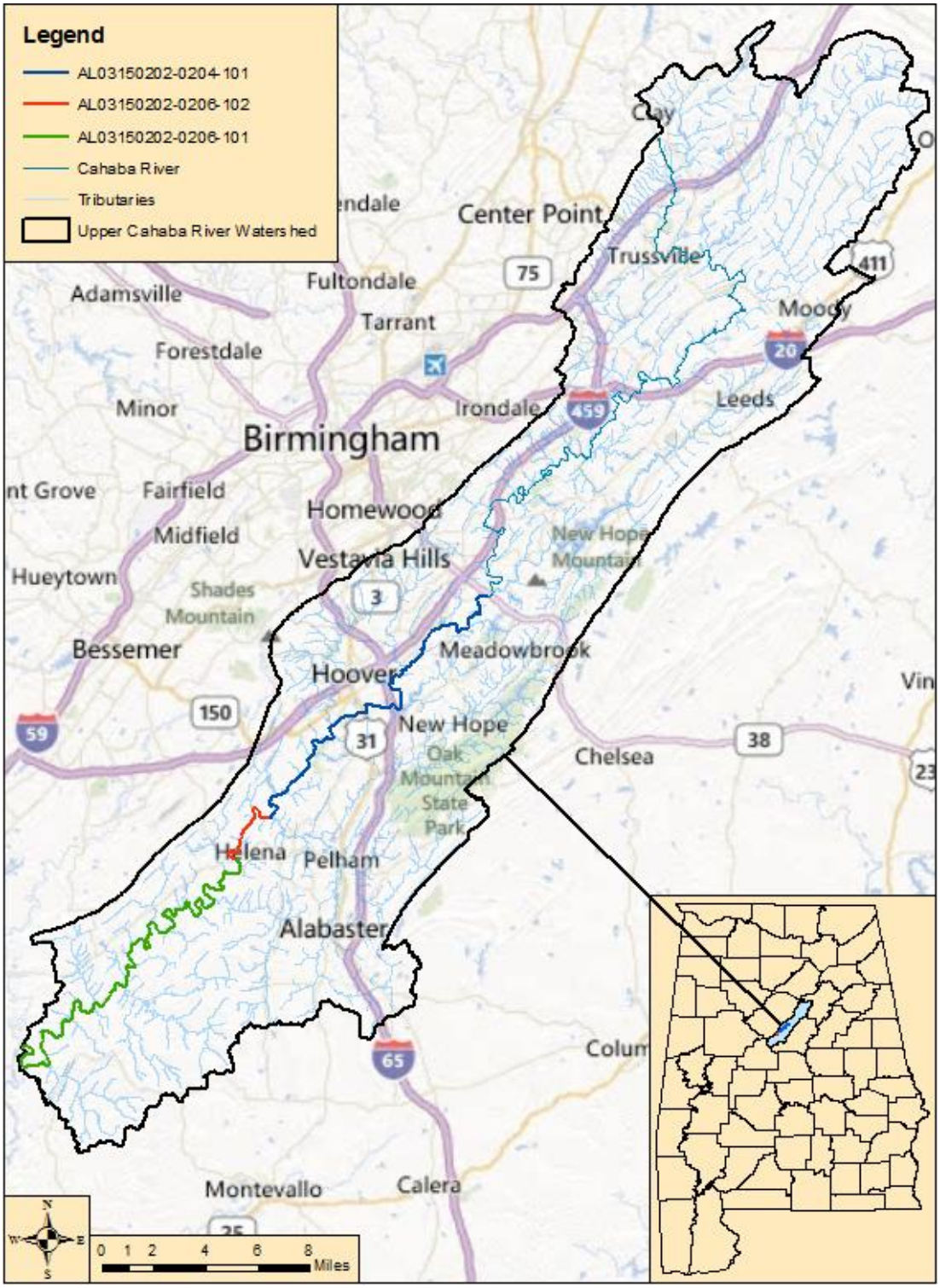
# Final
## Total Maximum Daily Load (TMDL)
## For
## The Cahaba River

## Assessment Unit ID # AL03150202-0204-101
## Assessment Unit ID # AL03150202-0206-101
## Assessment Unit ID # AL03150202-0206-102

## Pathogens (E. coli)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
August 2013

**Figure 1-1 Upper Cahaba River Watershed**



## *Table of Contents* *Page*

## *List of Figures* *Page*



## *List of Tables*

## *List of Photos*

# *1.0 Executive Summary*

Section §303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify waterbodies which are not meeting their designated uses and to determine the Total Maximum Daily Load (TMDL) for pollutants causing the use impairment. A 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 Cahaba River headwaters originate in Jefferson County just north and east of Birmingham. It is recognized as the longest free-flowing river in the State of Alabama. The Cahaba River Basin is a sub-basin of the Alabama River Basin, which eventually drains into the Mobile River, one of the largest primary stream drainage basins in North America. The Cahaba River spans nearly 194 miles through central Alabama and has a contributing drainage area of 1,824 square miles. The upper portion of the watershed, which drains a large part of Birmingham and surrounding suburbs, is a highly developed urban area which results in an effluent-dominated stream network.

The Cahaba River was first listed on Alabama's §303(d) list in 1996 for nutrients. In 1999, The U.S. Environmental Protection Agency (USEPA) added other parameters after reviewing ADEM's 1998 §303(d) list. Four segments of the mainstem Cahaba River were listed as impaired for siltation, three of which were listed for other habitat alteration, and one segment was listed for pathogens. The Cahaba River Nutrient TMDL was completed and approved by EPA in 2006. The Draft Cahaba River Siltation/Habitat Alteration TMDL was completed in 2012 and is pending finalization.

Three segments of the Cahaba River are currently listed on Alabama's §303(d) list as impaired for pathogens. Two of the three segments, namely AL03150202-0206-101 (Shades Creek to Shelby County Road 52) and AL03150202-0206-102 (Shelby County Road 52 to Buck Creek) were originally on the §303(d) list in 1998 as AL/Cahaba R_03. AL/Cahaba R_03 spanned 26.5 miles and was also listed for nutrients and siltation/habitat alteration. This segment was then divided into two different segments in 2004 to better match use classifications, and in 2010, the Assessment Unit IDs for these two segments were changed from AL03150202-0203-101 and AL03150202-0203-102 to AL03150202-0206-101 and AL03150202-0206-102. Neither segment is meeting water quality standards for pathogens; therefore, both segments will be covered in this report. The third segment currently listed on the §303(d) list is AL03150202-0204-101 (Buck Creek to the dam near US Highway 280). It was originally listed for pathogens in 2010. This segment is not meeting water quality standards for pathogens and will also be covered in this report.

Every year from 1991-1995 and from 1998-2012, §303(d) sampling studies were performed by ADEM on the Cahaba River to further assess the water quality on the impaired segments. The January 2012 edition of *Alabama's Water Quality Assessment and Listing Methodology* section 4.8.2, prepared by ADEM, provides the rationale for the Department to use the most recent data

to prepare a TMDL for an impaired waterbody when that data indicates a change in water quality has occurred. Also, as a result of the Alabama Environmental Management Commission's (EMC) adoption of the Escherichia coli (E. coli) criteria as the new bacterial indicator, this TMDL will be developed using E. coli data collected. Therefore, this TMDL will be developed using E. coli data from 2009-2012 because it is the most current data and provides the best picture of the current water quality conditions of the river. The 2009-2012 bacterial data is listed in Appendix 7.2, Table 7-1, Table 7-2, Table 7-3, and Table 7-4 for reference. From 2009-2012, ADEM collected a total of 140 samples from four different stations. According to the data, the upper Cahaba River was not meeting the pathogen criterion applicable to its use classifications. Therefore, a TMDL will be developed for pathogens (E. coli) for the upper portion of the Cahaba River.

A mass balance approach was used for calculating the pathogen TMDL for Cahaba River. The mass balance approach utilizes the conservation of mass principle. Existing loads were calculated by multiplying the E. coli concentration times the respective in-stream flows and a conversion factor. The mass loading was calculated using the single or geometric mean sample exceedance event which resulted in the highest percent reduction. In this case it was determined that the highest percent reduction was calculated for a single sample violation of 3,465.8 colonies/100mL measured on 6/27/2011 at station C-3 and on 9/6/2011 at station CAHS-1. Both violations resulted in a reduction of 87%. In the same manner as existing loads were calculated, an allowable load was calculated for the single sample E. coli criterion of 438.3 colonies/100 mL (487 colonies/100 mL – 10% Margin of Safety).

The existing pathogen loading for this TMDL was calculated using the single sample exceedances at station C-3 (6/27/2011) and station CAHS-1 (9/6/2011) with reported concentrations of 3,465.8 colonies/100mL at both stations. This concentration was then multiplied by the respective flow at each station and a conversion factor. The allowable loading, defined by the single sample criterion including a margin of safety, was calculated using the same measured flows times the E. coli single sample target of 438.3 colonies/100mL (487 colonies/100Ml – 10% Margin of Safety). The reduction required to meet the allowable loading was then calculated by subtracting the allowable loading from the existing loading and then dividing by the existing loading. Both violations call for a reduction of 87%.

Table 1-1 is a summary of the estimated existing load, allowable load, and percent reduction for the single sample criterion vs. the geometric mean criterion for segment AL03150202-0204-101 at station CAHS-1. Table 1-2 is a summary of the estimated existing load, allowable load, and percent reduction for the single sample criterion vs. the geometric mean criterion for segment AL03150202-0206-101 at station CABS-1. Table 1-3 is a summary of the estimated existing load, allowable load, and percent reduction for the single sample criterion vs. the geometric mean criterion for segment AL03150202-0206-102 at station C-3. Table 1-4 provides the details of the TMDL along with the corresponding reductions for the Cahaba River which are protective of E. coli water quality standards year round.

## Table 1-1 E. coli Load and Required Reduction for AL03150202-0204-101 at CAHS-1

| Source | Existing Load (colonies/day) | Allowable Load (colonies/day) | Required Reduction (colonies/day) | % Reduction |
|---|---|---|---|---|
| **Nonpoint Source Load - Single Sample** | 5.19E+14 | 6.56E+13 | 4.53E+14 | 87% |
| **Nonpoint Source Load - Geometric Mean** | 1.66E+12 | 2.66E+11 | 1.39E+12 | 84% |
| **Point Source Load[a]** | 1.96E+11 | 4.42E+12 | 0.00E+00 | 0% |

a. PS loads and load reductions are based on permit limits during the month of the highest instream E. coli exceedance. Most permit limits were based on fecal coliform as well as a design flow of the municipal discharges. Therefore, units are actually fecal coliform colonies/day vs. E. coli colonies/day as in the NPS load reductions. Based on these figures, one can conclude that no reductions are necessary to achieve appropriate pathogen loading for the permitted facility. Facilities which had only E. coli measurements were omitted from totals to keep the correct units.

## Table 1-2 E. coli Load and Required Reduction for AL03150202-0206-101 at CABS-1

| Source | Existing Load (colonies/day) | Allowable Load (colonies/day) | Required Reduction (colonies/day) | % Reduction |
|---|---|---|---|---|
| **Nonpoint Source Load - Single Sample** | 4.25E+12 | 1.81E+12 | 2.44E+12 | 57% |
| **Nonpoint Source Load - Geometric Mean** | 3.07E+11 | 7.46E+11 | 0.00E+00 | 0% |
| **Point Source Load[a]** | 1.96E+11 | 4.42E+12 | 0.00+00 | 0% |

a. PS loads and load reductions are based on permit limits during the month of the highest E. coli exceedance. Most permit limits were based on fecal coliform as well as a design flow of the municipal discharges. Therefore, units are actually fecal coliform colonies/day vs. E. coli colonies/day as in the NPS load reductions. Based on these figures, one can conclude that no reductions are necessary to achieve appropriate pathogen loading for the permitted facility. Facilities which had only E. coli measurements were omitted from totals to keep the correct units.

## Table 1-3 E. coli Load and Required Reduction for AL03150202-0206-102 at C-3

| Source | Existing Load (colonies/day) | Allowable Load (colonies/day) | Required Reduction (colonies/day) | % Reduction |
|---|---|---|---|---|
| **Nonpoint Source Load - Single Sample** | 2.12E+13 | 2.68E+12 | 1.85E+13 | 87% |
| **Nonpoint Source Load - Geometric Mean** | 1.45E+12 | 5.41E+11 | 9.05E+11 | 63% |
| **Point Source Load[a]** | 1.96E+11 | 4.42E+12 | 0.00+00 | 0% |

a. PS loads and load reductions are based on permit limits during the month of the highest E. coli exceedance. Most permit limits were based on fecal coliform as well as a design flow of the municipal discharges. Therefore, units are actually fecal coliform colonies/day vs. E. coli colonies/day as in the NPS load reductions. Based on these figures, one can conclude that no reductions are necessary to achieve appropriate pathogen loading for the permitted facility. Facilities which had only E. coli measurements were omitted from totals to keep the correct units.

**Table 1-4 E. coli TMDL for the Cahaba River**

| TMDL[e] | 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) |
| 7.40E+13 | 7.29E+12 | 1.11E+12 | 87% | 0 | 6.56E+13 | 87% |

a. There are no CAFOs in the Cahaba River 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 in-stream 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 E. coli loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for E. coli.
e. TMDL was established using the F&W single sample criterion of 487 colonies/100ml.

Compliance with the terms and conditions of existing and future NPDES 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 River watershed. As additional data and/or information become 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 and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify waterbodies which are not meeting their designated uses and to determine the total maximum daily load (TMDL) for pollutants causing use impairment. The TMDL process establishes the allowable loading of pollutants 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 and restore and maintain the quality of their water resources (USEPA, 1991).

In 1998, one portion of the Cahaba River was listed as impaired for nutrients, siltation/habitat alteration, and pathogens under the Assessment Unit ID, AL/Cahaba R_03. AL/Cahaba R_03 spanned 26.5 miles from Shades Creek to Buck Creek. This segment was then divided at Shelby County Road 52 into two different segments in 2004 (AL03150202-0203-101 and AL03150202-0203-102) to better match designated use classifications. In 2010, the Assessment Unit IDs for these two segments were changed to AL03150202-0206-101 and AL03150202-0206-102. AL03150202-0206-101, Shades Creek to Shelby County Road 52, spans 23.61 miles and is not

meeting water quality standards for pathogens; therefore, this segment will be covered in this report. AL03150202-0206-102, Shelby County Road 52 to Buck Creek, spans 3.62 miles and is not meeting water quality standards for pathogens. The pathogens impairment for this segment will also be covered in this report. The sources of the impairment for these two segments, as listed in the §303(d) list, are municipals and urban runoff/storm sewers. The nutrient and siltation/habitat alteration impairments have already been addressed by ADEM. The Cahaba River Nutrient TMDL was completed and approved by the EPA in 2006, and the Cahaba River Siltation/Habitat Alteration TMDL was completed in 2012 and is pending finalization.

In 2010, another segment of the Cahaba River was placed on Alabama's §303(d) list as impaired for pathogens. Segment AL03150202-0204-101, Buck Creek to the dam near US Highway 280, spans 17.46 miles. The sources of the pathogen impairment for this segment, as listed on the §303(d) list, are municipals and urban runoff/storm sewers. This segment is not meeting water quality standards and will also be covered in this report.

## *2.2 Problem Definition*

| | |
|---|---|
| Waterbody Impaired: | Cahaba River – From Shades Creek to Shelby County Road 52<br>Cahaba River – From Shelby County Road 52 to Buck Creek<br>Cahaba River – From Buck Creek to the dam near US Highway 280 |
| Water Quality Standard Violation: | Pathogens (Single Sample Max, E. coli) |
| Pollutant of Concern: | Pathogens (E. coli) |
| Water Use Classifications: | Fish and Wildlife (F&W) and Outstanding Alabama Water (OAW) |

Usage Related to Classification:
Two of the impaired segments (AL03150202-0204-101 and AL03150202-0206-102) are classified as Fish and Wildlife (F&W). Usage of waters in this classification is described in ADEM Admin. Code R. 335-6-10-.09(5)(a), (b), (c), and (d) as shown below:

*(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.*

AL03150202-0206-101 is classified as Outstanding Alabama Water (OAW) as well as Fish and Wildlife (F&W). Usage of waters in the F&W use classification is shown above. Usage of waters in the OAW classification is described in ADEM Admin. Code R. 335-6-10-.09(1)(a) and (b) as shown below:

*(a) Best usage of waters: activities consistent with the natural characteristics of the waters.*

*(b) Conditions related to best usage:*

*1. High quality waters that constitute an outstanding Alabama resource, such as waters of state parks and wildlife refuges and waters of exceptional recreation or ecological significance, may be considered for classification as an Outstanding Alabama Water (OAW).*

E. coli Criteria:

Criterion for acceptable bacteria levels for the F&W use classification is 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 E. coli group shall not exceed a geometric mean of 548 colonies/100 ml; nor exceed a maximum of 2,507 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 E. coli organism density does not exceed 126 colonies/100 ml nor exceed a maximum of 487 colonies/100 ml in any sample 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.*

Criterion for acceptable bacteria levels for the OAW use classification is described in ADEM Admin. Code R. 335-6-10-.09(1)(c)7 as follows:

*7. Bacteria: in non-coastal waters, bacteria of the E. coli group shall not exceed a geometric mean of 126 colonies/100 ml nor exceed a maximum of 235 colonies/100 ml in any sample. In coastal waters, bacteria of the enterococci group shall not exceed a geometric mean of 35 colonies/100 ml nor exceed a maximum of 104 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.*

Criteria Exceeded:

Segment AL03150202-0206-101 (Cahaba River from Shades Creek to Shelby County Road 52) and AL03150202-0206-102 (Cahaba River from Shelby County Road 52 to Buck Creek) were listed in 1998 based on fecal coliform data collected by ADEM from 1993-1997. Segment AL03150202-0204-101 (Cahaba River from Buck Creek to the dam near US Highway 280) was listed in 2010 based on fecal coliform data collected by ADEM in 2009. At the time of the listings, the binomial distribution function was employed to calculate the number of exceedances in each range of sample sizes collected over a six year period that exceed the single-sample maximum criterion of 2,000 colonies/100 mL for pathogens needed to say with 90% confidence that the criterion is exceeded in more than 10% of the population represented by the available samples. Waters in which samples collected over a six year period exceeding the single-sample maximum of 2,000 colonies/100 mL is less than or equal to the allowable exceedances for that sample size or a geometric mean less than or equal to 200 colonies/100 mL (June-September) or 1000 colonies/100 mL (October-May) in at least five samples collected in a thirty day period were considered to comply with Alabama's water quality standard for pathogens. Waters in which the samples collected over a six year period exceeding the single-sample maximum of 2000 colonies/100 mL is greater than the allowable exceedances for that sample size or a geometric mean greater than 200 colonies/100 mL (June-September) or 1000 colonies/100 mL (October-May) in at least five samples collected in a thirty day period were considered impaired and listed for pathogens on Alabama's §303(d) list.

Starting in 1991, ADEM began collecting samples from the Cahaba River on Segment AL03150202-0206-101 and Segment AL03150202-0206-102 (then known as AL/Cahaba R_03) at station C-3. From 1991-1997, 53 fecal coliform samples were collected at C-3. Of the 53 samples collected, 7 samples exceeded the fecal coliform criteria. These exceedances were the basis for listing this segment on §303(d) list. ADEM continued to collect fecal coliform samples

until 2009 when ADEM adopted the Escherichia coli (E. coli) criteria as the new bacterial indicator. From 1998-2010, ADEM collected 121 fecal coliform samples at C-3. Of those 121 samples, 6 single samples and 1 geometric mean sample exceeded the fecal coliform criteria. From 2009-2012, ADEM collected 42 E. coli samples at C-3. Of those 42 samples collected, 8 single samples and 2 geometric mean samples exceeded the E. coli criteria. In 2011, ADEM began collecting E. coli samples at CABS-1. ADEM collected 15 samples, and of those 15 samples collected, 1 single sample and 0 geometric mean samples exceeded the E. coli criteria.

Beginning in 2001, ADEM began collecting samples from the Cahaba River on Segment AL03150202-0204-101 at station C-2. From 1991-2010 there were 134 fecal coliform samples collected at C-2. Of those 134 samples, there were only 3 single sample exceedances. Starting in 2003, ADEM began collecting samples on Segment AL03150202-0204-101 at station CAHS-1. In 2003, ADEM collected 16 fecal coliform samples. Of those 16 samples, there were 3 single sample exceedance and 2 geometric mean exceedances. These exceedances were the basis for listing this segment on the §303(d) list. ADEM continued to sample at CAHS-1, and from 2004-2010, ADEM collected 77 fecal coliform samples. Of those 77 samples, only 2 single sample exceedances occurred. In 2009, ADEM began collecting E. coli samples at both C-2 and CAHS-1. From 2009-2012, ADEM collected 43 E. coli samples at C-2 and 43 E. coli samples at CAHS-1. Of the 43 E. coli samples collected at C-2, there were only 2 single sample exceedances and 0 geometric mean exceedances. Of the 43 E. coli samples collected at CAHS-1, there were 9 single sample exceedances and 2 geometric mean exceedances.

# *3.0 Technical Basis for TMDL Development*

## *3.1 Water Quality Target Identification*

On December 11, 2009, the Alabama EMC adopted the E. coli criteria as the bacterial indicator to assess the levels of bacteria in freshwater. Prior to the adoption of the E. coli criteria, the fecal coliform criteria were used by ADEM as the bacterial indicator for freshwater. The E. coli criteria were recommended by the EPA as a better correlation to swimming and incidental water contact associated health effects than fecal coliform in the 1986 publication *Quality Criteria for Water*, (EPA 440/5-86-001). As a result of this bacterial indicator change, this TMDL will be developed from E. coli data collected at stations C-3 and CAHS-1; even though the data that prompted the listing of the Cahaba River was based on fecal coliform criteria.

The impaired segments of the Cahaba River have two different use classifications. AL03150202-0206-101 has a use classification of Outstanding Alabama Water (OAW) and Fish and Wildlife (F&W), while AL03150202-0206-102 and AL03150202-0204-101 both only have a use classification of Fish and Wildlife (F&W). Although the OAW use classification has more stringent criteria, the highest percent reduction of pathogens in the three impaired segments comes from the two segments which hold a F&W use classification. Therefore, for the purpose of this TMDL, a single sample maximum E. coli target of 438.3 colonies/100mL will be used.

This target was derived by using a 10% explicit margin of safety from the F&W single sample maximum of 487 colonies/100 mL criterion. This target is considered protective of water quality standards and should not allow the single sample maximum of 487 colonies/100 mL to be exceeded in any of the impaired segments.

## *3.2 Source Assessment*

### 3.2.1 Point Sources in the Cahaba River Watershed

A point source can be defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source contributions can typically be attributed to municipal wastewater facilities, illicit discharges, and leaking sewer systems in urban areas. Municipal wastewater treatment facilities are permitted through the National Pollutant Discharge Elimination System (NPDES) process administered by ADEM. In urban settings, sewer lines typically run parallel to streams in the floodplain. If a leaking sewer line is present, high concentrations of E. coli can flow into the stream or leach into the groundwater. Illicit discharges are found at facilities that are discharging E. coli bacteria when not permitted, or when E. coli criterion established in the issued NPDES permit is not being upheld.

#### *3.2.1.1 Continuous Point Source Discharges (NPDES)*

There are multiple NPDES permitted facilities in the Cahaba River watershed. There are 12 major (≥1.0 MGD) NPDES-Permitted point source discharges, and there are 11 minor (<1.0 MGD) NPDES-Permitted point source discharges. All but one of the major facilities currently have an E. coli permit limit, and all but one of the major facilities discharge into a waterbody that has a use classification of Fish and Wildlife (F&W). Blackjack WWTF is the only one of the major facilities which still has a fecal coliform permit limit. It has a monthly average fecal coliform limit of 200 colonies/100 mL and a daily maximum fecal coliform limit of 2000 colonies/100 mL for the summer months, June through September; and for winter months, October through May, a monthly average fecal coliform limit of 1000 colonies/100 mL and a daily maximum fecal coliform limit of 2000 colonies/100 mL is stipulated. Since ADEM has adopted E. coli as the bacterial indicator, Blackjack WWTF will be given E. coli limits when they renew their permit. All of the rest of the facilities have a permitted monthly average E. coli limit of 126 colonies/100 mL and a permitted daily maximum E. coli limit of 487 colonies/100 mL for the summer months, June through September. For the winter months, October through May, they have a permitted monthly average E. coli limit of 548 colonies/100 mL and a permitted daily maximum E. coli limit of 2507 colonies/100 mL. One major facility, Alabaster WWTP, does not discharge to a waterbody that has the use classification of F&W. Alabaster WWTP discharges to a waterbody that has a Limited Warmwater Fishery (LWF) use classification; however, according to ADEM Admin. Code R. 335-6-11-.02, this waterbody still has to meet the F&W bacteria criteria. A list of all of the major facilities is shown in Table 3-1, and Figure 3-1 shows the locations of these facilities.

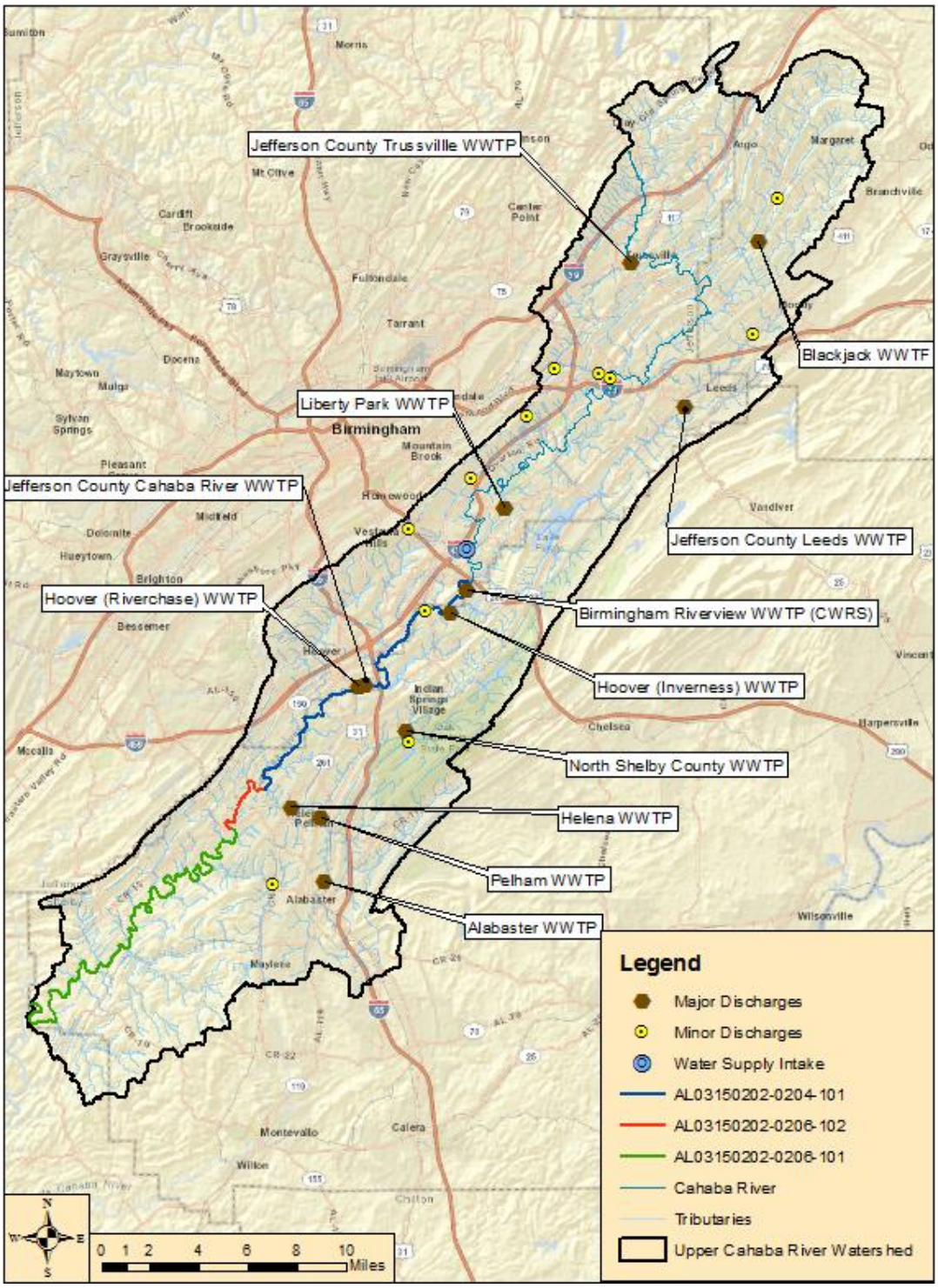
**Table 3-1 List of Major (≥1.0 MGD) NPDES Permitted Dischargers in the Upper Cahaba River Watershed**

| Facility Name | NPDES Permit Number | Latitude | Longitude | Major/Minor | Design Flow (MGD) | Receiving Stream |
|---|---|---|---|---|---|---|
| Jefferson County Trussville WWTP | AL0022934 | 33.618611 | -86.600556 | Major | 4.00 | Cahaba River |
| Jefferson County Cahaba River WWTP | AL0023027 | 33.370444 | -86.787361 | Major | 12.00 | Cahaba River |
| Helena WWTP | AL0023116 | 33.29778 | -86.83972 | Major | 4.95 | Buck Creek |
| Alabaster WWTP | AL0025828 | 33.253333 | -86.816389 | Major | 7.60 | Buck Creek |
| Hoover (Inverness) WWTP* | AL0025852 | 33.412469 | -86.727797 | Major | 1.20 (HCR)* | Cahaba River |
| Hoover (Riverchase) WWTP | AL0041653 | 33.369311 | -86.792386 | Major | 3.00 | Cahaba River |
| Birmingham Riverview WWTP (CWRS) | AL0045969 | 33.426667 | -86.715556 | Major | 3.00 | Cahaba River |
| Pelham WWTP | AL0054666 | 33.291667 | -86.819444 | Major | 4.00 | Buck Creek |
| North Shelby County WWTP | AL0056251 | 33.34259 | -86.75851 | Major | 3.00 | Cahaba Valley Creek |
| Jefferson County Leeds WWTP | AL0067067 | 33.5349 | -86.5606 | Major | 2.00 | Little Cahaba River |
| Liberty Park WWTP** | AL0067814 | 33.4748 | -86.6885 | Major | 0.2-3.0 (HCR)** | Unknown Tributary to Gumsuck Branch |
| Blackjack WWTF | AL0079651 | 33.63317 | -86.50745 | Minor | 2.00 | Middle Black Creek |

*Hoover Inverness WWTP has a summer hydraulically-controlled release permit that stipulates no discharge when flow in the Cahaba River is less than 100 cfs, up to 3 MGD when the Cahaba River streamflow is 100 cfs ≤ Q < 200 cfs and up to 10 MGD when the Cahaba River streamflow is 200 cfs or greater.

**Liberty Park has a hydraulically-controlled release permit that stipulates no discharge when the flow in the Cahaba River is less than 40 cfs. If the Cahaba River is flowing ≥ 40 cfs: up to 0.2 MGD; if ≥ 50 cfs: up to 0.6 MGD; if ≥ 75 cfs: up to 1.5 MDG; if ≥100 cfs: up to 2.2 MGD; and if ≥ 150 cfs: up to 3 MGD.

**Figure 3-1 Locations of Major (≥1.0 MGD) NPDES Permitted Dischargers in the Upper Cahaba River Watershed**



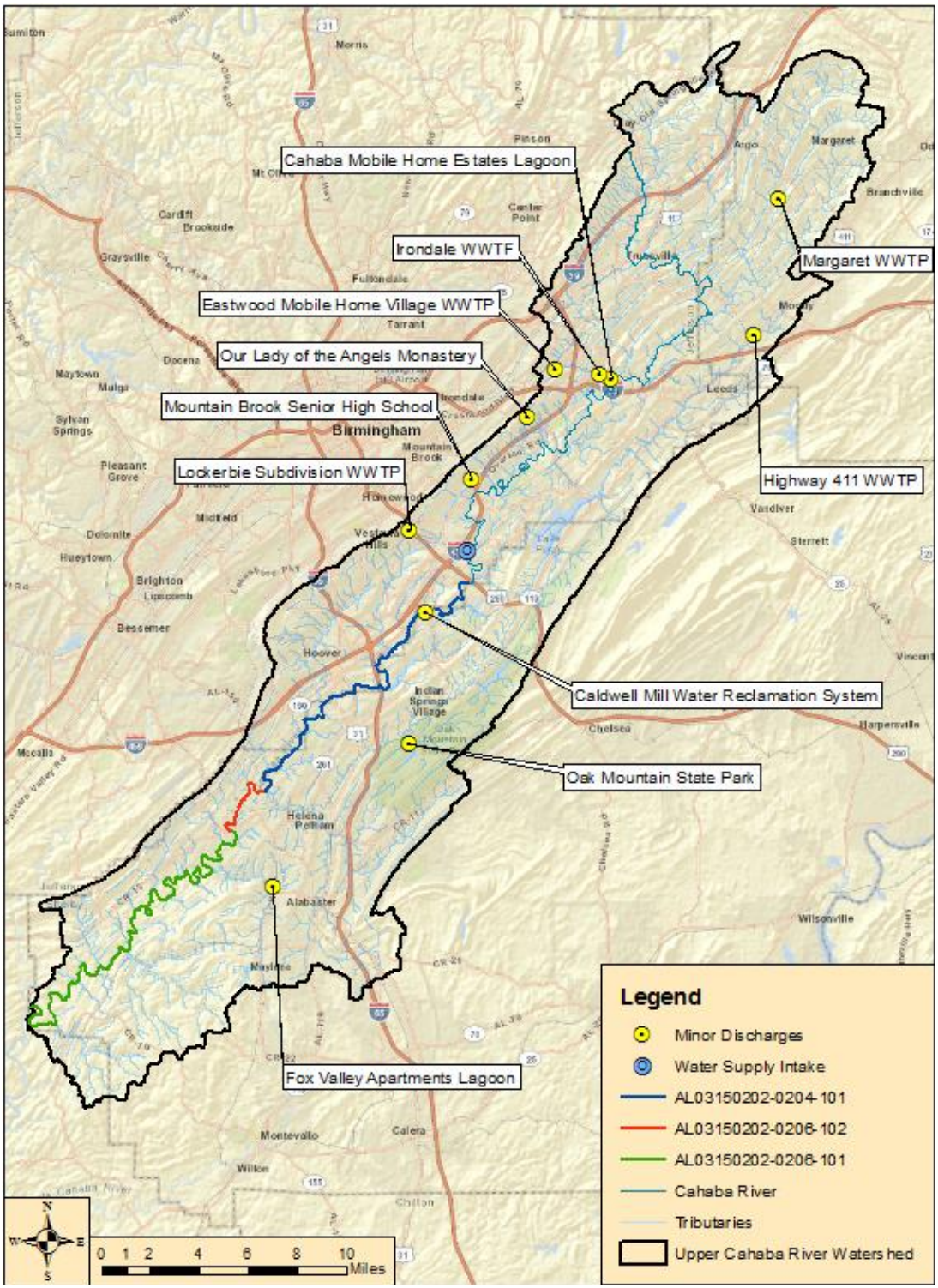
Since ADEM recently adopted E. coli as its bacterial indicator, some of the minor facilities still have the old fecal coliform permit limits. These facilities with the old fecal coliform limits will eventually receive the new E. coli limits when they renew their permits again. Currently, seven minor facilities have the E. coli limits, and four of the minor facilities have the old fecal coliform limits. Lockerbie Subdivision WWTP, Mountain Brook Senior High School, Eastwood Mobile Home Village WWTP, Irondale WWTF, Cahaba Mobile Home Estates Lagoon, Margaret WWTP, and Fox Valley Apartments Lagoon all have E. coli limits imposed in their permits. All of these permits have a monthly average limit of 126 colonies/100 mL and a daily maximum limit of 487 colonies/100 mL for summer months, June through September; and for winter months, October through May, a monthly average limit of 548 colonies/100 mL and a daily maximum limit of 2507 colonies/100 mL is stipulated. The rest of the minor facilities – Oak Mountain State Park, Highway 411 WWTP, Our Lady of the Angels Monastery, and Caldwell Mill Water Reclamation System – still have fecal coliform limits imposed in their permits. These permits have a monthly average fecal coliform limit of 200 colonies/100 mL and a daily maximum fecal coliform limit of 2000 colonies/100 mL for the summer months, June through September; and for winter months, October through May, a monthly average fecal coliform limit of 1000 colonies/100 mL and a daily maximum fecal coliform limit of 2000 colonies/100 mL is stipulated. A complete list of all of the minor facilities is shown in Table 3-2, and Figure 3-2 shows the locations of these facilities.

**Table 3-2 List of Minor (<1.0 MGD) NPDES Permitted Dischargers in the Upper Cahaba River Watershed**

| Facility Name | NPDES Permit Number | Latitude | Longitude | Major/Minor | Design Flow (MGD) | Receiving Stream |
|---|---|---|---|---|---|---|
| Lockerbie Subdivision WWTP | AL0047571 | 33.4625 | -86.756389 | Minor | 0.03 | Unknown Tributary to Little Shades Creek |
| Oak Mountain State Park | AL0050831 | 33.3358 | -86.75618 | Minor | 0.085 | Unknown Tributary to Dry Branch |
| Mountain Brook Senior High School | AL0050971 | 33.49307 | -86.71143 | Minor | 0.05 | Unknown Tributary to Cahaba River |
| Highway 411 WWTP | AL0055255 | 33.57722 | -86.512222 | Minor | 0.50 | Little Cahaba River |
| Eastwood Mobile Home Village WWTP* | AL0056685 | 33.55778 | -86.652417 | Minor | 0.07 | Abes Creek |
| Cahaba Mobile Home Estates Lagoon | AL0057487 | 33.55161 | -86.61306 | Minor | 0.039 | Cahaba River |
| Our Lady of the Angels Monastery | AL0057681 | 33.52969 | -86.672111 | Minor | 0.02 | Unknown Tributary to Cahaba River |
| Caldwell Mill Water Reclamation System | AL0063088 | 33.41388 | -86.744444 | Minor | 0.09 | Cahaba River |
| Margaret WWTP | AL0078204 | 33.65867 | -86.493657 | Minor | 0.50 | Middle Black Creek |
| Irondale WWTF* | AL0078395 | 33.55444 | -86.621389 | Minor | 0.50 | Abes Creek |
| Fox Valley Apartments Lagoon | AL0054330 | 33.25136 | -85.85247 | Minor | 0.026 | Beaverdam Creek |

*Irondale is in the process of building a new facility. As soon as the facility is complete, Eastwood Mobile Home Village WWTP will transfer their waste-flow to the Irondale WWTF.

**Figure 3-2 Locations of Minor (<1.0 MGD) NPDES Permitted Dischargers in the Upper Cahaba River Watershed**



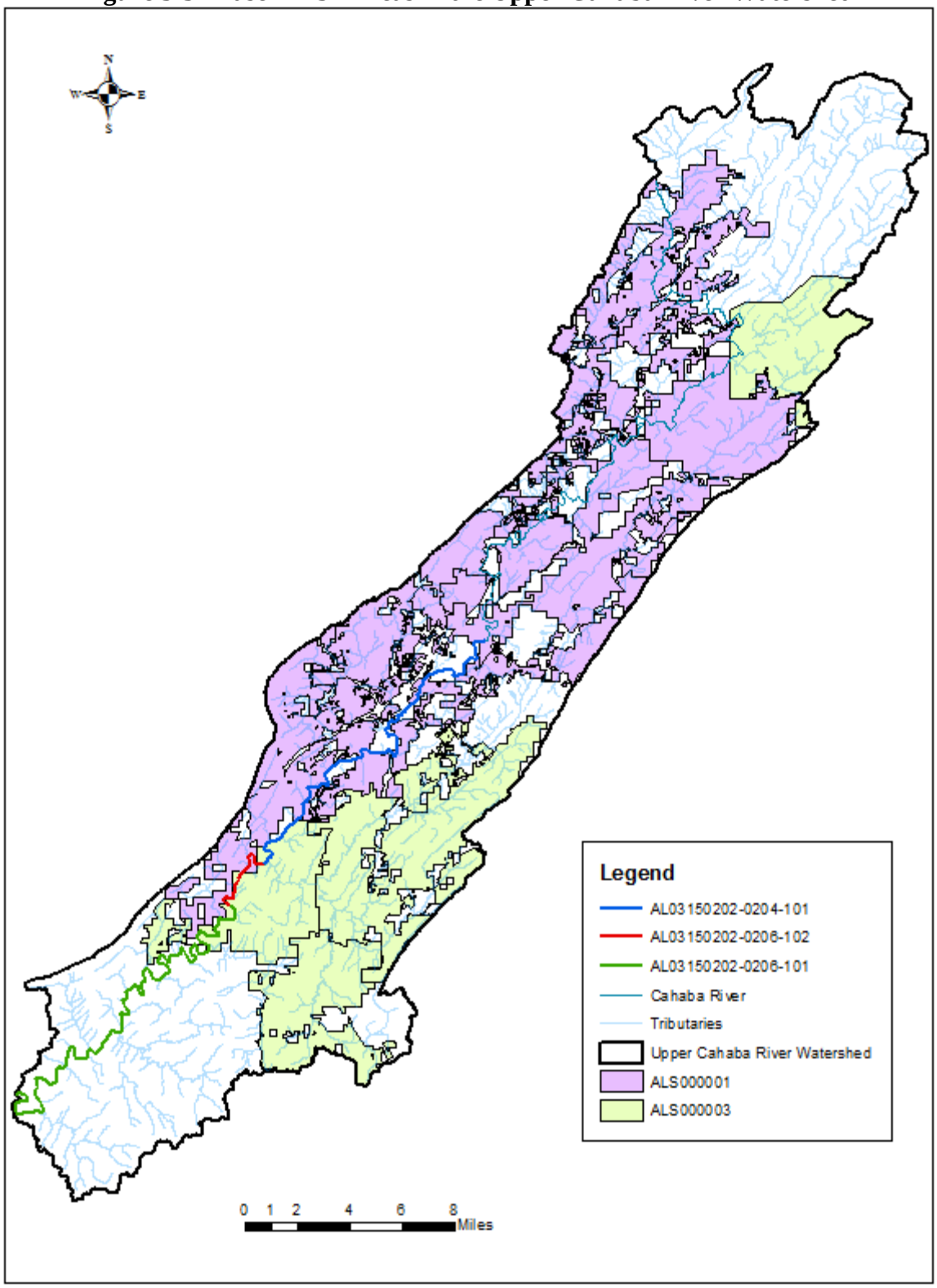
## Municipal Separate Storm Sewer Systems (MS4s)

A significant portion of the upper Cahaba River 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 upper Cahaba River watershed are within the boundary of the Birmingham-Jefferson Co. Area Phase I MS4 (ALS000001), and the Birmingham-Shelby Co. Area Phase I MS4 (ALS000003). Figure 3-3 identifies the coverage areas of both Phase I MS4 areas in the upper Cahaba River watershed. Contributions from both Phase I MS4 areas drain to the pathogen impaired segments of the Cahaba River watershed and 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 the 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 River watershed and therefore would be considered a source of pathogens to the Cahaba River.

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

**Figure 3-3 Phase I MS4 Areas in the Upper Cahaba River Watershed**



### 3.2.2 Nonpoint Sources in the Cahaba River Watershed

Nonpoint sources of E. coli bacteria do not have a defined discharge point, but rather, occur over the entire length of a stream or waterbody. On the land surface, E. coli bacteria can accumulate over time and be washed into streams or waterbodies during rain events. Therefore, there is some net loading of E. coli bacteria into streams as dictated by the watershed hydrology.

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

E. coli bacteria can also originate from forested areas due to the presence of wild animals such as deer, raccoons, turkeys, beaver, and waterfowl. 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.

E. coli 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, sewer overflows due to I & I (infiltration and inflow), 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 E. coli bacteria to surface waters due to system failure and malfunction.

## *3.3 Land Use Assessment*

Land use for the Cahaba River watershed was determined using ArcMap with land use datasets derived for the 2006 National Land Cover Dataset (NLCD). Figure 3-4 displays the land use areas for the upper Cahaba River watershed. Table 3-3 depicts the primary land uses in the Cahaba River watershed. Figure 3-5 shows the grouped land uses in the upper Cahaba River Watershed.

The majority of the upper Cahaba River watershed is forests at 63% and developed land at 30%. The remaining land use is approximately 5% agricultural lands and 1% open water. Developed land includes both commercial and residential land uses and is mostly contained within the City of Birmingham.

**Figure 3-4 Land Use Map for the Upper Cahaba River Watershed**

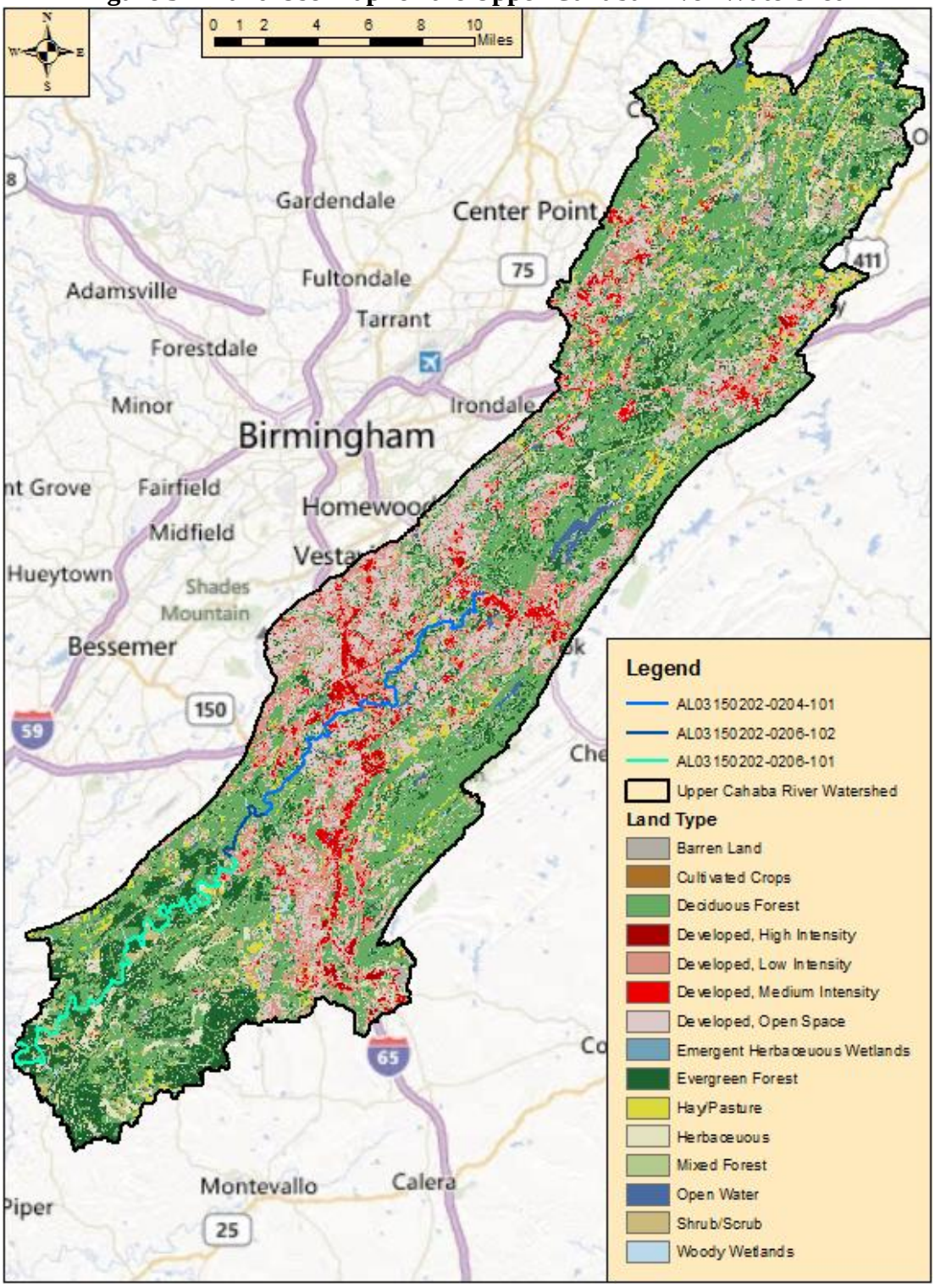
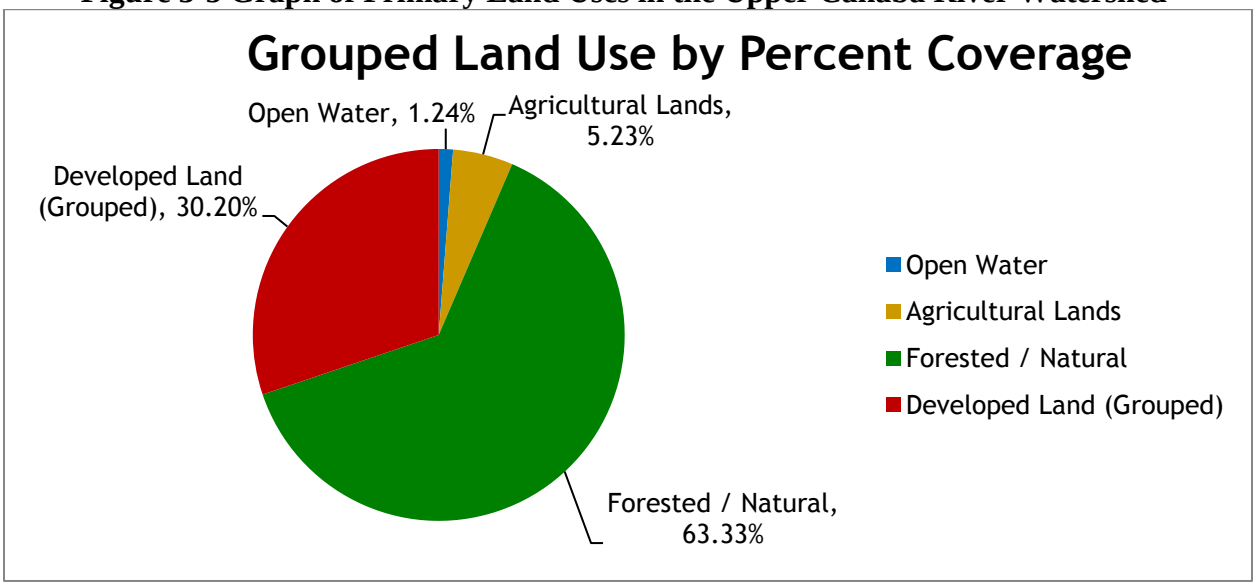


**Table 3-3 Land Use Areas for the Upper Cahaba River Watershed**

| Class Description | Miles² | Acres | Percent |
|---|---|---|---|
| Open Water | 5.16 | 3304.12 | 1.24% |
| Developed, Open Space | 62.38 | 39926.10 | 14.96% |
| Developed, Low Intensity | 43.45 | 27807.36 | 10.42% |
| Developed, Medium Intensity | 13.13 | 8400.96 | 3.15% |
| Developed, High Intensity | 3.24 | 2071.39 | 0.78% |
| Barren Land | 3.73 | 2385.63 | 0.89% |
| Deciduous Forest | 158.19 | 101244.80 | 37.94% |
| Evergreen Forest | 55.10 | 35262.25 | 13.21% |
| Mixed Forest | 19.12 | 12234.16 | 4.58% |
| Shrub/Scrub | 11.68 | 7473.80 | 2.80% |
| Herbaceous | 17.01 | 10886.89 | 4.08% |
| Hay/Pasture | 19.35 | 12384.50 | 4.64% |
| Cultivated Crops | 2.45 | 1567.66 | 0.59% |
| Woody Wetlands | 2.98 | 1907.70 | 0.71% |
| Emergent Herbaceous Wetlands | 0.01 | 4.89 | 0.00% |
| **TOTALS →** | **416.97** | **266862.21** | **100.00%** |
| Class Description | Mi² | Acres | Percent |
| Open Water | 5.16 | 3304.12 | 1.24% |
| Agricultural Lands | 21.80 | 13952.16 | 5.23% |
| Forested / Natural | 264.09 | 169014.50 | 63.33% |
| Developed Land (Grouped) | 125.92 | 80591.43 | 30.20% |
| **TOTALS →** | **416.97** | **266862.21** | **100.00%** |

**Figure 3-5 Graph of Primary Land Uses in the Upper Cahaba River Watershed**



## *3.4 Linkage Between Numerical Targets and Sources*

The upper Cahaba River watershed has two main land uses, namely forested/natural and developed land. Pollutant loadings from forested areas tend to be low due to their filtering capabilities and will be considered as background conditions. Based on the load duration curves that were developed, it appears the most likely sources of pathogen loadings in the upper Cahaba River watershed are from sewer overflows and urban/stormwater runoff. As can be seen in Figure 3-4, most of the impaired segments run directly though the developed areas of the watershed.

### 3.4.1 Load Duration Curves

Load duration curves were developed to get a better understanding of the potential sources of the pathogen impairment. Load duration curves use the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the range of flows in which pathogen exceedances occur the most. Pathogen exceedances occurring during higher flows might indicate that urban runoff and sewer overflows would be the main source of the pathogen impairment, while pathogen exceedances occurring during drier or low flow conditions might point more toward point sources and illicit discharges (Cleland, 2003).

Load duration curves depend on an adequate period of flow data. There were two USGS gauges with adequate data. These USGS gauges were located at the same locations as the ADEM sampling stations C-3 and CAHS-1. USGS gauge 02423555 was used to develop a load duration curve at station C-3. It has over 10 years of flow data beginning in October 1995. USGS gauge 02423500 was used to develop the load duration curve at CAHS-1. It has over 25 years of data beginning in October 1983. A load duration curve was not developed for station C-2 or CABS-1 since there were so few E. coli exceedances in the past six years.

Flow duration curves were developed by ranking flows from highest to lowest and calculating the probability of occurrence (as a percentage or duration interval), where zero corresponds to the highest flow. The duration interval can be used to determine the percentage of time a given flow is achieved or exceeded, based on the period of record. The flow duration curves were then divided into five hydrological condition categories: High flows, Moist conditions, Mid-Range Flows, Dry Conditions, and Low Flows. Using these hydrologic categories, it can be determined in which conditions most of the pathogen exceedances occurred. As stated above, more exceedances during higher flows might indicate urban runoff or sewer overflows, while exceedances during dry and low flow conditions might indicate point source or illicit discharge issues.

Load duration curves were then developed by calculating the allowable load using daily flow, the E. coli water quality standard concentration, and a conversion factor. Since the critical period for pathogen exceedances is during the summer months and most of the exceedances occur during the summer months, only the summer flows and the summer water quality criteria of 487

col./100 mL were used to develop the load duration curves. The measured E. coli loadings were then plotted against the load duration curve. Water quality samples measured on a day when the stream flow of the Cahaba River was 50% greater than the previous day's stream flow were also uniquely identified (SF>50%) on the load duration curve. This was to show a potential recent rain event. The load duration curves for stations C-3 and CAHS-1 are shown below.

**Figure 3-6 Load Duration Curve for Station C-3**

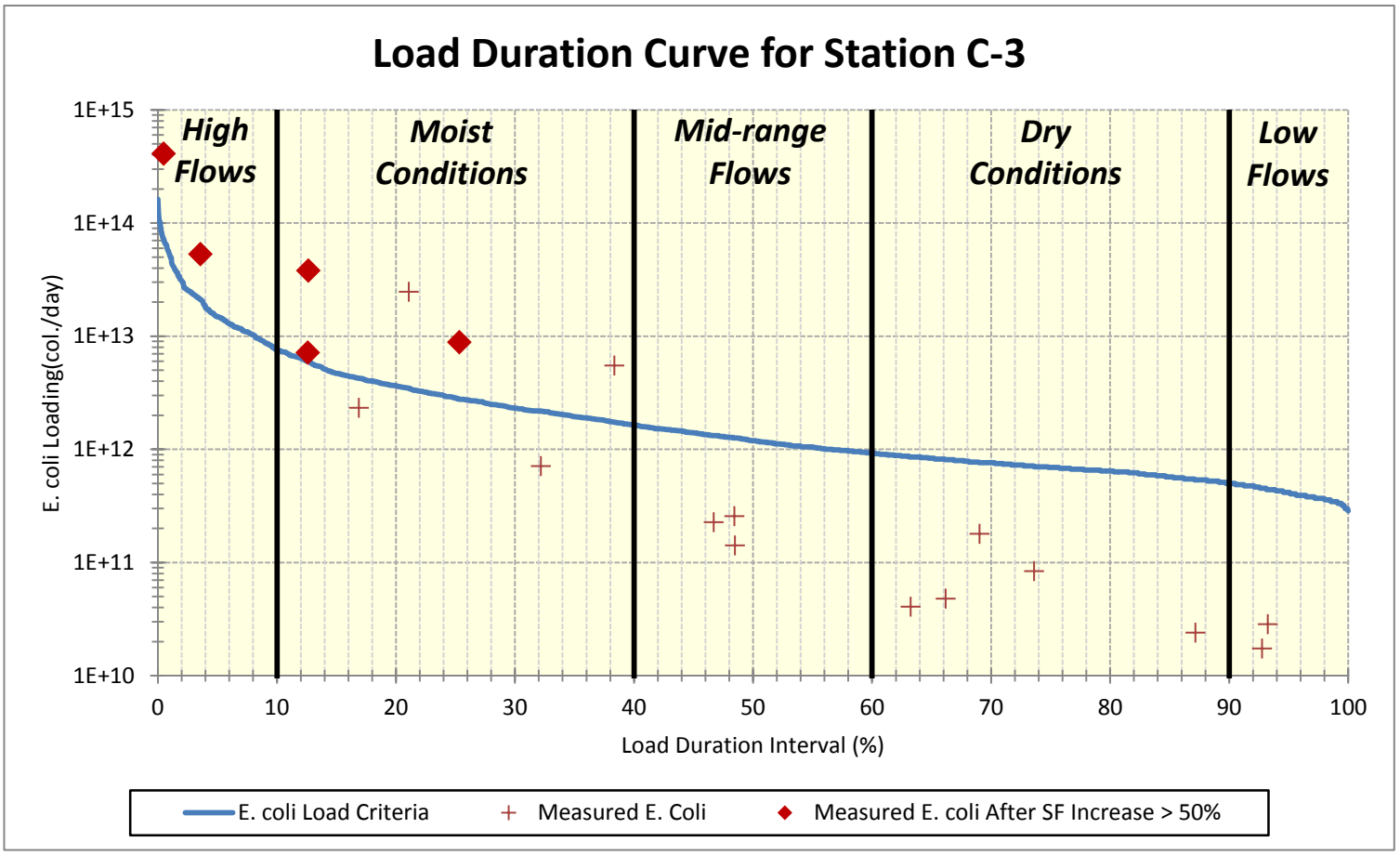
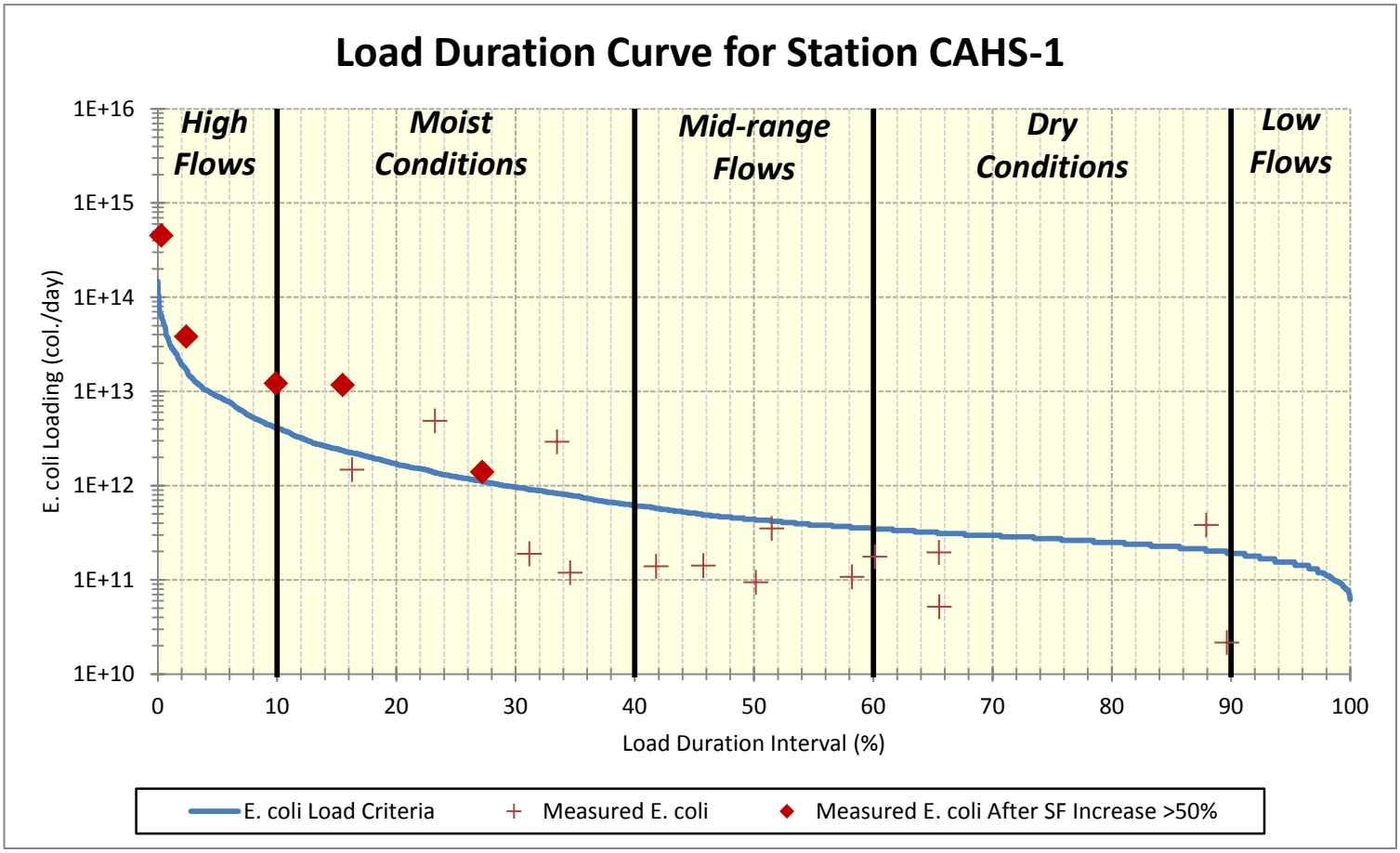


**Figure 3-7 Load Duration Curve for Station CAHS-1**




As can be seen in both load duration curves, all but one of the exceedances occurred during higher flow conditions, which points more toward urban runoff and sewer overflows as the most likely source of the pathogen impairment.

## *3.5 Data Availability and Analysis*

ADEM collected monthly water quality data for the Cahaba River at multiple stations along the impaired segments. Segment AL03150202-0206-101 has one station (CABS-1) where monthly water quality data was collected. In 2011, there were 15 E. coli samples collected. Of those 15 samples, there was 1 single sample violation and 0 geometric mean sample violations. This exceedance is shown in Table 3-4. Segment AL03150202-0206-102 has one station (C-3) where monthly water quality data was collected. There were 37 fecal coliform samples collected between 2007 and 2010, and there were 42 E. coli samples collected between 2009 and 2012. Again since the bacterial indicator is E coli, this is what will be analyzed in this section of the TMDL. Of the 42 E. coli samples collected at C-3, there were 8 single sample violations and 2 geometric mean violations. These exceedances are shown in Table 3-5. AL03150202-0204-101

has two stations (C-2 & CAHS-1) where monthly water quality data was collected. At C-2, there were 36 fecal coliform samples collected between 2007 and 2010, and there were 43 E. coli samples collected between 2009 and 2012. Of the 43 E. coli samples collected at C-2, there were 2 single sample violations and 0 geometric mean violations. At CAHS-1, there were 37 fecal coliform samples collected between 2007 and 2010, and there were 43 E. coli samples collected between 2009 and 2012. Of the 43 E. coli samples collected at CAHS-1, there were 9 single sample violations and 2 geometric mean violations. Exceedances for these two stations are shown in Table 3-6.

**Table 3-4 E. coli Exceedances on Cahaba River Segment AL03150202-0206-101**

| Station ID | Visit Date | E Coli (col/100mL) | E Coli Dc | Geometric Mean (col/100mL) | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|---|
| CABS-1 | 6/27/2011 | 496.2 | | | NO-FLOW CONDITIONS<br>HAZARDOUS | |

Exceedances shown in red

**Table 3-5 E. coli Exceedances on Cahaba River Segment AL03150202-0206-102**

| Station ID | Visit Date | E Coli (col/100 mL) | E Coli Dc | Geometric Mean (col/100 mL) | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|---|
| C-3 | 6/15/2010 | 579.4 | | | YES-USGS | 227 |
| C-3 | 4/5/2011 | 3465.8 | | | YES-USGS | 3330 |
| C-3 | 6/7/2011 | 18.7 | | 303.01 | YES-USGS | 41 |
| C-3 | 6/13/2011 | 21.8 | | | YES-USGS | 48 |
| C-3 | 6/20/2011 | 114.5 | | | YES-USGS | 65 |
| C-3 | 6/23/2011 | 3106.2 | | | YES-USGS | 571 |
| C-3 | 6/27/2011 | 3465.8 | | | YES-USGS | 250 |
| C-3 | 7/5/2011 | 1540.2 | | | NO-METER MALFUNCTIONED | |
| C-3 | 9/6/2011 | 2827.2 | | 189.58 | YES-USGS | 6050 |
| C-3 | 9/12/2011 | 99 | | | YES-USGS | 109 |
| C-3 | 9/19/2011 | 58.1 | | | YES-USGS | 55 |
| C-3 | 9/27/2011 | 266.5 | | | YES-USGS | 344 |
| C-3 | 10/4/2011 | 56.5 | | | YES-USGS | 96 |
| C-3 | 7/10/2012 | 1553.1 | | | YES-USGS | 167 |
| C-3 | 9/4/2012 | 1226.3 | | | YES-USGS | 1470 |

Exceedances shown in red

**Table 3-6 E. coli Exceedances on Cahaba River Segment AL03150202-0204-101**

| Station ID | Visit Date | E Coli (col/100 mL) | E Coli Dc | Geometric Mean (col/100 mL) | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|---|
| C-2 | 9/7/2011 | 651.1 | | | YES-USGS | 617 |
| C-2 | 9/5/2012 | 615.2 | | | YES-USGS | 546 |
| CAHS-1 | 6/15/2010 | 2419.6 | | | YES-USGS | 125 |
| CAHS-1 | 6/7/2011 | 920.8 | | 707.33 | YES-USGS | 16 |
| CAHS-1 | 6/13/2011 | 307.6 | | | YES-USGS | 25 |
| CAHS-1 | 6/20/2011 | 248.1 | | | YES-USGS | 27 |
| CAHS-1 | 6/23/2011 | 1454 | | | YES-USGS | 318 |
| CAHS-1 | 6/27/2011 | 1732.9 | | | YES-USGS | 94 |
| CAHS-1 | 7/5/2011 | 615.2 | | | YES-USGS | 85 |
| CAHS-1 | 9/1/2011 | 55.2 | | 231.81 | YES-USGS | 17 |
| CAHS-1 | 9/6/2011 | 3465.8 | | | YES-USGS | 6120 |
| CAHS-1 | 9/12/2011 | 73.8 | | | YES-USGS | 69 |
| CAHS-1 | 9/19/2011 | 146.7 | | | YES-USGS | 31 |
| CAHS-1 | 9/27/2011 | 323.2 | | | YES-USGS | 202 |
| CAHS-1 | 12/6/2011 | 4839.1 | | | YES-USGS | 1130 |
| CAHS-1 | 7/10/2012 | 1732.9 | | | YES-USGS | 54 |
| CAHS-1 | 9/4/2012 | 1095 | | | YES-USGS | 1300 |

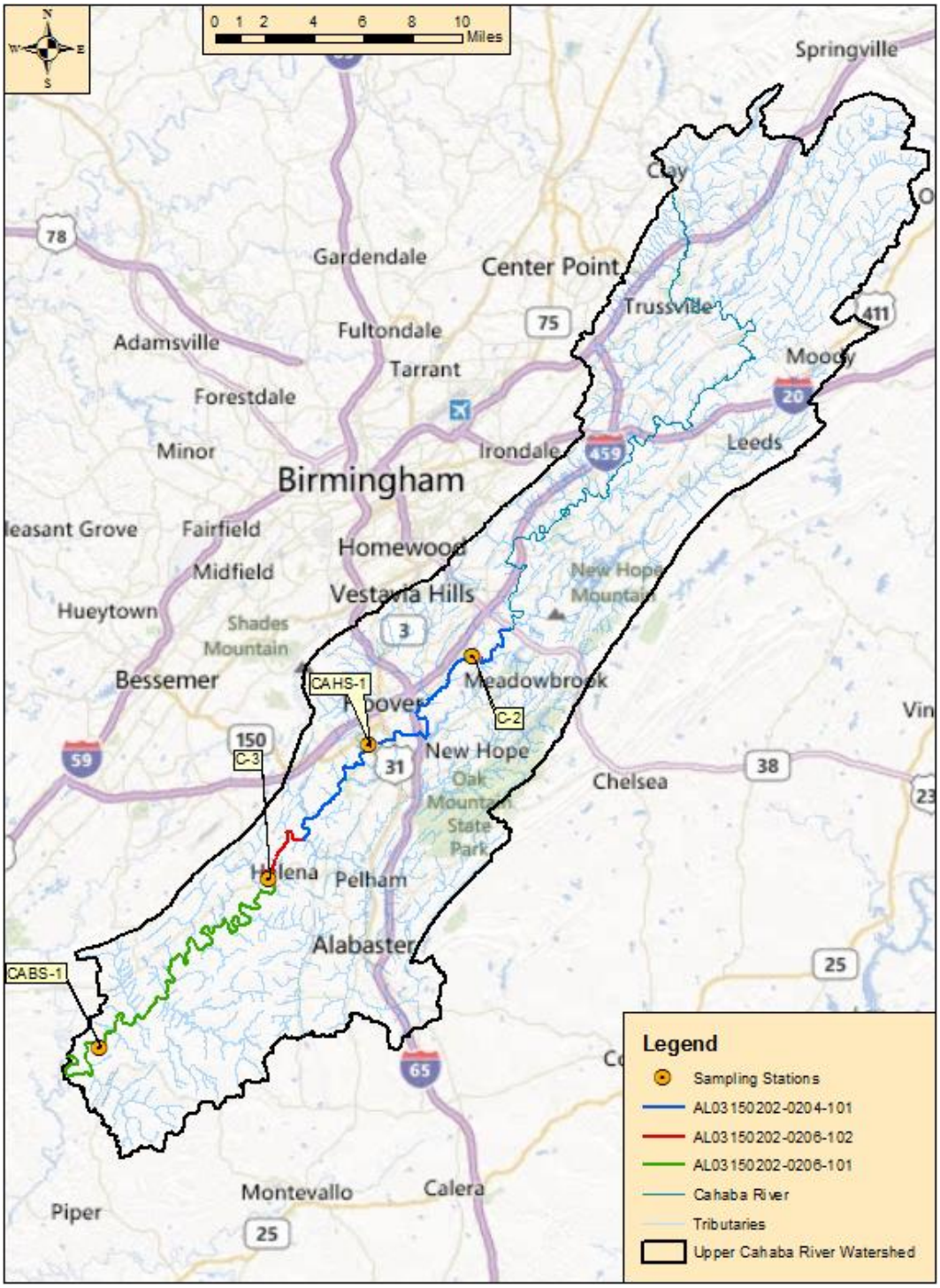
Exceedances shown in red

**Table 3-7 ADEM Sampling Stations on the Cahaba River**

| Station | Local Name | Station Description | Latitude | Longitude |
|---|---|---|---|---|
| CABS-1 | Cahaba River | Cahaba River off of Shelby CR 251 | 33.1856° | -87.0009° |
| C-3 | Cahaba River | Cahaba River at Shelby CR 52 Bridge west of Helena | 33.2847° | -86.8828° |
| CAHS-1 | Cahaba River | Cahaba River at Shelby CR 175 Bains Bridge (Old Montgomery Hwy) | 33.3635° | -86.8132° |
| C-2 | Cahaba River | Cahaba River at Shelby CR 29--Caldwell Mill Rd Caldwell Ford Bridge | 33.4155° | -86.7400° |

*Note: Not all of ADEM's sampling stations on the Cahaba River are shown in the table above. Only the stations referenced in this report are shown.

**Figure 3-8 Map of ADEM Sampling Stations on the Cahaba River**




*Note: Not all of ADEM's sampling stations are shown in the map above; only the stations referenced in this report are shown.

### *3.6 Critical Conditions*

Summer months (June-September) are generally considered critical conditions. This can be explained by the nature of storm events in the summer versus the winter. In summer, periods of dry weather interspersed with thunderstorms allow for the accumulation and washing off of E. coli bacteria into streams, resulting in spikes of E. coli bacteria counts. In winter, frequent low intensity rain events are more typical and do not allow for the build-up of E. coli bacteria on the land surface, resulting in a more uniform loading rate.

The impaired portion of the upper Cahaba River watershed generally follows the trends described above for the summer months of June through September. The critical condition for this pathogen TMDL was taken to be the one with the highest E. coli single sample exceedance value. That value was 3,465.8 colonies/100mL and occurred once at C-3 on June 27, 2011 and once at CAHS-1 on September 6, 2011. Flows were above normal or at flood conditions when each sample was taken.

### *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.

Both an explicit and implicit MOS were incorporated into this TMDL. The MOS accounts for the uncertainty associated with the limited availability of E. coli data used in this analysis. An explicit MOS was applied to the TMDL by reducing the target single sample criterion concentration by ten percent and calculating a mass loading target with measured flow data. The single sample maximum value of 487 colonies/100 mL was reduced by 10% to 438.3 colonies/100 mL. An implicit MOS was also incorporated in the TMDL by basing the existing condition on the highest measured E. coli concentration that was collected during critical conditions.

## *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 both implicit and 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 pathogen TMDL for the Cahaba River. The mass balance approach utilizes the conservation of mass principle. Total mass loads can be calculated by multiplying the E. coli concentration times the in-stream flow times a conversion factor. 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 and geometric mean criterion. The TMDL was based on the violation that produced the highest percent reduction of E. coli loads necessary to achieve applicable water quality criteria, whether it was the single sample or geometric mean sample. It should be noted that the highest exceedance occurred at two different stations on two different days. Both exceedances ultimately end up producing the same final percent reduction, but only sample calculations from one of those exceedances will be shown in the following sections of this report.

### 4.2.1 Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest single sample E. coli exceedance concentration of 3,465.8 colonies/100 mL times the measured flow at the time the sample was taken. This concentration was calculated based on measurements at C-3 on June 27, 2011 and at CAHS-1 on September 6, 2011. These measurements can be found in Appendix 7.2, Table 7-1 and Table 7-2. The product of the concentration, measured flow, and a conversion factor gives the total mass loading (colonies per day) of E. coli to the Cahaba River under a single sample exceedance condition. Sample calculations below only show the calculations for the exceedance at CAHS-1.

$$\frac{6{,}120.0\ \text{ft}^3}{\text{s}} \times \frac{3{,}465.8\ \text{colonies}}{100\ \text{mL}} \times \frac{24{,}465{,}755\quad 100\ \text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{5.19 \times 10^{14}\ \text{colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean exceedance concentration of 707.33 colonies/100 mL times the average flow of the five samples. This concentration was calculated based on measurements at CAHS-1 between June 7, 2011 and June 27, 2011 and can be found in Appendix 7.2, Table 7-2. The average stream flow was determined to be 96.0 cfs. The product of these two values times the conversion factor gives the

total mass loading (colonies per day) of E. coli to the Cahaba River under the geometric mean exceedance condition. Sample calculations are shown below.

$$\frac{96.0\ \text{ft}^3}{\text{s}} \times \frac{707.33\ \text{colonies}}{100\,\text{mL}} \times \frac{24{,}465{,}755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.66 \times 10^{12}\ \text{colonies}}{\text{day}}$$

The existing loading for the WLA portion of this TMDL was calculated using Discharge Monitoring Reports (DMRs) from the NPDES permitted facilities. Since the highest exceedance happened in September 2011, the loading from the NPDES point sources in September 2011 was used. The monthly average flow from each facility as reported on their DMRs was multiplied by the reported maximum daily fecal coliform loading (since most of the facilities do not have the E. coli limit yet). The product of these two values and a conversion factor gives the total mass loading (colonies per day) of fecal coliform for each facility. These loadings are then added together to get the total existing loading for the WLA portion of this TMDL. A sample calculation from one of the facilities is shown below. Complete results are shown in Appendix 7.3, Table 7-8.

$$\frac{2.50 \times 10^6\ gal.}{day} \times \frac{260\ fecal\ colonies}{100\ mL} \times \frac{3{,}785.41\ mL}{gal.} = \frac{2.46 \times 10^{10} fecal\ colonies}{day}$$

### 4.2.2 Allowable Conditions

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

$$\frac{6120.0\ \text{ft}^3}{\text{s}} \times \frac{438.3\ \text{colonies}}{100\,\text{mL}} \times \frac{24{,}465{,}755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{6.56 \times 10^{13}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety of 48.7 colonies/100 mL equals a daily loading of:

$$\frac{6120.0\ \text{ft}^3}{\text{s}} \times \frac{48.7\ \text{colonies}}{100\,\text{mL}} \times \frac{24{,}465{,}755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{7.29 \times 10^{12}\ \text{colonies}}{\text{day}}$$

For the **geometric mean** E. coli target concentration of 113.4 colonies/100 mL, the allowable E. coli loading is:

$$\frac{96.0\ \text{ft}^3}{\text{s}} \times \frac{113.4\ \text{colonies}}{100\,\text{mL}} \times \frac{24{,}465{,}755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.66 \times 10^{11}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety of 12.6 colonies/100 mL equals a daily loading of:

$$\frac{96.0\ \text{ft}^3}{\text{s}} \times \frac{12.6\ \text{colonies}}{100\,\text{mL}} \times \frac{24{,}465{,}755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.96 \times 10^{10}\ \text{colonies}}{\text{day}}$$

The allowable loading for the WLA portion of this TMDL was calculated by multiplying the design flow for each facility in the watershed by the in-stream single sample fecal coliform criteria or single sample E. coli criteria for the summer months. This value was then multiplied by a conversion factor to come up with the appropriate loading. This process was completed for every facility in the watershed, and then all of the loadings were added together to obtain the total allowable loading. A sample calculation of one facility is shown below. Complete results are shown in Appendix 7.3, Table 7-8.

$$\frac{4.0 \times 10^6 \text{gal.}}{\text{day}} \times \frac{2000\ \text{fecal colonies}}{100\ \text{mL}} \times \frac{3785.41\ \text{mL}}{\text{gal.}} = \frac{3.03 \times 10^{11} \text{fecal colonies}}{\text{day}}$$

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 E. coli water quality criterion. The TMDL was calculated as the total daily E. coli load to the Cahaba River as evaluated at stations C-3 and CAHS-1. Table 4-1, Table 4-2, Table 4-3 and Table 4-4 show the results of the E. coli TMDL and percent reductions for each criterion.

Table 4-1, Table 4-2, and Table 4-3 are summaries of the estimated existing loads, allowable loads, and percent reductions for both the geometric mean and single sample criterion for each impaired segment. Table 4-4 provides the details of the TMDL along with the corresponding reductions for the Cahaba River which are protective of E. coli water quality standards year round.

**Table 4-1 E. coli Load and Required Reduction for AL03150202-0204-101 at CAHS-1**

| Source | Existing Load (colonies/day) | Allowable Load (colonies/day) | Required Reduction (colonies/day) | % Reduction |
|---|---|---|---|---|
| **Nonpoint Source - Load Single Sample** | 5.19E+14 | 6.56E+13 | 4.53E+14 | 87% |
| **Nonpoint Source - Load Geometric Mean** | 1.66E+12 | 2.66E+11 | 1.39E+12 | 84% |
| **Point Source Load[a]** | 1.96E+11 | 4.42E+12 | 0 | 0% |

a. PS loads and load reductions are based on permit limits during the month of the highest in-stream E. coli exceedance. Most permit limits were based on fecal coliform as well as a design flow of the municipal discharges. Therefore, units are actually fecal coliform colonies/day vs. E. coli colonies/day as in the NPS load reductions. Based on these figures, one can conclude that no reductions are necessary to achieve appropriate pathogen loading for the permitted facility. Facilities which had only E. coli measurements were omitted from totals to keep the correct units.

**Table 4-2 E. coli Load and Required Reduction for AL03150202-0206-101 at CABS-1**

| Source | Existing Load (colonies/day) | Allowable Load (colonies/day) | Required Reduction (colonies/day) | % Reduction |
|---|---|---|---|---|
| **Nonpoint Source - Load Single Sample** | 4.25E+12 | 1.81E+12 | 2.44E+12 | 57% |
| **Nonpoint Source - Load Geometric Mean** | 3.07E+11 | 7.46E+11 | 0.00E+00 | 0% |
| **Point Source Load[a]** | 1.96E+11 | 4.42E+12 | 0 | 0% |

a. PS loads and load reductions are based on permit limits during the month of the highest in-stream E. coli exceedance. Most permit limits were based on fecal coliform as well as a design flow of the municipal discharges. Therefore, units are actually fecal coliform colonies/day vs. E. coli colonies/day as in the NPS load reductions. Based on these figures, one can conclude that no reductions are necessary to achieve appropriate pathogen loading for the permitted facility. Facilities which had only E. coli measurements were omitted from totals to keep the correct units.

**Table 4-3 E. coli Load and Required Reduction for AL03150202-0206-102 at C-3**

| Source | Existing Load (colonies/day) | Allowable Load (colonies/day) | Required Reduction (colonies/day) | % Reduction |
|---|---|---|---|---|
| **Nonpoint Source - Load Single Sample** | 2.12E+13 | 2.68E+12 | 1.85E+13 | 87% |
| **Nonpoint Source - Load Geometric Mean** | 1.45E+12 | 5.41E+11 | 9.05E+11 | 63% |
| **Point Source Load[a]** | 1.96E+11 | 4.42E+12 | 0 | 0% |

a. PS loads and load reductions are based on permit limits during the month of the highest in-stream E. coli exceedance. Most permit limits were based on fecal coliform as well as a design flow of the municipal discharges. Therefore, units are actually fecal coliform colonies/day vs. E. coli colonies/day as in the NPS load reductions. Based on these figures, one can conclude that no reductions are necessary to achieve appropriate pathogen loading for the permitted facility. Facilities which had only E. coli measurements were omitted from totals to keep the correct units.

From Table 4-1, compliance with the single sample criterion of 487 colonies/100 mL requires the greatest reduction in the E. coli load of 87%. The TMDL, WLA, LA, and MOS values necessary to achieve the applicable E. coli criterion are provided in Table 4-4 below.

**Table 4-4 E. coli TMDL for the Cahaba River**

| TMDL[e] | 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) |
| 7.40E+13 | 7.29E+12 | 1.11E+12 | 87% | 0 | 6.56E+13 | 87% |

a. There are no CAFOs in the Cahaba River 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 in-stream 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 E. coli loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for E. coli.
e. TMDL was established using the single sample criterion of 487 colonies/100ml.

## *4.3 TMDL Summary*

The Cahaba River was first placed on Alabama's §303(d) list in 1996. It was originally listed as AL/Cahaba R_03 and spanned 26.5 miles from Shades Creek to Buck Creek. This segment was divided into two different segments and given different Assessment Unit IDs in 2004 to better match use classifications. In 2010, the Assessment Unit IDs for the two segments were changed to their current Assessment Unit IDs, namely AL03150202-0206-101 and AL03150202-0206-102. Neither segment is currently meeting water quality standards. It was determined that an 87% reduction of E. coli loadings from the watershed is needed for these segments of the Cahaba River to meet water quality standards. Another segment of the Cahaba River, AL03150202-0204-101 (Buck Creek to the dam near US Highway 280), was listed on Alabama's §303(d) list in 2010. This segment is not currently meeting water quality standards and it was determined that an 87% reduction of E. coli loadings from the watershed is needed for this segment of the Cahaba River to meet 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 River watershed. As additional data and/or

information become 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 in Table 5-1.

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

| River Basin Group | Year to be Monitored |
|---|---|
| Tennessee | 2013 |
| Chattahoochee / Chipola / Choctawhatchee / Perdido-Escambia | 2014 |
| Alabama / Coosa / Tallapoosa | 2015 |
| Escatawpa / Mobile / Lower Tombigbee / Upper Tombigbee | 2016 |
| Black Warrior / Cahaba | 2017 |

## *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 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 could 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 have become part of the administrative record. ADEM has 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.

# *7.0 Appendices*

## *7.1 References*

ADEM Administrative Code, 2010. Water Division - Water Quality Program, Chapter 335-6-10, Water Quality Criteria.

ADEM Administrative Code, 2010. Water Division - Water Quality Program, Chapter 335-6-11, Use Classifications for Interstate and Intrastate Waters.

Alabama's §303(d) Monitoring Program. 2009, 2010, 2011, & 2012. ADEM.

Alabama Department of Environmental Management (ADEM), Alabama's Water Quality Assessment and Listing Methodology, January 2012.

Alabama's §303(d) List and Fact Sheet. 1998, 2000, 2002, 2004, 2006, 2008, 2010 & 2012. ADEM.

Alabama Department of Environmental Management (ADEM) Laboratory QA Manual, Chapter 5, Table 5-2: ADEM Laboratory Qualifier Codes and, June 13, 2005.

Cleland, Bruce. "TMDL Development from the "Bottom Up" – Part III: Duration Curves and Wet-weather Assessments." Washington, D.C.: America's Clean Water Foundation, September 15, 2003.

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, 1986. Quality Criteria for Water. Office of Water. EPA 440/4-91-001.

## *7.2 Water Quality Data*

**Table 7-1 E. coli Data for Station C-3**

| Station ID | Visit Date | E Coli (col/100 mL) | E Coli Dc | Geometric Mean (col/100 mL) | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|---|
| C-3 | 9/2/2009 | 83.6 | | | YES-USGS | 119 |
| C-3 | 10/6/2009 | 770.1 | | | YES-USGS | 1590 |
| C-3 | 11/3/2009 | 82.3 | | | YES-USGS | 477 |
| C-3 | 12/8/2009 | 117.8 | | | YES-USGS | 720 |
| C-3 | 1/12/2010 | 117.8 | | | YES-USGS | 232 |
| C-3 | 2/9/2010 | 260.3 | | | YES-USGS | 1710 |
| C-3 | 3/9/2010 | 29.5 | | | YES-USGS | 260 |
| C-3 | 4/6/2010 | 67 | | | YES-USGS | 241 |
| C-3 | 5/11/2010 | 108.1 | | | YES-USGS | 140 |
| C-3 | 6/15/2010 | 579.4 | | | YES-USGS | 227 |
| C-3 | 8/24/2010 | 54.6 | | | YES-USGS | 109 |
| C-3 | 9/28/2010 | 28.8 | | | YES-USGS | 70 |
| C-3 | 10/12/2010 | 27.9 | | | YES-USGS | 55 |
| C-3 | 11/16/2010 | 2419.6 | G | | YES-USGS | 1520 |
| C-3 | 12/14/2010 | 2419.6 | G | | YES-USGS | 126 |
| C-3 | 1/18/2011 | 68.9 | | | YES-USGS | 106 |
| C-3 | 2/16/2011 | 104.3 | | | YES-USGS | 250 |
| C-3 | 3/8/2011 | 496.2 | | | YES-USGS | 1690 |
| C-3 | 4/5/2011 | 3465.8 | | | YES-USGS | 3330 |
| C-3 | 6/7/2011 | 18.7 | | 303.01 | YES-USGS | 41 |
| C-3 | 6/13/2011 | 21.8 | | | YES-USGS | 48 |
| C-3 | 6/20/2011 | 114.5 | | | YES-USGS | 65 |
| C-3 | 6/23/2011 | 3106.2 | | | YES-USGS | 571 |
| C-3 | 6/27/2011 | 3465.8 | | | YES-USGS | 250 |
| C-3 | 7/5/2011 | 1540.2 | | | NO-METER MALFUNCTIONED | |
| C-3 | 8/2/2011 | 23.1 | | | YES-USGS | 73 |
| C-3 | 9/1/2011 | 31.5 | | | YES-USGS | 37 |
| C-3 | 9/6/2011 | 2827.2 | | 189.58 | YES-USGS | 6050 |
| C-3 | 9/12/2011 | 99 | | | YES-USGS | 109 |
| C-3 | 9/19/2011 | 58.1 | | | YES-USGS | 55 |
| C-3 | 9/27/2011 | 266.5 | | | YES-USGS | 344 |
| C-3 | 10/4/2011 | 56.5 | | | YES-USGS | 96 |
| C-3 | 11/1/2011 | 37.7 | | | YES-USGS | 48 |
| C-3 | 12/6/2011 | 1454 | | | YES-USGS | 1030 |
| C-3 | 1/10/2012 | 1226.3 | | | YES-USGS | 503 |
| C-3 | 2/21/2012 | 106.7 | | | YES-USGS | 727 |
| C-3 | 3/13/2012 | 209.8 | | | YES-USGS | 585 |
| C-3 | 4/10/2012 | 172.3 | | | YES-USGS | 260 |
| C-3 | 5/1/2012 | 29.5 | | | YES-USGS | 90 |
| C-3 | 6/5/2012 | 159.7 | | | YES-USGS | 151 |
| C-3 | 7/10/2012 | 1553.1 | | | YES-USGS | 167 |
| C-3 | 9/4/2012 | 1226.3 | | | YES-USGS | 1470 |

G: The actual Number is probably greater than the number reported
Exceedances are highlighted in red

**Table 7-2 E. coli Data for Station CAHS-1**

| Station ID | Visit Date | E Coli (col/100 mL) | E Coli Dc | Geometric Mean (col/100 mL) | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|---|
| CAHS-1 | 9/2/2009 | 118.7 | | | YES-USGS | 51 |
| CAHS-1 | 10/6/2009 | 1553.1 | | | YES-USGS | 1150 |
| CAHS-1 | 11/3/2009 | 56.5 | | | YES-USGS | 260 |
| CAHS-1 | 12/8/2009 | 146.7 | | | YES-USGS | 388 |
| CAHS-1 | 1/12/2010 | 387.3 | | | YES-USGS | 122 |
| CAHS-1 | 2/9/2010 | 218.7 | | | YES-USGS | 1190 |
| CAHS-1 | 3/9/2010 | 4.1 | | | YES-USGS | 174 |
| CAHS-1 | 4/6/2010 | 727 | | | YES-USGS | 157 |
| CAHS-1 | 5/11/2010 | 70.6 | | | YES-USGS | 107 |
| CAHS-1 | 6/15/2010 | 2419.6 | | | YES-USGS | 125 |
| CAHS-1 | 7/27/2010 | 141.4 | | | YES-USGS | 43 |
| CAHS-1 | 8/24/2010 | 410.6 | | | YES-USGS | 24 |
| CAHS-1 | 9/28/2010 | 81.6 | | | YES-USGS | 24 |
| CAHS-1 | 10/12/2010 | 1046.2 | | | YES-USGS | 22 |
| CAHS-1 | 11/16/2010 | 2419.6 | | | YES-USGS | 980 |
| CAHS-1 | 12/14/2010 | 74.8 | | | YES-USGS | 75 |
| CAHS-1 | 1/18/2011 | 18.9 | | | YES-USGS | 60 |
| CAHS-1 | 2/16/2011 | 9.7 | | | YES-USGS | 139 |
| CAHS-1 | 3/8/2011 | 167.8 | | | YES-USGS | 1220 |
| CAHS-1 | 4/5/2011 | 1158.9 | | | YES-USGS | 2930 |
| CAHS-1 | 6/7/2011 | 920.8 | | 707.33 | YES-USGS | 16 |
| CAHS-1 | 6/13/2011 | 307.6 | | | YES-USGS | 25 |
| CAHS-1 | 6/20/2011 | 248.1 | | | YES-USGS | 27 |
| CAHS-1 | 6/23/2011 | 1454 | | | YES-USGS | 318 |
| CAHS-1 | 6/27/2011 | 1732.9 | | | YES-USGS | 94 |
| CAHS-1 | 7/5/2011 | 615.2 | | | YES-USGS | 85 |
| CAHS-1 | 8/2/2011 | 107.1 | | | YES-USGS | 37 |
| CAHS-1 | 9/1/2011 | 55.2 | | 231.81 | YES-USGS | 17 |
| CAHS-1 | 9/6/2011 | 3465.8 | | | YES-USGS | 6120 |
| CAHS-1 | 9/12/2011 | 73.8 | | | YES-USGS | 69 |
| CAHS-1 | 9/19/2011 | 146.7 | | | YES-USGS | 31 |
| CAHS-1 | 9/27/2011 | 323.2 | | | YES-USGS | 202 |
| CAHS-1 | 10/4/2011 | 88.4 | | | YES-USGS | 41 |
| CAHS-1 | 11/1/2011 | 72.3 | | | YES-USGS | 26 |
| CAHS-1 | 12/6/2011 | 4839.1 | | | YES-USGS | 1130 |
| CAHS-1 | 1/10/2012 | 293.4 | | | YES-USGS | 260 |
| CAHS-1 | 2/21/2012 | 133.4 | | | YES-USGS | 454 |
| CAHS-1 | 3/13/2012 | 90.8 | | | YES-USGS | 376 |
| CAHS-1 | 4/10/2012 | 67.7 | | | YES-USGS | 157 |
| CAHS-1 | 5/1/2012 | 75.9 | | | YES-USGS | 52 |
| CAHS-1 | 6/5/2012 | 101.7 | | | YES-USGS | 68 |
| CAHS-1 | 7/10/2012 | 1732.9 | | | YES-USGS | 54 |
| CAHS-1 | 9/4/2012 | 1095 | | | YES-USGS | 1300 |

Exceedances are highlighted in red

## Table 7-3 E. coli Data for Station CABS-1

| Station ID | Visit Date | E Coli (col/100mL) | E Coli Dc | Geometric Mean (col/100mL) | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|---|
| CABS-1 | 3/17/2011 | 172.3 | | | NO-FLOW CONDITIONS HAZARDOUS | |
| CABS-1 | 4/14/2011 | 167.2 | | | NO-FLOW CONDITIONS HAZARDOUS | |
| CABS-1 | 6/9/2011 | 4.1 | | 40.53 | DATA COLLECTED BUT LOST | |
| CABS-1 | 6/13/2011 | 68.3 | | | NO-METER MALFUNCTIONED | |
| CABS-1 | 6/20/2011 | 14.8 | | | NO-METER MALFUNCTIONED | |
| CABS-1 | 6/23/2011 | 220.1 | | | NO-FLOW CONDITIONS HAZARDOUS | |
| CABS-1 | 6/27/2011 | 496.2 | | | NO-FLOW CONDITIONS HAZARDOUS | |
| CABS-1 | 7/7/2011 | 9.8 | | | NO-FLOW CONDITIONS HAZARDOUS | |
| CABS-1 | 8/4/2011 | 3 | | | YES-ADEM | 104.5692 |
| CABS-1 | 9/1/2011 | 17.3 | | 46.76 | NO-FLOW CONDITIONS HAZARDOUS | |
| CABS-1 | 9/8/2011 | 209.2 | | | NO-FLOW CONDITIONS HAZARDOUS | |
| CABS-1 | 9/12/2011 | 29.5 | | | NO-FLOW CONDITIONS HAZARDOUS | |
| CABS-1 | 9/19/2011 | 13.5 | | | NO-FLOW CONDITIONS HAZARDOUS | |
| CABS-1 | 9/27/2011 | 155.1 | | | NO-FLOW CONDITIONS HAZARDOUS | |
| CABS-1 | 10/6/2011 | 20.9 | | | YES-ADEM | 204.4282 |

Exceedances are highlighted in red

**Table 7-4 E. coli Data for Station C-2**

| Station ID | Visit Date | E Coli (col/100 mL) | E Coli Dc | Geometric Mean (col/100 mL) | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|---|
| C-2 | 9/3/2009 | 156.5 | | | YES-USGS | 13 |
| C-2 | 10/7/2009 | 1413.6 | | | YES-USGS | 1120 |
| C-2 | 11/4/2009 | 55.6 | | | YES-USGS | 150 |
| C-2 | 12/9/2009 | 488.4 | | | YES-USGS | 2660 |
| C-2 | 1/13/2010 | 18.5 | | | YES-USGS | 52 |
| C-2 | 2/10/2010 | 40.4 | | | YES-USGS | 682 |
| C-2 | 3/17/2010 | 43.5 | | | YES-USGS | 517 |
| C-2 | 4/7/2010 | 21.3 | | | YES-USGS | 67 |
| C-2 | 5/12/2010 | 40.4 | | | YES-USGS | 98 |
| C-2 | 6/16/2010 | 112.6 | | | YES-USGS | 59 |
| C-2 | 7/28/2010 | 52 | | | YES-USGS | 23 |
| C-2 | 8/25/2010 | 39.9 | | | YES-USGS | 34 |
| C-2 | 9/29/2010 | 18.5 | | | YES-USGS | 11 |
| C-2 | 10/13/2010 | 1046.2 | | | YES-USGS | 9.1 |
| C-2 | 11/17/2010 | 1413.6 | | | YES-USGS | 199 |
| C-2 | 12/15/2010 | 80.9 | | | YES-USGS | 21 |
| C-2 | 1/19/2011 | 7.5 | | | YES-USGS | 59 |
| C-2 | 2/17/2011 | 145.5 | | | YES-USGS | 54 |
| C-2 | 3/14/2011 | 51.2 | | | YES-USGS | 462 |
| C-2 | 4/6/2011 | 419.6 | | | YES-USGS | 976 |
| C-2 | 6/8/2011 | 7.5 | | 61.11 | YES-USGS | 2.4 |
| C-2 | 6/13/2011 | 63.1 | | | YES-USGS | 7.4 |
| C-2 | 6/20/2011 | 34.5 | | | YES-USGS | 8.2 |
| C-2 | 6/23/2011 | 456.4 | | | YES-USGS | 170 |
| C-2 | 6/27/2011 | 93.3 | | | YES-USGS | 16 |
| C-2 | 7/6/2011 | 74.9 | | | YES-USGS | 11 |
| C-2 | 8/3/2011 | 39.3 | | | YES-USGS | 11 |
| C-2 | 9/1/2011 | 16.8 | | 67.00 | YES-USGS | 3.5 |
| C-2 | 9/7/2011 | 651.1 | | | YES-USGS | 617 |
| C-2 | 9/12/2011 | 34.1 | | | YES-USGS | 10 |
| C-2 | 9/19/2011 | 21.1 | | | YES-USGS | 2.1 |
| C-2 | 9/27/2011 | 171.5 | | | YES-USGS | 150 |
| C-2 | 10/5/2011 | 34.5 | | | YES-USGS | 7.4 |
| C-2 | 11/2/2011 | 40.8 | | | YES-USGS | 15 |
| C-2 | 12/7/2011 | 922.2 | | | YES-USGS | 2360 |
| C-2 | 1/11/2012 | 615.2 | | | YES-USGS | 187 |
| C-2 | 2/15/2012 | 19.9 | | | YES-USGS | 150 |
| C-2 | 3/14/2012 | 28.8 | | | YES-USGS | 249 |
| C-2 | 4/11/2012 | 28.8 | | | YES-USGS | 21 |
| C-2 | 5/2/2012 | 35.9 | | | YES-USGS | 10 |
| C-2 | 6/6/2012 | 50.4 | | | YES-USGS | 5.8 |
| C-2 | 7/11/2012 | 18.9 | | | YES-USGS | 6.5 |
| C-2 | 9/5/2012 | 615.2 | | | YES-USGS | 546 |

Exceedances are highlighted in red

**Table 7-5 Fecal Coliform Data for Station C-3**

| Station ID | Visit Date | Fecal Coliform (col/100 mL) | Fecal Col dc | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|
| C-3 | 3/12/1991 | 88 | | | |
| C-3 | 4/24/1991 | 66 | | | 46.88 |
| C-3 | 5/22/1991 | 620 | G | | |
| C-3 | 6/26/1991 | 7000 | | | |
| C-3 | 7/25/1991 | 1700 | | | |
| C-3 | 8/21/1991 | 170 | | | |
| C-3 | 9/25/1991 | 600 | G | | |
| C-3 | 10/23/1991 | 68 | | | |
| C-3 | 11/13/1991 | 52 | | | |
| C-3 | 1/22/1992 | 1020 | | | 47.45 |
| C-3 | 2/19/1992 | 4800 | | | |
| C-3 | 3/25/1992 | 150 | | | |
| C-3 | 4/29/1992 | 96 | | | |
| C-3 | 5/27/1992 | 6 | | | 55 |
| C-3 | 6/17/1992 | 20 | | | 52 |
| C-3 | 7/15/1992 | 11 | | | 96 |
| C-3 | 8/5/1992 | 1300 | | | 97 |
| C-3 | 9/9/1992 | 190 | | | 500 |
| C-3 | 10/14/1992 | 58 | | | 48 |
| C-3 | 11/12/1992 | 46 | | | |
| C-3 | 12/16/1992 | 620 | G | | 1310 |
| C-3 | 1/20/1993 | 420 | | | |
| C-3 | 2/17/1993 | 3300 | | | |
| C-3 | 3/17/1993 | 9900 | | | |
| C-3 | 4/20/1993 | 200 | | | |
| C-3 | 5/12/1993 | 108 | | | |
| C-3 | 6/9/1993 | 28 | | | |
| C-3 | 8/18/1993 | 156 | | | |
| C-3 | 9/8/1993 | 90 | | | |
| C-3 | 10/13/1993 | 2 | | | |
| C-3 | 12/8/1993 | 56 | | | |
| C-3 | 1/4/1994 | 610 | | | |
| C-3 | 2/23/1994 | 13700 | | | |
| C-3 | 3/16/1994 | 100 | | | |
| C-3 | 4/27/1994 | 120 | | | |
| C-3 | 5/18/1994 | 152 | | | |
| C-3 | 6/8/1994 | 10600 | | | |
| C-3 | 7/13/1994 | 2400 | | | |
| C-3 | 8/10/1994 | 60 | | | |
| C-3 | 9/8/1994 | 124 | | | |
| C-3 | 10/12/1994 | 430 | | | |
| C-3 | 11/9/1994 | 36 | | | |
| **Station ID** | **Visit Date** | **Fecal Coliform (col/100 mL)** | **Fecal Col dc** | **Flow Measured** | **Flow (cfs)** |

| C-3 | 12/13/1994 | 370 | | | |
|---|---|---|---|---|---|
| C-3 | 3/15/1995 | 144 | | | |
| C-3 | 4/6/1995 | 42 | | | |
| C-3 | 5/10/1995 | 124 | | | |
| C-3 | 6/7/1995 | 80 | | | |
| C-3 | 7/19/1995 | 20 | | | |
| C-3 | 8/16/1995 | 90 | | | |
| C-3 | 9/7/1995 | 10 | | | |
| C-3 | 10/11/1995 | 188 | | | |
| C-3 | 11/7/1995 | 1200 | G | | |
| C-3 | 12/11/1995 | 300 | | | |
| C-3 | 8/19/1998 | 240 | G | | |
| C-3 | 10/14/1998 | 39 | | | |
| C-3 | 6/2/1999 | 300 | | | |
| C-3 | 8/5/1999 | 20 | | | |
| C-3 | 10/13/1999 | 260 | | | |
| C-3 | 6/7/2000 | 65 | | | |
| C-3 | 8/9/2000 | 80 | | | 42 |
| C-3 | 10/11/2000 | 88 | | | 26 |
| C-3 | 6/6/2001 | 102 | | | 246 |
| C-3 | 8/8/2001 | 720 | | | 300 |
| C-3 | 10/10/2001 | 33 | | | 80 |
| C-3 | 1/29/2002 | 500 | | NO-FLOW CONDITIONS HAZARDOUS | |
| C-3 | 2/20/2002 | 66 | | NO-FLOW CONDITIONS HAZARDOUS | |
| C-3 | 3/28/2002 | 22 | | NO-FLOW CONDITIONS HAZARDOUS | |
| C-3 | 4/11/2002 | 114 | | | |
| C-3 | 5/2/2002 | 1080 | | | |
| C-3 | 5/23/2002 | 43 | | | |
| C-3 | 6/5/2002 | 116 | | | 225 |
| C-3 | 6/18/2002 | 26 | | | |
| C-3 | 7/16/2002 | 310 | | NO-NOT WADEABLE | |
| C-3 | 8/6/2002 | 74 | | | 42 |
| C-3 | 8/13/2002 | 22 | | NO-FLOW CONDITIONS HAZARDOUS | |
| C-3 | 10/2/2002 | 120 | | | |
| C-3 | 3/10/2003 | 230 | | | |
| C-3 | 4/8/2003 | 1000 | | | |
| C-3 | 5/7/2003 | 5500 | | | |
| C-3 | 6/4/2003 | 620 | G | | |
| C-3 | 6/9/2003 | 1000 | | | |
| C-3 | 6/12/2003 | 2100 | | | |
| C-3 | 6/16/2003 | 2100 | | | |
| C-3 | 6/19/2003 | 2500 | | | |
| C-3 | 6/23/2003 | 1220 | | | |
| **Station ID** | **Visit Date** | **Fecal Coliform (col/100 mL)** | **Fecal Col dc** | **Flow Measured** | **Flow (cfs)** |
| C-3 | 7/29/2003 | 184 | | | |

| C-3 | 8/7/2003 | 1440 | | | |
|---|---|---|---|---|---|
| C-3 | 8/18/2003 | 1060 | | | |
| C-3 | 9/15/2003 | 36 | | | |
| C-3 | 9/18/2003 | 92 | | NO-NOT REQUIRED | |
| C-3 | 9/22/2003 | 620 | G | | |
| C-3 | 9/25/2003 | 260 | | | |
| C-3 | 9/29/2003 | 64 | | NO-NOT REQUIRED | |
| C-3 | 10/8/2003 | 65 | | NO-NOT REQUIRED | |
| C-3 | 10/15/2003 | 50 | | | |
| C-3 | 2/24/2004 | 1 | L | NO-NOT REQUIRED | |
| C-3 | 3/17/2004 | 530 | | NO-NOT REQUIRED | |
| C-3 | 4/21/2004 | 63 | | NO-NOT REQUIRED | |
| C-3 | 5/12/2004 | 30 | | NO-NOT REQUIRED | |
| C-3 | 6/3/2004 | 36 | | NO-NOT REQUIRED | |
| C-3 | 6/15/2004 | 1 | L | NO-NOT REQUIRED | |
| C-3 | 6/21/2004 | 12 | | NO-NOT REQUIRED | |
| C-3 | 6/22/2004 | 21 | | YES-ADEM | 76.9 |
| C-3 | 6/24/2004 | 176 | | NO-NOT REQUIRED | |
| C-3 | 6/30/2004 | 600 | G | NO-NOT REQUIRED | |
| C-3 | 7/14/2004 | 1820 | | | |
| C-3 | 8/2/2004 | 67 | | NO-NOT REQUIRED | |
| C-3 | 8/3/2004 | 67 | | | |
| C-3 | 9/2/2004 | 40 | | NO-NOT REQUIRED | |
| C-3 | 9/22/2004 | 56 | | NO-NOT REQUIRED | |
| C-3 | 9/27/2004 | 26 | | NO-NOT REQUIRED | |
| C-3 | 9/28/2004 | 39 | | NO-NOT REQUIRED | |
| C-3 | 9/29/2004 | 148 | | NO-NOT REQUIRED | |
| C-3 | 10/6/2004 | 19 | | | |
| C-3 | 10/14/2004 | 25 | | NO-NOT REQUIRED | |
| C-3 | 3/23/2005 | 1200 | G | NO-NOT REQUIRED | 2460 |
| C-3 | 4/12/2005 | 112 | | NO-NOT WADEABLE | 954 |
| C-3 | 5/11/2005 | 20 | | NO-NOT REQUIRED | 192 |
| C-3 | 6/16/2005 | 54 | | NO-NOT REQUIRED | 530 |
| C-3 | 7/20/2005 | 600 | G | NO-NOT REQUIRED | 600 |
| C-3 | 8/11/2005 | 100 | | NO-NOT REQUIRED | 245 |
| C-3 | 9/29/2005 | 82 | | NO-NOT REQUIRED | 183 |
| C-3 | 10/13/2005 | 39 | | YES-ADEM | 70 |
| C-3 | 11/16/2005 | 600 | G | NO-NOT REQUIRED | 285 |
| C-3 | 12/13/2005 | 23 | | NO-NOT REQUIRED | 128 |
| C-3 | 1/25/2006 | 140 | | NO-NOT REQUIRED | 2200 |
| C-3 | 2/15/2006 | 60 | | NO-NOT REQUIRED | 640 |
| C-3 | 3/23/2006 | 164 | | YES-USGS | 1870 |
| **Station ID** | **Visit Date** | **Fecal Coliform (col/100 mL)** | **Fecal Col dc** | **Flow Measured** | **Flow (cfs)** |
| C-3 | 4/20/2006 | 600 | G | YES-USGS | 520 |
| C-3 | 5/17/2006 | 70 | | YES-USGS | 365 |

| | | | | | |
|---|---|---|---|---|---|
| C-3 | 6/29/2006 | 17 | | YES-USGS | 50 |
| C-3 | 7/26/2006 | 45 | | YES-USGS | 60 |
| C-3 | 8/24/2006 | 480 | | YES-USGS | 300 |
| C-3 | 9/26/2006 | 112 | | YES-USGS | 90 |
| C-3 | 10/11/2006 | 49 | | YES-USGS | 37 |
| C-3 | 11/7/2006 | 40 | | YES-USGS | 160 |
| C-3 | 12/6/2006 | 5 | | YES-USGS | 70 |
| C-3 | 1/24/2007 | 64 | | YES-USGS | 590 |
| C-3 | 2/22/2007 | 27 | | YES-USGS | 196 |
| C-3 | 3/21/2007 | 9 | J | YES-USGS | 187 |
| C-3 | 4/11/2007 | 20 | | YES-USGS | 76 |
| C-3 | 5/16/2007 | 39 | | YES-USGS | 50 |
| C-3 | 6/18/2007 | 5 | J | YES-USGS | 34 |
| C-3 | 7/18/2007 | 23 | | YES-USGS | 55 |
| C-3 | 8/15/2007 | 14 | J | YES-USGS | 21 |
| C-3 | 9/12/2007 | 41 | | YES-USGS | 1.29 |
| C-3 | 10/17/2007 | 29 | | YES-USGS | 23 |
| C-3 | 11/13/2007 | 17 | J | YES-USGS | 37 |
| C-3 | 12/11/2007 | 9 | J | YES-USGS | 30 |
| C-3 | 2/12/2008 | 8 | J | YES-USGS | 99 |
| C-3 | 3/11/2008 | 24 | J | YES-USGS | 496 |
| C-3 | 4/8/2008 | 260 | | YES-USGS | 733 |
| C-3 | 5/6/2008 | 57 | | YES-USGS | 205 |
| C-3 | 6/3/2008 | 140 | | YES-USGS | 344 |
| C-3 | 7/8/2008 | 72 | J | YES-USGS | 133 |
| C-3 | 8/5/2008 | 11 | J | YES-USGS | 42 |
| C-3 | 9/9/2008 | 47 | | YES-USGS | 90 |
| C-3 | 10/1/2008 | 27 | | YES-USGS | 41 |
| C-3 | 11/18/2008 | 10 | J | YES-USGS | 50 |
| C-3 | 12/16/2008 | 420 | | NO-METER MALFUNCTIONED | |
| C-3 | 1/6/2009 | 3200 | | NO-METER MALFUNCTIONED | |
| C-3 | 2/10/2009 | 10 | J | YES-USGS | 196 |
| C-3 | 3/4/2009 | 200 | | YES-USGS | 1210 |
| C-3 | 4/1/2009 | 390 | | YES-USGS | 1460 |
| C-3 | 5/5/2009 | 2200 | | YES-USGS | 1850 |
| C-3 | 6/2/2009 | 41 | | YES-USGS | 355 |
| C-3 | 7/7/2009 | 270 | | YES-USGS | 148 |
| C-3 | 8/3/2009 | 240 | | YES-USGS | 414 |
| C-3 | 9/2/2009 | 36 | J | YES-USGS | 119 |
| C-3 | 10/6/2009 | 560 | | YES-USGS | 1590 |
| C-3 | 11/3/2009 | 36 | J | YES-USGS | 477 |
| C-3 | 12/8/2009 | 136 | | YES-USGS | 720 |
| C-3 | 1/12/2010 | 36 | | YES-USGS | 232 |
| C-3 | 2/9/2010 | 172 | | YES-USGS | 1710 |

G: The actual Number is probably greater than the number reported
J: Micro: Reported microbiological result is an estimate
Exceedances are highlighted in red

## Table 7-6 Fecal Coliform Data for Station CAHS-1

| Station ID | Visit Date | Fecal Coliform (col/100 mL) | Fecal Coliform dc | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| CAHS-1 | 3/10/2003 | 84 | | | |
| CAHS-1 | 4/8/2003 | 290 | | | |
| CAHS-1 | 5/7/2003 | 1800 | | | |
| CAHS-1 | 6/9/2003 | 620 | G | YES-USGS | |
| CAHS-1 | 6/12/2003 | 2700 | | | |
| CAHS-1 | 6/16/2003 | 2700 | | | |
| CAHS-1 | 6/19/2003 | 3300 | | | |
| CAHS-1 | 6/23/2003 | 1200 | G | | |
| CAHS-1 | 7/29/2003 | 620 | G | | |
| CAHS-1 | 8/7/2003 | 1480 | | | |
| CAHS-1 | 9/15/2003 | 730 | | | |
| CAHS-1 | 9/18/2003 | 670 | | NO-NOT REQUIRED | |
| CAHS-1 | 9/22/2003 | 620 | G | | |
| CAHS-1 | 9/25/2003 | 1200 | G | | |
| CAHS-1 | 9/29/2003 | 370 | | NO-NOT REQUIRED | |
| CAHS-1 | 10/8/2003 | 1420 | | | |
| CAHS-1 | 2/23/2004 | 620 | G | NO-NOT REQUIRED | |
| CAHS-1 | 3/15/2004 | 1200 | G | NO-NOT REQUIRED | |
| CAHS-1 | 4/22/2004 | 1 | L | NO-NOT REQUIRED | |
| CAHS-1 | 5/11/2004 | 1 | L | NO-NOT REQUIRED | |
| CAHS-1 | 6/15/2004 | 1 | L | NO-NOT WADEABLE | |
| CAHS-1 | 6/21/2004 | 80 | | NO-NOT REQUIRED | |
| CAHS-1 | 6/22/2004 | 80 | | NO-NOT REQUIRED | |
| CAHS-1 | 6/24/2004 | 172 | | NO-NOT REQUIRED | |
| CAHS-1 | 6/28/2004 | 5 | | NO-FLOW CONDITIONS HAZARDOUS | |
| CAHS-1 | 6/30/2004 | 600 | G | NO-NOT REQUIRED | |
| CAHS-1 | 7/14/2004 | 1920 | | | |
| CAHS-1 | 8/4/2004 | 148 | | NO-NOT REQUIRED | |
| CAHS-1 | 9/1/2004 | 84 | | NO-NOT REQUIRED | |
| CAHS-1 | 9/22/2004 | 88 | | NO-NOT REQUIRED | |
| CAHS-1 | 9/27/2004 | 92 | | NO-NOT REQUIRED | |
| CAHS-1 | 9/28/2004 | 48 | | NO-NOT REQUIRED | |
| CAHS-1 | 9/29/2004 | 54 | | NO-NOT REQUIRED | |
| CAHS-1 | 10/13/2004 | 49 | | NO-NOT REQUIRED | |
| CAHS-1 | 3/23/2005 | 660 | | NO-NOT WADEABLE | 1300 |
| CAHS-1 | 4/12/2005 | 120 | | NO-NOT REQUIRED | 590 |
| CAHS-1 | 5/11/2005 | 33 | | NO-NOT REQUIRED | 52 |
| CAHS-1 | 6/16/2005 | 54 | | NO-NOT REQUIRED | 368 |
| CAHS-1 | 7/20/2005 | 96 | | NO-NOT REQUIRED | 342 |
| CAHS-1 | 8/11/2005 | 130 | | NO-NOT REQUIRED | 90 |
| **Station ID** | **Visit Date** | **Fecal Coliform (col/100 mL)** | **Fecal Coliform dc** | **Flow Measured** | **Flow (cfs)** |
| CAHS-1 | 9/29/2005 | 128 | | NO-NOT REQUIRED | |
| CAHS-1 | 10/13/2005 | 45 | | NO-NOT REQUIRED | |
| CAHS-1 | 11/16/2005 | 600 | G | NO-NOT REQUIRED | 132 |

| CAHS-1 | 12/13/2005 | 57 | | NO-NOT REQUIRED | 68 |
|---|---|---|---|---|---|
| CAHS-1 | 1/25/2006 | 128 | | NO-NOT REQUIRED | 1550 |
| CAHS-1 | 2/15/2006 | 88 | | NO-NOT REQUIRED | 460 |
| CAHS-1 | 3/23/2006 | 212 | | YES-USGS | 1270 |
| CAHS-1 | 4/20/2006 | 600 | G | YES-USGS | 516 |
| CAHS-1 | 5/17/2006 | 64 | | | |
| CAHS-1 | 6/29/2006 | 56 | | YES-USGS | 17 |
| CAHS-1 | 7/26/2006 | 152 | | YES-USGS | 35 |
| CAHS-1 | 8/24/2006 | 131 | | YES-USGS | 160 |
| CAHS-1 | 9/26/2006 | 600 | G | YES-USGS | 34 |
| CAHS-1 | 10/11/2006 | 60 | | YES-USGS | 19 |
| CAHS-1 | 11/7/2006 | 240 | | YES-USGS | 140 |
| CAHS-1 | 12/6/2006 | 41 | | YES-USGS | 25 |
| CAHS-1 | 1/24/2007 | 80 | | YES-USGS | 390 |
| CAHS-1 | 2/22/2007 | 30 | | YES-USGS | 97 |
| CAHS-1 | 3/21/2007 | 29 | | YES-USGS | 86 |
| CAHS-1 | 4/11/2007 | 44 | | YES-USGS | 22 |
| CAHS-1 | 5/16/2007 | 164 | | YES-USGS | 23 |
| CAHS-1 | 6/18/2007 | 72 | J | YES-USGS | 18 |
| CAHS-1 | 7/18/2007 | 80 | | YES-USGS | 21 |
| CAHS-1 | 8/15/2007 | 92 | | YES-USGS | 12 |
| CAHS-1 | 9/12/2007 | 132 | | YES-USGS | 1.81 |
| CAHS-1 | 10/17/2007 | 128 | | YES-USGS | 26 |
| CAHS-1 | 11/13/2007 | 128 | | YES-USGS | 24 |
| CAHS-1 | 12/11/2007 | 340 | | YES-USGS | 19 |
| CAHS-1 | 2/12/2008 | 35 | | YES-USGS | 35 |
| CAHS-1 | 3/11/2008 | 44 | J | YES-USGS | 248 |
| CAHS-1 | 4/8/2008 | 560 | | YES-USGS | 461 |
| CAHS-1 | 5/6/2008 | 590 | | YES-USGS | 89 |
| CAHS-1 | 6/3/2008 | 390 | | YES-USGS | 225 |
| CAHS-1 | 7/8/2008 | 220 | | YES-USGS | 74 |
| CAHS-1 | 8/5/2008 | 104 | | YES-USGS | 22 |
| CAHS-1 | 9/9/2008 | 52 | J | YES-USGS | 24 |
| CAHS-1 | 10/1/2008 | 120 | | YES-USGS | 19 |
| CAHS-1 | 11/18/2008 | 28 | | YES-USGS | 19 |
| CAHS-1 | 12/16/2008 | 380 | J | YES-USGS | 378 |
| CAHS-1 | 1/6/2009 | 2800 | | YES-USGS | 3250 |
| CAHS-1 | 2/10/2009 | 23 | | YES-USGS | 153 |
| CAHS-1 | 3/4/2009 | 192 | | YES-USGS | 990 |
| CAHS-1 | 4/1/2009 | 120 | | YES-USGS | 1000 |

| Station ID | Visit Date | Fecal Coliform (col/100 mL) | Fecal Coliform dc | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|
| CAHS-1 | 5/5/2009 | 3200 | | YES-USGS | 1630 |
| CAHS-1 | 6/2/2009 | 64 | J | YES-USGS | 245 |
| CAHS-1 | 7/7/2009 | 600 | G | YES-USGS | 97 |
| CAHS-1 | 8/3/2009 | 230 | | YES-USGS | 254 |

| | | | | | |
|---|---|---|---|---|---|
| CAHS-1 | 9/2/2009 | 64 | J | YES-USGS | 51 |
| CAHS-1 | 10/6/2009 | 600 | G | YES-USGS | 1150 |
| CAHS-1 | 11/3/2009 | 56 | | YES-USGS | 260 |
| CAHS-1 | 12/8/2009 | 112 | | YES-USGS | 388 |
| CAHS-1 | 1/12/2010 | 160 | | YES-USGS | 122 |
| CAHS-1 | 2/9/2010 | 196 | | YES-USGS | 1190 |

G: The actual Number is probably greater than the number reported
J: Micro: Reported microbiological result is an estimate
L: The analyte is present, but the amount of the analyte is determined to be below an acceptable level for quantitation. QC measurements indicate a high bias for the sample result reported or an accurate result cannot be calculated, but is determined to be less than the value given.
Exceedances are highlighted in red

## Table 7-7 Fecal Coliform Data for Station C-2

| Station ID | Visit Date | Fecal Coliform (col/100 mL) | Fecal Coliform dc | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|
| C-2 | 3/11/1991 | 1920 | | | |
| C-2 | 4/23/1991 | 40 | | | 34.55 |
| C-2 | 5/21/1991 | 144 | | | |
| C-2 | 6/26/1991 | 660 | | | |
| C-2 | 7/23/1991 | 160 | | | |
| C-2 | 8/20/1991 | 1540 | | | |
| C-2 | 9/24/1991 | 600 | G | | |
| C-2 | 10/22/1991 | 7100 | | | |
| C-2 | 1/21/1992 | 30 | | | 35.91 |
| C-2 | 2/18/1992 | 210 | | | 980 |
| C-2 | 3/24/1992 | 164 | | | 644 |
| C-2 | 4/28/1992 | 340 | | | |
| C-2 | 5/21/1992 | 36 | | | 5 |
| C-2 | 6/16/1992 | 120 | | | 60 |
| C-2 | 7/14/1992 | 12 | | | 18 |
| C-2 | 8/4/1992 | 40 | | | 23 |
| C-2 | 9/8/1992 | 172 | | | 500 |
| C-2 | 10/13/1992 | 18 | | | 6 |
| C-2 | 12/15/1992 | 28 | | | |
| C-2 | 1/19/1993 | 98 | | | |
| C-2 | 2/17/1993 | 112 | | | |
| C-2 | 3/16/1993 | 52 | | | |
| C-2 | 4/21/1993 | 490 | | | |
| **Station ID** | **Visit Date** | **Fecal Coliform (col/100 mL)** | **Fecal Coliform dc** | **Flow Measured** | **Flow (cfs)** |
| C-2 | 5/11/1993 | 52 | | | |
| C-2 | 6/8/1993 | 18 | | | |
| C-2 | 8/17/1993 | 58 | | | |
| C-2 | 9/7/1993 | 52 | | | |
| C-2 | 10/12/1993 | 9 | | | |

| C-2 | 11/9/1993 | 136 | | | |
|---|---|---|---|---|---|
| C-2 | 12/7/1993 | 16 | | | |
| C-2 | 1/3/1994 | 12 | | | |
| C-2 | 2/22/1994 | 50 | | | |
| C-2 | 2/23/1994 | 13 | | | |
| C-2 | 3/17/1994 | 100 | | | |
| C-2 | 4/26/1994 | 104 | | | |
| C-2 | 5/17/1994 | 56 | | | |
| C-2 | 6/7/1994 | 520 | | | |
| C-2 | 7/12/1994 | 360 | | | |
| C-2 | 9/6/1994 | 52 | | | |
| C-2 | 10/11/1994 | 188 | | | |
| C-2 | 11/8/1994 | 82 | | | |
| C-2 | 12/12/1994 | 960 | | | |
| C-2 | 3/14/1995 | 128 | | | |
| C-2 | 4/4/1995 | 60 | | | |
| C-2 | 5/9/1995 | 54 | | | |
| C-2 | 6/6/1995 | 98 | | | |
| C-2 | 7/18/1995 | 46 | | | |
| C-2 | 8/15/1995 | 390 | | | |
| C-2 | 9/6/1995 | 22 | | | |
| C-2 | 10/10/1995 | 212 | | | |
| C-2 | 11/8/1995 | 2780 | | | |
| C-2 | 12/11/1995 | 136 | | | |
| C-2 | 8/18/1998 | 248 | | | |
| C-2 | 10/13/1998 | 70 | | | |
| C-2 | 6/2/1999 | 52 | | | |
| C-2 | 8/4/1999 | 84 | | | |
| C-2 | 10/12/1999 | 780 | | | |
| C-2 | 6/6/2000 | 22 | | | 5 |
| C-2 | 8/8/2000 | 15 | | | 5 |
| C-2 | 10/10/2000 | 15 | | | 4 |
| C-2 | 6/5/2001 | 100 | | | 128 |
| C-2 | 8/7/2001 | 1200 | G | | 100 |
| C-2 | 10/9/2001 | 49 | | | 35 |
| C-2 | 1/29/2002 | 120 | | NO-NOT REQUIRED | |
| C-2 | 2/20/2002 | 62 | | NO-NOT REQUIRED | |
| C-2 | 3/28/2002 | 42 | | NO-NOT REQUIRED | |
| C-2 | 4/11/2002 | 50 | | NO-NOT REQUIRED | |

| Station ID | Visit Date | Fecal Coliform (col/100 mL) | Fecal Coliform dc | Flow Measured | Flow (cfs) |
|---|---|---|---|---|---|
| C-2 | 5/2/2002 | 580 | | NO-NOT REQUIRED | |
| C-2 | 5/23/2002 | 74 | | NO-NOT REQUIRED | |
| C-2 | 6/4/2002 | 23 | | | 6.5 |
| C-2 | 6/18/2002 | 15 | | NO-NOT REQUIRED | |
| C-2 | 7/16/2002 | 56 | | NO-NOT REQUIRED | |

| C-2 | 8/5/2002 | 54 | | | 3.5 |
|---|---|---|---|---|---|
| C-2 | 8/13/2002 | 12 | | NO-NOT REQUIRED | |
| C-2 | 10/3/2002 | 62 | | | |
| C-2 | 6/3/2003 | 540 | | | |
| C-2 | 8/18/2003 | 87 | | | |
| C-2 | 10/14/2003 | 84 | | | |
| C-2 | 3/15/2004 | 4 | | NO-NOT REQUIRED | |
| C-2 | 4/22/2004 | 1 | L | NO-NOT REQUIRED | |
| C-2 | 5/11/2004 | 1 | L | NO-NOT REQUIRED | |
| C-2 | 6/2/2004 | 1 | L | | |
| C-2 | 7/14/2004 | 1400 | | | |
| C-2 | 8/4/2004 | 14 | | NO-NOT REQUIRED | |
| C-2 | 9/1/2004 | 29 | | NO-NOT REQUIRED | |
| C-2 | 10/5/2004 | 101 | | NO-NOT REQUIRED | |
| C-2 | 3/22/2005 | 168 | | NO-FLOW CONDITIONS HAZARDOUS | 241 |
| C-2 | 4/12/2005 | 39 | | NO-FLOW CONDITIONS HAZARDOUS | 427 |
| C-2 | 5/9/2005 | 17 | | NO-NOT REQUIRED | 67 |
| C-2 | 6/14/2005 | 120 | | NO-NOT REQUIRED | 398 |
| C-2 | 7/19/2005 | 65 | | NO-NOT REQUIRED | 409 |
| C-2 | 8/9/2005 | 48 | | NO-NOT REQUIRED | 80 |
| C-2 | 9/27/2005 | 600 | G | NO-NOT REQUIRED | 104 |
| C-2 | 10/12/2005 | 31 | | YES-ADEM | 6.5 |
| C-2 | 11/16/2005 | 420 | | NO-NOT REQUIRED | 1.62 |
| C-2 | 12/13/2005 | 47 | | NO-NOT REQUIRED | 28 |
| C-2 | 1/25/2006 | 108 | | NO-NOT REQUIRED | 900 |
| C-2 | 2/15/2006 | 25 | | NO-NOT REQUIRED | 350 |
| C-2 | 3/20/2007 | 15 | J | YES-USGS | 100 |
| C-2 | 4/12/2007 | 112 | | YES-USGS | 7.8 |
| C-2 | 5/17/2007 | 32 | | YES-USGS | 6 |
| C-2 | 6/14/2007 | 16 | J | YES-USGS | 15 |
| C-2 | 7/19/2007 | 90 | J | YES-USGS | 15 |
| C-2 | 8/16/2007 | 15 | J | YES-USGS | 10 |
| C-2 | 9/13/2007 | 33 | | YES-USGS | 7.4 |
| C-2 | 10/18/2007 | 60 | J | YES-USGS | 7.4 |
| C-2 | 11/14/2007 | 54 | | YES-USGS | 6.5 |
| C-2 | 12/12/2007 | 23 | | YES-USGS | 10 |
| C-2 | 1/23/2008 | 31 | | YES-USGS | 10 |
| **Station ID** | **Visit Date** | **Fecal Coliform (col/100 mL)** | **Fecal Coliform dc** | **Flow Measured** | **Flow (cfs)** |
| C-2 | 2/13/2008 | 34 | | YES-USGS | 33 |
| C-2 | 3/12/2008 | 26 | | YES-USGS | 180 |
| C-2 | 4/9/2008 | 57 | | YES-USGS | 279 |
| C-2 | 5/7/2008 | 22 | | YES-USGS | 66 |
| C-2 | 6/4/2008 | 76 | J | YES-USGS | 100 |
| C-2 | 7/9/2008 | 17 | J | YES-USGS | 6.5 |

| | | | | | |
|---|---|---|---|---|---|
| C-2 | 8/6/2008 | 24 | | YES-USGS | 8 |
| C-2 | 9/10/2008 | 152 | | YES-USGS | 30 |
| C-2 | 10/2/2008 | 12 | J | YES-USGS | 5.1 |
| C-2 | 11/19/2008 | 10 | J | YES-USGS | 9.1 |
| C-2 | 12/10/2008 | 640 | | YES-USGS | 290 |
| C-2 | 1/7/2009 | 1100 | | YES-USGS | 6150 |
| C-2 | 2/18/2009 | 36 | | YES-USGS | 119 |
| C-2 | 3/5/2009 | 60 | J | YES-USGS | 450 |
| C-2 | 4/2/2009 | 52 | J | YES-USGS | 735 |
| C-2 | 5/19/2009 | 160 | J | YES-USGS | 526 |
| C-2 | 6/3/2009 | 27 | | YES-USGS | 56 |
| C-2 | 7/8/2009 | 72 | J | YES-USGS | 46 |
| C-2 | 8/4/2009 | 116 | | YES-USGS | 193 |
| C-2 | 9/3/2009 | 52 | | YES-USGS | 13 |
| C-2 | 10/7/2009 | 1200 | G | YES-USGS | 1120 |
| C-2 | 11/4/2009 | 24 | | YES-USGS | 150 |
| C-2 | 12/9/2009 | 700 | JH | YES-USGS | 2660 |
| C-2 | 1/13/2010 | 5 | J | YES-USGS | 52 |
| C-2 | 2/10/2010 | 25 | | YES-USGS | 682 |

G: The actual Number is probably greater than the number reported
J: Micro: Reported microbiological result is an estimate
L: The analyte is present, but the amount of the analyte is determined to be below an acceptable level for quantitation. QC measurements indicate a high bias for the sample result reported or an accurate result cannot be calculated, but is determined to be less than the value given.
JH: The identification of the analyte is acceptable; the reported value is an estimate. The analytical holding times for analysis are exceeded.
Exceedances are highlighted in red

## 7.3 Water Quality Calculations

### Table 7-8 Point Source Summary of Existing and Allowable Loading

| Facility Name | NPDES Permit Number | Major/Minor | Conversion Factor (mL/gal.) | DMR Flow (gal./day)[a] | DMR Fecal Coliform Loading (colonies/100 mL)[b] | DMR E. Coli Loading (colonies/100 mL)[b] | Existing Load (colonies/day) | Design Flow (gal./day) | Bacterial Limit (colonies/100mL) | Allowable Load (colonies/day) | Allowable Load for TMDL(colonies/day)[g] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jefferson County Trussville WWTP | AL0022934 | Major | 3785.41 | 2.50E+06 | 260 | | 2.46E+10 | 4.00E+06 | 2000 | 3.03E+11 | 7.37E+10 |
| Jefferson County Cahaba River WWTP | AL0023027 | Major | 3785.41 | 1.03E+07 | 230 | | 1.02E+11 | 1.20E+07 | 2000 | 9.08E+11 | 2.21E+11 |
| Helena WWTP | AL0023116 | Major | 3785.41 | 1.57E+06 | 312 | | 1.85E+10 | 4.95E+06 | 2000 | 3.75E+11 | 9.13E+10 |
| Alabaster WWTP | AL0025828 | Major | 3785.41 | 3.00E+06 | 41 | 23 | 4.66E+09 | 7.60E+06 | 2000 | 5.75E+11 | 1.40E+11 |
| Hoover (Inverness) WWTP[c] | AL0025852 | Major | 3785.41 | 1.11E+06 | 1 | | 4.19E+07 | 1.00E+07 (HCR) | 2000 | 7.57E+11 | 1.84E+11 |
| Hoover (Riverchase) WWTP | AL0041653 | Major | 3785.41 | 1.32E+06 | 180 | | 1.91E+10 | 3.00E+06 | 2000 | 2.27E+11 | 5.53E+10 |
| Birmingham Riverview WWTP (CWRS) | AL0045969 | Major | 3785.41 | 2.47E+06 | 25 | | 2.67E+09 | 3.00E+06 | 2000 | 2.27E+11 | 5.53E+10 |
| Pelham WWTP | AL0054666 | Major | 3785.41 | 2.51E+06 | 177 | | 1.68E+10 | 4.00E+06 | 2000 | 3.03E+11 | 7.37E+10 |
| North Shelby County WWTP | AL0056251 | Major | 3785.41 | 2.13E+06 | 9 | 2 | 7.27E+08 | 3.00E+06 | 2000 | 2.27E+11 | 5.53E+10 |
| Jefferson County Leeds WWTP | AL0067067 | Major | 3785.41 | 1.66E+06 | | 34 | 2.14E+09 | 2.00E+06 | 487 | 3.69E+10 | 3.69E+10 |
| Liberty Park WWTP[c] | AL0067814 | Major | 3785.41 | 1.69E+06 | 56 | | 3.59E+09 | 2.0E+05 - 3.0E+06 (HCR) | 2000 | 2.27E+11 | 5.53E+10 |
| Blackjack WWTF[d] | AL0079651 | Major | 3785.41 | 0.00E+00 | 0 | 0 | 0.00E+00 | 2.00E+06 | 2000 | 1.51E+11 | 3.69E+10 |
| Lockerbie Subdivision WWTP | AL0047571 | Minor | 3785.41 | 1.40E+04 | 2 | | 1.06E+06 | 3.00E+04 | 2000 | 2.27E+09 | 5.53E+08 |
| Oak Mountain State Park | AL0050831 | Minor | 3785.41 | 3.44E+04 | 2 | | 2.60E+06 | 8.50E+04 | 2000 | 6.44E+09 | 1.57E+09 |
| Mountain Brook Senior High School | AL0050971 | Minor | 3785.41 | 2.00E+03 | 1 | | 7.57E+04 | 5.00E+04 | 2000 | 3.79E+09 | 9.22E+08 |
| Highway 411 WWTP | AL0055255 | Minor | 3785.41 | 3.71E+05 | 235 | | 3.30E+09 | 5.00E+05 | 2000 | 3.79E+10 | 9.22E+09 |
| Eastwood Mobile Home Village WWTP[e] | AL0056685 | Minor | 3785.41 | 4.90E+03 | | 240 | 4.45E+07 | 7.00E+04 | 487 | 1.29E+09 | 1.29E+09 |
| Cahaba Mobile Home Estates Lagoon | AL0057487 | Minor | 3785.41 | 2.60E+04 | | 31 | 3.05E+07 | 3.90E+04 | 487 | 7.19E+08 | 7.19E+08 |
| Our Lady of the Angels Monastery | AL0057681 | Minor | 3785.41 | 2.40E+03 | 4 | | 3.63E+05 | 2.00E+04 | 2000 | 1.51E+09 | 3.69E+08 |
| Caldwell Mill Water Reclamation System | AL0063088 | Minor | 3785.41 | 3.06E+04 | 2 | | 2.32E+06 | 9.00E+04 | 2000 | 6.81E+09 | 1.66E+09 |
| Margaret WWTP | AL0078204 | Minor | 3785.41 | 2.89E+04 | 2 | | 2.19E+06 | 5.00E+05 | 2000 | 3.79E+10 | 9.22E+09 |
| Irondale WWTF[e] | AL0078395 | Minor | 3785.41 | 0.00E+00 | 0 | 0 | 0.00E+00 | 5.00E+05 | 2000 | 3.79E+10 | 9.22E+09 |
| Fox Valley Apartments Lagoon | AL0054330 | Minor | 3785.41 | 3.70E+04 | | 7 | 9.80E+06 | 2.60E+04 | 487 | 4.79E+08 | 4.79E+08 |
| | | | | | | Total: | 1.96E+11 [f] | | Total: | 4.42E+12 [f] | 1.11E+12 |

a. Monthly average flow from September 2011 DMRs was used for DMR Flows unless otherwise noted
b. Daily Maximum Bacterial load from September 2011 DMRs was used for DMR Bacterial Loadings
c. Hoover (Inverness) WWTP and Liberty Park WWTP both have hydraulically-controlled release permits; therefore the max allowed discharge will be used in calculating allowable loading
d. Construction of Blackjack WWTF has not been completed therefore no discharge has been reported
e. Eastwood Mobile Home Village WWTP will be transferring its flow to Irondale WWTF as soon as the Irondale WWTF is complete
f. Units are fecal coliform col./day. Facilities with only E. coli measurements have been omitted from the totals in order to keep correct units. This allowable loading shows no reduction necessary.
g. The units for the Allowable Load for TMDL are E. coli col./day and are based off of the E. coli single sample criteria of 487 col./100mL. This number will be used in the TMDL calculation.

## 7.4 Cahaba River Watershed Photos

**Photo 7-1 C-3 Looking Upstream**

**Photo 7-2 C-3 Looking Downstream**

**Photo 7-3 CAHS-1 Looking Upstream**

**Photo 7-4 CAHS-1 Looking Downstream**

**Photo 7-5 C-2 Looking Upstream**

**Photo 7-6 C-2 Looking Downstream**