Draft
Total Maximum Daily Load (TMDL)
for
Patrick Creek

Assessment Unit ID # AL03140202-0601-200

Pathogens (*E. coli*)

Coffee County

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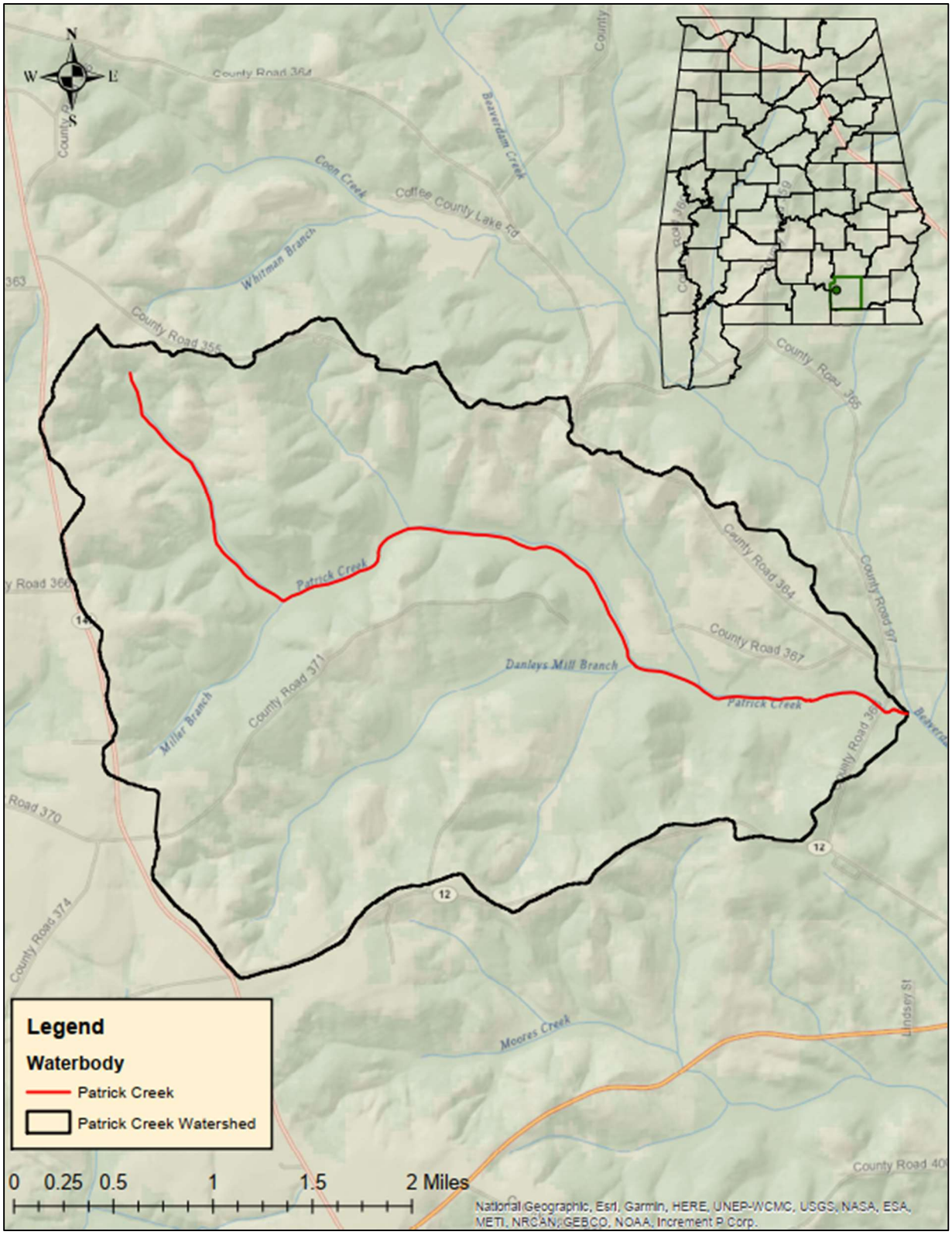
Figure 1: Patrick Creek Watershed



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1.0 Executive Summary

Section 303(d) of the Clean Water Act and the Environmental Protection Agency (EPA) 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 wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS).

Patrick Creek, part of the Choctawhatchee River basin, begins just east of Alabama Highway 141 in Coffee County (northwest of Elba, Alabama) and flows east-southeast for 5.18 miles into Beaverdam Creek. The total drainage area for the Patrick Creek watershed is approximately 9.1 square miles. Patrick Creek has a designated use classification of Fish and Wildlife (F&W) and is currently included on Alabama's §303(d) list as impaired for pathogens (*E. coli)* from Beaverdam Creek to its source.

Patrick Creek was first included on the §303(d) list for pathogens in 2016 based on data collected by the Alabama Department of Environmental Management (ADEM) in 2014 at ADEM station PATC-1. This data, which can be found in Table 3, indicated that the stream was impaired for pathogens (*E. coli*), which will be the basis for this TMDL.

In 2024, §303(d) sampling studies were performed by ADEM on Patrick Creek to further assess the water quality of the impaired stream. ADEM collected seventeen *E. coli* samples from Patrick Creek at station PATC-1. A review of the general water quality and intensive *E. coli* studies revealed that the listed segment of Patrick Creek was still not meeting the pathogen criteria applicable to its use classification (F&W).

A mass balance approach was used for calculating the pathogen TMDL for Patrick 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 that 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 *E. coli* exceedance at station PATC-1 on August 13, 2024, with a value of 2419.6 colonies/100 ml. 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 Patrick Creek.

Table 1: *E. coli* Loads and Required Reductions for AL03140202-0601-200 at PATC-1

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Single Sample Load	5.92×10^9	6.56×10^8	5.26×10^9	89%
Geometric Mean Load	2.25×10^9	2.77×10^8	1.97×10^9	88%

Table 2: *E. coli* TMDL for Patrick 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)	(col/day)
7.29×10^8	7.29×10^7	NA	NA	0	6.56×10^8	89%

Note: NA = not applicable

a. There are no CAFOs in the Patrick Creek watershed. Future CAFOs will be assigned a WLA of zero.

b. There are currently no NPDES-permitted WWTPs in the Patrick Creek watershed. Future WWTPs must meet the applicable in-stream water quality criteria for pathogens at the point of discharge.

c. Future MS4 areas and other NPDES stormwater sources will 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 practical, 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/100 ml.

Compliance with the terms and conditions of existing and future National Pollutant Discharge Elimination System (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 Patrick 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 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 5.18 miles of Patrick Creek as impaired for pathogens. The §303(d) listing was originally reported on Alabama's 2016 List of Impaired Waters based on data collected in 2014 and has been included on all subsequent lists.

2.2 Problem Definition

Waterbody Impaired:	Patrick Creek – from Beaverdam Creek to its source
Impaired Reach Length:	5.18 miles
Impaired Drainage Area:	9.1 sq. 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:
Patrick Creek 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 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:

Patrick Creek was placed on the §303(d) list for pathogens in 2016 based on data collected during 2014 at ADEM station PATC-1. *E. coli* sampling at station PATC-1 showed that the applicable single sample criterion was exceeded in two out of eight samples. (At the time of the original 2016 listing, the geometric mean criterion was 126 col/100 ml, and the single sample criterion was 487 col/100 ml during the months of June – September. During the months of October – May, the geometric mean criterion was 548 col/100 ml, and the single sample criterion was 2507 col/100 ml.) The listing data is summarized below in Table 3.

Table 3: Data for §303(d) Listing - Ambient Monitoring

Station ID	Sample Date	*E. Coli* (col/100ml)	*E. coli* Detect Criteria *	Single Sample Criteria	Flow (cfs)	Flow Measured by ADEM
PATC-1	3/19/2014	193.5	H	2507	15.8	YES
PATC-1	4/10/2014	310.6		2507	34.1	YES
PATC-1	5/7/2014	157.6	H	2507	12.4	YES
PATC-1	6/12/2014	275.5		487	9.3	YES
PATC-1	7/9/2014	155.3	H	487	1.9	YES
PATC-1	8/6/2014	2419.6	G	487	1.8	YES
PATC-1	9/3/2014	496.2	H	487	1.7	YES
PATC-1	10/8/2014	579.4		2507	1.6	YES

*H - The analytical holding time for analysis was exceeded; G – The actual number was probably greater than the number reported.

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 criterion to be exceeded. In addition, a geometric mean target of 113.4 colonies/100 ml will be used for a series of at least five samples taken no less than 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 Point Sources in the Patrick 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 pathogen 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 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 Patrick Creek watershed. In addition, the Patrick Creek watershed does not presently qualify as a municipal separate storm sewer system (MS4) area. There are also currently no Animal Feeding Operation/Concentrated Animal Feeding Operation (AFO/CAFO) facilities located within the Patrick 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.

Sanitary sewer overflows (SSOs) have the potential to severely impact water quality and can often result in the violation of water quality standards. From review of ADEM files, it was found that no recent SSOs have been reported within the Patrick Creek watershed.

There are currently no registered sites in the Patrick Creek watershed where land application of by-products for beneficial use is present. Beneficial use sites are regulated by ADEM's Land Division and are required to implement appropriate best management practices (BMPs) and agronomic application rates to protect the environment.

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 Patrick 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 is commonly a source of *E. coli* bacteria. Runoff from pastures, animal feeding areas, improper land application of animal wastes, and animals with direct access to streams are all mechanisms that can contribute bacteria to waterbodies. To account for the potential influence from animals with direct access to stream reaches in the watershed, *E. coli* loads can be calculated as a direct source into the stream.

E. coli bacteria can also originate from forested areas due to the presence of wild animals such as deer, raccoons, turkey, waterfowl, etc. Wildlife will deposit feces onto land surfaces, where it can be transported during rainfall events to nearby streams. Control of these sources is usually limited to land management BMPs and may be impracticable in most cases. As a result, forested areas are not specifically targeted in this TMDL.

E. coli loading from developed areas is potentially attributable to multiple sources including stormwater runoff, unpermitted discharges of wastewater, runoff from improper disposal of waste materials, failing septic tanks, and domestic animals. On-site septic systems may be direct or indirect sources of bacterial pollution via ground and surface waters due to system failures and malfunctions.

The nature and extent of bacterial sources in the watershed will be identified more specifically during the implementation phase of the TMDL.

3.3 Land Use Assessment

Land use percentages for the Patrick Creek watershed were determined from the 2021 National Land Cover Dataset (NLCD). The total drainage area of the Patrick Creek watershed is approximately 9.1 square miles. Table 4 lists the various land uses and their associated percentages for the Patrick Creek watershed. A pie chart illustrating the major cumulative land use types for the Patrick Creek watershed is shown in Figure 2.

Table 4: Patrick Creek Watershed Landuse (2021 NLCD)

2021 Alabama NLCD Land Cover	NLCD Legend	Area (square miles)	%
Open Water	11	0.10390	1.141%
Developed, Open Space	21	0.21197	2.328%
Developed, Low Intensity	22	0.05247	0.576%
Developed, Medium Intensity	23	0.00556	0.061%
Developed, High Intensity	24	0.00035	0.004%
Barren Land	31	0.00069	0.008%
Deciduous Forest	41	0.03683	0.405%
Evergreen Forest	42	3.03638	33.345%
Mixed Forest	43	2.02553	22.244%
Shrub/Scrub	52	0.60081	6.598%
Herbaceuous	71	1.01468	11.143%
Hay/Pasture	81	1.16931	12.841%
Cultivated Crops	82	0.27521	3.022%
Woody Wetlands	90	0.55321	6.075%
Emergent Herbaceuous Wetlands	95	0.01911	0.210%
Total Land Use		**9.1**	**100.00%**
Cumalative Alabama Land Cover	**NLCD Legend**	**Area (square miles)**	**%**
Open Water	11	0.10	1.14%
Developed	21,22,23,24	0.27	2.97%
Barren Land	31	0.00	0.01%
Forested	41,42,43	5.10	55.99%
Grassland/Shrub	52,71	1.62	17.74%
Agriculture	81,82	1.44	15.86%
Wetlands	90,95	0.57	6.29%
Total Land Use		**9.1**	**100.00%**

Figure 2: Patrick Creek Watershed Cumulative Land Use

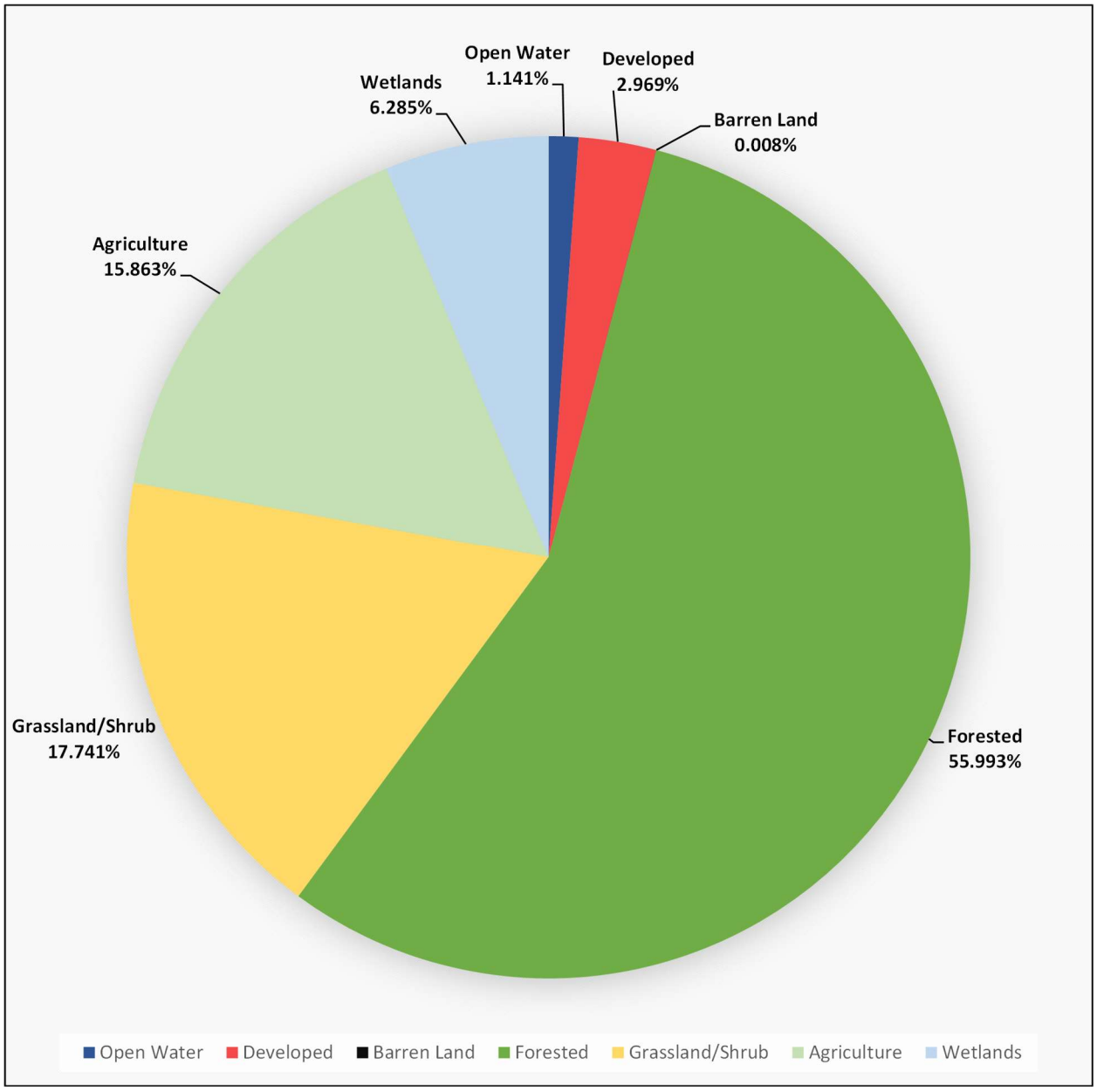
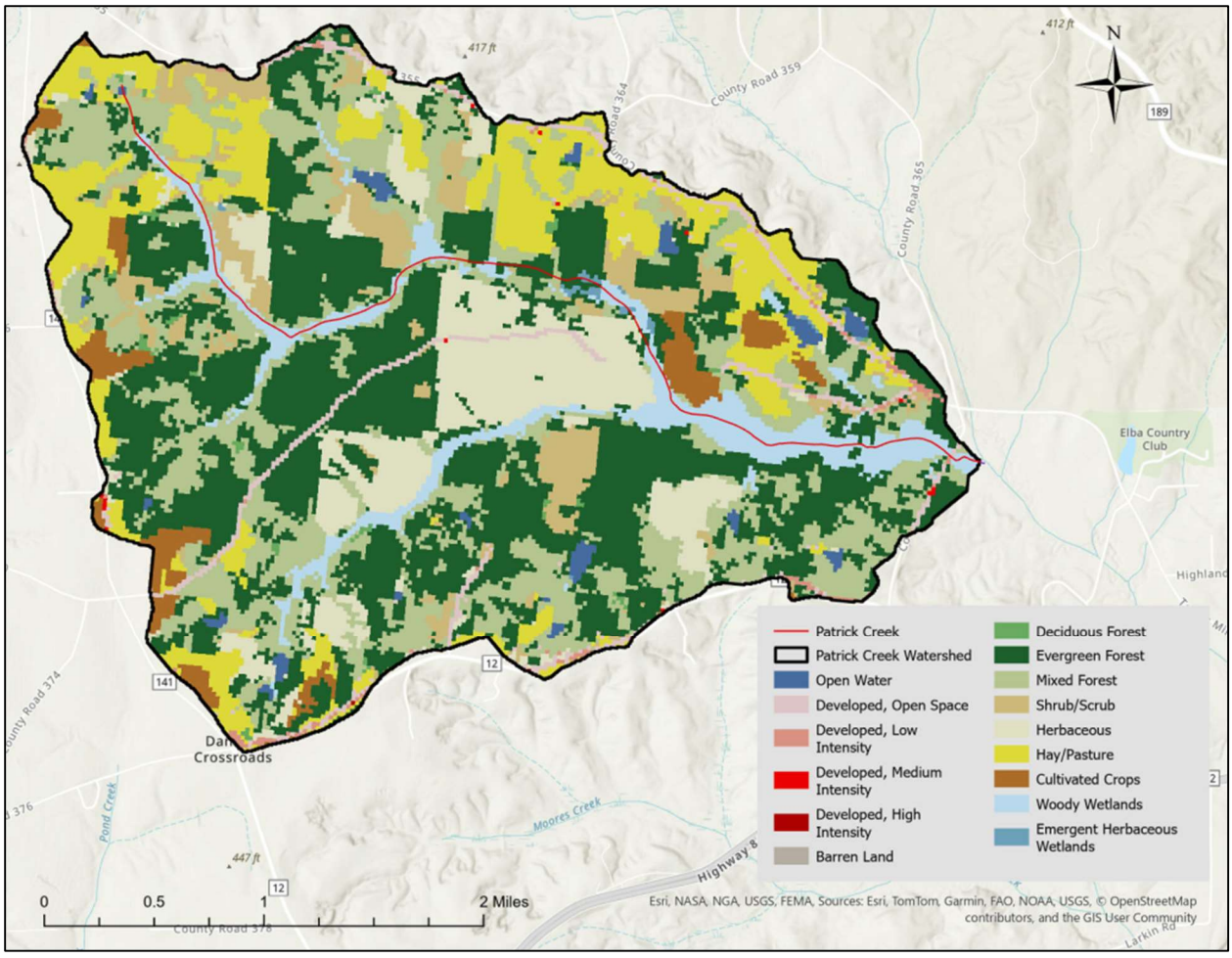


Figure 3: 2021 NLCD Map of the Patrick Creek Watershed



As can be seen from an inspection of the table, chart, and map above, forested land is the predominant land use in the watershed at 55.99%. Grassland/shrub covers approximately 17.74%, agriculture covers approximately 15.86%, and wetlands covers approximately 6.29% of the watershed. Developed land, which covers approximately 2.97% of the watershed, represents both commercial and residential urbanized land uses, and includes the following individual land use categories: Developed – Open Space, Developed – Low Intensity, Developed – Medium Intensity, and Developed – High Intensity. The remaining land use in the watershed consists of open water (1.14%).

3.4 Linkage between Numeric Targets and Sources

The dominant land use coverage in the Patrick Creek watershed is forested/natural, followed by 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 source of pathogen loadings in Patrick Creek are from agricultural land uses. 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 2024, §303(d) sampling studies were performed by ADEM on Patrick Creek at station PATC-1 to further assess the water quality of the impaired stream. For purposes of this TMDL, the 2024 data will be used to assess the water quality of Patrick Creek because it is the most recent data and provides the best picture of the current water quality conditions 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.

Seventeen *E. coli* samples were collected during 2024 at station PATC-1, and intensive bacteria studies were performed during the months of May and August. Each intensive bacteria study consisted of collecting at least five *E. coli* samples over a thirty-day time window, with a minimum of 24 hours between each sample collection.

Of the seventeen total *E. coli* samples collected in 2024, eleven exceeded the summer single sample maximum criterion of 298 colonies/100 ml. Furthermore, the geometric mean criterion of 126 colonies/100 ml was exceeded during both intensive bacteria studies. A summary of the *E. coli* results is provided below in Table 6. All *E. coli* criteria exceedances are highlighted in red.

Table 5: Station Description

Station	Agency	Latitude	Longitude	Description
PATC-1	ADEM	31.4384	-86.1121	Patrick Creek at Coffee County Road 368

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Figure 4: ADEM 2024 Sampling Station in the Patrick Creek Watershed

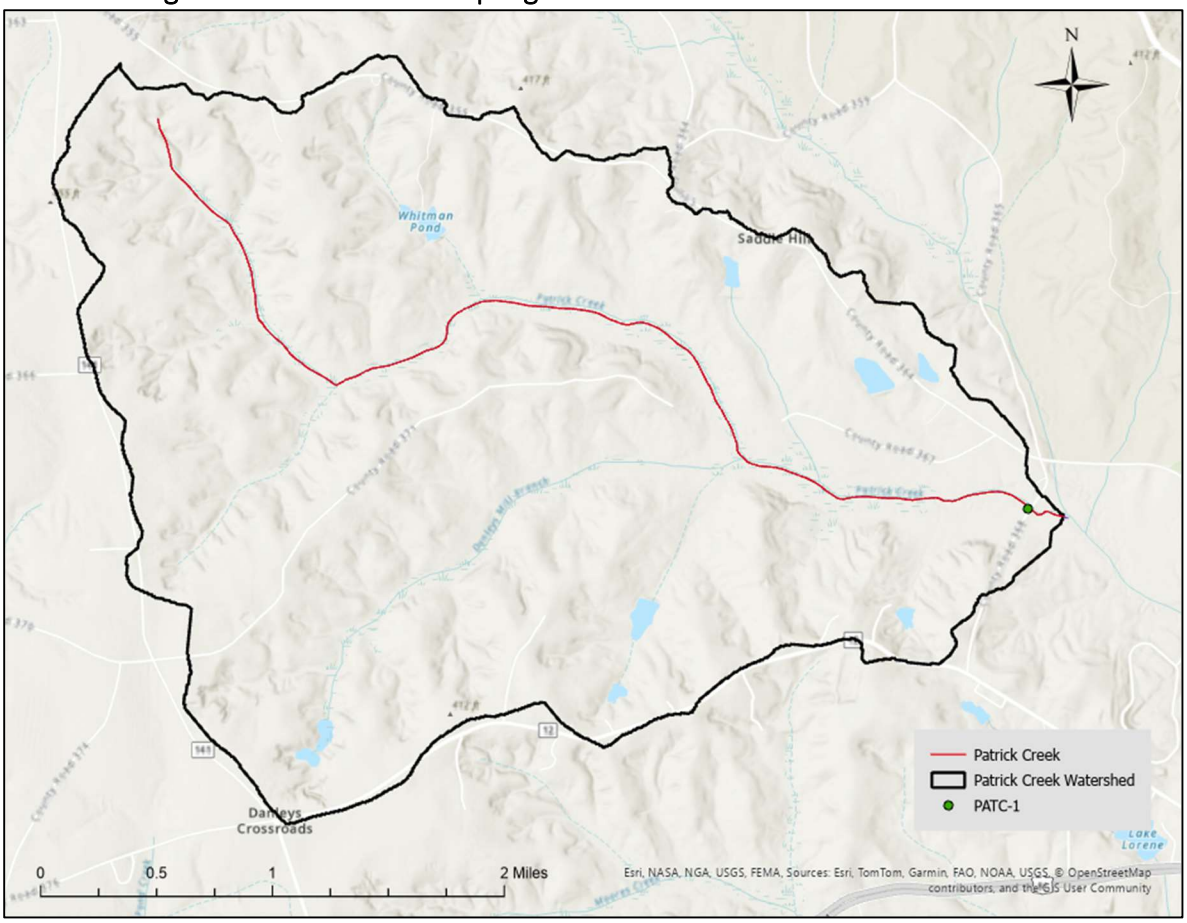

Table 6: 2024 *E. coli* Data for Patrick Creek

Station ID	Sample Date	*E. Coli* (col/100ml)	Single Sample Criteria	Geometric Mean Calculation	Geometric Mean Criteria	Flow (cfs)	Flow Measured by ADEM
PATC-1	3/27/2024	686.7	2507			14.4	YES
PATC-1	4/9/2024	613.1	2507			6.1	YES
PATC-1	5/6/2024	237.4	298			4	YES
PATC-1	5/7/2024	615.2	298	353.8	126	3.5	YES
PATC-1	5/8/2024	270.8	298			4.1	YES
PATC-1	5/9/2024	345	298			4.9	YES
PATC-1	5/15/2024	389	298			14.2	YES
PATC-1	6/5/2024	248.1	298			5.7	YES
PATC-1	7/10/2024	435.2	298			3.1	YES
PATC-1	8/13/2024	2419.6	298	918.6	126	0.1	YES+
PATC-1	8/19/2024	980.4	298			0.1	YES+
PATC-1	8/20/2024	866.4	298			0.1	YES+
PATC-1	8/21/2024	770.1	298			0.1	YES+
PATC-1	8/22/2024	387.3	298			0.1	YES+
PATC-1	8/27/2024	980.4	298			0.1	YES+
PATC-1	9/4/2024	547.5	298			0.5	YES
PATC-1	10/29/2024	275.5	298			0.1	YES+

+ Flow in the stream was visible, but not detectable using flow measurement device.

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

The impaired portion of Patrick 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. The highest single sample *E. coli* exceedance of 2419.6 colonies/100 ml was taken at station PATC-1 on August 13, 2024. The use of the highest single sample exceedance to calculate the TMDL is expected to be protective of water quality in Patrick Creek year-round.

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 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 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:

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

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

Existing Conditions

The **single sample** mass loading was calculated by multiplying the highest *E. coli* single sample exceedance concentration of 2419.6 colonies/100 ml by the measured flow on the day of the exceedance. The calculation for the existing condition was based on the measurement at PATC-1 on August 13, 2024. The product of the concentration, measured flow, and a conversion factor gives the total mass loading (colonies per day) of *E. coli* to Patrick Creek under the single sample exceedance condition.

$$\frac{0.1\ \text{ft}^3}{\text{s}} \times \frac{2419.6\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{5.92 \times 10^9 \text{colonies}}{\text{day}}$$

The **geometric mean** mass loading was calculated by multiplying the highest geometric mean exceedance concentration of 918.6 colonies/100 ml times the average of the stream flows measured during the geometric mean sampling period. This concentration was calculated based on measurements at PATC-1 between August 13, 2024, and August 27, 2024. The flows during the August geometric mean sampling period were too low to be measured; however, stream flow was visible in the stream. An estimated flow of 0.1 cfs was utilized for the calculations. The product of the *E. coli* concentration, flow, and the conversion factor gives the total mass loading (colonies per day) of *E. coli* to Patrick Creek under the geometric mean exceedance condition.

$$\frac{0.1\ \text{ft}^3}{\text{s}} \times \frac{918.64\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{2.25 \times 10^9 \text{colonies}}{\text{day}}$$

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 measured 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:

$$\frac{0.1\ \text{ft}^3}{\text{s}} \times \frac{268.2\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{6.56 \times 10^8 \text{colonies}}{\text{day}}$$

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

$$\frac{0.1\ \text{ft}^3}{\text{s}} \times \frac{29.8\ \text{colonies}}{100\ \text{ml}} \times \frac{24{,}465{,}755 * 100\ \text{ml} * \text{s}}{\text{ft}^3 * \text{day}} = \frac{7.29 \times 10^7 \text{colonies}}{\text{day}}$$

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

$$\frac{0.1\ ft^3}{s} \times \frac{113.4\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100 mL * s}{ft^3 * day} = \frac{2.77 \times 10^8 colonies}{day}$$

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

$$\frac{0.1\ ft^3}{s} \times \frac{12.6\ colonies}{100\ mL} \times \frac{24{,}465{,}755 * 100\ mL * s}{ft^3 * day} = \frac{3.08 \times 10^7 colonies}{day}$$

The difference between the existing conditions (violation event) and the allowable conditions converted to a percent reduction represents the total load reduction needed to achieve the *E. coli* water quality criteria. Table 7 below depicts the existing and allowable *E. coli* loads and required reductions for the Patrick Creek watershed.

Table 7: *E. coli* Loads and Required Reductions for AL03140202-0601-200

Source	Existing Load (colonies/day)	Allowable Load (colonies/day)	Required Reduction (colonies/day)	% Reduction
Single Sample Load	5.92 x 10^9	6.56 x 10^8	5.26 x 10^9	89%
Geometric Mean Load	2.25 x 10^9	2.77 x 10^8	1.97 x 10^9	88%

The TMDL was calculated as the total daily *E. coli* load to Patrick Creek as evaluated at station PATC-1. From Table 7, compliance with the simple 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 in Table 8 below.

Table 8: *E. coli* TMDL for Patrick 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
7.29×10^8	7.29×10^7	NA	NA	0	6.56×10^8	89%

Note: NA = not applicable

a. There are no CAFOs in the Patrick Creek watershed. Future CAFOs will be assigned a WLA of zero.

b. There are currently no NPDES-permitted WWTPs in the Patrick Creek watershed. Future WWTPs must meet the applicable in-stream water quality criteria for pathogens at the point of discharge.

c. Future MS4 areas and other NPDES stormwater sources will 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 practical, 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/100 ml.

4.3 TMDL Summary

Patrick Creek was first included on the §303(d) list for pathogens in 2016 based on data collected in 2014 at ADEM station PATC-1. In 2024, §303(d) sampling studies were performed by ADEM on Patrick Creek to further assess the water quality of the impaired stream. ADEM collected seventeen *E. coli* samples from Patrick Creek at station PATC-1. A review of the general water quality and intensive *E. coli* studies revealed that Patrick Creek was still not meeting the pathogen criteria applicable to its use classification (F&W).

The data collected by ADEM in 2024 confirmed the pathogen impairment and provided the basis for TMDL development. A mass balance approach was used to calculate the *E. coli* TMDL for Patrick 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 current 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 Patrick 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 to the schedule shown in Table 9.

Table 9: Follow-up Monitoring Schedule

River Basin Group	Years to be Monitored
Coosa, Escatawpa, Tennessee (Guntersville), Tombigbee	2025/2028
Alabama, Cahaba, Mobile, Tallapoosa, Tennessee (Pickwick and Wilson)	2026/2029
Black Warrior, Blackwater, Chattahoochee, Chipola, Choctawhatchee, Escambia, Perdido, Tennessee (Wheeler), Yellow	2027/2030

6.0 Public Participation

As part of the public participation process, this TMDL will be placed on public notice and made available for review and comment. The public notice and subject TMDL will be made available on ADEM's website: www.adem.alabama.gov. In addition, the public notice will be submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. The public may 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 will be 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 will become part of the administrative record. ADEM will consider all comments received by the public prior to final completion of this TMDL and subsequent submission to EPA Region 4 for final approval.

7.0 Appendices

7.1 References

ADEM Administrative Code, 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. 2014, 2024. ADEM.

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

Alabama's §303(d) List and Fact Sheet. 2016, 2018, 2020, 2022, 2024. 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 Patrick Creek Watershed Photos

Figure 5: At PATC-1: Upstream View of Patrick Creek (5/6/2024)

Figure 6: At PATC-1: Downstream View of Patrick Creek (5/6/2024)