FINAL REPORT
December 2002
ID: 902120801

Fecal Coliform TMDL for Coldwater River

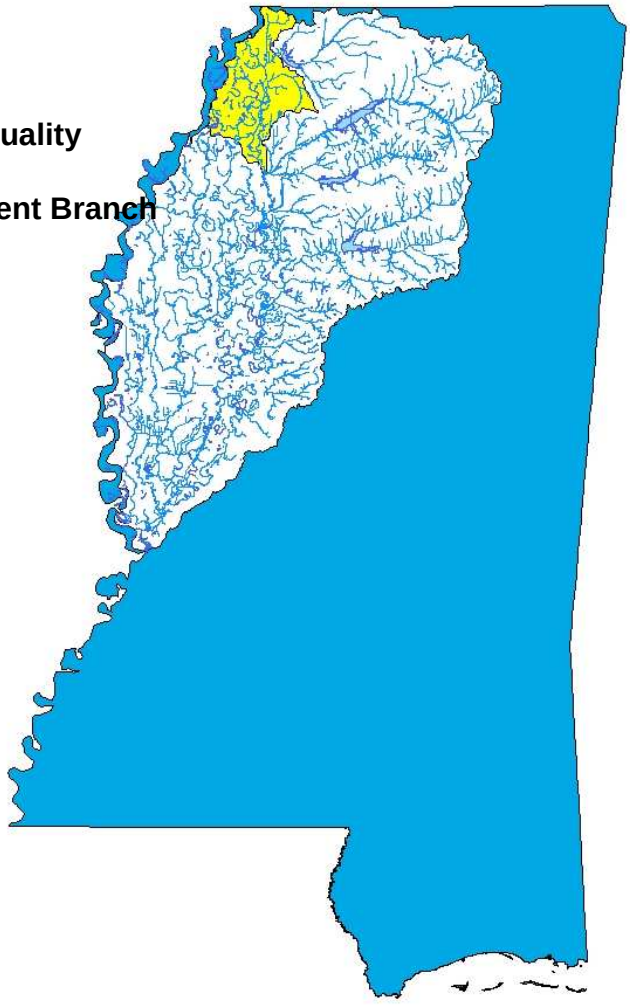
Yazoo River Basin

Desoto, Tate, Tunica, and Quitman Counties, Mississippi

Prepared By

Mississippi Department of Environmental Quality
Office of Pollution Control
TMDL/WLA Section/Water Quality Assessment Branch

MDEQ
PO Box 10385
Jackson, MS 39289-0385
(601) 961-5171
www.deq.state.ms.us



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

CONTENTS

PHOTOS

FIGURES

TABLES

TMDL INFORMATION PAGE

Table i. Listing Information

Name	ID	County	HUC	Cause	Mon/Eval
Coldwater River	MSCOLDR2M2	Desoto Tate Tunica	08030204	Pathogens	Monitored
At Prichard: From confluence with Cub Lake Bayou to split with Pompey Ditch above Sara (below Savage)					
Coldwater River	MSCOLDR1E	Quitman	08030204	Pathogens	Evaluated
At Coldwater River: From confluence with Pompey Ditch near Darling to confluence with Old Little Tallahatchie					
Coldwater River	MSCOLDR2E	Tate Tunica	08030204	Pathogens	Evaluated
At Coldwater River: From spillway of Arkabutla Reservoir to confluence with Pompey Ditch					
Pompey Ditch	MSPOMPEYE	Tunica Quitman	08030204	Pathogens	Evaluated
From confluence of Coldwater River North of Sarah to southern terminus near Darling					

Table ii. Water Quality Standard

Parameter	Beneficial use	Water Quality Criteria
Fecal Coliform	Secondary Contact	**May - October**: Fecal coliform colony counts not to exceed a geometric mean of 200 per 100ml, nor shall more than 10 percent of samples examined during any month exceed a colony count of 400 per 100ml. **November – April**: Fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml, nor shall more than 10 percent of the samples examined during any month exceed a colony count of 4000 per 100 ml.

Table iii. NPDES Facilities

NPDES ID	Facility Name	Subwatershed	Receiving Water
MS0049123	Buck Island Bayou MHP	08030204014	Buck Island Bayou
MS0020656	USACOE Arklabutla N Abutment	08030204014	Spillway Channel
MS0040673	USACOE Bayou Pt-Arkabutla Lake	08030204014	Coldwater River
MS0051934	Austin Trailer Park	08030204037	Beaverdam Bayou
MS0049557	Blue Lake Springs S/D	08030204037	A tributary of Duck Pond Bayou
MS0034188	Lake Forest S/D	08030204037	Johnson Creek
MS0037925	Skylane Trailer Park	08030204037	Big Six Creek
MS0022543	Twin Lakes #1	08030204037	Johnson Creek
MS0029467	Twin Lakes #2	08030204037	Johnson Creek
MS0053830	Wilson Mill Subdivision	08030204037	Jackson Creek
MS0030104	Como POTW	08030204012	Porter Creek
MS0045055	Sam Minor Headstart	08030204012	Arkabutla Creek
MS0048861	Westside Church of Christ	08030204012	McIvor Canal
MS0035181	Strayhorn Elementary School	08030204011	Strayhorn Creek
MS0039802	Pride of the Pond,	08030204039	White Oak Bayou
MS0032786	Tunica Industrial Park	08030204039	White Oak Bayou
MS0042323	Tunica POTW	08030204039	Ephimeral stream to White Oak Bayou
MS0049964	Henson Night Club	08032004039	White Oak Bayou
MS0050563	Tunica County S/D	08030204039	White Oak Bayou
MS0024261	Westgate Utilities-White Oak	08030204039	White Oak Bayou
MS0054798	Dundee School	08030204039	Unnamed branch of Philips Bayou
MS0026930	Crenshaw POTW	08030204006	Unnamed ditch to David Bayou
MS0025151	Lula POTW	08030204007	Muddy Bayou
MS0036731	Falcon POTW	08030204007	Burrell Bayou to Coldwater River

Table iii continued

NPDES ID	Facility Name	Subwatershed	Receiving Water
MS0021016	Sledge POTW	08030204007	David Bayou
MS0044237	Coahoma POTW	08030204007	Mill Creek
MS0024660	Marks POTW	08030204001	Coldwater River

Table iv. Total Maximum Daily Load for all 303(d) Listed Segments

Type	Number		Unit	MOS Type
	Summer	Winter		
WLA	9.28E+11	9.28E+11	counts/30 day critical period	
LA	3.39E+14	33.9E+14	counts/30 day critical period	
MOS	4.24E+13	42.4E+13	counts/30 day critical period	Explicit/Implicit
TMDL	**3.81E+14**	**38.11E+14**	counts/30 day critical period	

EXECUTIVE SUMMARY

A segment of the Coldwater River has been placed on the Mississippi 1998 Section 303(d) List of Waterbodies as a monitored 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.

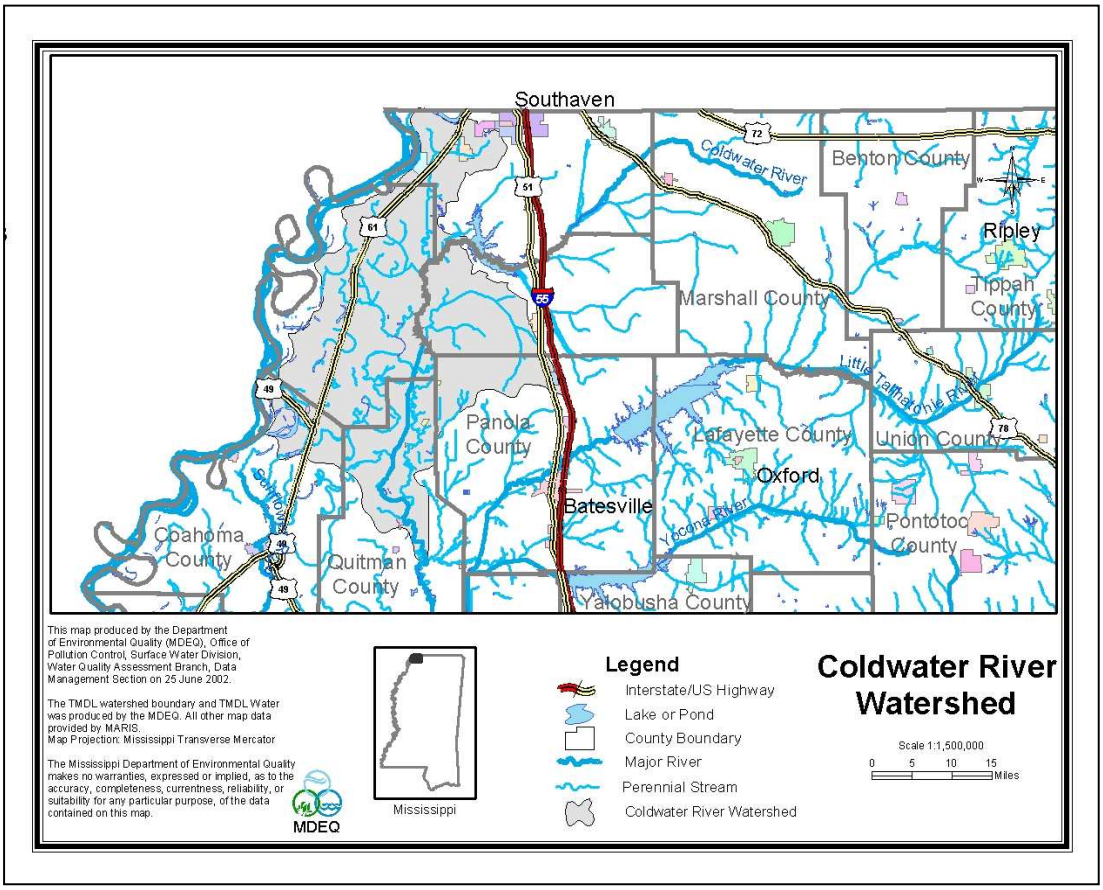
Photo 1. Coldwater River at Highway 4

The Coldwater River, photo 1, flows in a southwestern direction from its headwaters near Hudsonville, Mississippi into Arkabutla Lake. Coldwater River then flows from Arkabutla Lake to the Tallahatchie River. This TMDL has been developed for three listed sections of the Coldwater River and one listed section of Pompey Ditch.

While fecal coliform loadings from point and nonpoint sources in the watershed were not able to be explicitly represented with a model, a source assessment was still conducted for the Coldwater River Watershed, the location of which is shown in Figure 1. There are 26 NPDES Permitted discharges included as point sources in the waste load allocation (WLA). Most of the permitted facilities currently have requirements in their NPDES Permits that require disinfection to meet water quality standards for pathogens at the end of pipe. Therefore, no changes are required for those existing NPDES permits. However, this TMDL recommends that upon reissuance the other NPDES Permits be modified to require disinfection. Monitoring of the permitted facilities in the Coldwater River Watershed should continue to ensure that compliance with permit limits is consistently attained.

Water quality data indicate violation of the fecal coliform standard in the waterbody. A mass balance approach was used to calculate the TMDL. This method of analysis was selected due to the lack of a gage near the impaired segment as well the limited amount of water quality data. MDEQ used the annual average flow for calculating this TMDL; therefore, the seasonal differences are incorporated in the averaging of the flow values. An explicit margin of safety (MOS) of 10% for the summer and winter was used to accommodate uncertainty in the mass balance method. After using this approach, summer and winter TMDLs were determined to be 3.81E+14 counts per 30 days and 38.11E+14 counts per 30 days, respectively for all listed segments of the TMDL. The estimated percent reduction for this TMDL is 93%.

Figure 1: Location of Coldwater River Watershed



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 nonpoint sources, maintain permit requirements for point sources, and restore and maintain the quality of water resources.

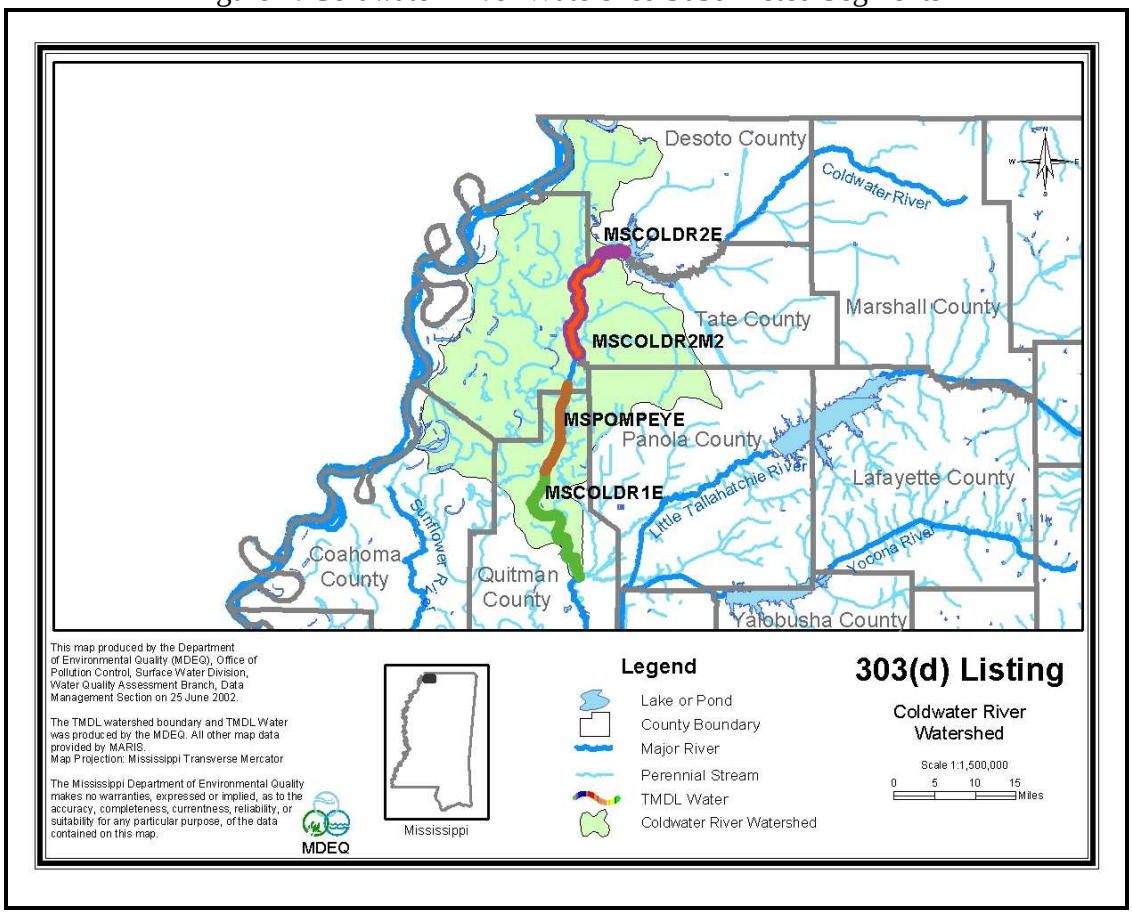
This TMDL has been developed for the impaired segment of the Coldwater River, the two evaluated segments of the Coldwater River, and the evaluated segment of the Pompey Ditch found on the 303(d) List. The monitored segment of the Coldwater River (MSCOLDR2M2) is found in Desoto, Tate, and Tunica Counties. It begins just below Arkabutla Dam, at the confluence of Cub Lake. This segment ends at the split with Pompey Ditch which is above Sarah. The first evaluated segment (MSCOLDR2E) is found in Desoto, Tate, Tunica, and Quitman Counties. It begins at the spillway of the Arkabutla Reservoir and continues to the confluence with Pompey Ditch near Darling.. The second evaluated segment (MSCOLDR1E) lies completely in Quitman County. It begins at the confluence of Pompey Ditch and ends at the confluence with Old Little Tallahatchie Creek. The evaluated segment of Pompey Ditch is found in Tunica and Quitman Counties. It begins at the split with the Coldwater River, which is north of Sarah. The evaluated segment of the Pompey Ditch ends at its southern terminus near Darling. The locations of the listed waterbody segment and drainage areas in the Coldwater River Watershed are shown in Figure 2.

The Coldwater River Drainage Area is in the Yazoo River Basin Hydrologic Unit Code (HUC) 08030204 in northwest Mississippi. The drainage area is approximately 590,000 acres; and lies within portions of Coahoma, Desoto, Panola, Quitman, Tate, and Tunica Counties. The watershed is rural. Forest and Pasture are the dominant landuses within the watershed. The land distribution is shown in Table 1.1.

Table 1: Land Distribution for the Coldwater River Watershed

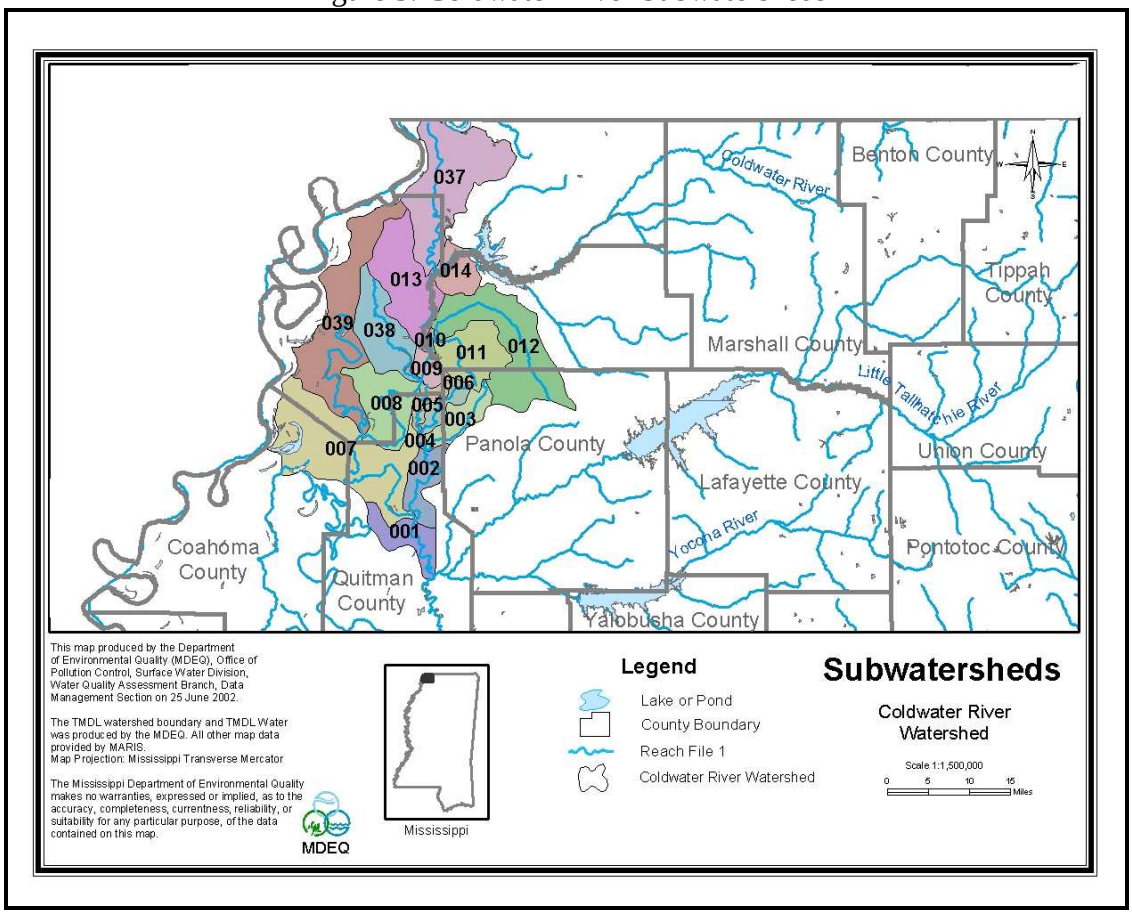
	Urban	Forest	Cropland	Pasture	Barren	Wetland	Aquaculture	Water	Total
Area (acres)	3,540	30,139	400,588	109,012	160	37,261	2,903	7,290	590,893
% Area	1%	5%	68%	18%	0%	6%	0%	1%	100%

Figure 2: Coldwater River Watershed 303d Listed Segments



The drainage area, or watershed, has been divided into 17 subwatersheds based on the major tributaries and topography. The figure below shows the subwatersheds with a three-digit Reach File 1 segment identification number. Each subwatershed is assigned a corresponding identification number, which is a combination of the eight-digit HUC and the three-digit Reach File 1 segment identification number. The most downstream reach of the evaluated drainage area is segment 08030204001.

Figure 3: Coldwater River Subwatersheds



1.2 Applicable Waterbody Segment Use

Designated beneficial uses and water quality standards are established by the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* regulations. The designated use for the Coldwater River and Pompey Ditch as defined by the regulations is Fish and Wildlife.

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 from May through October the fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than 10 percent of samples examined during any month exceed a colony count of 400 per 100 ml, and from November through April the fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml, nor shall more than 10 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.

TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

2.1 Selection of a TMDL Endpoint and Critical Condition

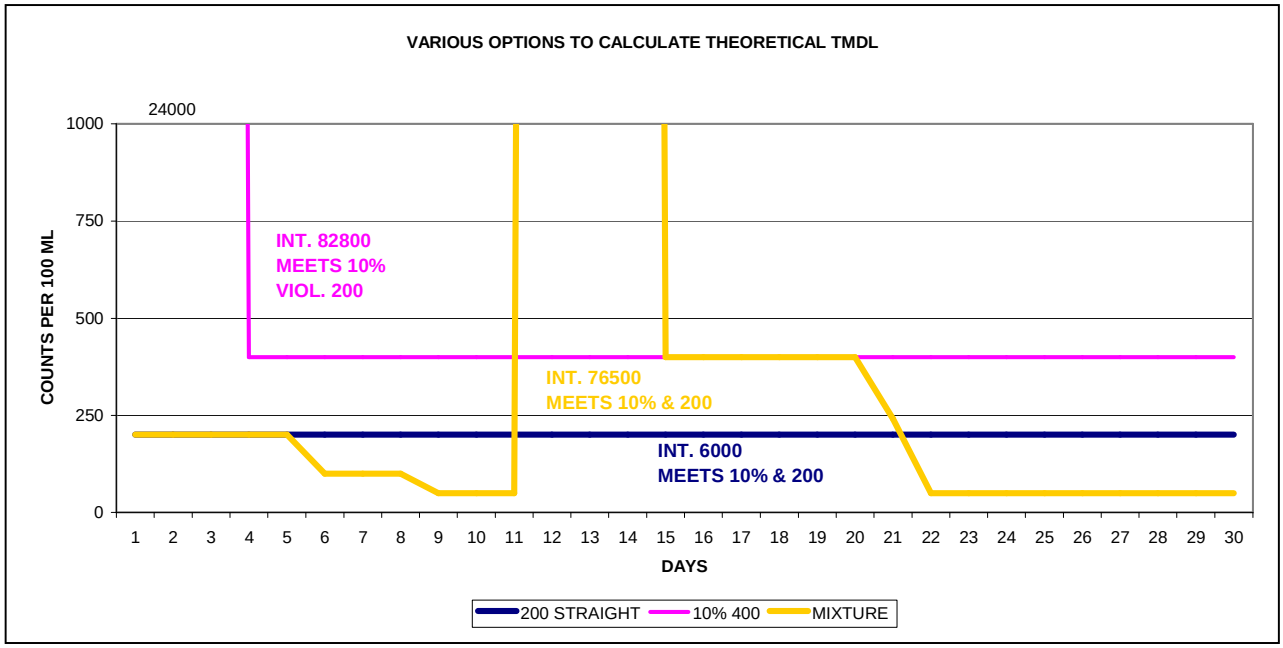
One of the major components of a TMDL is the establishment of instream numeric endpoints, which are used to evaluate the attainment of acceptable water quality. Instream numeric endpoints, therefore, represent the water quality goals that are to be achieved by implementing the load and waste load reductions 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 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 Coldwater River, 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 these data meet 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 4: Theoretical TMDL Calculations



2.2 Discussion of Instream Water Quality

Water quality data available for the monitored segment of the Coldwater River show that water quality standards for fecal coliform bacteria are occasionally violated in the stream. There was one ambient station operated by MDEQ where fecal coliform monitoring data were collected. This station, 7279300, is located on the Coldwater River near Prichard, MS. MDEQ monitoring for flow and fecal coliform was performed at station 7279300 between January of 1988 and November 1993. This station, however, is no longer routinely monitored for fecal coliform bacteria.

In order to gather fecal coliform data, MDEQ now goes to monitoring stations six times within a 30-day period. These data are used to calculate the geometric mean for the waterbody. This stream was recently included in this type of monitoring. These data were used to confirm impairment in this waterbody for fecal coliform.

2.2.1 Inventory of Available Water Quality Monitoring Data

Data collected at station 07279300 from January 1988 to November 1993 are included in Table 2. Data collected from the three stations included in the geometric mean study from 2001 are listed in Tables 3-5.

Table 2: Fecal Coliform Data reported in the Coldwater River, Station 07279300 January 1988 to March 1993

Date	Time	Fecal Coliform (counts/100ml)	Flow (cfs)
5-Jan-88	10:15	30	4450
7-Mar-88	11:15	27	1250
2-May-88	10:30	5	800
5-Jul-88	**11:00**	**920**	**38**
6-Sep-88	10:15	350	-
7-Nov-88	9:45	31	1050
10-Jul-89	11:05	110	-
5-Sep-89	10:45	120	3150
6-Nov-89	13:45	2400	-
8-Jan-90	11:15	170	2400
1-May-90	12:00	110	2250
9-Jul-90	13:20	110	0
4-Sep-90	13:45	20	1630
5-Nov-90	11:50	3500	510
7-Jan-91	10:00	540	3900
6-May-91	10:30	130	260
8-Jul-91	11:15	49	-
9-Sep-91	10:00	**920**	**2450**
4-Nov-91	11:45	230	1570
6-Jan-92	10:25	330	1690
3-Mar-92	10:00	790	1610
4-May-92	10:00	79	330
13-Jul-92	13:10	30	1,370
14-Sep-92	13:20	60	1,760
2-Nov-92	**14:15**	**9200**	**1,020**
12-Jan-93	9:25	1300	2800
9-Mar-93	10:30	79	838
3-May-93	**10:15**	**2,400**	**3,100**
12-Jul-93	11:11	33	877
13-Sep-93	11:30	23	1,400
2-Nov-93	10:35	23	620

Table 3. Fecal Coliform Data reported in the Coldwater River, Station 29, Coldwater River at Highway 4 September 2001 to December 2001

Date	Tape Down Measurement	Fecal Coliform (counts/100ml)	Geometric Mean
9/27/2001 11:15	37.20	46	276
10/5/2001 9:50	37.40	66	
10/10/2001 9:45	37.30	50	
10/16/2001 10:58	37.15	**5100**	
10/18/2001 11:02	37.20	**4100**	
10/24/2001 11:12	34.46	140	
11/14/2001 10:47	33.37	72	133
11/20/2001 10:40	32.74	42	
11/27/2001 11:10	23.18	70	
11/29/2001 11:50	19.65	3600	
12/6/2001 12:20	30.79	<2	
12/11/2001 11:35	31.04	54	

Table 4. Fecal Coliform Data reported in the Coldwater River, Station 30, Unnamed Road off of Belle's Bend September 2001 to December 2001

Date	Tape Down Measurement	Fecal Coliform (counts/100ml)	Geometric Mean
9/27/2001 9:15	32.89	102	97
10/5/2001 7:55	33.20	62	
10/10/2001 8:20	33.30	60	
10/16/2001 8:23	18.40	204	
10/18/2001 9:37	22.24	100	
10/24/2001 9:43	29.14	110	
11/14/2001 9:12	29.74	112	530
11/20/2001 8:50	27.81	62	
11/27/2001 9:25	24.32	**5300**	
11/29/2001 10:00	18.15	**6000**	
12/6/2001 10:25	15.43	600	
12/11/2001 9:55	15.83	168	

Table 5. Fecal Coliform Data reported in the Coldwater River, Station 31, Darling-Birdie Road September 2001 to December 2001

Date	Tape Down Measurement	Fecal Coliform (counts/100ml)	Geometric Mean
9/27/2001 10:00	29.00	18	244
10/5/2001 8:47	29.00	230	
10/10/2001 8:52	28.95	220	
10/16/2001 9:38	16.88	**4100**	
10/18/2001 10:12	19.76	500	
10/24/2001 10:21	24.90	114	
11/14/2001 9:51	24.79	84	361
11/20/2001 9:35	23.41	76	
11/27/2001 10:05	16.36	3400	
11/29/2001 10:45	11.43	**6000**	
12/6/2001 11:05	11.94	94	
12/11/2001 10:30	12.66	180	

2.2.2 Analysis of Instream Water Quality Monitoring Data

Historically, MDEQ compared all of the samples to no more than 10% greater than the instantaneous maximum standard of 400 counts per 100 ml for the summer months and 4000 counts per 100 ml for the winter months. This is not technically in line with the current fecal coliform standard. The data were used to list this waterbody. The new data recently collected have been assessed by calculating the geometric mean of a minimum of five samples within a 30-day period. Also, the data are compared to no more than 10% greater than 400 counts per 100 ml for the summer months and 4000 counts per 100 ml for the winter. The recent data indicate the waterbody is impaired as shown in the table below.

Table 6. Summer Statistical Summaries of Water Quality Data

Station Number	Number of Samples	Maximum Value (counts/100ml)	Minimum Value (counts/100ml)	Geometric Mean	Percent Instantaneous Exceedance
29	6	5100	46	276	33%
30	6	204	60	97	0%
31	6	4100	18	244	33%

Table 7. Winter Statistical Summaries of Water Quality Data

Station Number	Number of Samples	Maximum Value (counts/100ml)	Minimum Value (counts/100ml)	Geometric Mean	Percent Instantaneous Exceedance
29	6	3600	42	133	17%
30	6	6000	62	530	33%
31	6	6000	76	361	17%

SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known potential fecal coliform sources in the Coldwater River Watershed. The source assessment was used as the basis of development for the model and ultimate analysis of the TMDL allocation options. The sources were analyzed according to the 17 separate subwatersheds. The subwatershed delineations were based primarily on an analysis of the Reach File 3 (RF3) stream network and the digital elevation model of the watershed. In evaluation of the sources, loads were characterized by the best available information, monitoring data, literature values, and local management activities. This section documents the available information and interpretation for the analysis.

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. Thus, a careful evaluation of point sources that discharge fecal coliform bacteria was necessary in order to quantify the degree of impairment present during the low flow, critical condition period. There are 26 known wastewater treatment plants discharging into the Coldwater River Watershed.

Once the permitted discharger was located, the effluent was characterized based on all available monitoring data including permit limits, discharge monitoring reports, and information on treatment types. Discharge monitoring reports (DMRs) were the best data source for characterizing effluent because they report measurements of flow and fecal coliform present in effluent samples. The DMRs for the NPDES facility within the Coldwater River watershed were used to determine the existing load from this source. The facility's permit limits were used as the allocated load in the mass balance. The facilities are shown below in Table 8.

Table 8: Inventory of Point Source Dischargers

Facility Name	NPDES ID	Subwatershed	Design Flow	Permitted Concentration	Receiving Water
Buck Island Bayou MHP	MS0049123	08030204014	.041	200	Buck Island Bayou
USACOE Arklabutla N Abutment	MS0020656	08030204014	.014	200	Spillway Channel
USACOE Bayou Pt-Arkabutla Lake	MS0040673	08030204014	.020	200	Coldwater River
Austin Trailer Park	MS0051934	08030204037	.006	200	Beaverdam Bayou
Blue Lake Springs S/D	MS0049557	08030204037	.120	200	A tributary of Duck Pond Bayou
Lake Forest S/D	MS0034188	08030204037	1.000	200	Johnson Creek
Skylane Trailer Park	MS0037925	08030204037	.022	200	Big Six Creek
Twin Lakes #1	MS0022543	08030204037	.150	200	Johnson Creek
Twin Lakes #2	MS0029467	08030204037	.130	200	Johnson Creek
Wilson Mill Subdivision	MS0053830	08030204037	.012	200	Jackson Creek

Facility Name	NPDES ID	Subwatershed	Design Flow	Permitted Concentration	Receiving Water
Como POTW	MS0030104	08030204012	.100	200 (April- Oct) 2,000 (Nov – March)	Porter Creek
Sam Minor Headstart	MS0045055	08030204012	.001	200	Arkabutla Creek
Westside Church of Christ	MS0048861	08030204012	.001	200	McIvor Canal
Strayhorn Elementary School	MS0035181	08030204011	.008	200	StrayhornCreek
Pride of the Pond,	MS0039802	08030204039	.696	200	White Oak Bayou
Tunica Industrial Park	MS0032786	08030204039	.060	200 (April- Oct) 2,000 (Nov – March)	White Oak Bayou
Tunica POTW	MS0042323	08030204039	.440	N/A	Ephemeral stream to White Oak Bayou
Henson Night Club	MS0049964	08030204039	.003	200	White Oak Bayou
Tunica County S/D	MS0050563	08030204039	.010	200	White Oak Bayou
Westgate Utilities-	MS0024261	08030204039	.053	200	White Oak Bayou
Crenshaw POTW	MS0026930	08030204006	.210	200 (April- Oct) 2,000 (Nov – March)	Unnamed ditch to David Bayou
Lula POTW	MS0025151	08030204007	.044	200 (April- Oct) 2,000 (Nov – March)	Muddy Bayou
Falcon POTW	MS0036731	08030204007	.023	200 (April- Oct) 2,000 (Nov – March)	Burrell Bayou to Coldwater River
Sledge POTW	MS0021016	08030204007	.220	N/A	David Bayou
Coahoma POTW	MS0044237	08030204006	.050	200	Mill Creek
Marks POTW	MS0024660	08030204001	.660	200 (April- Oct) 2,000 (Nov – March)	Coldwater River

3.2 Assessment of Nonpoint Sources

There are many potential nonpoint sources of fecal coliform bacteria for the Coldwater River, including:

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

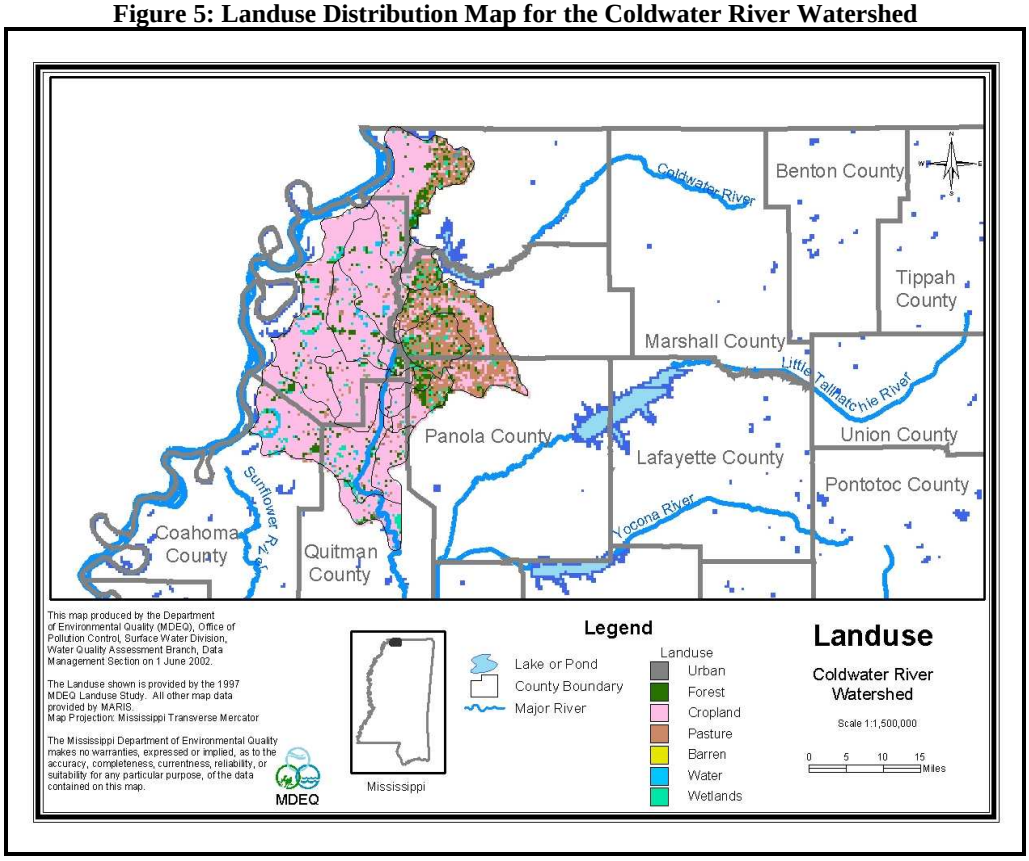
The 590,893 acre drainage area of the Coldwater River contains many different landuse types, including urban, forest, cropland, pasture, barren, and wetlands. The modeled landuse information for the watershed is based on the State of Mississippi's Automated Resource Information System (MARIS), 1997. 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. For modeling purposes the landuse categories were grouped into the landuses of urban, forest, cropland, pasture, barren, and wetlands. Figure 5 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 BASINS model to extract landuse sizes, populations, 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 Coldwater River Watershed. The Mississippi State Department of Health was contacted regarding the failure rate of septic tank systems in this portion of the state. Mississippi State University researchers provided information on manure application practices and loading rates for hog farms and cattle operations. The Natural Resources Conservation Service gave MDEQ information on manure treatment practices and land application of manure. Additionally, the USDA ARS Sediment Lab in Oxford has been assisting MDEQ in developing TMDL targets and application figures for best management practices.

Table 9: Landuse Distribution for Each Subwatershed (acres)

Subwatershed	Urban	Forest	Cropland	Pasture	Barren	Wetland	Aquaculture	Water	Total
08030204001	480	0	17,123	615	0	2,684	0	421	21,323
08030204002	61	0	17,795	972	0	1,175	0	115	20,118
08030204003	197	2,837	8,335	6,025	33	292	0	66	17,785
08030204004	0	0	1,190	38	0	115	0	0	1,343
08030204005	119	2,044	5,855	2,283	0	184	0	29	10,514
08030204006	132	181	6,368	499	0	436	0	129	7,745
08030204007	185	0	75,476	3,725	0	12,139	0	3,898	95,422
08030204008	0	0	34,253	1,413	0	1,610	0	134	37,410
08030204009	0	500	5,370	1,015	0	2,033	0	46	8,964
08030204010	0	15	986	251	0	19	0	6	1,277
08030204011	7	5,795	4,491	21,370	86	14	0	35	31,797
08030204012	516	6,893	21,630	43,223	0	71	0	142	72,475
08030204013	45	517	44,953	2,080	0	2,507	747	245	51,095
08030204014	0	3,145	6,857	6,476	0	637	0	70	17,187
08030204037	1,034	8,211	49,726	15,647	41	2,735	480	745	78,619
08030204038	290	0	30,880	939	0	3,535	882	252	36,777
08030204039	474	0	69,300	2,442	0	7,075	794	959	81,044
Total	3,540	30,139	400,588	109,012	160	37,261	2,903	7,290	590,893
Percent	**1%**	**5%**	**68%**	**18%**	**0%**	**6%**	**0%**	**1%**	**100%**

Figure 5: Landuse Distribution Map for the Coldwater River Watershed



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.

Septic systems have the greatest impact on nonpoint source fecal coliform impairment in the Yazoo Basin. The best management practices needed to reduce this pollutant load need to prioritize elimination of septic tank loads from failures and improper use of individual onsite treatment systems.

3.2.2 Wildlife

Wildlife present in the Coldwater River Watershed contributes to fecal coliform bacteria on the land surface. For The Coldwater River calculations, all wildlife were accounted for by estimating a constant load for wildlife. It was assumed that the wildlife population remained constant throughout the year, and that wildlife were 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 Yazoo River 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 Yazoo River Basin operate by either keeping the animals confined or by allowing hogs to graze in a small pasture or pen. For this TMDL, 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.

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. Beef cattle have access to pastureland for grazing all of the time.

3.2.5 Land Application of Poultry Litter

There are no chickens sold in this area. There are very few layers and no broilers produced in the Coldwater River Watershed. The loading contribution from these few layers was considered insignificant.

3.2.6 Other Direct Inputs

Other direct inputs of fecal coliform includes 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 the Coldwater River was considered. Fecal coliform contributions from urban areas may come from storm water runoff, failing sewer pipes, runoff from construction sites, and runoff contribution from improper disposal of materials such as litter.

MASS BALANCE PROCEDURE

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 Calculation Framework Selection

A mass balance approach was used to calculate the TMDL. This method of analysis was selected due to the lack of a gage in the delineated watershed and the limited amount of water quality data available. 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)

where the conversion factor = $\frac{[28316.8 \text{ ml} * 60\text{s} * 60\text{min} * 24\text{hr} * 30\text{days}]}{100 \; 1\text{ft}^3 \; 1\text{min} \; 1\text{hr} \quad \text{day}}$

$= 7.35\text{E+08 ml } (\text{ft}^3)^{-1} \text{ s}$

4.2 Calculation of Flow

The average annual flow in the Coldwater River was estimated to be 2883 cfs. This value is the sum of the average annual discharge from the drainage area below Arkabutla Lake and the average annual discharge from Arkabutla Lake. The average annual discharge from the area below Arkabutla Lake was calculated using South Fork Tillatoba station 07280340 near Charleston, Mississippi, using the drainage area ratio method discussed in Low Flow And Flow Duration Characteristics of MS Streams (Telis, 1991.) For this TMDL, it was deemed necessary to add the average annual discharge from Arkabutla Lake to account for the upstream flow entering subwatershed 08030204014. Therefore, the calculations are as follows.

Avg Discharge (cfs)={[07280340 Avg Annual Discharge (cfs)]/[07280340 Drainage Area (square mile)]}*[Coldwater River Drainage Area (square mile)] + [Average Annual Discharge from Arkabutla Lake (cfs) (USACOE, Water Control Manual, 2000)]

Avg Discharge (cfs) = {{[86.1 (cfs)]/[53.9 (square mile)]}*[923 (square mile)] +1409 cfs}}

Avg Discharge (cfs) = 1474.4 (cfs) +1409 (cfs)

Avg Discharge (cfs) = 2883 cfs

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

Within this watershed, the contribution of each discharger was based on the facility's discharge monitoring data and other records of past performance. Table 10 lists the point source contributions, along with their existing load, allocated load, and percent reduction. .

Table 10: Wasteload Allocations

Subwatershed	Existing Flow (cfs)	Existing Load (counts/30 Days)	Allocated Flow (cfs)	Allocated Load (counts/30 Days)	Percent Reduction
08030204001	1.022	7.49E+11	1.022	1.50E+11	80
08030204006	0.325	1.19E+11	0.325	4.76E+10	60
08030204007	0.522	2.48E+12	0.522	7.63E+10	97
08030204011	0.012	3.63E+09	0.012	1.81E+09	50
08030204012	0.157	9.14E+10	0.157	2.30E+10	75
08030204014	0.116	2.63E+10	0.116	1.70E+10	35
08030204037	2.229	3.26E+11	2.229	3.26E+11	0
08030204039	1.954	9.86E+11	1.954	2.86E+11	71
Total	**6.337**	**4.78E+12**	**6.337**	**9.28E+11**	**81**

5.2 Existing Load

The existing load for the Coldwater River is calculated using the worse case fecal coliform value from station 07279300 and its measured flow during the period of January 1988 to November 1993. The new data at stations 29, 30, and 31 were not considered because of the lack of flow data. Since these are all new stations, there are no previous records of flow. Therefore, a flow was not calculated from the stage data given in Tables 3-5.

In calculating the existing load component, the seasonal water quality is taken into account. For the Coldwater TMDL, the summer existing load is based on a fecal coliform concentration of 2400 counts/100 ml and a flow of 3100 cfs. The resulting summer existing load is 5.46E+15 counts/30 days. The winter existing load is based on a fecal coliform concentration of 9200 counts/100 ml and 1020 cfs. The resulting winter existing load is 6.9E+15 counts/30 days.

Summer

Existing Load = Worst Case Measured Fecal Coliform Summer Value (counts/100 ml) * Measured Flow (cfs)

Existing Load = 2400 (counts/100 ml)*3100 (cfs)*7.35E+8 ml $(ft^3)^{-1}$ s

Existing Load = 5.46E+15 counts/30 days

Winter

Existing Load = Worst Case Measured Fecal Coliform Winter Value (counts/100 ml) * Measured Flow (cfs)

Existing Load = 9200 (counts/100 ml)*1020 cfs* 7.35E+8 ml $(ft^3)^{-1}$ s

Existing Load = 6.9E+15 counts/30 days

5.3 TMDL Load

The TMDL for the Coldwater River is calculated using the water quality criterion and the average annual flow. In calculating the TMDL, the seasonal water quality is reduced by a margin of safety. For the Coldwater River TMDL, the summer TMDL is based on a fecal coliform concentration of 180 counts/100 ml and the annual average flow of 2883 cfs. The resulting summer allocation is estimated to be 3.81E+14 counts/30 days. In calculating the winter TMDL, the water quality standard of 2000 counts/100 ml is used. The resulting winter TMDL is based on a fecal coliform concentration of 1800 counts/100 ml and the average annual flow of 2883 cfs. The resulting winter allocation is estimated to be 38.1E+14 counts/30 days.

Summer

TMDL Load = 180 (counts/100 ml) * 2883 (cfs) * 7.35E+8 ml $(ft^3)^{-1}$ s

TMDL Load = 3.81E+14 counts for 30 days

Winter

TMDL Load = 1800 (counts/100 ml) * 2883 (cfs) * 7.35E+8 ml $(ft^3)^{-1}$ s

TMDL Load = 38.11E+14 counts for 30 days

5.4 Incorporation of a Margin of Safety (MOS)

The two types of MOS development are to implicitly incorporate the MOS using conservative assumptions and/or to explicitly specify a portion of the total TMDL as the MOS. For this study, the MOS is incorporated explicitly and implicitly. By selecting the instream target concentration at 180 counts/100 ml for the summer and 1800 counts/100 ml for the winter, an explicit MOS is incorporated. Also, by using the maximum fecal coliform concentrations and their flows at station 07279300, a degree of MOS is assumed because the fecal concentrations will not be the maximum fecal concentrations indicated for the summer and winter 100 percent of the time. The resulting explicit load attributed to the MOS for the summer is 4.24E+13 counts/30 days and 42.4E+13 for the winter.

Summer

MOS = 20 (counts/100ml) * 2883 (cfs) * 7.35E+8 ml $(ft^3)^{-1}$ s

MOS = 4.24E+13 counts for 30 days

Winter

MOS = 200 (counts/100ml) * 2883 (cfs) * 7.35E+8 ml $(ft^3)^{-1}$ s

MOS = 42.4E+13counts for 30 days

5.5 Calculation of Load Allocation

The load allocation for the Coldwater River is calculated using the following equation

LA = TMDL –(WLA + MOS)

where WLA is the Waste Load Allocation, LA is the Load Allocation, and MOS is the Margin of Safety.

WLA = Total Allocated Contribution from NPDES Permitted Facilities listed in Table 10

LA = Surface Runoff + Other Direct Inputs

MOS = explicit value

Summer

LA = 3.81E+14 (Summer TMDL) - (9.28E+11(WLA) + 4.24E+13(Summer MOS))

LA = 3.39E+14 counts for 30 days

Winter

LA = 38.11E+14 (Winter TMDL)– (9.28E+11(WLA)+42.4E+13 (Winter MOS))

LA = 33.9E+14 counts for 30 days

5.5 Calculation of the Percent Reduction

The percent reduction is calculated from the following equation:

$$\% \text{ Reduction} = \frac{(\text{Existing Load} - \text{TMDL Load})}{\text{Existing Load}} * 100$$

Summer

$$\% \text{ Reduction} = \frac{(5.46\text{E+15 counts/30 days} - 3.81\text{E+14 counts for 30 days})}{5.46\text{E+15 counts/30 days}} * 100$$

% Reduction = 93.0

Winter

$$\% \text{ Reduction} = \frac{(6.9\text{E+15 counts/30 days} - 38.11\text{E+14 counts for 30 days})}{6.9\text{E+15 counts/30 days}} * 100$$

% Reduction = 44.8

Table 11. TMDL Summary for all 303(d) Listed Segments in Coldwater River Watershed (counts/30 days) Summer and Winter

	Summer	**Winter**
WLA	9.28E+11	9.28E+11
LA	3.39E+14	33.9E+14
MOS	4.24E+13	42.4E+13
TMDL = WLA + LA +MOS	**3.81E+14**	**38.11E+14**

5.6 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. MDEQ used the annual average flow for calculating this TMDL; therefore, the seasonal differences are incorporated in the averaging of the flow values.

5.7 Reasonable Assurance

This component of TMDL development does not apply to this TMDL Report. There are no point sources (WLA) requesting a reduction based on promised Load Allocation components and reductions. This TMDL will recommend that all point sources discharge treated and disinfected effluent that will be below the 200 colony counts per 100ml target at the end of the pipe.

CONCLUSION

The fecal coliform reduction scenario recommended by this TMDL includes requiring all NPDES Permitted dischargers of fecal coliform to meet water standards for disinfection, along with reducing their assumed existing load by 81%.

The TMDL will not impact existing or future NPDES Permits as long as the effluent is disinfected to meet water quality standards for pathogens. 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 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 Yazoo River Basin, the Coldwater River will receive additional monitoring to identify any change in water quality. The Coldwater River is also scheduled to receive monitoring in the fall. The purpose of this study will be to obtain samples adequate in quantity for providing a geometric mean for modeling. 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. 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 be included on the TMDL mailing list should contact Linda Burrell at (601) 961-5062 or Linda_Burrell@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 written 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

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 *n*th 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, ($\mathbf{d}_1$, $\mathbf{d}_2$, $\mathbf{d}_3$) 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, pon ds, 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

WLA .....Waste Load Allocation

REFERENCES

Horner, 1992. Water Quality Criteria/Pollutant Loading Estimation/Treatment Effectiveness Estimation. In R.W. Beck and Associates. Covington Master Drainage Plan. King County Surface Water Management Division, Seattle, WA.

Horsley & Whitten, Inc. 1996. Identification and Evaluation of Nutrient Bacterial Loadings to Maquoit Bay, Brunswick, and Freeport, Maine. Casco Bay Estuary Project.

Metccalf and Eddy. 1991. *Wastewater Engineering: Treatment, Disposal, Reuse*. 3rd Edition. McGraw-Hill, Inc., New York.

MDEQ. 1994. *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.* Office of Pollution Control.

MDEQ. 1995. *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. Office of Pollution Control.

MDEQ. 1998. *Mississippi List of Waterbodies, Pursuant to Section 303(d) of the Clean Water Act*. Office of Pollution Control.

MDEQ. 1998. *Mississippi 1998 Water Quality Assessment, Pursuant to Section 305(b) of the Clean Water Act*. Office of Pollution Control.

NCSU, 1994. *Livestock Manure Production and Characterization in North Carolina*, North Carolina Cooperative Extension Service, North Carolina State University (NCSU) College of Agriculture and Life Sciences, Raleigh, January 1994.

USEPA. 1998. *Better Assessment Science Integrating Point and Nonpoint Sources, BASINS, Version 2.0 User's Manual*. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.