FINAL REPORT
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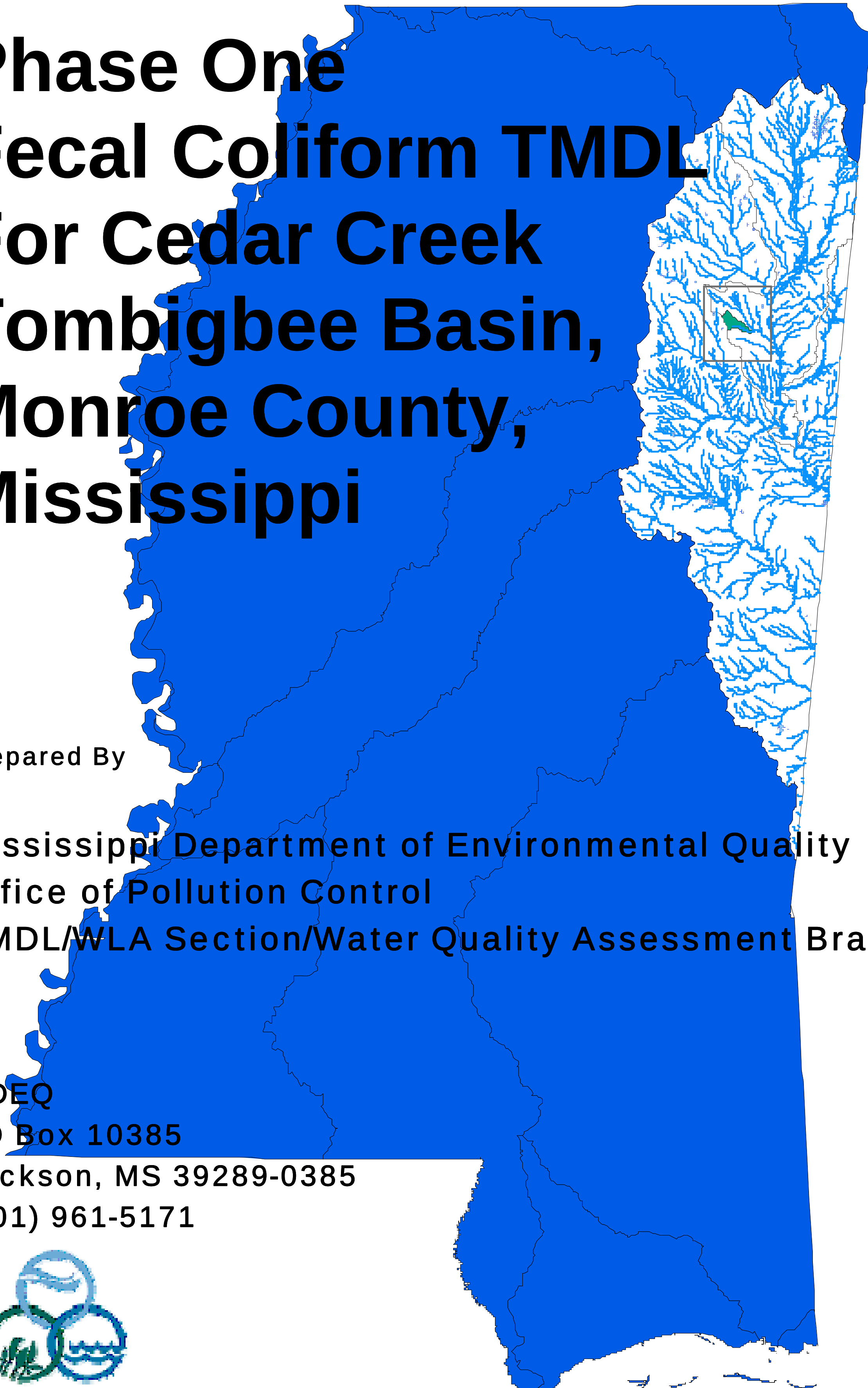

Phase One Fecal Coliform TMDL For Cedar Creek Tombigbee Basin, Monroe County, Mississippi

Prepared By

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MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY

FOREWORD

This report has been prepared in accordance with the schedule contained within the federal consent decree dated December 22, 1998. The report contains one or more Total Maximum Daily Loads (TMDLs) for waterbody segments found on Mississippi's 1996 Section 303(d) List of Impaired Waterbodies. 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.

Prefixes for fractions and multiples of SI units

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

Conversion Factors

To convert from	To	Multiply by	To Convert from	To	Multiply by
Acres	Sq. miles	0.0015625	Days	Seconds	86400
Cubic feet	Cu. Meter	0.028316847	Feet	Meters	0.3048
Cubic feet	Gallons	7.4805195	Gallons	Cu feet	0.133680555
Cubic feet	Liters	28.316847	Hectares	Acres	2.4710538
cfs	Gal/min	448.83117	Miles	Meters	1609.344
cfs	MGD	.6463168	Mg/l	ppm	1
Cubic meters	Gallons	264.17205	μg/l * cfs	Gm/day	2.45

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EVALUATED SEGMENT IDENTIFICATION

Name:	Cedar Creek - DA
Waterbody ID:	MS009MM
Location:	Drainage Area near Egypt
County:	Monroe and Chickasaw Counties, Mississippi
USGS HUC Code:	03160101
Use Impairment:	Secondary Contact
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
NPDES Permits:	There are no NPDES Permits issued for facilities that potentially discharge fecal coliform in the watershed (Table 3.1).
Standards Variance:	None
Pollutant Standard:	For the months May through October, fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml. For the months November through April, fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 4000 per 100 ml
Waste Load Allocation:	0.00E+12 counts per 30 day critical period (The TMDL requires all dischargers to meet water quality standards for disinfection.)
Load Allocation:	2.49E+12 counts per 30 day critical period
Margin of Safety:	0.28E+12 counts per 30 day critical period
Total Maximum Daily Load (TMDL):	2.77E+12 counts per 30 day critical period The TMDL is a combination of the direct input of fecal coliform from NPDES Permitted dischargers and nonpoint sources due to failing septic tanks, other direct inputs, and land surface fecal coliform application rates.

EXECUTIVE SUMMARY

A segment of Cedar Creek has been placed on the Mississippi 1998 Section 303(d) List of Waterbodies as an evaluated waterbody segment, due to fecal coliform bacteria. The applicable state standard specifies that for the summer months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 200 colonies per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml. For the winter months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 2000 colonies per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 4000 per 100 ml.

Cedar Creek flows in an eastern direction from its headwaters near Egypt, Mississippi to the confluence with Matubby Creek. This TMDL has been developed for one listed section of Cedar Creek.

Fecal coliform loadings from nonpoint sources in the watershed come from wildlife populations, livestock populations, and urban development. Also considered were the nonpoint sources such as failing septic systems and other direct inputs to tributaries of Cedar Creek. MDEQ assumed there is a 40% failure rate of septic tanks in the drainage area. There are no NPDES Permitted discharges that discharge fecal coliform in the watershed.

MDEQ utilized a mass-balance approach to calculate the TMDL for this report. This method was selected due to the lack of real data available for this report. This method is supported by EPA in "Protocol for Developing Pathogen TMDLs" dated January 2001.

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 fecal coliform. Fecal coliform bacteria are used as indicator organisms. They are readily identifiable and indicate the possible presence of other pathogenic organisms in the waterbody. The TMDL process can be used to establish water quality based controls to reduce pollution from both point and nonpoint sources, and restore and maintain the quality of water resources.

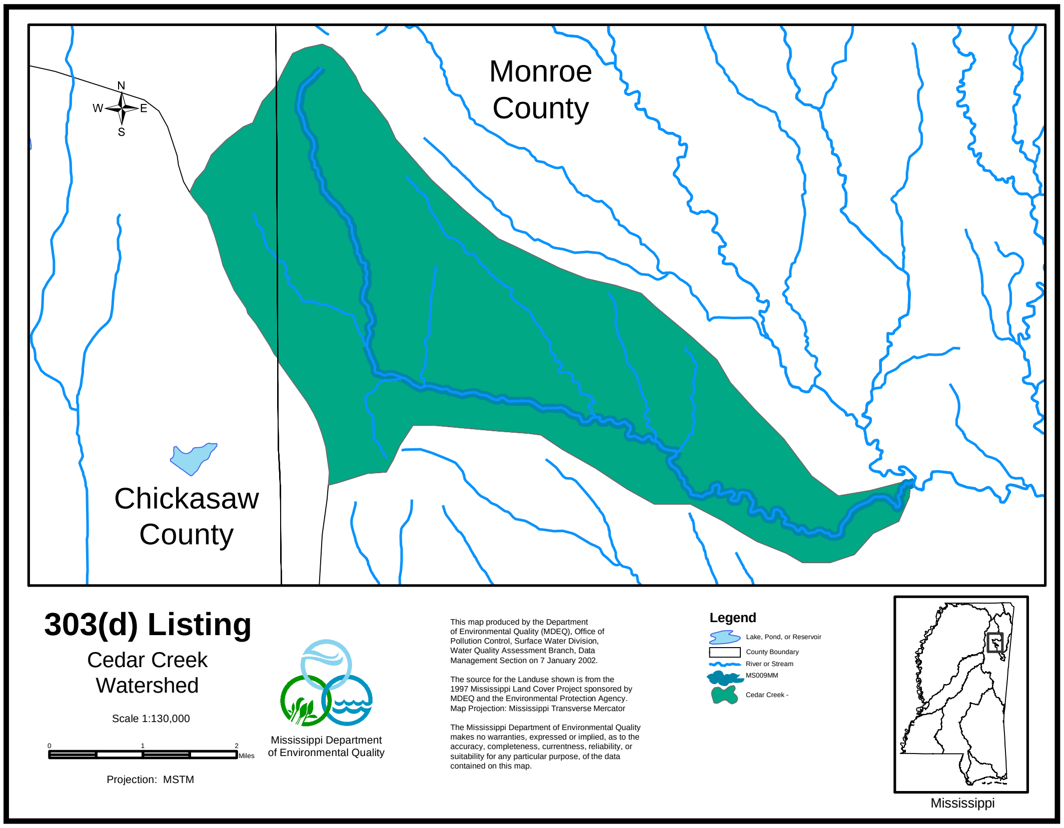
The Mississippi Department of Environmental Quality (MDEQ) has placed the Cedar Creek Drainage Area on the evaluated section of the Mississippi 1998 Section 303(d) List of Waterbodies. In 1996, MDEQ listed this stream as monitored in error. This drainage area was listed based on Nonpoint Source Surveys from NRCS in the late 1980's. The listed drainage area is near Egypt, Mississippi. The 303d listed section is shown in Figure 1.1a.

The Cedar Creek Drainage Area is in the Tombigbee Basin Hydrologic Unit Code (HUC) 03160101 in northeast Mississippi. The drainage area is approximately 10,000 acres; and lies within portions of Monroe and Chickasaw Counties. The watershed is rural. Cropland and Pasture are the dominant landuses within the watershed. The land distribution is shown in Table 1.1.

Table 1.1 Land Distribution in Acres for the Cedar Creek Watershed

	Urban	**Forest**	**Cropland**	**Pasture**	**Barren**	**Wetland**	**Total**
Area (Acres)	19	594	4,611	4,901	0	0	10,126
% Area	0%	6%	46%	48%	0%	0%	100%

Figure 1.1a Cedar Creek Watershed 303d Listed Segment



1.2 Applicable Waterbody Segment Use

The water use classification for the listed segment of Cedar Creek, as established by the State of Mississippi in the *Water Quality Criteria for Intrastate, Interstate and Coastal Waters* regulation, is Fish and Wildlife Support. The designated beneficial uses for Cedar Creek are Secondary Contact and Aquatic Life Support.

1.3 Applicable Waterbody Segment Standard

The water quality standard applicable to the use of the waterbody and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. The standard states that for the summer months the fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml. For the winter months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 2000 colonies per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 4000 per 100 ml. This water quality standard will be used as targeted endpoints to evaluate impairments and establish this TMDL.

2.0 TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

2.1 Selection of a TMDL Endpoint and Critical Condition

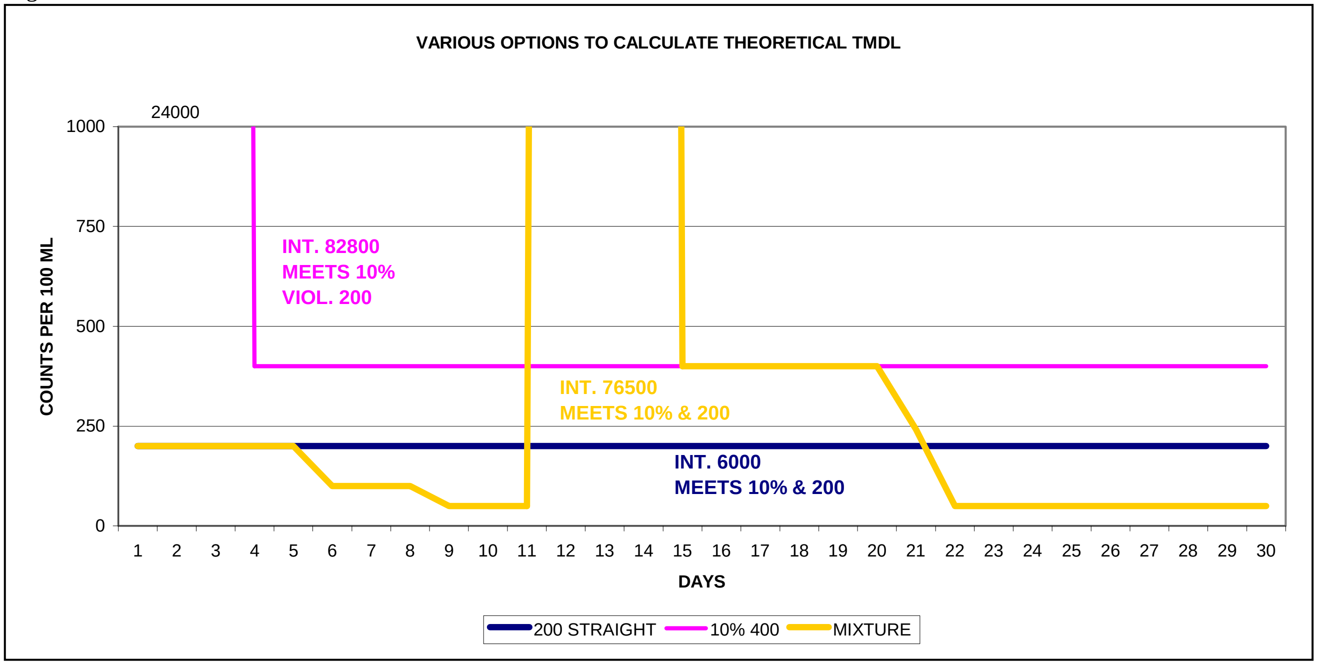
One of the major components of a TMDL is the establishment of instream numeric endpoints, which are used to evaluate the attainment of acceptable water quality. Instream numeric endpoints, therefore, represent the water quality goals that are to be achieved by implementing the load and waste load reductions 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 fecal coliform target for this TMDL is a 30-day geometric mean of 200 colony counts per 100 ml.

MDEQ calculated the TMDL using the more appropriate of the sections of the fecal coliform standard. It is important to remember that this mass-balance method for calculating the total maximum 30-day load is theoretical and is not supported by data. If data were available, MDEQ would have modeled the stream to calculate the TMDL and compare the model results to the standard. Also, the flow used for these calculations is the annual average flow. Therefore, there is no variance in the flow figure for the 30-day calculation. If flow data were available for the stream, this method could be modified to account for variance in flow.

The current fecal coliform standard says the counts shall not exceed a 30-day geometric mean of 200 per 100 ml nor shall more than 10% of the samples examined during any month exceed 400 counts per 100 ml. To calculate the TMDL for Cedar Creek, the average annual flow was multiplied by the 30-day geometric mean of 200 counts per 100 ml standard. MDEQ believes this to be the most protective calculation using the mass-balance method. MDEQ developed the following chart to illustrate this. All three lines meet the 10% section of the standard. The blue line represents a constant 200 count for 30 days. The integral of the area below the curve is 6000. The geometric mean is 200. The purple line represents 3 days reading 24,000 counts and 27 days reading 400. The purple line represents the maximum load possible that meets the 10% section of the standard. The integral of the area below the curve is 82,800. However, the geometric mean is 602. While this data set meets the 10% section of the standard, it does not meet the 200 geometric mean section. The yellow line represents a data set with the same 3-day readings of 24,000 counts and 27 days below 400. This data set meets the 10% section of the standard as well as the geometric mean section. The integral of the area below the curve is 76,500. Therefore when comparing all three sample data sets, MDEQ believes the selection of calculating the load by multiplying 30 days by the 200 count is the more appropriate of the approaches. Additionally when the margin of safety is added, this value is reduced by an additional 10%.

Critical conditions for waters impaired by nonpoint sources generally occur during periods of wet-weather and high surface runoff. But, critical conditions for point source dominated systems generally occur during periods of low flow, low dilution conditions.

Figure 2.1 Theoretical TMDL Calculations



2.2 Discussion of Instream Water Quality

There are no ambient stations on the listed segment operated by MDEQ that collected fecal coliform monitoring data. There are no available water quality data.

3.0 SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known potential fecal coliform sources in the Cedar Creek Watershed. This section documents the available information and interpretation for the analysis. The representation of the following sources in the model is discussed in Section 4.0, Modeling Procedure: Linking the Sources to the Endpoint.

3.1 Assessment of Point Sources

Point sources of fecal coliform bacteria have their greatest potential impact on water quality during periods of low flow. There are no point sources that discharge fecal coliform in the Cedar Creek Watershed.

3.2 Assessment of Nonpoint Sources

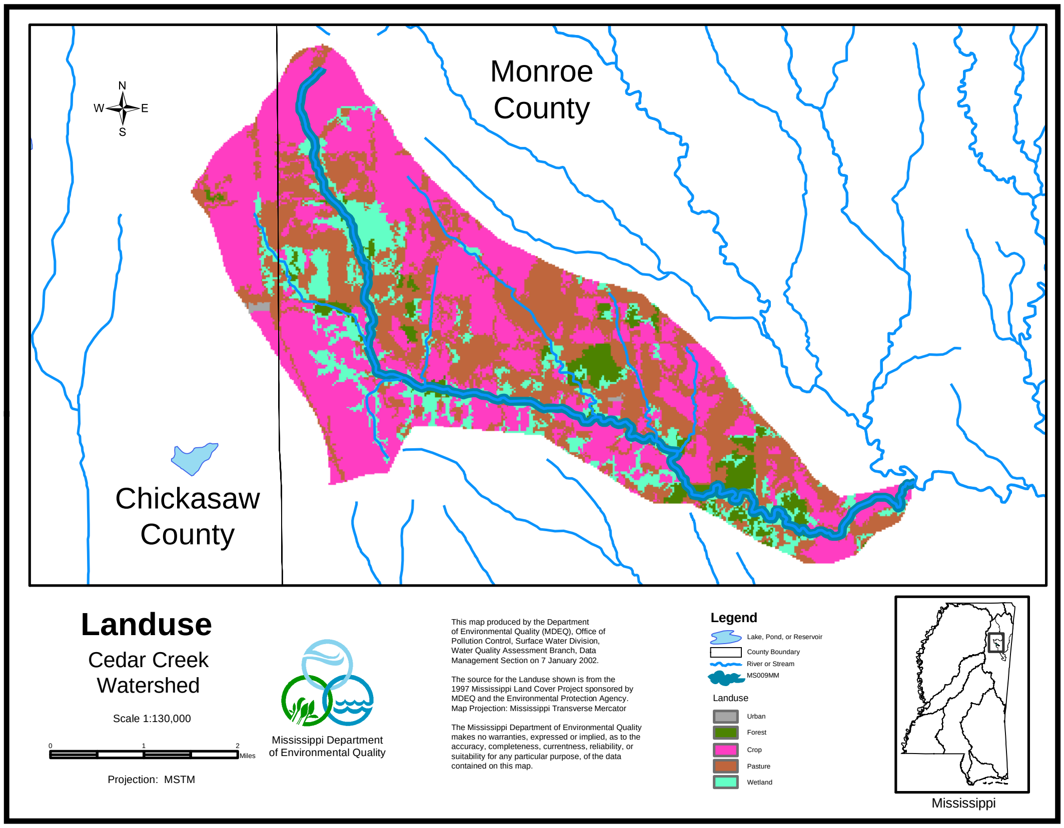
There are many potential nonpoint sources of fecal coliform bacteria for Cedar Creek, including:

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

The 10,000-acre drainage area of Cedar Creek contains many different landuse types, including forest, cropland, pasture, barren, and wetlands. The modeled landuse information for the watershed is based on the State of Mississippi's Automated Resource Information System (MARIS), 1997. This data set is based Landsat Thematic Mapper digital images taken between 1992 and 1993. The MARIS data are classified on a modified Anderson level one and two system with additional level two wetland classifications. The landuse categories were grouped into the landuses of urban, forest, cropland, pasture, barren, and wetlands. Figure 3.2 shows the landuse distribution for the watershed.

The nonpoint fecal coliform contribution from each landuse was estimated using the latest information available. The MARIS landuse data for Mississippi was utilized by The Watershed Characterization System (WCS) to display, analyze, and compile data, such as MARIS landuse, population, and agriculture census data. MDEQ contacted several agencies to refine the assumptions made in determining the fecal coliform loading. The Mississippi Department of Wildlife, Fisheries, and Parks provided information of wildlife density in the Cedar Creek Watershed. The Mississippi State Department of Health was contacted regarding the failure rate of septic tank systems in this portion of the state. Mississippi State University researchers provided information on manure application practices and loading rates for hog farms and cattle operations. The Natural Resources Conservation Service also gave MDEQ information on manure treatment practices and land application of manure.

Figure 3.2 Landuse Distribution



3.2.1 Failing Septic Systems

Septic systems have a potential to deliver fecal coliform bacteria loads to surface waters due to malfunctions, failures, and direct pipe discharges. Properly operating septic systems treat wastewater and dispose of the water through a series of underground field lines. The water is applied through these lines into a rock substrate, thence into underground absorption. The systems can fail when the field lines are broken, or when the underground substrate is clogged or flooded. A failing septic system's discharge can reach the surface, where it becomes available for wash-off into the stream. Another potential problem is a direct bypass from the system to a stream. In an effort to keep the water off the land, pipes are occasionally placed from the septic tank or the field lines directly to the creek.

Another consideration is the use of individual onsite wastewater treatment plants. These treatment systems are in wide use in Mississippi. They can adequately treat wastewater when properly maintained. However, these systems may not receive the maintenance needed for proper, long-term operation. These systems require some sort of disinfection to properly operate. When this expense is ignored, the water does not receive adequate disinfection prior to release. Due to this consideration, failing septic tanks are typically designated as both point and nonpoint sources of fecal coliform and the load are evenly split between the waste load allocation and the load allocation for calculating the TMDL.

3.2.2 Wildlife

Wildlife present in the Cedar Creek Watershed contributes to fecal coliform bacteria on the land surface. Wildlife was accounted for by considering contributions from deer. Estimates of deer population were designed to account for the deer combined with all of the other wildlife contributing to the area. An upper limit of 45 deer per square mile was used as the estimate. It was assumed that the wildlife population remained constant throughout the year, and that wildlife was present on all land classified as pastureland, cropland, and forest. It was also assumed that the wildlife and the manure produced by the wildlife were evenly distributed throughout these land types.

3.2.3 Land Application of Hog and Cattle Manure

In the Tombigbee Basin, processed manure from confined hog and dairy operations is collected in lagoons and routinely applied to pastureland during April through October. This manure is a potential contributor of bacteria to receiving waterbodies due to runoff produced during a rain event. Hog farms in the Tombigbee Basin operate by either keeping the animals confined or by allowing hogs to graze in a small pasture or pen. It was assumed that all of the hog manure produced by either farming method was applied evenly to the available pastureland. Application rates of hog manure to pastureland from confined operations varied monthly according to management practices currently used in this area.

The dairy farms that are currently operating in the Tombigbee Basin confine the animals for a limited time during the day. A confinement time of four hours per day, during which time the cattle are milked and fed, was assumed. The manure collected during confinement is applied to the available pastureland in the watershed. Like the hog farms, application rates of dairy cow manure to pastureland vary monthly according to management practices currently used in this area.

3.2.4 Grazing Beef and Dairy Cattle

Grazing cattle deposit manure on pastureland where it is available for wash-off and delivery to receiving waterbodies. Dairy cattle are also assumed to graze on pasturelands when not confined. Beef cattle have access to pastureland for grazing all of the time.

3.2.5 Land Application of Poultry Litter

There are apparently no chickens sold in this area according to the agriculture census. There are very few layers and no broilers produced in the Cedar Creek Watershed. The loading contribution from these few layers is considered insignificant.

3.2.6 Other Direct Inputs

Due to the general topography in the Cedar Creek Watershed, it was assumed that all land slopes in the watershed are such that unconfined animals are able to access the intermittent streams in all pastures. To estimate the amount of bacteria introduced into streams by all animals, it is assumed that, for the winter months, cattle deposit 0.026 percent of their bacteria load in the stream; and that for the summer months, cattle deposit 0.052 percent of their bacteria load in the stream. This direct input of cattle manure represents all animal access to streams (domestic and wild), illicit discharges of fecal coliform bacteria, and leaking sewer collection lines.

3.2.7 Urban Development

Urban areas include land classified as urban and barren. Even though only a small percentage of the watershed is classified as urban, the contribution of the urban areas to fecal coliform loading in Cedar Creek was considered. Fecal coliform contributions from urban areas may come from storm water runoff, runoff from construction sites, and runoff contribution from improper disposal of materials such as litter.

4.0 MODELING PROCEDURE: LINKING THE SOURCES TO THE ENDPOINT

Establishing the relationship between the instream water quality target and the source loading is a critical component of TMDL development. It allows for the evaluation of management options that will achieve the desired source load reductions. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain waterbody responses to flow and loading conditions. In this section, the selection of the modeling tools, setup, and model application are discussed.

4.1 Modeling Framework Selection

A mass balance approach was used to calculate the TMDL. This method of analysis was selected due to the size of the watershed and the absence of water quality data. Utilizing the conservation of mass principle, loads can be calculated using the following relationship:

Load (counts/30days) = [**Concentration** (counts/ 100 ml)] * [**Flow** (cfs)] * (Conversion Factor)

As discussed in section 2.1, MDEQ considered using both parts of the fecal coliform standard and determined the more protective of the methods was to utilize the 200 geometric mean section of the standard.

4.2 Model Setup

The Cedar Creek Watershed was delineated into a single watershed to be used with WCS in identifying potential pollutant sources.

Flow influences the instream fecal coliform concentration. The average annual flow was used to calculate the TMDL rather than the seven day, ten year ($7Q_{10}$) low flow because the critical period for non point sources would not occur during low flow. The standard is based on base flow conditions characterized by the average annual flow. The average annual flow in Cedar Creek was estimated based on the method included in MDEQ regulations to be 18.85 cfs based on the average discharge of Chuquatonchee Creek at station 02440000 near Egypt, Mississippi. (Telis)

Avg Discharge (cfs)={[**02440000 Avg Discharge** (cfs)]/[**02440000 Drainage Area** (square mile)]} *[**Cedar Creek Drainage Area** (square mile)]

Avg Discharge (cfs) = {[**199** (cfs)]/[**167** (square mile)]}*[**15.82** (square mile)]

Avg Discharge (cfs) = 18.85 cfs

5.0 ALLOCATION

The allocation for this TMDL involves a wasteload allocation for point sources, a load allocation for nonpoint sources, and a margin of safety.

5.1 Wasteload Allocations

There are no NPDES permitted dischargers of fecal coliform bacteria in the Cedar Creek Watershed. Therefore, the WLA component is zero. This WLA must be recalculated upon receipt of future NPDES permit applications. Any future permitted dischargers of fecal coliform bacteria in the watershed shall meet end-of-pipe standards of 200-counts/100 ml.

5.2 Load Allocations

The load allocation (LA) for Cedar Creek is calculated using the water quality criterion and the average annual flow. In calculating the LA component, the water quality standard of 200-counts/100 ml is reduced by the margin of safety. For the Cedar Creek TMDL, the LA is based on a fecal coliform concentration of 180-counts/100 ml and an annual average flow of 18.85 cfs. The resulting LA is estimated to be 2.49E12 counts/30 days.

LA = 180 (counts/100ml) * 18.85 (cfs) * 7.35E8 (conversion factor)

LA = 2.49E12 counts/30days

5.3 Incorporation of a Margin of Safety (MOS)

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. For this study, the MOS is incorporated explicitly by selecting the instream target concentration at 180 counts/100 ml. Assuming the average annual flow, the resulting load attributed to the MOS is 0.28E12 counts/30 days.

MOS = 20 (counts/100ml) * 18.85 (cfs) * 7.35E8 (conversion factor)

MOS = 0.28E12 counts/30days

5.4 Calculation of the TMDL

This TMDL is calculated based on the following equation where WLA is the wasteload allocation (the load from the point sources), the LA is the load allocation (the load from nonpoint sources), and MOS is the margin of safety:

TMDL = WLA + LA + MOS

WLA = NPDES Permitted Facilites

LA = Surface Runoff + Other Direct Inputs + Septic Tank Failures

MOS = explicit

Table 5.4 TMDL Summary for Listed Segment (counts/30 days)

	MS009MM
WLA	0.00E+12
LA	2.49E+12
MOS	0.28E+12
TMDL = WLA + LA +MOS	**2.77E+12**

5.5 Seasonality

For many streams in the state, fecal coliform limits vary according to the seasons. This stream is designated for the use of secondary contact. For this use, the pollutant standard is seasonal. By assuming the average annual flow is the critical flow in calculating the allowable load, seasonality is considered, as this flow is representative of wet weather conditions. The standard is based on base flow conditions.

6.0 CONCLUSION

The TMDL will not impact existing or future NPDES Permits as long as the effluent is disinfected to meet water quality standards for fecal coliform bacteria. MDEQ will not approve any NPDES Permit application that does not plan to meet water quality standards for disinfection. Education projects that teach best management practices should be used as a tool for reducing nonpoint source contributions. These projects may be funded by CWA Section 319 Nonpoint Source (NPS) Grants.

6.1 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 Tombigbee Basin, Cedar Creek will receive additional monitoring to identify any change in water quality. MDEQ produced guidance for future Section 319 project funding will encourage NPS restoration projects that attempt to address TMDL related issues within Section 303(d)/TMDL watersheds in Mississippi.

6.2 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 area of the watershed. 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 hearing.

If a public hearing is deemed appropriate, the public will be given a 30-day notice of the hearing to be held at a location near the watershed. That public hearing would be an official hearing of the Mississippi Commission on Environmental Quality, and would be transcribed.

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

DEFINITIONS

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

Assimilative capacity: the 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.

Calibrated model: a model in which reaction rates and inputs are significantly based on actual measurements using data from surveys on the receiving waterbody.

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

Effluent: treated wastewater flowing out of the treatment facilities.

Fecal coliform bacteria: a group of bacteria that normally live within the intestines of mammals, including humans. Fecal coliform bacteria are used as an indicator of the presence of pathogenic organisms in natural water.

Geometric mean: the nth root of the product of n numbers. A 30-day geometric mean is the 30^{th} root of the product of 30 numbers.

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. It also contains a portion of the contribution from septic tanks.

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

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.

Regression Coefficient: an expression of the functional relationship between two correlated variables that is often empirically determined from data, and is used to predict values of one variable when given values of the other variable.

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

Sigma (Σ): shorthand way to express taking the sum of a series of numbers. For example, the sum or total of three amounts 24, 123, 16, ($\mathbf{d_l}$, $\mathbf{d_2}$, $\mathbf{d_3}$) respectively could be shown as:

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

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. It also contains a portion of the contribution from septic tanks.

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

BASINS ....Better Assessment Science Integrating Point and Nonpoint Sources

BMP ....Best Management Practice

CWA ....Clean Water Act

DMR ....Discharge Monitoring Report

EPA ....Environmental Protection Agency

GIS ....Geographic Information System

HUC ....Hydrologic Unit Code

LA ....Load Allocation

MARIS ....State of Mississippi Automated Information System

MDEQ..Mississippi Department of Environmental Quality

MOS..Margin of Safety

NRCS ....National Resource Conservation Service

NPDES..National Pollution Discharge Elimination System

NPSM...Nonpoint Source Model

RF3...Reach File 3

USGS ....United States Geological Survey

WCS...Watershed Characterization System

WLA ....Waste Load Allocation

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