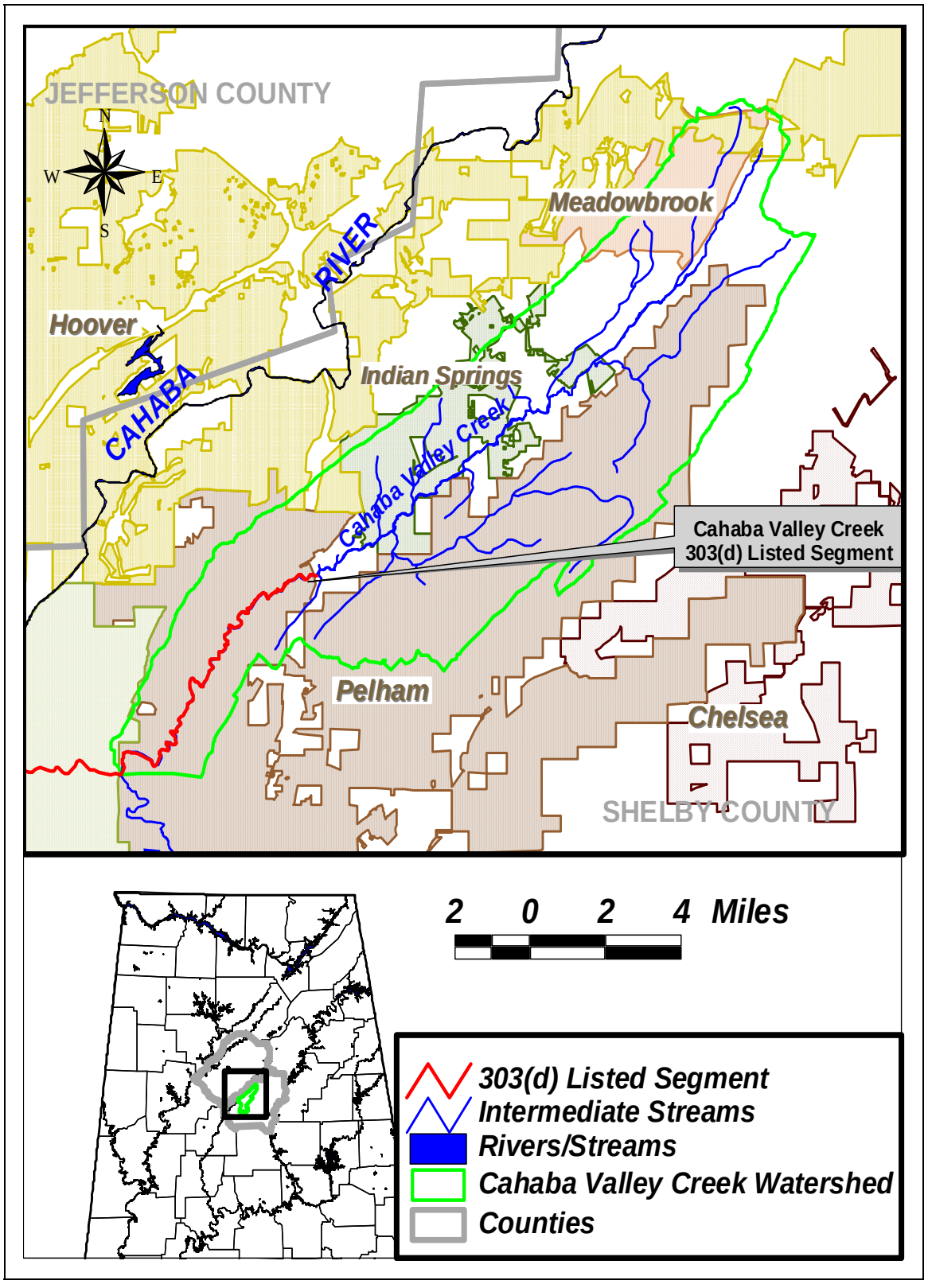
FINAL

Total Maximum Daily Load (TMDL)
for
Cahaba Valley Creek
Assessment Unit ID # AL03150201-0202-401
Pathogens (fecal coliform)

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

Figure I. §303(d) Listed Portion of Cahaba Valley Creek in the Cahaba River Basin



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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).

Cahaba Valley Creek is located in the Cahaba River basin of central Alabama. Cahaba Valley Creek originates in western Shelby County and flows southwest into Buck Creek while remaining in the western portion of Shelby County. The pathogens listed portion of Cahaba Valley Creek extends from Buck Creek upstream to US Highway 31. This 4.67 mile segment was first placed on the State of Alabama's §303(d) use impairment list for pathogens in 2004 with the source of pathogens being attributed to urban runoff/storm sewers. The listed segment of Cahaba Valley Creek retains a designated stream use classification of Fish and Wildlife (F&W). Cahaba Valley Creek represents a tributary to Buck Creek, which was also listed for pathogens on the §303(d) use impairment list in 2008.. The following Total Maximum Daily Load (TMDL), however, will only address the pathogen impaired segment of Cahaba Valley Creek.

Data collected in 1999 and 2000 by the United States Geological Survey (USGS) first indicated that Cahaba Valley Creek was impaired due to pathogens (fecal coliform). A total of 30 samples were collected from February 1999 through November 2000. Seven of these samples exceeded the 2000 colonies/100 mL single sample criterion for fecal coliform. Of two geometric mean concentrations determined in 1999, both exceeded the 200 colonies/100 mL geometric mean concentration criterion for fecal coliform. Cahaba Valley Creek was further sampled by the Alabama Department of Environmental Management (ADEM) at multiple stream locations during both 2007 and 2008. Eleven out of 104 of these samples again exceeded the single sample criterion and eleven out of sixteen additional geometric mean concentrations also exceeded geometric mean concentration criterion.

A mass balance approach was used to calculate the fecal coliform TMDL for Cahaba Valley Creek. 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. 2008 Fecal Coliform Loads and Required Reductions

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	Reduction %
NPS Load Single Sample	2.60E+12	7.79E+11	1.82E+12	70%
NPS Load Geomean	7.17E+11	6.56E+10	6.52E+11	91%

From Table 1-1, compliance with the geometric mean criterion of 200 col/100ml requires the greatest reduction in fecal coliform load. Therefore the TMDL will be based on the geometric mean criterion. The TMDL values for the geometric mean criterion are provided in Table 1-2 below.

Table 1-2. 2008 Coliform Loads and Required Reductions

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	Reduction %
Nonpoint Source	7.17E+11	6.56E+10	6.52E+11	91%
Point Source	1.16E+08	4.61E+10	0.00E+00	0%

Allowable loading was derived by taking the same average streamflow and multiplying it times the fecal coliform geometric mean concentrations criterion target of 180 colonies/100 mL (200 colonies/100 mL – 10% Margin of Safety). Reductions needed to meet the allowable loading were then determined by subtracting allowable loading from current loading. Table 1-2 summarizes both current, allowable loadings, and required reductions needed to meet the applicable water quality pathogen geometric mean concentration criterion for Cahaba Valley Creek. Table 1-3 lists required TMDL pathogen loadings under critical conditions for Cahaba Valley Creek.

Table 1-3. Fecal Coliform TMDL for Cahaba Valley Creek

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)
1.19E+10	7.29E+9	4.61E+10	91%	0	6.56E+10	91%

a. There are no Cahaba Valley Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum. 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 Cahaba Valley Creek watershed. As additional data and/or information becomes available, it may become necessary to revise and/or modify the TMDL accordingly.

2.0 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 water. 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 4.67 mile segment of the Cahaba Valley Creek from Buck Creek to US Highway 31 in Shelby 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 on the 2008 §303(d) list.

2.2 Problem Definition

Waterbody Impaired:	Cahaba Valley Creek from Buck Creek to US Highway 31.
Waterbody Length:	4.67 miles
Waterbody Drainage Area:	27.3 square miles

Water Quality Standard Violation:	Fecal Coliform (single sample) Fecal Coliform (geometric mean)
Pollutant of Concern:	Pathogens (fecal coliform)
Water Use Classification:	Fish and Wildlife

Usage Related to Classification:
The impaired segment of Cahaba Valley Creek 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:

Water quality data collected by the Alabama Department of Environmental Management (ADEM) in 2000 and 2001 was used for listing Cahaba Valley Creek on Alabama's 2002 §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 a 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.

USGS collected data on Cahaba Valley Creek for the period February 1999 through November 2000. According to the 2004 §303(d) list fact sheet, Cahaba Valley Creek was listed as impaired based on 11 out of 36 samples exceeding the single sample maximum criterion. Upon further analysis of the 1999 and 2000 USGS data, Cahaba Valley Creek was in violation of the single sample water quality criterion of 2000 colonies/100 mL a total of 7 out of 30 samples. Additionally, two geometric mean sampling events were both above the 200 colonies/100 mL water quality criterion.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

For the purpose of this TMDL a geometric mean concentrations fecal coliform target of 180 colonies/100 mL will be used. This target was derived by using a 10% explicit margin of safety from the geometric mean concentrations of 200 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 Cahaba Valley Creek Watershed

Continuous Point Sources

As of April 01, 2009, there are only two NPDES permitted point sources within the Cahaba Valley Creek watershed as presented in Table 3-1. Figure 3-1 displays the location of these facilities in relation to the overall watershed. North Shelby County WWTP discharges directly to Cahaba Valley Creek, while Oak Mountain State Park, discharges to an unnamed tributary (UT) of Dry Branch which in turns flows to the pathogen listed segment of Cahaba Valley Creek. Both facility's' NPDES permits stipulate a 200 colonies/100 mL monthly average and 2000 colonies/100 mL daily maximum fecal coliform limit for June through September along with a 1000 colonies/100 mL monthly average and 2000 colonies/100 mL daily maximum fecal coliform permit limit for October through May.

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.

Table 3-1. Permitted NPDES dischargers in the Cahaba Valley Creek Basin

Type	NPDES #	Facility Name	Stream	Flow (MGD)
SPP	AL0050831	Oak Mountain State Park	UT to Dry Branch	0.085
Municipal	AL0056251	North Shelby County WWTP	Cahaba Valley Creek	6.0

SPP = Semi-public/private

Non-Continuous Point Sources

A significant portion of the Cahaba Valley Creek watershed is classified as a Municipal Separate Stormwater Sewer System (MS4) area and therefore must be addressed in the TMDL as part of the Wasteload Allocation (WLA). Portions of the Cahaba Valley Creek watershed are within the boundary of the Birmingham-Jefferson Co. Area Phase I MS4 (ALS000001), and Birmingham-Shelby Co. Area Phase I MS4 (ALS000003). Figure 3-2 identifies the coverage areas of both Phase I MS4 areas in the Cahaba Creek watershed. Contributions from the both MS4 Phase I drain to the pathogen impaired segment of Cahaba Valley Creek watershed will be considered as point sources and 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 potentially occurred in the Cahaba Valley Creek watershed and therefore would be considered a source of pathogens to Cahaba Valley Creek.

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

Figure 3-1. NPDES Permitted Point Sources in the Cahaba Valley Creek Watershed

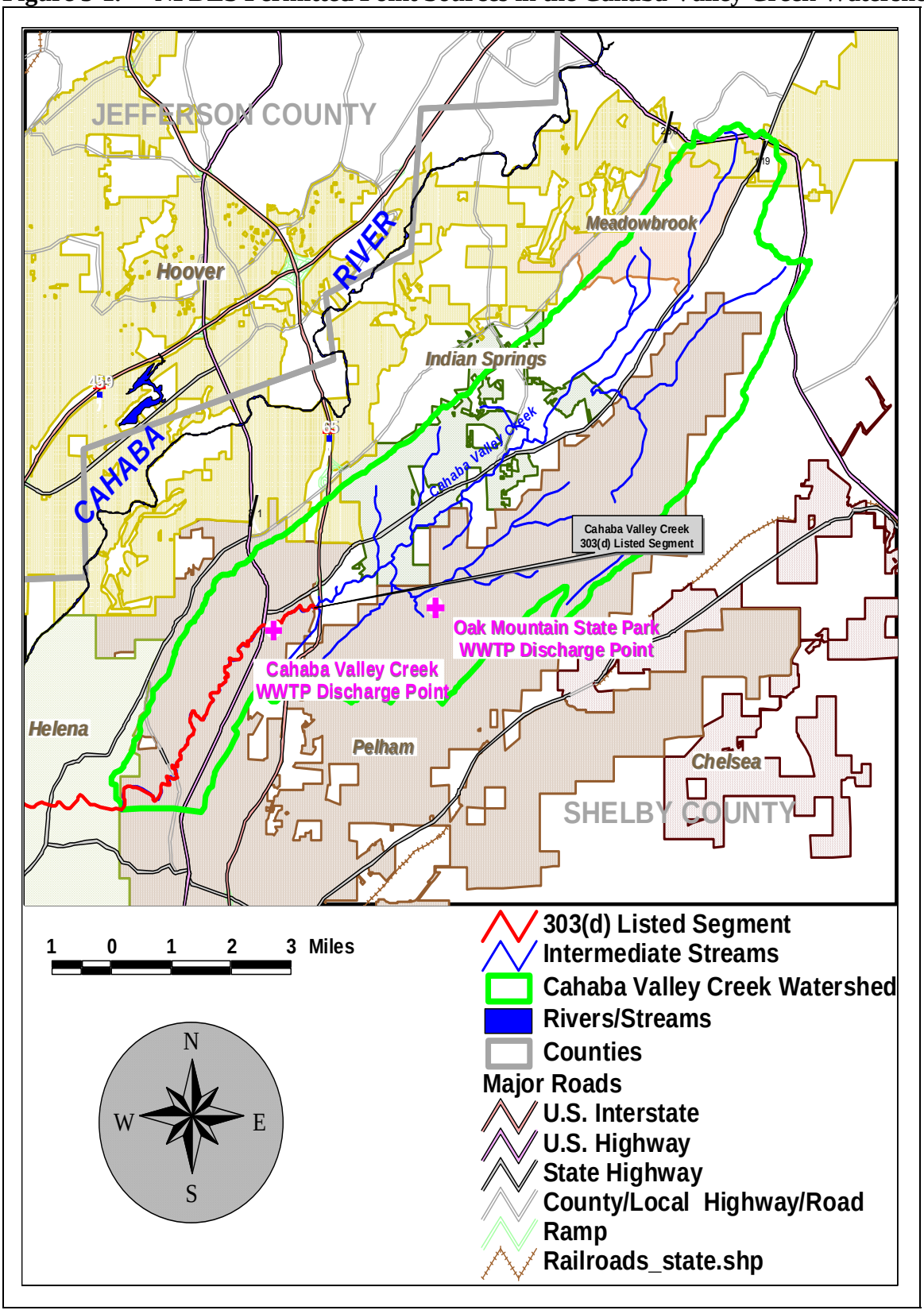
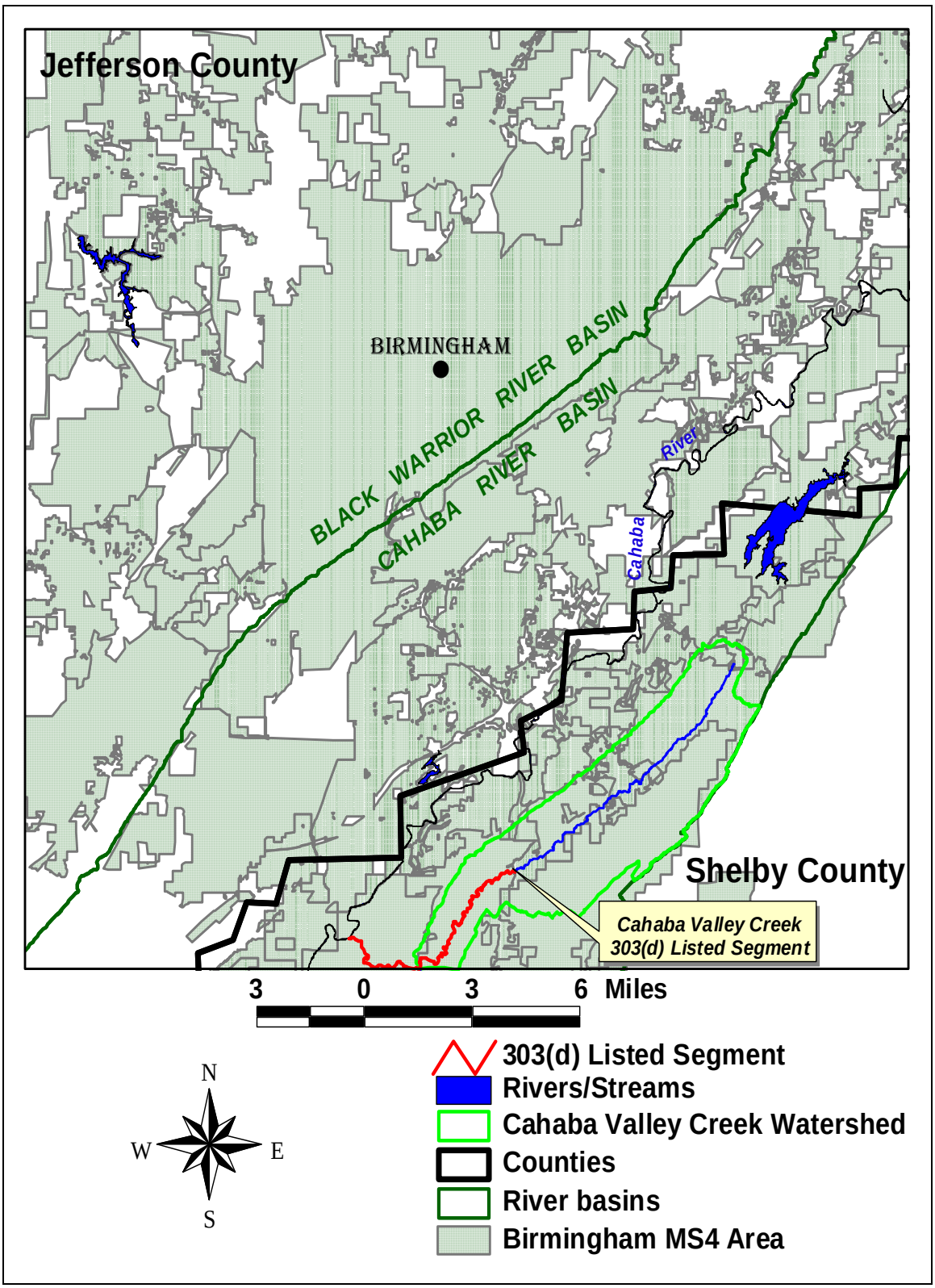


Figure 3-2. MS4 Areas in the Cahaba Valley Creek Watershed



3.2.2 Nonpoint Sources in the Cahaba Valley Creek 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 are washed 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 is 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 the 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

The Cahaba Valley Creek watershed is completely located within the 12-digit hydrologic unit code (HUC) 03150202-0202, which in turn is a part of the larger the 8-digit catalogue unit 03150202. The total drainage area of the Cahaba Valley Creek watershed is approximately 27.3 square miles. Land use activity percentages for the Cahaba Valley Creek watershed were derived using ArcView 3.3 with land use information provided from the 2001 National Land Cover Dataset (NLCD). Table 3-3 summarizes the percentages of various land use activities and Figure 3-3 provides a color-coded map of land use activity locations within the Cahaba Valley Creek watershed.

Roughly 59% of the Cahaba Valley Creek watershed consists of forest, with approximately 33% classified as developed, 7% designated as agricultural, with croplands representing 1% and pasturelands at 5%, and a remaining 2% comprised of other activities.

The combined percentages of forest and agriculture represent approximately 66% of the watershed with the remaining 34% representing a combination of residential, commercial, and other uses. Based on these percentages, the Cahaba Valley Creek watershed can be viewed as

representing a mix of various urban and rural land use activities. Agricultural areas, if it is not properly managed, have the potential for significant nonpoint source impacts.

Table 3-2. 12-Digit HUCs in the Buck Creek Watershed

12 Digit HUC	12 Digit HUC Name
031502020202	Cahaba River – Buck Creek

Figure 3-3. Land Use Map for the Cahaba Valley Creek Watershed

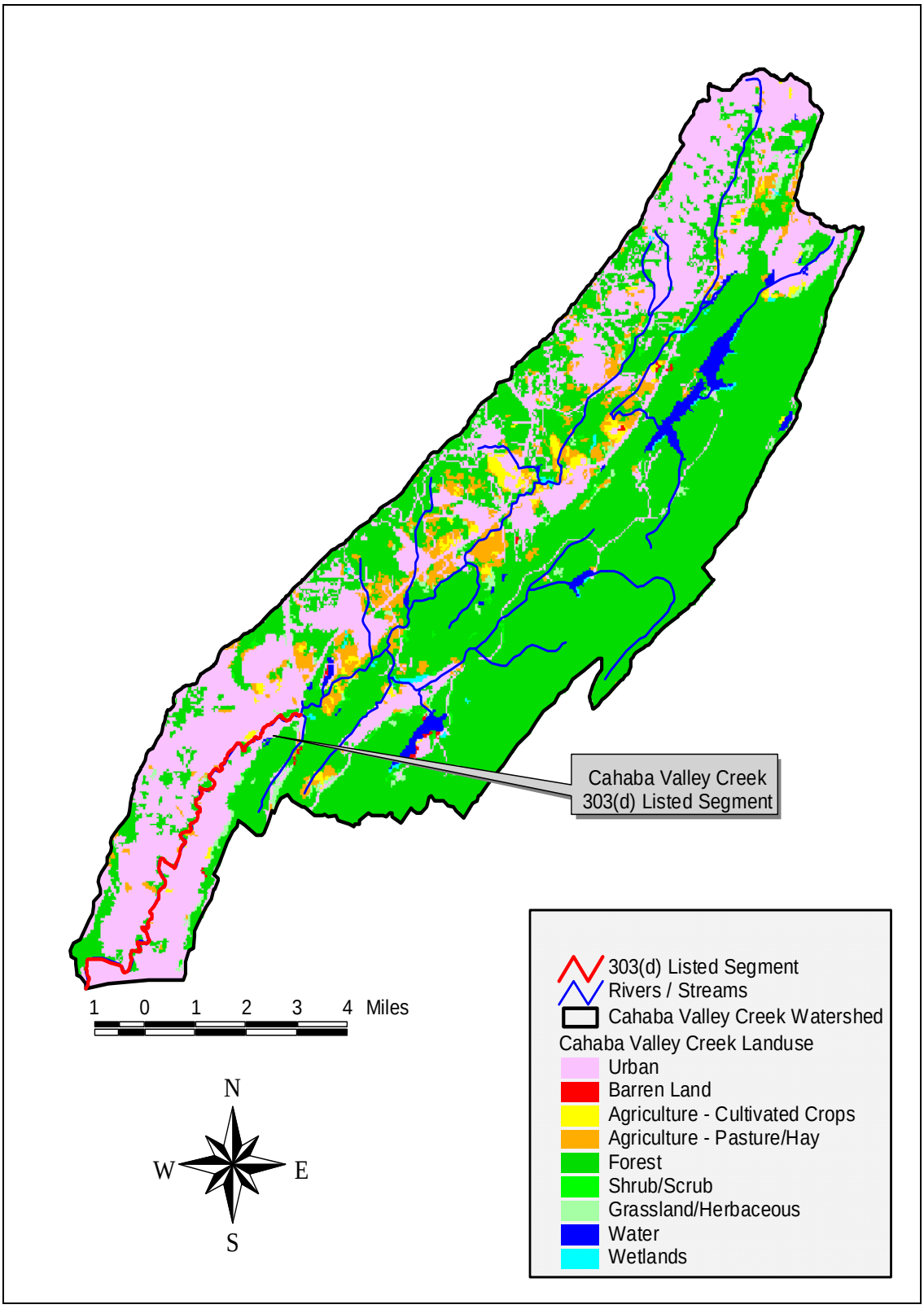


Table 3-3. Land Use Areas for the Cahaba Valley Creek Watershed

Landuse	Cahaba Valley Creek		
	Acers	Sq. Miles	Percent
Open Water	288.0	0.45	1.6%
Urban	5,696.0	8.90	32.6%
Barren or Mining	19.2	0.03	0.1%
Tran	-	-	0.0%
Agriculture - Cropland	224.0	0.35	1.3%
Agriculture - Pasture	934.4	1.46	5.4%
Forest	9,843.2	15.38	56.4%
Upland Shrub Land	121.6	0.19	0.7%
Grass Land	262.4	0.41	1.5%
Wetlands	70.4	0.11	0.4%
Total	**17,459.1**	**27.28**	**100.0%**
Agriculture	1158.4	1.81	6.6%
Forest	10297.6	16.09	59.0%
Developed	5715.2	8.93	32.7%
Other	288.0	0.45	1.6%
Total	**17459.1**	**27.28**	**100.0%**

3.4 Linkage Between Numeric Targets and Sources

The Cahaba Valley Creek watershed is highly disturbed with approximately 33% of the drainage area classified as urban, 7% classified as agricultural and the remaining land use/cover being forest, shrub and woody wetlands. 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 watershed characteristics, it is believed that the most likely sources of pathogen loadings in the Cahaba Valley Creek watershed are from activities in the MS4/urban areas and from agricultural activities. Such activities include leaking sewer pipes, illicit sewer connections, failing septic systems and urban runoff and runoff from pastures and animal feeding operations. From review of ADEM files it was determined that numerous sanitary sewer overflows (SSO) have potentially occurred in the Cahaba Valley Creek watershed, which would be considered a likely source of pathogens.

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 pathogen (fecal coliform) impaired segment of Cahaba Valley Creek was listed on the basis of water quality data collected by USGS from February 10, 1999 through November 7, 2000.

Seven out of 30 fecal coliform samples collected exceeded the single sample water quality criterion of 2000 colonies/100 mL and both 30-day fecal coliform geometric mean concentrations exceeded the 30-day geometric mean water quality criterion of 200 colonies/100 mL.

ADEM conducted further sampling on Cahaba Valley Creek at various stream locations along the pathogen listed segment of Cahaba Valley Creek during 2007 and again in 2008 as part of Alabama's §303(d) Monitoring Program. Table 3-4 provides a list of sampling station IDs, verbal description of their locations, latitude and longitude coordinates, and years of sampling and Figure 3-5 displays their locations in relation to the overall watershed.

Table 3-4. ADEM Sampling Stations on the Cahaba Valley Creek

Years	Station ID	Station Location	Latitude	Longitude
2007, 2008	CHVS-1	Cahaba Valley Creek @ Indian Trail Road in Indian Springs, AL	33.34436	-86.75930
2008	CHVS-2	Cahaba Valley Creek @ Cross Creek Road in Pelham, AL	33.31333	-86.80638
2007, 2008	CHVS-3	Cahaba Valley Creek @ Bearden Rd in Pelham, AL	33.30222	-86.81336
2007, 2008	CHVS-4	Cahaba Valley Creek @ Hwy 31 in Pelham, AL	33.33004	-86.81336
2008	CHVS-5	Cahaba Valley Ck @ Bishop Ln in Indian Springs, AL	33.35780	-86.73770
2008	CHVS-6	Cahaba Valley Creek @ Palomino Rd near Indian Springs, AL	33.36304	-86.72648
2008	CHVS-7	Cahaba Valley Creek @ entrance to recreational park near Indian Springs, AL	33.36327	-86.72674

One out of 54 fecal coliform samples collected by ADEM in 2007 exceeded the single sample maximum criterion of 2000 colonies/100 mL. Geometric mean concentrations were developed from Stations CHVS-1, CHVS-3, and CHVS-4 in June and September 2007 for comparison to the 30-day geometric mean criterion of 200 colonies/100mL. The geometric mean concentration determined from Station CHVS-1 during September 2007 sampling was 207.5 colonies/100 mL. The geometric mean concentration from Station CHVS-3 during June 2007 sampling was 200.5 colonies/100 mL and 281.7 colonies/100 mL during September 2007 sampling. Geometric mean concentration results for Station CHVS-1 during June 2007 and for Station CHVS-4 during both sampling periods were less than 200 colonies/100 mL.

Nine out of the 50 fecal coliform samples collected by ADEM during 2008 exceeded the single sample maximum criterion of 2000 colonies/100 mL. Geometric mean concentrations were determined for Stations CHVS-1, CHVS-2, CHVS-5, CHVS-6, and CHVS-7 during July and September 2008. Eight of ten geometric mean concentrations were found to have exceeded the maximum criterion of 200 colonies/100 mL. Complete listing of all water quality data collected by ADEM provided within Appendix 7.2.

Direct stream flow measurements or representative drainage area ratioed equivalent streamflows from USGS gauging stations are necessary when relating fecal coliform samples to total mass loading of fecal coliform. Actual streamflow measurements are not always feasible at the time of fecal coliform sampling due to unsafe or non-wadeable conditions. Direct streamflows could

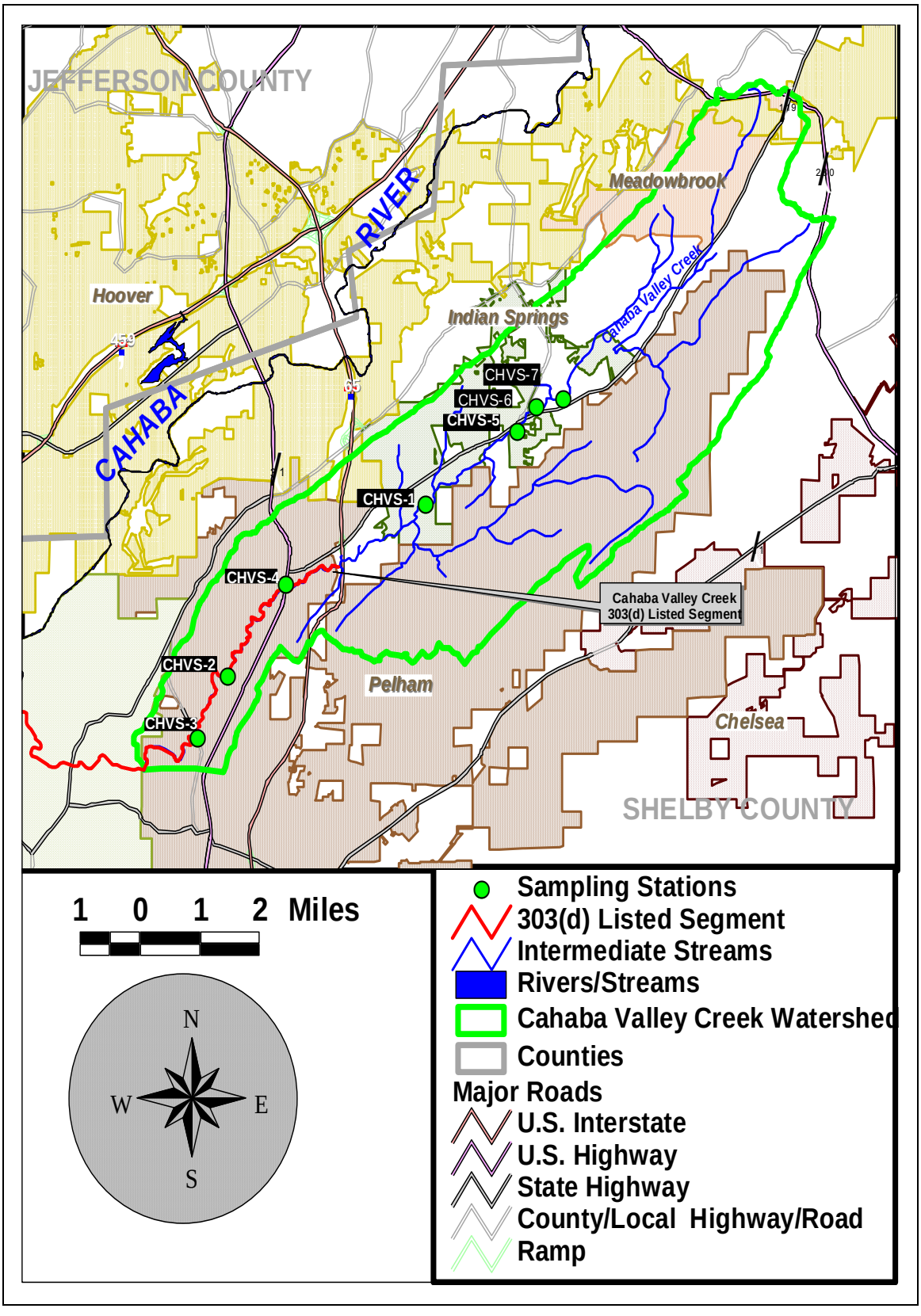
not be measured for all of the fecal coliform samples collected at CHVS-1, CHVS-2, CHVS-3, CHVS-4, CHVS-5, CHVS-6, and CHVS-7 due to dangerous or non-wadeable conditions. United States Geological Survey (USGS) Gauge #0242354750 is a continuously recording gauge which provides real-time streamflow and stage measurements on Cahaba Valley Creek at Cross Creek Road. Missing streamflows were determined by ratioing the recorded USGS gauge flow to the drainage area of the fecal coliform sampling station when actual flow measurements were not possible.

Table 3-5. Drainage Areas of ADEM Sampling Stations on Cahaba Valley Creek

Station ID	Drainage Area*
CHVS-1	15.87
CHVS-2	25.61
CHVS-3	26.74
CHVS-4	23.90
CHVS-5	11.90
CHVS-6	10.55
CHVS-7	10.56

*Drainage areas estimated using ArcView

Figure 3-4. Map of ADEM Sampling Stations



3.6 Critical Conditions

Critical conditions typically occur during the summer months. This can be explained by the nature and occurrence of summer storm events versus winter. Periods of dry weather interspersed with thunderstorms allow for the accumulation and wash off of fecal coliform bacteria into adjacent streams, resulting in abrupt increases of fecal coliform bacteria concentration. By comparison winter rain events, while more frequent, are typically less intense with a more gradual build-up and uniform loading of fecal coliform bacteria on the land surface.

The Cahaba Valley Creek watershed generally conforms to these trends with respect to the summer months of June through September. Figure 3-5 illustrates how a majority of high fecal coliform concentrations occur in Cahaba Valley Creek during higher streamflows. The same relationship holds true for the geometric mean concentrations as seen in Figure 3-6. The maximum geometric mean concentration of 1967.5 colonies/100 mL which occurred with an average streamflow of 14.9 cfs at Station CHVS-6 was selected for estimating TMDL pathogen loadings to Cahaba Valley Creek under critical conditions.

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 geometric mean criteria was reduced by ten percent to achieve the target concentrations 180 colonies/100 mL.

Figure 3-5. Cahaba Valley Creek Single Sample Fecal Coliform Data (2007 and 2008)

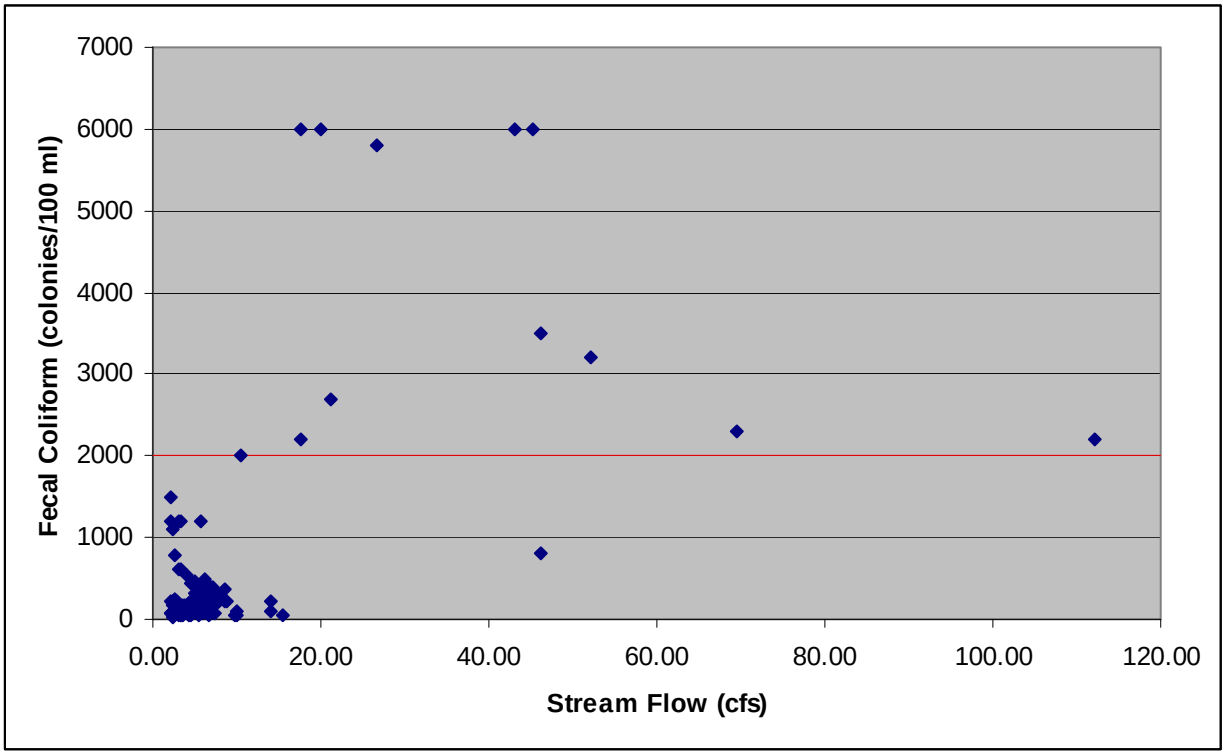
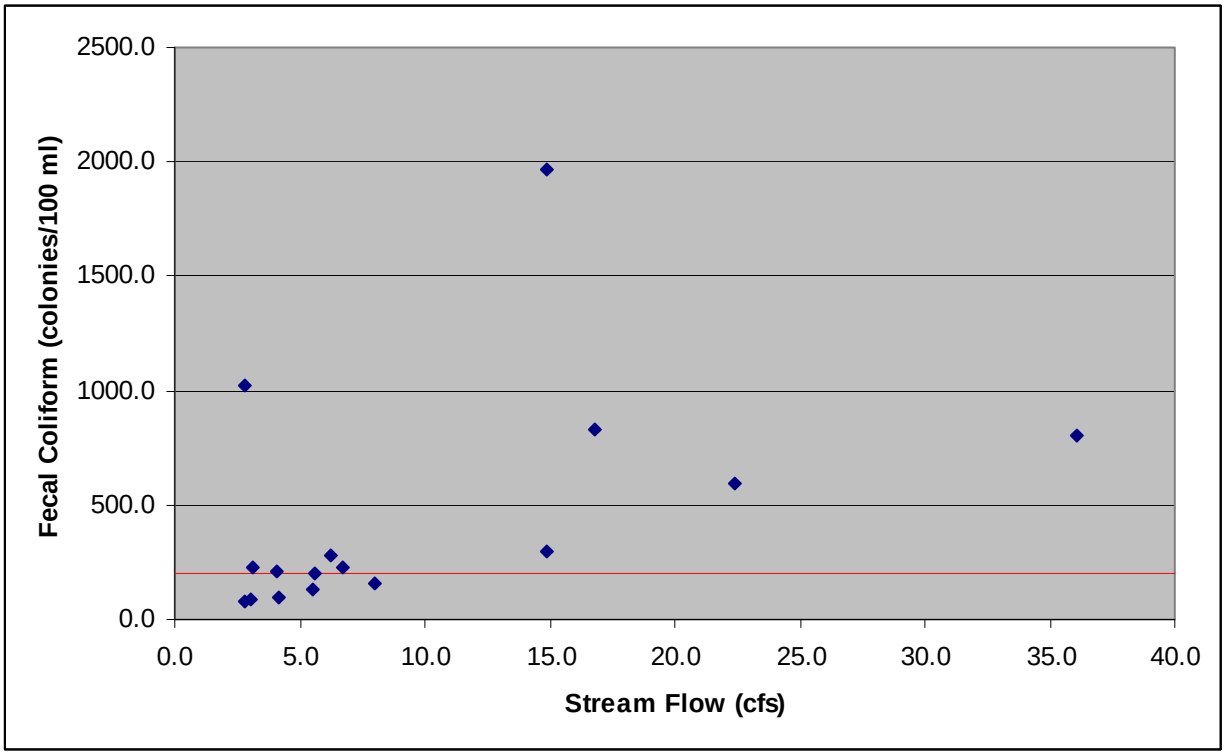


Figure 3-6. Cahaba Valley Geometric Mean Fecal Coliform Data (2007 and 2008)



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 utilized to determine total pathogen loading or TMDL for Cahaba Valley Creek. The mass balance approach employs the conservation of mass principle by multiplying fecal coliform concentration times streamflow to determine total mass loading.

Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest single sample exceedance concentration of 6,000 colonies/100 ml times the estimated flow for that day. This concentration was calculated based on measurements at CHVS-6 on September 15, 2008 and can be found in Table 7-5, Appendix 7.2. The estimated stream flow, determined by the drainage area ratio of stream flows estimated from USGS Gage 0242354750, for that sampling event was 17.7 cfs. The product of these two values and a conversion factor gives the total mass loading (colonies per day) of fecal coliform to Cahaba Valley Creek under a single sample exceedance conditions.

$$\frac{17.7\,\text{ft}^3}{\text{s}} \times \frac{6000\,\text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.60 \times 10^{12}\,\text{colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean sample exceedance concentration of 1967.5 colonies/100 ml times the average flow for all five of the fecal coliform measurements. This concentration was calculated based on measurements at CHVS-6 on August 8, and September 2, 15, 18, 22, 2008 and can be found in Table 7-5, Appendix 7.2. The average stream flow, determined by a drainage area ratio of stream flows estimated from USGS Gage 0242354750, for these five sampling events was 14.9 cfs. The product of these two values and a conversion factor gives the total mass loading of fecal coliform to Cahaba Valley Creek under geometric mean exceedance conditions.

$$\frac{14.9\,\text{ft}^3}{\text{s}} \times \frac{1967.5\,\text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{7.17 \times 10^{11}\,\text{colonies}}{\text{day}}$$

The second mass loading represents the allowable loading from NPDES point sources in the watershed that are defined as facilities that contribute continuous wasteflow to the system. Since exceedance conditions are based on September 2008 conditions, loading from NPDES point sources during September 2008 were used. A list of permitted NPDES point sources with discharge to the pathogen listed segment of Cahaba Valley Creek in September 2008 is located in Table 4-1. North Shelby County WWTP and the Oak Mountain State Park represent the only permitted wastewater treatment facilities that actively discharged during September 2008.

Table 4-1. NPDES Point Sources Located in the Cahaba Valley Creek Watershed

Type	NPDES #	Facility Name	Stream	Flow (MGD)
SPP	AL0050831	Oak Mountain State Park	UT to Dry Branch	0.085
Municipal	AL0056251	North Shelby County WWTP	Cahaba Valley Creek	6.0

SPP = Semi-public/private

$WWTP_{WLA}$ loading during the September 2008 violation period consisted of these two point sources, North Shelby County WWTP and Oak Mountain State Park. The September 2008 discharge monitoring report (DMR) for North Shelby County WWTP reported an average wasteflow of 1.516 million gallons per day (MGD) and an average fecal coliform concentration of 2 colonies/100 mL, with a maximum wasteflow of 1.846 MGD and maximum fecal coliform concentration of 10 colonies/100 mL. Mass loading from the North Shelby County WWTP during September 2008 was calculated as follows:

$$\frac{1.516 \times 10^6\,\text{gal}}{\text{day}} \times \frac{3785.41\,\text{mL}}{\text{gal}} \times \frac{2\ \text{colonies}}{100\,\text{mL}} = \frac{1.15 \times 10^8\,\text{colonies}}{\text{day}}$$

The September 2008 DMR for Oak Mountain State Park reported an average wasteflow of 0.0403 MGD and an average fecal coliform concentration of 1 colonies/100 mL, with a maximum wasteflow of 0.057 MGD and maximum fecal coliform concentration of 1 colonies/100 mL. Mass loading from Oak Mountain State Park during September 2008 was calculated as follows:

$$\frac{4.03 \times 10^4\,\text{gal}}{\text{day}} \times \frac{3785.41\,\text{mL}}{\text{gal}} \times \frac{1\ \text{colonies}}{100\,\text{mL}} = \frac{1.53 \times 10^6\,\text{colonies}}{\text{day}}$$

Combined mass loading from both North Shelby County WWTP and Oak Mountain State Park during September 2008 was:

$$\frac{1.15 \times 10^8\,\text{colonies}}{\text{day}} + \frac{1.53 \times 10^6\ \text{colonies}}{\text{day}} = \frac{1.16 \times 10^8\,\text{colonies}}{\text{day}}$$

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:

$$\frac{17.7\ \text{ft}^3}{\text{s}} \times \frac{1800\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{7.79 \times 10^{11}\ \text{colonies}}{\text{day}}$$

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

$$\frac{17.7\,\text{ft}^3}{\text{s}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{8.66 \times 10^{10}\ \text{colonies}}{\text{day}}$$

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

$$\frac{14.9\,\text{ft}^3}{\text{s}} \times \frac{180\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{6.56 \times 10^{10}\ \text{colonies}}{\text{day}}$$

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

$$\frac{14.9\,\text{ft}^3}{\text{s}} \times \frac{20\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{7.29 \times 10^{9}\ \text{colonies}}{\text{day}}$$

Table 4-2. NPDES Point Sources included in the WLA Portion of the TMDL

Type	NPDES #	Facility Name	Stream	Flow (MGD)
SPP	AL0050831	Oak Mountain State Park	UT to Dry Branch	0.085
Municipal	AL0056251	North Shelby County WWTP	Cahaba Valley Creek	6.0

SPP = Semi-public/private

$WWTP_{WLA}$ allowable loading consisted of only two point source, North Shelby County WWTP and Oak Mountain State Park. North Shelby County WWTP has a permitted wasteflow of 6.00 million gallons per day (MGD) and monthly average effluent fecal coliform concentration of 200 colonies/100 mL. Allowable mass loading from North Shelby County WWTP:

$$\frac{6.00 \times 10^{6}\,\text{gal}}{\text{day}} \times \frac{3785.41\,\text{mL}}{\text{gal}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} = \frac{4.54 \times 10^{10}\ \text{colonies}}{\text{day}}$$

Oak Mountain State Park has a permitted wasteflow of 0.085 million gallons per day (MGD) and monthly average effluent fecal coliform concentration of 200 colonies/100 mL. Allowable mass loading from Oak Mountain State Park:

$$\frac{0.085\times10^{6}\,\text{gal}}{\text{day}}\times\frac{3785.41\,\text{mL}}{\text{gal}}\times\frac{200\ \text{colonies}}{100\,\text{mL}}=\frac{6.44\times10^{8}\ \text{colonies}}{\text{day}}$$

Combined allowable mass loading from both North Shelby County WWTP and Oak Mountain State Park:

$$\frac{4.54\times10^{10}\,\text{colonies}}{\text{day}}+\frac{6.44\times10^{8}\ \text{colonies}}{\text{day}}=\frac{4.61\times10^{10}\ \text{colonies}}{\text{day}}$$

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 applicable fecal coliform water quality criteria. The TMDL was calculated as the total daily fecal coliform load to Cahaba Valley Creek as evaluated at Station CHVS-6. Table 4-3 shows the results of the fecal coliform TMDL and percent reductions for each criterion

Table 4-3. 2008 Fecal Coliform Loads and Required Reductions

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	Reduction %
NPS Load Single Sample	2.60E+12	7.79E+11	1.82E+12	70%
NPS Load Geometric Mean	7.17E+11	6.56E+10	6.52E+11	91%

From Table 4-3, compliance with the geometric mean criterion of 200 col/100ml requires the greatest reduction in fecal coliform load. Therefore the TMDL will be based on the geometric mean criterion. The TMDL, WLA, LA and MOS values necessary to achieve the applicable fecal coliform criteria are provided in Table 4-4 below.

Table 4-4. 2008 Coliform Loads and Required Reductions

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	Reduction %
Nonpoint Source	7.17E+11	6.56E+10	6.52E+11	91%
Point Source	1.16E+08	4.61E+10	0.00E+00	0%

Allowable loading was derived by taking the average streamflow which occurred at Station CHVS-6 on September, 2008, and multiplying it times the fecal coliform geometric mean criterion target of 180 colonies/100 mL (200 colonies/100 mL – 10% Margin of Safety). Reductions needed in meeting allowable loading were then determined by subtracting allowable loading from existing loading. Table 4-4 summarizes the existing loads, allowable loads, and required reductions needed to meet applicable fecal coliform criteria for Cahaba Valley Creek. Table 4-5 lists required TMDL pathogen loadings under critical streamflow conditions for Cahaba Valley Creek.

Table 4-5. Fecal Coliform TMDL for Cahaba Valley Creek

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)
1.19E+10	7.29E+09	4.61E+10	91%	0	6.56E+10	91%

a. There are no Cahaba Valley Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum. 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

Cahaba Valley Creek was placed on Alabama's §303(d) list in 2004 based on data collected by ADEM in 1999 and 2000. In 2007 and 2008, 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 Cahaba Valley Creek. Based on the TMDL analysis, it was determined that a 91% 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 Cahaba Valley Creek 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
Tennessee	2014

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.

ADEM Administrative Code, 2007. Water Division - Water Quality Program, Chapter 335-6-11, Use Classifications for Interstate and Intrastate Waters.

Alabama's §303(d) Monitoring Program. 2003, and 2004. ADEM.

Alabama Department of Environmental Management (ADEM), Alabama's Water Quality Assessment and Listing Methodology, January 2008.

Alabama's §303(d) Lists. 2002, 2004, 2006, and 2008 §303(d) List. ADEM.

U.S. Census Bureau, 2007. Table 3: Estimates of Population Change for Counties of Alabama and County Rankings: July 1, 2005 to July 1, 2006 (CO-EST2006-03-01). Population Division, March 22, 2007

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

United States Environmental Protection Agency, PCS website. http://www.epa.gov/enviro/html/pcs/index.html

Appendix 7.2

Water Quality Data

Table 7-1. Pathogen Data Collected by ADEM at Station CHVS-1 in 2007

Station ID	Date	Time	Turbidity (NTU)	Stream Flow (CFS)	USGS Flow from DA ratio (CFS)	Fecal Coliform (col/100ml)	Fecal Coliform oor*	Daily Criterion	Fecal Geomean (col/100ml)	30-Day Geometric Mean Criterion
CHVS - 1	3/27/2007	11:15	7.94	5.4	7.4	42		OK		
CHVS - 1	4/17/2007	11:20	7.73	4.2	6.2	52	J	OK		
CHVS - 1	5/22/2007	11:00	7.16	3.6	3.2	55		OK		
CHVS-1	6/7/2007	10:51	11.2	3.3	2.7	150		OK		
CHVS-1	6/12/2007	10:29	14.3	3.7	2.8	90		OK		
CHVS-1	6/14/2007	10:25	12	3.7	3.5	130		OK	86.3	OK
CHVS-1	6/18/2007	10:24	12.6	2.6	3.0	70		OK		
CHVS - 1	6/20/2007	11:30	8.6	2.4	3.3	28	J	OK		
CHVS-1	6/21/2007	10:59	14.2	2.5	3.0	120		OK		
CHVS-1	7/5/2007	14:15	10.8	2.9	4.6	64	J	OK		
CHVS-1	8/21/2007	10:40	8.32	2.3	2.7	188		OK		
CHVS-1	8/27/2007	12:01	9.89	2.1	3.3	230		OK		
CHVS-1	9/10/2007	12:08	6.82	2.8	3.5	120		OK		
CHVS-1	9/13/2007	11:53	5.54	2.6	7.4	110		OK		
CHVS - 1	9/18/2007	10:30	6.91	6.5	4.1	270		OK	207.5	VIOLATION
CHVS-1	9/20/2007	12:36	6.5	4.1	3.6	540		OK		
CHVS-1	9/24/2007	11:54	5.57	4.3	3.5	200		OK		
CHVS - 1	10/23/2007	11:00	25	10.4	30.4	2000		OK		

Table 7-2. Pathogen Data Collected by ADEM at Station CHVS-3 in 2007

Station ID	Date	Time	Turbidity (NTU)	Stream Flow (CFS)	USGS Flow from DA ratio (CFS)	Fecal Coliform (col/100ml)	Fecal Coliform oor*	Daily Criterion	Fecal Geomean (col/100ml)	30-Day Geometric Mean Criterion
CHVS - 3	3/27/2007	9:45	2.78	15.5	12.5	56		OK		
CHVS - 3	4/17/2007	10:00	2.31	9.8	10.4	60	J	OK		
CHVS - 3	5/22/2007	9:30	3.8	7.3	5.4	212		OK		
CHVS-3	6/7/2007	9:54	5.68	6	4.6	220		OK		
CHVS-3	6/12/2007	9:39	6.01	5	4.7	240		OK		
CHVS-3	6/14/2007	9:28	7.42	7.1	5.8	380		OK	200.5	VIOLATION
CHVS-3	6/18/2007	9:18	6.91	5.3	5.1	230		OK		
CHVS - 3	6/20/2007	10:30	7.41	5.4	5.6	64	J	OK		
CHVS-3	6/21/2007	9:38	6.07	4.9	5.0	220		OK		
CHVS-3	7/5/2007	11:20	5.74	5.9	7.8	80		OK		
CHVS-3	8/21/2007	9:30	6.98	4.5	4.6	144		OK		
CHVS-3	8/27/2007	11:07	7.07	4.6	5.6	440		OK		
CHVS-3	9/10/2007	11:18	6.84	5	5.8	320		OK		
CHVS-3	9/13/2007	11:24	6.05	2.5	12.5	250		OK		
CHVS - 3	9/18/2007	9:30	8.33	8.5	6.9	360		OK	281.7	VIOLATION
CHVS-3	9/20/2007	11:39	7.5	7.8	6.1	280		OK		
CHVS-3	9/24/2007	11:00	6.06	7.2	6.0	220		OK		
CHVS - 3	10/23/2007	10:00	51.3	45.2	51.2	6000	G	VIOLATION		

Table 7-3. Pathogen Data Collected by ADEM at Station CHVS-4 in 2007

Station ID	Date	Time	Turbidity (NTU)	Stream Flow (CFS)	USGS Flow from DA ratio (CFS)	Fecal Coliform (col/100ml)	Fecal Coliform oor*	Daily Criterion	Fecal Geomean (col/100ml)	30-Day Geometric Mean Criterion
CHVS - 4	3/27/2007	10:30	3.28	14	11.2	104		OK		
CHVS - 4	4/17/2007	10:50	1.78	10.1	9.3	51		OK		
CHVS - 4	5/22/2007	10:15	2.09	7.4	4.9	80		OK		
CHVS-4	6/7/2007	10:26	4.31	5.3	4.1	87		OK		
CHVS-4	6/12/2007	10:07	3.8	5	4.2	130		OK		
CHVS-4	6/14/2007	9:56	4.37	5	5.2	460		OK	131.2	OK
CHVS-4	6/18/2007	9:55	2.99	5.5	4.6	70		OK		
CHVS - 4	6/20/2007	11:00	2.29	6.7	5.0	56	J	OK		
CHVS-4	6/21/2007	10:23	2.3	5.7	4.5	250		OK		
CHVS-4	7/5/2007	12:30	3.03	6.7	7.0	92		OK		
CHVS-4	8/21/2007	10:00	3.42	4.1	4.1	104		OK		
CHVS-4	8/27/2007	11:33	3.37	6.3	5.0	400		OK		
CHVS-4	9/10/2007	11:42	3.6	6.4	5.2	180		OK		
CHVS-4	9/13/2007	10:57	3.62	6.8	11.2	80	J	OK		
CHVS - 4	9/18/2007	10:00	4.39	8.9	6.2	220		OK	159.9	OK
CHVS-4	9/20/2007	12:07	4	10	5.4	110		OK		
CHVS-4	9/24/2007	11:26	3.94	8	5.3	300		OK		
CHVS - 4	10/23/2007	10:30	43.6	21.1	45.7	2700		VIOLATION		

Table 7-4. Pathogen Data Collected by ADEM at Stations CHVS-1 and CHVS-2 in 2008

Station ID	Date	Time	Turbidity (NTU)	Stream Flow (CFS)	USGS Flow from DA ratio (CFS)	Fecal Coliform (col/100ml)	Fecal Coliform oor*	Daily Criterion	Fecal Geomean (col/100ml)	30-Day Geometric Mean Criterion
CHVS-1	6/30/2008		4		4.6	220		OK		
CHVS-1	7/2/2008		3.2		3.3	56		OK		
CHVS-1	7/14/2008		4.1		4.8	84		OK	94.1	OK
CHVS-1	7/17/2008		5.3		4.6	54		OK		
CHVS-1	7/28/2008		4.8		3.5	132		OK		
CHVS-1	8/25/2008		14.8		69.4	2300		VIOLATION		
CHVS-1	9/2/2008		13.4		8.7	212		OK		
CHVS-1	9/15/2008		16.4		26.7	5800		VIOLATION	596.7	VIOLATION
CHVS-1	9/18/2008		7		3.9	176		OK		
CHVS-1	9/22/2008		5.1		3.2	152		OK		
CHVS-2	6/30/2008		8.3		7.4	350		OK		
CHVS-2	7/2/2008		6.6		5.3	132		OK		
CHVS-2	7/14/2008		11		7.8	220		OK	226.9	VIOLATION
CHVS-2	7/17/2008		9.5		7.4	160		OK		
CHVS-2	7/28/2008		3.2		5.6	370		OK		
CHVS-2	8/25/2008		19		112.0	2200		VIOLATION		
CHVS-2	9/2/2008		12		14.0	228		OK		
CHVS-2	9/15/2008		45		43.0	6000		VIOLATION	806.9	VIOLATION
CHVS-2	9/18/2008		8.3		6.3	490		OK		
CHVS-2	9/22/2008		6.4		5.2	232		OK		

Table 7-5. Pathogen Data Collected by ADEM at Stations CHVS-5 and CHVS-6 in 2008

Station ID	Date	Time	Turbidity (NTU)	Stream Flow (CFS)	USGS Flow from DA ratio (CFS)	Fecal Coliform (col/100ml)	Fecal Coliform oor*	Daily Criterion	Fecal Geomean (col/100ml)	30-Day Geometric Mean Criterion
CHVS-5	6/30/2008		3.4		3.4	600		OK		
CHVS-5	7/2/2008		2.9		2.5	168		OK		
CHVS-5	7/14/2008		2.5		3.6	180		OK	224.9	VIOLATION
CHVS-5	7/17/2008		3.4		3.4	144		OK		
CHVS-5	7/28/2008		3.3		2.6	220		OK		
CHVS-5	8/25/2008		10.2		52.1	3200		VIOLATION		
CHVS-5	9/2/2008		9.7		6.5	450		OK		
CHVS-5	9/15/2008		8.7		20.0	6000		VIOLATION	826.1	VIOLATION
CHVS-5	9/18/2008		5.4		2.9	210		OK		
CHVS-5	9/22/2008		3.6		2.4	212		OK		
CHVS-6	6/30/2008				3.0	600		OK		
CHVS-6	7/2/2008				2.2	1200		OK		
CHVS-6	7/14/2008				3.2	1200		OK	1026.6	VIOLATION
CHVS-6	7/17/2008				3.0	1200		OK		
CHVS-6	7/28/2008				2.3	1100		OK		
CHVS-6	8/25/2008		8		46.2	3500		VIOLATION		
CHVS-6	9/2/2008		8.1		5.8	1200		OK		
CHVS-6	9/15/2008		7.2		17.7	6000		VIOLATION	1967.5	VIOLATION
CHVS-6	9/18/2008		3.3		2.6	780		OK		
CHVS-6	9/22/2008		2.4		2.1	1500		OK		

Table 7-6. Pathogen Data Collected by ADEM at Station CHVS-7-1 in 2008

Station ID	Date	Time	Turbidity (NTU)	Stream Flow (CFS)	USGS Flow from DA ratio (CFS)	Fecal Coliform (col/100ml)	Fecal Coliform oor*	Daily Criterion	Fecal Geomean (col/100ml)	30-Day Geometric Mean Criterion
CHVS-7	6/30/2008		2.1		3.0	152		OK	80.3	OK
CHVS-7	7/2/2008				2.2	84		OK		
CHVS-7	7/14/2008		1.1		3.2	56		OK		
CHVS-7	7/17/2008				3.0	53		OK		
CHVS-7	7/28/2008				2.3	88		OK		
CHVS-7	8/25/2008		8.8		46.2	800		OK	293.5	VIOLATION
CHVS-7	9/2/2008		7		5.8	92		OK		
CHVS-7	9/15/2008		3.4		17.7	2200		VIOLATION		
CHVS-7	9/18/2008		3.4		2.6	160		OK		
CHVS-7	9/22/2008		1.9		2.1	84		OK		

Table 7-7. Pathogen Data Collected by USGS at Station 242354750 in 1999 and 2000

Station ID	Date	Time	Turbidity (NTU)	Stream Flow (CFS)	USGS Flow from DA ratio (CFS)	Fecal Coliform (col/100ml)	Fecal Coliform oor*	Daily Criterion	Fecal Geomean (col/100ml)	30-Day Geometric Mean Criterion
242354750	2/10/1999	13:29			116.0	8800	E	VIOLATION		
242354750	3/3/1999	10:30			103.0	4600		VIOLATION		
242354750	3/15/1999	13:00			134.1	220		OK		
242354750	3/24/1999	11:00			34.0	67		OK		
242354750	3/30/1999	10:30			36.0	66		OK		
242354750	4/6/1999	11:00			53.0	110		OK		
242354750	4/15/1999	9:15			90.0	22000	E	VIOLATION		
242354750	4/22/1999	10:30			16.0	180		OK	1268.5	VIOLATION
242354750	4/28/1999	10:45			22.0	580		OK		
242354750	5/6/1999	10:45			86.0	13000	E	VIOLATION		
242354750	5/20/1999	10:30			14.0	130		OK		
242354750	6/1/1999	10:30			17.0	220		OK		
242354750	6/8/1999	10:00			7.9	77		OK		
242354750	6/15/1999	11:15			20.0	160		OK	225.7	VIOLATION
242354750	6/22/1999	10:30			8.9	120		OK		
242354750	6/30/1999	11:00			84.0	1800		OK		
242354750	7/15/1999	11:00			17.0	230		OK		
242354750	7/20/1999	8:30			27.0	370	E	OK		
242354750	9/16/1999	11:00			6.2	200		OK		
242354750	9/28/1999	9:00			8.0	530		OK		
242354750	1/4/2000	10:30			25.0	1400	E	OK		
242354750	1/25/2000	10:15			28.0	120		OK		
242354750	2/9/2000	10:15			13.0	E 32		OK		
242354750	3/11/2000	1:15			280.1	4500		VIOLATION		
242354750	3/19/2000	12:30			270.1	14000		VIOLATION		
242354750	4/3/2000	12:00			1410.6	7900		VIOLATION		
242354750	4/20/2000	9:40			23.0	120		OK		
242354750	5/15/2000	10:20			12.0	100		OK		
242354750	7/5/2000	11:00			7.1	230		OK		
242354750	11/7/2000	12:50			8.7	220		OK		

E = Estimated