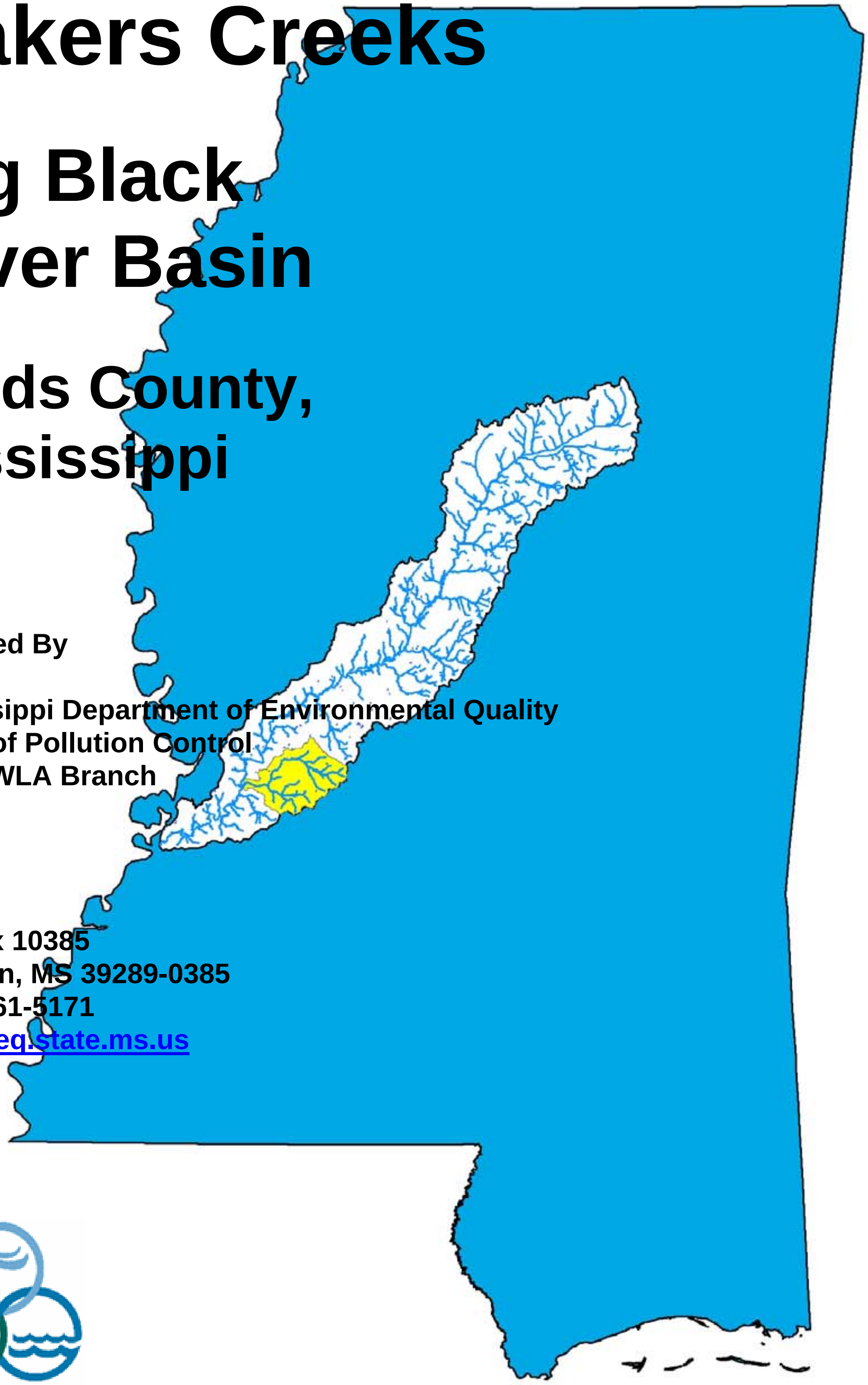
FINAL REPORT
June 2006
ID: 106040101

Fecal Coliform TMDL for Fourteen Mile and Bakers Creeks

Big Black River Basin

Hinds County, Mississippi



Prepared By

Mississippi Department of Environmental Quality
Office of Pollution Control
TMDL/WLA 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 water body segments found on Mississippi's 1996 Section 303(d) List of Impaired Waterbodies. Because of the accelerated schedule required by the consent decree, many of these TMDLs have been prepared out of sequence with the State's rotating basin approach. The implementation of the TMDLs contained herein will be prioritized within Mississippi's rotating basin approach.

The amount and quality of the data on which this report is based is 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	0.00156	Days	Seconds	86400
Cubic feet	Cu. Meter	0.02832	Feet	Meters	0.3048
Cubic feet	Gallons	7.4805	Gallons	Cu feet	0.13368
Cubic feet	Liters	28.316	Hectares	Acres	2.4711
cfs	Gal/min	448.83	Miles	Meters	1609.34
cfs	MGD	0.64632	Mg/l	ppm	1
Cubic meters	Gallons	264.173	µg/l * cfs	Gm/day	2.45

CONTENTS

PHOTOS

FIGURES

TABLES

TMDL INFORMATION PAGE

Listing Information

Name	ID	County	HUC	Cause	Mon/Eval
Fourteen Mile Creek	MS441FE	Hinds	08060202	Pathogens	Evaluated
Near Newman from headwaters to mouth at Big Black River					
Bakers Creek	MS441BE	Hinds	08060202	Pathogens	Evaluated
Near Morning Star from headwaters to mouth at Fourteen Mile Creek					

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 based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 400 per 100ml more than 10% of the time. **November – April**: Fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 4000 per 100 ml more than 10% of the time.

NPDES Facilities

NPDES ID	Facility Name	Receiving Water
MS0054984	Bolton Edwards School	UNT of Bakers Creek
MS0021032	Bolton POTW	Bakers Creek
MS0059641	Campbells Warehouse	UNT of Smith Creek
MS0030015	Central Hinds Academy	Snake Creek
MS0055921	Central Mississippi Research and Extension Center	Snake Creek
MS0054992	Clinton POTW, Southside	Bakers Creek
MS0022250	Country Oaks Mobile Home Park	UNT of Bakers Creek
MS0036382	Edwards POTW, Southeast	Bakers Creek
MS0036277	Gulf States Canners Inc	UNT of Little Bakers Creek
MS0043745	Pine Lakes Village, Inc.	UNT of Bakers Creek
MS0051772	Raymond POTW	Fourteen Mile Creek
MS0025852	Raymond POTW, East	Snake Creek
MS0042102	Saint Thomas Headstart	UNT of Little Bakers Creek
MS0058092	Speedway Mobile Home Park	UNT of Lindsey Creek
MS0031186	United Pentecostal Campground	UNT of Bakers Creek
MS0031453	West View Subdivision	UNT of Little Bakers Creek

Fourteen Mile Creek

Season	WLA (counts per 30 days)	LA (counts per 30 days)	MOS (counts per 30 days)	Total TMDL (counts per 30 days)	TMDL Percent Reduction
Summer	3.41E+10	2.53E+13	2.82E+12	2.82E+13	52%
Winter	3.41E+11	8.45E+13	9.43E+12	9.43E+13	0%

Bakers Creek

Season	WLA (counts per 30 days)	LA (counts per 30 days)	MOS (counts per 30 days)	Total TMDL (counts per 30 days)	TMDL Percent Reduction
Summer	1.10E+12	1.33E+13	1.60E+12	1.60E+13	80%
Winter	1.08E+13	3.73E+13	5.35E+12	5.35E+13	0%

EXECUTIVE SUMMARY

A fecal coliform TMDL has been developed for the evaluated water body segments of Fourteen Mile and Bakers Creeks, MS441FE and MS441BE, respectively, which are on the Mississippi 2004 Section 303(d) List of Impaired Water Bodies. The segments are listed for pathogens based on anecdotal information, but impairment has been verified through recent monitoring. These recent monitoring data were assessed based on the 2002 *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. MDEQ selected fecal coliform as an indicator organism for pathogenic bacteria for monitoring and TMDL development.

Fourteen Mile Creek flows in a northwesterly direction from its headwaters near Oakley to the confluence with the Big Black River in Hinds County. Bakers Creek flows in a westerly direction from its headwaters near Clinton to the confluence with Fourteen Mile Creek. The locations of Fourteen Mile and Bakers Creeks are shown in Figure 1. This TMDL has been developed for both creeks from their headwaters until their confluence with their receiving water bodies. Due to data limitations, complex dynamic modeling was inappropriate for performing the TMDL allocations for this study, as were load duration curves. Therefore, a mass balance approach was used to develop the TMDL for segments MS441FE and MS441BE.

Fecal coliform loadings from point and nonpoint sources in the watershed are described in a source assessment that was conducted for the Fourteen Mile and Bakers Creeks watershed, but they are not explicitly represented with a model. Nonpoint sources of fecal coliform include livestock, wildlife, urban development, failing septic systems, and other direct inputs to both Fourteen Mile and Bakers Creeks.

There are 16 NPDES Permitted discharges included as point sources in the waste load allocation (WLA). None of the permitted facilities will require changes to their existing NPDES permit because they already include disinfection to meet water quality standards for pathogens at the end of their pipe or are exempt. Monitoring of the permitted facilities should continue to ensure that compliance with permit limits is consistently attained.

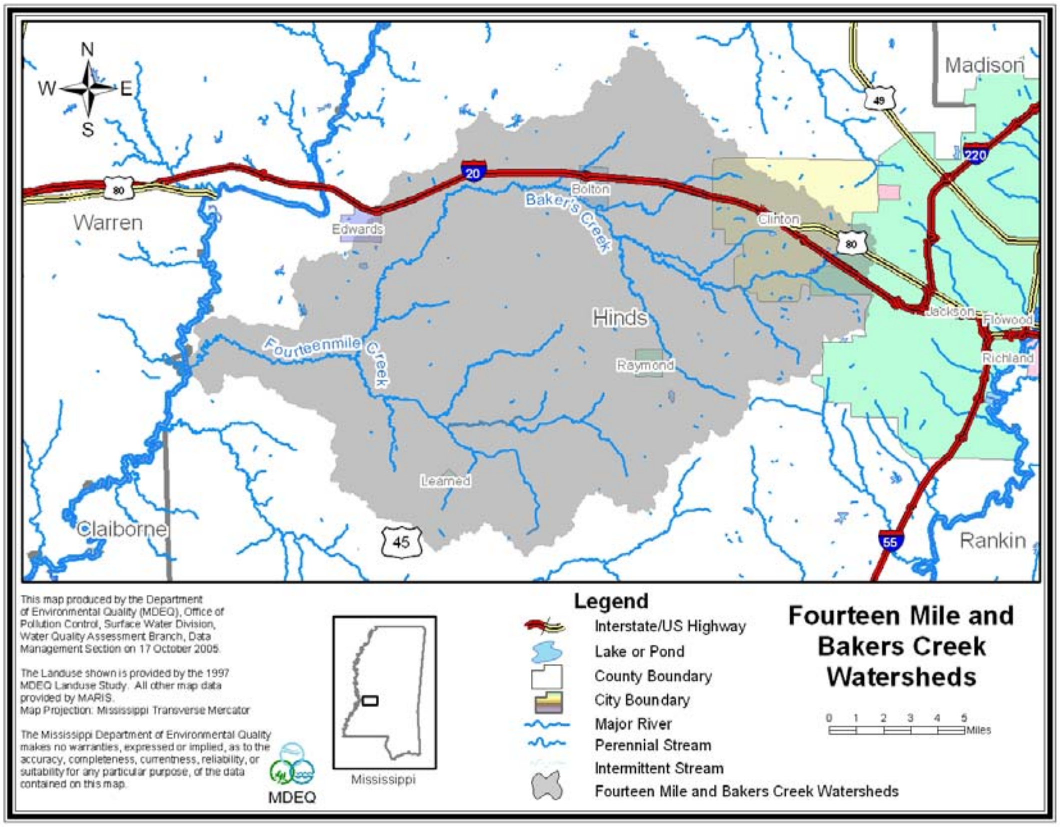
The seasonal variations in hydrology, climatic conditions, and watershed activities are represented through the use of a seasonal TMDL based on seasonal average flows and seasonal monitoring. The critical period for both water bodies was determined to be the summer season. Water quality data indicate violations of both portions of the fecal coliform standard in the two water bodies.

The TMDL for Fourteen Mile and Bakers Creeks was calculated using a mass balance procedure. In order to account for uncertainty in the mass balance procedure an explicit 10% margin of safety (MOS) was used. The estimated reduction of fecal coliform for each water body segment is shown in Table 1.

Table 1. Estimated Fecal Coliform Reductions

Name	ID	Summer % Reduction
Fourteen Mile Creek	MS441FE	52%
Bakers Creek	MS441BE	80%

Figure 1. Location of the Fourteen Mile and Bakers Creeks Watershed



INTRODUCTION

1.1 Background

The identification of water bodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those water bodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR part 130). The TMDL process is designed to restore and maintain the quality of those impaired water bodies through the establishment of pollutant specific allowable loads. The pollutant of concern for this TMDL is pathogens as indicated by fecal coliform. Fecal coliform bacteria are used as indicator organisms because they are readily identifiable and indicate the possible presence of other pathogenic organisms in the water body. 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.

A TMDL has been developed for the 303(d) listed segments MS441FE, Fourteen Mile Creek, and MS441BE, Bakers Creek. Fourteen Mile Creek, Photo 1, is a 25.4 mile segment that flows in a northwesterly direction from its headwaters near Oakley to the confluence with the Big Black River in Hinds County. Bakers Creek, Photo 2, is a 35.0 mile segment that flows in a westerly direction from its headwaters near Clinton to the confluence with Fourteen Mile Creek. The 303(d) listed segments for both creeks are shown in Figure 2. Segments MS441FE and MS441BE are listed on Mississippi's 2004 Section 303(d) List as evaluated for pathogens based on anecdotal information. These segments have recently had data collected that confirmed impairment. The fecal coliform data that were recently collected for these segments are listed in Section 2.2.

Figure 2. Fourteen Mile and Bakers Creeks Watershed Segments

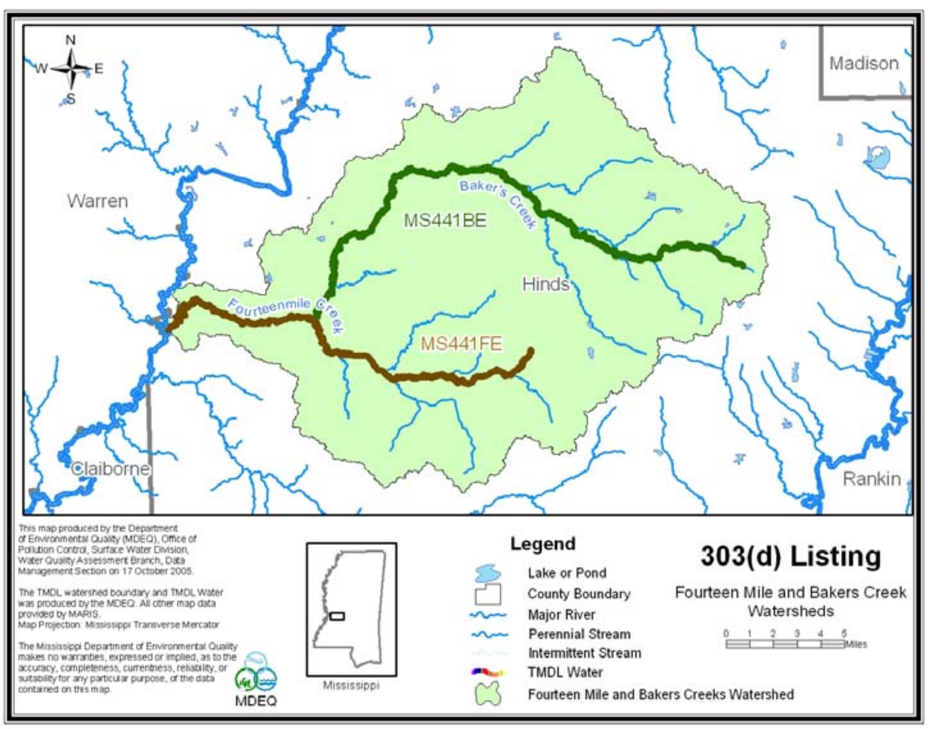
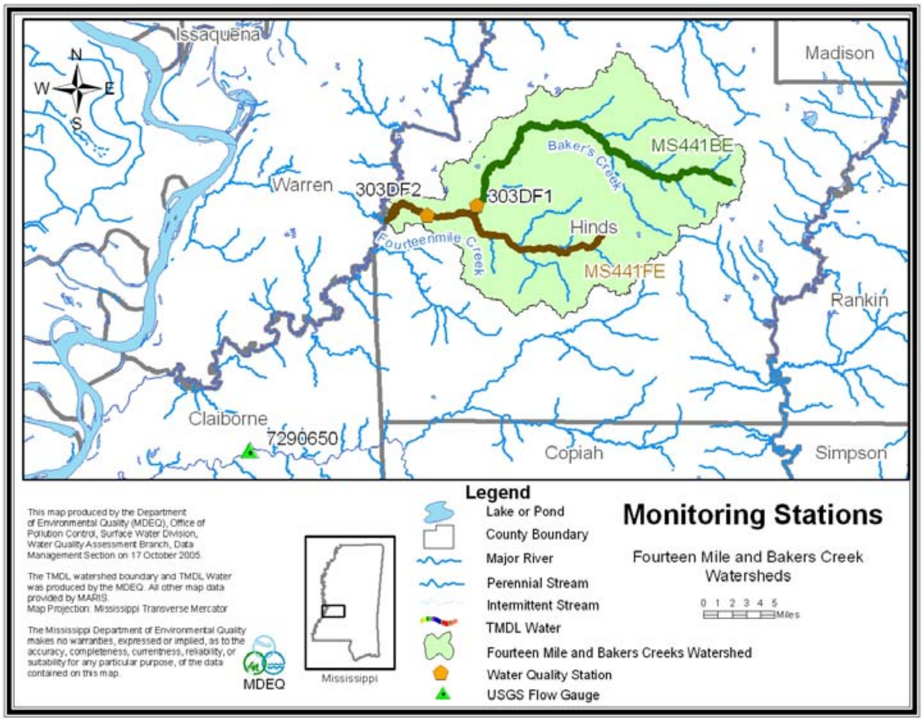


Photo 1. Fourteen Mile Creek at Middle Road

Photo 2. Bakers Creek at Mt. Moriah Road

This TMDL was developed using a mass balance method. This method is an applicable method for TMDL development when quality data are collected in a manner consistent with the water quality standards, which is at least 5 samples collected within a 30 day period. The mass balance method requires water quality data and flow data. The water body segments along with the location of the water quality station and flow gage are shown in Figure 3. The TMDL for segments MS441FE and MS441BE were developed using the mass balance method with water quality data from stations 303DF2 and 303DF1 and flow data from gage 07290650 on Bayou Pierre near Willows, MS.

Figure 3. 303(d) Segments with Water Quality Stations and Flow Gage



Both Fourteen Mile and Bakers Creek are in Hydrologic Unit Code (HUC) 08060202 in Central Mississippi. The watershed is approximately 163,019 acres and is primarily rural. The dominant landuse for the watershed is pasture. For this fecal coliform TMDL, the entire watershed is included.

1.2 Applicable Water Body Segments Use

The water use classification for the listed segments of Fourteen Mile and Bakers Creeks, as established by the State of Mississippi in the 2002 *Water Quality Criteria for Intrastate, Interstate and Coastal Waters*, is Fish and Wildlife Support. The designated beneficial uses for Fourteen Mile and Bakers Creeks are Secondary Contact and Aquatic Life Support. Secondary Contact is defined as incidental contact with the water during activities such as wading, fishing and boating, that are not likely to result in full body immersion.

1.3 Applicable Water Body Segments Standard

The water quality standard applicable to the use of the water body and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (2002). The standard for fecal coliform is different for summer and winter for a secondary contact use, where summer is defined as the months of May through October, and winter is defined as the months of November through April. For the summer months the fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 400 per 100 ml more than 10% of the time. For the winter months, the fecal coliform colony counts shall not exceed a geometric mean of 2000 colonies per

100 ml, based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 4000 per 100 ml more than 10% of the time. The water quality standard was used to assess the data to determine impairment in the water body.

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. MDEQ's fecal coliform standard allows for a statistical review of any fecal coliform data set. There are two tests, the geometric mean test and the 10% test, that the data set must pass to show acceptable water quality.

The geometric mean test states that for the summer the fecal coliform colony count shall not exceed a geometric mean of 200 per 100 ml based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples and for the winter the fecal coliform colony count shall not exceed a geometric mean of 2000 per 100 ml based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples. The 10% test states that for the summer the samples examined during a 30-day period shall not exceed a count of 400 per 100 ml more than 10% of the time and for the winter the samples examined during a 30-day period shall not exceed a count of 4000 per 100 ml more than 10% of the time.

2.1.1 Discussion of the Geometric Mean Test

The level of fecal coliform found in a natural water body varies greatly depending on several independent factors such as temperature, flow, or distance from the source. This variability is accentuated by the standard laboratory analysis method used to measure fecal coliform levels in the water. The membrane filtration (MF) method uses a direct count of bacteria colonies on a nutrient medium to estimate the fecal level. The fecal coliform colony count per 100 ml is determined using an equation that incorporates the dilution and volume to the sample filtered.

The geometric mean test is used to dampen the impact of the large numbers when there are smaller numbers in the data set. The geometric mean is calculated by multiplying all of the data values together and taking the root of that number based on the number of samples in the data set.

$$G = \sqrt[n]{s1 * s2 * s3 * s4 * s5 * sn}$$

The water quality standard requires a minimum of 5 samples be used to determine the geometric mean. MDEQ routinely gathers 6 samples within a 30-day period in case there is a problem with one of the samples. It is conceivable that there would be more samples available in an intensive survey, but typically each data set will contain 6 samples therefore, n would equal 6. For the data set to indicate no impairment, the result must be less than or equal to 200 in summer and 2000 in winter.

2.1.2 Discussion of the 10% Test

The 10% test looks at the data set as representing the 30 days for 100% of the time. The data points are sorted from the lowest to the highest and each value then represents a point on the curve from 0% to 100% or from day 1 to day 30. The lowest value becomes the 1st data point and the highest data point becomes the nth data point. The water quality standard requires that 90% of the time, the counts of fecal coliform in the stream be less than or equal to 400 counts per 100 ml in summer and 4000 counts per 100 ml in winter.

By calculating a concentration of fecal coliform for every percentile point based on the data set, it is possible to determine a curve that represents the percentile ranking of the data set. Once the 90th percentile of the data set has been determined, it may be compared to the standard of 400 counts per 100 ml. If the 90th percentile of the data is greater than 400, then the stream will be considered impaired. This can be used not only to assess actual water quality data, but also computer generated daily average model results. Actual water quality data will typically have 5 or 6 values in the data set, and computer generated model results would have 30 daily values.

2.1.3 Discussion of Combining the Tests

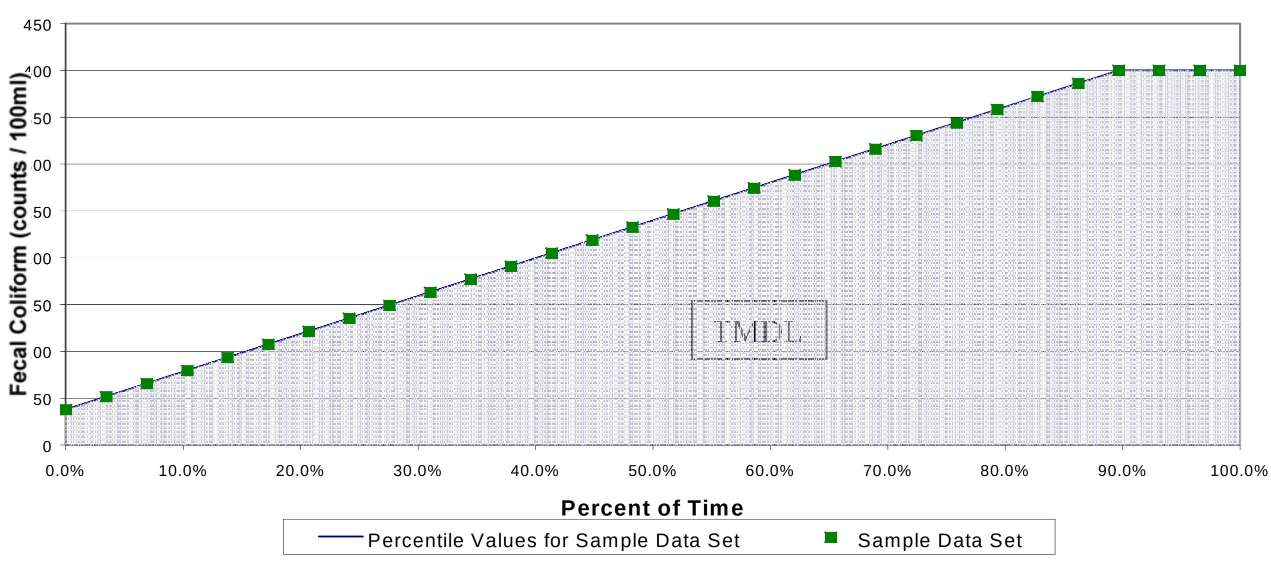
MDEQ determined a theoretical maximum allowable load data set that meets both portions of the water quality standard and is indicative of possible water quality conditions. This theoretical maximum allowable load data set is shown in Table 2. The theoretical maximum allowable load data set was constructed to represent the maximum amount of fecal coliform per day that will still meet both portions of the water quality standard. The theoretical maximum allowable load data set was then plotted, generating a theoretical maximum allowable load data set curve. This curve can be seen in Figure 4. The integral of the theoretical maximum allowable load data set curve is used for mass balance TMDL calculations. By multiplying the integral of the theoretical maximum allowable load data set curve by the flow in a given water body, the mass balance TMDL is calculated.

When actual data are collected from a water body, and the data are plotted in a similar way, an existing load can be calculated based on the integral of the existing load curve and the flow in the water body. This existing load can be compared to the TMDL calculated using the theoretical maximum allowable load data set curve to determine the percent reduction of fecal coliform necessary for the water body to meet both portions of the water quality standard, the geometric mean test and the 10% test.

Table 2. Theoretical Capacity Data Set

Fecal Coliform (counts/100ml)	Percentile Ranking
37.82	0.0%
51.75	3.4%
65.68	6.9%
79.61	10.3%
93.54	13.8%
107.47	17.2%
121.4	20.7%
135.33	24.1%
149.26	27.6%
163.19	31.0%
177.12	34.5%
191.05	37.9%
204.98	41.4%
218.91	44.8%
232.84	48.3%
246.77	51.7%
260.7	55.2%
274.63	58.6%
288.56	62.1%
302.49	65.5%
316.42	69.0%
330.35	72.4%
344.28	75.9%
358.21	79.3%
372.14	82.8%
386.07	86.2%
400	89.7%
400	93.1%
400	96.6%
400	100.0%

Figure 4. Theoretical Capacity Curve



2.1.4 Discussion of the Targeted Endpoint

While the endpoint of a TMDL calculation is similar to a standard for a pollutant, the endpoint is not the standard. For a mass balance TMDL, the endpoint selected is both portions of the standard, that is the geometric mean test and the 10% test. Meeting the geometric mean test and applying the 10% test to the data sets applies both parts of the standard to an actual data set or when considering a computer generated data set. It is therefore appropriate to select both portions of the standard as the targeted endpoint for the mass balance TMDL.

2.1.5 Discussion of the Critical Condition for Fecal Coliform

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. Therefore, an examination of the data is needed to determine the critical 30-day period to be used for the TMDL.

2.2 Discussion of Instream Water Quality

Monitoring was performed in a manner consistent with the water quality standards. At least 5 samples were collected in a 30-day period, at stations 1 and 2 in segments MS441BE and MS441FE during three summer seasons and two winter seasons in 2001, 2002, 2003, and 2004.

2.2.1 Inventory of Available Water Quality Monitoring Data

The data collected at Station 2 on Fourteen Mile Creek is provided in Tables 3 through 7 and the data collected at Station 1 on Bakers Creek is provided in Tables 8 through 12.

Fourteen Mile Creek

Table 3. Fecal Coliform Data reported in Fourteen Mile Creek, Station 2
Winter 2001

Date and Time	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Test Violation	90th Percentile	10% Test Violation
12/4/01 14:00	820	431	No, geometric mean is less than 2000	2412	No, 90th percentile is less than 4000
12/5/01 13:00	320				
12/7/01 12:30	210				
12/10/01 13:30	150				
12/12/01 12:45	250				
12/19/01 13:15	4800				
12/21/01 12:45	280				

Table 4. Fecal Coliform Data reported in Fourteen Mile Creek, Station 2
Summer 2002

Date and Time	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Test Violation	90^{th} Percentile	10% Test Violation
5/1/02 11:20	100	33	No, geometric mean is less than 200	91	No, 90^{th} percentile is less than 400
5/3/02 10:28	27				
5/6/02 10:20	50				
5/8/02 12:00	81				
5/10/02 10:15	31				
5/14/02 11:35	4				

Table 5. Fecal Coliform Data reported in Fourteen Mile Creek, Station 2
Winter 2003

Date and Time	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Test Violation	90^{th} Percentile	10% Test Violation
3/17/03 14:30	96	227	No, geometric mean is less than 2000	2700	No, 90^{th} percentile is less than 4000
3/21/03 13:15	5200				
3/24/03 13:20	200				
3/26/03 13:40	85				
3/28/03 13:15	100				
3/31/03 13:30	160				

Table 6. Fecal Coliform Data reported in Fourteen Mile Creek, Station 2
Summer 2003

Date and Time	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Test Violation	90^{th} Percentile	10% Test Violation
8/1/03 13:15	1080	640	Yes, geometric mean is greater than 200	3540	Yes, 90^{th} percentile is greater than 400
8/6/03 12:45	440				
8/8/03 12:50	800				
8/11/03 13:40	155				
8/15/03 12:20	6000				
8/18/03 13:15	195				

Table 7. Fecal Coliform Data reported in Fourteen Mile Creek, Station 2
Summer 2004

Date and Time	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Test Violation	90^{th} Percentile	10% Test Violation
7/16/04 10:10	150	410	Yes, geometric mean is greater than 200	3280	Yes, 90^{th} percentile is greater than 400
7/19/04 10:45	420				
7/21/04 10:50	225				
7/23/04 10:00	100				
7/26/04 10:15	6000				
7/29/04 10:00	560				

Bakers Creek

Table 8. Fecal Coliform Data reported in Bakers Creek, Station 1
Winter 2001

Date and Time	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Test Violation	90th Percentile	10% Test Violation
12/4/01 13:20	320	384	No, geometric mean is less than 2000	2216	No, 90th percentile is less than 4000
12/5/01 12:15	300				
12/7/01 11:50	180				
12/10/01 13:00	140				
12/12/01 12:00	360				
12/19/01 12:00	5000				
12/21/01 12:10	280				

Table 9. Fecal Coliform Data reported in Bakers Creek, Station 1
Summer 2002

Date and Time	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Test Violation	90th Percentile	10% Test Violation
5/1/02 11:00	200	140	No, geometric mean is less than 200	215	No, 90th percentile is less than 400
5/3/02 10:45	104				
5/6/02 10:38	130				
5/8/02 12:15	110				
5/10/02 10:35	230				
5/14/02 12:00	110				

Table 10. Fecal Coliform Data reported in Bakers Creek, Station 1
Winter 2003

Date and Time	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Test Violation	90th Percentile	10% Test Violation
3/17/03 13:45	200	205	No, geometric mean is less than 2000	2150	No, 90th percentile is less than 4000
3/21/03 12:30	4100				
3/24/03 12:45	115				
3/26/03 13:10	81				
3/28/03 13:45	104				
3/31/03 14:00	92				

Table 11. Fecal Coliform Data reported in Bakers Creek, Station 1
Summer 2003

Date and Time	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Test Violation	90th Percentile	10% Test Violation
8/1/03 12:30	6000	1674	Yes, geometric mean is greater than 200	6000	Yes, 90th percentile is greater than 400
8/6/03 12:15	860				
8/8/03 12:15	3100				
8/11/03 13:00	1700				
8/15/03 13:50	6000				
8/18/03 13:45	135				

Table 12. Fecal Coliform Data reported in Bakers Creek, Station 1
Summer 2004

Date and Time	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Test Violation	90th Percentile	10% Test Violation
7/16/04 11:00	300	347	Yes, geometric mean is greater than 200	1010	Yes, 90th percentile is greater than 400
7/19/04 11:15	840				
7/21/04 9:50	165				
7/23/04 10:40	125				
7/29/04 10:30	285				
8/3/04 10:00	1180				

2.2.2 Analysis of Instream Water Quality Monitoring Data

For segment MS441FE, Fourteen Mile Creek and segment MS441BE, Bakers Creek the data collected at the representative stations during the summer monitoring periods of 2003 and 2004 indicate a violation of the geometric mean portion of the standard and the percent of time in exceedence.

A graphical representation of the data for MS441FE and MS441BE can be seen below in Figures 5 through 8. A line has been added to the graphs representing 400 counts/100 ml and showing that this occurs less than 90% of the time, meaning that the counts of fecal coliform in the stream are greater than 400 more than 10% of the time. However, the data collected during the two winter monitoring periods and the 2002 summer monitoring period indicated no violations of either portion of the standard. Since the violations occurred during the summer seasons, it is considered the critical period for both Fourteen Mile and Bakers Creeks.

Fourteen Mile Creek

Figure 5. 10% Test Curve for Station 2, Summer 2003

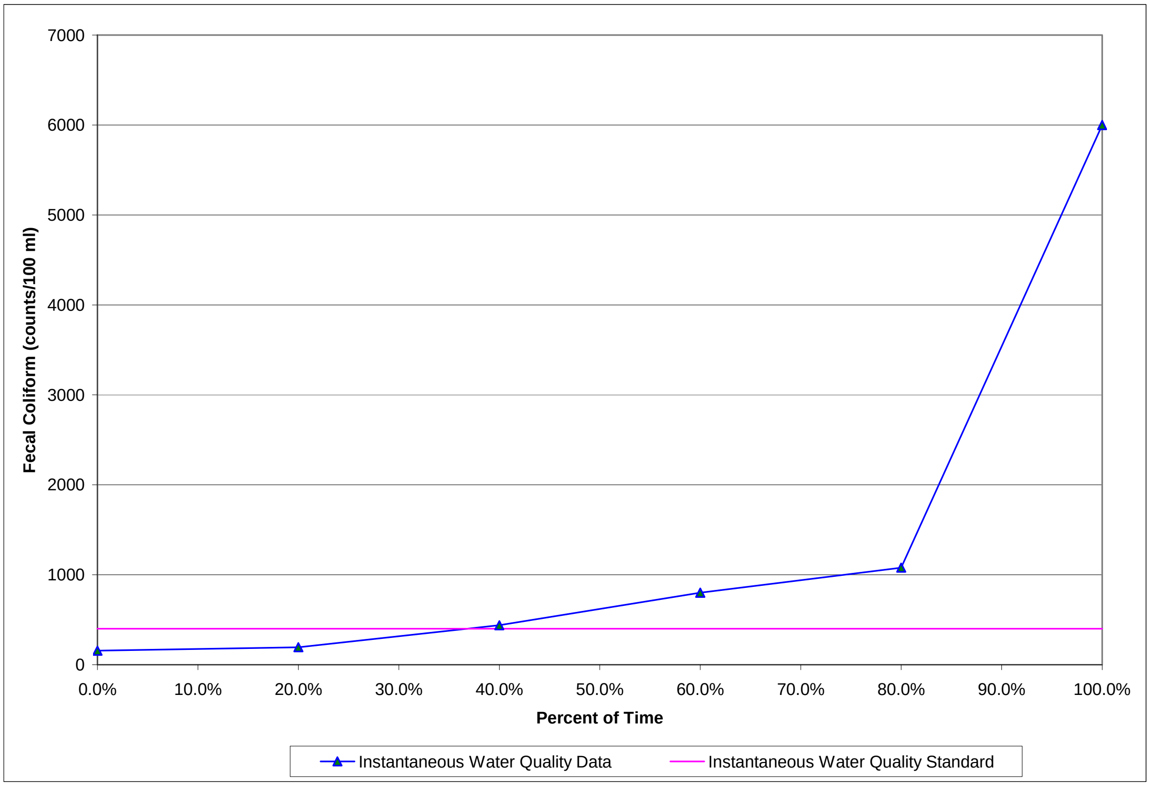
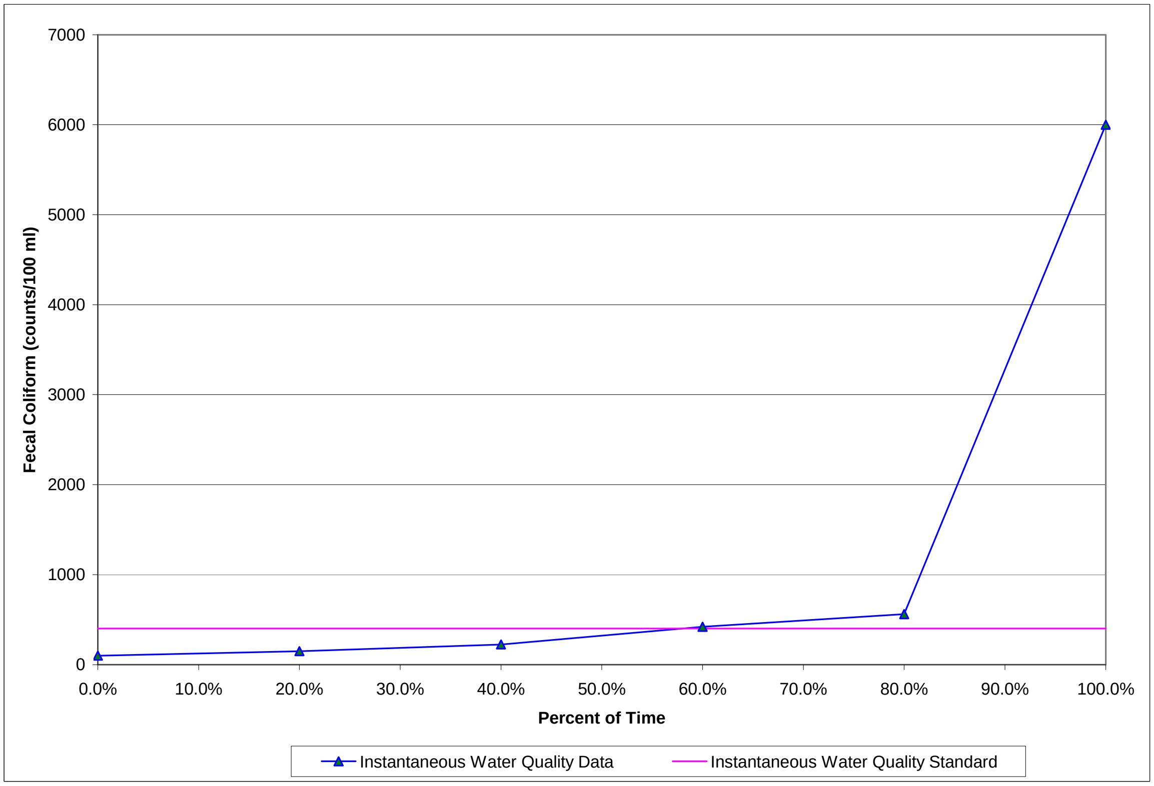


Figure 6. 10% Test Curve for Station 2, Summer 2004



Bakers Creek

Figure 7. 10% Test Curve for Station 1, Summer 2003

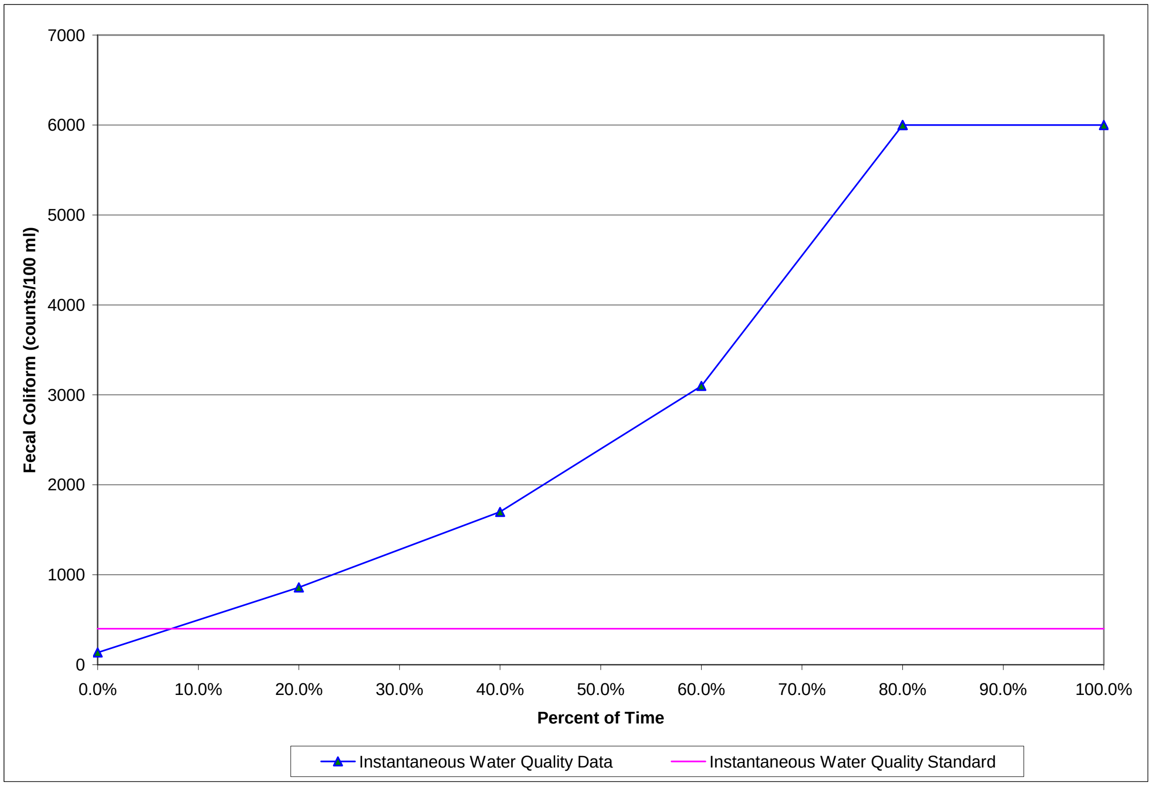
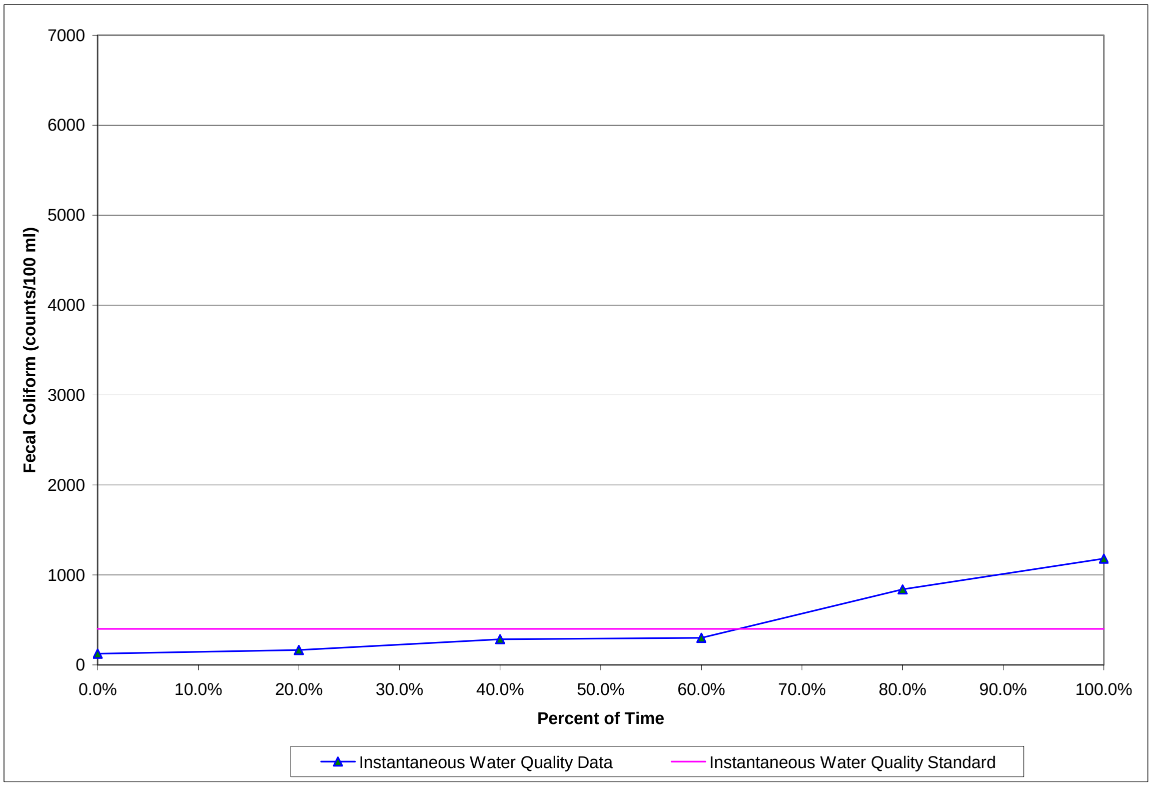


Figure 8. 10% Test Curve for Station 1, Summer 2004



SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known potential fecal coliform sources in the Fourteen Mile and Bakers Creeks 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.

The effluent from all NPDES permitted facilities was characterized based on all available monitoring data including permit limits, discharge monitoring reports, and information on treatment type. Several of the permitted facilities in the Fourteen Mile and Bakers Creek watershed have had permit violations during the past several years. These compliance issues are being handled by MDEQ's Environmental Compliance and Enforcement Division (ECED). The receiving water body and the flow for all NPDES facilities are shown in Table 13.

Table 13. Inventory of Point Source Dischargers

NPDES ID	Facility Name	Receiving Water	Design Flow (MGD)
MS0054984	Bolton Edwards School	UNT of Bakers Creek	0.0192
MS0021032	Bolton POTW	Bakers Creek	0.21
MS0059641	Campbells Warehouse	UNT of Smith Creek	0.0015
MS0030015	Central Hinds Academy	Snake Creek	0.014
MS0055921	Central Mississippi Research and Extension Center	Snake Creek	0.0015
MS0054992	Clinton POTW, Southside	Bakers Creek	3.5
MS0022250	Country Oaks Mobile Home Park	UNT of Bakers Creek	0.01
MS0036382	Edwards POTW, Southeast	Bakers Creek	0.33
MS0036277	Gulf States Canners Inc	UNT of Little Bakers Creek	0.098
MS0043745	Pine Lakes Village, Inc.	UNT of Bakers Creek	0.021
MS0051772	Raymond POTW	Fourteen Mile Creek	0.15
MS0025852	Raymond POTW, East	Snake Creek	0.6
MS0042102	Saint Thomas Headstart	UNT of Little Bakers Creek	0.0015
MS0058092	Speedway Mobile Home Park	UNT of Lindsey Creek	0.001
MS0031186	United Pentecostal Campground	UNT of Bakers Creek	0.015
MS0031453	West View Subdivision	UNT of Little Bakers Creek	0.032

3.2 Assessment of Nonpoint Sources

There are many potential nonpoint sources of fecal coliform bacteria for Fourteen Mile and Bakers Creeks, including:

- Grazing animals
- CAFOs

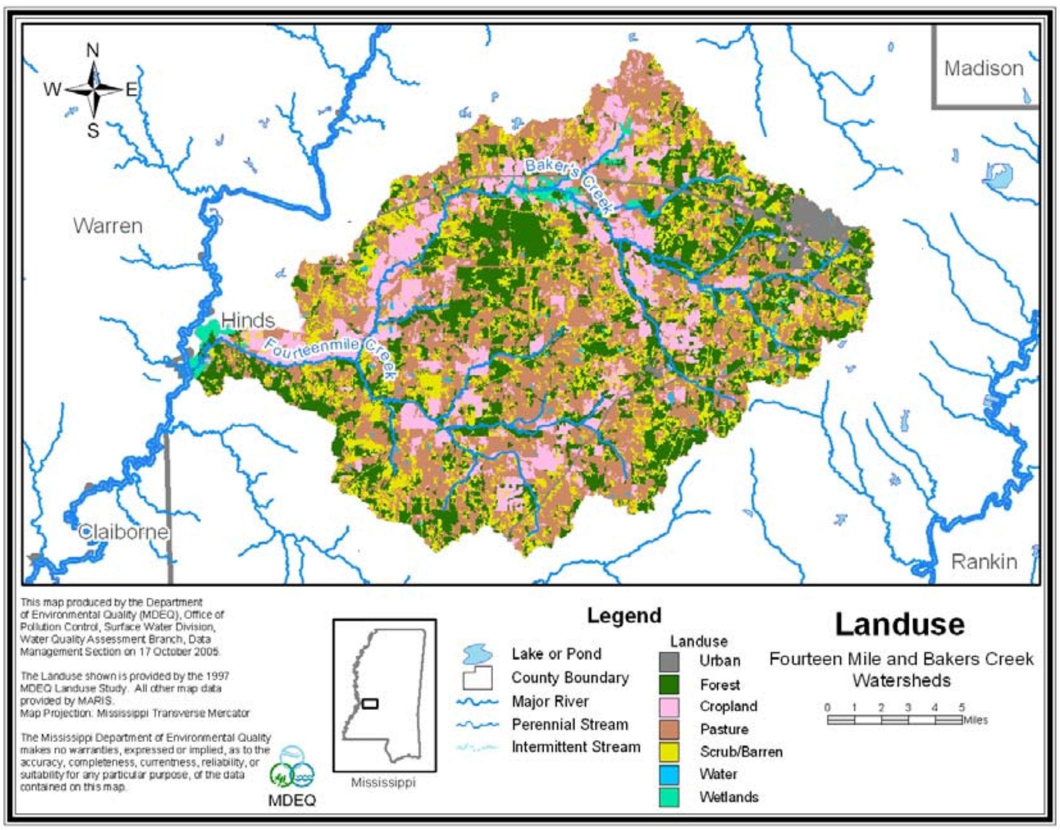
- Failing septic systems
- Wildlife
- Urban development
- Other Direct Inputs

The 163,019 acre drainage area of Fourteen Mile and Bakers Creeks contains many different landuse types, including urban, forest, cropland, pasture, scrub/barren, water, and wetlands. The area directly surrounding the impaired segments, MS441FE and MS441BE, is predominantly agricultural. The landuse distribution for the watershed is provided in Table 14 and displayed in Figure 9. The 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, disturbed, wetlands, and water.

Table 14. Landuse Distribution (acres)

	Urban	Forest	Cropland	Pasture	Scrub/Barren	Wetland	Water	Total
Area (acres)	5,005	43,547	23,023	56,188	31,740	2,524	992	163,019
% Area	3.1%	26.7%	14.1%	34.5%	19.5%	1.5%	0.6%	100%

Figure 9. Landuse Distribution Map for the Fourteen Mile and Bakers Creeks Watershed



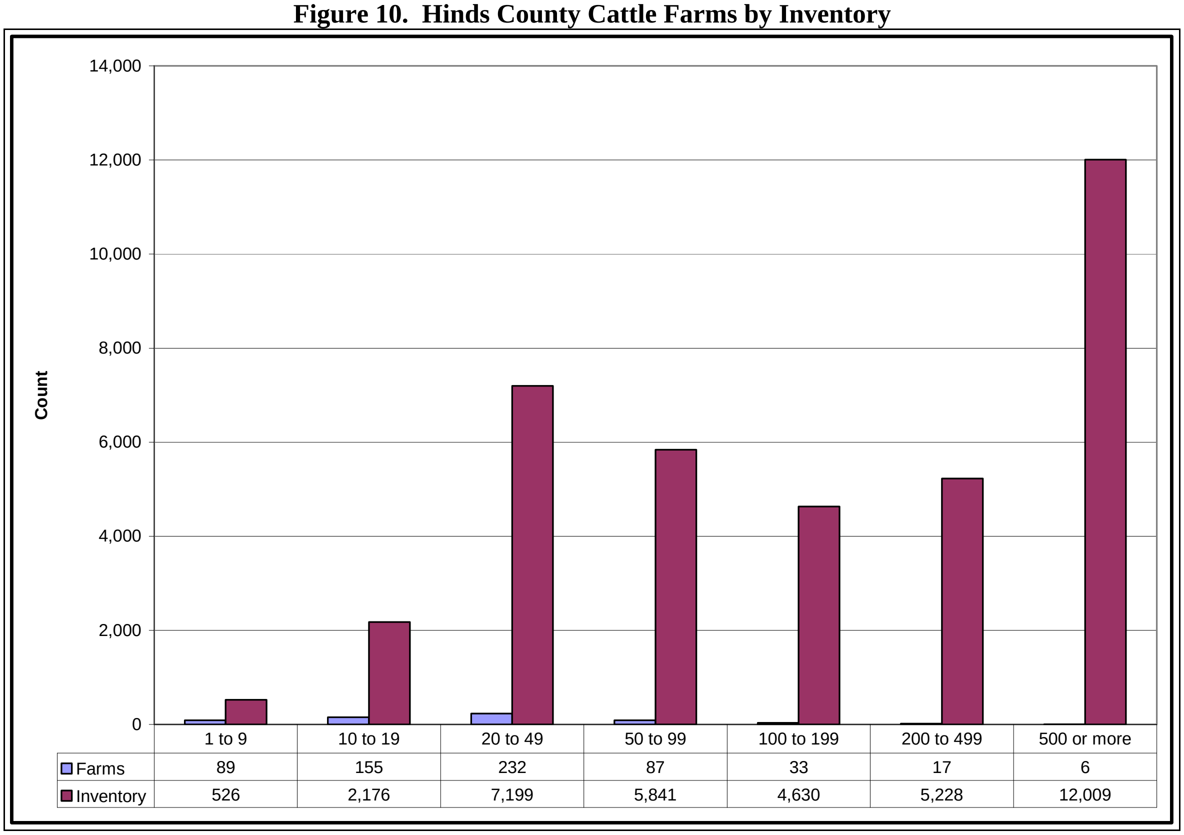
3.2.1 Beef and Dairy Cattle

Grazing cattle deposit manure on pastureland where it is available for wash-off and delivery to receiving water bodies. Beef cattle have access to pastureland for grazing all of the time. For dairy cattle, the dry cattle and heifers have access to pastureland for grazing all of the time. Manure produced by grazing beef and dairy cows is directly deposited onto pastureland and is available for wash off.

Large dairy farms, over 200 head, typically confine the milking herd at all times. Small dairy farms confine the lactating cattle for a limited time during the day for milking and feeding. The manure collected during confinement is applied to the available pastureland in the watershed. Application rates of dairy cow manure to pastureland vary monthly according to management practices currently used in this area.

Based on *2002 Census of Agriculture* produced by the National Agriculture Statistics Service, Hinds County has 619 cattle farms, with a combined total of over 37,000 head of cattle. In 2002, there were 24 farms with greater than 200 head of beef cows or other cattle. These cattle are primarily beef cattle, heifers, steers, and bulls. There is only one farm in Hinds County with greater than 200 head of dairy cattle.

Figure 10. Hinds County Cattle Farms by Inventory



	1 to 9	10 to 19	20 to 49	50 to 99	100 to 199	200 to 499	500 or more
Farms	89	155	232	87	33	17	6
Inventory	526	2,176	7,199	5,841	4,630	5,228	12,009

3.2.2 Combined Animal Feeding Operations (CAFOs)

In the Fourteen Mile and Bakers Creek watershed there is at least one Combined Animal Feeding Operation (CAFO), Cal-Maine Farms. The facility is located about 4 miles southeast of Edwards in

Hinds County. The facility consists of a combined dairy farm and chicken egg farm. The chicken egg farm can be further divided into layer hens, layer pullets, and layer breeders.

As of 2002, the facility had a capacity of approximately 1,440 dairy cattle, 2,021,400 layer hens, 782,000 layer pullets, and 75,000 layer breeders. Waste from the dairy operation is flushed or drained to two primary anaerobic lagoons. Then it is transferred to two storage lagoons before land application using center pivot irrigation systems. The waste from the layer hen operations is also flushed to primary anaerobic lagoons. The wastewater is then removed from the lagoons and land applied using center pivot irrigation systems, as needed to maintain the proper functionality of the lagoons. The solids are also removed from the lagoon and land applied then disked as needed. The wastewater can also be transferred between lagoon systems to optimize the use of their capacity when land application is not possible. There are approximately 1,724 acres of crop land and 1,994 acres of pasture land on Cal-Maine properties available for land application either by center pivot irrigation, traveling rigs, or spreading and disking. Approximately 450 of the 3,718 acres available for land application are located off site of the main facility. There are no direct surface water discharges from this facility, all wastewater and waste is land applied.

3.2.3 Wildlife

Wildlife present in the Fourteen Mile and Bakers Creeks Watershed contributes to fecal coliform bacteria on the land surface which is then available for wash-off and delivery to receiving water bodies. Some form of wildlife may be present on all landuses within the watershed. Also, wildlife is present throughout the year.

3.2.4 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. These facilities are permitted with no discharge to surrounding areas, but they may be a significant nonpoint source of fecal coliform during rainfall events.

Some counties in Mississippi manage the problem of onsite treatment systems through the use of a wastewater ordinance. A wastewater ordinance requires that the wastewater treatment and disposal system used be certified as sufficient. It also ensures that electricity, water, or natural gas will not be made available without written approval from the county Health Department or the Mississippi

Department of Environmental Quality that the wastewater treatment and disposal system used is sufficient. Hinds County has a wastewater ordinance in effect. However, septic systems may still fail after the initial approval.

Failing septic systems may have an impact on nonpoint source fecal coliform impairment in the Fourteen Mile and Bakers Creek watersheds. The best management practices needed to reduce this pollutant load need to prioritize eliminating septic tank failures and improving maintenance and proper use of individual onsite treatment systems.

3.2.5 Urban Development

The headwaters of Bakers Creek lie within the urban areas of Clinton and Jackson. Fecal coliform contributions from these metropolitan areas may come from storm water runoff, failing sewer collection lines, sewer bypasses, and runoff contribution from improper disposal of materials such as pet waste and litter.

3.2.6 Other Direct Inputs

Other direct inputs of fecal coliform bacteria to water bodies in the Fourteen Mile and Bakers Creeks Watershed include illicit discharges, human recreation, and access of both domestic and wild animals to the stream.

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 water body 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 for segments MS441FE and MS441BE. This method of analysis was selected because data limitations precluded the use of more complex methods. Therefore, the mass balance approach is suitable for this TMDL

4.2 Calculation of Allowable Load

The mass balance approach utilizes the conservation of mass principle. Loads can be calculated by multiplying the fecal coliform concentration in the water body for a 30-day period by the flow. The principle of the conservation of mass allows for the addition and subtraction of those loads to determine the appropriate numbers necessary for the TMDL. The loads can be calculated using the following relationship:

$$\text{Load}\,(\textit{counts per } 30\textit{ days}) = \text{Theoretical 30 day Capacity}\left(\frac{\text{day}\cdot\text{counts}}{100\,\text{ml}}\right)\times\text{Flow (cfs)} * \text{ConversionF actor}$$

$$\text{when ConversionFactor} = \left(\frac{28316.8\text{ml}}{\text{ft}^3}\right)\times\left(\frac{100\text{ml}}{100\text{ml}}\right)\times\left(\frac{60\text{s}}{1\text{min}}\right)\times\left(\frac{60\text{min}}{1\text{hr}}\right)\times\left(\frac{24\text{hr}}{1\text{day}}\right)$$

$$= 2.45E+07\left(\frac{100\,\text{ml}\cdot\text{s}}{\text{ft}^3\cdot\text{day}}\right)$$

The theoretical 30 day capacity is calculated, as shown in the equation below, by taking the integral of the theoretical capacity curve, Figure 4.

$$\int_0^{26.91}\left[13.47x + 37.82\right] + \int_{26.91}^{30} 400 = \mathbf{7129.4}\ (\text{day} * \text{counts}/100\,\text{ml})$$

To calculate the flow for segments MS441FE and MS441BE a drainage area ratio was used with flow data from USGS flow gage 07290650 on Bayou Pierre near Willows, MS. The monthly stream flow for gage 07290650 is given in Table 15. The average summer discharge at the flow gage was calculated by averaging the USGS monthly mean stream flows for the summer period (May through October) for the period of record of the gage. The average winter discharge at the flow gage was calculated accordingly. The average summer flow for Fourteen Mile and Bakers Creeks was estimated based on the average summer discharge at station 07290650 as shown in the equations below. The average summer discharge for Fourteen Mile Creek was determined to be 161.2 cfs and the average summer discharge for Bakers Creek was determined to be 91.4 cfs. This method was also used to calculate the average winter discharge for both creeks. For Fourteen Mile Creek the average winter discharge was determined to be 540.0 cfs and for Bakers Creek the average winter discharge was determined to be 306.2 cfs..

Table 15. USGS Gage 07290650 Monthly Stream Flow

Month	January	February	March	April	May	June
Flow (cfs)	1,571	1,685	1,756	1,671	999	451
Month	**July**	**August**	**September**	**October**	**November**	**December**
Flow (cfs)	319	245	203	266	509	1,128

Avg Seasonal Discharge (cfs)={[**07290650 Avg Seasonal Discharge** (cfs)]/[**07290650 Drainage Area** (acres)]}*[**MS441FE or MS441BE Drainage Area** (acres)]

MS441FE Avg Summer Discharge (cfs)= {[413.8 (cfs)]/[418558 (acres)]}*[163019 (acres)]
= 161.2 cfs

MS441BE Avg Summer Discharge (cfs) = {[413.8 (cfs)]/[418558 (acres)]}*[92416 (acres)]
= 91.4 cfs

4.3 Calculation of Existing Load

For the calculation of the existing load, the estimated daily stream flow was multiplied by the fecal coliform concentration for the dates the water quality samples were taken to get a daily load. The daily stream flow was estimated using the same drainage area ratio used to calculate the average seasonal flows with daily flow data from USGS flow gage 07290650. An existing daily load curve was then developed for the daily loads. The integral of this daily load curve over 30 days was then multiplied by the conversion factor to get the existing load in counts per 30 days. The existing loads for Fourteen Mile Creek are shown in tables 16 and 17 and the existing loads for Bakers Creek are shown in tables 18 and 19. The critical condition for both water bodies occurred during the summers of 2003 and 2004. The existing load for the most critical period was used to calculate the necessary percent reductions that are shown in Table 24.

Fourteen Mile Creek

Table 16. Existing Load in Fourteen Mile Creek, Station 2

Summer 2003

Date and Time	Fecal Coliform (counts/100ml)	Flow (cfs)	Existing Load (counts per day)	Existing Load (counts per30days)
8/1/03 13:15	1080	60.4	1.60E+12	5.83E+13
8/6/03 12:45	440	102.8	1.11E+12	
8/8/03 12:50	800	70.1	1.37E+12	
8/11/03 13:40	155	45.6	1.73E+11	
8/15/03 12:20	6000	72.8	1.07E+13	
8/18/03 13:15	195	40.1	1.92E+11	

Table 17. Existing Load in Fourteen Mile Creek, Station 2
Summer 2004

Date and Time	Fecal Coliform (counts/100ml)	Flow (cfs)	Existing Load (counts per day)	Existing Load (counts per30days)
7/16/04 10:10	150	102.4	3.76E+11	5.10E+13
7/19/04 10:45	420	98.1	1.01E+12	
7/21/04 10:50	225	87.2	4.81E+11	
7/23/04 10:00	100	69.7	1.71E+11	
7/26/04 10:15	6000	76.3	1.12E+13	
7/29/04 10:00	560	68.9	9.45E+11	

Bakers Creek

Table 18. Existing Load in Bakers Creek, Station 1
Summer 2003

Date and Time	Fecal Coliform (counts/100ml)	Flow (cfs)	Existing Load (counts per day)	Existing Load (counts per30days)
8/1/03 0:00	6000	34.2	5.03E+12	8.06E+13
8/6/03 0:00	860	58.3	1.23E+12	
8/8/03 0:00	3100	39.8	3.02E+12	
8/11/03 0:00	1700	25.8	1.07E+12	
8/15/03 0:00	6000	41.3	6.07E+12	
8/18/03 0:00	135	22.7	7.51E+10	

Table 19. Existing Load in Bakers Creek, Station 1
Summer 2004

Date and Time	Fecal Coliform (counts/100ml)	Flow (cfs)	Existing Load (counts per day)	Existing Load (counts per 30days)
7/16/04 11:00	300	58.1	4.27E+11	1.62E+13
7/19/04 11:15	840	55.7	1.15E+12	
7/21/04 9:50	165	49.5	2.00E+11	
7/23/04 10:40	125	39.5	1.21E+11	
7/29/04 10:30	285	39.1	2.73E+11	
8/3/04 10:00	1180	40.9	1.18E+12	

ALLOCATION

The allocation for this TMDL includes a wasteload allocation (WLA) for point sources, a load allocation (LA) for nonpoint sources, and a margin of safety (MOS).

5.1 Wasteload Allocations

The wasteload allocation is based on the permitted concentration and flow of the existing point sources in the Fourteen Mile and Bakers Creeks Watersheds. The point source in segment MS441FE, Fourteen Mile Creek, and its allocated load is shown in Table 20. The point sources in segment MS441BE, Bakers Creek, and their allocated loads are shown in Table 21. The first value is the average fecal coliform concentration that the facility may discharge and the second is the maximum fecal coliform concentration that the facility may discharge. While the allocated loads included in the TMDL calculation are based upon the permit limit of the average allowable concentration, the maximum portion of the permit is still allowable and does not indicate any permit modification is necessary.

Table 20. Wasteload Allocations for Segment MS441FE

NPDES ID	Summer Permit Limit Average/Maximum (counts/100ml)	Winter Permit Limit Average/Maximum (counts/100ml)	Average Summer Allocated Load (counts per 30days)	Average Winter Allocated Load (counts per 30days)	Permit Modification Necessary
MS0051772	200/400	2000/4000	3.41E+10	3.41E+11	No
Total			**3.41E+10**	**3.41E+11**	

Table 21. Wasteload Allocations for Segment MS441BE

NPDES ID	Summer Permit Limit Average/Maximum (counts/100ml)	Winter Permit Limit Average/Maximum (counts/100ml)	Average Summer Allocated Load (counts per 30days)	Average Winter Allocated Load (counts per 30days)	Permit Modification Necessary
MS0054984	200/400	200/400	4.36E+09	4.36E+09	No
MS0021032	200/400	2000/4000	4.77E+10	4.77E+11	No
MS0059641	200/400	200/400	3.41E+08	3.41E+08	No
MS0030015	200/400	200/400	3.18E+09	3.18E+09	No
MS0055921	200/400	200/400	3.41E+08	3.41E+08	No
MS0054992	200/400	2000/4000	7.95E+11	7.95E+12	No
MS0022250	200/400	200/400	2.27E+09	2.27E+09	No
MS0036382	200/400	2000/4000	7.50E+10	7.50E+11	No
MS0036277	200/400	2000/4000	2.23E+10	2.23E+11	No
MS0043745	200/400	200/400	4.77E+09	4.77E+09	No
MS0025852	200/400	2000/4000	1.36E+11	1.36E+12	No
MS0042102	200/400	200/400	3.41E+08	3.41E+08	No
MS0058092	200/400	200/400	2.27E+08	2.27E+08	No
MS0031186	200/400	200/400	3.41E+09	3.41E+09	No
MS0031453	200/400	200/400	7.27E+09	7.27E+09	No
Total			**1.10E+12**	**1.08E+13**	

5.2 Load Allocations

The load allocation for segments MS441FE and MS441BE is calculated using the water quality criteria and the estimated critical flow. The load allocation is assumed to represent nonpoint sources as described in section 3.2. In calculating the LA component, the total TMDL for the water body is reduced by a 10% MOS. For this TMDL, the summer load is based on a fecal coliform concentration for 30 days determined by the integral of the theoretical maximum allowable load curve and the average summer flow. The resulting winter LA was estimated using the average winter flow and the integral of the theoretical maximum allowable load curve. The resulting load allocations are shown below in Table 22.

Table 22. Load Allocations

Name	ID	Summer LA (counts per 30 days)	Winter LA (counts per 30 days)
Fourteen Mile Creek	MS441FE	2.53E+13	8.45E+13
Bakers Creek	MS441BE	1.33E+13	3.73E+13

Fourteen Mile Creek

Summer

LA = 0.9*7129.4(day*counts/100ml)* 161.2(cfs) * 2.45E+07[(100ml*s)/(ft^3 *day)] – 3.41E+10 (counts per 30 days)

LA = 2.53E+13 (counts per 30 days)

Winter

LA = 0.9*7129.4(day*counts/100ml)* 540.0(cfs) * 2.45E+07[(100ml*s)/(ft^3 *day)] – 3.41E+11 (counts per 30 days)

LA = 8.45E+13 (counts per 30 days)

Bakers Creek

Summer

LA = 0.9*7129.4(day*counts/100ml)* 91.4(cfs) * 2.45E+07[(100ml*s)/(ft^3 *day)] – 1.10E+12 (counts per 30 days)

LA = 1.33E+13 (counts per 30 days)

Winter

LA = 0.9*7129.4(day*counts/100ml)* 306.2(cfs) * 2.45E+07[(100ml*s)/(ft^3 *day)] – 1.08E+13 (counts per 30 days)

LA = 3.73E+13 (counts per 30 days)

5.3 Incorporation of a Margin of Safety (MOS)

The two types of MOS development are to implicitly incorporate the MOS using conservative assumptions or to explicitly specify a portion of the total TMDL as the MOS. An explicit 10% margin of safety was used for this TMDL. The margin of safety is calculated below for segments MS441FE and MS441BE using the average seasonal flows and theoretical maximum allowable load data set curve. The results of the calculations are shown in Table 23.

Table 23. Margin of Safety

Name	ID	Summer MOS (counts per 30 days)	Winter MOS (counts per 30 days)
Fourteen Mile Creek	MS441FE	2.82E+12	9.43E+12
Bakers Creek	MS441BE	1.60E+12	5.35E+12

Fourteen Mile Creek

Summer

MOS = 0.1*7129.4(day*counts/100ml)* 161.2(cfs) * 2.45E+07[(100ml*s)/(ft^3*day)]

MOS = 2.82E+12 (counts per 30 days)

Winter

MOS = 0.1*7129.4(day*counts/100ml)* 540.0(cfs) * 2.45E+07[(100ml*s)/(ft^3*day)]

MOS = 9.43E+12 (counts per 30 days)

Bakers Creek

Summer

MOS = 0.1*7129.4(day*counts/100ml)* 91.4(cfs) * 2.45E+07[(100ml*s)/(ft^3*day)]

MOS = 1.60E+12 (counts per 30 days)

Winter

MOS = 0.1*7129.4(day*counts/100ml)* 306.2(cfs) * 2.45E+07[(100ml*s)/(ft^3*day)]

MOS = 5.35E+12 (counts per 30 days)

5.4 Calculation of the TMDL

The TMDL for segments MS441FE and MS441BE is calculated based on the following equation:

TMDL = WLA + LA + MOS

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

WLA = NPDES Permitted Facilities

LA = Surface Runoff + Other Direct Inputs

MOS = 10% explicit

The summer TMDL for segments MS441FE and MS441BE was calculated based on the average summer flow of the watershed, and a fecal coliform concentration for 30 days determined by the integral of the theoretical maximum allowable load data set curve. The winter TMDL was calculated based on the average winter flow of the watershed, and a fecal coliform concentration for 30 days determined by the integral of the theoretical maximum allowable load data set curve. The necessary percent reductions are shown below in Table 24. The necessary reductions occur during the summer season, which is considered the critical period for both Fourteen Mile and Bakers Creeks.

Table 24. Estimated Fecal Coliform Reductions

Name	ID	Summer % Reduction
Fourteen Mile Creek	MS441FE	52%
Bakers Creek	MS441BE	80%

Fourteen Mile Creek

<u>Summer</u>

TMDL = 7129.4(day*counts/100ml)* 161.2(cfs) * 2.45E+07[(100ml*s)/(ft^3*day)]

TMDL = 2.82E+13 (counts per 30 days)

<u>Winter</u>

TMDL = 7129.4(day*counts/100ml)* 540.0(cfs) * 2.45E+07[(100ml*s)/(ft^3*day)]

TMDL = 9.43E+13 (counts per 30 days)

Table 25. TMDL Summary for Fourteen Mile Creek – MS441FE (counts per 30 days)

	Summer	Winter
WLA	3.41E+10	3.41E+11
LA	2.53E+13	8.45E+13
MOS	2.82E+12	9.43E+12
TMDL = WLA + LA +MOS	2.82E+13	9.43E+13

Bakers Creek

Summer

TMDL = 7129.4(day*counts/100ml)* 91.4(cfs) * 2.45E+07[(100ml*s)/(ft^3*day)]

TMDL = 1.60E+13 (counts per 30 days)

Winter

TMDL = 7129.4(day*counts/100ml)* 306.2(cfs) * 2.45E+07[(100ml*s)/(ft^3*day)]

TMDL = 5.35E+13 (counts per 30 days)

Table 26. TMDL Summary for Bakers Creek – MS441BE (counts per 30 days)

	Summer	Winter
WLA	1.10E+12	1.08E+13
LA	1.33E+13	3.73E+13
MOS	1.60E+12	5.35E+12
TMDL = WLA + LA +MOS	1.60E+13	5.35E+13

5.5 Seasonality

For many streams in the state, fecal coliform limits vary according to the seasons. Both Fourteen Mile and Bakers Creeks are designated for the use of secondary contact. For this use, the fecal coliform standard is seasonal.

MDEQ used the average summer flow for calculating the summer TMDL and the average winter flow for calculating the winter TMDL; therefore, the season differences are incorporated in the seasonal average flow values.

5.6 Reasonable Assurance

This component of TMDL development does not apply to this TMDL Report. There is no WLA reduction request based on promised LA components and reductions.

CONCLUSION

None of the existing permitted facilities will require changes to their NPDES permits. MDEQ's Environmental Compliance and Enforcement Division will continue to address compliance issues with the facilities located in the Fourteen Mile and Bakers Creek watershed to ensure that permit limits are maintained.

The TMDL will not impact future NPDES Permits as long as the effluent is disinfected to meet water quality standards for fecal coliform. 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 year long cycle, MDEQ resources for water quality monitoring will be focused on one of the basin groups. During the next monitoring phase in the Big Black River Basin, Fourteen Mile and Bakers Creeks may 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. The public will be given an opportunity to review the TMDL and submit comments. MDEQ also distributes all TMDLs at the beginning of the public notice to those members of the public who have requested to be included on a TMDL mailing list. TMDL mailing list members may request to receive the TMDL reports through either, email or the postal service. Anyone wishing to become a member of the TMDL mailing list should contact Greg Jackson at (601) 961-5098 or Greg_Jackson@deq.state.ms.us.

All comments should be directed to Greg Jackson at Greg_Jackson@deq.state.ms.us or Greg Jackson, MDEQ, PO Box 10385, Jackson, MS 39289. All comments received during the public notice period and at any public hearings become a part of the record of this TMDL and will be considered in the submission of this TMDL to EPA Region 4 for final approval.

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.

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 natural body of water to receive wastewaters or toxic materials without deleterious effects and without damage to aquatic life or humans who use the water.

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 water body may be based upon a similar, unaltered or least impaired, water body 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 water body.

Critical Condition: hydrologic and atmospheric conditions in which the pollutants causing impairment of a water body have their greatest potential for adverse effects.

Daily discharge: the discharge of a pollutant measured during a 24-hour period that reasonably represents the 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 discharge is calculated as the average measurement of the pollutant over the day.

Designated Uses: (1) those uses specified in the water quality standards for each water body or segments whether or not they are being attained. (2) those water uses identified in state water quality standards which must be achieved and maintained as required under the Clean Water Act. Uses can include public water supply, recreation, etc.

Discharge monitoring report (DMR): the EPA uniform national form, including any subsequent additions, revisions, or modifications for the reporting of self-monitoring results by permittees.

Effluent: wastewater – treated or untreated – that flows out of a treatment plant or industrial outfall. Generally refers to wastes discharged into surface waters.

Effluent limitation: (1) any restriction established by a State or the Administrator on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters, the waters of the contiguous zone, or the ocean, including schedules of compliance. (2) restrictions established by a State or EPA on quantities, rates, and concentrations in wastewater discharges.

Effluent standard: any effluent standard or limitation, which may include a prohibition of any discharge, established or proposed to be established for any toxic pollutant under section 307(a) of the Act.

Fecal Coliform Bacteria: (1) those organisms associated with the intestines of warm-blooded animals that are commonly used to indicate the presence of fecal material and the potential presence of organisms capable of causing human disease. (2) bacteria found in the intestinal tracts of mammals. Their presence in water or sludge is an indicator of pollution and possible contamination by pathogens.

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

Impaired Water Body: any water body 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 that is attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loads should be distinguished.

Loading: the introduction of waste into a waste management unit but not necessarily to complete capacity.

Mass Balance: a concept based on a fundamental law of physical science (conservation of mass) which says that matter can not be created or destroyed. It is used to calculate all input and output streams of a given substance in a system.

Model: a quantitative or mathematical representation or computer simulation which attempts to describe the characteristics or relationships of physical events.

National pollutant discharge elimination system (NPDES): the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under section 307, 402, 318, and 405 of the Clean Water Act.

Nonpoint Source: the pollution sources which generally are not controlled by establishing effluent limitations under section 301, 302, and 402 of the Clean Water Act. Nonpoint source pollutants are not traceable to a discrete identifiable origin, but generally result from land runoff, precipitation, drainage, or seepage.

Outfall: the point where an effluent is discharges into receiving waters

Point Source: a stationery location or fixed facility from which pollutants are discharges or emitted. Also, any single identifiable source of pollution, e.g., a pipe, ditch, ship, ore pit, factory smokestack.

Pollution: generally, the presence of matter or energy whose nature, location or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, biological, and radiological integrity of water.

Publicly Owned Treatment Works (POTW): the treatment works treating domestic sewage that is owned by a municipality or State.

Regression: a relationship of y and x in a function of y = f(x), where: y is the expected value of an independent random variable x. The parameters in the function f(x) are determined by the method of least squares. When f(x) is a linear function of x, the term linear regression is used.

Regression Coefficient: a quantity that describes the slope and intercept of a regression line.

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: (1) the calculated maximum permissible pollutant loading introduced to a water body such that any additional loading will produce a violation of water quality standards. (2) the sum of the individual waste load allocations and load allocations. A margin of safety is included with the two types of allocations so that any additional loading, regardless of source, would not produce a violation of water quality standards.

Waste: (1) useless, unwanted or discarded material resulting form (agricultural, commercial, community and industrial) activities. Wastes include solids, liquids, and gases. (2) any liquid resulting from industrial, commercial, mining, or agricultural operations, or from community activities that is discarded or is being accumulated, stored, or physically, chemically, or biologically treated prior to being discarded or recycled.

Wasteload allocation (WLA): (1) the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality based effluent limitation. (2) the portion of a receiving water's total maximum daily load that is allocated to one of its existing or future point source of pollution. (3) the maximum load of pollutants each discharger of waste is allowed to release into a particular waterway. Discharge limits are usually required for each specific water quality criterion being, or expected to be, violated. The portion of a stream's total assimilative capacity assigned to an individual discharge.

Water Quality Standards: State-adopted and EPA-approved regulations mandated by the Clean Water Act and specified in 40 CFR 131 that describe the designated uses of a water body, the numeric and narrative water quality criteria designed to protect those uses, and an antidegredation statement to protect existing levels of water quality. Standards are designed to safeguard the public health and welfare, enhance the quality of water and serve the purposes of the Clean Water Act.

Water quality criteria: numeric water quality values and narrative statements which are derived to protect designated uses. Numeric criteria are scientifically-derived ambient concentrations developed by EPA or States for various pollutants of concern to protect human health and aquatic life. Narrative criteria are statements that describe the desired water quality goal. Ambient waters that meet applicable water quality criteria are considered to support their designated 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: (1) the land area that drains (contributes runoff) into a stream. (2) the land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common delivery point.

ABBREVIATIONS

BMP .... Best Management Practice

CWA .... Clean Water Act

DMR..Discharge Monitoring Report

ECED ....Environmental Compliance and Enforcement Division

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

NLCD……………………………………………………..…………National Land Cover Data

NRCS .... National Resource Conservation Service

NPDES ....National Pollution Discharge Elimination System

UNT...Unnamed Tributary

USGS...United States Geological Survey

WLA.. Waste Load Allocation

REFERENCES

Cal-Maine Foods, Inc.. July, 2002. *Nutrient Management Plan.* Edwards, Mississippi.

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.

Lee, C.C.. 1998. *Environmental Engineering Dictionary*. 3rd Edition. Government Institutes, Inc., Rockville, Maryland.

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

MDEQ. 2002. *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. Office of Pollution Control.

MDEQ. 2002. *Mississippi List of Water Bodies, Pursuant to Section 303(d) of the Clean Water Act*. Office of Pollution Control.

MDEQ. 2001. *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. 2000. *Mississippi 2000 Water Quality Assessment, Pursuant to Section 305(b) of the Clean Water Act. Pascagoula River Supplement*. 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.

Sheely. 2002. *Load Duration Curves: Development and Application to Data Analysis for Streams in the Yazoo River Basin, MS*. Special Project, Summer 2002, Jackson Engineering Graduate Program.

USDA. 2004. *2002 Census of Agriculture*. U.S. Department of Agriculture, National Agricultural Statistics Service, Washington, D.C.

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.