Alabama Department of Environmental Management

Final

Total Maximum Daily Load (TMDL)
For
Wahalak Creek
Assessment Unit ID # AL03160201-0904-101
Pathogens (E. coli)

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

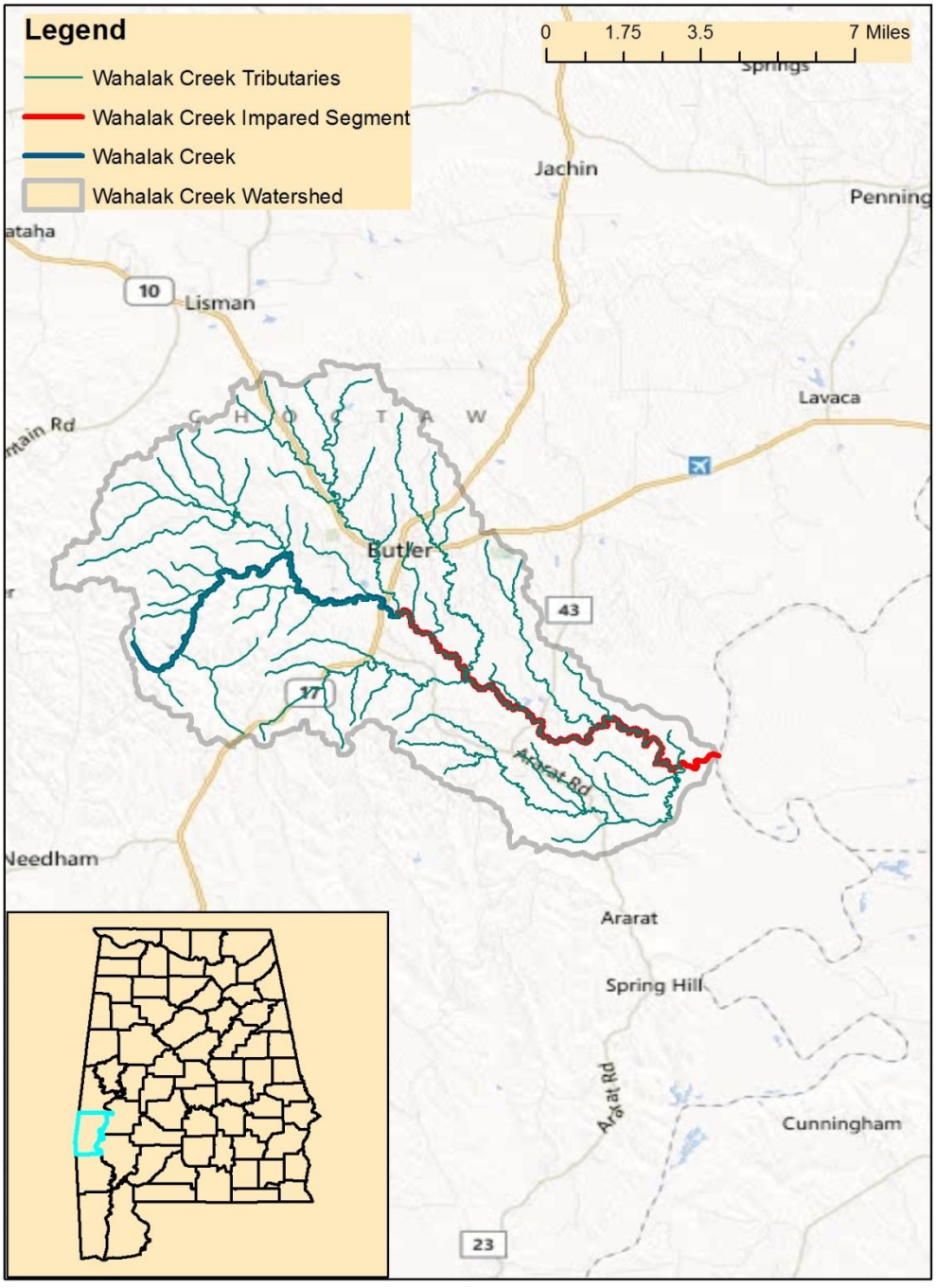

Figure 1: Wahalak Creek Watershed

Contents

List of Figures

List of Tables

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).

Wahalak Creek is on the §303(d) list for pathogens from the Tombigbee River to Spear Creek, which is located near the Town of Butler, Alabama. Wahalak Creek forms in Choctaw County and is included in the Lower Tombigbee River Basin. The stream forms northwest of the Town of Butler and flows southeast for approximately 29 miles until it empties into the Tombigbee River. The total drainage area for the Wahalak Creek watershed is 70.2 square miles. The primary use classification for Wahalak Creek is Fish & Wildlife.

Wahalak Creek was first listed on the §303(d) list in 2006 based on data collected in 2001 by the Alabama Department of Environmental Management (ADEM) which indicated the stream was impaired for fecal coliform. Wahalak Creek was initially sampled in 2001 and was found to exceed the fecal coliform water quality criteria. The exceedances were found at stations WHKC-1. The pathogen indicator was changed in December 2009 to Escherichia coli (E. coli). Due to this change, the creek was sampled in 2011 for E. coli, which will be the basis for this TMDL.

In 2011, §303(d) sampling studies were performed by ADEM on Wahalak Creek to further assess the water quality of the impaired stream. For purposes of this TMDL, the 2011 data will be used to assess the water quality of Wahalak Creek because it is the most current data and provides the best picture of the current water quality conditions of the stream. 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 from E. coli data collected at station COFC-8 in 2011; even though the 2001 data that prompted the listing of Wahalak Creek was based on the fecal coliform criteria. The 2011 bacterial data is listed in Appendix 7.2 for reference. ADEM collected 34 samples from Wahalak Creek in 2011. According to the data collected in 2011, Wahalak Creek was not meeting the pathogen criterion applicable to its use classification of Fish and Wildlife. Therefore, a TMDL will be developed for pathogens (E. coli) for Wahalak Creek.

A mass balance approach was used for calculating the pathogen TMDL for Wahalak Creek. The mass balance approach utilizes the conservation of mass principle. Existing loads were calculated by multiplying the E. coli concentrations times 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 613.1

colonies/100 mL measured on 7/28/2011 at COFC-8. This violation calls for a reduction of 28%. There was also a geometric mean violation of 147.9 colonies/100 mL. This violation resulted in a reduction of only 23%, and therefore will have no bearing in this TMDL document. 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).

An E. coli concentration of 613.1 colonies/100 mL was measured on 7/28/2011 with a stream flow of 18.6 cubic feet per second (cfs) being estimated by taking the ratio of drainage areas at station COFC-8 and station WHKC-2 and multiplying by a flow measurement taken at WHKC-2 during the same week. The estimate was necessary due to station COFC-8 being an embayment station where flow was not taken.

The existing pathogen loading for this TMDL was calculated using the single sample exceedance concentration of 613.1 colonies/100 mL that was collected by ADEM on 7/28/2011. The allowable loading, defined by the single sample criterion including a margin of safety, was calculated using the same flow value times the E. coli single sample target of 438.3 colonies/100 mL. The reduction required to meet the allowable loading was then calculated by subtracting the allowable loading from the existing loading.

Table 1-1 is a summary of the estimated existing load, allowable load, and percent reduction for the single sample criterion. Table 1-2 lists the TMDL defined as the maximum allowable E. coli loading under critical conditions (June-September) for Wahalak Creek. Using critical conditions for the TMDL development will ensure that water quality is maintained throughout the year.

Table 1: E. coli Loads and Required Reductions

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Nonpoint Source Load Single Sample	2.79E+11	2.00E+11	7.90E+10	28%
Point Source Load	1.73E+10	5.36E+10	0	0%

Table 2: E. coli TMDL for Wahalak Creek

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)
2.76E+11	2.22E+10	5.36E+10	NA	0	2.00E+11	28%

a. There are no CAFOs in the Wahalak Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum. Future WWTPs must meet the applicable in-stream water quality criteria for E. coli at the point of discharge.
c. NA = not applicable, no regulated MS4 areas. 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 zero 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.

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 Wahalak Creek 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).

The State of Alabama has identified the 14.83 mile reach of Wahalak Creek as impaired for pathogens. The §303(d) listing was originally reported on Alabama's 2006 List of Impaired Waters based on ADEM data collected in 2001 and subsequently included on the 2008, 2010, and 2012 lists. The source of the impairment is listed on the 2010 §303(d) list as Municipal Urban Runoff/Storm Sewers.

2.2 Problem Definition

Waterbody Impaired:	Wahalak Creek – Tombigbee River to Spear Creek
Impaired Reach Length:	14.83 miles
Impaired Drainage Area:	70.2 square miles
Water Quality Standard Violation:	Pathogens (Single Sample Max, E. coli)
Pollutant of Concern:	Pathogens (E.coli)
Water Use Classification:	Fish and Wildlife

Usage Related to Classification:
The impaired stream segment is 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).

(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.

E. coli Criterion:
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.

Criteria Exceeded:

The original listing of Wahalak Creek, according to the 2006 §303(d) list fact sheet, was due to violations of the fecal coliform criteria detected at station WHKC-1 during 2001 as part of the ADEM 303(d) monitoring program.

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 was 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 station COFC-8 in 2011; even though the 2001 data that prompted the listing of Wahalak Creek was based on the fecal coliform criteria.

For the purpose of this TMDL a single sample maximum E. coli target of 438.3 colonies/100 mL will be used. This target was derived by using a 10% explicit margin of safety from the single sample summer season sample maximum of 487 colonies/100 mL criterion. This target is considered protective of water quality standards and should not allow the geometric mean maximum of 126 colonies/100 mL (June-September F&W criteria) to be exceeded.

3.2 Source Assessment

3.2.1 Point Sources in the Wahalak Creek 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.

Continuous Point Sources

There is currently one NPDES permitted facility in the Wahalak Creek watershed. Butler WWTP (HCR Lagoon and Land Application), which is in the middle portion of the Wahalak Creek watershed, discharges to Wahalak Creek downstream from station WHKC-2. One E. coli violation has occurred downstream of this facility. Also, according to discharge monitoring reports (DMRs) since April of 2010, five pathogen violations were reported at the Butler WWTP. The current permit for the Butler WWTP requires a daily maximum of 487 col/100ml and a monthly average of 126 col/100ml which is equal to the E. coli criteria for a Fish and Wildlife waterbody.

An analysis of the available instream data does not seem to indicate that the Butler WWTP is the primary source of the pathogens problem in Wahalak Creek. Of the two water quality criteria violations, one occurred upstream of the WWTP and the other occurred several miles downstream from the facility. Meanwhile no water quality violations for pathogens have been recorded at the monitoring station located closer to the WWTP, namely station WHKC-1. While there have been some permit violations at the WWTP, it does not appear to be the primary source of pathogens to the Wahalak Creek.

Any future NPDES regulated discharges that are considered by the Department to be a pathogen source will be required to meet the in-stream water quality criteria for pathogens at the point of discharge.

Table 3: Permitted NPDES dischargers in the Wahalak Creek Watershed

Type	NPDES #	Facility Name	Stream	Flow (MGD)
Municipal	AL0050211	Butler WWTP HCR Lagoon and Land Application	Wahalak Creek	0.417

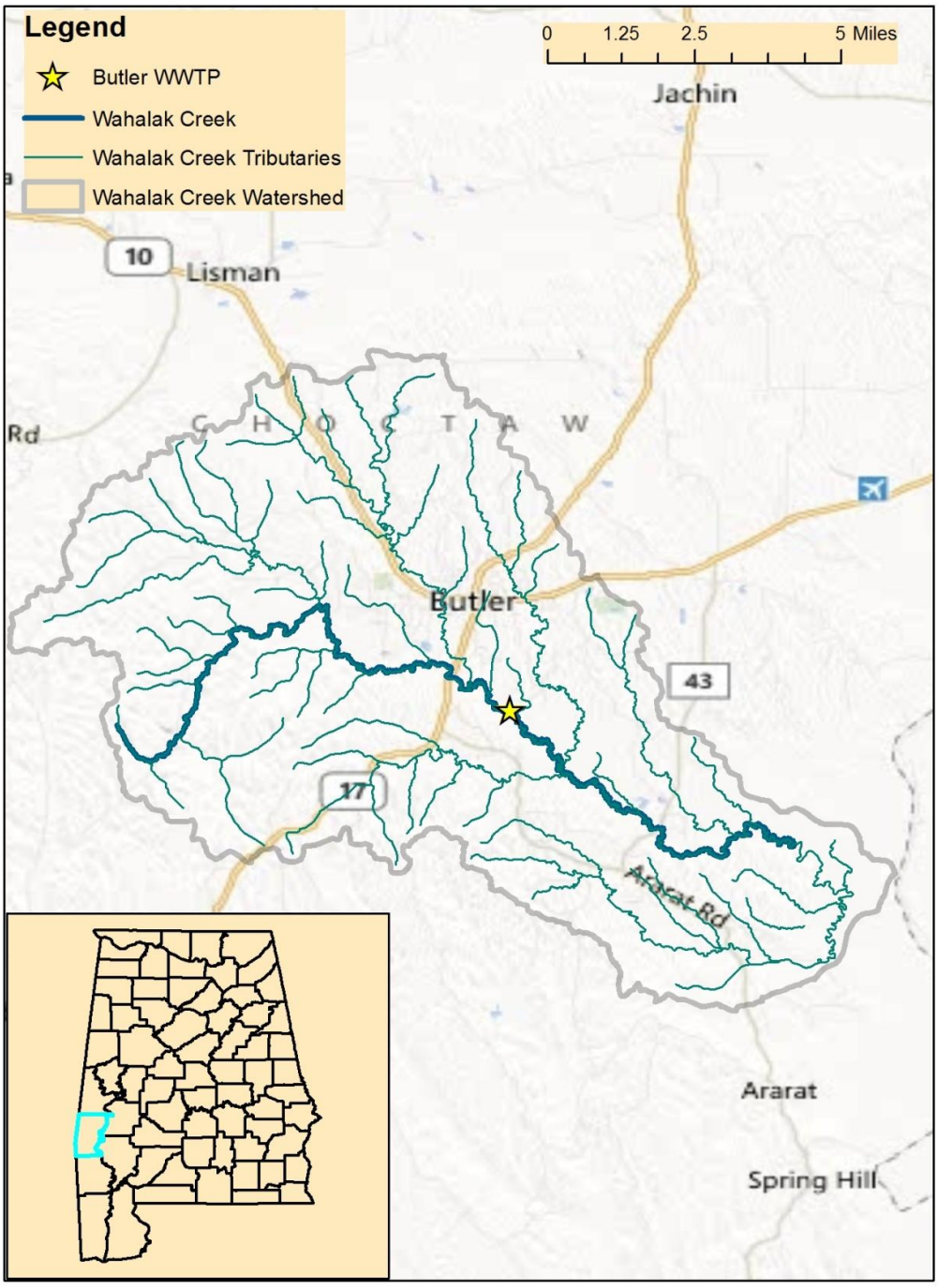

Figure 2: NPDES Permitted Dischargers in the Wahalak Creek Watershed

Non-Continuous Point Sources

Currently, there are no Municipal Separate Stormwater Sewer System (MS4) areas located within the Wahalak Creek watershed. Future NPDES regulated stormwater discharges will be required to demonstrate consistency with the assumptions and requirements of this TMDL.

Sanitary sewer overflows (SSOs) have the potential to severely impact water quality and can often result in the violation of water quality standards. It is the responsibility of the NPDES wastewater discharger or collection system operator for non-permitted "collection only" systems to ensure that releases do not occur. Unfortunately, releases to surface waters from SSOs are not always preventable or reported. From review of ADEM SSO files it was found that Butler Lagoon has not reported any SSOs since 2005 and only reported five incidents prior to 2005.

3.2.2 Nonpoint Sources in the Wahalak Creek 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.

Due to the absence and location of major point sources in the Wahalak Creek watershed, nonpoint sources are believed to be the primary source of E. coli bacteria. Land use in this watershed is primarily agriculture and forest. Approximate land use proportions are 4% agricultural, 72.8% forested, and 4% developed, with the remaining 20% being spread among open water, wetlands, and barren land.

Agricultural land can be a source of E. coli bacteria. Runoff from pastures, animal feeding areas, improper land application of animal wastes, and animals with direct access to streams is all mechanisms that can contribute E. coli bacteria to waterbodies.

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

E. coli loading from urban areas is potentially attributable to multiple sources including storm water runoff, unpermitted discharges of wastewater, runoff from improper disposal of waste materials, failing septic tanks, and domestic animals. On-site 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 due to system failures and malfunctions.

3.3 Land Use Assessment

Land use for the Wahalak Creek watershed was determined using ArcMap with land use datasets derived from the 2006 National Land Cover Dataset (NLCD). Figure 3 displays the land use areas for the Wahalak Creek watershed. Table 4 depicts the primary land uses in the Wahalak Creek watershed.

The vast majority of the Wahalak Creek watershed is forested. There is little agricultural activity in the Wahalak Creek watershed, comprising less than 3% of the land. The remaining land use being approximately 3.9% developed. Developed land includes both commercial and residential land uses and is mostly contained within the Town of Butler. The remaining 20% of the land is classified as other and includes grasslands, wetlands, and scrub. Because 93% of the watershed is not developed or farmed, it is unlikely that those uses are contributing significantly to the impairment. On-site 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 due to system failures and malfunctions.

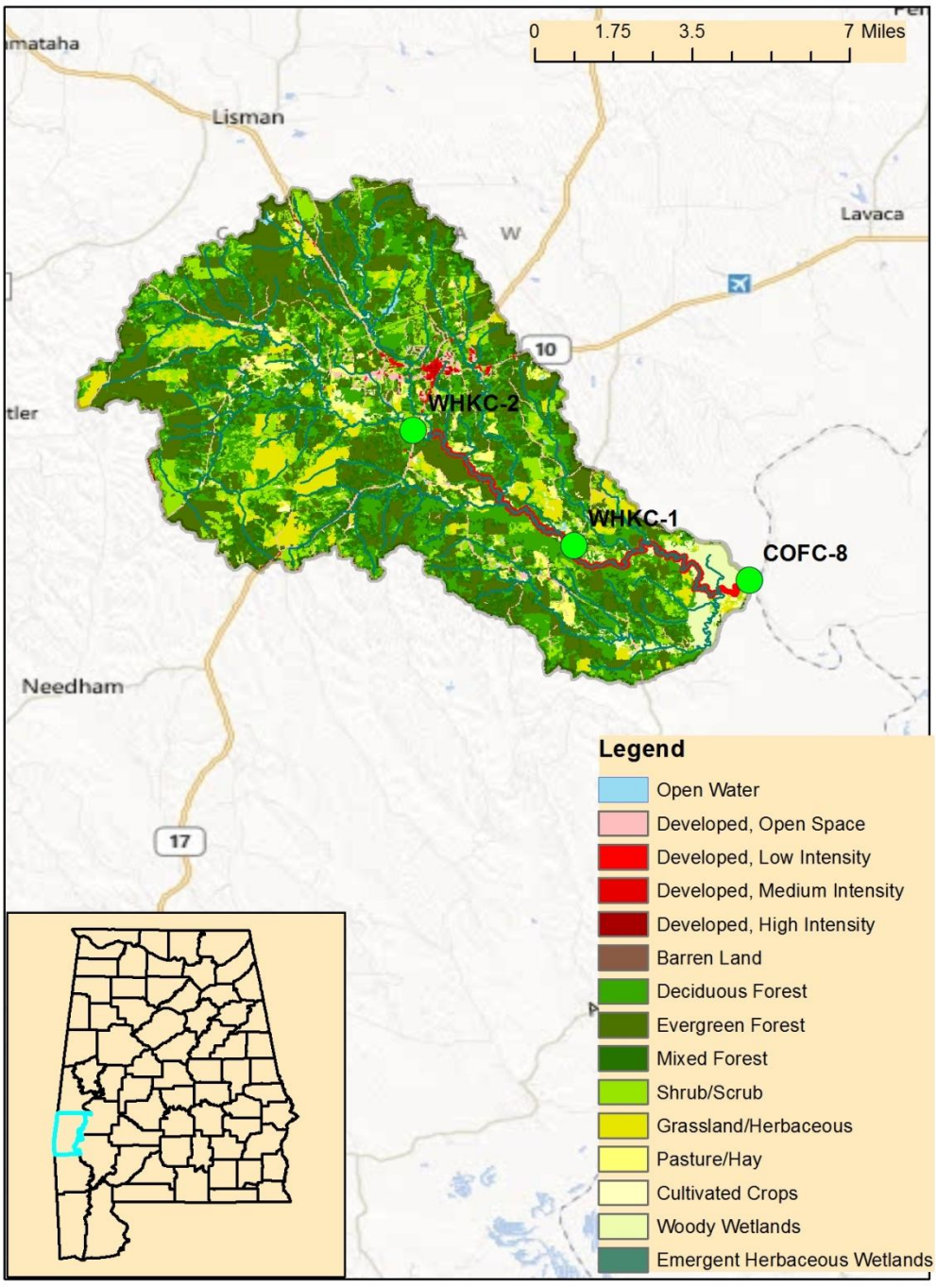

Figure 3: Land Use for the Wahalak Creek Watershed

Table 4: Land Use in the Wahalak Creek Watershed

Land Use	Percent
Open Water	0.45%
Developed, Open Space	3.42%
Developed, Low Intensity	0.28%
Developed, Medium Intensity	0.19%
Developed, High Intensity	0.04%
Deciduous Forest	0.04%
Evergreen Forest	26.18%
Mixed Forest	25.36%
Shrub/Scrub	16.35%
Grassland/Herbaceous	13.30%
Pasture/Hay	6.22%
Cultivated Crops	2.42%
Woody Wetlands	0.31%
Emergent Herbaceous Wetland	5.42%
Total	**100.00%**
Cumulative Land Use	
Developed	3.94%
Forested	73.31%
Agriculture	2.73%
Other	20.03%
Total	**100.00%**

3.4 Linkage Between Numeric Targets and Sources

The Wahalak Creek watershed has three main land uses, namely agriculture, forest, and developed. Pollutant loadings from forested areas tend to be low due to their filtering capabilities and will be considered as background conditions. The most likely sources of pathogen loadings in the Wahalak Creek watershed are from the agricultural land uses and failing septic systems. It is not considered a logical approach to calculate individual components for nonpoint source loadings. Hence, there will not be individual loads or reductions calculated for the various nonpoint sources. The loadings and reductions will only be calculated as a single total nonpoint source load and reduction.

3.5 Data Availability and Analysis

ADEM collected monthly water quality data for Wahalak Creek at 3 stations along the impaired water body in 2011, from which 34 samples were collected. Of the 34 samples 13 were taken at station WHKC-1, with no violations detected. Additionally ten of those samples were part of two intensive survey events. Neither of these intensive surveys detected E. coli concentrations greater than the geometric mean criteria.

Eight samples were taken at station COFC-8, where there was one single sample violation. An E. coli concentration of 613.1 colonies/100 mL was measured on July 28, 2011. No flow was taken at this time, as this is an embayment station where Wahalak Creek meets the Tombigbee River. No other violations occurred at this station. Since no flow was measured on the day of this exceedance, a flow was estimated utilizing the ratio method with a flow taken at another station on Wahalak creek. This flow was used in conjunction with the exceedance concentration to determine an accurate mass loading.

At station WHKC-2, 13 single samples were taken. None of these single samples exceeded the single sample criteria for E. coli. Additionally ten of those samples were part of two intensive survey events. The geometric mean criterion for E. coli, 126 colonies/100 mL for summer months, was exceeded. This exceedance occurred between August 22nd and September 14th of 2011. A geometric mean of 147.9 colonies/100 mL was recorded at the station, but did not require as high of a percent reduction that the single sample violation did.

Table 5: E. coli Single Sample Maximum Violations on Wahalak Creek

Station	Date	E.coli col/100mL	Flow (cfs)	Flow measured (?)
COFC-8	11/28/12	613.1		Not requested for embayment stations.

Table 6: E. coli Geometric Mean Violations on Wahalak Creek

Station	Violation	E.coli col/100mL	Date Range
WHKC-2	GEOMETRIC MEAN =	147.9	8/22/2011-9/14/2011

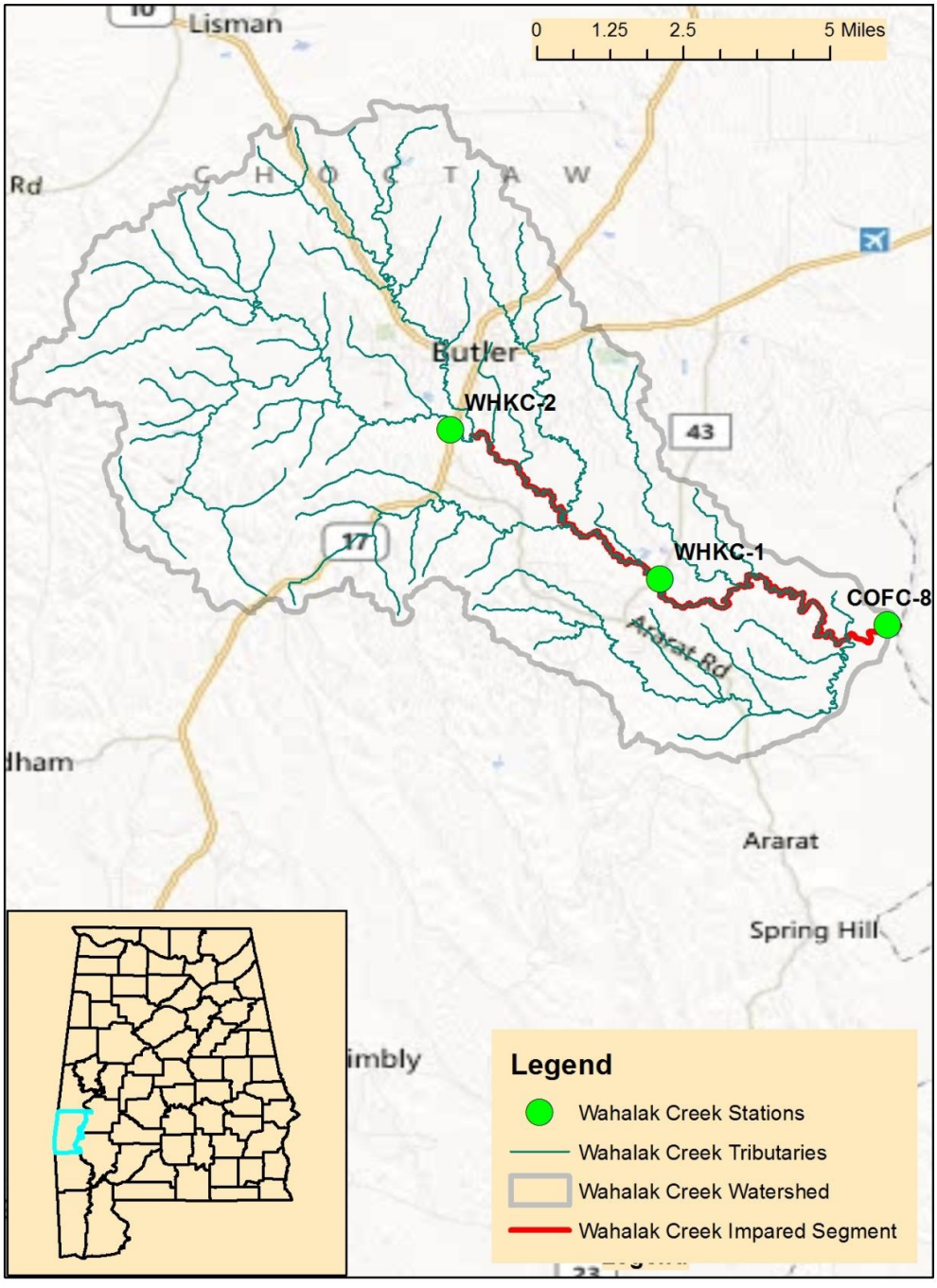

Figure 4: ADEM Sampling Stations on Wahalak Creek

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 Wahalak Creek 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 613.1 colonies/100 mL and occurred on July 28, 2011 at station COFC-8. A flow of 18.6 cfs was estimated for COFC-8 at the time of the sample collection.

3.7 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the TMDL 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 was 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 E. coli target geometric mean 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 series of E. coli concentrations that were 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 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 E. coli TMDL for Wahalak Creek. The mass balance approach utilizes the conservation of mass principle. Total mass loads can be calculated by multiplying the E. coli concentration and the estimated in-stream flow together. The existing load was calculated for the violation in 2011 that gave the highest percent reduction. This violation was a single sample exceedance. In the same manner, the allowable load was calculated for the single sample criterion of 438.3 colonies/100 mL. Although there was a geometric mean violation in 2011, the TMDL was based on the highest calculated E. coli load percent reduction to achieve applicable water quality criteria.

Existing Conditions

The **single sample** mass loading was calculated by multiplying the E. coli single sample exceedance concentration of 613.1 colonies/100 mL by the estimated flow of 18.6 cfs. This concentration was calculated based on a sample taken at COFC-8 on July 28, 2011, and a flow measurement at WHKC-2 taken on July 25, 2011. The flow estimate was calculated by taking the ratios of the drainage areas for the stations WHKC-2 and COFC-8 and multiplying by the flow measured at WHKC-2. The product of the flow estimate and the sample result, times the conversion factor gives the total mass loading (colonies per day) of E. coli to Wahalak Creek under the single sample exceedance condition.

$$\frac{70.2\text{mi}^2}{24.2\text{mi}^2} \times 6.413 cfs = 18.6 cfs$$

$$\frac{18.6\,\text{ft}^3}{\text{s}} \times \frac{613.1\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\ \ 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.79 \times 10^{11}\,\text{colonies}}{\text{day}}$$

During the month of July the Town of Butler WWTP discharged directly to Wahalak Creek as the flow was suitable under their Hydrograph Controlled Release permit, instead of utilizing their spray field. According to the DMRs submitted by the WWTP the flow through the spray field was zero, therefore no existing load can be attributed to the spray field outfall 0021. Outfall 0011, the conventional discharge point on Wahalak Creek reported a maximum and average flow rate of 4.5 cfs and an E. coli concentration 157 colonies/100mL as the result of their one monthly sample. This makes the maximum daily loading attributable to Butler WWTP as follows:

$$\frac{4.5\ ft^3}{s} * \frac{157\ colonies}{100mL} * \frac{24465755*100mL*s}{ft^3*day} = \frac{1.73x10^{10} colonies}{day}$$

Allowable Conditions

The **allowable load** to the watershed was calculated under the same physical conditions as discussed above for the single sample criterion. This is done by taking the product of the estimated flow and the allowable concentration. This value is then multiplied by the conversion factor to calculate the allowable load.

For the **single sample** E. coli concentration of 487 colonies/100 mL, the allowable E. coli loading is:

$$\frac{18.6\ ft^3}{s} \times \frac{487\ colonies}{100\,mL} \times \frac{24465755\quad 100\,mL*s}{ft^3*day} = \frac{2.22\times10^{11}\ colonies}{day}$$

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

$$\frac{18.6\,ft^3}{s} \times \frac{48.7\,colonies}{100\,mL} \times \frac{24465755\quad 100\,mL*s}{ft^3*day} = \frac{2.22\times10^{10}\ colonies}{day}$$

This gives an allowable loading of

$$\frac{2.22\times10^{11}\ colonies}{day} - \frac{2.22\times10^{10}\ colonies}{day} = \frac{2.00\times10^{11}\ colonies}{day}$$

The WLA portion of this TMDL was calculated by multiplying the design flow of Butler WWTP facility by the in-stream E. coli criteria for the summer months, June-September, of 487 colonies/100 mL. This value was then multiplied by a conversion factor to come up with the appropriate loading. This calculation results in a loading of:

$$\frac{4.5\,ft^3}{s} \times \frac{487\,colonies}{100\,mL} \times \frac{24465755\quad 100\,mL*s}{ft^3*day} = \frac{5.36\times10^{10}\ colonies}{day}$$

The difference in the pathogen loading between the existing condition (violation event) and the allowable condition 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 Wahalak Creek as evaluated at station COFC-8. Table 4-1 shows the result of the E. coli TMDL and percent reduction for the single sample criterion.

Table 7: E. coli Load and Required Reduction

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Nonpoint Source Load Single Sample	2.79E+11	2.00E+11	7.90E+10	28%
Point Source Load	1.73E+10	5.36E+10	0	0%

Compliance with the single sample criterion maximum of 487 colonies/100 mL requires and overall reduction of 28% to existing nonpoint source loads and no reduction to existing point source loads from the Butler WWTP. The TMDL, WLA, LA and MOS values necessary to achieve the applicable E. coli criterion are provided in the table below.

Table 8: E. coli TMDL for Wahalak Creek

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)
2.76E+11	2.22E+10	5.36E+10	NA	0	2.00E+11	28%

a. There are no CAFOs in the Wahalak Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as a daily maximum. Future WWTPs must meet the applicable in-stream water quality criteria for E. coli at the point of discharge.
c. NA = not applicable, no regulated MS4 areas. 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 zero 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

Wahalak Creek was placed on Alabama's §303(d) list in 2006 based on data collected by ADEM in 2001. In 2011, ADEM collected additional water quality data using the newly adopted pathogen impairment criteria, with E. coli serving as the primary pathogen indicator. The data collected by ADEM in 2011 confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the E. coli TMDL for Wahalak Creek. Based on the TMDL analysis, it was determined that a 28% reduction in E. coli loading was necessary to achieve compliance with applicable water quality standards.

Currently, Butler WWTP has E. coli limits as part of their NPDES permit that meets in stream water quality criteria. During the next permit re-issuance, no changes will be necessary to maintain compliance with current water quality standards or the conditions of this TMDL.

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 Wahalak Creek 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, ADEM's 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 9.

Table 9: 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 have requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL was made available on ADEM's Website: www.adem.state.al.us. The public can also request paper or electronic copies of the TMDL by contacting Mr. Chris Johnson at 334-271-7827 or cljohnson@adem.state.al.us. The public was given an opportunity to review the TMDL and submit comments to the Department in writing. At the end of the public review period, all written comments received during the public notice period became part of the administrative record. ADEM considered all comments received by the public prior to finalization of this TMDL and subsequent submission to EPA Region 4 for final review and approval.

7.0 Appendices

Appendix 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. 2002, 2006 & 2010. ADEM.

Alabama Department of Environmental Management (ADEM), Alabama's Water Quality Assessment and Listing Methodology, January 2010.

Alabama Department of Environmental Management, 2006 §303(d) List and Fact Sheet. ADEM.

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

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.

Appendix 7.2

ADEM Water Quality Data

Designated Use

	OAW	PWS		S	SH	F&W		LWF	A&I
		Summer	Winter			Summer	Winter		
Geometric Mean, cfu/100 ml	126	126	548	126	126	126	548	548	700
Single Sample Max, cfu/100 ml	235	487	2507	235	235	487	2507	2507	3200

winter

summer

Single sample violation

Geomean violation

Station ID	Activity Date	Flow CFS	E Coli	Geometric Mean
COFC-8	3/31/2011		2419.6	
COFC-8	5/12/2011		15.3	
COFC-8	5/25/2011		3.1	
COFC-8	6/29/2011		68.4	
COFC-8	7/28/2011		613.1	
COFC-8	8/24/2011		18.9	
COFC-8	9/28/2011		90.6	
COFC-8	10/18/2011		30.1	

Station ID	Activity Date	Flow CFS	E Coli	Geometric Mean
WHKC-1	4/6/2011		866.4	
WHKC-1	6/2/2011		17.1	
WHKC-1	6/30/2011	2.3469	115.3	120.5
WHKC-1	7/7/2011		69.1	
WHKC-1	7/14/2011	11.773	178.5	
WHKC-1	7/21/2011	3.36	58.3	
WHKC-1	7/25/2011	19.855	305.8	
WHKC-1	8/22/2011	2.007	108.6	86.1
WHKC-1	8/30/2011		110.6	
WHKC-1	9/1/2011	1.169	42.6	
WHKC-1	9/12/2011	6.957	75.4	
WHKC-1	9/14/2011	4.981	122.3	
WHKC-1	10/19/2011		124.6	

Station ID	Activity Date	Flow CFS	E Coli	Geometric Mean
WHKC-2	4/6/2011	31.303	272.3	
WHKC-2	6/2/2011	1.56	82	
WHKC-2	6/30/2011	3.0416	37.9	79.7
WHKC-2	7/7/2011	2.6	36.4	
WHKC-2	7/14/2011	3.846	178.5	
WHKC-2	7/21/2011	2.419	61.3	
WHKC-2	7/25/2011	6.413	213.4	
WHKC-2	8/22/2011	1.246	139.6	147.9
WHKC-2	8/30/2011	0.749	166.4	
WHKC-2	9/1/2011	0.756	90.6	
WHKC-2	9/12/2011	3.4	103.4	
WHKC-2	9/14/2011	2.717	325.5	
WHKC-2	10/19/2011	1.232	142.1	

Appendix 7.2

Butler HCR Lagoon and Land Application Data

Permit Number	Stage
AL0050211	EFFLUENT

Monitoring Period End Date	Parameter Name	Monthly Average col/100mL	Maximum Daily col/100mL
04/30/10	E. Coli	0	0
07/31/10	E. Coli	1300	1300
11/30/10	E. Coli	1990	1990
02/28/11	E. Coli	248	248
04/30/11	E. Coli	0	0
05/31/11	E. Coli	579	579
06/30/11	E. Coli	<1	<1
07/31/11	E. Coli	157	157
08/31/11	E. Coli	39	39
10/31/11	E. Coli	6	6
11/30/11	E. Coli	<1	<1
12/31/11	E. Coli	114	114
01/31/12	E. Coli	<1	<1
02/29/12	E. Coli	<1	<1
03/31/12	E. Coli	201	201
04/30/12	E. Coli	0	0
09/30/12	E. Coli	28	28
10/31/12	E. Coli	6	6

winter
summer
Violation

Appendix 7.4
Wahalak Creek Watershed Photos

Figure 5: WHKC-1 Looking Downstream

Figure 6: WHKC-1 Looking Upstream

Figure 7: WHKC-2 Looking Downstream

Figure 8: WHKC-2 Looking Upstream