FINAL
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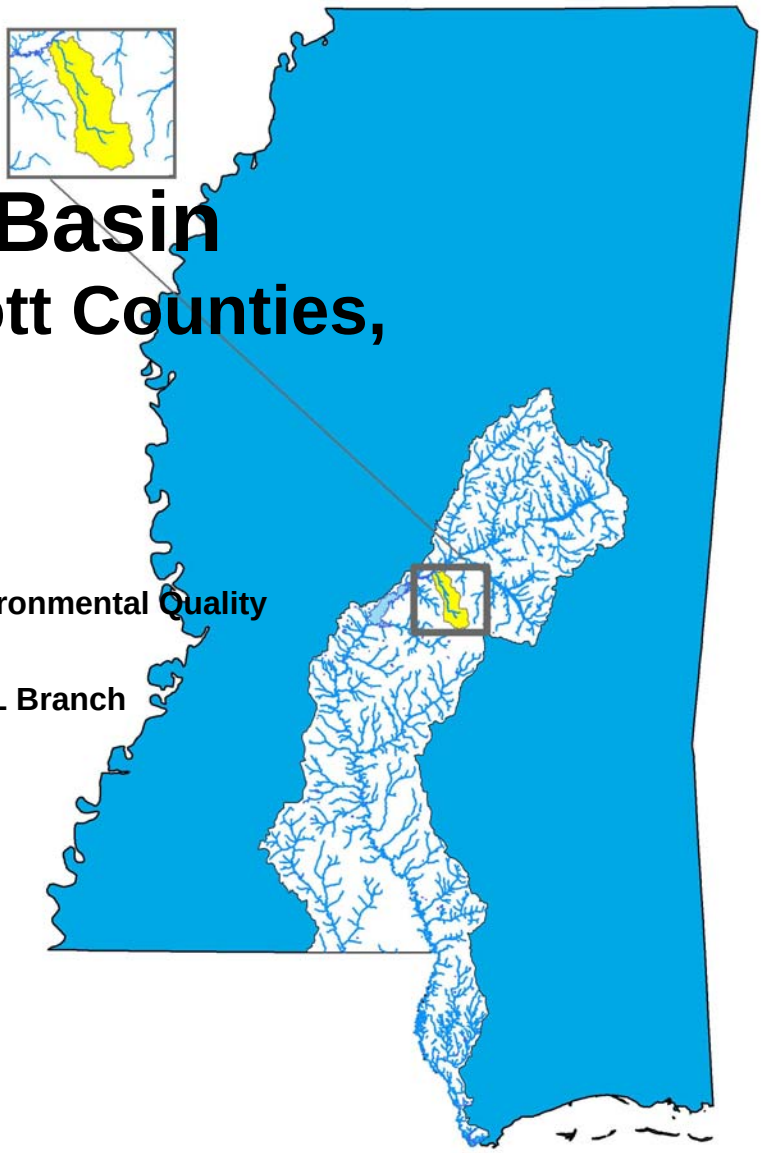
Total Maximum Daily Load

Nutrients and Organic Enrichment / Low DO For Coffee Bogue Creek



Pearl River Basin

Leake and Scott Counties, Mississippi

Prepared By

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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 water body segments found on Mississippi's 1996 Section 303(d) List of Impaired Water bodies. 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	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

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Table 1. Listing Information

Name	ID	County	HUC	Evaluated Cause
Coffee Bogue Creek	MS149E	Leake and Scott	03180002	Nutrients and Organic Enrichment / Low DO
Near Branch from Headwaters to the Pearl River				

Table 2. Water Quality Standards

Parameter	Beneficial use	Water Quality Criteria
Nutrients	Aquatic Life Support	Waters shall be free from materials attributable to municipal, industrial, agricultural, or other dischargers producing color, odor, taste, total suspended or dissolved solids, sediment, turbidity, 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.
Dissolved Oxygen	Aquatic Life Support	DO concentrations shall be maintained at a daily average of not less than 5.0 mg/l with an instantaneous minimum of not less than 4.0 mg/l. Natural conditions are defined as background water quality conditions due only to non-anthropogenic sources. The criteria herein apply specifically with regard to substances attributed to sources (discharges, nonpoint sources, or instream activities) as opposed to natural phenomena. Waters may naturally have characteristics outside the limits established by these criteria. Therefore, naturally occurring conditions that fail to meet criteria should not be interpreted as violations of these criteria.

Table 3. Total Maximum Daily Load for Coffee Bogue Creek

	WLA lbs/day	**LA lbs/day**	**MOS**	**TMDL lbs/day**
Total Nitrogen	**0**	**421.5**	**Implicit**	**421.5**
Total Phosphorous	**0**	**60.3**	**Implicit**	**60.3**
TBODu	**0**	**1203.9***	**Implicit**	**1203.9**

*Based on a background concentration of 2 mg/l at the annual average flow, loads will be lower for flows less than the annual average

EXECUTIVE SUMMARY

This TMDL has been developed for Coffee Bogue Creek which was placed on the Mississippi 2008 Section 303(d) List of Impaired Water Bodies. Coffee Bogue Creek was listed due to biological impairment. A stressor identification report indicated that organic enrichment/low dissolved oxygen, nutrients, and sediment were the primary probable stressors for the stream. Sediment will be addressed in a separate TMDL report. This TMDL will provide an estimate of the total biochemical oxygen demand (TBODu), total nitrogen (TN), and total phosphorus (TP).

Mississippi does not have water quality standards for allowable nutrient concentrations. MDEQ currently has a Nutrient Task Force (NTF) working on the development of criteria for nutrients. An annual concentration of 0.7 mg/l is an applicable target for TN and 0.10 mg/l for TP for water bodies located in ecoregion 65. MDEQ is presenting these preliminary target values for TMDL development which are subject to revision after the development of numeric nutrient criteria.

The Coffee Bogue Creek Watershed is located in HUC 03180002. The listed portion of Coffee Bogue Creek is near Branch from headwaters to the Pearl River. The location of the watershed for the listed segment is shown in Figure 1.

The Coffee Bogue Creek Watershed evaluation indicated that the impairment is due to phosphorus from nonpoint sources. The limited nutrient data and estimated existing ecoregion concentrations indicate reductions of phosphorus can be accomplished with installation of best management practices.

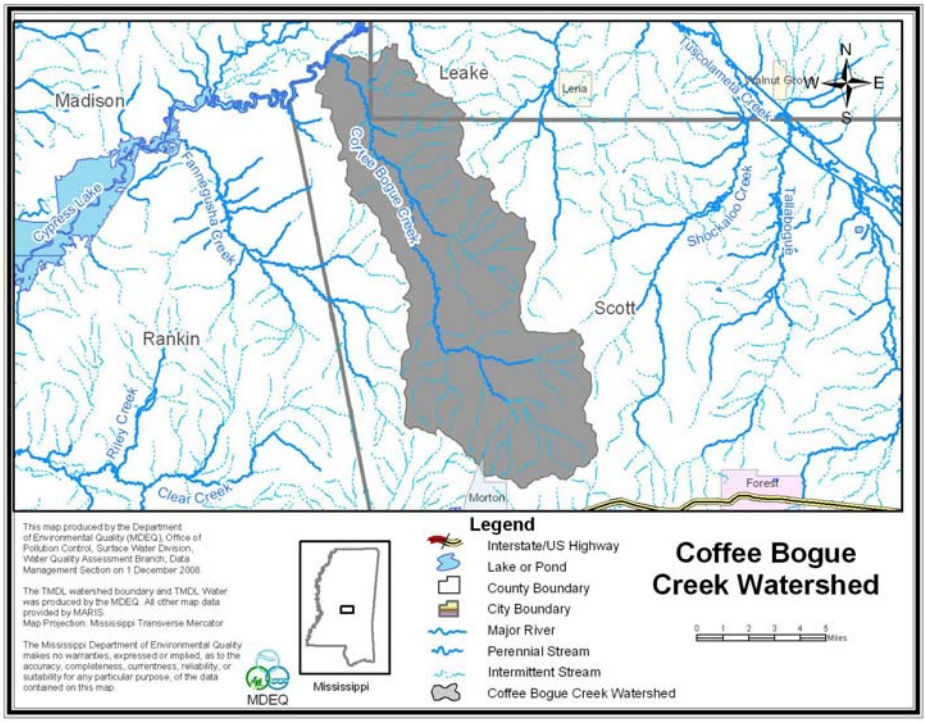


Figure 1. Coffee Bogue Creek

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 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. This TMDL has been developed for the 2008 §303(d) listed segment shown in Figure 2.

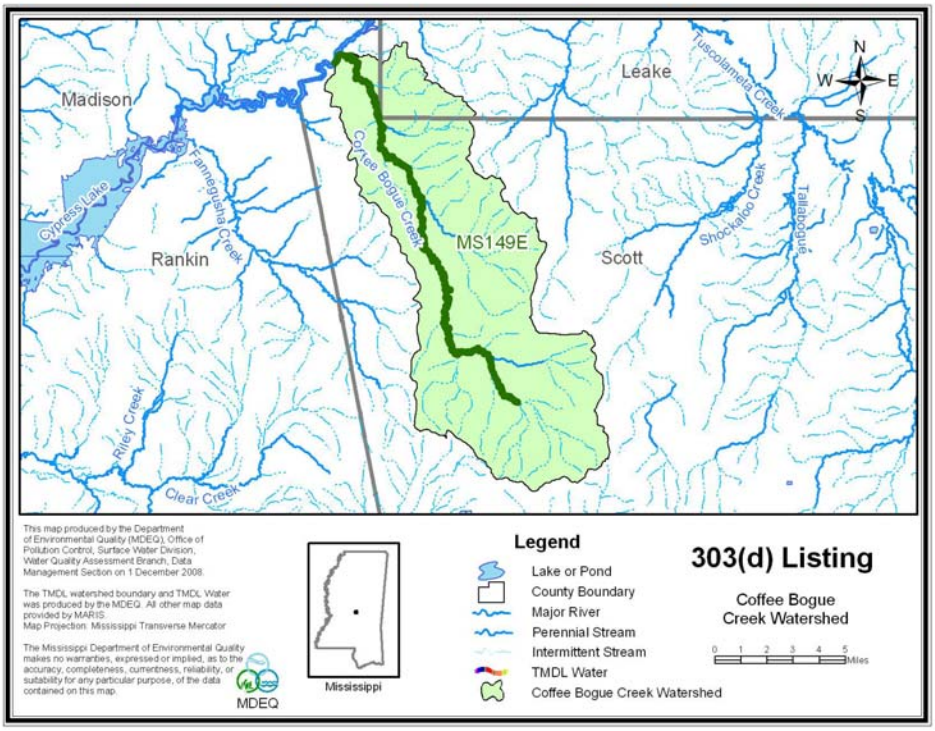


Figure 2. Coffee Bogue Creek §303(d) Listed Segment

1.2 Listing History

The impaired segment was originally listed as an evaluated segment. In 2001, Coffee Bogue Creek was monitored and found to be biologically impaired due to organic enrichment and nutrients. A stressor identification report was completed by MDEQ in 2008 and details the findings of the creek.

There are no state criteria in Mississippi for nutrients. These criteria are currently being developed by the Mississippi Nutrient Task Force in coordination with EPA Region 4. MDEQ proposed a work plan for nutrient criteria development that has been mutually agreed upon with EPA Region 4 and is on schedule according to the approved timeline for development of nutrient criteria (MDEQ, 2007).

1.3 Applicable Water Body Segment Use

The water use classifications are established by the State of Mississippi in the document *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2007). The designated beneficial use for the listed segments is Fish and Wildlife.

1.4 Applicable Water Body Segment Standards

The water quality standard applicable to the use of the water body and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2007). Mississippi's current standards contain a narrative criteria that can be applied to nutrients which states "*Waters shall be free from materials attributable to municipal, industrial, agricultural, or other discharges producing color, odor, taste, total suspended or dissolved solids, sediment, turbidity, 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 use* (MDEQ, 2007)."

The standard for dissolved oxygen states, "DO concentrations shall be maintained at a daily average of not less than 5.0 mg/l with an instantaneous minimum of not less than 4.0 mg/l." In addition, the State water quality standard regulations include a natural condition clause which will be used to determine the appropriate DO for Coffee Bogue Creek under critical conditions. Natural conditions are defined as background water quality conditions due only to non-anthropogenic sources. The criteria herein apply specifically with regard to substances attributed to sources (discharges, nonpoint sources, or instream activities) as opposed to natural phenomena. Waters may naturally have characteristics outside the limits established by these criteria. Therefore, naturally occurring conditions that fail to meet criteria should not be interpreted as violations of these criteria.

1.5 Nutrient Target Development

In the 1999 Protocol for Developing Nutrient TMDLs, EPA suggests several methods for the development of numeric criteria for nutrients (USEPA, 1999). In accordance with the 1999 Protocol, "*The target value for the chosen indicator can be based on: comparison to similar but unimpaired waters; user surveys; empirical data summarized in classification systems; literature values; or professional judgment*."

For this TMDL, MDEQ is presenting preliminary targets for TN and TP. An annual concentration 0.7 mg/l is an applicable target for TN and 0.1 mg/l for TP for water bodies located in ecoregion 65. However, MDEQ is presenting these preliminary target values for TMDL development which are subject to revision after the development of nutrient criteria, when the work of the NTF is complete.

WATER BODY ASSESSMENT

2.1 Water Quality Data

The impaired segment was monitored and found to be biologically impaired due to organic enrichment and nutrients. Data exist for IBI Site 311. Based upon this completed stressor identification report, the strength of evidence analysis showed low DO to be a primary probable cause of impairment. Some biological metrics also indicated altered food sources (nutrient enrichment). Physical/chemical data from M-BISQ and 2008 recon indicate low DO and DO% saturation measurements during the non-critical season. Nutrients were slightly elevated over the Least Disturbed (LD)/Site Specific Comparators (SSC) with COD and TOC much higher than the LD reference site and all SSC during M-BISQ. No historical data is available. A few potential sources exist in the watershed for this cause including limited reaeration due to hydrology, high % silt/clay sediment conducive to sediment oxygen demand (SOD), some agriculture (cattle) with confirmation of livestock utilizing the Mississippi Watershed Characterization & Ranking Tool (MWCRT), scattered unsewered residential, and moderate potential for clearcutting. No point sources are present and only minimal urban is noted.

2.2 Assessment of Point Sources

There are no point sources in the watershed.

2.3 Assessment of Non-Point Sources

Non-point loading of nutrients and organic material in a water body results from the transport of the pollutants into receiving waters by overland surface runoff, groundwater infiltration, and atmospheric deposition. The two primary nutrients of concern are nitrogen and phosphorus. Total nitrogen is a combination of many forms of nitrogen found in the environment. Inorganic nitrogen can be transported in particulate and dissolved phases in surface runoff. Dissolved inorganic nitrogen can be transported in groundwater and may enter a water body from groundwater infiltration. Finally, atmospheric gaseous nitrogen may enter a water body from atmospheric deposition.

Unlike nitrogen, phosphorus is primarily transported in surface runoff when it has been sorbed by eroding sediment. Phosphorus may also be associated with fine-grained particulate matter in the atmosphere and can enter streams as a result of dry fallout and rainfall (USEPA, 1999). However, phosphorus is typically not readily available from the atmosphere or the natural water supply (Davis and Cornwell, 1988). As a result, phosphorus is typically the limiting nutrient in most non-point source dominated rivers and streams, with the exception of watersheds which are dominated by agriculture and have high concentrations of phosphorus contained in the surface runoff due to fertilizers and animal excrement or watersheds with naturally occurring soils which are rich in phosphorus (Thomann and Mueller, 1987).

Watersheds with a large number of failing septic tanks may also deliver significant loadings of phosphorus to a water body. All domestic wastewater contains phosphorus which comes from humans and the use of phosphate containing detergents. Table 4 presents the estimated loads

from various land use types in the Pearl Basin based on information from USDA ARS Sedimentation Laboratory. (Shields, et. al., 2008)

The watershed contains mainly forest land but also has different landuse types, including urban, water, and wetlands. The land use information for the watershed is based on the National Land Cover Database (NLCD). Forest is the dominant landuse within this watershed. The landuse distribution for the Coffee Bogue Creek Watershed is shown in Table 4 and Figure 3. By multiplying the landuse category size by the estimated nutrient load, the watershed specific estimate can be calculated. Table 4 presents the estimated loads, the target loads, and the reductions needed to meet the TMDLs.

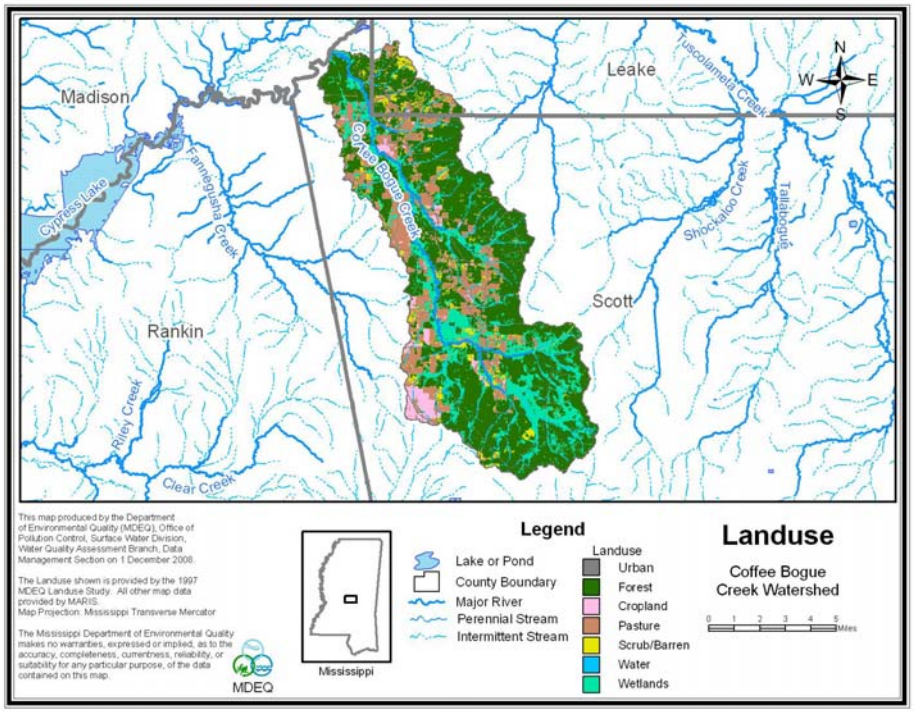
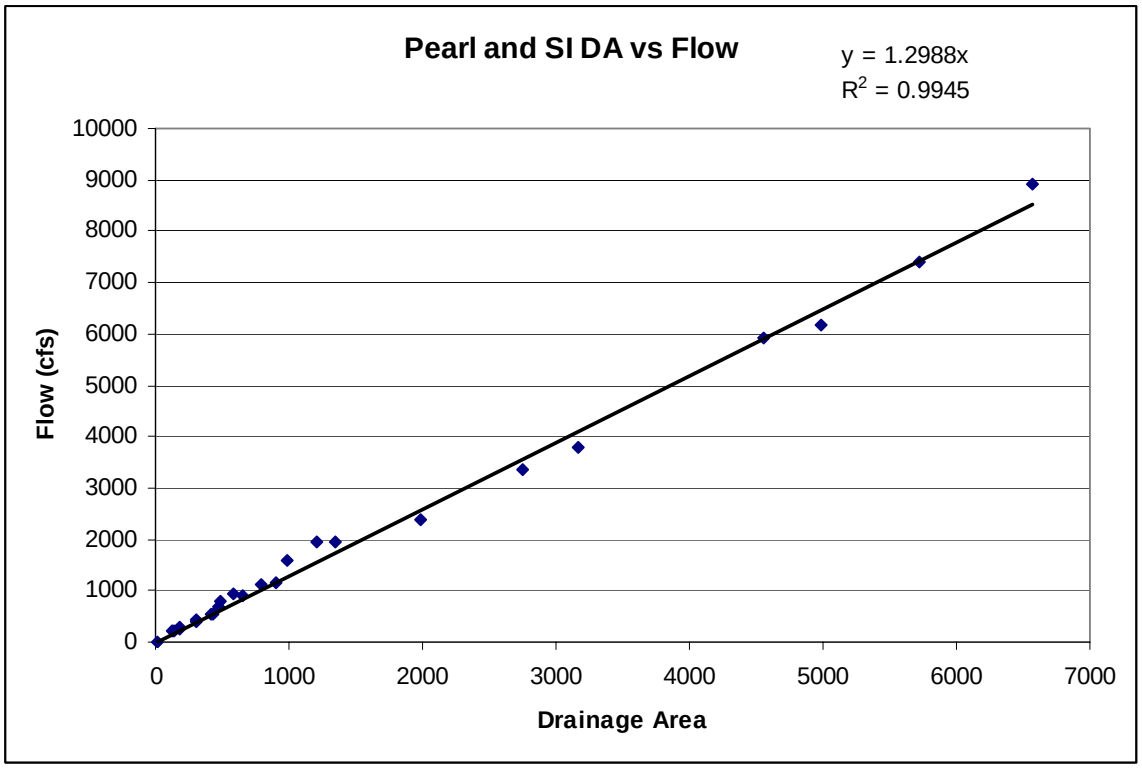


Figure 3. Coffee Bogue Creek Watershed Landuse

2.4 Estimated Existing Load for Total Nitrogen and Total Phosphorus

The average annual flow in the watershed was calculated by utilizing the flow vs. watershed area graph shown in Figure 4 below. All available gages were compared to the watershed size. A very strong correlation between flow and watershed size was developed for the Pearl and South Independent Streams Basins. The equation for the line that best fits the data was then used to estimate the annual average flow for the Coffee Bogue Creek watershed. The TMDL target TN and TP loads were then calculated, using Equation 1 and the results are shown in Table 4.

Figure 4. Pearl and South Independent Drainage Area to Flow Comparison



Nutrient Load (lb/day) = Flow (cfs) * 5.394 (conversion factor)* Nutrient Concentration (mg/L) (Equation 1)

Table 6. TMDL Calculations and Watershed Sizes

Water body	**Coffee Bogue Creek**		**Water**	**Urban**	**Scrub/Barren**	**Forest**	**Pasture/Grass**	**Cropland**	**Wetland**	**Total**	
		Acres	238.2	1858.8	2473	29552	8477.0	1651.1	10756.8	55006.9	
Land Use	**TN kg/mile2**	Percent	0.4%	3.4%	4.5%	53.7%	15.4%	3.0%	19.6%	100.0%	
Forest	111.3	Miles^2 in watershed	0.4	2.9	3.9	46.2	13.2	2.6	16.8	85.9	
Pasture	777.2	Flow in cfs based on area	111.6	cfs							
Cropland	5179.9										
Urban	296.4	TN Load kg/mi^2 annual avg	257.4	296.4	111.3	111.3	777.2	5179.9	265.2		
Water	257.4	TP Load kg/mi^2 annual avg	257.4	3.1	62.1	62.1	777.2	2589.9	265.2		
Wetland	265.2										
aquaculture	111.3	TN Load kg/day	0.3	2.4	1.2	14.1	28.2	36.6	12.2	94.9	kg/day
		TP Load kg/day	0.3	0.0	0.7	7.9	28.2	18.3	12.2	67.5	kg/day
Land Use	**TP kg/mile2**										
Forest	62.1	TN target concentration	0.7	mg/l							
Pasture	777.2	TP target concentration	0.1	mg/l							
Cropland	2589.9										
Urban	3.1	TN estimated concentration	0.35	mg/l							
Water	257.4	TP estimated concentration	0.25	mg/l							
Wetland	265.2										
aquaculture	62.1	TN target load	421.5	lbs/day							
		TP target load	60.3	lbs/day							
		TBODu target load	1203.9	lbs/day							
		TN estimated load per day	209.2	lbs/day							
		TP estimated load per day	148.9	lbs/day							
		TN reduction needed	*NA*								
		TP reduction needed	59.6%								
		TBODu reduction needed	*NA*								

The land use calculations are based on 2004 data. The nutrient estimates are based on USDA ARS. The TMDL targets are based on EPA guidance for calculation of targets when considering all available data.

ALLOCATION

3.1 Wasteload Allocation

There are no point sources in the watershed. Future permits will be considered in accordance with Mississippi's *Wastewater Regulations for National Pollutant Discharge Elimination System (NPDES) Permits, Underground Injection Control (UIC) Permits, State Permits, Water Quality Based Effluent Limitations and Water Quality Certification*(1994).

3.2 Load Allocation

Best management practices (BMPs) should be encouraged in the watersheds to reduce potential TBODu, TN, and TP loads from non-point sources. The LA for TBODu, TN, and TP was calculated by subtracting the WLA from the TMDL. For land disturbing activities related to silvaculture, construction, and agriculture, it is recommended that practices, as outlined in "Mississippi's BMPs: Best Management Practices for Forestry in Mississippi" (MFC, 2000), "Planning and Design Manual for the Control of Erosion, Sediment, and Stormwater" (MDEQ, et. al, 1994), and "Field Office Technical Guide" (NRCS, 2000), be followed, respectively.

3.3 Incorporation of a Margin of Safety

The margin of safety is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving water body. The two types of MOS development are to implicitly incorporate the MOS using conservative model assumptions or to explicitly specify a portion of the total TMDL as the MOS. The MOS selected for this model is implicit.

3.4 Calculation of the TMDL

Equation 1 was used to calculate the TMDL for TP and TN. The target concentration was used with the average flow for the watershed to determine the nutrient TMDLs. The TBODu portion of the TMDL was calculated by setting the background TBODu concentration to 2.0 mg/l and using Equation 1 to find the load. Therefore, the TBODu LA is based on a background concentration of 2 mg/l at the annual average flow. However, the TBODu LA loads will be lower for flows less than the annual average. The allocations in the TMDL are established to attain the applicable water quality standards.

Table 5. TMDL Loads

	WLA lbs/day	LA lbs/day	MOS	TMDL lbs/day
Total Nitrogen	**0**	**421.5**	**Implicit**	**421.5**
Total Phosphorous	**0**	**60.3**	**Implicit**	**60.3**
TBODu	**0**	**1203.9**	**Implicit**	**1203.9**

The nutrient TMDL loads were then compared to the estimated existing loads previously calculated. A 59.6% reduction in TP loading is recommended. Best management practices are encouraged in this watershed to reduce the nonpoint nutrient loads.

3.5 Seasonality and Critical Condition

This TMDL accounts for seasonal variability by requiring allocations that ensure year-round protection of water quality standards, including during critical conditions.

CONCLUSION

Nutrients were addressed through an estimate of a preliminary total phosphorous concentration target and a preliminary total nitrogen concentration target. Based on the estimated existing and target total phosphorous concentrations, this TMDL recommends a 59.6% reduction of the nonpoint phosphorous loads entering these water bodies to meet the preliminary target of 0.10 mg/l. The implementation of BMP activities should reduce the nutrient load entering the creek. This will provide improved water quality for organic enrichment and the support of aquatic life in the water bodies, and will result in the attainment of the applicable water quality standards.

4.1 Next Steps

MDEQ's Basin Management Approach and Nonpoint Source Program emphasize restoration of impaired waters with developed TMDLs. During the watershed prioritization process to be conducted by the Pearl River Basin Team, this TMDL will be considered as a basis for implementing possible restoration projects. The basin team is made up of state and federal resource agencies and stakeholder organizations and provides the opportunity for these entities to work with local stakeholders to achieve quantifiable improvements in water quality. Together, basin team members work to understand water quality conditions, determine causes and sources of problems, prioritize watersheds for potential water quality restoration and protection activities, and identify collaboration and leveraging opportunities. The Basin Management Approach and the Nonpoint Source Program work together to facilitate and support these activities.

The Nonpoint Source Program provides financial incentives to eligible parties to implement appropriate restoration and protection projects through the Clean Water Act's Section 319 Nonpoint Source (NPS) Grant Program. This program makes available around $1.6M each grant year for restoration and protections efforts by providing a 60% cost share for eligible projects.

Mississippi Soil and Water Conservation Commission (MSWCC) is the lead agency responsible for abatement of agricultural NPS pollution through training, promotion, and installation of BMPs on agricultural lands. USDA Natural Resource Conservation Service (NRCS) provides technical assistance to MSWCC through its conservation districts located in each county. NRCS assists animal producers in developing nutrient management plans and grazing management plans. MDEQ, MSWCC, NRCS, and other governmental and nongovernmental organizations work closely together to reduce agricultural runoff through the Section 319 NPS Program.

Mississippi Forestry Commission (MFC), in cooperation with the Mississippi Forestry Association (MFA) and Mississippi State University (MSU), have taken a leadership role in the development and promotion of the forestry industry Best Management Practices (BMPs) in Mississippi. MDEQ is designated as the lead agency for implementing an urban polluted runoff control program through its Stormwater Program. Through this program, MDEQ regulates most construction activities. Mississippi Department of Transportation (MDOT) is responsible for implementation of erosion and sediment control practices on highway construction.

Due to this TMDL, projects within this watershed will receive a higher score and ranking for funding through the basin team process and Nonpoint Source Program described above.

4.2 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. The public will be given an opportunity to review the TMDLs 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. Anyone wishing to become a member of the TMDL mailing list should contact Kay Whittington at Kay_Whittington@deq.state.ms.us.

All comments should be directed to Kay_Whittington@deq.state.ms.us or Kay Whittington, MDEQ, PO Box 2261, Jackson, MS 39225. All comments received during the public notice period and at any public hearings become a part of the record of this TMDL and will be considered in the submission of this TMDL to EPA Region 4 for final approval.

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