Final

Total Maximum Daily Load (TMDL)

For

Chase Creek

Assessment Unit ID# AL06030002-0403-302

Madison County

Pathogens (*E. coli*)

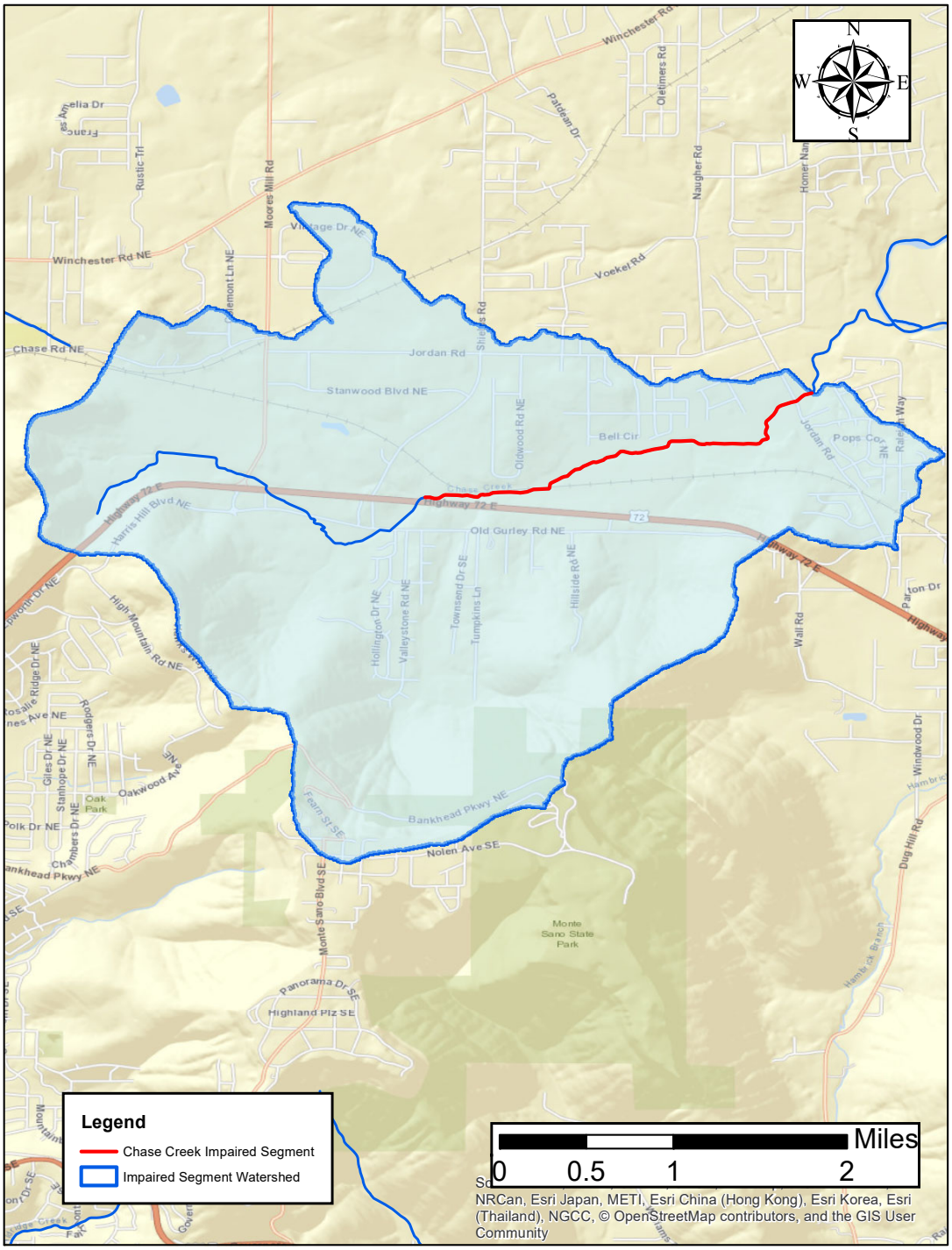
Alabama Department of Environmental Management

Water Quality Branch

Water Division

August 2022

Figure 1: Chase 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).

Chase Creek in Madison County, part of the Tennessee River basin, is currently included on Alabama's §303(d) list as impaired for pathogens (*E. coli*) from Acuff Spring to Alabama Highway 72. This segment of Chase Creek has a designated use classification of Fish and Wildlife (F&W). The headwater source of Chase Creek begins northeast of Huntsville, Alabama. The creek flows along Alabama Highway 72 and ends at its confluence with the Flint River. The total drainage area for the Chase Creek watershed is approximately eight square miles.

Chase Creek was first listed as impaired for pathogens on the §303(d) list in 2018 based on data collected by the Alabama Department of Environmental Management (ADEM) in 2015. The exceedances were found at station CHSM-190. This data, which can be found in Appendix 7.2, Table 11, indicated the stream was impaired for *E. coli*.

Sampling studies were performed by ADEM on Chase Creek to further assess the water quality of the impaired stream. For purposes of this TMDL, data from 2021 will be used to assess the water quality of Chase Creek because it is the most current data and provides the best picture of the current water quality conditions of the stream. The 2022 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. All of the available and recent bacterial data is listed in the Appendix for reference. ADEM collected 16 samples at station CHSM-190 on Chase Creek in 2021 and, according to the collected data, Chase 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 Chase Creek.

A mass balance approach was used for calculating the pathogen TMDL for Chase 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/100mL-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 *E. coli* violation of 2419.6 colonies/100 mL measured on August 12, 2021 at station CHSM-190. This violation calls for a reduction of 89%.

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. Table 2 lists the TMDL, defined as the maximum allowable *E. coli* loading under critical conditions for Chase Creek.

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

Source	Existing Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	% Reduction
Single Sample Load	1.18E+10	1.31E+9	1.05E+10	89%
Geometric Mean Load	2.64E+10	6.24E+9	2.01E+10	76%

Table 2. *E. coli* TMDL for Chase 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
1.46E+9	1.46E+8	N/A	89%	0	1.31E+9	89%

Note: N/A = not applicable
a. There are no CAFOs in the Chase Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. 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 maximum criterion of 298 colonies/100 ml.

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 Chase 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 2.14-mile segment of Chase Creek from Acuff Spring to Alabama Highway 72 as impaired for pathogens. Chase Creek was originally listed on Alabama's 2018 List of Impaired Waters for pathogens based on data collected in 2015. The source of the pathogens impairment is listed on the 2018 §303(d) list as pasture grazing.

2.2 Problem Definition

Waterbody Impaired:	Chase Creek, from Acuff Spring to Alabama Highway 72
Impaired Reach Length:	2.14 miles
Impaired Drainage Area:	8 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.

(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 areas 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 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.

Criteria Exceeded:

Chase Creek was included on Alabama's 2018 §303(d) list for pathogens (*E. coli*) based on data collected in 2015. Monthly sample results taken from CHSM-190 for *E.coli* showed 9 out of 13 samples exceeding the single sample criterion. The *E. coli* geometric mean criterion was also exceeded in 2015. This data can be seen in Appendix 7.2, Table 11.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

For the purpose of this TMDL, a single sample maximum *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 of 298 colonies/100 ml to be exceeded. In addition, a geometric mean *E. coli* 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 derived by using a 10% explicit margin of safety from the geometric mean maximum of 126 colonies/100 ml criterion. This target is considered protective of water quality standards and should not allow the geometric mean of 126 colonies/100 ml to be exceeded.

3.2 Source Assessment

3.2.1 Point Sources in the Chase 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.

There are no NPDES regulated continuous point sources in the Chase Creek watershed that would contribute to the *E. coli* loading. There are several facilities with NPDES general permits and one facility with an NPDES industrial individual permit in the watershed; however, it is not believed that these facilities are contributing to the pathogen impairment in Chase Creek based on the nature of their processes.

Urban areas designated as part of the Municipal Separate Storm Sewer System (MS4) program are regulated by NPDES, and as such, are considered to be point sources by EPA and receive waste load allocations (WLAs) in TMDLs. The EPA defines an MS4 as *"a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):*

(i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law);

(ii) Designed or used for collecting or conveying stormwater;

(iii) Which is not a combined sewer; and

(iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2."

During rain events in an urbanized watershed, stormwater runoff has the potential to collect pollutants which are transported through MS4 systems before discharging into state waters. Therefore, in 1990 the EPA developed the NPDES stormwater program, which promulgated rules, in two different phases, in order to address the potential negative water quality effects associated with stormwater runoff. In 1990, the EPA issued Phase I regulations under the NPDES stormwater program, which required both medium and large cities and also counties with populations of 100,000 or more to obtain NPDES permit coverage specifically for their stormwater discharges. In 1999, the second phase of the NPDES stormwater program amended existing regulations in addition to requiring NPDES permits for stormwater discharges from certain small MS4 systems.

A portion of the Chase Creek watershed is classified as an MS4 area and therefore must be addressed in the TMDL as part of the WLA. The Chase Creek watershed contains areas included in one Phase I permit and one Phase II permit. Contributions from the Phase I and Phase II MS4 areas drain to the pathogen impaired segment of the Chase Creek watershed and will be allocated as MS4 WLAs in the TMDL. The table below lists the MS4 permits within the Chase Creek watershed.

Table 3. MS4 Permits in the Chase Creek Watershed

Permit Number	Name	Phase
ALS000005	City of Huntsville	I
ALR040014	Madison County	II

There are currently no Animal Feeding Operation/Concentrated Animal Feeding Operation (AFO/CAFO) facilities located within the Chase 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.

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.

3.2.2 Nonpoint Sources in the Chase 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. Stormwater runoff from pastures and animal feeding areas can be a source of *E. coli*. In addition, improper land application of animal wastes and animals with direct access to streams are 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 storm water runoff, unpermitted discharges of wastewater, runoff from improper disposal of waste materials, failing septic tanks, and domestic animals. On-site septic systems 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 Chase Creek watershed was determined using ArcMap with land use datasets derived from the 2019 National Land Cover Dataset (NLCD). The total drainage area of the Chase Creek watershed is approximately 8.03 square miles. Table 4 depicts the primary land uses in the Chase Creek watershed.

The majority of the Chase Creek watershed is comprised of forested/natural land (43.57%) and developed land (38.94%). Developed land includes both commercial and residential land uses. The remaining land use is approximately 17.5% agricultural land and 0.01% open water.

Figure 2. Land Use in the Chase Creek Watershed

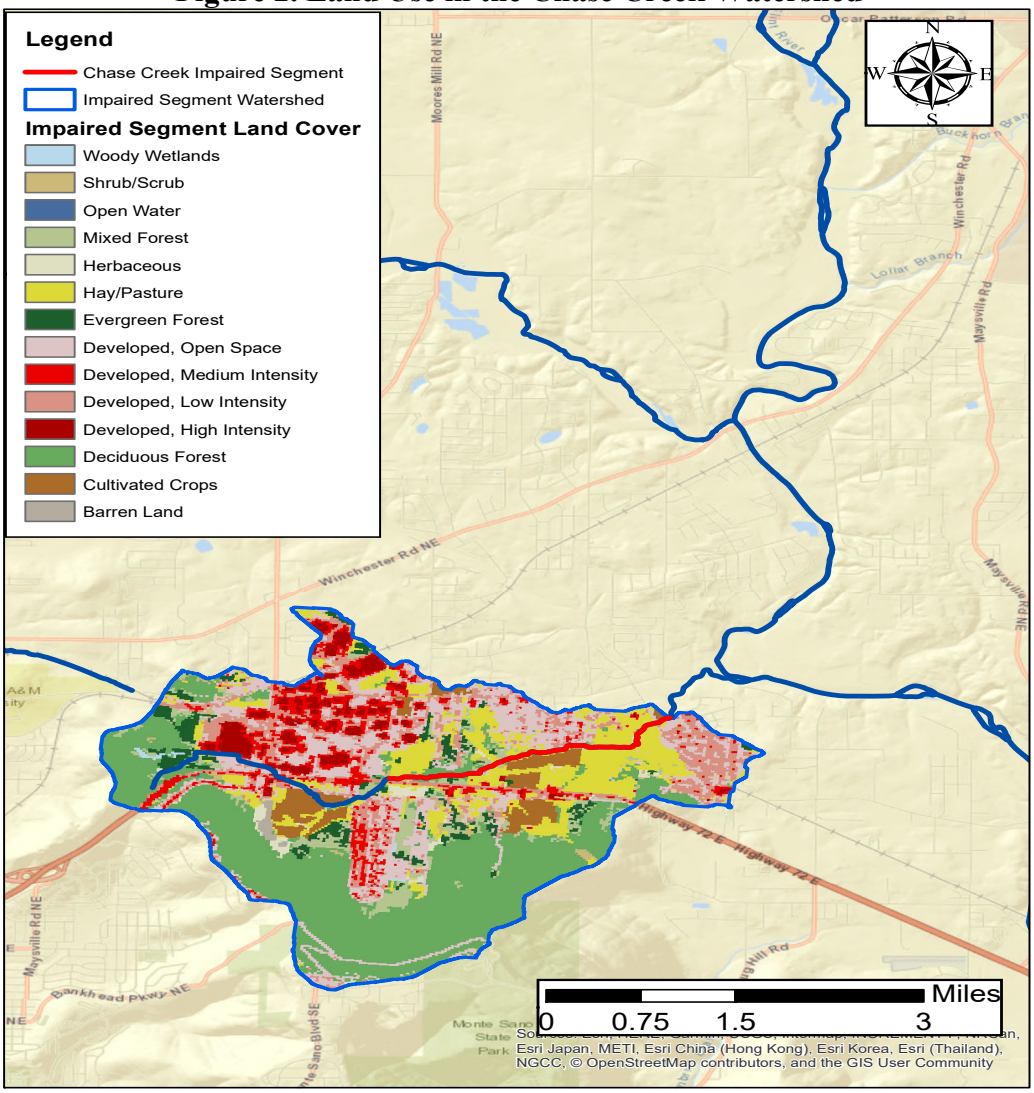

Figure 3: Pie Chart of Land Use Distribution in the Chase Creek Watershed

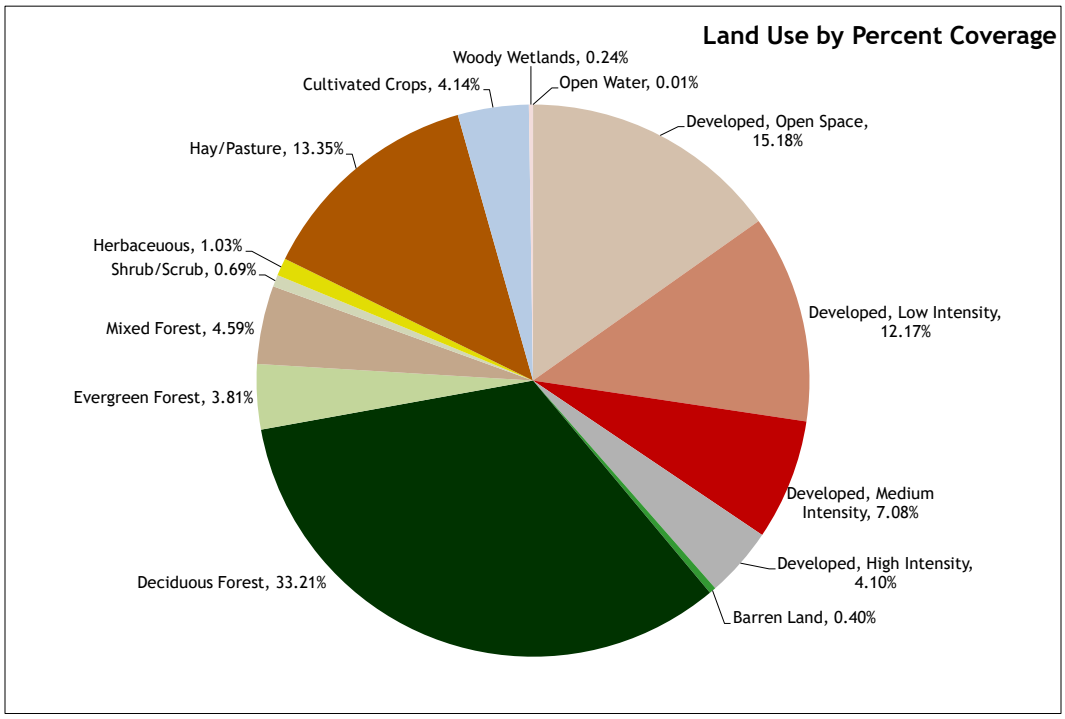

Table 4: Land Use (2019) in the Chase Creek Watershed

Land Use	Miles^2	Acres	Percent
Open Water	0.00	0.44	0.01%
Developed, Open Space	1.22	779.94	15.18%
Developed, Low Intensity	0.98	625.37	12.17%
Developed, Medium Intensity	0.57	363.84	7.08%
Developed, High Intensity	0.33	210.83	4.10%
Barren Land	0.03	20.46	0.40%
Deciduous Forest	2.67	1705.99	33.21%
Evergreen Forest	0.31	195.49	3.81%
Mixed Forest	0.37	235.74	4.59%
Shrub/Scrub	0.06	35.36	0.69%
Herbaceous	0.08	53.15	1.03%
Hay/Pasture	1.07	685.64	13.35%
Cultivated Crops	0.33	212.61	4.14%
Woody Wetlands	0.02	12.45	0.24%
Emergent Herbaceous Wetlands	0.00	0.00	0.00%
Totals→	**8.03**	**5137.32**	**100.00%**
Class Description	**Miles^2**	**Acres**	**Percent**
Open Water	0	0.44	0.01%
Agricultural Lands	1.40	898.25	17.48%
Forested/Natural	3.50	2238.18	43.57%
Developed Land (Grouped)	3.13	2000.44	38.94%
Totals→	**8.03**	**5137.32**	**100.00%**

3.4 Linkage between Numeric Targets and Sources

The major land usages in the Chase Creek watershed are forested/natural, developed, and agriculture. 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 Chase Creek are from the agricultural land uses, urban runoff, and leaking or failing septic tanks. 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 will be calculated as a single total nonpoint source load and reduction.

3.5 Data Availability and Analysis

In 2021, ADEM performed §303(d) sampling on Chase Creek to further assess the water quality of the impaired stream. For purposes of this TMDL, the data from 2021 will be used to assess the water quality of Chase Creek because it is the most current data and provides the best picture of the current water quality conditions of the stream. The 2022 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.

ADEM collected monthly water quality data for the Chase Creek watershed at station CHSM-190. A description of the location of station CHSM-190 can be found in Table 5 and a map showing the location of station CHSM-190 can be found in Figure 4. A total of sixteen *E. coli* samples were collected at station CHSM-190 in 2021. Of the sixteen samples that were collected, there were ten exceedances of the single sample maximum criterion. In addition, there were geometric mean exceedances at station CHSM-190 in both July 2021 and September 2021. Sampling completed at station CHSM-190 from July 8, 2021 to July 28, 2021 yielded a geometric mean of 443.95 colonies/100 ml. Sampling completed September 7, 2021 to September 27, 2021 yielded a geometric mean of 478.89 colonies/day. The average of the flows taken during July and September were calculated to be 1.55 cfs and 2.25 cfs, respectively; these were used for geometric mean load calculations. A complete list of available data used in this report and photographs at CHSM-190 can be found in Appendices 7.2 and 7.3.

Table 5: ADEM Sampling Station in the Chase Creek Watershed

Station Name	Agency Name	Latitude	Longitude	Description
CHSM-190	ADEM	34.7809	-86.4926	At Jordan Rd just upstream of Flint River

Figure 4: ADEM sampling station in the Chase Creek Watershed

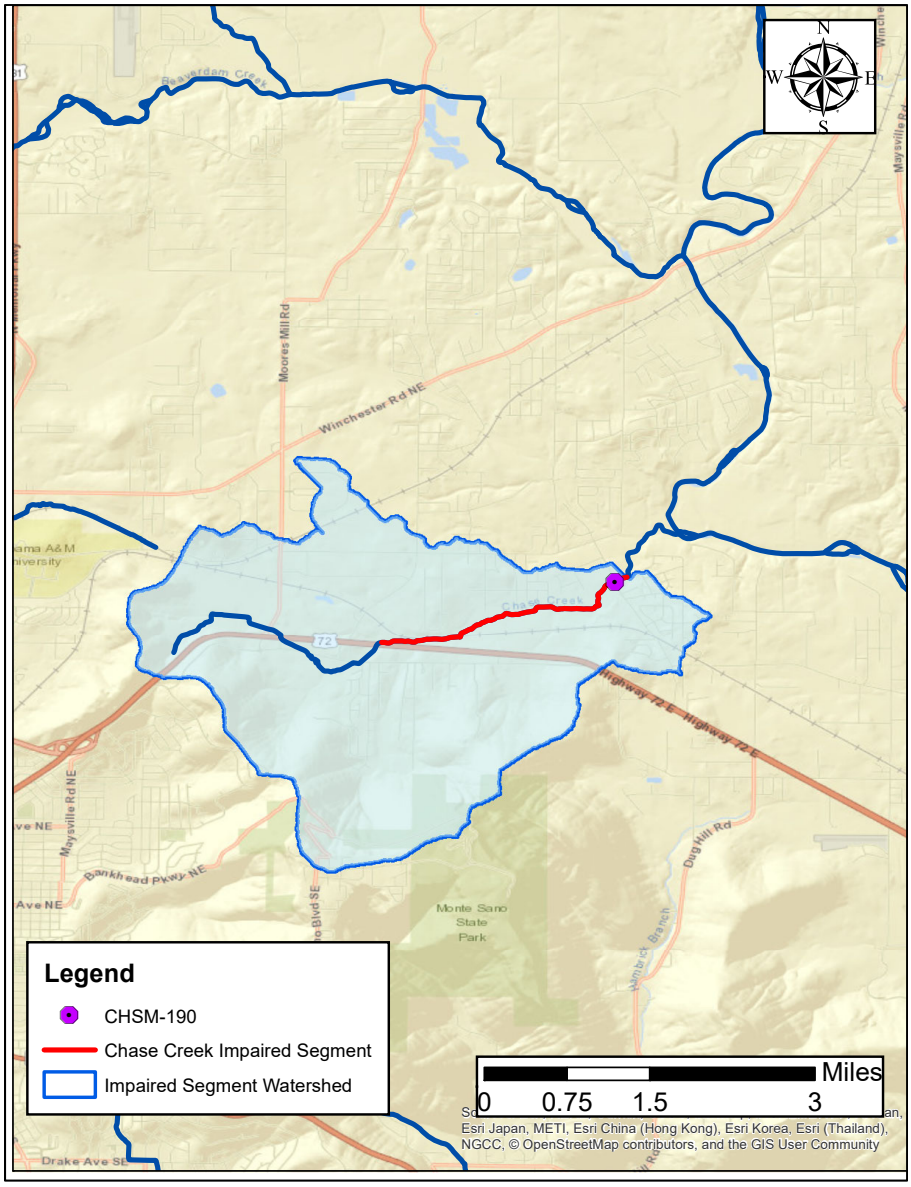

Table 6: 2021 *E. coli* data for Chase Creek (AL06030002-0403-302)

Station ID	Visit Date	Single Sample (col/100 ml)	*E. coli* Dc	Single Sample Criteria (col/100 ml)	Geometric Mean (col/100 ml)	Geometric Mean Criteria (col/100 ml)	Flow (cfs)
CHSM-190	3/11/2021	816.4	-	2,507			2.2965
CHSM-190	4/14/2021	231	-	2,507			4.4837
CHSM-190	5/20/2021	770.1	-	298			0.8686
CHSM-190	6/16/2021	816.4	-	298			-
CHSM-190	7/8/2021	145	-	298			-
CHSM-190	7/13/2021	686.7	-	298			2.8861
CHSM-190	7/22/2021	770	-	298	443.95	126	-
CHSM-190	7/26/2021	816.4	-	298			-
CHSM-190	7/28/2021	275.5	-	298			0.2105
CHSM-190	8/12/2021	2419.6	G	298			-
CHSM-190	9/7/2021	686.7	-	298			-
CHSM-190	9/9/2021	648.8	-	298			1.3336
CHSM-190	9/13/2021	206.4	-	298	478.89	126	0.4845
CHSM-190	9/24/2021	435.2	-	298			4.896
CHSM-190	9/27/2021	629.4	-	298			2.2909
CHSM-190	10/20/2021	240	-	298			0.2603

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

3.6 Critical Conditions

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 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 Chase Creek watershed generally follows the trends described above for the summer months of May through October. The maximum single sample concentration of 2419.6 colonies/100 ml at station CHSM-190 will be used to estimate the TMDL pathogen loadings to Chase Creek under critical conditions. The highest *E. coli* single sample exceedance value occurred on August 12, 2021. Since the flow was characterized as visible but not measurable with a meter on this date, a flow of 0.2 cfs will be assumed.

3.7 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the TMDL 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 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 criterion 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:

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

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

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

4.2 Load Calculations

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

4.2.1 Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest single sample *E. coli* concentration of 2419.6 colonies/100 ml times the estimated flow at the time the sample was taken. This concentration was based on a measurement at station CHSM-190 on August 12, 2021. This measurement can be found in Appendix 7.2, Table 10. The product of the concentration, estimated flow, and a conversion factor gives the total mass loading (colonies per day) of *E. coli* to Chase Creek under the single sample exceedance condition.

$$\frac{0.2\ \text{ft}^3}{\text{s}} \times \frac{2419.6\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.18 \times 10^{10}\text{colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean exceedance concentration of 478.89 colonies/100 ml times the average of the measured flows taken during the geometric mean sampling period. This concentration was calculated based on measurements at station CHSM-190 between September 7, 2021 and September 27, 2021, and can be found in Appendix 7.2, Table 10. The average stream flow was determined to be 2.25 cfs. The product of these two values times the conversion factor gives the total mass loading (colonies per day) of *E. coli* to Chase Creek under the geometric mean exceedance condition.

$$\frac{2.25\ \text{ft}^3}{\text{s}} \times \frac{478.89\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.64 \times 10^{10}\text{colonies}}{\text{day}}$$

4.2.2 Allowable Conditions

The **allowable load** to the watershed was calculated under the same physical conditions as discussed above for the single sample and geometric mean criteria. This was done by taking the product of the measured or estimated flow for the violation event, the allowable concentration, and the conversion factor.

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

$$\frac{0.2\ \text{ft}^3}{\text{s}} \times \frac{268.2\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.31 \times 10^{9}\text{colonies}}{\text{day}}$$

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

$$\frac{0.2\ \text{ft}^3}{\text{s}} \times \frac{29.8\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{1.46 \times 10^{8}\text{colonies}}{\text{day}}$$

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

$$\frac{2.25\ \text{ft}^3}{\text{s}} \times \frac{113.4\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{6.24 \times 10^{9}\text{colonies}}{\text{day}}$$

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

$$\frac{2.25\ \text{ft}^3}{\text{s}} \times \frac{12.6\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{6.94 \times 10^{8}\text{colonies}}{\text{day}}$$

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 Chase Creek as evaluated at station CHSM-190. Table 7 shows the existing and allowable *E. coli* loads and required reductions for the Chase Creek watershed.

Table 7: *E. coli* Loads and Required Reductions

Source	Existing Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	% Reduction
Single Sample Load	1.18E+10	1.31E+9	1.05E+10	89%
Geometric Mean Load	2.64E+10	6.24E+9	2.01E+10	76%

From Table 7, compliance with the single sample criterion of 298 colonies/100 ml requires a reduction of 89% in the *E. coli* load. The TMDL, WLA, LA, and MOS values necessary to achieve the applicable *E. coli* criteria are provided below in Table 8.

Table 8: *E. coli* TMDL for Chase 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)	(col/day)
1.46E+9	1.46E+8	N/A	89%	0	1.31E+9	89%

Note: N/A = not applicable
a. There are no CAFOs in the Chase Creek watershed. Future CAFOs will be assigned a waste load allocation (WLA) of zero.
b. 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 single sample maximum criterion of 298 colonies/100 ml.

4.3 TMDL Summary

Chase Creek was placed on Alabama's §303(d) list in 2018 based on data collected in 2015. Additional water quality data with *E. coli* serving as the primary pathogen indicator was collected by ADEM in 2021. The data collected by ADEM during that sampling period confirmed the pathogen impairment and provided the basis for TMDL development.

A mass balance approach was used to calculate the *E. coli* TMDL for Chase Creek. Based on the TMDL analysis, it was determined that an 89% 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 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 Chase 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 9.

Table 9: Follow-up Monitoring Schedule

River Basin Group	Years to be Monitored
Coosa, Escatawpa, Tennessee (Guntersville), Tombigbee	2022/2025
Alabama, Cahaba, Mobile, Tallapoosa, Tennessee (Pickwick and Wilson)	2023/2026
Black Warrior, Blackwater, Chattahoochee, Chipola, Choctawhatchee, Escambia, Perdido, Tennessee (Wheeler), Yellow	2024/2027

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 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. 2015, 2021. ADEM.

Alabama Department of Environmental Management (ADEM), Alabama's Water Quality Assessment and Listing Methodology, 2022.

Alabama's §303(d) List and Fact Sheet. 2018, 2020. 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 10: 2021 *E. coli* Data for Station CHSM-190

Station ID	Visit Date	Single Sample (col/100 ml)	*E. coli* Dc	Single Sample Criteria (col/100 ml)	Geometric Mean (col/100 ml)	Geometric Mean Criteria (col/100 ml)	Flow (cfs)
CHSM-190	3/11/2021	816.4	-	2,507			2.2965
CHSM-190	4/14/2021	231	-	2,507			4.4837
CHSM-190	4/22/2021	-	-	-			0.781
CHSM-190	5/19/2021	-	-	-			0.879
CHSM-190	5/20/2021	770.1	-	298			0.8686
CHSM-190	6/15/2021	-	-	-			-
CHSM-190	6/16/2021	816.4	-	298			-
CHSM-190	7/8/2021	145	-	298			-
CHSM-190	7/13/2021	686.7	-	298			2.8861
CHSM-190	7/22/2021	770	-	298	443.95	126	-
CHSM-190	7/26/2021	816.4	-	298			-
CHSM-190	7/28/2021	275.5	-	298			0.2105
CHSM-190	8/12/2021	2419.6	G	298			-
CHSM-190	9/7/2021	686.7	-	298			-
CHSM-190	9/9/2021	648.8	-	298			1.3336
CHSM-190	9/10/2021	-	-	-	478.89	126	1.074
CHSM-190	9/13/2021	206.4	-	298			0.4845
CHSM-190	9/24/2021	435.2	-	298			4.896
CHSM-190	9/27/2021	629.4	-	298			2.2909
CHSM-190	10/20/2021	240	-	298			0.2603

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

Table 11. 2015 *E. coli* Listing Data for Station CHSM-190

Station ID	Visit Date	Single Sample (col/100 mL)	*E. coli* Dc	Single Sample Criteria (col/100 ml)	Geometric Mean (col/100 ml)	Geometric Mean Criteria (col/100 ml)	Flow (cfs)
CHSM-190	3/17/2015	64	-	2,507			10.9777
CHSM-190	4/7/2015	579	-	2,507			9.1298
CHSM-190	5/12/2015	193.5	-	298			1.0309
CHSM-190	6/1/2015	2419.6	-	298			1.0157
CHSM-190	6/10/2015	290.9	-	298			-
CHSM-190	6/17/2015	1119.9	-	298			-
CHSM-190	7/14/2015	686.7	-	298			0.1403
CHSM-190	8/18/2015	8664	-	298	1021.6	126	21.2903
CHSM-190	8/19/2015	1014	-	298			-
CHSM-190	8/20/2015	908	-	298			1.6958
CHSM-190	8/24/2015	461.1	-	298			-
CHSM-190	8/26/2015	613.1	-	298			0.3623
CHSM-190	8/31/2015	504	-	298			-

7.3 Chase Creek Watershed Photos

Figure 5. At Station CHSM-190: Upstream View of Chase Creek (8/12/2021)

Figure 6. At Station CHSM-190: Downstream View of Chase Creek (8/12/2021)

Figure 7: At Station CHSM-190: Upstream View of Chase Creek (10/20/2021)

Figure 8: At Station CHSM-190: Downstream View of Chase Creek (10/20/2021)