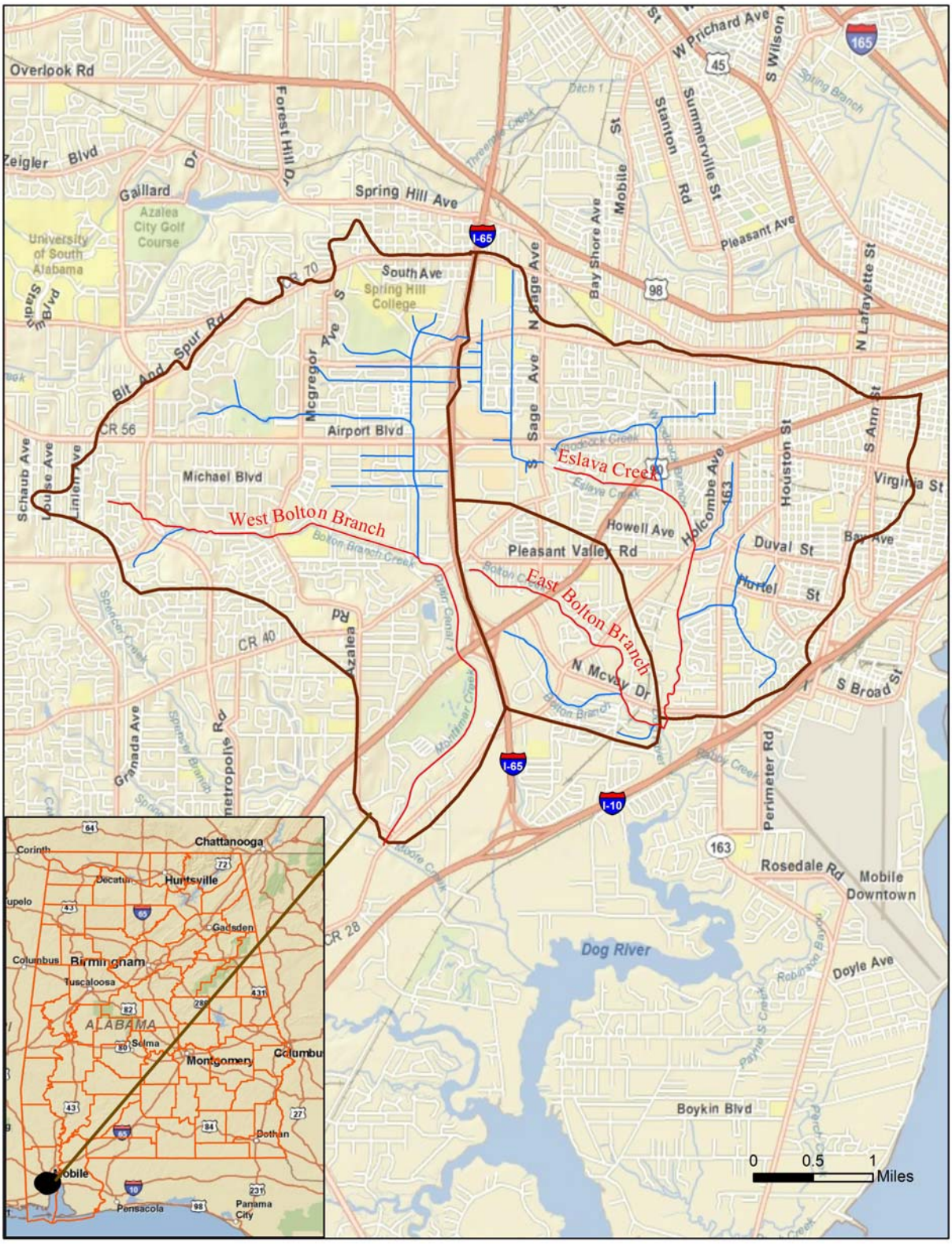
FINAL

Total Maximum Daily Load (TMDL)
for
West Bolton Branch
Assessment Unit ID # AL03160205-0202-700
Pathogens (fecal coliform)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
September 2009

Figure I. §303(d) Listed Portion of West Bolton Branch



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1.0 Executive Summary

Section §303(d) of the Clean Water Act (CWA) and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for waterbodies that are not meeting designated uses under technology-based pollution controls. A TMDL is the maximum amount of pollutant a waterbody can assimilate while meeting water quality standards for the pollutant of concern. All TMDLs include a wasteload allocation (WLA) for all National Pollutant Discharge Elimination System (NPDES) regulated discharges, a load allocation (LA) for all nonpoint sources, and an explicit and/or implicit margin of safety (MOS).

Bolton Branch was originally placed on the 2004 §303(d) list. After additional evaluation of the waterbody it was determined that with the building of Interstate 65, Bolton Branch had been rerouted approximately mid distance of its length. Now there are two distinct watersheds which will be referred to as West Bolton Branch and East Bolton Branch separated by Interstate 65. A correction was made to the 2006 §303(d) list to reflect the above. The current §303(d) list, does not list East or West in the "Waterbody Name" but for clarification this TMDL report will. A separate TMDL report will be developed for West Bolton Branch and East Bolton Branch.

A fecal coliform TMDL was developed for the impaired segment of West Bolton Branch located in the Mobile River basin just west of downtown Mobile, Alabama. West Bolton Branch was originally placed on Alabama's 2004 §303(d) list of impaired waters for pathogens based on data collected by the Mobile Area Water and Sewer Service (MAWSS) in 2003. According to the 2008 §303(d) list, West Bolton Branch is impaired for pathogens from Moore Creek to its source, a distance of approximately 5.69 miles. The designated use classification of West Bolton Branch is Fish and Wildlife (F&W). The West Bolton Branch watershed is characterized as being highly urban and has a drainage area of 9.78 square miles. The entire West Bolton Branch watershed is within the boundary of the Mobile Area Phase I MS4 (ALS000002). ADEM records indicate there are no active NPDES continuous sources in the West Bolton Branch watershed that are regulated under the NPDES program. However, the West Bolton Branch watershed qualifies as a Municipal Separate Stormwater Sewer System (MS4) area and must be addressed in the TMDL as part of the Wasteload Allocation (WLA).

A mass balance approach was used to calculate the fecal coliform TMDL for West Bolton Branch. The mass balance approach utilizes the conservation of mass principle. Total existing mass loads were calculated by multiplying the fecal coliform concentration times the corresponding stream flow. Mass loads were calculated for the highest geometric mean sample exceedance and the highest single sample exceedance. In the same manner, allowable loads were calculated for both the single sample criterion of 2000 col/100ml and the geometric mean criterion of 200 col/100ml. The TMDL was based on the violation that produced the highest percent reduction of fecal coliform loads necessary to achieve applicable water quality criteria, whether it be the single sample or geometric mean criterion.

Table 1-1 shows the results of the fecal coliform TMDL and percent reductions for each criterion.

Table 1-1. 2007 Fecal Coliform Loads and Required Reductions

Source	2007 Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	Reduction %
NPS Load Single Sample	5.44E+12	7.53E+11	4.69E+12	86%
NPS Load Geometric Mean	2.88E+11	7.35E+10	2.14E+11	74%
Point Source	NA	NA	NA	NA

From Table 1-1, compliance with the Single Sample criterion of 2000 col/100ml requires the greatest reduction in fecal coliform load. Therefore the TMDL will be based on the Single Sample criterion. The TMDL values for the single sample criterion are provided in Table 1-2 below.

Table 1-2. Fecal Coliform TMDL and Percent Reductions for West Bolton Branch

TMDL	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation(LA)	
		WWTPs[b]	MS4s[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
8.37E+11	8.37E+10	NA	86%	0	7.53E+11	86%

a. There are no CAFOs in the West Bolton Branch watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum; NA = not applicable, no point sources. Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.
c. Future MS4 areas would be required to demonstrate consistency with the assumptions and requirements of this TMDL.
d. The objective for leaking collection systems is a WLA of zero. It is recognized, however, that a WLA of 0 colonies/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in fecal coliform loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for fecal coliform.

Compliance with the terms and conditions of existing and future NPDES sanitary and stormwater permits will effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. Required load reductions in the LA portion of this TMDL can be implemented through voluntary measures and may be eligible for CWA §319 grants.

The Department recognizes that adaptive implementation of this TMDL will be needed to achieve applicable water quality criteria and we are committed towards targeting the load reductions to improve water quality in the West Bolton Branch watershed. As additional data and/or information becomes available, it may become necessary to revise and/or modify the TMDL accordingly.

Basis for §303(d) Listing

2.1 Introduction

Section 303(d) of the Clean Water Act (CWA) as amended by the Water Quality Act of 1987 and EPA's Water Quality Planning and Management Regulations [(Title 40 of the Code of Federal Regulations (CFR), Part 130)] require states to identify waterbodies which are not meeting water quality standards applicable to their designated use classifications. The identified waters are prioritized based on severity of pollution with respect to designated use classifications. Total maximum daily loads (TMDLs) for all pollutants causing violation of applicable water quality standards are established for each identified waterbody. Such loads are established at levels necessary to implement the applicable water quality standards with seasonal variations and margins of safety. The TMDL process establishes the allowable loading of pollutants, or other quantifiable parameters for a waterbody, based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Alabama has identified the 5.69 mile segment of West Bolton Branch from Moore Creek to its source in Mobile County as being impaired by pathogens (fecal coliform). The §303(d) listing was originally reported on Alabama's 2004 List of Impaired Waters, and subsequently included on the 2006 and 2008 lists. The source of the impairment is listed as urban runoff/storm sewers and collection system failure on the 2008 §303(d) list.

2.2 Problem Definition

Waterbody Impaired:	West Bolton Branch from Moore Creek to its source.
Waterbody Length:	5.69 miles
Waterbody Drainage Area:	9.78 square miles
Water Quality Standard Violation:	Fecal Coliform (single sample)
Pollutant of Concern:	Pathogens (fecal coliform)
Water Use Classification:	Fish and Wildlife

Usage Related to Classification:
The impaired segment of West Bolton Branch is classified as Fish and Wildlife. Usage of waters in this classification is described in ADEM Admin. Code R. 335-6-10-.09(5)(a), (b), (c), and (d).

(a) Best usage of waters: fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming and water-contact sports or as a source of water supply for drinking or food-processing purposes.

(b) Conditions related to best usage: the waters will be suitable for fish, aquatic life and wildlife propagation. The quality of salt and estuarine waters to which this classification is assigned will also be suitable for the propagation of shrimp and crabs.

(c) Other usage of waters: it is recognized that the waters may be used for incidental water contact and recreation during June through September, except that water contact is strongly discouraged in the vicinity of discharges or other conditions beyond the control of the Department or the Alabama Department of Public Health.

(d) Conditions related to other usage: the waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports.

Fecal Coliform Criteria:
Criteria for acceptable bacteria levels for the Fish and Wildlife use classification are described in ADEM Admin. Code R. 335-6-10-.09(5)(e)7(i) and (ii) as follows:

7. Bacteria:

(i) In non-coastal waters, bacteria of the fecal coliform group shall not exceed a geometric mean of 1,000 colonies/100 mL; nor exceed a maximum of 2,000 colonies/100 mL in any sample. In coastal waters, bacteria of the enterococci group shall not exceed a maximum of 275 colonies/100 mL in any sample. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours.

(ii) For incidental water contact and recreation during June through September, the bacterial quality of water is acceptable when a sanitary survey by the controlling health authorities reveals no source of dangerous pollution and when the geometric mean fecal coliform organism density does not exceed 200 colonies/100 mL in non-coastal waters. In coastal waters, bacteria of the enterococci group shall not exceed a geometric mean of 35 colonies/100 mL nor exceed a maximum of 158 colonies/100 mL in any sample. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours. When the geometric bacterial coliform organism density exceeds these levels, the bacterial water quality shall be considered acceptable only if a second detailed sanitary survey and evaluation discloses no significant public health risk in the use of the waters. Waters in the immediate vicinity of discharges of sewage or other wastes likely to contain bacteria harmful to humans, regardless of the degree of treatment afforded these wastes, are not acceptable for swimming or other whole body water-contact sports.

Criteria Exceeded:
The original listing for Bolton Branch was based on 5 of 40 fecal coliform samples, collected by the MAWSS exceeding the single sample maximum criterion of 2000 colonies/100 mL in year 2003. MAWSS was required to collect this data through a Consent Decree with Alabama Department of Environmental Management (ADEM). MAWSS collected data on West Bolton Branch from 2003 through 2007. In addition, ADEM sampled West Bolton Branch at multiple locations in 2007. The ADEM data showed multiple violations of the single sample maximum criterion and geometric mean criterion. These data are included in the Appendix 7.2.

Water quality data collected by MAWSS in 2003 was used for listing Bolton Branch on Alabama's 2004 §303(d) list. At the time of the listing, waters in which less than or equal to 10% of the samples collected over a five year period exceed the single-sample maximum of 2000 colonies/100 mL were considered to comply with Alabama's water quality standard for fecal coliform bacteria. Geometric mean samples comprised of at least 5 samples collected over a thirty day period that were reported less than or equal to 200 colonies/100 mL (June-September) or 1000 colonies/100 mL (October-May) were considered to comply with Alabama's water quality standard for fecal coliform bacteria. Waters in which greater than 10% of the samples exceed the single-sample maximum criterion of 2000 colonies/100 mL or any geometric mean sample that exceeded the geometric mean criterion of 200 colonies/100 mL (June-September) or 1000 colonies/100 mL (October-May) were considered impaired and subsequently listed for pathogens (fecal coliform) on Alabama's §303(d) list.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

For the purpose of this TMDL a single sample fecal coliform target of 1800 colonies/100 mL will be used. This target was derived by using a 10% explicit margin of safety from the single sample of 2000 colonies/100 mL criterion. This target should not allow the geometric mean of 200 colonies/100 mL or the single sample maximum of 2000 colonies/100 mL to be exceeded.

3.2 Source Assessment

3.2.1 Point Sources in the West Bolton Branch Watershed

Continuous Point Sources
There are no continuous NPDES discharges located in the West Bolton Branch watershed. However, any future NPDES regulated discharges that are considered by the Department to be a pathogen source will be required to meet the instream water quality criteria for pathogens at the point of discharge.

Non-Continuous Point Sources
The West Bolton Branch watershed qualifies as a Municipal Separate Stormwater Sewer System (MS4) area and must be addressed in the TMDL as part of the Wasteload Allocation (WLA). The entire West Bolton Branch watershed is within the boundary of the Mobile Area Phase I

MS4 (ALS000002). The entire West Bolton Branch watershed will be allocated as MS4 WLAs in the TMDL.

Sanitary sewer overflows (SSOs) have the potential to severely impact water quality and can often result in the violation of water quality standards. It is the responsibility of the NPDES wastewater discharger, or collection system operator for non-permitted "collection only" systems, to ensure that releases do not occur. Unfortunately releases to surface waters from SSOs are not always preventable or reported. From review of ADEM files it was determined that numerous SSOs have occurred in the Bolton Branch watershed.

Future NPDES regulated stormwater discharges will be required to demonstrate consistency with the assumptions and requirements of this TMDL.

3.2.2 Nonpoint Sources in the West Bolton Branch Watershed

Nonpoint sources of fecal coliform bacteria do not have a defined discharge point, but rather, occur over the entire length of a stream or waterbody. On the land surface, fecal coliform bacteria can accumulate over time in the soil and then wash off during rain events. As the runoff transports the sediment over the land surface, more fecal coliform bacteria are collected and carried to the stream or waterbody. Therefore, there is some net loading of fecal coliform bacteria into the stream as dictated by the watershed hydrology.

Agricultural land can be a source of fecal coliform bacteria. Runoff from pastures, animal feeding areas, improper land application of animal wastes, and animals with direct access to streams are all mechanisms that can contribute fecal coliform bacteria to waterbodies. To account for the potential influence from animals with direct access to stream reaches in the watershed, fecal coliform loads can be calculated as a direct source into the stream.

Fecal coliform bacteria can also originate from forested areas due to the presence of wild animals such as deer, raccoons, turkeys, waterfowl, etc. Wildlife deposit feces onto land surfaces where it can be transported during rainfall events to nearby streams. Control of these sources is usually limited to land management BMPs and may be impracticable in most cases. As a result, forested areas are not specifically targeted in this TMDL.

Fecal coliform loading from urban areas is potentially attributable to multiple sources including storm water runoff, illicit discharges of wastewater, runoff from improper disposal of waste materials, failing septic tanks, and domestic animals. Septic systems are common in unincorporated portions of a watershed and may be direct or indirect sources of bacterial pollution via ground and surface waters. Onsite septic systems have the potential to deliver fecal coliform bacteria to surface waters due to system failure and malfunction.

3.3 Land Use Assessment

As mentioned in the Executive Summary, this report is specifically for West Bolton Branch but additional information about East Bolton Branch and Eslava Creek are in the report due to all the watersheds being so small and adjacent to one another. With that said, the predominant land use

characteristic of the West Bolton Branch watershed is urban (80%). A map depicting landuses is shown in Figure 3-1. Tabulated landuses are shown in Table 3-1.

Figure 3-1. Land Use Map for East & West Bolton Branches and Eslava Creek Watersheds

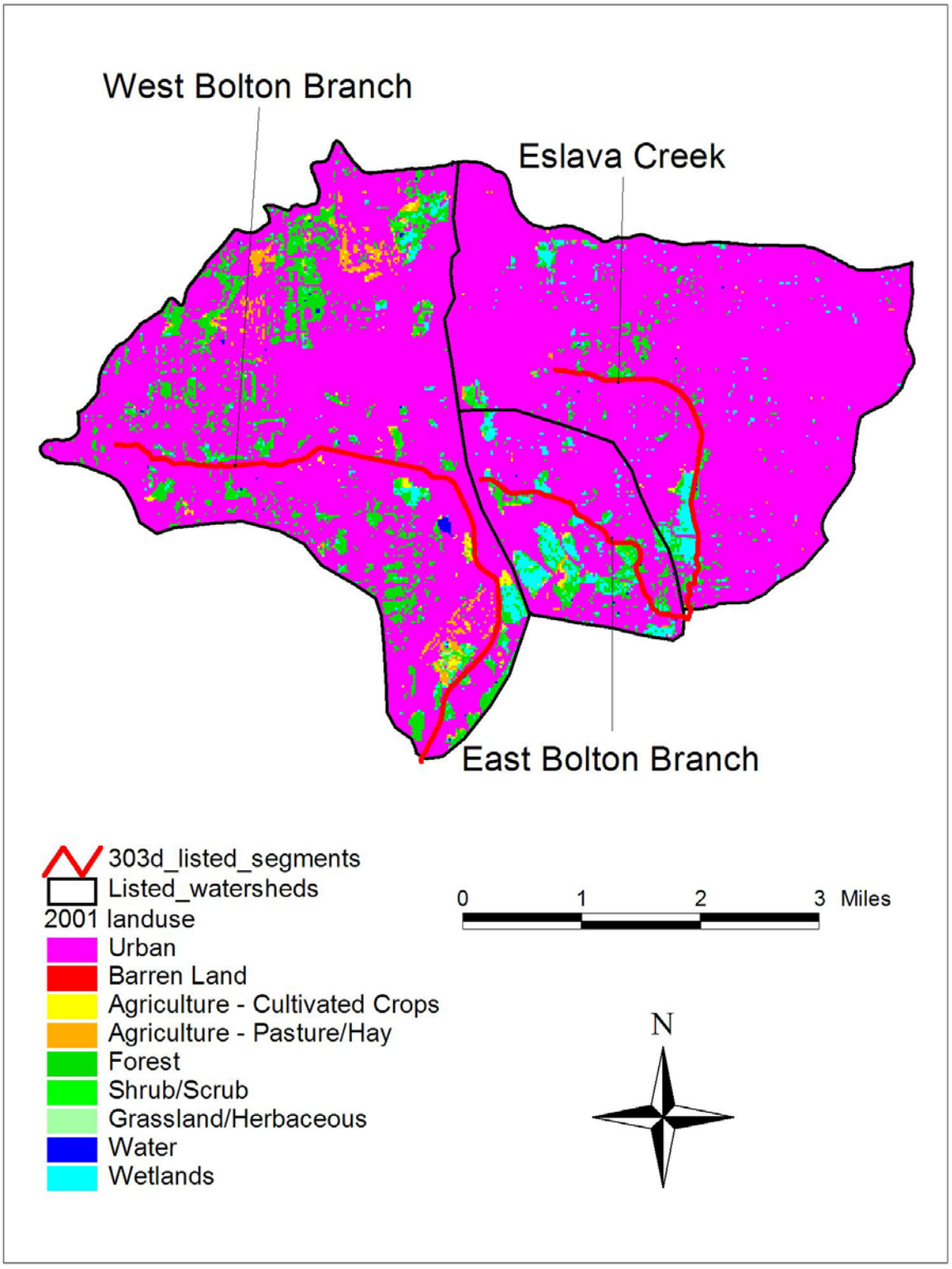


Table 3-1. Land Use Areas for East & West Bolton Branches and Eslava Creek Watersheds

2001 NLCD name	West Bolton Branch		East Bolton Branch		Eslava Creek	
	square miles	percent	square miles	percent	square miles	percent
Open Water	0.02	0.2%	0.003	0.1%	0.01	0.1%
Developed Open Space	3.95	40.4%	0.86	36.5%	2.94	35.7%
Developed Low Intensity	2.01	20.5%	0.47	19.9%	3.04	36.8%
Developed Medium Intensity	1.30	13.3%	0.30	13.0%	1.17	14.2%
Developed High Intensity	0.61	6.2%	0.13	5.7%	0.57	6.9%
Deciduous Forest	0.04	0.4%	0.01	0.6%	0.01	0.1%
Evergreen Forest	1.06	10.8%	0.19	8.0%	0.21	2.5%
Mixed Forest	0.10	1.0%	0.04	1.6%	0.03	0.4%
Shrub/Scrub	0.16	1.6%	0.04	1.8%	0.03	0.4%
Grassland/Herbaceous	0.01	0.1%	0.01	0.3%	0.001	0.01%
Pasture/Hay	0.23	2.3%	0.02	0.8%	0.02	0.2%
Cultivated Crops	0.09	0.9%	0.01	0.6%	0.01	0.1%
Woody Wetlands	0.19	1.9%	0.25	10.6%	0.21	2.6%
Emergent Herbaceous Wetlands	0.02	0.2%	0.01	0.5%	0.01	0.1%
Total	9.78	100.0%	2.34	100.0%	8.25	100.0%

Aggregate						
Developed	7.86	80%	1.76	75%	7.72	94%
Agriculture	0.32	3%	0.03	1%	0.02	0.3%
Forest	1.19	12%	0.24	10%	0.24	3%
Other	0.41	4%	0.31	13%	0.27	3%
Total	9.78	100%	2.34	100%	8.25	100%

3.4 Linkage Between Numeric Targets and Sources

The West Bolton Branch watershed is highly developed with 80% of the drainage area classified as urban, with the remaining land use/cover being forested and woody wetlands and 3% being classified agriculture. Fecal coliform loads from forests and wetlands tend to be low due to their filtering capabilities and are considered as natural or background conditions with respect to pollutant sources. Based on the highly urbanized watershed, it is believed that the most likely sources of pathogen loadings in the West Bolton Branch watershed are from activities in the MS4 area. Such activities include leaking sewer pipes, illicit sewer connections, failing septic systems and urban runoff. From review of ADEM files it was determined that numerous sanitary sewer overflows (SSO) have occurred in the Bolton Branch watershed, which would be considered a likely source of pathogens to West Bolton Branch.

It is not considered practicable to calculate individual components for nonpoint source loadings. Hence, there will not be individual loads or reductions calculated for different nonpoint sources such as forest, agriculture, and septic systems. The loadings and reductions will only be calculated as a single total nonpoint source load and reduction.

3.5 Data Availability and Analysis

The original listing for Bolton Branch was based on 5 of 40 fecal coliform samples collected by MAWSS exceeding the single sample maximum criterion in the year 2003 as described in the 2004 §303(d) Fact Sheet. MAWSS was required to collect this data through a Consent Decree with Alabama Department of Environmental Management (ADEM). MAWSS collected 129 fecal coliform samples at 2 different locations on West Bolton Branch and one tributary of West Bolton Branch from 2003 through 2007. For Station-ID 15MCR, of the 129 samples collected, 24 exceeded the single sample maximum of 2000 colonies/100 ml. For Station-ID 14BBC, of the 129 samples collected, 9 exceeded the single sample maximum of 2000 colonies/100 ml. For Station-ID 13MCR, of the 129 samples collected, 15 exceeded the single sample maximum of 2000 colonies/100 ml. No flows were collected for any of the sampling events.

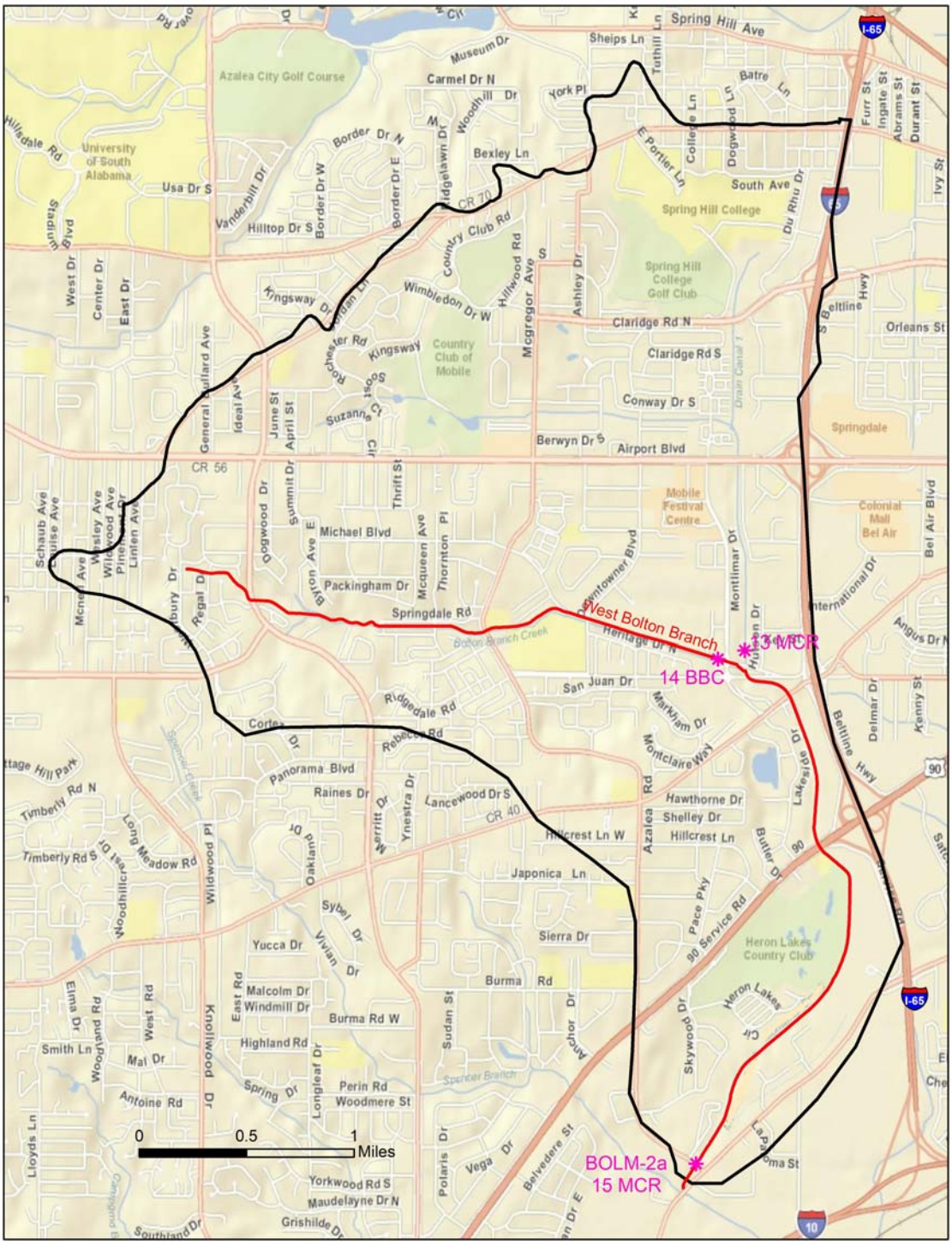
This waterbody was subsequently sampled by ADEM at one location in 2007. The ADEM data showed multiple violations of the single sample maximum criterion and geometric mean criterion. However, no flows were measured for any of the sampling events. An estimated stream flow for each sampling event was determined using a drainage area ratio of stream flows estimated from USGS Gage 02471001 (Chickasaw Creek Near Kushla, Al). This gage was assumed to be the most representative of the West Bolton Branch watershed for which data could be attained. The ADEM 2007 data will used for TMDL Development which is consistent with ***Alabama's Water Quality Assessment and Listing Methodology***. These data are included in Appendix 7.2. From reviewing the data it can be observed that most of the violations occurred during higher flow events.

Table 3-2. Sampling Stations on the West Bolton Branch Listed Segment

Years	Station ID	Station Location	Latitude	Longitude
2007	BOLM-2a	West Bolton Branch at Azalea Road	30.62853	-88.13524
2003 - 2007	15MCR	West Bolton Branch at Azalea Road	30.62853	-88.13524

2003 - 2007	13MCR	Tributary to West Bolton Branch @ Micheal Blvd.	30.66331	-88.13182
2003 - 2007	14BBC	West Bolton Branch at Montlimar Dr.	30.6627	-88.13389

Figure 3-2. Map of ADEM and MAWSS Sampling Stations



3.6 Critical Conditions

Critical conditions typically occur during the summer months.. This can be explained by the nature of storm events in the summer versus the winter. Periods of dry weather interspersed with thunderstorms allow for the accumulation and washing off of fecal coliform bacteria into streams, resulting in spikes of fecal coliform bacteria counts. In winter, frequent low intensity rain events are more typical and do not allow for the build-up of fecal coliform bacteria on the land surface, resulting in a more uniform loading rate. Also, the summer fecal coliform criterion is more stringent than the winter criterion.

3.7 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the analysis: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations, or 2) by explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations.

An explicit MOS was incorporated in this TMDL. The explicit MOS includes the uncertainty of the fecal coliform data used in this analysis and the uncertainty of selecting an appropriate critical condition from the existing fecal coliform loads. A margin of safety was applied to the TMDL by reducing the criterion concentration by ten percent and calculating a mass loading target with measured flow data. The summer single sample criteria was reduced by ten percent to achieve the target concentrations of 1800 colonies/100 mL and the summer geometric mean criteria was reduced by ten percent to achieve the target concentrations of 180 colonies/100 mL.

4.0 TMDL Development

4.1 Definition of a TMDL

A total maximum daily load (TMDL) is the sum of individual wasteload allocations for point sources (WLAs), load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS). The margin of safety can be included either explicitly or implicitly and accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. As discussed earlier, the MOS is explicit in this TMDL. A TMDL can be denoted by the equation:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody while achieving water quality standards under critical conditions. For some pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). However, for pathogens, TMDL loads are typically expressed in terms of organism counts per day (colonies/day), in accordance with 40 CFR 130.2(i).

4.2 Load Calculations

A mass balance approach was used to calculate the fecal coliform TMDL for West Bolton Branch. The mass balance approach utilizes the conservation of mass principle. Total existing mass loads were calculated by multiplying the fecal coliform concentration times the corresponding stream flow. Existing loads were calculated for the highest geometric mean sample exceedance and the highest single sample exceedance. In the same manner, allowable loads were calculated for both the single sample criterion of 2000 col/100ml and the geometric mean criterion of 200 col/100ml. The TMDL was based on the violation that produced the highest percent reduction of fecal coliform loads necessary to achieve applicable water quality criteria, whether it be the single sample or geometric mean criterion.

Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest single sample exceedance concentration of 13,000 colonies/100 ml times the estimated flow for that day. This concentration was calculated based on measurements at BOLM-2a on June 19, 2007 and can be found in Table 7-1, Appendix 7.2. The estimated stream flow, determined by the drainage area ratio of stream flows estimated from USGS Gage 02471001, for that sampling event was 17.1 cfs. The product of these two values and a conversion factor gives the total mass loading (colonies per day) of fecal coliform to West Bolton Branch under a single sample exceedance conditions.

$$\frac{17.1\,\text{ft}^3}{\text{s}} \times \frac{13000\,\text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{5.44 \times 10^{12}\,\text{colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean sample exceedance concentration of 704 colonies/100 ml times the average flow for all five of the fecal coliform measurements. This concentration was calculated based on measurements at BOLM-2a on June 19, 2007 and July 2, 9, 16, & 18, 2007 and can be found in Table 7-1, Appendix 7.2. The average stream flow, determined by a drainage area ratio of stream flows estimated from USGS Gage 02471001, for these five sampling events was 16.7 cfs. The product of these two values and a conversion factor gives the total mass loading of fecal coliform to West Bolton Branch under geometric mean exceedance conditions.

$$\frac{16.7\,\text{ft}^3}{\text{s}} \times \frac{704\,\text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.88 \times 10^{11}\,\text{colonies}}{\text{day}}$$

Allowable Conditions

The **allowable loads** to the watershed were calculated under the same physical conditions as discussed above for the single sample and the geometric mean criterion. This is done by taking the product of the flow used for the violation event times the conversion factor times the allowable concentration which are as follows:

For the **single sample** fecal concentration of 1800 colonies/100 mL. The allowable fecal coliform loading is:

$$\frac{17.1\ \text{ft}^3}{\text{s}} \times \frac{1800\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{7.53 \times 10^{11}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety of 200 colonies/100 mL equals a daily loading of:

$$\frac{17.1\text{ft}^3}{\text{s}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{8.37 \times 10^{10}\ \text{colonies}}{\text{day}}$$

For the **geometric mean** fecal concentration of 180 colonies/100 mL. The allowable fecal coliform loading is:

$$\frac{16.7\,\text{ft}^3}{\text{s}} \times \frac{180\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{7.35 \times 10^{10}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety of 20 colonies/100 mL equals a daily loading of:

$$\frac{16.7\,\text{ft}^3}{\text{s}} \times \frac{20\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{8.17 \times 10^{9}\ \text{colonies}}{\text{day}}$$

The difference in the pathogen loading between the existing conditions (violation event) and the allowable conditions converted to a percent reduction represents the total load reduction needed to achieve the fecal coliform water quality criterion. The TMDL was calculated as the total daily fecal coliform load to West Bolton Branch as evaluated at station BOLM-2a. Table 4-1 shows the results of the fecal coliform TMDL and percent reductions for each criterion.

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Table 4-1. 2007 Fecal Coliform Loads and Required Reductions

Source	2007 Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	Reduction %
NPS Load Single Sample	5.44E+12	7.53E+11	4.69E+12	86%
NPS Load Geometric mean	2.88E+11	7.35E+10	2.14E+11	74%
Point Source	NA	NA	NA	NA

From Table 4-1, compliance with the single sample criterion of 2000 col/100ml requires the greatest reduction in fecal coliform load. Therefore the TMDL will be based on the single sample criterion. The TMDL, WLA, LA and MOS values necessary to achieve the applicable fecal coliform criteria are provided in Table 1-2 below. Additional TMDL calculations are provided in Appendix 7.3.

Table 4-2. Fecal Coliform TMDL and Percent Reductions for West Bolton Branch

TMDL	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation(LA)	
		WWTPs[b]	MS4s[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
8.37E+11	8.37E+10	NA	86%	0	7.53E+11	86%

a. There are no CAFOs in the West Bolton Branch watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum; NA = not applicable, no point sources. Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.
c. Future MS4 areas would be required to demonstrate consistency with the assumptions and requirements of this TMDL.
d. The objective for leaking collection systems is a WLA of zero. It is recognized, however, that a WLA of 0 colonies/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in fecal coliform loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for fecal coliform.

4.3 TMDL Summary

Bolton Branch was placed on Alabama's §303(d) list in 2004 based on data collected by MAWSS in 2003. In 2007, ADEM collected additional water quality data which confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the fecal coliform TMDL for West Bolton Branch. Based on the TMDL analysis, it was determined that a 86% reduction in fecal coliform loading was necessary to achieve compliance with applicable water quality standards.

Compliance with the terms and conditions of existing and future NPDES sanitary and stormwater permits will effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. Required load reductions in the LA portion of this TMDL can be implemented through voluntary measures and may be eligible for CWA §319 grants.

The Department recognizes that adaptive implementation of this TMDL will be needed to achieve applicable water quality criteria and we are committed towards targeting the load reductions to improve water quality in the West Bolton Branch watershed. As additional data and/or information becomes available, it may become necessary to revise and/or modify the TMDL accordingly.

5.0 Follow Up Monitoring

ADEM has adopted a basin approach to water quality management; an approach that divides Alabama's fourteen major river basins into five groups. Each year, the ADEM water quality resources are concentrated in one of the five basin groups. One goal is to continue to monitor §303(d) listed waters. Monitoring will help further characterize water quality conditions resulting from the implementation of best management practices in the watershed. This monitoring will occur in each basin according the schedule shown.

Table 5-1. §303(d) Follow Up Monitoring Schedule

River Basin Group	Year to be Monitored
Tennessee	2009
Alabama / Coosa / Tallapoosa	2010
Escatawpa / Mobile / Lower Tombigbee / Upper Tombigbee	2011
Black Warrior / Cahaba	2012
Chattahoochee / Chipola / Choctawhatchee / Perdido-Escambia	2013

6.0 Public Participation

As part of the public participation process, this TMDL was placed on public notice and made available for review and comment. The public notice was prepared and published in the four major daily newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL was made available on ADEM's Website: www.adem.state.al.us. The public can also request paper or electronic copies of the TMDL by contacting Mr. Chris Johnson at 334-271-7827 or cljohnson@adem.state.al.us. The public was given an opportunity to review the TMDL and submit comments to the Department in writing. At the end of the public review period, all written comments received during the public notice period became part of the administrative record. ADEM considered all comments received by the public prior to finalization of this TMDL and subsequent submission to EPA Region 4 for final review and approval.

Appendix 7.1

References

ADEM Administrative Code, 2007. Water Division - Water Quality Program, Chapter 335-6-10, Water Quality Criteria.

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United States Environmental Protection Agency, 1991. Guidance for Water Quality-Based Decisions: The TMDL Process. Office of Water. EPA 440/4-91-001.

Mobile Area Water and Sewer Service (MAWSS) surface water monitoring data

Appendix 7.2

Water Quality Data

Table 7-1. ADEM Pathogen Data at Stations BOLM-2a

Station_ID	Date	Fecal Coliform (col/100ml)	Geometric means Fecal Coliform (col/100ml)	Eslava Creek ratioed flows (cfs)
BOLM-2a	4/26/2007	2900		5.9
BOLM-2a	5/9/2007	34		3.6
BOLM-2a	6/19/2007	13000		17.1
BOLM-2a	7/2/2007	100		4.4
BOLM-2a	7/9/2007	230		19.4
BOLM-2a	7/16/2007	2000		29.9
BOLM-2a	7/18/2007	290	704	12.7
BOLM-2a	8/14/2007	490		2.7
BOLM-2a	8/27/2007	60		9.2
BOLM-2a	8/29/2007	1200		16.4
BOLM-2a	8/30/2007	530		16.7
BOLM-2a	9/11/2007	440	383	4.1
BOLM-2A	10/11/2007	16		3.8

Table 7-2 Mobile Area Water and Sewer Systems (MAWSS) Data at Station 15MCR

Date	Fecal Coliform Col/100 ml		Date	Fecal Coliform Col/100 ml		Date	Fecal Coliform Col/100 ml
6/10/2003	1000		2/3/2004	290		11/24/2005	60
6/25/2003	670		2/17/2004	190		12/7/2005	20
7/9/2003	620		3/2/2004	150		12/19/2005	80
7/24/2003	2865		3/16/2004	6200		1/4/2006	50
8/7/2003	1270		3/18/2004	40		1/18/2006	80
8/17/2003	9010		3/31/2004	10		1/31/2006	120
8/21/2003	8860		4/14/2004	20		2/14/2006	20
9/4/2003	220		4/27/2004	7790		3/1/2006	50
9/9/2003	950		5/11/2004	390		3/15/2006	180
9/9/2003	230		5/26/2004	2040		3/28/2006	20
9/16/2003	630		6/8/2004	6925		4/12/2006	220
9/24/2003	660		6/24/2004	28750		4/25/2006	890
9/24/2003	380		7/20/2004	6860		5/12/2006	60
9/25/2003	530		8/3/2004	146370		5/23/2006	4290
9/25/2003	180		9/2/2004	5440		6/9/2006	4960
9/29/2003	70		9/23/2004	31620		7/6/2006	3720
9/29/2003	90		10/7/2004	21000		7/20/2006	570
9/30/2003	60		10/19/2004	7450		8/3/2006	10000
10/2/2003	110		11/2/2004	60300		8/24/2006	7500
10/2/2003	90		11/16/2004	870		9/7/2006	1000
10/9/2003	80		11/29/2004	140		9/20/2006	1520
10/9/2003	25		12/14/2004	530		10/3/2006	5030
10/14/2003	100		12/29/2004	20		10/25/2006	390
10/14/2003	300		1/11/2005	100		11/9/2006	180
10/15/2003	110		1/25/2005	70		11/27/2006	30
10/15/2003	180		2/9/2005	270		12/14/2006	270
10/16/2003	170		2/22/2005	60		1/3/2007	40
10/16/2003	160		3/8/2005	190		1/18/2007	210
10/20/2003	30		3/23/2005	240		1/30/2007	20
10/20/2003	0		4/5/2005	430		2/15/2007	70
10/21/2003	0		4/20/2005	290		2/28/2007	30
10/21/2003	10		5/5/2005	650		3/13/2007	170
10/22/2003	230		5/16/2005	1790		3/30/2007	90
10/22/2003	50		6/10/2005	820		4/13/2007	80
10/28/2003	670		6/23/2005	2070		4/25/2007	10
10/28/2003	1000		7/13/2005	8440		5/10/2007	230
10/29/2003	660		8/2/2005	2790		5/25/2007	40
10/29/2003	740		8/18/2005	750		6/5/2007	170
11/11/2003	10		9/14/2005	8900		6/25/2007	730
11/25/2003	150		9/28/2005	310		7/19/2007	170
12/11/2003	300		10/12/2005	4500		8/3/2007	190
1/6/2004	130		10/25/2005	190		8/16/2007	640
1/20/2004	200		11/9/2005	170		8/31/2007	1340

Table 7-2 Mobile Area Water and Sewer Systems (MAWSS) Data at Station 14BBC

Date	Fecal Coliform Col/100 ml		Date	Fecal Coliform Col/100 ml		Date	Fecal Coliform Col/100 ml
6/10/2003	500		2/3/2004	30		11/24/2005	20
6/25/2003	390		2/17/2004	70		12/7/2005	30
7/9/2003	320		3/2/2004	20		12/19/2005	0
7/24/2003	550		3/16/2004	4560		1/4/2006	20
8/7/2003	1005		3/18/2004	40		1/18/2006	30
8/17/2003	3970		3/31/2004	10		1/31/2006	10
8/21/2003	1160		4/14/2004	210		2/14/2006	10
9/4/2003	490		4/27/2004	480		3/1/2006	80
9/9/2003	290		5/11/2004	110		3/15/2006	20
9/9/2003	170		5/26/2004	120		3/28/2006	460
9/16/2003	210		6/8/2004	680		4/12/2006	20
9/24/2003	410		6/24/2004	9515		4/25/2006	40
9/24/2003	210		7/20/2004	200		5/12/2006	180
9/25/2003	300		8/3/2004	450		5/23/2006	60
9/25/2003	220		9/2/2004	360		6/9/2006	50
9/29/2003	130		9/23/2004	21600		7/6/2006	19520
9/29/2003	50		10/7/2004	210		7/20/2006	30
9/30/2003	30		10/19/2004	60		8/3/2006	5
10/2/2003	70		11/2/2004	40900		8/24/2006	120
10/2/2003	70		11/16/2004	0		9/7/2006	20
10/9/2003	30		11/29/2004	80		9/20/2006	260
10/9/2003	230		12/14/2004	0		10/3/2006	10
10/14/2003	20		12/29/2004	10		10/25/2006	30
10/14/2003	100		1/11/2005	70		11/9/2006	180
10/15/2003	120		1/25/2005	10		11/27/2006	30
10/15/2003	120		2/9/2005	390		12/14/2006	980
10/16/2003	110		2/22/2005	0		1/3/2007	70
10/16/2003	50		3/8/2005	130		1/18/2007	70
10/20/2003	50		3/23/2005	30		1/30/2007	0
10/20/2003	30		4/5/2005	160		2/15/2007	20
10/21/2003	50		4/20/2005	460		2/28/2007	0
10/21/2003	20		5/5/2005	200		3/13/2007	30
10/22/2003	40		5/16/2005	4880		3/30/2007	0
10/22/2003	70		6/10/2005	120		4/13/2007	695
10/28/2003	610		6/23/2005	190		4/25/2007	0
10/28/2003	240		7/13/2005	3870		5/10/2007	10
10/29/2003	65		8/2/2005	270		5/25/2007	10
10/29/2003	50		8/18/2005	1070		6/5/2007	10
11/11/2003	90		9/14/2005	50		6/25/2007	0
11/25/2003	60		9/28/2005	18000		7/19/2007	80
12/11/2003	90		10/12/2005	90		8/3/2007	220
1/6/2004	0		10/25/2005	20		8/16/2007	200
1/20/2004	30		11/9/2005	50		8/31/2007	400

Table 7-2 Mobile Area Water and Sewer Systems (MAWSS) Data at Station 13MCR

Date	Fecal Coliform Col/100 ml		Date	Fecal Coliform Col/100 ml		Date	Fecal Coliform Col/100 ml
6/10/2003	9700		2/3/2004	50		11/24/2005	20
6/25/2003	1360		2/17/2004	120		12/7/2005	50
7/9/2003	780		3/2/2004	520		12/19/2005	20
7/24/2003	1180		3/16/2004	8650		1/4/2006	20
8/7/2003	1535		3/18/2004	440		1/18/2006	315
8/17/2003	9400		3/31/2004	130		1/31/2006	180
8/21/2003	11650		4/14/2004	690		2/14/2006	10
9/4/2003	870		4/27/2004	2520		3/1/2006	40
9/9/2003	1060		5/11/2004	65		3/15/2006	70
9/9/2003	870		5/26/2004	180		3/28/2006	0
9/16/2003	450		6/8/2004	900		4/12/2006	70
9/24/2003	550		6/24/2004	6990		4/25/2006	85
9/24/2003	1470		7/20/2004	810		5/12/2006	120
9/25/2003	570		8/3/2004	2120		5/23/2006	280
9/25/2003	680		9/2/2004	1620		6/9/2006	100
9/29/2003	290		9/23/2004	4730		7/6/2006	15250
9/29/2003	690		10/7/2004	14000		7/20/2006	90
9/30/2003	100		10/19/2004	1360		8/3/2006	460
10/2/2003	270		11/2/2004	52000		8/24/2006	415
10/2/2003	230		11/16/2004	160		9/7/2006	30
10/9/2003	150		11/29/2004	60		9/20/2006	485
10/9/2003	230		12/14/2004	100		10/3/2006	70
10/14/2003	530		12/29/2004	10		10/25/2006	30
10/14/2003	955		1/11/2005	140		11/9/2006	70
10/15/2003	910		1/25/2005	30		11/27/2006	30
10/15/2003	590		2/9/2005	800		12/14/2006	350
10/16/2003	740		2/22/2005	90		1/3/2007	10
10/16/2003	420		3/8/2005	1580		1/18/2007	20
10/20/2003	40		3/23/2005	210		1/30/2007	0
10/20/2003	50		4/5/2005	340		2/15/2007	20
10/21/2003	370		4/20/2005	270		2/28/2007	0
10/21/2003	715		5/5/2005	410		3/13/2007	30
10/22/2003	1010		5/16/2005	3660		3/30/2007	10
10/22/2003	120		6/10/2005	970		4/13/2007	160
10/28/2003	910		6/23/2005	370		4/25/2007	20
10/28/2003	350		7/13/2005	3040		5/10/2007	40
10/29/2003	80		8/2/2005	430		5/25/2007	10
10/29/2003	290		8/18/2005	1210		6/5/2007	40
11/11/2003	70		9/14/2005	90		6/25/2007	120
11/25/2003	5740		9/28/2005	1530		7/19/2007	200
12/11/2003	185		10/12/2005	60		8/3/2007	700
1/6/2004	1210		10/25/2005	20		8/16/2007	430
1/20/2004	90		11/9/2005	75		8/31/2007	2410

Appendix 7.3

TMDL Calculation Worksheets

Load Reduction and TMDL Calculations for West Bolton Branch

For the Single Sample Maximum

Flow measured at BOLM-2a For Single Sample Maximum Violation: 17.1 cfs on 6/19/2007
Single Sample Fecal coliform concentration measured: 13000 col/100 mL
Allowable fecal coliform maximum concentration minus MOS: 1800 col/100mL = 2000 - 10%
Margin of safety for the maximum criteria 200 col/100mL = 10% of criteria

Load Calculations:

Load = Fecal Coliform Conc * Measured Flow * Conversion Factor
Load = colonies of Fecal Coliform/day Measured Flow = cfs
Fecal Coliform Conc = colonies/100 mL Conversion Factor = 24465755 (ml-s/ft3-day)

Current Load:

Nonpoint source load (LA)	5.44E+12	colonies/day	
Point source load (WLA)	NA	colonies/day	There are no point sources in this watershed
Current load =	5.44E+12	colonies/day	

Allowable Load:

Nonpoint source load (LA)	7.53E+11	colonies/day	
Point source load (WLA)	NA	colonies/day	There are no point sources in this watershed
Allowable load =	7.53E+11	colonies/day	

Margin of Safety:

MOS load = 8.37E+10 colonies/day

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
LA	5.44E+12	7.53E+11	4.69E+12	86%	7.53E+11
WLA	NA	NA	NA	NA	NA
Total	5.44E+12	7.53E+11	4.69E+12	86%	7.53E+11

Total Maximum Daily Load (TMDL): TMDL = WLA + LA + MOS

TMDL	WLA	LA	MOS
8.37E+11	NA	7.53E+11	8.37E+10

Percent Reduction to Achieve the Fecal Coliform Standard:

Total reduction: 86% = (current load - allowable load) / current load

The following assumptions are made for calculating the allowable load.

The single sample max water quality criteria for fecal coliform is 2000 col/100 mL.

To account for an explicit Margin of Safety (MOS) a target concentration of 1800 col/100 ml was used to calculate the allowable load.

Load Reduction and TMDL Calculations for West Bolton Branch

For the Geometric Mean

Average Flow measured at BOLM-2a for Geometric Mean Samples:	16.7 cfs	
Geometric Mean Fecal coliform concentration measured:	704 col/100 mL	
Allowable fecal coliform maximum concentration minus MOS:	180 col/100mL	= 200 - 10%
Margin of safety for the maximum criteria	20 col/100mL	= 10% of criteria

Load Calculations:

Load = Fecal Coliform Conc * Measured Flow * Conversion Factor

Load = colonies of Fecal Coliform/day — Measured Flow = cfs

Fecal Coliform Conc = colonies/100 mL — Conversion Factor = 24465755 (ml-s/ft3-day)

Current Load:

Nonpoint source load (LA)	2.88E+11	colonies/day	
Point source load (WLA)	NA	colonies/day	There are no point sources in this watershed
Current load =	2.88E+11	colonies/day	

Allowable Load:

Nonpoint source load (LA)	7.35E+10	colonies/day	
Point source load (WLA)	NA	colonies/day	There are no point sources in this watershed
Allowable load =	7.35E+10	colonies/day	

Margin of Safety:

MOS load = 8.17E+09 colonies/day

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
LA	2.88E+11	7.35E+10	2.14E+11	74%	7.35E+10
WLA	NA	NA	NA	NA	NA
Total	2.88E+11	7.35E+10	2.14E+11	74%	7.35E+10

Total Maximum Daily Load (TMDL): TMDL = WLA + LA + MOS

TMDL	WLA	LA	MOS
8.17E+10	NA	7.35E+10	8.17E+09

Percent Reduction to Achieve the Fecal Coliform Standard:

Total reduction: 74% = (current load - allowable load) / current load

The following assumptions are made for calculating the allowable load.

The water quality criteria for fecal coliform for summer geometric means is 200 col/100 mL.

To account for an explicit Margin of Safety (MOS) a target concentration of 180 col/100 ml was used to calculate the allowable load compared to the maximum criteria which = 200 – 10%