Alabama Department of Environmental Management

Final

Total Maximum Daily Load (TMDL)
For
Rocky Creek

Assessment Unit ID #: AL03140303-0201-101

Pathogens (E. coli)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
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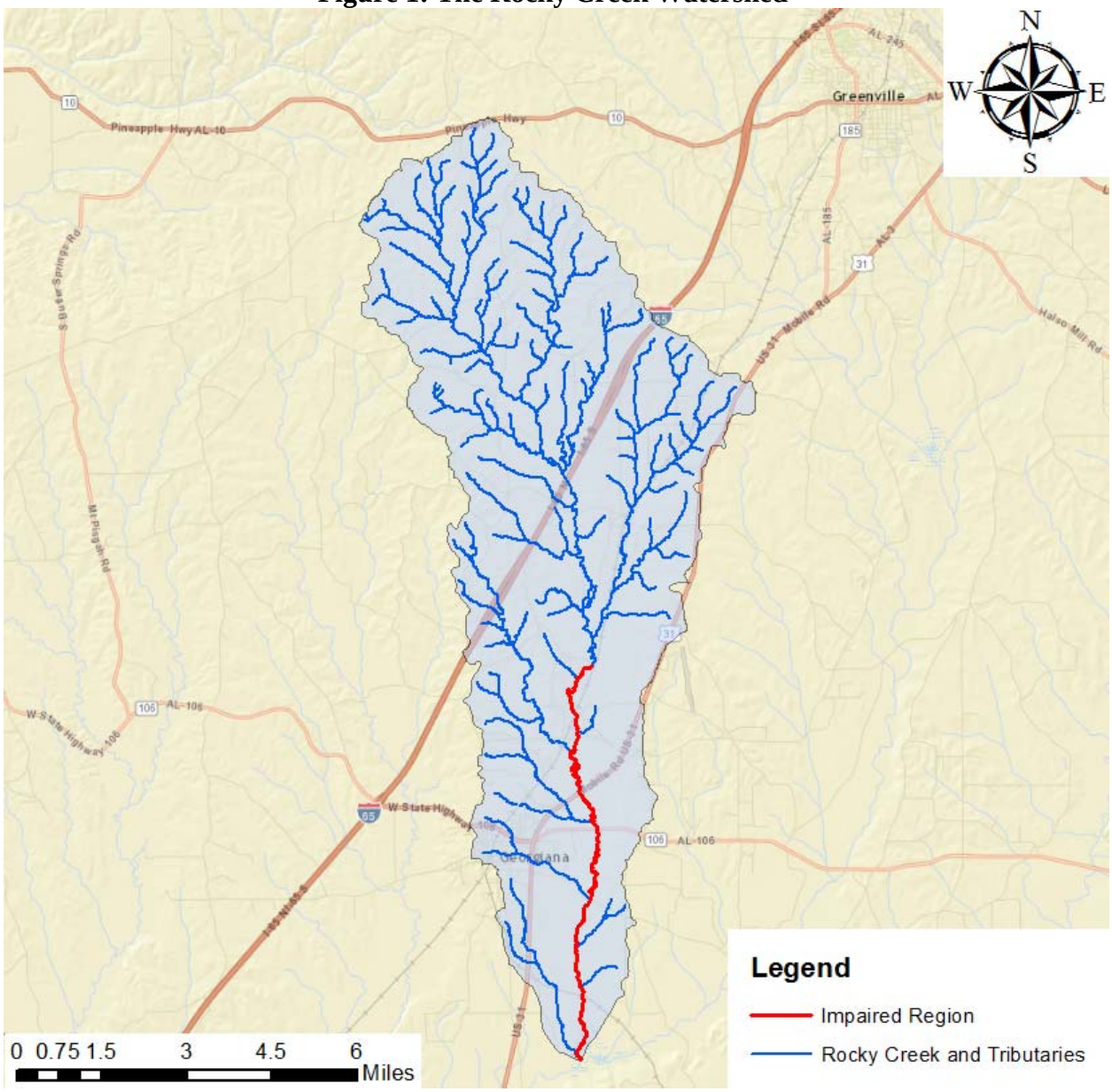
Figure 1: The Rocky Creek Watershed



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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 sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS).

Rocky Creek is currently included on Alabama's §303(d) list as impaired for pathogens from approximately its midpoint to its confluence with Persimmon Creek, located near Chapman, Alabama. Rocky Creek forms in Butler County and is included in the Perdido-Escambia River Basin. Rocky Creek is a tributary of Persimmon Creek and flows south for approximately 20 miles until it empties into Persimmon Creek, which then drains into the Sepulga River. The total drainage area for the Rocky Creek watershed is about 56 square miles. The primary use classification for Rocky Creek is Fish & Wildlife.

Rocky Creek was originally listed on the §303(d) list for unknown toxicity in 1998. Based on data collected in 2008, this impairment was changed from unknown to pathogens in 2012. Rocky Creek was initially sampled in 1998 and was found to exceed toxicity standards at the time. The historical pathogens data for Rocky Creek is included in Appendix 7.2. The pathogen indicator for non-coastal waters was changed in December 2009 from fecal coliform to Escherichia coli (E. coli). Due to this change, Rocky Creek was sampled from 2008-2014 for E. coli, which will be the basis for this TMDL.

In 2014, §303(d) sampling studies were performed by ADEM on Rocky Creek to further assess the water quality of the impaired stream. For purposes of this TMDL, the 2014 data will be used to assess the water quality of Rocky Creek because it is the most current data and provides the best picture of the current water quality conditions of the stream. The 2016 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. Also, as a result of the Alabama Environmental Management Commission's (EMC) adoption of the E. coli criteria as the new bacterial indicator, this TMDL will be developed from E. coli data collected at station RYC-3 since it is data collected within the past six years. All of the available and recent bacterial data is listed in the Appendix for reference. ADEM collected 38 samples from Rocky Creek in 2014 and, according to the collected data, Rocky Creek was not meeting the pathogen criteria applicable to its use classification of Fish and Wildlife. Therefore, this TMDL has been developed for pathogens (E. coli) for Rocky Creek.

A mass balance approach was used for calculating the pathogen TMDL for Rocky Creek. The mass balance approach utilizes the conservation of mass principle. Existing loads were calculated by multiplying the E. coli concentrations 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 from a single sample E. coli violation of 2419.6

colonies/100mL measured on June 10, 2012, at RYC-3. This violation calls for a reduction of 82%. In the same manner as existing loads were calculated, an allowable load was calculated for the single sample E. coli target of 438.3 colonies/100mL (487 colonies/100mL – 10% Margin of Safety).

Table 1 is a summary of the estimated existing load, allowable load, and percent reduction for the single sample criterion and the geometric mean criterion, as well as for the point sources continuously discharging into the Rocky Creek watershed. Table 2 lists the TMDL, defined as the maximum allowable E. coli loading under critical conditions for Rocky Creek.

Table 1: E. coli Loads and Required Reductions

Source	Existing Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	% Reduction
Nonpoint Source Load - Single Sample	3.77E+12	6.83E+11	3.09E+12	82%
Nonpoint Source Load - Geometric Mean	4.07E+11	1.12E+11	2.95E+11	72%
Point Source Load[a]	1.82E+8	2.28E+10	0	0%

a. PS loads and load reductions are based on permit limits during the month of the highest E.coli exceedance. Permit limits for Georgiana WWTP were based on fecal coliform and a design flow of 0.3 MGD. Therefore, units are actually fecal coliform colonies/day vs. E.coli colonies/day as in the NPS reductions. Based on these figures, one can conclude that no reductions are necessary to achieve appropriate pathogen loading for the permitted facility. The permit for Georgiana WWTP was reissued in November 2014 and now has limits for E. coli.

Table 2: E. coli TMDL for Rocky 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
7.64E+11	7.59E+10	5.54E+9	NA	0	6.83E+11	82%

Note: NA = not applicable
a. There is one CAFO in the Rocky Creek watershed. Both existing and 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 E. coli 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 to targeting the load reductions to improve water quality in the Rocky 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 9.23 mile segment of Rocky Creek as impaired for pathogens. The §303(d) listing was originally reported on Alabama's 1998 List of Impaired Waters for unknown toxicity based on data collected from 1986-1990 and was included on all subsequent lists. The impairment was changed to pathogens in 2012. The source of the impairment is listed on the 2014 §303(d) list as unknown.

2.2 Problem Definition

Waterbody Impaired:	Rocky Creek - From Persimmon Creek to County Road north of Chapman
Impaired Reach Length:	9.23 miles
Impaired Drainage Area:	19.2 square miles
Water Quality Standard Violation:	Pathogens (Single Sample Maximum, Geometric Mean)
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 Criteria:
Criteria for acceptable bacteria levels for the F&W 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 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:
Initially, data collected in 1986-1990 was used for listing Rocky Creek on Alabama's 1998 §303(d) list. It was listed for unknown toxicity until 2012, when it was changed to pathogens based off of data collected in 2008 at station RYC-3. Sample results from this station for fecal coliform taken between June 12, 2008, and August 13, 2008, were 2,000, 26,000 and 40,000 colonies/100mL. Fecal coliform was the indicator species for the pathogens criteria until it was changed to E. coli in 2009.

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 RYC-3, which was sampled most recently in 2014.

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 single sample maximum criterion of 487 colonies/100mL. This target is considered protective of water quality standards and should not allow the single sample maximum of 487 colonies/100mL to be exceeded. In addition, a geometric mean target of 113.4 colonies/100mL will be used for a series of five samples taken at least 24 hours apart over the course of 30 days. This target was also derived by using a 10% explicit margin of safety from the geometric mean criterion of 126 colonies/100ml. This target is considered protective of water quality standards and should not allow the geometric mean criterion to be exceeded.

3.2 Source Assessment

3.2.1 Point Sources in the Rocky Creek Watershed

A point source can be defined as a discernible, 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 bacteria can flow into the stream or leach into the groundwater. Illicit discharges

are found at facilities that are discharging bacteria when not permitted, or when the pathogens criterion established in the issued NPDES permit is not being upheld.

Continuous Point Sources

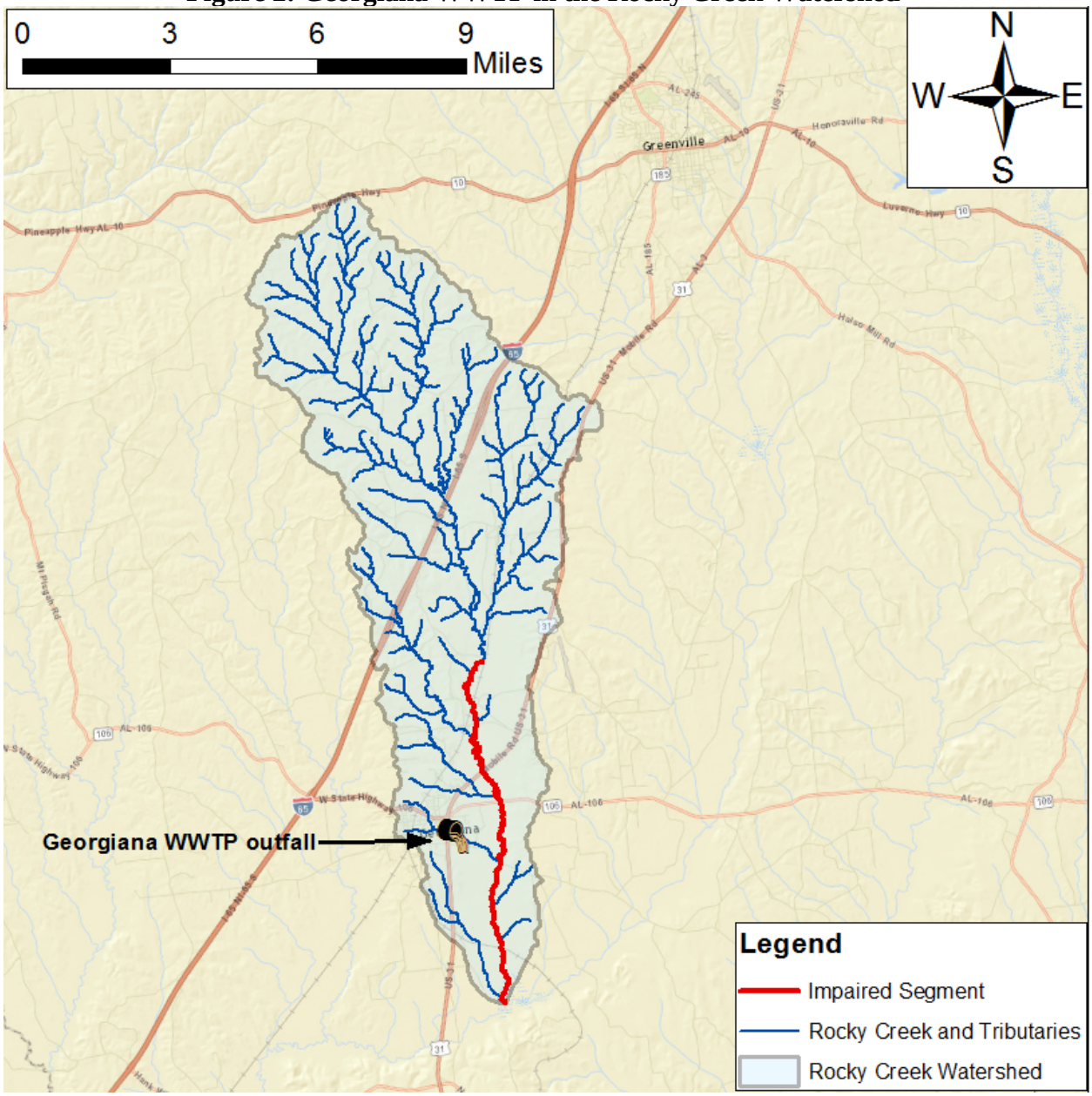
Georgiana WWTP is currently the only continuous NPDES permitted facility in the Rocky Creek watershed. The Georgiana WWTP is a municipal facility that is located approximately 3.5 miles east of I-65 in Georgiana, Alabama. The facility is in the lower part of the Rocky Creek watershed and discharges to an unnamed tributary to Rocky Creek. Currently, the permit for the Georgiana WWTP has a design flow of 0.3 million gallons per day (MGD) and has daily maximum and monthly average E. coli limits for the June-September and October-May seasons. These limits are the applicable pathogen criteria for the Fish and Wildlife use classification. They are as follows:

June-September (monthly average): 126 colonies/100mL
June-September (daily maximum): 487 colonies/100mL
October-May (monthly average): 548 colonies/100mL
October-May (daily maximum): 2507 colonies/100mL

Table 3: Permitted NPDES continuous dischargers in the Rocky Creek Watershed

Type	NPDES #	Facility Name	Receiving Stream	Flow (MGD)
Municipal	AL0043532	Georgiana WWTP	Rocky Creek UT	0.3

Figure 2: Georgiana WWTP in the Rocky Creek Watershed



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.

Non-Continuous Point Sources

There are currently two NPDES stormwater discharge permits within the Rocky Creek watershed. Coastal Forest Products has two general permits (ALG160148 and ALG060043) for stormwater discharges associated with lumber, wood, and paper products. These facilities are not considered to be a source of pathogens due to the lack of process discharges and the nature of their processes.

No E.coli loading to Rocky Creek will be attributed to these facilities, and they will not receive an allocation in this TMDL.

Currently, there are no Municipal Separate Stormwater Sewer System (MS4) areas located within the Rocky 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 files, it was found that Georgiana WWTP has reported 20 SSOs between January 2009 and December 2015 (none reported in 2014). The reported SSOs are listed in Appendix 7.4.

3.2.2 Nonpoint Sources in the Rocky Creek Watershed

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

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 are all mechanisms that can contribute 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, turkey, waterfowl, etc. Wildlife will 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 developed areas is potentially attributable to multiple sources including stormwater 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

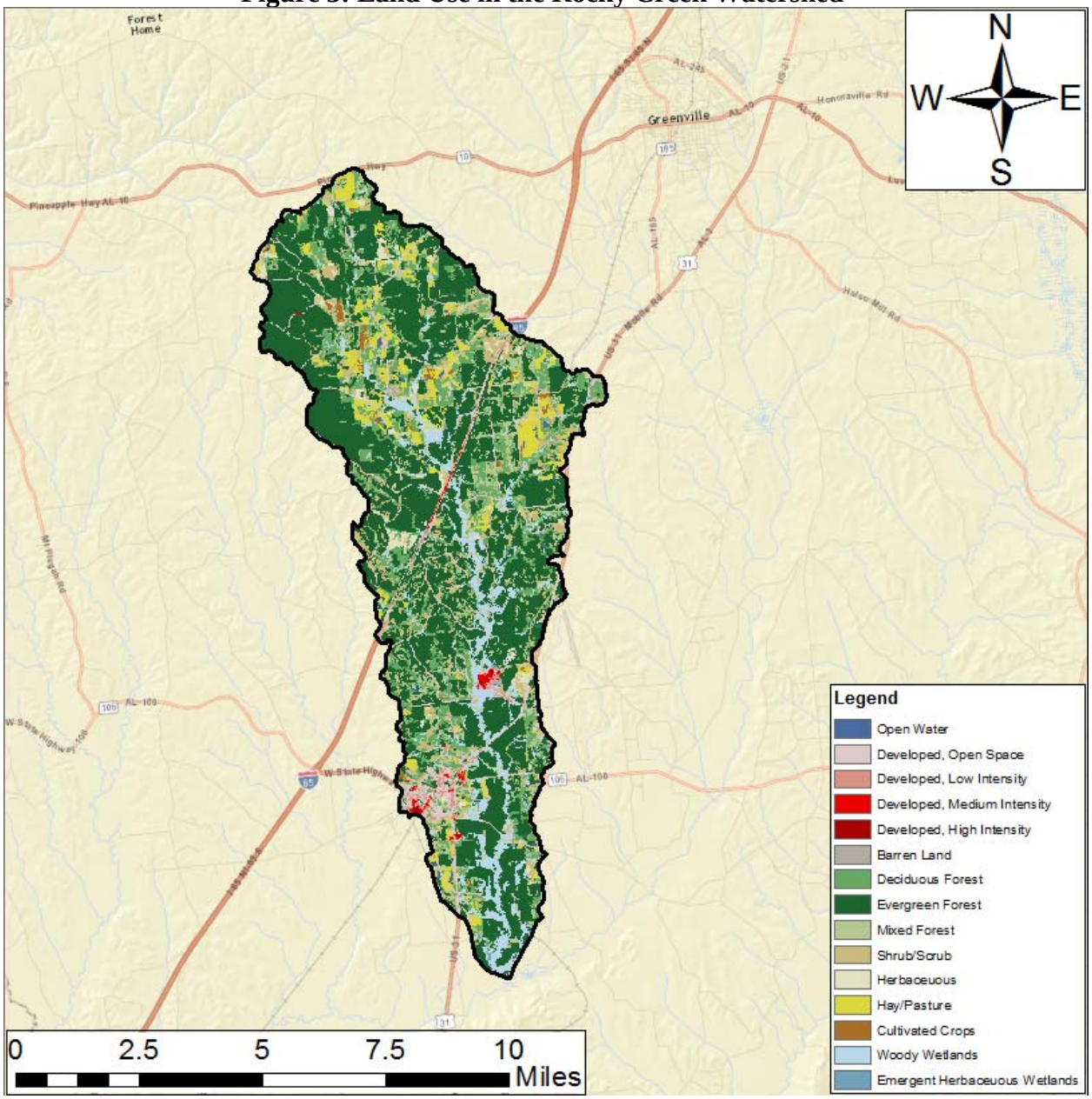
Land use for the Rocky Creek watershed was determined using ArcMap with land use datasets derived from the 2011 National Land Cover Dataset (NLCD). Table 4 depicts the primary land uses in the Rocky Creek watershed. Figure 3 displays the land use areas for the Rocky Creek watershed.

The majority of the Rocky Creek watershed is comprised of naturally occurring forested areas that make up 86.5% of the watershed area. The forested areas break down as follows: evergreen forest (48.13%), deciduous forest (14.09%), shrub (7.89%), woody wetlands (7.45%), mixed forest (7.09%), herbaceous (1.65%), and emergent herbaceous wetlands (0.19%). Developed land includes both commercial and residential land uses. A further break down of the land use reveals that only about 13.5% of the land consists of open water, agricultural lands, and developed land, all combined. 5.48% of the watershed area is hay/pasture, both of which can be utilized for cattle grazing during certain periods throughout the year and, in turn, contribute to pathogen run-off into streams if proper BMPs are not employed.

Table 4: Land use (2011) in the Rocky Creek watershed

Land Use	Miles^2	Acres	Percent
Open Water	0.23	147.23	0.41%
Developed, Open Space	3.08	1968.42	5.50%
Developed, Low Intensity	0.56	360.50	1.01%
Developed, Medium Intensity	0.20	125.21	0.35%
Developed, High Intensity	0.04	24.91	0.07%
Barren Land	0.06	37.81	0.11%
Deciduous Forest	7.87	5038.80	14.09%
Evergreen Forest	26.89	17212.47	48.13%
Mixed Forest	3.96	2536.64	7.09%
Shrub/Scrub	4.41	2822.64	7.89%
Herbaceous	0.92	591.57	1.65%
Hay/Pasture	3.06	1960.63	5.48%
Cultivated Crops	0.32	203.49	0.57%
Woody Wetlands	4.17	2665.85	7.45%
Emergent Herbaceous Wetlands	0.10	66.94	0.19%
Totals→	**55.88**	**35763.09**	100.00%
Class Description	**Miles^2**	**Acres**	**Percent**
Open Water	0.23	147.23	0.41%
Agricultural Lands	3.38	2164.12	6.05%
Forested/Natural	48.34	30934.90	86.50%
Developed Land (Grouped)	3.93	2516.84	7.04%
Totals→	**55.88**	**35763.09**	100%

Figure 3: Land Use in the Rocky Creek Watershed



3.4 Linkage between Numeric Targets and Sources

The major land usage in the Rocky Creek watershed is forest, with developed areas and agriculture a distant second and third, respectively. 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 Rocky 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 E. coli data for the Rocky Creek watershed at four stations (RYC-2, RYC-3, UTRB-1, UTRB-2) along the impaired waterbody from May 2014 to October 2014, from which 38 samples were collected. RYC-3 was the only station that recorded E. coli violations. The other stations had no E. coli exceedances or did not contain sufficient data. The Rocky Creek watershed E. coli data is presented in Appendix 7.2.

Single sample violations occurred at RYC-3 on June 10, 2014, and June 25, 2014, with an E. coli concentration of 2419.6 colonies/100mL on both days. Because of a lack of flow data available at RYC-3, flows had to be calculated from data at station UTRB-2, which is approximately 2 miles downstream of RYC-3 on an unnamed tributary to Rocky Creek. From this data, flows of 63.73 cfs and 25.1 cfs were calculated at RYC-3 for June 10 and June 25, respectively. In addition, sampling between June 10 and June 25 yielded a geometric mean violation of 412.05 colonies/100mL. The average of the flows taken during this sampling period was calculated to be 40.33 cfs, which was used for geometric mean load calculations.

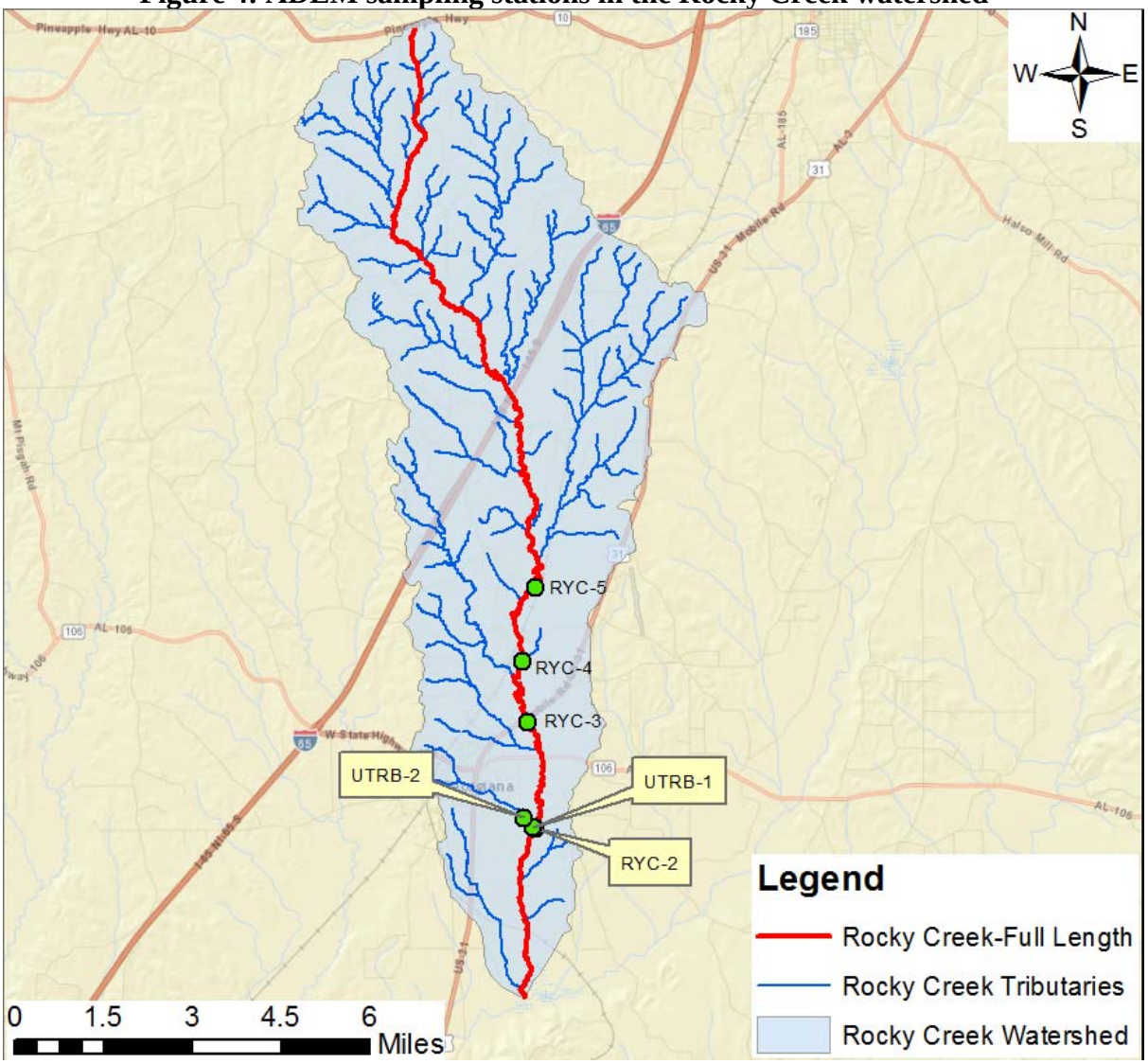
Table 5: E. coli Exceedances on Rocky Creek Segment AL03140303-0201-101

Station	Visit Date	Single Sample (col/100mL)	Geometric Mean (col/100mL)	Flow Measured	Flow (cfs)
RYC-3	6/10/2014	**2419.6**	**412.05**	No-estimated	63.73
RYC-3	6/16/2014	143.4		No-estimated	28.18
RYC-3	6/18/2014	120.1		No-estimated	13.64
RYC-3	6/23/2014	117.8		No-estimated	71.03
RYC-3	6/25/2014	**2419.6**		No-estimated	25.09

Table 6: ADEM Sampling Stations in the Rocky Creek Watershed

Station	Local Name	Latitude	Longitude
RYC-2	Rocky Creek	31.62615586°	-86.71205687°
RYC-3	Rocky Creek	31.653°	-86.7157°
RYC-4	Rocky Creek	31.6674°	-86.7149°
RYC-5	Rocky Creek	31.68532	-86.71178°
UTRB-1	Rocky Creek UT	31.6259°	-86.7126°
UTRB-2	Rocky Creek UT	31.62877247°	-86.71530337°

Figure 4: ADEM sampling stations in the Rocky Creek watershed*



***RYC-2 is located on Rocky Creek. UTRB-1 is on an unnamed tributary to Rocky Creek. They are two different locations, just very close to each other.**

3.6 Critical Conditions

Critical conditions typically occur during the summer months (June-September). 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 bacteria into streams, resulting in spikes of bacteria counts. In winter, frequent low intensity rain events are more typical and do not allow for the build-up of bacteria on the land surface, resulting in a more uniform loading rate.

The impaired portion of the Rocky 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

2419.6 colonies/100mL and occurred on June 10, 2014, and June 25, 2014, at RYC-3. Flows of 63.73 cfs and 25.09 cfs for June 10 and June 25, respectively, were estimated for RYC-3 at the time of the sample collections.

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 were incorporated into this TMDL. The MOS accounts for the uncertainty associated with the limited availability of data used in this analysis. An explicit MOS was applied to the TMDL by reducing the appropriate target criterion concentration by ten percent and calculating a mass loading target with measured or calculated flow data. The single sample E coli maximum value of 487 colonies/100 mL was reduced by 10% to 438.3 colonies/100mL, while the geometric mean criteria was reduced in the same fashion to 113.4 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 waste load allocations (WLAs) for point sources, 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 explicit and implicit 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 Rocky Creek. The mass balance approach utilizes the conservation of mass principle. Total mass loads can be calculated by multiplying the E. coli concentration times the estimated 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 the geometric mean criterion. There were single-sample and geometric mean violations; the TMDL was based on the violation that produced the highest calculated percent reduction to achieve applicable water quality criteria.

Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest E. coli single sample exceedance concentration of 2419.6 colonies/100 mL by the calculated flow on the day of the exceedance. There were no flow values measured at RYC-3, so the flow at RYC-3 was calculated by taking the ratio of the drainage areas for stations RYC-3 and UTRB-2 and multiplying that by the flow measured at UTRB-2. There were single sample exceedances on two different days, but the samples taken were the same concentration (2419.6 colonies/100 mL) on both days. The calculation for the existing condition was based on the measurement at RYC-3 on June 10, 2014. The product of the concentration times the flow times the conversion factor gives the total mass loading (colonies per day) of E. coli to Rocky Creek under the single sample exceedance condition.

$$\frac{63.73\ ft^3}{s} \times \frac{2419.6\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{3.77 \times 10^{12} colonies}{day}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean exceedance concentration of 412.05 colonies/100 mL times the average flow of the five samples. This concentration was calculated based on measurements at RYC-3 between June 10, 2014, and June 25, 2014, and can be found in Appendix 7.2. There were no flow values captured at RYC-3, so the flows were taken from UTRB-2 and the ratio method was employed to calculate the flows at RYC-3. The average stream flow was determined to be 40.33 cfs. The product of the concentration times the flow times the conversion factor gives the total mass loading (colonies per day) of E. coli to Rocky Creek under the geometric mean exceedance condition.

$$\frac{40.33\ ft^3}{s} \times \frac{412.05\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{4.07 \times 10^{11} colonies}{day}$$

The **continuous point sources** mass loading was calculated by taking the average discharge flow from the month of June 2014 (since this is when the exceedance occurred) and multiplying that by the reported maximum daily fecal coliform value for the same month. These numbers were found in the June 2014 Discharge Monitoring Report (DMR) submitted by the facility. This was then multiplied by the conversion factor to determine the existing load in colonies per day.

Georgiana WWTP[a]:

$$0.24\ MGD\ \times \frac{1.55\ ft^3}{s * MGD} \times \frac{20\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{1.82 \times 10^8 colonies}{day}$$

a. Because the exceedance occurred while E. coli monitoring was not yet in place, June 2014 fecal coliform data from this facility is used as the concentration in the above calculation. The November 2014 permit for the Georgiana WWTP contains limits for E. coli as opposed to fecal coliform. Monitoring for E.coli at the facility began in November 2014.

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 criteria. This was done by taking the product of the estimated flow and the allowable concentration. This value was then multiplied by the conversion factor to calculate the allowable load.

For the **single sample** E. coli target concentration of 438.3 colonies/100 mL, the allowable E. coli loading is:

$$\frac{63.73\ \text{ft}^3}{\text{s}} \times \frac{438.3\ \text{colonies}}{100\ \text{mL}} \times \frac{24{,}465{,}755 * 100\ \text{mL} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{6.83 \times 10^{11}\text{colonies}}{\text{day}}$$

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

$$\frac{63.73\ ft^3}{s} \times \frac{48.7\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{7.59 \times 10^{10} colonies}{day}$$

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

$$\frac{40.33\ ft^3}{s} \times \frac{113.4\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100 mL * s}{ft^3 * day} = \frac{1.12 \times 10^{11} colonies}{day}$$

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

$$\frac{40.33\ ft^3}{s} \times \frac{12.6\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{1.24 \times 10^{10} colonies}{day}$$

The WLA portion of this TMDL was calculated by multiplying the design flow of the Georgiana WWTP by the applicable in-stream 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.

Georgiana WWTP:

$$0.3\ MGD \times \frac{1.55\ ft^3}{s * MGD} \times \frac{487\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{5.54 \times 10^9 colonies}{day}$$

The difference 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 criteria. The TMDL was calculated as the total daily E. coli load to Rocky Creek as evaluated at station RYC-3. Table 7 shows the existing and allowable E. coli loads and required reductions for the point and nonpoint sources located in the Rocky Creek watershed.

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	3.77E+12	6.83E+11	3.09E+12	82%
Nonpoint Source Load - Geometric Mean	4.07E+11	1.12E+11	2.95E+11	72%
Point Source Load[a]	1.82E+8	2.28E+10	0	0%

a. PS loads and load reductions are based on permit limits during the month of the highest E.coli exceedance. Permit limits for Georgiana WWTP were based on fecal coliform and a design flow of 0.3 MGD. Therefore, units are actually fecal coliform colonies/day vs. E.coli colonies/day as in the NPS reductions. Based on these figures, one can conclude that no reductions are necessary to achieve appropriate pathogen loading for the permitted facility. The permit for Georgiana WWTP was reissued in November 2014 and now has limits for E. coli.

From Table 7, compliance with the single sample E. coli criterion of 487 colonies/100mL requires a reduction of 82% in the E. coli load. The TMDL, WLA, LA and MOS values necessary to achieve the applicable E. coli criteria are provided in Table 8 below.

Table 8: E. coli TMDL for Rocky 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
7.64E+11	7.59E+10	5.54E+9	NA	0	6.83E+11	82%

Note: NA = not applicable
a. There is one CAFO in the Rocky Creek watershed. Both existing and 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 E. coli criterion of 487 colonies/100ml.

4.3 TMDL Summary

Rocky Creek was placed on Alabama's §303(d) list in 1998 based on data collected from 1986 to 1990. In 2014, ADEM collected additional water quality data using the newly adopted pathogen criteria, with E. coli serving as the primary pathogen indicator. The data collected by ADEM in 2014 confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the E. coli TMDL for Rocky Creek. Based on the TMDL analysis, it was determined that an 82% reduction in E. coli loading was necessary to achieve compliance with applicable water quality standards.

Compliance with the terms and conditions of existing and future NPDES sanitary and storm water 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 to targeting the load reductions to improve water quality in the Rocky 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 statewide approach to water quality management. Each year, ADEM's water quality resources are divided among multiple priorities statewide including §303(d) listed waterbodies, waterbodies with active TMDLs, and other waterbodies as determined by the Department. Monitoring will help further characterize water quality conditions resulting from the implementation of best management practices and load reductions in the watershed.

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 could also request paper or electronic copies of the TMDL by contacting Ms. Kimberly Minton at 334-271-7826 or kminton@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 final completion of this TMDL and subsequent submission to EPA Region 4 for final 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. 2014. ADEM.

Alabama Department of Environmental Management (ADEM), Alabama's Water Quality Assessment and Listing Methodology, 2016.

Alabama's §303(d) List and Fact Sheet. 1998, 2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014. 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.

7.2 Water Quality Data

Table 9: E. coli Data for Station RYC-2

Visit Date	Single Sample (col/100mL)	E. coli Dc	Geometric Mean	Flow Measured	Flow (cfs)
3/20/2014	770.1	-	-	No	-
4/10/2014	177.2	-	-	No	-
9/8/2014	235.9	-	**100.9**	No	-
9/10/2014	65.7	-		No	-
9/16/2014	36.4	-		No	-
9/24/2014	60.2	-		No	-
10/1/2014	307.6	-		No	-

Table 10: E. coli Data for Station RYC-3

Visit Date	Single Sample (col/100mL)	E. coli Dc	Geometric Mean (col/100mL)	Flow Measured	Flow (cfs)
3/20/2014	920.8	-	-	No	-
4/10/2014	107.4	-	-	No	-
6/10/2014	**2419.6**	-	**412.05**	No-estimated	63.73
6/16/2014	143.4	-		No-estimated	28.18
6/18/2014	120.1	-		No-estimated	13.64
6/23/2014	117.8	-		No-estimated	71.03
6/25/2014	**2419.6**	G		No-estimated	25.09
7/2/2014	122.6	-	-	No-estimated	4.91
7/8/2014	107.6	-	-	No	-
8/4/2014	4.1	-	**18.83**	No	-
8/12/2014	31.6	-		No	-
8/21/2014	19.4	-		No	-
8/25/2014	40.4	-		No	-
8/27/2014	23.3	-		No	-
10/1/2014	30.1	-	-	No	-

*G denotes that the analyte is present, but is above an acceptable level for quantitation.

Table 11: E. coli Data for Station UTRB-1

Visit Date	Single Sample (col/100mL)	E. coli Dc	Geometric Mean (col/100mL)	Flow Measured	Flow (cfs)
4/10/2014	202.4	-	-	No	-
9/16/2014	193.5	-	-	Yes	0.1226
10/1/2014	71.7	-	-	No	-

Table 12: E. coli Data for Station UTRB-2

Visit Date	Single Sample (col/100mL)	E. coli Dc	Geometric Mean (col/100mL)	Flow Measured	Flow (cfs)
5/6/2014	139.6	-		No	-
6/10/2014	198.9	-	104.7	Yes	2.307
6/16/2014	30.5	-		Yes	1.0201
6/18/2014	45.5	-		Yes	0.4936
6/23/2014	461.1	-		Yes	2.5714
6/25/2014	98.8	-		Yes	0.9081
7/2/2014	45.7	-		Yes	0.1778
7/8/2014	67	-		No	
8/4/2014	15.6	-	53.8	No	
8/12/2014	58.3	-		No	
8/21/2014	95.9	-		Yes	0.3179
8/25/2014	101.4	-		No	
8/27/2014	51.2	-		Yes	0.027

Table 13: Fecal Coliform Data for Station RYC-2

Visit Date	Single Sample (col/100mL)	Fecal coliform Dc	Geometric Mean (col/100mL)	Flow Measured	Flow (cfs)
4/19/1999	55		-	Yes	20.2
3/9/2004	530	H	-	Yes	28.5
4/6/2004	40	H	-	Yes	3.4
5/12/2004	20	JH	-	Yes	0.4
6/29/2004	600	GH	-	No	-
7/21/2004	210	H	-	Yes	7.21
8/10/2004	100	H	-	No	-
10/13/2004	180	H	-	Yes	4.3
4/15/2008	230		-	No	-
5/22/2008	130		-	No	-
6/12/2008	30		-	Yes	3.27
7/10/2008	28		-	No	-
8/13/2008	680	G	-	No	-
9/11/2008	87		-	No	-
10/8/2008	190		-	No	-
11/18/2008	40	J	-	No	-

*G denotes that the analyte is present, but is above an acceptable level for quantitation.
**H denotes that the holding times for analysis were exceeded.
*J denotes that the determined value is an estimate.
*GH denotes that the analytical holding times were exceeded, but actual value is probably greater than the reported value.

Table 14: Fecal Coliform Data for Station RYC-3

Visit Date	Single Sample (col/100mL)	Fecal coliform Dc	Geometric Mean (col/100mL)	Flow Measured	Flow (cfs)
4/19/1999	37		-	No	-
6/29/1999	430		-	No	-
7/19/1999	**5567**	G	-	No	-
3/9/2004	1190	GH	-	No	-
4/6/2004	15	JH	-	No	-
5/12/2004	30	JH	-	No	-
6/29/2004	600	GH	-	No	-
7/21/2004	110	H	-	No	-
8/10/2004	480	H	-	No	-
10/13/2004	80	H	-	No	-
4/15/2008	310		-	No	-
5/22/2008	240		-	No	-
6/12/2008	2000	G	-	No	-
7/10/2008	**26000**	G	-	No	-
8/13/2008	**40000**	G	-	No	-
9/11/2008	20	J	-	No	-
10/8/2008	670		-	No	-
11/18/2008	40	J	-	No	-

*G denotes that the analyte is present, but is above an acceptable level for quantitation.
**H denotes that the holding times for analysis were exceeded.
*J denotes that the determined value is an estimate.
*GH denotes that the analytical holding times were exceeded, but actual value is probably greater than the reported value.
*JH denotes that analytical holdings times were exceeded and that the value is an estimate.

Table 15: Fecal Coliform Data for Station RYC-4

Visit Date	Single Sample (col/100mL)	Fecal coliform Dc	Geometric Mean (col/100mL)	Flow Measured	Flow (cfs)
4/19/1999	42		-	No	42
6/29/1999	310		-	No	310
7/19/1999	**5467**	G	-	No	5467
4/15/2008	210		-	No	210
5/22/2008	90		-	No	90
6/12/2008	600	G	-	No	600
7/10/2008	30	J	-	No	30
8/13/2008	600	G	-	No	600
9/11/2008	200	J	-	No	200
10/8/2008	1000		-	No	1000
11/18/2008	7	J	-	No	7

*G denotes that the analyte is present, but is above an acceptable level for quantitation.
*J denotes that the determined value is an estimate.

Table 16: Fecal Coliform Data for Station RYC-5

Visit Date	Single Sample (col/100mL)	Fecal coliform Dc	Geometric Mean (col/100mL)	Flow Measured	Flow (cfs)
3/9/2004	40	H	-	Yes	28.2
4/6/2004	15	JH	-	Yes	2
5/12/2004	43	H	-	Yes	0.4
6/29/2004	260	H	-	Yes	0.9
7/21/2004	120	H	-	Yes	1.4
8/10/2004	47	H	-	No	-
10/13/2004	57	H	-	Yes	2
4/15/2008	20	J	-	Yes	8.1
5/22/2008	93		-	Yes	0.4
6/12/2008	57		-	Yes	0.24
7/10/2008	22		-	No	-
8/13/2008	320		-	Yes	2
9/11/2008	67		-	Yes	3.7
10/8/2008	**4600**	G	-	Yes	0.54
11/18/2008	20	J	-	No	-

*****H denotes that the holding times for analysis were exceeded.
*JH denotes that analytical holdings times were exceeded and that the value is an estimate.
*J denotes that the determined value is an estimate.
*G denotes that the analyte is present, but is above an acceptable level for quantitation.

Table 17: Fecal Coliform Data for Station URTB-1

Visit Date	Single Sample (col/100mL)	Fecal coliform Dc	Geometric Mean (col/100mL)	Flow Measured	Flow (cfs)
8/6/1998	433	G	-	No	-

*G denotes that the analyte is present, but is above an acceptable level for quantitation.

7.3-Continuous Point Source Effluent Data

Table 18: Georgiana WWTP E. coli Data*

Monitoring Period End Date	Monthly Average Concentration (col/100mL)	Maximum Daily Concentration (col/100mL)
11/30/2014	36.5	90
12/31/2014	17.7	60
1/31/2015	3.25	6
2/28/2015	6	20
3/31/2015	17.9	50
4/30/2015	23	80
5/31/2015	3.5	10
6/30/2015	6.33	15
7/31/2015	2.63	5
8/31/2015	4.38	10
9/30/2015	6.7	20
10/31/2015	8.63	25
11/30/2015	5.9	22
12/31/2015	12.88	23
1/31/2016	3.3	7
2/29/2016	7.63	18

*No E. coli exceedances for this facility. Facility began monitoring E. coli in November 2014.

Table 19: Georgiana WWTP Fecal Coliform Data

Monitor Period End Date	Monthly Average Concentration (col/100Ml)	Maximum Daily Concentration (col/100Ml)
1/31/2014	6	24
2/28/2014	4	10
3/31/2014	7	48
4/30/2014	3	5
5/31/2014	2	5
6/30/2014	5	20
7/31/2014	1	5
8/31/2014	8	70
9/30/2014	3.75	20
10/31/2014	21.55	40

7.4-Sanitary Sewer Overflow (SSO) Data

Table 20: SSOs in the Rocky Creek watershed from Georgiana WWTP (Permit No. AL0043532)

Date	Estimated Release Volume (gallons)	Duration (hours)
1/7/2009	200,000	2
2/6/2009	500	96
3/15/2009	400,000	12
3/26/2009	200,000	6
3/28/2009	200,000	2.5
5/4/2009	175,000	6
6/4/2009	200,000	32
7/26/2009	7,000	8
8/27/2009	300,000	11
9/12/2009	100,000	20
10/14/2009	200,000	6.5
12/18/2009	300,000	*
1/20/2010	300,000	32
1/29/2010	250,000	8
3/11/2010	120,000	8.5
5/3/2010	300,000	9.5
2/4/2011	550,000	16.5
3/9/2011	500,000	18
7/1/2011	150,000	48
12/26/2015	>1,000	7

* This SSO was reported as gallons per hour with no information on how long it persisted.

Appendix 7.5
Rocky Creek Watershed Photos

At station RYC-3 on Rocky Creek, looking upstream

At station RYC-3 on Rocky Creek, looking downstream

Rocky Creek at W Dogwood Trail, looking upstream

Rocky Creek at W Dogwood Trail, looking downstream

Rocky Creek at AL-106, looking upstream

Rocky Creek at AL-106, looking downstream

Rocky Creek at Wesley Chapel Road (station RYC-2), looking upstream

Rocky Creek at Wesley Chapel Road (station RYC-2), looking downstream