FINAL

Total Maximum Daily Load (TMDL)
for
Hurricane Creek
Assessment Unit ID # AL03140201-0502-100
Pathogens (fecal coliform)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
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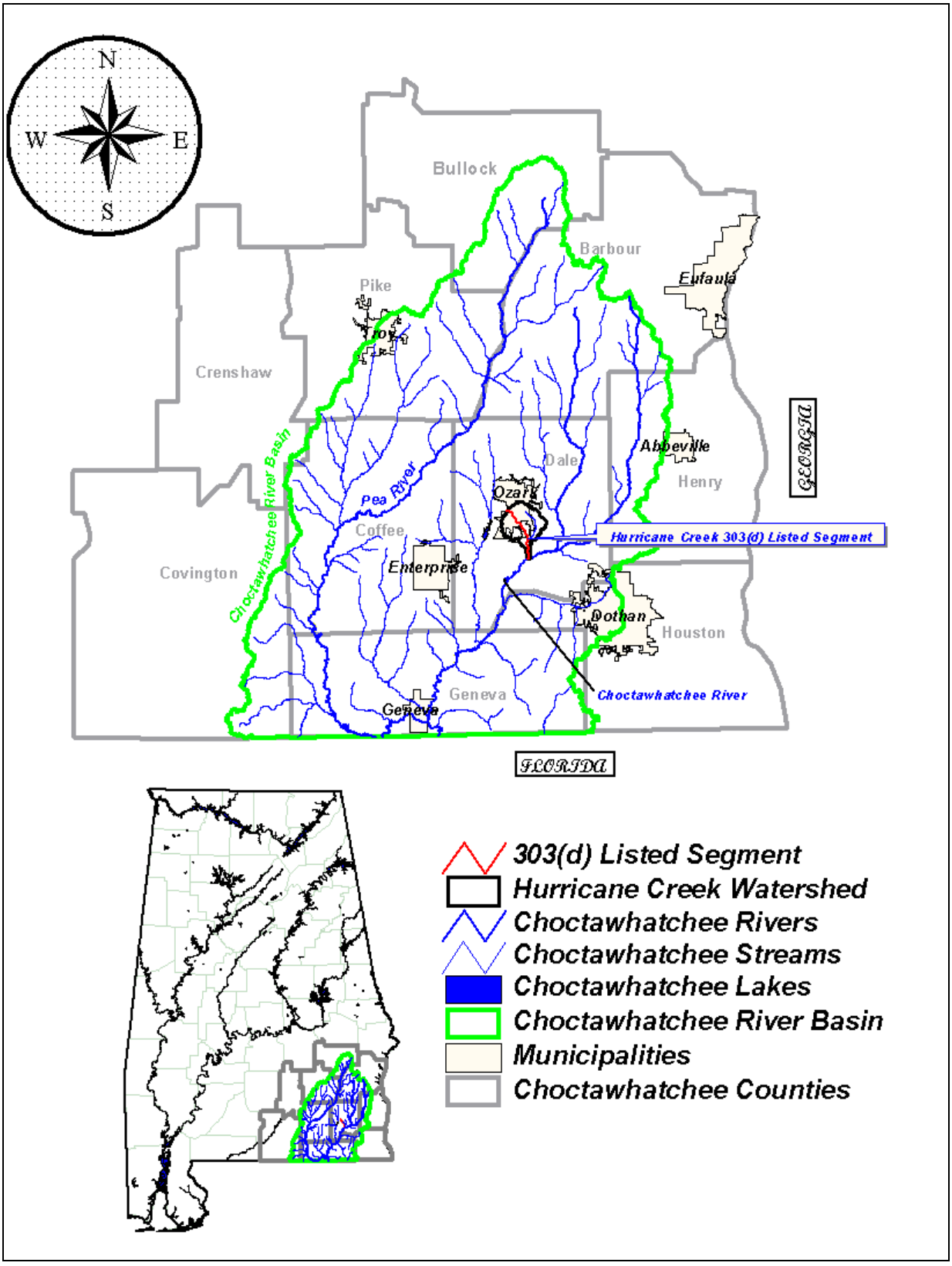
Figure 1-1. Listed Portion of Hurricane Creek in the Choctawhatchee River Basin



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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 maximum amount of pollutant a waterbody can assimilate while meeting water quality standards for the pollutant of concern. All TMDLs include a wasteload allocation (WLA) for all National Pollutant Discharge Elimination System (NPDES) regulated discharges, a load allocation (LA) for all nonpoint sources, and an explicit and/or implicit margin of safety (MOS).

Hurricane Creek is on the §303(d) list for pathogens (fecal coliform) from the Choctawhatchee River to its source. Hurricane Creek is in the Choctawhatchee River Basin and forms in central Dale county, within the city limits of Ozark. Hurricane Creek passes the mouth of Klondike Creek just before flowing into the Choctawhatchee River. The total length of Hurricane Creek is 8.56 miles, all of which is on the §303(d) list. The total drainage area of Hurricane Creek is 27 square miles. Hurricane Creek has a use classification of Fish & Wildlife (F&W).

Data collected in 1991 by the Geological Survey of Alabama (GSA) indicated to EPA that Hurricane Creek was impaired for pathogens (fecal coliform). EPA placed Hurricane Creek on the Alabama §303(d) list in 1998 for this impairment. GSA collected data from June through October 1991 for the Alabama Clean Water Strategy Water Quality Assessment Report, published by ADEM in December of 1992. A sample was taken during each month of the study, totaling five samples. The data can be found in Appendix B, Table 7-1.

In 2004, a §303(d) sampling study was performed by ADEM on Hurricane Creek for additional water quality assessment. ADEM collected 31 samples from Hurricane Creek in 2004. According to the data collected in 2004, Hurricane Creek was still not meeting the pathogen criterion applicable to its use classification of Fish and Wildlife. Therefore, a TMDL will be developed for pathogens on the listed reach.

A mass balance approach was used for calculating the pathogen TMDL for Hurricane Creek. The mass balance approach utilizes the conservation of mass principle. Loads are calculated by multiplying the fecal coliform concentrations times respective instream flows times a conversion factor. The existing (impaired) pathogen loading to Hurricane Creek was calculated using a single sample exceedance concentration times the measured flow times a conversion factor. The single sample criterion was used because it yielded a greater reduction than the geomean criterion. The allowable loading, defined as the single sample criterion including margin of safety, was calculated using the exceedance flow value times the fecal coliform single sample allowable concentration of 1800 colonies/100 mL (2000 colonies/100 mL – 10% Margin of Safety) times a conversion factor. Reductions to meet the allowable loading were then calculated by subtracting the allowable loading from the current loading.

Table 1.1 is a summary of estimated existing loads and allowable loads required to meet the applicable water quality pathogen single sample criterion for Hurricane Creek. Table 1.2 lists the TMDL (maximum allowable) pathogen loadings under critical conditions for Hurricane Creek.

Table 1-1. Fecal Coliform Loads and Required Reductions

Source	Existing Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %
NPS load	1.22E+13	5.35E+12	6.85E+12	56%
Point Source	1.59E+10	1.59E+10	0.00E+00	0%

Table 1-2. Fecal Coliform TMDL and Percent Reductions for Hurricane Creek

TMDL	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation(LA)	
		WWTPs[b]	MS4s[c]	Leaking Collection Systems[d]		
(colonies/day)	(colonies/day)	(colonies/day)	(% reduction)	(colonies/day)	(colonies/day)	(% reduction)
5.96E+12	5.96E+11	1.59E+10	NA	0	5.35E+12	56%

a. There are no CAFOs in the Hurricane Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs expressed as fecal coliform loads (colonies/day). Future WWTPs must meet instream water quality criteria at the point of discharge as specified in their NPDES permits**.**
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 0 colonies/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in fecal coliform loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for fecal coliform.

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

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

2.0 Basis for §303(d) Listing

2.1 Introduction

Section §303(d) of the Clean Water Act 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 instream 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 8.56 miles of Hurricane Creek as impaired for pathogens. The §303(d) listing was originally reported on Alabama's 1998 List of Impaired Waters based on a 1991 study.

2.2 Problem Definition

Waterbody Impaired:	Hurricane Creek from Choctawhatchee River to its source
Impaired Reach:	8.56 miles
Impaired Drainage Area:	27 square miles
Water Quality Standard Violation:	Fecal Coliform (Pathogens)
Water Use Classification:	Fish and Wildlife

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

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

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

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

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

Fecal Coliform Criterion:

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

7. Bacteria:

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

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

Criterion Exceeded:

Water quality data collected by GSA in 1991 was used by EPA Region 4 for listing Hurricane Creek on Alabama's 1998 §303(d) list. The fecal coliform criterion, which EPA indicated that Hurricane Creek exceeded in 1991, was the incidental water contact and recreational swimming geometric mean from June through September of 200 col/100 ml. Of the five samples collected, one of the samples was collected in October and GSA therefore excluded it from the geometric mean calculation. The four remaining samples were calculated by GSA and resulted in a geometric mean of 712.7 col/100 ml.

The ADEM §303(d) monitoring program data collected in 2004 resulted in exceedances both of the single sample maximum criterion of 2000 col/100 ml and the incidental water contact and recreational swimming geometric mean criterion from June through September of 200 col/100 ml. There were three single sample maximum exceedances of 2,820 col/100 mL, 4,100 col/100 ml, and 2,200 col/100 mL, and there were two geometric mean exceedances of 228 col/100 ml and 309 col/100 mL. This data can be viewed in Appendix B, Table 7.2.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

The loadings and reductions were calculated for all exceedances reported in 2004. The highest single sample exceedance will be used for the purpose of this TMDL as it yielded the greatest

reduction and will be more protective of the use of F&W. The single sample fecal coliform allowable concentration of 1800 colonies/100 mL will be used. This allowable concentration was derived by using the single sample criterion of 2000 colonies/100 mL and a 10% (200 colonies/100 ml) explicit margin of safety. This allowable concentartion is considered protective of water quality standards and should not allow the geometric mean of 200 colonies/100 mL (June – September), the geometric mean of 1000 col/ 100 ml (October – May), or the single sample maximum of 2000 colonies/100 mL to be exceeded.

3.2 Source Assessment

3.2.1 Point Sources in the Hurricane Creek Watershed

Continuous Point Sources

A point source is defined as any discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. The NPDES program regulates point source discharges. Point sources can be described by two broad categories: 1) NPDES regulated municipal and industrial wastewater treatment facilities; and 2) NPDES regulated industrial activities and MS4 discharges. The only point source in the Hurricane Creek watershed is a continuous municipal wastewater treatment plant (WWTP), Ozark Southside WWTP. The Ozark Southside WWTP (AL 0056324) discharges to Klondike Creek which is a tributary to Hurricane Creek. This facility has seasonal fecal coliform permit limits equivalent to water quality criteria. From June through September, the permit limits the WWTP to a fecal coliform limit of 200 counts/100mL on a monthly average. From October through May, the permit limits the WWTP to a fecal coliform limit of 1000 counts/100mL on a monthly average. The annual maximum fecal coliform permit limit is 2000 counts/100mL. Effluent discharges at or below the water quality criterion do not cause or contribute to water quality impairment. Therefore, the required reduction for the point sources was determined to be zero, and the 56% reduction in pathogens (fecal coliform) was allocated to the LA portion of the TMDL. Future continuous discharge facilities located in the Hurricane Creek watershed should not discharge wastewater at concentrations exceeding the water quality criterion.

The Discharge Monthly Report (DMR) data received from Ozark Southside WWTP was reviewed for fecal coliform violations. In 2004, Ozark reported compliance with the permitted fecal coliform limitations with the exception of two violation events. In January of 2004, there was a single sample maximum violation of 5,000 col/100 mL which was attributed to a contaminated sample bottle. In November of 2004, there was a single sample maximum violation of 2,800 col/100 mL which was indicated to be due to high TSS values in the effluent from sloughing off of denitrification towers. The majority of the DMR data show Ozark Southside WWTP to be operating well within their permitted fecal coliform limits. However, in July of 2006, the Environmental Protection Agency performed a Performance Audit Inspection (PAI) that was deemed unsatisfactory. The main area of interest for this TMDL was laboratory deficiencies in regard to fecal coliform. Also, Alabama Water Watch data has indicated high levels of bacteria below Ozark Southside WWTP. Considering the EPA PAI and citizen monitoring, Ozark Southside WWTP should be considered a potential source of impairment if they discharge fecal coliform concentrations greater than allowed by their NPDES permit.

Non-Continuous Point Sources

The Hurricane Creek watershed does not lie within a qualified Municipal Separate Stormwater Sewer System (MS4) area, therefore a WLA is not applicable. In determining what point sources were in the watershed, concentrated animal feeding operations (CAFOs) were also considered but none were identified. All future NPDES regulated non-continuous 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. From review of ADEM's SSO database, eight reported SSOs have occurred in the impaired portion of the Hurricane Creek watershed between 2004 and 2009

3.2.2 Nonpoint Sources in the Hurricane Watershed

Nonpoint sources are believed to be the most significant source of fecal coliform bacteria in the Hurricane Creek watershed. Land use in this watershed is highly forested, consisting of 66% forest. Developed land accounts for 18% and agriculture 12%. The following are examples of how different land uses can contribute to fecal coliform bacterial loading:

- Agricultural land can be a source of fecal coliform bacteria due to runoff from pastures, animal operations, improper land application of animal wastes, and animals with access to streams. These mechanisms can significantly contribute to the loading of fecal coliform bacteria.

- Forested areas can be a source of fecal coliform bacteria due to the presence of wild animals such as deer, raccoons, turkeys, beavers, waterfowl, etc. Control of these sources is usually limited and may be impractical in most cases. As a result, forested areas are not specifically targeted in this TMDL.

- Developed land can be a source of fecal coliform bacteria due to storm water runoff, illicit discharges of wastewater, runoff from improper disposal of waste materials, failing septic tanks, and domestic animals. Illicit discharges refers to non permitted facilities or individuals discharging wastewater through storm drains or directly to the waterbody.

3.3 Land Use Assessment

Land uses for the Hurricane Creek watershed were determined using ArcView. The land use datasets were derived from the 2001 National Land Cover Dataset (NLCD). Figure 3-1 displays land use areas and Table 3-1 displays land use categories and grouped land uses.

Figure 3-1. Land Use Map for the Hurricane Creek Watershed

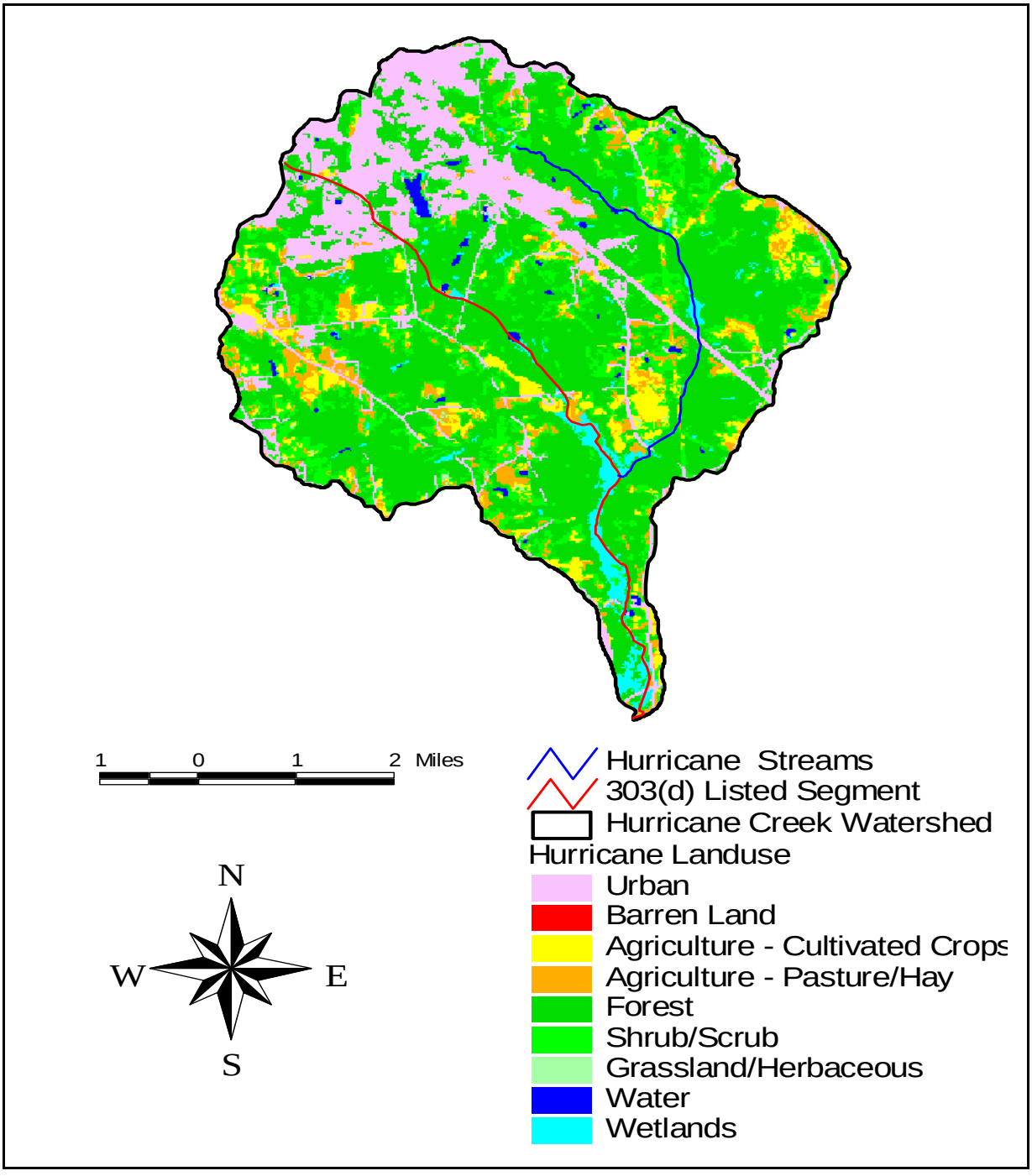

Table 3-1. Land Use Areas for the Hurricane Creek Watershed

Land Use	Acres	Sq. Miles	Percentages
Open Water	1430	0	1
Low Intensity Residential	18232	3	11
High Intensity Residential	8762	1	5
High Intensity Commercial	3182	0	2
Developed	1034	0	1
Deciduous Forest	25406	4	15
Evergreen Forest	48192	8	28
Mixed Forest	12343	2	7
Evergreen Shrubland	27723	4	16
Grassland/Herbaceous	558	0	0
Pasture/Hay	10508	2	6
Row Crops	11115	2	6
Wetlands	4904	1	3
Total	**173389**	**27**	**100**

Grouped Landuses	Acres	Sq. Miles	Percentages
Agriculture	21623	3	12
Forest	113664	18	66
Developed	31210	5	18
Other	6892	1	4
Total	**173389**	**27**	**100**

3.4 Linkage Between Numeric Targets and Sources

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 Hurricane Creek are from the agricultural, developed land uses, and point source. Individual loads and reductions will not be calculated for the range of nonpoint sources, but rather, the loadings and reductions will be calculated as a single total nonpoint source load and reduction.

3.5 Data Availability and Analysis

GSA collected monthly water quality data for Hurricane Creek at CR 5 during June through October in 1991. Of the five samples taken, only the samples from June through September were used by GSA to calculate a geomean. The calculated geometric mean resulted in EPA placing Hurricane Creek on the 1998 §303(d) list. This data can be viewed in Appendix B, Table 7.1.

ADEM collected water quality data on Hurricane Creek in 2004 as part of ADEM's §303(d) Monitoring Program at Station HURD-1 and HURD-2, at CR 21 and Harry Walker Road, respectively. Figure 3-2 and Table 3-3 display locations and list descriptions for the GSA and ADEM stations. During the 2004 study, thirty-one samples were collected. Of the fecal coliform samples collected in 2004, there were exceedances both of the single sample maximum criterion

of 2000 col/100 ml and the incidental water contact and recreational swimming geometric mean criterion from June through September of 200 col/100 ml. There were three single sample maximum exceedances of 2,820 col/100 mL, 4,100 col/100 ml, and 2,200 col/100 mL and there were two geometric mean exceedances of 228 col/100 ml and 309 col/100 mL. The necessary flow data to calculate loading for Hurricane Creek could not collected due to the stream being too deep or no visible flow. Therefore, flow data for Hurricane Creek was calculated using the ratio method with Klondike Creek flow data. Klondike Creek is in the same 12-digit HUC as Hurricane Creek and was sampled on the same schedule as Hurricane Creek. This data can be viewed in Appendix B, Table 7.2 and Table 7.3.

Figure 3-2. Map of ADEM and TVA Sampling Stations on Hurricane Creek

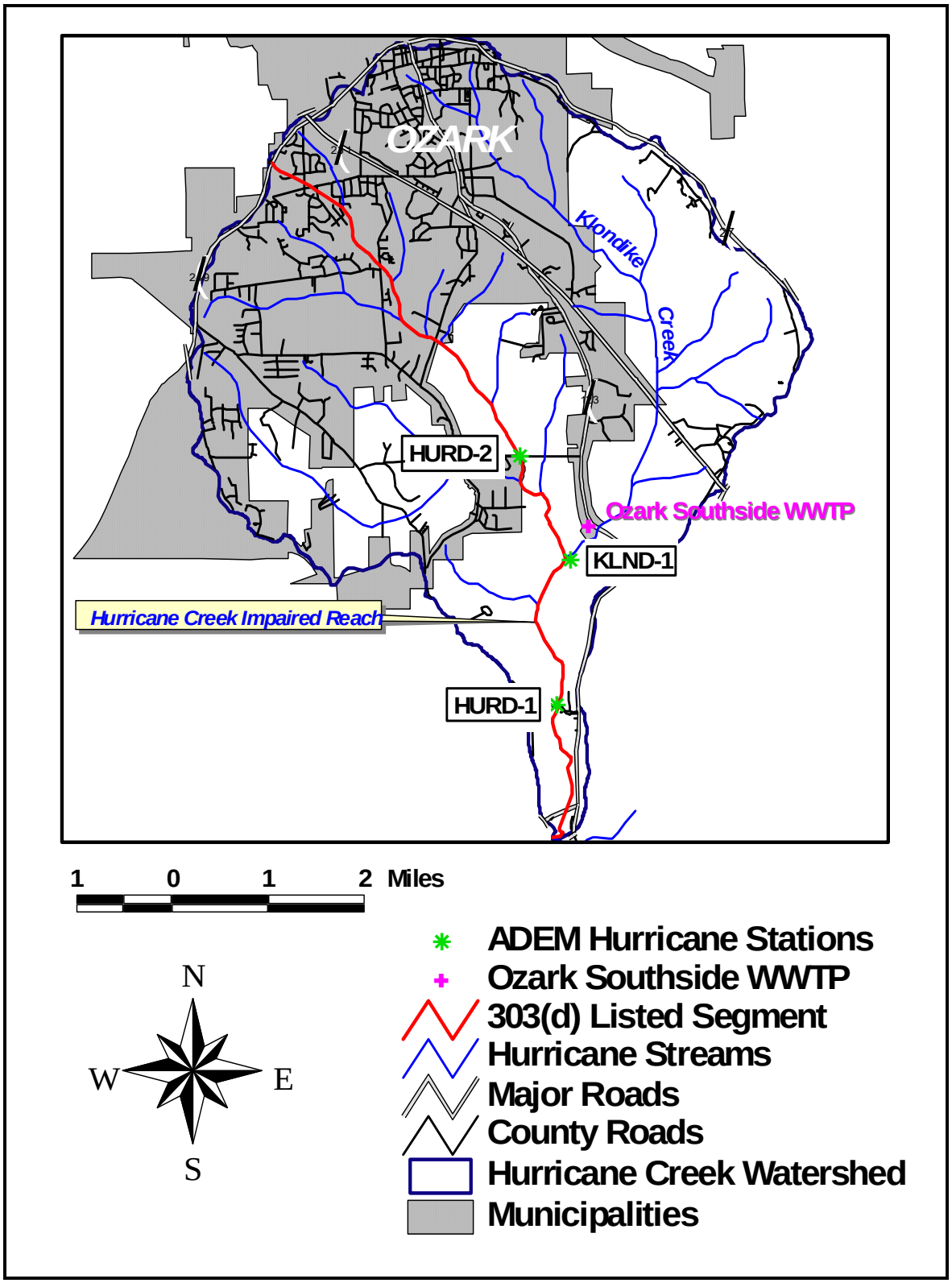

Table 3-3. Hurricane Creek Sampling Station Descriptions

Years	Station ID	Data Source	Station Location	Latitude	Longitude
1991, 2004	GSA Station HURD-2	GSA ADEM	Hurricane Creek @ Harry Walker Road	31.39895	-85.62181
2004	HURD-1	ADEM	Hurricane Creek @ C.R. 21	31.36309	-85.61576
2004	KLND-1	ADEM	Klondike Creek approx 0.3 miles downstream of WWTP	31.38425	-85.61295

3.6 Critical Conditions

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

The data collected by ADEM in 2004 in the Hurricane Creek watershed follows this trend. The single sample exceedance values were accompanied by an increase in flow.

3.7 Margin of Safety

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

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

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). As discussed earlier, the MOS is explicit in this TMDL.

A TMDL can be denoted by the equation:

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody while achieving water quality standards under critical conditions.

For some pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). However, for pathogens, TMDL loads are typically expressed in terms of organism counts per day (colonies/day), in accordance with 40 CFR 130.2(i).

4.2 Load Calculations

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

Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest single sample exceedance concentration of 4,100 colonies/100 ml times the estimated flow for that day. This concentration was calculated based on measurements at HURD-1 on 10/20/2004 and can be found in Table 7-1, Appendix B. The estimated stream flow, determined by the drainage area ratio of stream flows estimated from ADEM data collected at Klondike Creek, for that sampling event was 121.8 cfs. The product of these two values and a conversion factor gives the total mass loading (colonies per day) of fecal coliform to Hurricane Creek under a single sample exceedance conditions.

$$\frac{121.8\,\text{ft}^3}{\text{s}} \times \frac{4{,}100\,\text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.22 \times 10^{13}\,\text{colonies}}{\text{day}}$$

The WLA component mass loading to Hurricane Creek was determined by multiplying the maximum fecal coliform concentration reported on the Ozark Southside WWTP's DMR reports for October 2004 times the design flow of the wastewater treatment facility times a conversion factor. The Ozark Southside WWTP has a design flow of 3.25 cfs.

$$\frac{3.25\,\text{ft}^3}{\text{s}} \times \frac{50\,\text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{3.97 \times 10^{09}\,\text{colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean sample exceedance concentration of 309 colonies/100 ml times the average flow for all five of the fecal coliform measurements. This concentration was calculated based on measurements at HURD-2 on July 6, 19, 22, 29 and August 3, 2004 and can be found in Table 7-1, Appendix B. The average stream flow, determined by a drainage area ratio of stream flows estimated from ADEM data collected at Klondike Creek, for these five sampling events was 14.63 cfs. The product of these two values and a conversion factor gives the total mass loading of fecal coliform to Hurricane Creek under geometric mean exceedance conditions.

$$\frac{14.63\,\text{ft}^3}{\text{s}} \times \frac{309\,\text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.11 \times 10^{11}\,\text{colonies}}{\text{day}}$$

The WLA component mass loading to Hurricane Creek was determined by multiplying the monthly average fecal coliform concentration reported on Ozark Southside WWTP's DMR reports for July 2004 times the design flow of the wastewater treatment facility times a conversion factor. The Ozark Southside WWTP has a design flow of 3.25 cfs.

$$\frac{3.25\,\text{ft}^3}{\text{s}} \times \frac{27\,\text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.15 \times 10^{09}\,\text{colonies}}{\text{day}}$$

Allowable Conditions

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

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

$$\frac{121.8\ \text{ft}^3}{\text{s}} \times \frac{1800\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{5.36 \times 10^{12}\,\text{colonies}}{\text{day}}$$

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

$$\frac{121.8\,\text{ft}^3}{\text{s}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755 \quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{5.96 \times 10^{11}\,\text{colonies}}{\text{day}}$$

The allowable WLA component mass loading to Hurricane Creek was also calculated under the same conditions as discussed above for the single sample criterion. This is done by taking the product of the design flow and/or the annual average flow of the wastewater treatment facility

flow used for the violation event times the conversion factor times the allowable WLA concentration which are as follows:

The allowable fecal coliform load will be based on a concentration of 200 colonies/100 mL. The allowable fecal coliform loading is:

$$\frac{3.25\,\text{ft}^3}{\text{s}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.59 \times 10^{10}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety does not apply to the WLA since 200 col/100mL is a permitted value.

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

$$\frac{14.63\,\text{ft}^3}{\text{s}} \times \frac{180\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{6.44 \times 10^{10}\ \text{colonies}}{\text{day}}$$

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

$$\frac{14.63\,\text{ft}^3}{\text{s}} \times \frac{20\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{7.16 \times 10^{9}\ \text{colonies}}{\text{day}}$$

The allowable WLA component mass loading to Hurricane Creek was also calculated under the same conditions as discussed above for the geometric mean criterion. This is done by taking the product of the design flow and/or the annual average flow of the wastewater treatment facility flow used for the violation event times the conversion factor times the allowable WLA concentration which are as follows:

For the **geometric mean** fecal concentration of 200 colonies/100 mL. The allowable fecal coliform loading is:

$$\frac{3.25\,\text{ft}^3}{\text{s}} \times \frac{200\ \text{colonies}}{100\,\text{mL}} \times \frac{24465755\quad 100\,\text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.59 \times 10^{10}\ \text{colonies}}{\text{day}}$$

The explicit margin of safety does not apply to the WLA since 200 col/100mL is a permitted value.

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

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Table 4-1. 2004 Fecal Coliform Loads and Required Reductions

Source	2004 Exceedance Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	Reduction %
NPS Load Single Sample	1.22E+13	5.35E+12	6.87E+12	56%
NPS Load Geometric Mean	1.11E+11	4.85E+10	6.21E+10	42%
Point Source (single sample)	3.97E+09	1.59E+10	0.00E+00	0%
Point Source (geometric mean)	2.15E+09	1.59E+10	0.00E+00	0%

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

Table 4-2. Fecal Coliform TMDL and Percent Reductions for Hurricane Creek

TMDL	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation(LA)	
		WWTPs[b]	MS4s[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
5.96E+12	5.96E+11	1.59E+10	NA	0	5.35E+12	56%

a. There are no CAFOs in the Hurricane Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. WLAs for WWTPs are expressed as fecal coliform loads (colonies/day). Future WWTPs must meet instream water quality criteria at the point of discharge as specified in their NPDES permits.
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 0 colonies/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in fecal coliform loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for fecal coliform.

A mass balance approach was used to calculate the pathogen TMDL for Hurricane Creek. The mass balance approach utilizes the conservation of mass principle. Total mass loads can be calculated by multiplying the fecal coliform concentration times the stream flow times a conversion factor.

4.3 TMDL Summary

Hurricane Creek was placed on Alabama's §303(d) list in 1998 based on data collected by GSA data collected in 1991. In 2004, ADEM collected additional water quality data which confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the fecal coliform TMDL for Hurricane Creek. Based on the TMDL analysis, it was determined that a 56% reduction in fecal coliform loading was necessary to achieve compliance with applicable water quality standards.

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

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

5.0 Follow Up Monitoring

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

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

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

6.0 Public Participation

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

Appendix A
References

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

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

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

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

Alabama Department of Environmental Management, 1998 - 2006 §§303(d) List. ADEM.

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

Appendix B
Water Quality Data

Table 7-1. GSA Pathogen Data Collected on Hurricane Creek

Station ID	Data	Time	Fecal Coliform (col/100ml)
@ CR 5	6/4/1991	16:15	920
@ CR 5	7/9/1991	13:00	500
@ CR 5	8/6/1991	13:10	330
@ CR 5	9/10/1991	13:00	1700
@ CR 5	10/8/1991	13:30	300

Table 7-2. ADEM Pathogen Data Collected on Hurricane Creek

Station ID	Date	Calculated Flow (cfs)	Fecal Coliform (col/100ml)
HURD-1	3/25/2004	N/A	160
HURD-1	4/13/2004	N/A	**2820**
HURD-1	5/11/2004	16.47	51
HURD-1	6/2/2004	N/A	870
HURD-1	7/6/2004	22.68	170
HURD-1	7/6/2004	22.68	200
HURD-1	7/19/2004	16.2	330
HURD-1	7/22/2004	11.61	240
HURD-1	7/29/2004	12.69	170
HURD-1	8/3/2004	9.99	230
		Geomean:	**228**
HURD-1	8/16/2004	7.83	160
HURD-1	8/23/2004	11.61	360
HURD-1	9/1/2004	8.91	240
HURD-1	9/14/2004	9.72	410
HURD-1	9/30/2004	16.74	540
HURD-1	10/20/2004	121.8	**4100**
HURD-2	3/25/2004	N/A	100
HURD-2	4/13/2004	N/A	1150
HURD-2	5/11/2004	16.47	57
HURD-2	6/2/2004	N/A	1000
HURD-2	7/6/2004	22.68	280
HURD-2	7/19/2004	16.2	320
HURD-2	7/22/2004	11.61	320
HURD-2	7/29/2004	12.69	220
HURD-2	8/3/2004	9.99	450
		Geomean:	**309**
HURD-2	8/16/2004	7.83	280
HURD-2	8/23/2004	11.61	830
HURD-2	9/1/2004	8.91	400

Station ID	Date	Calculated Flow (cfs)	Fecal Coliform (col/100ml)
HURD-2	9/14/2004	9.72	510
HURD-2	9/30/2004	16.74	190
HURD-2	10/20/2004	121.77	**2200**

Table 7-3. ADEM Flow Data Collected on Klondike Creek

Station ID	Date	Stream Flow (cfs)
KLND-1	4/7/2004	N/A
KLND-1	5/13/2004	N/A
KLND-1	3/24/2004	8.7
KLND-1	4/13/2004	N/A
KLND-1	5/11/2004	6.1
KLND-1	6/2/2004	N/A
KLND-1	7/6/2004	8.4
KLND-1	7/19/2004	6
KLND-1	7/22/2004	4.3
KLND-1	7/29/2004	4.7
KLND-1	8/3/2004	3.7
KLND-1	8/16/2004	2.9
KLND-1	8/23/2004	4.3
KLND-1	9/1/2004	3.3
KLND-1	9/14/2004	3.6
KLND-1	9/30/2004	6.2
KLND-1	10/20/2004	45.1

Appendix C
Calculations

Figure 7-1. Load Calculations

Load Reduction and TMDL Calculations for Hurricane Creek

Flow measured at Hurricane Creek for single sample max:	121.8 cfs	
Single sample Fecal coliform concentration measured:	4100 col/100 mL	
Allowable fecal coliform maximum concentration minus MOS:	1800 col/100mL	= 2000 - 10%
Margin of saftey for the maximum criteria	200 col/100mL	= 10% of criteria
Design Flow of Point Source:	2.1 MGD	
Measured Oct 2004 fecal coliform for point source:	50 col/100mL	
Allowabel fecal coliform for point source:	200 col/100mL	

Load Calculations:

Load = Fecal Coliform Conc * Measured Flow * Conversion Factor

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

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

Current Load:

Nonpoint source load (LA)	1.22E+13	colonies/day
Point source load (WLA)	3.97E+09	colonies/day
Current load =	1.22E+13	colonies/day

Allowable Load:

Nonpoint source load (LA)	5.35E+12	colonies/day
Point source load (WLA)	1.59E+10	colonies/day
Allowable load =	5.36E+12	colonies/day

Margin of Saftey:

MOS load = 5.96E+11 colonies/day

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
LA	1.22E+13	5.35E+12	6.87E+12	56%	5.35E+12
WLA	3.97E+09	1.59E+10	0.00E+00	0%	1.59E+10
Total	1.22E+13	5.36E+12	6.87E+12	56%	5.36E+12

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

TMDL	WLA	LA	MOS
5.96E+12	1.59E+10	5.35E+12	5.96E+11

Percent Reduction to Achieve the Fecal Coliform Standard:

Total reduction: 56% = (current load - allowable load) / current load

The following assumptions are made for calculating the allowable load.

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

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