	liters	28.3	hectares	acres	2.47
cfs	gal/min	448.8	miles	meters	1609.3
cfs	MGD	0.646	tonnes	tons	1.1
m^3	gallons	264.2	µg/l * cfs	gm/day	2.45
m^3	liters	1000	µg/l * MGD	gm/day	3.79

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	:	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

Table 1. Listing Information

ID	Name	County	Cause	Mon/Eval
MS352BE	Big Sand Creek	Carroll, Leflore	Oil and Grease	Evaluated
Near Bright Corner from Watershed 353 Boundary to the Yalobusha River through Big Sand Creek Cutoff				

Table 2. Water Quality Standard

Parameter	Beneficial use	Narrative Water Quality Criteria
Oil and Grease	Aquatic Life Support	Waters shall be free from materials attributable to municipal, industrial, agricultural, or other dischargers producing color, odor, taste, total suspended solids, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated uses.

Table 3. Total Maximum Daily Load Kg/Day MS352BE

Pollutant	WLA	LA	MOS	TMDL
Soluble Hydrocarbons	0.31	0.95	0.31	1.57
Dispersants	1.57	4.70	1.57	7.84
Kerosene	0.31	0.95	0.31	1.57
Fresh Crude	0.31	0.95	0.31	1.57

EXECUTIVE SUMMARY

Big Sand Creek is listed in the 2004 Section 303(d) List of Impaired Water Bodies for Oil and Grease on the evaluated portion of the list, or section B, (MDEQ, 2006). This TMDL addresses the segment of Big Sand Creek for Oil and Grease in USGS Hydrologic Unit Code (HUC) 08030205 in the Yazoo River Basin.

This TMDL is being completed for oil and grease. The *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* regulation does not include a numerical water quality standard for aquatic life protection due to oil and grease (MDEQ, 2003). The narrative standard for the protection of aquatic life is sufficient for justification of TMDL development, but does not provide a quantifiable TMDL target. The target for this TMDL is based on EPA's Gold Book (EPA, 1986).

There are no data available to indicate impairment existed in this stream for oil and grease. Therefore, in order to develop the TMDL, MDEQ is relying on the values for impairment to aquatic life from EPA's Gold Book (EPA, 1986) as the basis for TMDL development. The TMDL targets for this TMDL were selected from the Gold Book (EPA, 1986) from historical studies of impairment due to oil and grease. According to 40 CFR §130.2 (i), TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure. This TMDL is expressed as kilograms per day of various petroleum products that could be discharged into Big Sand Creek based on the 7Q10 flow.

It is expected that attainment of the TMDL will result in attainment of aquatic life support due to impairment from oil and grease.

Figure 1. Big Sand Creek Headwaters below Legion Lake

1.0 INTRODUCTION

1.1 Background

The identification of water bodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those water bodies are required by Section 303(d) of the Clean Water Act (CWA) 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 water bodies through the establishment of pollutant specific allowable loads. The pollutants of concern for this TMDL are oil and grease.

Big Sand Creek is listed in the 2006 Section 303(d) List of Impaired Water Bodies for Biological Impairment (monitored section A) and Oil and Grease (evaluated section B), (MDEQ, 2006). This TMDL addresses the listed segment of Big Sand Creek (MS352BE) for Oil and Grease.

Big Sand Creek flows from Legion Lake in Carroll County westward down out of the Yazoo Hills into the Mississippi Delta at Greenwood. The creek has an extensive levee system and other flood control structures in place to protect Greenwood, Mississippi as Big Sand Creek flows out of the Yazoo River Basin Hills.

Fig. 2 Big Sand Levee Corp Sign

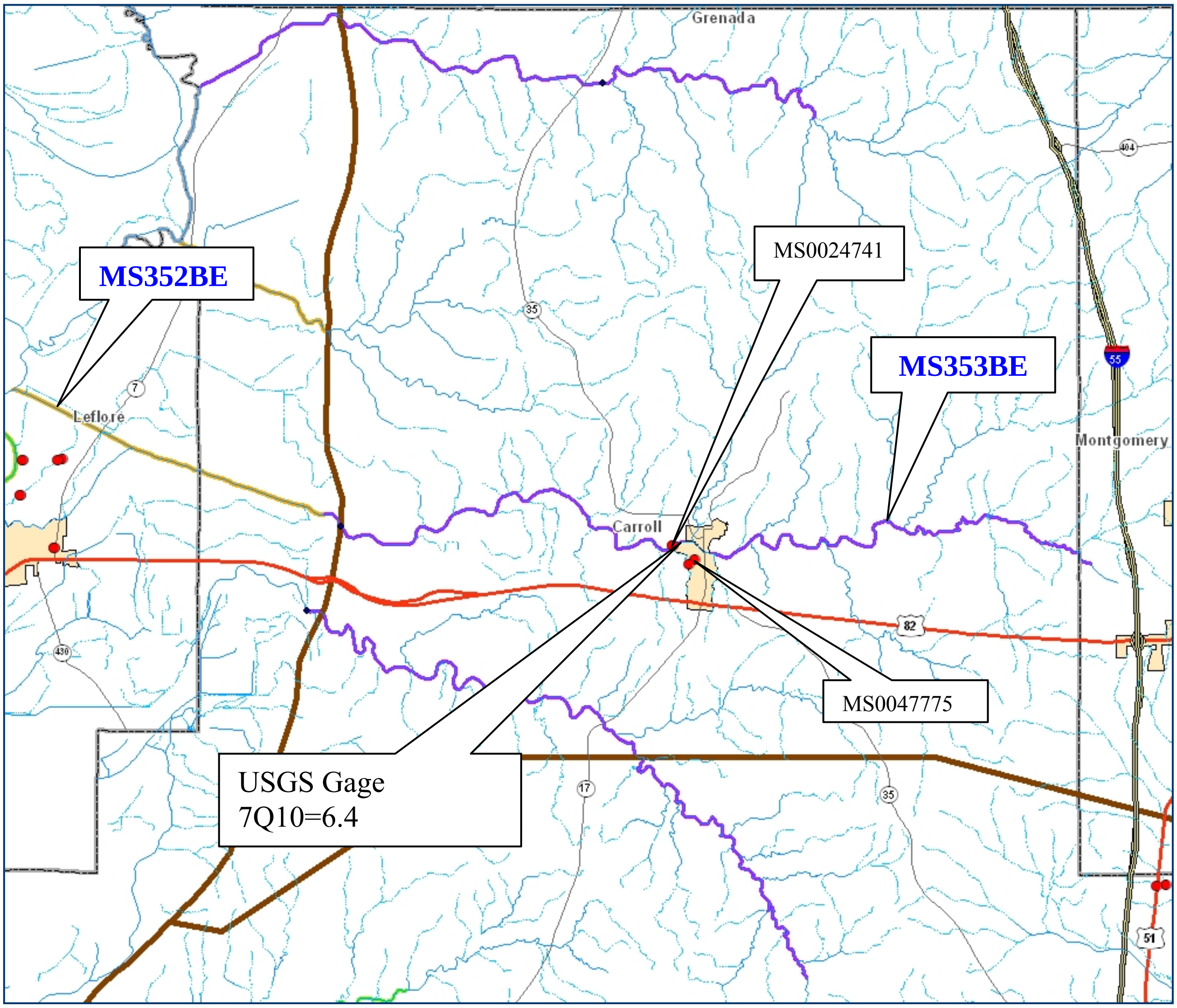
1.2 Applicable Water Body Segment Use

The water use classification for Big Sand Creek, as established by the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* regulation, is Fish and Wildlife Support (MDEQ, 2003). 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, which is defined as incidental contact with water including wading and occasional swimming.

1.3 Applicable Water Body Segment Standard

The *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* do not include a water quality standard applicable to aquatic life protection due to oil and grease (MDEQ, 2003). However, a narrative standard for the protection of aquatic life was interpreted to determine an applicable target for this TMDL. The narrative standard is that waters shall be free from materials attributable to municipal, industrial, agricultural, or other dischargers producing color, odor, taste, total suspended solids, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated uses.

Figure 3. Location of Big Sand Creek between Winona and Greenwood, Mississippi



2.0 TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

2.1 EPA's Gold Book Discussion on Oil and Grease

It has been estimated that between 5 to 10 million metric tons of oil enter the marine environment annually (Blumer, 1970). A major difficulty encountered in the setting of criteria for oil and grease is that these are not definitive chemical categories, but include thousands of organic compounds with varying physical, chemical, and toxicological properties. They may be volatile or nonvolatile, soluble or insoluble, persistent or easily degraded.

Field and laboratory evidence have demonstrated both acute lethal toxicity and long-term sub-lethal toxicity of oils to aquatic organisms. Events such as the Tampico Maru wreck of 1957 in Baja, California, (Diaz-Piferrer, 1962), and the No. 2 fuel oil spill in West Falmouth, Massachusetts, in 1969 (Hampson and Sanders, 1969), both of which caused immediate death to a wide variety of organisms, are illustrative of the lethal toxicity that may be attributed to oil pollution. Similarly, a gasoline spill in South Dakota in November 1969 (Bugbee and Walter, 1973) was reported to have caused immediate death to the majority of freshwater invertebrates and 2,500 fish, 30 percent of which were native species of trout. Because of the wide range of compounds included in the category of oil, it is impossible to establish meaningful 96-hour LC50 values for oil and grease without specifying the product involved. However, the most susceptible category of organisms, the marine larvae, appear to be intolerant of petroleum pollutants, particularly the water soluble compounds, at concentraction as low as 0.1 mg/l.

The long-term sub-lethal effects of oil pollution refer to interferences with cellular and physiological processes such as feeding and reproduction and do not lead to immediate death of the organism. Disruption of such behavior apparently can result from petroleum product concentrations as low as 10 to 100 µg/l.

Table [5] summarizes some of the sub-lethal toxicities for various petroleum pollutants and aquatic species. In addition to sub-lethal effects reported at the 10 to 100 µg/l, it has been shown that petroleum products can harm aquatic life at concentration a low as 1 µg/l. (Jacobson and Boylan, 1973).

Bioaccumulation of petroleum products presents two especially important public health problems: 1) the tainting of edible, aquatic species, and 2) the possibility of edible marine organisms incorporating the high boiling, carcinogenic polycyclic aromatics in their tissues. Nelson-Smith (1971) reported that 0.01 mg/l of crude oil caused tainting in oysters. Moore, et al. (1973) reported that concentrations as low as 1 to 10 µg/l could lead to tainting within very short periods of time. It has been shown that chemicals responsible for cancer in animals and man (such as 3, 4-benzopyrene) occur in crude oil (Blumer, 1970). It has also been shown that marine organisms are capable of incorporating potentially carcinogenic compounds into their body fat where the compounds remain unchanged (Blumer, 1970).

Oil pollutants may also be incorporated into sediments. There is evidence that once this occurs in the sediments below the aerobic surface layer, petroleum oil can remain unchanged and toxic for long periods, since its rate of bacterial degradation is slow. For example, Blumer (1970) reported that No. 2 fuel oil incorporated into the sediments after the West Falmouth spill persisted for over a year, and even began spreading in the form of oil-laden sediments to more distant areas that had remained unpolluted immediately after the spill. The persistence of un-weathered oil within the sediment could have a long-term effect on the structure of the benthic community or cause the demise of specific sensitive important species. Moore et al. (1973) reported concentration of 5 mg/l for the carcinogen 3, 4-benzopyrene in marine sediments.

Mironov (1967) reported that 0.01 mg/l oil produced deformed inactive flatfish larvae. Mironov (1970) also reported inhibitioin or delay of cellular division in algae by oil concentrations of 10^{-4} to 10^{-1} mg/l. Jacobson and Boylan (1973) reported a reduction in the chemo-tactic perception of food by the snail, *Nassarius* at kerosene concentrations of 0.001 to 0.004 mg/l. Bellen et al. (1972) reported decreased survival and fecundity in worms at concentrations of 0.01 to 10 mg/l of detergent.

In view of the problem of petroleum oil incorporation in the sediments, its persistence and chronic toxic potential, and the present lack of sufficient toxicity data to support specific criteria, concentrations of oils in sediments should not approach levels that cause deleterious effects to important species or the bottom community as a whole.

Petroleum and non-petroleum oils share some similar physical and chemical properties. Because they share common properties, they may cause similar harmful effects in the aquatic environment by forming a sheen, film, or discoloration on the surface of the water. Like petroleum oils, non-petroleum oils may occur at four levels of the aquatic environment: a) floating on the surface, b) emulsified in the water column, c) solubilized, and d) settled on the bottom as sludge. Analogous to the grease balls from vegetable oil and animal fats are the tar balls of petroleum origin which have been found in the marine environment or washed ashore on beaches.

Oils of any kind can cause a) drowning of waterfowl because of loss of buoyancy, exposure because of loss of insulating capacity of feathers, and starvation and vulnerability to predators because of lack of mobility; b) lethal effects on fish by coating epithelial surfaces of gills, thus preventing respiration; c) potential fish kills resulting from biochemical oxygen demand; d) asphyxiation of benthic life forms when floating masses become engaged with surface debris and settle on the bottom; and e) adverse aesthetic effects of fouled shorelines and beaches. These and other effects have been documented in the U.S. Department of Health, Education and Welfare report on Oil Spills Affecting the Minnesota and Mississippi Rivers and the 1975 Proceedings of the Joint Conference on Prevention and Control of Oil Spills.

Oils of animal or vegetable origin generally are chemically nontoxic to human or aquatic life; however, floating sheens of such oils result in deleterious environmental effects described in this criterion. Thus, it is recommended that surface waters shall be virtually free from floating non-petroleum oils of vegetable or animal origin. This same recommendation applies to floating oils of petroleum origin since they too may produce similar effects. (EPA, 1984)

Table 5. Summary of lethal toxicities of various petroleum products to aquatic organisms all figures are in mg/l (EPA, 1976)

Type Organism	Soluble Hydrocarbons	Dispersants	Kerosene	Fresh Crude	Gasoline	Diesel	Refinery Effluents	Waste Oil	Lubricants	Residuals
Marine Flora	10 – 650	1.2 – 313	0.1					10		
Finfish	5 – 50	1 – 10	550	85 – 1800	91	200 - 420		1700		2000 - 10000
Larvae and eggs	0.1 – 1	1 – 42	0.1 – 4	0.1 – 100				1 - 25		
Pelagic Crustacea	1 – 10	5 – 100	5 – 50	10 – 40				15 - 50		
Benthic Crustacea	1 – 10	2 – 100	0.5	.56						10000
Gastropods	10 – 100	5 – 2000								
Bivalves	5 – 500	0.5 – 100	3000 – 4000	1000 – 10000						
Other Benthic Invertebrates	1 – 10	5 – 100000	5 – 50	100 - 6100						1952 - 2417
Freshwater Finfish	10 - 4924	10	1000 – 150000	0.3 - 800	180	150 - 4000	39		3000 - 180000	
Freshwater Flora		200								

2.2 Selection of a TMDL Endpoint and Critical Condition

One of the major components of a TMDL is the establishment of target endpoints, which are used to evaluate the attainment of acceptable water quality. Target endpoints, therefore, represent the water quality goals that are to be achieved by meeting the load and wasteload allocations specified in the TMDL. The endpoints allow for a comparison between observed conditions and conditions that are expected to restore designated uses.

To establish targets for this TMDL, MDEQ selected the petroleum product along with the most protective organism type. The refinery effluents category was not selected because there is no refinery in this watershed. Waste Oil, Lubricants, and Residuals were also discounted for this TMDL. For Soluble Hydrocarbons the larvae and eggs limit of 0.1 mg/l was selected as a target. For Dispersants the Bivalves limit of 0.5 mg/l was selected. For Kerosene the larvae and eggs limit of 0.1 mg/l was selected. For Fresh Crude the larvae and eggs limit of 0.1 was selected. For Gasoline and Diesel the freshwater finfish limits of 180 mg/l and 150 mg/l were selected respectively but eventually discarded for this TMDL due to the lack of information on toxicity to larvae and eggs.

3.0 SOURCE ASSESSMENT and LOAD ESTIMATION

An important part of the TMDL analysis is the identification of individual sources, source categories, or source subcategories of oil and grease in the watershed and the amount of pollutant loading contributed by each of these sources. Under the CWA, sources are broadly classified as either point or nonpoint sources. Under 40 CFR §122.2, a point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. The National Pollutant Discharge Elimination System (NPDES) program regulates point source discharges. Point sources can be described by two broad categories: 1) NPDES regulated municipal and industrial wastewater treatment plants (WWTPs) and 2) NPDES regulated industrial activities, which include construction activities and municipal storm water discharges (Municipal Separate Storm Sewer Systems [MS4s]).

3.1 Assessment of Point Sources

There are two NPDES facilities in the Big Sand Creek Watershed, MS0024741 North Carrollton POTW, and MS0047775 Carroll Academy shown in figure 3. There are no MS4 permits within the watershed. Both facilities are located in Carrollton. Both facilities have current language in their permits that prohibit the discharge of toxic materials including oil and grease. In addition, due to the holding time in the lagoon at the POTW, MDEQ does not consider this a significant source of oil and grease pollution. There is no known record of violations and/or enforcement regarding these pollutants for these point sources.

3.2 Assessment of Nonpoint Sources

Nonpoint loading of oil and grease in a water body results from the transport of the material into receiving waters by the processes of storm water runoff, accidental spills, and improper disposal. Sources include:

- Agriculture
- Silviculture
- Construction sites
- Roads
- Urban areas

One major potential source has been removed. The railroad that is adjacent to Big Sand Creek is no longer in operation. Many of the crossings have been paved over, and the tracks are no longer clear. Diesel spills from engine operations, spills from derailed tanker cars, and accidental spills from train / auto collisions are no longer potential sources for oil and grease into Big Sand Creek.

3.3 TMDL Calculations

Due to lack of data for calibration it was determined that a modeling exercise to quantify the load from each source and estimate the total existing load would be ineffective. Instead the TMDL was calculated based on the 7Q10 flow for Big Sand Creek multiplied by the most protective limit for various petroleum products that will protect aquatic life.

3.4 Flow Estimate

The most reasonable continuous-record gaging station to estimate flow for this watershed is the South Fork Tillatoba Creek gage near Charleston, Mississippi, (07280340). The drainage area for that gage is 53.9 mi^2. A partial-record station exists on Big Sand Creek (07286700) at Carrollton, Mississippi. The drainage area for 07286700 is 74.1 mi^2.

The 7Q10 flow is estimated to be 6.4 ft^3/s at gage 07286700 in *Low-Flow and Flow-Duration Characteristics of Mississippi Streams* (USGS, 1991). The 7Q10 flow was selected instead of the annual average flow as a conservative assumption to be protective of aquatic life at the critical condition. The gage 07286700 is located in Carrollton, which is in the hills portion of the watershed. When the stream comes out of the hills and into the Delta, the USACOE has constructed a levee system to control flooding downstream. There are flow control structures for the tributaries in the Delta flood control system. At 7Q10 flow conditions, it is not anticipated that very much additional flow would be available at the mouth beyond the 6.4 ft^3/s available at Carrollton. Therefore, that flow is also being used for the TMDL calculations for the lower segment. This is another conservative assumption in this TMDL calculation.

4.0 ALLOCATION

The allocation for this TMDL involves a wasteload allocation (WLA) for permitted sources, a load allocation (LA) for unpermitted nonpoint sources, and a margin of safety (MOS), which should result in attainment of water quality standards in Big Sand Creek. According to 40 CFR §130.2 (i), TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure. This TMDL is expressed as the kilograms per day of various petroleum products that can be discharged into Big Sand Creek for this segment of the creek.

4.1 Wasteload Allocations

The oil and grease contribution from wastewater treatment facilities was considered negligible in the development of this TMDL. The flow contribution of the point sources is minimal in comparison to the overall flow in the watershed. While it is not anticipated that kerosene or fresh crude would come thru the treatment plant, there is a possibility that dispersants and soluble hydrocarbons could come thru the treatment plant. Therefore, this TMDL will allocate 20% of the loads to point sources.

4.2 Load Allocations

The LA developed for this TMDL is an estimation of the acceptable contribution of all nonpoint sources in the watershed. This TMDL will allocate 60% of the load to non point sources.

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. The MOS selected for this TMDL is 20%.

4.4 Calculation of the TMDL

To calculate these TMDLs, the 7Q10 flow was multiplied by the TMDL target for various petroleum products. The total TMDL was then divided into WLA, LA, and MOS based on percentage factors of 20, 60, 20 respectively. If the watershed achieves the limits in this TMDL, aquatic life should be protected. Table 6 shows the total TMDL for the segment and petroleum product selected.

Table 6 TMDLs for Petroleum Products in Big Sand Creek

Stream Segment	Petroleum Product	TMDL Target µg/l	Flow ft^3/s	TMDL Kg/Day	WLA Kg/Day	LA Kg/Day	MOS Kg/Day
MS352BE	Soluble Hydrocarbons	100	6.4	1.57	0.31	0.95	0.31
MS352BE	Dispersants	500	6.4	7.84	1.57	4.70	1.57
MS352BE	Kerosene	100	6.4	1.57	0.31	0.95	0.31
MS352BE	Fresh Crude	100	6.4	1.57	0.31	0.95	0.31

4.5 Seasonality

The use of the 7Q10 flow accounts for the most critical flow in the watershed for larvae and eggs, i.e., the least available dilution. Therefore, seasonality is addressed in this TMDL.

5.0 CONCLUSION

This TMDL was completed to comply with the Federal Consent Decree regarding the evaluated listing for oil and grease on the 1996 §303(d) List of Waterbodies. These TMDLs as presented will protect aquatic life in the watershed. The 7Q10 flow used was calculated near the middle of the watershed and is applicable to both segments of Big Sand Creek.

5.1 Future Activities

MDEQ will complete a stressor identification study for Big Sand Creek based on the data collected for the M-BISQ study. This identification will provide the primary probable stressors to the macroinvertebrate community in the stream. Additional monitoring may take place as future M-BISQ studies are completed. MDEQ is also working on a fish community biotic study for Delta streams. Big Sand Creek may be targeted in that study.

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 both a statewide and local newspaper. The public will be given an opportunity to review the TMDL and submit comments. MDEQ also distributes all TMDLs at the beginning of the public notice to those members of the public who have requested to be included on a TMDL mailing list. TMDL mailing list members may request to receive the TMDL reports through either, email or the postal service. Anyone wishing to become a member of the TMDL mailing list should contact Kay Whittington at (601)961-5279 or Kay_Whittington@deq.state.ms.us.

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. 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.

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