Final
Total Maximum Daily Load (TMDL)
for
High Pine Creek

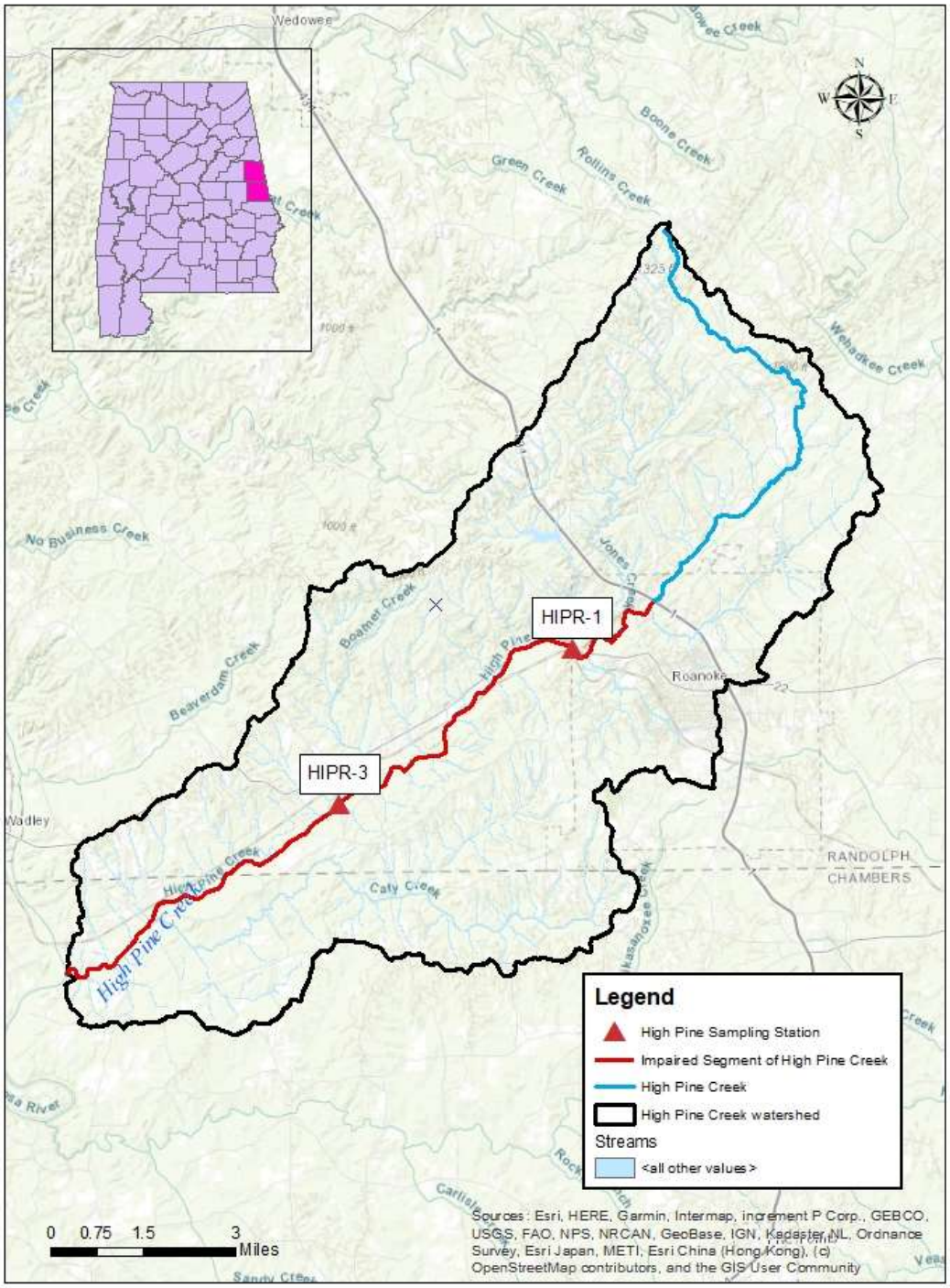
Assessment Unit ID Number
AL03150109-0303-100

Randolph and Chambers Counties

Pathogens (*E. coli*)

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

Figure 1-1 Map of High Pine Creek Watershed and ADEM Sampling Stations



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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).

High Pine Creek is currently included on Alabama's §303(d) list for pathogens (*E. coli*) from Highway 431 in Randolph County to the Tallapoosa River in Chambers County. The total impaired length for the impaired segment of High Pine Creek is 13.74 miles, and the total drainage area of the High Pine Creek watershed is 78.7 square miles. The impaired segment has a use classification of Fish & Wildlife (F&W).

High Pine Creek was first included on the §303(d) list for pathogens in 2018 based on ADEM monitoring data collected in 2016 at station HIPR-1. High Pine Creek has subsequently been listed for pathogens 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 the purposes of this TMDL, the 2023 data will be used to assess the water quality of High Pine 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 stations HIPR-1 and HIPR-3. The collective bacterial data is listed in Appendix 7.2, Tables 7-1 and 7-2 for reference. In 2023, ADEM collected 14 *E. coli* samples at station HIPR-1 and 14 samples at station HIPR-3. Two geometric mean studies were conducted at each station on High Pine Creek in 2023. According to the data, High Pine 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 High Pine 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).

Table 1-1 is a summary of the TMDL, defined as the maximum allowable *E. coli* loading under critical conditions for High Pine Creek.

Table 1-1 *E. coli* TMDL for High Pine Creek

TMDL[a]	Margin of Safety (MOS)	Waste Load Allocation (WLA)[e]			Load Allocation (LA)	
		WWTPs[b]	MS4s[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
4.55E+10	4.55E+9	7.17E+9	NA	0	3.38E+10	92%

Note: NA = not applicable
a. TMDL was established using the geometric mean criterion of 126 colonies/100ml.
b. Future WWTPs must meet the applicable instream 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. Future CAFOs will be assigned a wasteload allocation (WLA) of zero.

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 High Pine Creek watershed. As additional data and/or information becomes available, it may become necessary to revise and/or modify the TMDL accordingly.

2.0 Basis for §303(d) Listing

2.1 Introduction

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify waterbodies which are not meeting their designated uses and to determine the total maximum daily load (TMDL) for pollutants causing use impairment. The TMDL process establishes the allowable loading of pollutants for a waterbody based on the relationship between pollution sources and instream water quality conditions, so that states can establish water-quality based controls to reduce pollution and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Alabama has identified 13.74 miles of High Pine Creek as impaired for pathogens. The §303(d) listing for pathogens was originally reported on Alabama's 2018 List of Impaired Waters based on 2016 ADEM monitoring data from station HIPR-1. The source of the impairment on the 2022 §303(d) list is listed as pasture grazing and collection system failure.

2.2 Problem Definition

Waterbody Impaired:	High Pine Creek – from Highway 431 in Randolph County to its confluence with the Tallapoosa River in Chambers County.
Impaired Reach Length:	13.74 miles

Impaired Drainage Area:	78.7 square miles
Water Quality Standard Violation:	Pathogens (single sample, geometric mean)
Pollutant of Concern:	Pathogens (*E. coli*)
Water Use Classification:	Fish & Wildlife (F&W)

Usage Related to Classification:
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 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:

(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:
High Pine Creek was first included on the §303(d) list for pathogens in 2018 based on ADEM's 2016 *E. coli* data collected at station HIPR-1. Of the eight *E. coli* samples collected at station HIPR-1 in 2016, three exceeded the applicable single sample criterion of 298 colonies/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 for High Pine Creek. 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 geometric mean 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

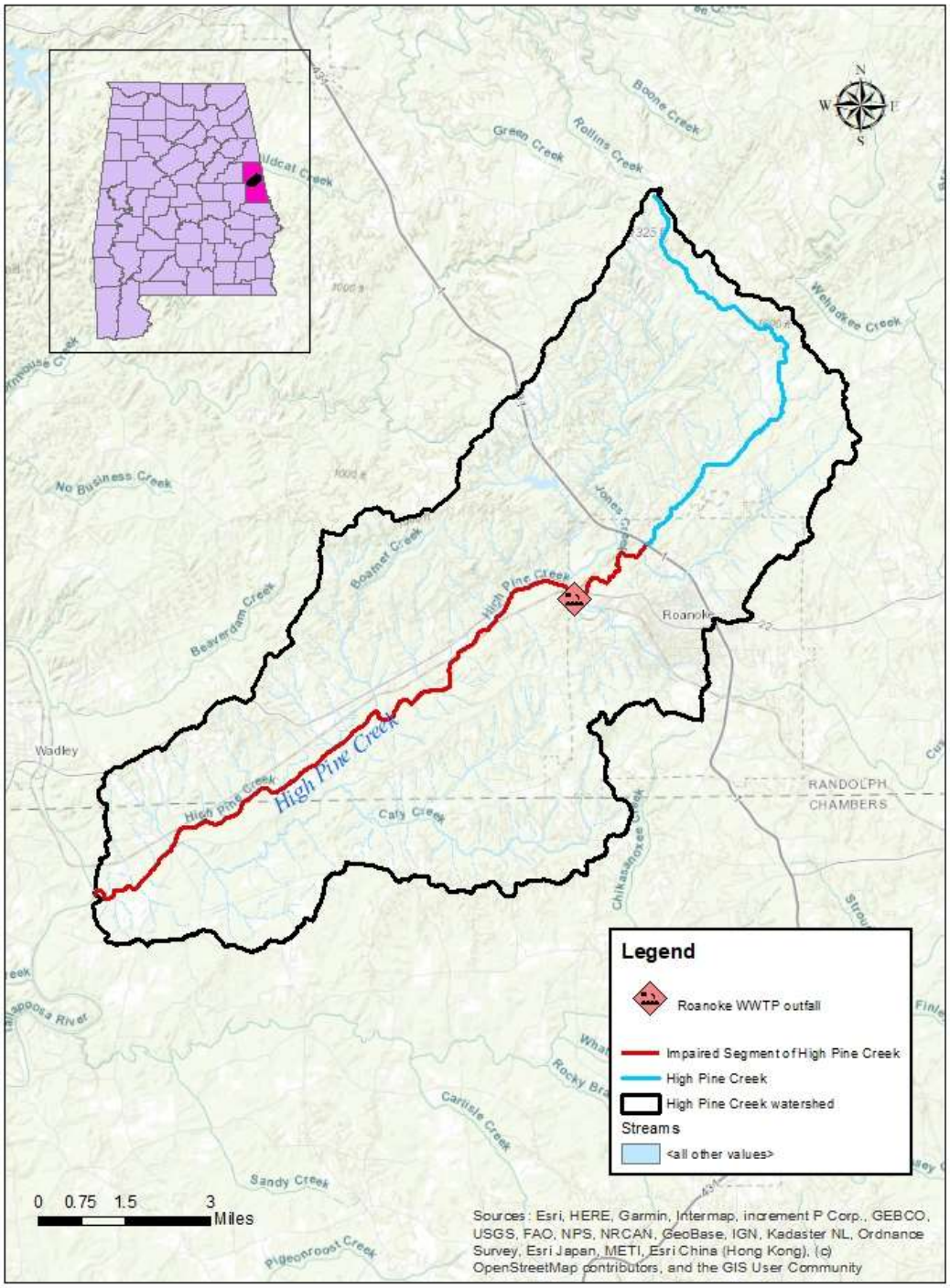
3.2.1 Point Sources in the High Pine Creek Watershed

A point source can be defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source contributions can typically be attributed to municipal wastewater facilities, illicit discharges, and leaking sewer systems in urban areas. Municipal wastewater treatment facilities are permitted through the National Pollutant Discharge Elimination System (NPDES) process administered by ADEM. In urban settings, sewer lines typically run parallel to streams in the floodplain. If a leaking sewer line is present, high concentrations of 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
There is one NPDES-permitted municipal wastewater treatment facility in the High Pine Creek watershed. Roanoke WWTF (AL0062715) is a major (>1 MGD) wastewater treatment plant with a design discharge flow of 1.5 MGD. The location of the facility is shown below in Figure 3-1; it is located just upstream of ADEM station HIPR-1. Roanoke WWTF has daily maximum and monthly average *E. coli* limits. The permit limits are the applicable pathogen criteria for the Fish and Wildlife use classification and are as follows:

Monthly average (May-October): 126 colonies/100ml
Monthly average (November-April): 548 colonies/100ml
Daily maximum (May-October): 298 colonies/100ml
Daily maximum (November-April): 2507 colonies/100ml

Figure 3-1 Map of Discharger in the High Pine Creek Watershed



Non-Continuous Point Sources

There is currently one NPDES stormwater discharge permit and one NPDES water treatment facility permit within the High Pine Creek watershed (see Table 3-1 below). These facilities are not required to monitor for *E. coli* under their current NPDES permits and are not considered to be a source of pathogens due to the nature of their processes. No *E. coli* loading to the watershed will be attributed to these facilities, and they will not receive an allocation in this TMDL.

Table 3-1 Permitted Non-Continuous Dischargers in the High Pine Creek Watershed

Permit Number	Name
AL0064661	Aladdin Manufacturing Corp.
ALG640045	Roanoke Water Filter Plant

There are no Concentrated Animal Feeding Operations (CAFOs) or Voluntary Animal Feeding Operations (AFOs) listed in the High Pine Creek watershed. AFOs/CAFOs are required to implement and maintain effective best management practices (BMPs) that meet or exceed Natural Resources Conservation Service (NRCS) technical standards and guidelines, and the ADEM AFO/CAFO rules currently prohibit point source discharges of pollutants from these facilities and their associated land application activities. As a result, future AFOs/CAFOs will receive a wasteload allocation of zero.

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 several SSOs have been reported in the High Pine Creek watershed in recent years. Since 2018, 32 SSOs within the watershed have been reported from the Roanoke WWTF. The numerous reported SSOs are considered a source of pathogens to High Pine Creek. The SSOs are shown in Appendix 7.2, Table 7-3, and a map of the SSO locations is shown in Figure 7-1.

3.2.2 Nonpoint Sources in the High Pine Creek Watershed

Nonpoint sources of *E. coli* bacteria do not have a defined discharge point, but rather occur over the entire length of a stream or waterbody. On the land surface, *E. coli* bacteria can accumulate over time 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.

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 High Pine Creek watershed was determined using ArcMap with land use datasets derived from the 2021 National Land Cover Dataset (NLCD). Table 3-2, Figure 3-2, and Figure 3-3 display the land use areas for the High Pine Creek watershed.

The majority of the High Pine Creek watershed is forested/natural (77.32%). Other land uses include agriculture (13.34%) and developed land (8.44%). The remaining 0.90% of the land area consists of open water. If not managed properly, agriculture can have significant nonpoint source impacts. Septic systems can also be a main source of bacteria if not properly installed and maintained.

Table 3-2 Land Use Areas for the High Pine Creek Watershed

Cumulative Land Use	Mi^2	Acres	Percent
Open Water	0.71	453.31	0.90%
Forested/Natural	60.85	38944.54	77.32%
Agriculture	10.50	6719.09	13.34%
Developed (cumulative)	6.64	4251.06	8.44%
Total	**78.70**	**50368.00**	**100.0%**

Figure 3-2 Land Use Graph for the High Pine Creek Watershed

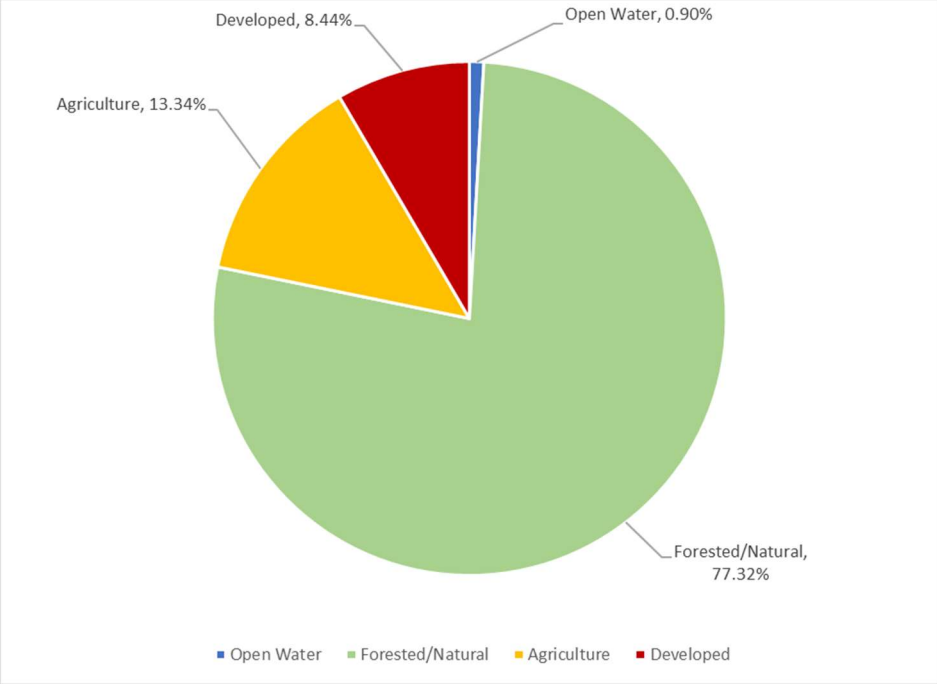
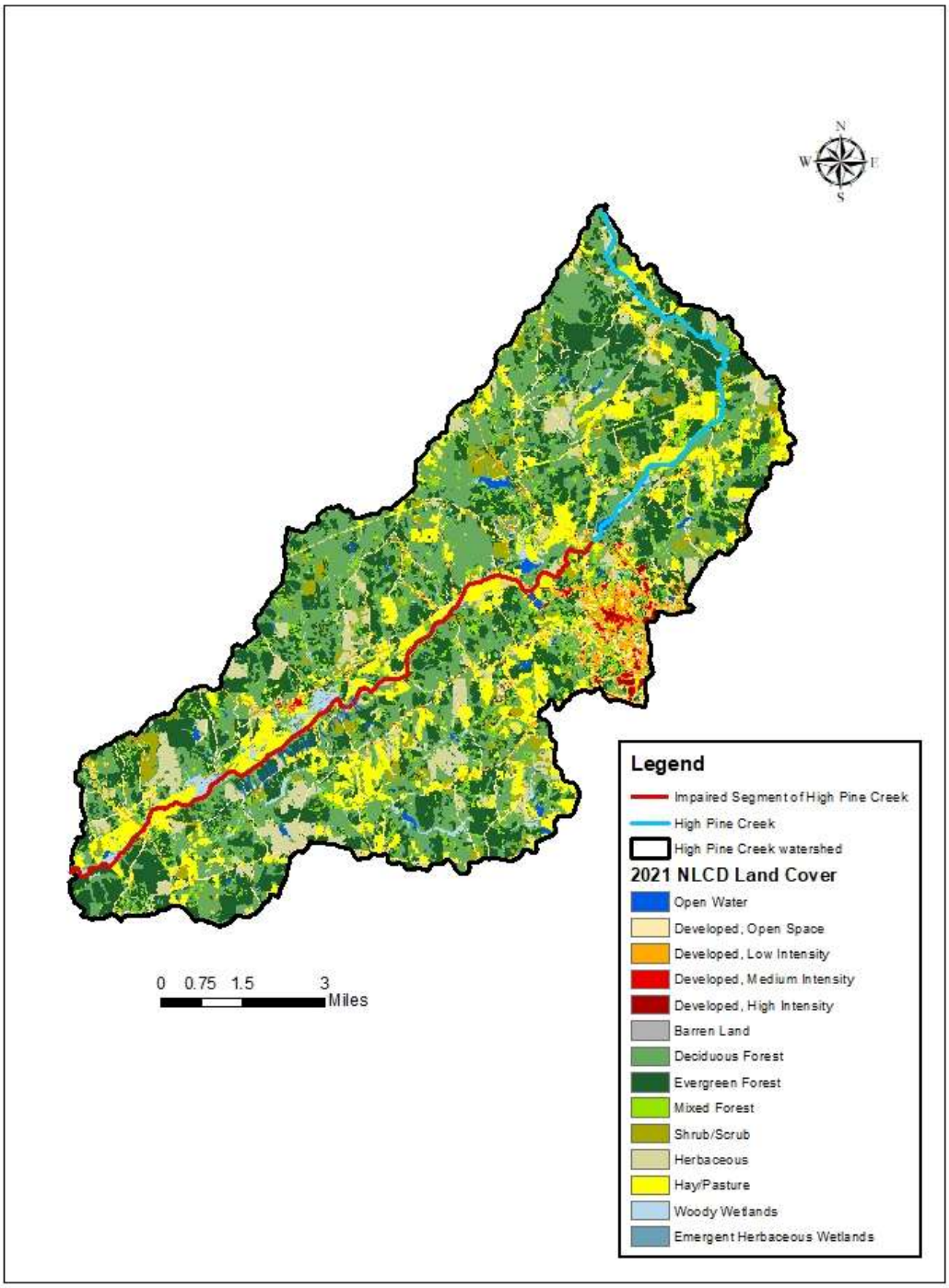


Figure 3-3 Land Use Map for the High Pine Creek Watershed



3.4 Linkage Between Numeric Targets and Sources

The High Pine 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 High Pine Creek are from the agricultural land uses, sanitary sewer overflows, 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 High Pine Creek at stations HIPR-1 and HIPR-3. Figure 1-1 and Table 3-3 display the location and description, respectively, for these stations. The 2023 data, shown in Tables 3-4 and 3-5, 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 3-3 ADEM Sampling Stations in the High Pine Creek Watershed

Station ID	Station Location	Latitude	Longitude
HIPR-1	High Pine Creek at Randolph CR 855	33.161013	-85.40357
HIPR-3	High Pine Creek at Randolph CR 3	33.124869	-85.46979

HIPR-1: Of the 14 *E. coli* samples collected in 2023, a total of 12 violated the single sample maximum criterion of 298 col/100 ml for the Fish and Wildlife use classification. The June 2023 and August 2023 geometric mean values both exceeded the geometric mean criterion (126 colonies/100 mL) for High Pine Creek. The 2023 data for HIPR-1 is shown below in Table 3-4.

Table 3-4 2023 *E. coli* data at HIPR-1

Station HIPR-1				
Visit Date	Single Sample (col/100 ml)	*E. coli* dc*	Geometric Mean (col/100 ml)	Flow (cfs)
3/21/2023	1986.3	H		28
5/2/2023	461.1	H		38.7
6/6/2023	2419.6		1408.3	15
6/8/2023	1373.4			13.8
6/13/2023	1632.8			12.5
6/21/2023	1542			
6/26/2023	662			17.8
7/12/2023	613.1	H		36.6
8/2/2023	307.6		137.5	6.5
8/7/2023	648.8			14.8
8/9/2023	307.6			11.9
8/14/2023	774.6			31.2
8/16/2023	142.1			17.2
9/6/2023	1553.1			7.4

*H = The analytical holding times for analysis are exceeded.

HIPR-3: Of the 14 *E. coli* samples collected in 2023, a total of nine violated the single sample maximum criterion of 298 col/100 ml for the Fish and Wildlife use classification. The June 2023 and August 2023 geometric mean values both exceeded the geometric mean criterion (126 colonies/100 mL) for High Pine Creek. The 2023 data for HIPR-3 is shown below in Table 3-5.

Table 3-5 2023 *E. coli* data at HIPR-3

Station HIPR-3				
Visit Date	Single Sample	*E. coli* dc*	Geometric Mean (col/100 ml)	Flow (cfs)
3/21/2023	686.7	H		94.4
5/2/2023	365.4	H		49.9
6/6/2023	365.4			8.8
6/8/2023	228.2			30.1
6/13/2023	307.6		395.43	27.7
6/21/2023	1050			98.2
6/26/2023	359			38.7
7/12/2023	248.9	H		47.4
8/2/2023	410.6			11.8
8/7/2023	727			31.8
8/9/2023	172.5		405.2	21.1
8/14/2023	615.2			63.5
8/16/2023	344.8			38.8
9/6/2023	275.5			11.8

*H = The analytical holding times for analysis are exceeded.

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 dispensing of *E. coli* bacteria into streams, resulting in spikes of *E. coli* bacteria counts. In winter, frequent low intensity rain events are more typical and do not allow for the build-up of *E. coli* bacteria on the land surface, resulting in a more uniform loading rate.

The High Pine Creek watershed 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* geometric mean exceedance value. That value was 1408.3 colonies/100 ml, which occurred at station HIPR-1 between June 6, 2023, and June 26, 2023. The average flow during this time was 14.8 cfs. The use of the highest exceedance to calculate the TMDL is expected to be protective of water quality in High Pine 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 flow data. For the F&W classification, the single sample *E. coli* maximum value of 298 colonies/100 ml was reduced by 10% to 268.2 colonies/100 ml. The geometric mean criterion of 126 colonies/ml was also reduced ten percent 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 wasteload 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 High Pine 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 and the geometric mean criterion. There were both 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, whether it be the single sample or geometric mean.

Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest single sample exceedance concentration by the flow on the day of the exceedance. The highest exceedance occurred on June 6, 2023, at station HIPR-1. The product of the concentration, flow, and the conversion factor gives the total mass loading (colonies per day) of *E. coli* to High Pine Creek.

$$\frac{15\ \text{ft}^3}{s} \times \frac{2419.6\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{8.88 \times 10^{11}\text{colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean exceedance concentration times the average of the measured stream flows over the geometric mean sampling period. This concentration was calculated based on measurements between June 6 through June 26, 2023, at station HIPR-1. The average streamflow for this time was 14.8 cfs. The product of the average streamflow, the

geometric mean value, and the conversion factor gives the total mass loading (colonies per day) of *E. coli* to High Pine Creek under the geometric mean exceedance condition.

$$\frac{14.8\ \text{ft}^3}{s} \times \frac{1408.3\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{5.09 \times 10^{11}\text{colonies}}{\text{day}}$$

The **continuous point sources** mass loading was calculated by taking the average discharge flow from the month of June 2023 (since this is when the highest exceedance occurred) and multiplying that by the reported monthly average *E. coli* value for the same month for the permitted facility in the High Pine Creek watershed. These numbers were found in the June 2023 Discharge Monitoring Reports (DMRs) submitted by the Roanoke WWTF.

Roanoke WWTF (AL0062715):

$$0.415\ MGD\ \times \frac{1.55\ ft^3}{s * MGD} \times \frac{33.46\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{5.27 \times 10^8 colonies}{day}$$

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 and the allowable concentration. This value was then multiplied by the conversion factor to calculate the allowable load. These calculations can be seen below.

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

$$\frac{15\ \text{ft}^3}{s} \times \frac{268.2\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{9.84 \times 10^{10}\text{colonies}}{\text{day}}$$

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

$$\frac{15\ \text{ft}^3}{s} \times \frac{29.8\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{1.09 \times 10^{10}\text{colonies}}{\text{day}}$$

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

$$\frac{14.8\ \text{ft}^3}{s} \times \frac{113.4\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{4.10 \times 10^{10}\text{colonies}}{\text{day}}$$

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

$$\frac{14.8\ \text{ft}^3}{s} \times \frac{12.6\ \text{colonies}}{100\text{ml}} \times \frac{24{,}465{,}755\ 100\text{ml} * s}{\text{ft}^3 * \text{day}} = \frac{4.55 \times 10^{9}\text{colonies}}{\text{day}}$$

The WLA for the continuous point sources was calculated by multiplying the design flow of the facility by the applicable geometric mean *E. coli* criterion (monthly average permit limitation). This value was then multiplied by a conversion factor to come up with the appropriate loading.

Roanoke WWTF (AL0062715):

$$1.5\ MGD\ \times \frac{1.55\ ft^3}{s * MGD} \times \frac{126\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{7.17 \times 10^9 colonies}{day}$$

The difference in the pathogen loading between the existing condition (violation event) and the allowable condition converted to a percent reduction represents the total load reduction needed to achieve the *E. coli* water quality criteria. The TMDL was calculated as the total daily *E. coli* load to High Pine Creek as evaluated at station HIPR-1. Table 4-1 shows the existing and allowable *E. coli* loads and required reductions for the High Pine Creek watershed.

Table 4-1 *E. coli* Loads and Required Reductions for High Pine Creek

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Single Sample Load	8.88E+11	9.84E+10	7.90E+11	89%
Geometric Mean Load	5.09E+11	4.10E+10	4.68E+11	92%
Roanoke WWTF (AL0062715)	5.27E+8	7.17E+9	0	0%

From Table 4-1, compliance with the geometric mean criterion of 126 colonies/100 ml requires a reduction in the *E. coli* load of 92%. 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 High Pine Creek

TMDL[a]	Margin of Safety (MOS)	Waste Load Allocation (WLA)[e]			Load Allocation (LA)	
		WWTPs[b]	MS4s[c]	Leaking Collection Systems[d]		
(col/day)	(col/day)	(col/day)	(% reduction)	(col/day)	(col/day)	(% reduction)
4.55E+10	4.55E+9	7.17E+9	NA	0	3.38E+10	92%

Note: NA = not applicable
a. TMDL was established using the geometric mean criterion of 126 colonies/100ml.
b. Future WWTPs must meet the applicable instream 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. Future CAFOs will be assigned a wasteload allocation (WLA) of zero.

4.3 TMDL Summary

High Pine Creek was first included on the §303(d) list for pathogens in 2018 based on ADEM's *E. coli* data collected from station HIPR-1 in 2016. In 2023, ADEM collected water quality data at stations HIPR-1 and HIPR-3 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 High Pine Creek. Based on the TMDL analysis, it was determined that a 92% reduction in the *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 load allocation portion of this TMDL will be implemented through voluntary measures/best management practices (BMPs). Cooperation and active participation by the public and various other groups are 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 necessary to achieve applicable water quality criteria, and we are committed to targeting the load reductions to improve water quality in the High Pine Creek watershed. As additional data and/or information becomes available, it may become necessary to revise and/or modify the TMDL accordingly.

5.0 Follow-up Monitoring

ADEM has adopted a basin approach to water quality 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 to 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. 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 Appendix

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. 2016 & 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, and 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 2016 *E. Coli* Data Collected on High Pine Creek

Station	Visit Date	Flow (cfs)	*E. coli* (col/100 ml)	*E. coli* dc*
HIPR-1	3/15/2016	31.7	30.5	H
HIPR-1	4/5/2016	45.4	151.5	H
HIPR-1	5/3/2016	25.7	260.3	H
HIPR-1	6/7/2016	11.6	410.6	H
HIPR-1	7/5/2016	3.3	866.4	H
HIPR-1	8/9/2016	2.3	127.4	H
HIPR-1	9/13/2016		198.9	H
HIPR-1	10/11/2016		727	H

*H = The analytical holding times for analysis are exceeded.

Table 7-2 2023 *E. Coli* Data Collected on High Pine Creek

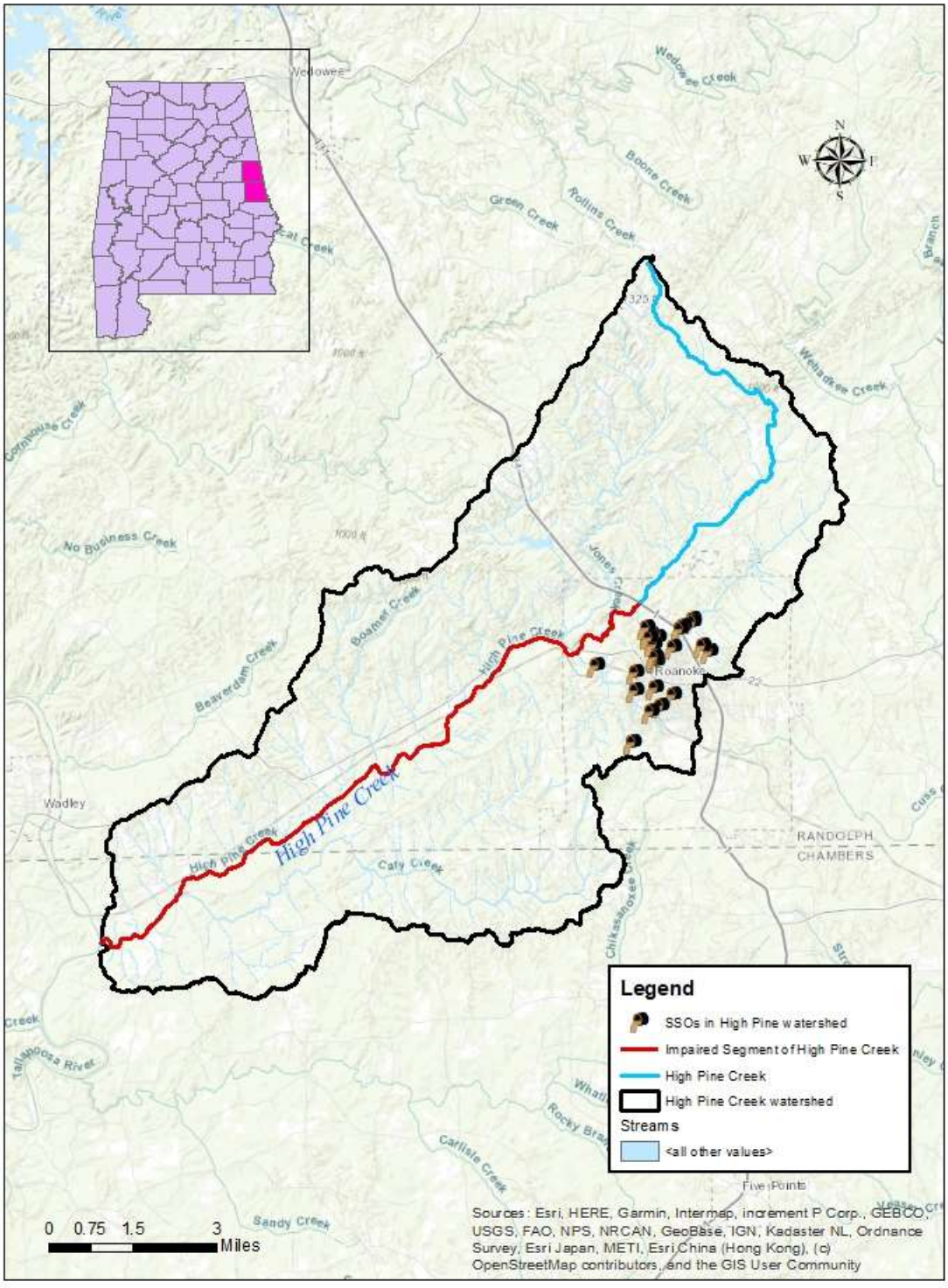
Station	Visit Date	Flow (cfs)	*E. coli* (col/100 ml)	*E. coli* dc*
HIPR-1	3/21/2023	28	1986.3	H
HIPR-1	5/2/2023	38.7	461.1	H
HIPR-1	6/6/2023	15	2419.6	
HIPR-1	6/8/2023	13.8	1373.4	
HIPR-1	6/13/2023	12.5	1632.8	
HIPR-1	6/21/2023		1542	
HIPR-1	6/26/2023	17.8	662	
HIPR-1	7/12/2023	36.6	613.1	H
HIPR-1	8/2/2023	6.5	307.6	
HIPR-1	8/7/2023	14.8	648.8	
HIPR-1	8/9/2023	11.9	307.6	
HIPR-1	8/14/2023	31.2	774.6	
HIPR-1	8/16/2023	17.2	142.1	
HIPR-1	9/6/2023	7.4	1553.1	
HIPR-3	3/21/2023	94.4	686.7	H
HIPR-3	5/2/2023	49.9	365.4	H
HIPR-3	6/6/2023	8.8	365.4	
HIPR-3	6/8/2023	30.1	228.2	
HIPR-3	6/13/2023	27.7	307.6	
HIPR-3	6/21/2023	98.2	1050	
HIPR-3	6/26/2023	38.7	359	
HIPR-3	7/12/2023	47.4	248.9	H
HIPR-3	8/2/2023	11.8	410.6	
HIPR-3	8/7/2023	31.8	727	
HIPR-3	8/9/2023	21.1	172.5	
HIPR-3	8/14/2023	63.5	615.2	
HIPR-3	8/16/2023	38.8	344.8	
HIPR-3	9/6/2023	11.8	275.5	

*H = The analytical holding times for analysis are exceeded.

Table 7-3 Reported SSOs in the High Pine Creek Watershed

Roanoke WWTF (Permit No. AL0062715)		
SSO began	Estimated Release Volume (gallons)	Duration (hours)
9/13/2018	< 1000	2
2/3/2018	8000	13
2/14/2018	1 000 - 10 000	28
4/1/2018	50	97
4/13/2018	5100	267
11/19/2018	< 1000	1
11/23/2018	< 1000	0
12/14/2018	750 000 < 1 000 000	71
12/18/2018	< 1000	2
1/11/2019	1 000 - 10 000	4
5/7/2019	50 000 - 75 000	73
10/23/2019	1 000 - 10 000	6
12/6/2019	1 000 - 10 000	2
1/17/2020	1 000 - 10 000	0
1/24/2020	< 1000	75
2/7/2020	< 1000	0
2/11/2020	< 1000	0
2/11/2020	< 1000	0
2/13/2020	25 000 - 50 000	293
3/25/2020	< 1000	2
4/29/2020	< 1000	1
5/4/2020	1 000 - 10 000	2
11/3/2020	1 000 - 10 000	1
2/26/2021	1 000 - 10 000	2
3/3/2021	1 000 - 10 000	7
3/15/2021	1 000 - 10 000	1
4/22/2021	< 1000	0
6/4/2021	1 000 - 10 000	4
7/19/2021	< 1000	3
8/18/2021	< 1000	2
4/8/2022	1 000 - 10 000	1
1/26/2023	< 1000	1

Figure 7-1 Map of SSOs in the High Pine Creek Watershed



7.3 High Pine Creek Watershed Photos (June 2023)

Photo 7-1 Station HIPR-1 on High Pine Creek at C.R. 885, upstream view.

Photo 7-2 Station HIPR-1 on High Pine Creek at C.R. 885, downstream view.

Photo 7-3 Station HIPR-3 on High Pine Creek at C.R. 3, upstream view.

Photo 7-4 Station HIPR-3 on High Pine Creek at C.R. 3, downstream view.