Alabama Department of Environmental Management

Final
Total Maximum Daily Load (TMDL)
for
Bughall Creek

Assessment Unit ID # AL03150110-0702-100

Pathogens (*E. coli*)

Bullock and Macon Counties

Alabama Department of Environmental Management
Water Quality Branch
Water Division
August 2024

Figure 1: Bughall Creek Watershed

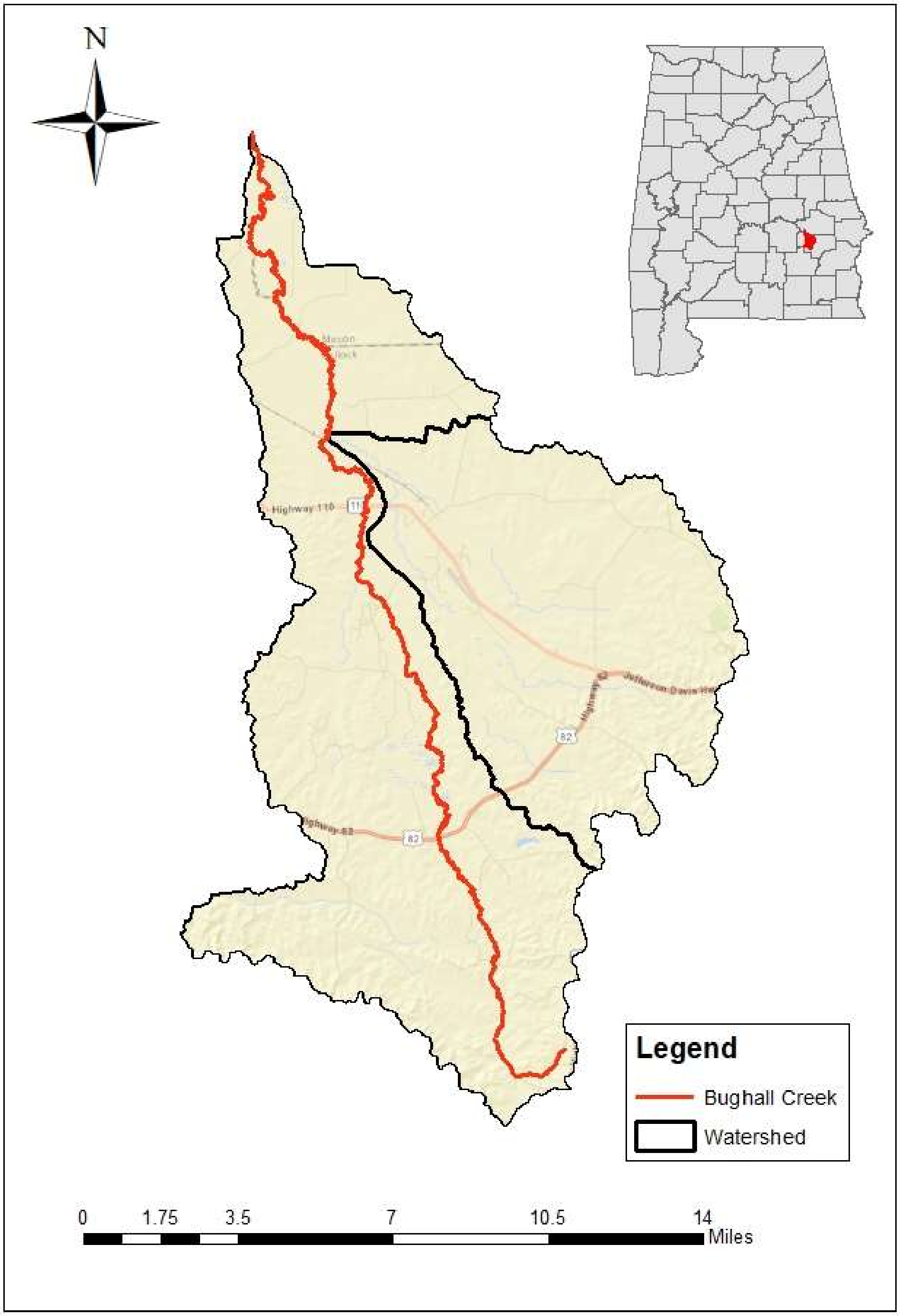


Table of Contents ***Page***

List of Figures

List of Tables

List of Photos

1.0 Executive Summary

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify waterbodies which are not meeting their designated uses and to determine the Total Maximum Daily Load (TMDL) for pollutants causing the use impairment. A TMDL is the sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS).

Bughall Creek is currently included on Alabama's §303(d) list for pathogens (*E. coli*) from its source to Old Town Creek. Bughall Creek forms southwest of the town of Union Springs and is part of the Tallapoosa River Basin. It flows northwest through Bullock County and into Old Town Creek. The total length of Bughall Creek is 31.44 miles, and the total drainage area of the Bughall Creek watershed is approximately 101 square miles. Bughall Creek has a use classification of Fish & Wildlife (F&W).

Bughall Creek was first included on the §303(d) list for pathogens in 2018 based on ADEM monitoring data collected in 2013 and 2015 at station BGHM-1. Bughall Creek has subsequently been listed on the 2020 and 2022 §303(d) lists of impaired waterbodies.

In 2023, sampling studies were performed by ADEM to further assess the water quality of the impaired stream. For purposes of this TMDL, the 2023 data will be used to assess the water quality of Bughall Creek because it provides the best picture of the current water quality of the stream. The 2024 edition of *Alabama's Water Quality Assessment and Listing Methodology*, prepared by ADEM, provides the rationale for the Department to use the most recent data to prepare a TMDL for an impaired waterbody. This TMDL will be developed from *E. coli* data collected at station BGHM-1. This bacterial data is listed in Appendix 7.2, Table 7-1 for reference. ADEM collected 14 *E. coli* samples and conducted two geometric mean studies on Bughall Creek in 2023. According to the data, Bughall Creek was not meeting the pathogen criteria applicable to its use classification of F&W. Therefore, this TMDL has been developed for pathogens (*E. coli*) for the listed reach.

A mass balance approach was used for calculating the pathogen TMDL for Bughall Creek. The mass balance approach utilizes the conservation of mass principle. The TMDL was calculated using the single sample or geometric mean sample exceedance event which resulted in the highest percent reduction. Existing loads were calculated by multiplying the *E. coli* concentrations times the respective in-stream flows and a conversion factor. In the same manner as existing loads were calculated, allowable loads were calculated for the single sample *E. coli* target of 268.2 colonies/100 ml (298 colonies/100 ml – 10% Margin of Safety) and geometric mean *E. coli* target of 113.4 colonies/100 ml (126 colonies/100 ml – 10% Margin of Safety). In this case, it was determined that the highest percent reduction was calculated from a single sample maximum *E. coli* exceedance at station BGHM-1 (June 20, 2023) with a value of 4839.2 colonies/100 ml. This violation calls for a reduction of 94%.

Table 1-1 is a summary of the estimated existing load, allowable load, and percent reduction for the geometric mean and single sample criteria. Table 1-2 provides the details of the TMDL along with the corresponding reductions for Bughall Creek, which are protective of the *E. coli* water quality criteria year-round.

Table 1-1. *E. coli* Loads and Required Reductions

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Single Sample Load	5.99E+12	3.32E+11	5.66E+12	94%
Geometric Mean Load	2.29E+12	2.29+11	2.06E+12	90%

Table 1-2. *E. coli* TMDL for Bughall Creek

TMDL[e]	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation (LA)	
		WWTPs[b]	Stormwater (MS4s and other NPDES sources)[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
3.69E+11	3.69E+10	NA	NA	0	3.32E+11	94%

Note: NA = not applicable
a. There are no CAFOs in the Bughall Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.
c. Future MS4 areas and other NPDES stormwater sources would be required to demonstrate consistency with the assumptions and requirements of this TMDL through implementation and maintenance of BMPs on a case-by-case basis.
d. The objective for leaking collection systems is a WLA of zero. It is recognized, however, that a WLA of 0 colonies/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in *E. coli* loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for *E. coli*.
e. TMDL was established using the single sample criterion of 298 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 Bughall 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 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 31.44 miles of Bughall Creek as impaired for pathogens. The §303(d) listing for pathogens was originally reported on Alabama's 2018 List of Impaired Waters based on 2013 and 2015 ADEM monitoring data from station BGHM-1 and was subsequently included on the 2020 and 2022 lists. The potential sources of the impairment on the 2022 §303(d) list are animal feeding operations and pasture grazing.

2.2 Problem Definition

Waterbody Impaired:	Bughall Creek – From Old Town Creek to its source
Impaired Reach Length:	31.44 miles
Impaired Drainage Area:	101 square miles
Water Quality Standard Violation:	Pathogens (single sample, 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 the F&W 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.

(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 year-round and whole body water-contact recreation during the months of May through October, 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.

<u>*E. coli* Criteria:</u>
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 whole body water-contact recreation during the months of May through October, 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 298 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.

<u>Criteria Exceeded:</u>
Bughall Creek was first included on the §303(d) list for pathogens in 2018 based on ADEM's 2013 and 2015 *E. coli* data from station BGHM-1. Of the twelve *E. coli* samples collected at station BGHM-1 in 2013 and 2015, four violated the applicable single sample maximum criterion of 298 col/100 ml. The listing data can be found in Appendix 7.2, Table 7.1.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

For the purpose of this TMDL, a single sample *E. coli* target of 268.2 colonies/100 ml will be used. This target was derived by using a 10% explicit margin of safety from the single sample maximum criterion of 298 colonies/100 ml. This target is considered protective of water quality standards and should not allow the single sample maximum criterion to be exceeded. In addition, a geometric mean target of 113.4 colonies/100 ml 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/100 ml. 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 <u>Point Sources in the Bughall Creek Watershed</u>

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 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.

There are currently no NPDES-regulated point sources in the Bughall Creek watershed. In addition, the Bughall Creek watershed does not presently qualify as a municipal separate storm sewer system (MS4) area. Any future NPDES-regulated discharger that is considered by the Department to be a pathogen source will be required to demonstrate consistency with the assumptions and requirements of this TMDL.

There are currently no Animal Feeding Operation/Concentrated Animal Feeding Operation (AFO/CAFO) facilities located within the Bughall Creek watershed. The ADEM AFO/CAFO rules prohibit discharges of pollutants from the facilities and their associated waste land application activities. As a result, future AFOs/CAFOs will receive a waste load allocation of zero.

3.2.2 <u>Nonpoint Sources in the Bughall Creek Watershed</u>

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 in the soil and then are washed off during rain events. As the runoff transports the sediment over the land surface, more *E. coli* bacteria are collected and carried to the stream or waterbody. Therefore, there is some net loading of *E. coli* bacteria into the stream as dictated by the watershed hydrology.

Nonpoint sources are the primary source of *E. coli* bacteria in the Bughall Creek watershed. Land use in this watershed is primarily forested/natural (74.21%) along with some agriculture and developed land (21.64% and 2.30%, respectively).

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 *E. coli* bacteria to waterbodies. To account for the potential influence from animals with direct access to stream reaches in the watershed, *E. coli* loads can be calculated as a direct source into the stream.

E. coli bacteria can also originate from forested areas due to the presence of wild animals such as deer, raccoons, 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. Septic systems may be direct or indirect sources of bacterial pollution via ground and surface waters. Onsite septic systems have the potential to deliver *E. coli* bacteria to surface waters due to system failure and malfunction.

3.3 Land Use Assessment

Land use for the Bughall Creek watershed was determined using ArcMap with land use datasets derived from the 2021 National Land Cover Dataset (NLCD). Figure 3-1 and Table 3-1 display the land use areas for the Bughall Creek watershed. Figure 3-2 is a graph depicting the primary land uses in the Bughall Creek watershed.

The majority of the Bughall Creek watershed is forested/natural (74.21%). Other land uses include agriculture (21.64%), developed land (2.30%), and open water (1.85%). Developed land includes both commercial and residential land uses. If not managed properly, agriculture can have significant nonpoint source impacts. Also, septic systems can be a main source of bacteria if not properly installed and maintained.

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

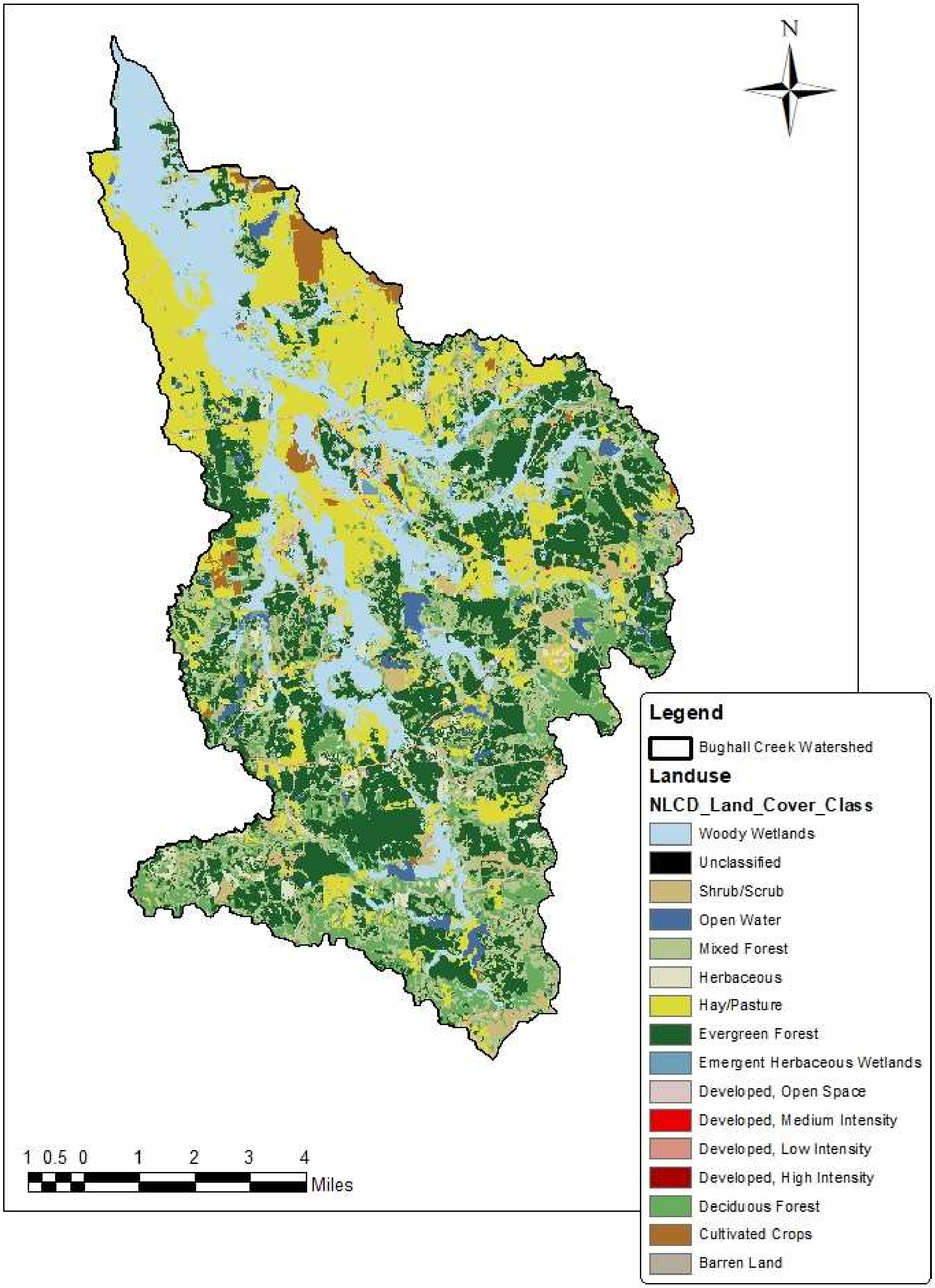
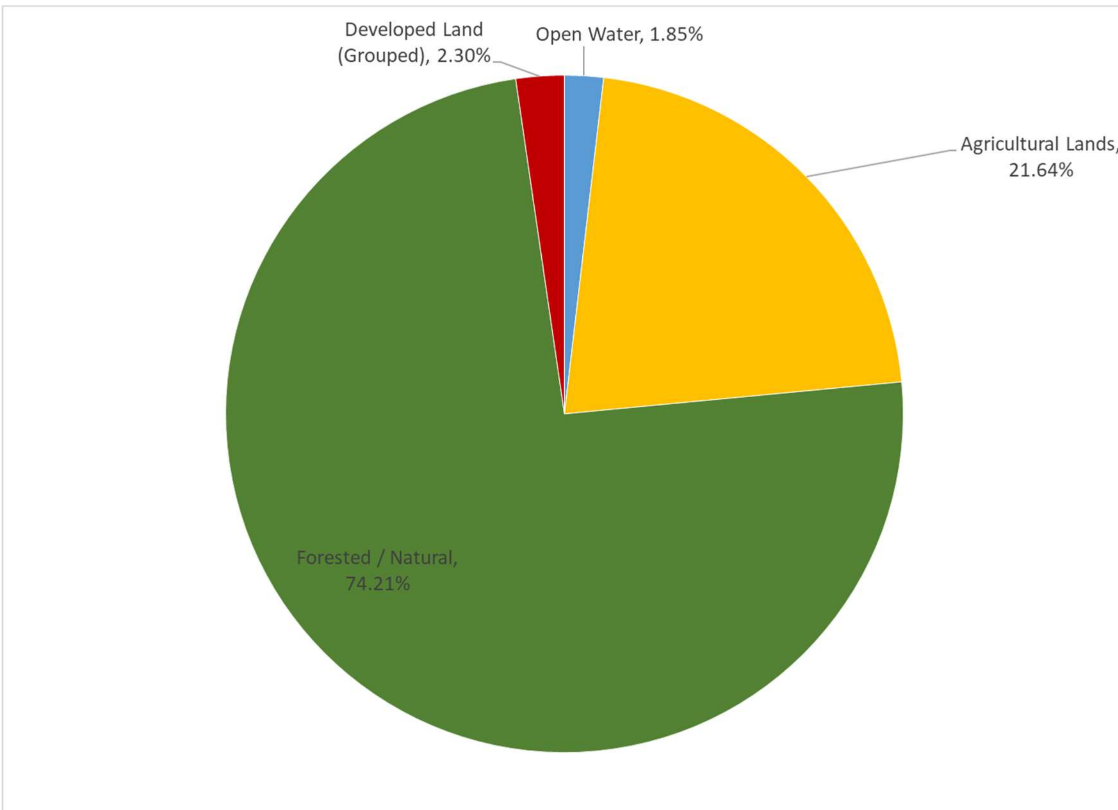


Table 3-1. Land Use Areas for the Bughall Creek Watershed

Class Description	Mi²	Acres	Percent
Open Water	1.87	1196.89	1.85%
Agricultural Lands	21.84	13976.13	21.64%
Forested / Natural	74.89	47927.50	74.21%
Developed Land (Grouped)	2.32	1485.32	2.30%
TOTALS →	**100.92**	**64585.84**	**100.00%**

Figure 3-2. Graph of Primary Land Uses in the Bughall Creek Watershed



3.4 Linkage Between Numeric Targets and Sources

The Bughall Creek watershed's main land use is forested/natural. 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 Bughall Creek are from the agricultural land uses and possibly 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.

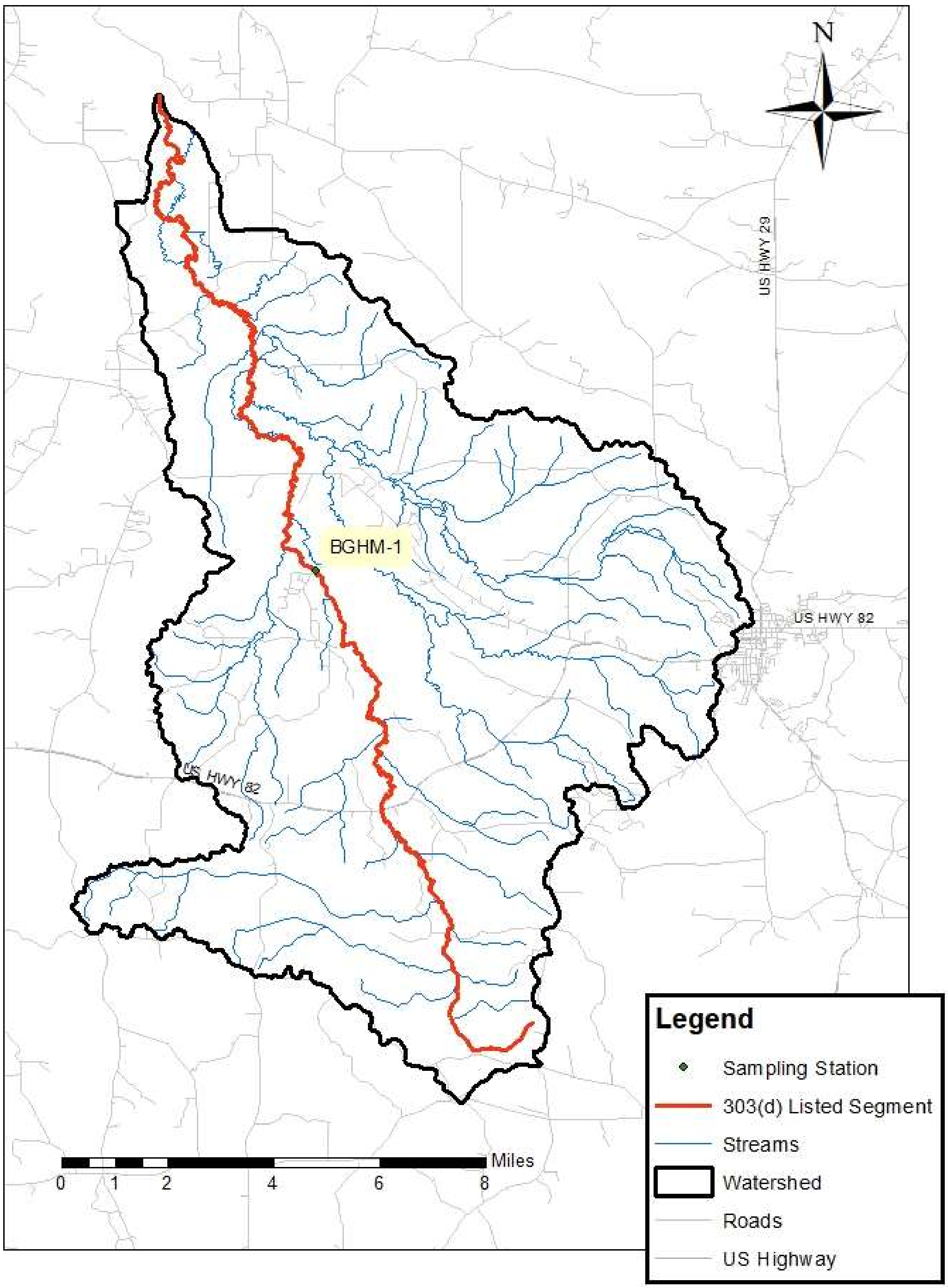
3.5 Data Availability and Analysis

In 2023, ADEM collected water quality data on Bughall Creek at station BGHM-1. Table 3-2 and Figure 3-3 display the description and location, respectively, for the ADEM sampling station. As previously mentioned, the 2023 data will be used for this TMDL. The January 2024 edition of *Alabama's Water Quality Assessment and Listing Methodology,* prepared by ADEM, provides the rationale for the Department to use the most recent data to prepare a TMDL for an impaired waterbody.

Table 3-2. Bughall Creek Sampling Station Description

ADEM Station	Station Location	Latitude	Longitude
BGHM-1	Bughall Creek at Bullock County Road 117	32.16144	-85.83485

Figure 3-3. Map of ADEM Sampling Station on Bughall Creek



Of the 14 *E. coli* samples collected at station BGHM-1 during 2023, 12 violated the single sample maximum criterion of 298 col/100 ml for the Fish & Wildlife use classification. In addition, there were exceedances of the geometric mean criterion of 126 col/100ml at station BGHM-1 in June 2023 and August 2023. This data can be viewed in Table 3-3 below and in Appendix 7.2, Table 7-1.

Table 3-3.
2023 *E. coli* Exceedances for the Bughall Creek Watershed

Station ID	Date	*E. coli* – Single Sample (col/100ml)	*E. coli* dc*	*E. coli* – Geometric mean (col/100ml)
BGHM-1	3/29/2023	547.5		
BGHM-1	5/4/2023	410.6		
BGHM-1	6/7/2023	248.1		
BGHM-1	6/12/2023	449.4		
BGHM-1	6/14/2023	922.2		
BGHM-1	6/20/2023	4839.2	G	1129.4
BGHM-1	6/22/2023	733		
BGHM-1	6/27/2023	1250		
BGHM-1	7/11/2023	365.4		
BGHM-1	8/10/2023	1297.6		
BGHM-1	8/15/2023	331.6		
BGHM-1	8/17/2023	651		581.1
BGHM-1	8/21/2023	325.5		
BGHM-1	8/22/2023	727		

*G = The actual number was probably greater than the number reported.

3.6 Critical Conditions/Seasonal Variation

Critical conditions typically occur during the summer months (May-October). 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.

Bughall Creek generally follows the trends described above for the summer months of May through October. 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 4839.2 colonies/100 ml that occurred on June 20, 2023, at station BGHM-1. A flow of 50.6 cfs was calculated for this sampling event. The use of the highest exceedance to calculate the TMDL is expected to be protective of water quality in Bughall Creek year-round.

3.7 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the analysis: 1) by implicitly incorporating 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.

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 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 298 colonies/100 ml was reduced by 10% to 268.2 colonies/100 ml, while the geometric mean criterion was reduced in the same fashion to 113.4 colonies/100 ml.

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 explicit in this TMDL. A TMDL can be denoted by the equation:

$$\text{TMDL} = \Sigma\ \text{WLAs} + \Sigma\ \text{LAs} + \text{MOS}$$

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

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

4.2 Load Calculations

A mass balance approach was used to calculate the pathogen TMDL for Bughall 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 instream flow times a conversion factor. Existing loads were calculated for the highest single sample exceedance and the highest geometric mean sample exceedance. In the same manner, allowable loads were calculated for both the single sample criterion of 298 col/100 ml and the geometric mean criterion of 126 col/100 ml. The TMDL was based on the violation that produced the highest percent reduction of *E. coli* loads necessary to achieve applicable water quality criteria, whether it be the single sample or geometric mean.

<u>Existing Conditions</u>

The **single sample** mass loading was calculated by multiplying the highest single sample exceedance concentration of 4839.2 colonies/100 ml times the calculated flow at the time the sample was collected. This concentration was measured at BGHM-1 on June 20, 2023. The stream flow was calculated to be 50.6 cfs at the time of the violation. The product of these two values times the conversion factor gives the total mass loading (colonies per day) of *E. coli* to Bughall Creek.

$$\frac{50.6\ \text{ft}^3}{s} \times \frac{4839.2\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{5.99 \times 10^{12}\text{colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean exceedance concentration of 1129.4 colonies/100 ml times the average of the five measured or calculated stream flows. This concentration was calculated based on measurements at BGHM-1 between June 12, 2023, and June 27, 2023, which are shown above in Table 3-3. The average stream flow was determined to be 82.7 cfs. The product of these two values times the conversion factor gives the total mass loading (colonies per day) of *E. coli* to Bughall Creek under the geometric mean exceedance condition.

$$\frac{82.7\ \text{ft}^3}{s} \times \frac{1129.4\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{2.29 \times 10^{12}\text{colonies}}{\text{day}}$$

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 flow used for the violation event times the conversion factor times the allowable concentration.

For the **single sample** *E. coli* target concentration of 268.2 colonies/100 ml, the allowable *E. coli* loading is:

$$\frac{50.6\ \text{ft}^3}{s} \times \frac{268.2\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{3.32 \times 10^{11}\text{colonies}}{\text{day}}$$

The explicit margin of safety of 29.8 colonies/100 ml equals a daily loading of:

$$\frac{50.6\ \text{ft}^3}{s} \times \frac{29.8\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{3.69 \times 10^{10}\text{colonies}}{\text{day}}$$

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

$$\frac{82.7\ \text{ft}^3}{s} \times \frac{113.4\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{2.29 \times 10^{11}\text{colonies}}{\text{day}}$$

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

$$\frac{82.7\ \text{ft}^3}{s} \times \frac{12.6\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{2.55 \times 10^{10}\text{colonies}}{\text{day}}$$

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 criteria. The TMDL was calculated as the total daily *E. coli* load to Bughall Creek as evaluated at station BGHM-1. Table 4-1 shows the existing and allowable *E. coli* loads and required reductions for the Bughall Creek watershed.

Table 4-1. *E. coli* Loads and Required Reductions

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Single Sample Load	5.99E+12	3.32E+11	5.66E+12	94%
Geometric Mean Load	2.29E+12	2.29E+11	2.06E+12	90%

From Table 4-1, compliance with the single sample criterion of 298 colonies/100 ml requires a reduction in the *E. coli* load of 94%. The TMDL, WLA, LA and MOS values necessary to achieve the applicable *E. coli* criterion are provided in Table 4-2 below.

Table 4-2. *E. coli* TMDL for Bughall Creek

TMDL[e]	Margin of Safety (MOS)	Waste Load Allocation (WLA)[a]			Load Allocation (LA)	
		WWTPs[b]	Stormwater (MS4s and other NPDES sources)[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
3.69E+11	3.69E+10	NA	NA	0	3.32E+11	94%

Note: NA = not applicable
a. There are no CAFOs in the Bughall Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. Future WWTPs must meet the applicable instream water quality criteria for pathogens at the point of discharge.
c. Future MS4 areas and other NPDES stormwater sources would be required to demonstrate consistency with the assumptions and requirements of this TMDL through implementation and maintenance of BMPs on a case-by-case basis.
d. The objective for leaking collection systems is a WLA of zero. It is recognized, however, that a WLA of 0 colonies/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in *E. coli* loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for *E. coli*.
e. TMDL was established using the single sample criterion of 298 colonies/100ml.

4.3 TMDL Summary

Bughall Creek was first included on the §303(d) list for pathogens in 2018 based on ADEM's 2013 and 2015 *E. coli* data from station BGHM-1. In 2023, ADEM collected water quality data that confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the *E. coli* TMDL for Bughall Creek. Based on the TMDL analysis, it was determined that a 94% 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 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 will be implemented through voluntary measures/best management practices (BMPs). Cooperation and active participation by the general public and various other groups is critical to successful implementation of TMDLs. Local citizen-led and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. Therefore, TMDL implementation activities for nonpoint sources will be coordinated through interaction with local entities and may be eligible for CWA §319 grants through the Department's Nonpoint Source Unit.

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 Bughall 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 monitoring, an approach that divides Alabama's sixteen major river basins into three groups. Each year, ADEM's water quality resources are concentrated in one of the three basin groups and are divided among multiple priorities 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. This monitoring will occur in each basin according the schedule shown in Table 5-1.

Table 5-1. Follow-up Monitoring Schedule

River Basin Group	Years to be Monitored
Black Warrior, Blackwater, Chattahoochee, Chipola, Choctawhatchee, Escambia, Perdido, Tennessee (Wheeler), Yellow	2024/2027
Coosa, Escatawpa, Tennessee (Guntersville), Tombigbee	2025/2028
Alabama, Cahaba, Mobile, Tallapoosa, Tennessee (Pickwick and Wilson)	2026/2029

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 four newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL were made available on ADEM's Website: www.adem.alabama.gov. The public could also request paper or electronic copies of the TMDL by contacting Ms. Kimberly Minton at 334-271-7826 or kminton@adem.alabama.gov. The public was given an opportunity to review the TMDL and submit comments to the Department in writing. No written comments were received during the public notice period.

7.0 Appendices

7.1 References

ADEM Administrative Code, 2021. Water Division - Water Quality Program, Chapter 335-6-10, Water Quality Criteria.

ADEM Administrative Code, 2021. Water Division - Water Quality Program, Chapter 335-6-11, Use Classifications for Interstate and Intrastate Waters.

Alabama's Monitoring Program. 2013, 2015 & 2023. ADEM.

Alabama Department of Environmental Management (ADEM), *Alabama's Water Quality Assessment and Listing Methodology*, January 2024.

Alabama Department of Environmental Management, 2018, 2020, & 2022 §303(d) Lists and Fact Sheets. ADEM.

Alabama Department of Environmental Management (ADEM), Laboratory Data Qualification SOP #4910 Revision 7.2, 2022.

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

United States Environmental Protection Agency, 1986. *Quality Criteria for Water.* Office of Water. EPA 440/4-91-001.

7.2 Water Quality Data

Table 7-1. ADEM Pathogen Data Collected on Bughall Creek

STATION ID	DATE	Flow (cfs)	Single Sample *E. coli* (col/100 ml)	*E. coli* dc^	Geomean *E. coli* (col/100 ml)
BGHM-1	3/27/2013	46.2	228.2		
BGHM-1	4/8/2013	19.7	275.5		
BGHM-1	5/1/2013	6.8	325.5		
BGHM-1	6/10/2013	0.6	1203.3		
BGHM-1	8/6/2013	12.3	613.1		
BGHM-1	9/11/2013	1.3	191.8		
BGHM-1	10/10/2013		129.1		
BGHM-1	3/18/2015	10.6	204.6	H	
BGHM-1	4/8/2015	3.9	344.8	H	
BGHM-1	5/5/2015	12.3	159.7	H	
BGHM-1	6/10/2015	0.6	579.4	H	
BGHM-1	6/30/2015	0.1	248.9	H	
BGHM-1	3/29/2023	16.2	547.5		
BGHM-1	5/4/2023	5.6	410.6		
BGHM-1	6/7/2023	1.4	248.1		
BGHM-1	6/12/2023	0.9	449.4		
BGHM-1	6/14/2023	1.1	922.2		
BGHM-1	6/20/2023	50.6*	4839.2	G	1129.4
BGHM-1	6/22/2023	327.2*	733		
BGHM-1	6/27/2023	33.8	1250		
BGHM-1	7/11/2023	6.6	365.4		
BGHM-1	8/10/2023	0.5	1297.6		
BGHM-1	8/15/2023	10.2	331.6		
BGHM-1	8/17/2023	23.8	651		581.1
BGHM-1	8/21/2023	4.2	325.5		
BGHM-1	8/22/2023	2.7	727		

^H = The analytical holding times for analysis are exceeded. G = The actual number was probably greater than the number reported.
*Flow was not measured due to non-wadeable conditions. Flow was estimated by calculating the average ratio of known 2023 flows at BGHM-1 to USGS 02419000 gauge flows for the corresponding date and multiplying that ratio by the gauge flow for the sampling dates when flow was not measured.

7.3 Bughall Creek Watershed Photos (July 11, 2023)

Photo 7-1 Bughall Creek at BGHM-1 (Bullock County Road 177), Looking Upstream

Photo 7-2 Bughall Creek at BGHM-1 (Bullock County Road 177), Looking Upstream

7.4 Bughall Creek Watershed Photos (February 27, 2024)

Photo 7-3 Bughall Creek at Highway 82, Looking Upstream

Photo 7-4 Bughall Creek at Highway 82, Looking Downstream

Photo 7-5 Bughall Creek at Highway 110, Looking Upstream

Photo 7-6 Bughall Creek at Highway 110, Looking Downstream