Final

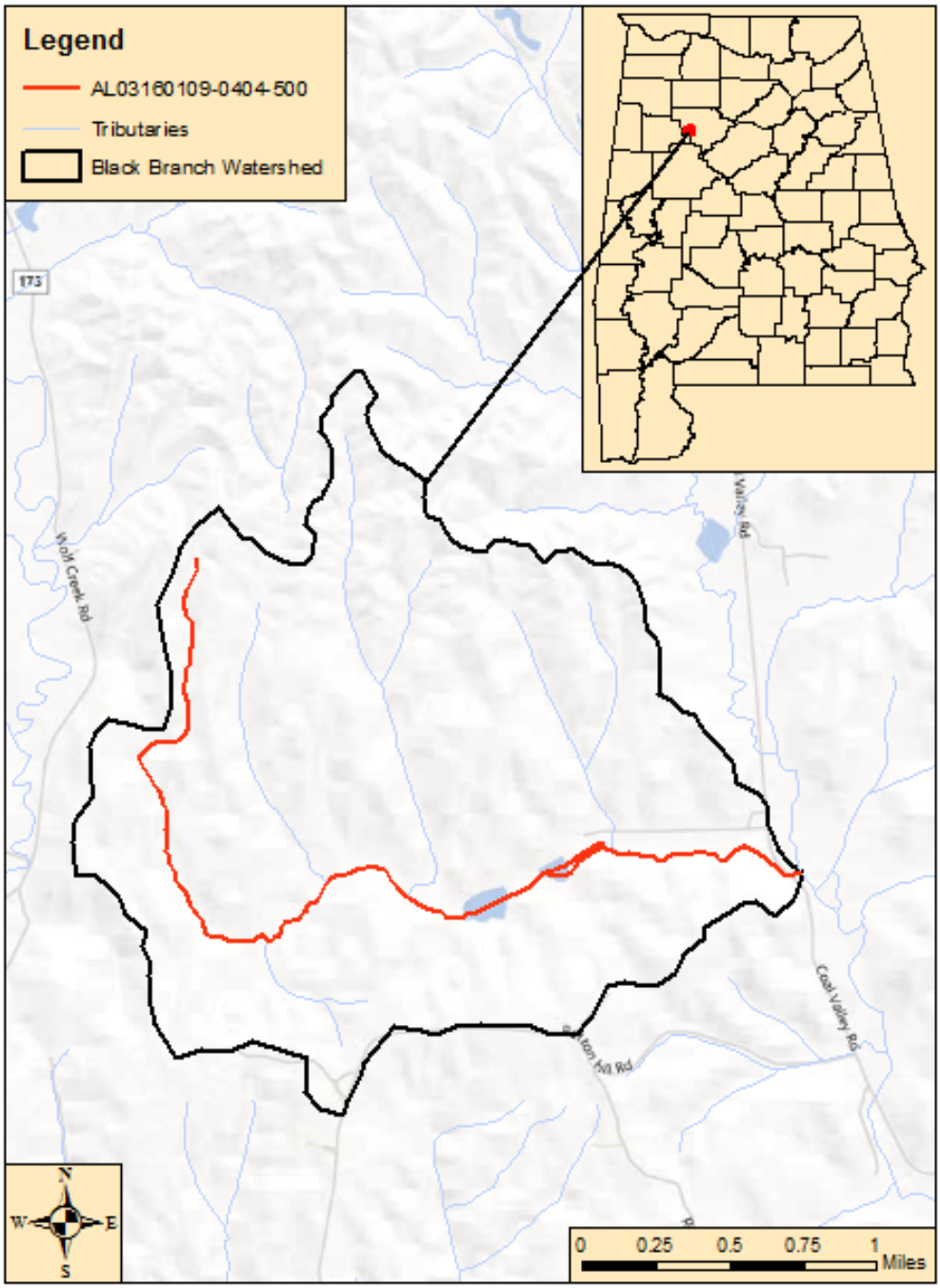
Total Maximum Daily Load
For
Black Branch

Assessment Unit ID # AL03160109-0404-500

Metals (Aluminum)
pH

Alabama Department of Environmental Management
Water Quality Branch
Water Division
August 2016

Figure 1-1 Black Branch 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 wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS).

Black Branch is located in Walker County approximately 2.5 miles northwest of the Town of Oakman in the Black Warrior River Basin. The total length of Black Branch is 4.11 miles, and it has a total drainage area of 3.35 square miles. Black Branch is a tributary to Cane Creek and has a use classification of Fish and Wildlife (F&W). The entire Black Branch watershed is located within the Level IV Eco-region 68f.

Black Branch was added to the State of Alabama's 1998 §303(d) list of impaired streams for metals, pH, siltation and other habitat alteration by the United States Environmental Protection Agency (USEPA). The listing was based on data collected by the Auburn Fisheries Cooperative Research Center in 1996 and 1997. Black Branch was subsequently listed on Alabama's §303(d) list of impaired streams from 2000-2014. The impaired segment extends from Cane Creek to its source. The source of the impairments is currently listed as abandoned surface mining.

In 2008, the metals impairment was narrowed down to aluminum and iron, and the habitat alteration impairment was combined with the siltation impairment. This TMDL will focus on the pH and metals (aluminum) impairments. The metals (iron) and siltation (habitat alteration) impairments were removed from the §303(d) list in 2014 based on recent data indicating that those impairments did not exist.

In 2007 and 2012, ADEM collected data on Black Branch at station BKBW-1 in an effort to more fully evaluate existing conditions as related to the previous listing decision. For the purposes of this TMDL, the 2012 data will be used to assess the water quality of Black Branch because it is the most current data and provides the best picture of the current water quality conditions of the stream. The 2016 edition of *Alabama's Water Quality Assessment and Listing Methodology* section 4.8.2, prepared by ADEM, provides the rationale for the Department to use the most recent data to prepare a TMDL for an impaired waterbody. The pH data collected was compared to Alabama's water quality standard of 6.0 – 8.5 SU. According to the data, Black Branch was not meeting water quality standards for pH. Because pH is not a load, but rather a measure of acidity and/or alkalinity of a given solution, Alabama's numeric pH standard is used as the TMDL target. 40 CFR § 130.2(i) provides rationale for TMDLs to be expressed in terms of *other appropriate measure.*

ADEM also collected metals (aluminum) data to evaluate the aluminum impairment. Alabama does not have numeric aluminum criteria; therefore, the data was compared to Alabama's 2010 Eco-regional Reference Guidelines. EPA does have a national recommended aluminum (total recoverable) acute criterion of 750 µg/L and a recommended chronic criterion of 87 µg/L when the pH is between 6.5 – 9.0 SU, but it is believed that the eco-regional reference value is more

representative of appropriate conditions for this stream. Also, the pH of the stream at the time the aluminum samples were taken was outside of the EPA recommended range, and when the pH is outside of this range, studies conducted on aluminum toxicity at different pH values were inconclusive. It is believed that correcting the pH impairment will also correct the aluminum impairment.

Table 1-1 is a summary of the estimated existing loads, allowable loads, and percent reduction for the aluminum impairment. It should be noted that the highest aluminum sample was taken on 8/15/2012. Table 1-2 provides the details of the TMDL for the pH impairment. Table 1-3 provides the details of the TMDL for the aluminum impairment.

Table 1-1. 2012 Total Aluminum Load and Required Reduction for AL03160109-0404-500

Source	Existing Load (lbs/day)	Allowable Load (lbs/day)	Required Reduction (lbs/day)	% Reduction
Nonpoint Source	4.56	0.52	4.04	89%
Point Source	N/A	N/A	N/A	N/A

Table 1-2. pH TMDL for Black Branch

Waste Load Allocations (WLA)	Load Allocations (LA)	Margin of Safety (MOS)	TMDL
N/A[a]	6.0 - 8.5 SU	N/A[b]	6.0 - 8.5 SU

a. N/A=not applicable, no point sources. Future point sources must meet the pH criteria of 6.0-8.5 SU.
b. A Margin of Safety (MOS) was not considered necessary due to the TMDL being established equal to the pH water quality criteria.

Table 1-3. Total Aluminum TMDL for Black Branch

TMDL[b]	Margin of Safety	Wasteload Allocations (WLA)		Load Allocations (LA)	
		Point Sources[a]	% Reduction	Nonpoint Sources	% Reduction
lbs/day	lbs/day	lbs/day	%	lbs/day	%
0.576	0.058	N/A	N/A	0.518	89%

a. N/A= not applicable, no point sources. Future point sources must meet the applicable eco-regional reference value at the point of discharge.
b. TMDL was established using the eco-regional reference value of 0.3055 mg/L.

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. It is noted that load reductions in the LA portion of this TMDL are in the process of being implemented through CWA §319

projects which are already in place. Noticeable increases in pH and decreases in aluminum concentrations have been observed, and it is the hope of the Department that the water quality in Black Branch will continue to improve as these projects are in place.

The Department recognizes that adaptive implementation of the TMDL will be needed to achieve applicable water quality criteria, and we are committed to targeting the load reductions to improve the water quality in the Black Branch watershed.

2.0 Basis for §303(d) Listing

2.1 Introduction

Section 303(d) of the Clean Water Act (CWA), as amended by the Water Quality Act of 1987 and EPA's Water Quality Planning and Management Regulations [Title 40 of the Code of Federal Regulations (CFR), Part 130], requires states to identify waterbodies which are not meeting water quality criteria applicable to their designated use classifications. The identified waters are prioritized based on severity of pollution with respect to designated use classifications. Total maximum daily loads (TMDLs) for all pollutants causing violation of applicable water quality criteria are established for each identified water. Such loads are established at levels necessary to implement the applicable water quality criteria with seasonal variations and margins of safety. The TMDL process establishes the allowable loading of pollutants, or other quantifiable parameters 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 from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

As mentioned in the "Executive Summary," Black Branch was listed on the 1998 §303(d) list by the USEPA based on data collected by the Auburn Fisheries Cooperative Research Center. Based on the historical data that could be retrieved, pH values were very low, and the metals data showed elevated concentrations. The source of the impairment is listed on the 2014 §303(d) list as abandoned surface mining.

2.2 Problem Definition

Waterbody Impaired:	Black Branch – From Cane Creek to its Source
Impaired Reach Length:	4.11 miles
Impaired Drainage Area:	3.35 square miles
Water Quality Standard Violation:	pH Metals (aluminum)
Water Use Classification:	Fish and Wildlife

Usage Related to Classification:
The impaired segment of Black Branch is classified as Fish and Wildlife (F&W). Usages of waters in this classification are described in ADEM Admin. Code R. 335-6-10-.09(5)(a), (b), (c), and (d).

(a) Best usage of waters: fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming and water-contact sports or as a source of water supply for drinking or food-processing purposes.

(b) Conditions related to best usage: the waters will be suitable for fish, aquatic life and wildlife propagation. The quality of salt and estuarine waters to which this classification is assigned will also be suitable for the propagation of shrimp and crabs.

(c) Other usage of waters: it is recognized that the waters may be used for incidental water contact and recreation during June through September, except that water contact is strongly discouraged in the vicinity of discharges or other conditions beyond the control of the Department or the Alabama Department of Public Health.

(d) Conditions related to other usage: the waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports.

pH Criteria:
Criteria for acceptable pH levels for the F&W use classification are described in ADEM Admin. Code R. 335-6-10-.09(5)(e)2. as follows:

2. pH: sewage, industrial wastes or other wastes shall not cause the pH to deviate more than one unit from the normal or natural pH, nor be less than 6.0, nor greater than 8.5. For salt waters and estuarine waters to which this classification is assigned, wastes as herein described shall not cause the pH to deviate more than one unit from the normal or natural pH, nor be less than 6.5, nor greater than 8.5.

Aluminum Criteria:
The State of Alabama does not have numeric criteria for aluminum. The State of Alabama has selected a "reference condition" approach to determine appropriate levels of aluminum and has compared ambient water quality data to eco-regional reference values.

Criteria Exceeded:
The original listing of Black Branch was based on data collected by the Auburn Fisheries Cooperative Research Center in 1996 and 1997. This data indicated 24 pH exceedances and 19 elevated aluminum samples at the Auburn Fisheries Cooperative Research Center station B-1. Starting in 2007, ADEM began collecting samples on Black Branch at station BKBW-1. Of the 14 pH samples collected in 2007 and 2012, 13 of those samples did not meet the pH criteria. Of the 12 total aluminum samples collected in 2007 and 2012, 10 of those samples exceeded Alabama's Eco-regional Reference Guidelines.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

Alabama's water quality criteria for pH is that sewage, industrial wastes or other wastes shall not cause the pH to deviate more than one unit from the natural pH, nor be less than 6.0 SU, nor greater than 8.5 SU. For the purpose of this TMDL, the 6.0 – 8.5 SU range will be the water quality target. No margin of safety is necessary due to the TMDL being established equal to the water quality criteria. This target is considered protective of water quality standards.

The State of Alabama currently has no numeric aluminum water quality criteria. With no numeric water quality criteria, ADEM has elected to use the "reference condition" approach for determining appropriate levels of aluminum. This approach is based on using ambient water quality data from candidate reference streams that are located in characteristically similar regions of Alabama known as eco-regions. An eco-region is defined as a relatively homogeneous area defined by similar climate, landform, soil, potential natural vegetation, hydrology and other ecologically relevant variables. "Reference streams" are defined as waterbodies that have been relatively undisturbed or minimally-impacted that can serve as examples of the natural biological integrity of a particular ecoregion. These "reference streams" can be monitored over time to establish a baseline to which other waters can be compared. Reference streams are not necessarily pristine or undisturbed by humans; however, they do represent waters within Alabama that are healthy and fully support their designated uses, to include protection of aquatic life. The reference streams selected for a particular analysis depends primarily on the available number of reference streams and associated data within a particular region. Therefore, the total number of reference sites selected and the aerial scale (i.e. Ecoregion Level III, Level IV) used to represent a reference condition will often vary on a case-by-case basis. ADEM believes that the "reference condition" approach used to determine appropriate aluminum targets for the Black Branch TMDL is reasonable, scientifically defensible, protective of designated uses, and consistent with USEPA guidance.

In developing and establishing reference conditions from best available data, ADEM elected to use the 90th percentile of the data distributions from the selected reference sites to establish a goal for total aluminum concentration on an eco-regional basis. Median values were used to represent existing conditions of total aluminum within the impaired waterbody. The 90th percentile of the data distribution was considered an appropriate target since it falls within an acceptable range of "least-impacted" conditions (i.e. upper quartile). If total aluminum concentrations within the impaired stream are relatively the same or below reference condition levels, then the stream is considered not to be impaired for aluminum.

The Black Branch aluminum target was calculated using a reference condition approach, which utilizes data collected from streams that are within the same ecoregion. The entire Black Branch watershed is within the Level IV ecoregion 68f. ADEM has not developed a reference value for this Level IV ecoregion; therefore, the Level III ecoregion (68) reference value will be used. The current list of values is included in a table referred to as "Alabama's 2010 Eco-regional Reference Guidelines." This table of relevant eco-reference data can be found in Appendix 7.2, Table 7-6. The 90th percentile of the data distributions from ecoregion 68 will be utilized in

establishing an aluminum target concentration. The aluminum target concentration for Black Branch is a total aluminum concentration of 0.3055 mg/L.

ADEM does recognize that EPA has national recommended water quality criteria for aluminum. The EPA recommends a freshwater acute toxicity concentration of 750 µg/L and a chronic toxicity concentration of 87 µg/L. Both of these values are expressed in total recoverable metal in the water column and only when the pH is between 6.5 and 9.0 SU. According to the EPA document, "Ambient Water Quality Criteria for Aluminum – 1988," multiple studies have been conducted to try and correlate pH with aluminum toxicity. These results were inconclusive with some studies showing aluminum toxicity increases with pH and others showing the exact opposite. Therefore, since most of the pH values obtained during the sampling of Black Branch are out of the specified range, and since the EPA recommended criteria is national criteria, it was decided that the local eco-regional reference values would be more representative of appropriate conditions for this stream.

3.2 Source Assessment

3.2.1 Point Sources in the Black Branch Watershed

Continuous Point Sources

Currently there are no active NPDES Permits within the Black Branch watershed.

Non-Continuous Point Sources

Black Branch does not currently have any non-continuous point sources within the watershed. There are no CAFOs located in the Black Branch watershed and currently none of the watershed qualifies as a Municipal Separate Stormwater Sewer System (MS4) area.

3.2.2 Nonpoint Sources in the Black Branch Watershed

From review of the data collected and land source assessment, it is believed that nonpoint sources are contributing to the pH and aluminum impairments in Black Branch. There is a history of coal mining in the Black Branch watershed. Documented studies show the abandoned mines in the watershed were continuing to discharge highly acidic run-off water into the drainage areas. ADEM, along with other state and federal agencies, have implemented a number of projects in the Black Branch watershed in an effort to improve the watershed and overall water quality of Black Branch.

3.3 Watershed Improvements

ADEM, along with other state and federal agencies, has dedicated much time and resources in efforts to improve the Black Branch watershed. In 1997, the Black Branch Project was started in order to try and reclaim some of the abandoned mines. During the period between June 2006 and May 2011, EPA and ADEM's nonpoint source section, along with other federal and state agencies, implemented a number of BMP projects in the Black Branch watershed in an effort to improve overall water quality in the watershed. Some of the highlights of these projects included

the filling of a large existing mine subsidence with limestone rip rap and remediating a gob pile left from the mining operations. Other projects include road and ditch repairs as well as constructing a passive water treatment system in one of the tributaries to Black Branch. ADEM hopes these efforts will continue to improve the water quality in this watershed and help mitigate the aluminum and pH impairments in Black Branch.

3.4 Land Use Assessment

Land use for the Black Branch watershed was determined using ArcMap with land use datasets derived from the 2011 National Land Cover Dataset (NLCD). Figure 3-1 and Table 3-1 display the land use areas for the Black Branch watershed. Figure 3-2 is a graph depicting the primary land uses in the Black Branch watershed.

The majority of the Black Branch watershed is forested/natural (98.72%). Other major land uses within the watershed are 0.67% open water, 0.35% developed land, and 0.26% agricultural land. Developed land includes both commercial and residential land uses.

Figure 3-1. Land Use Map for the Black Branch Watershed

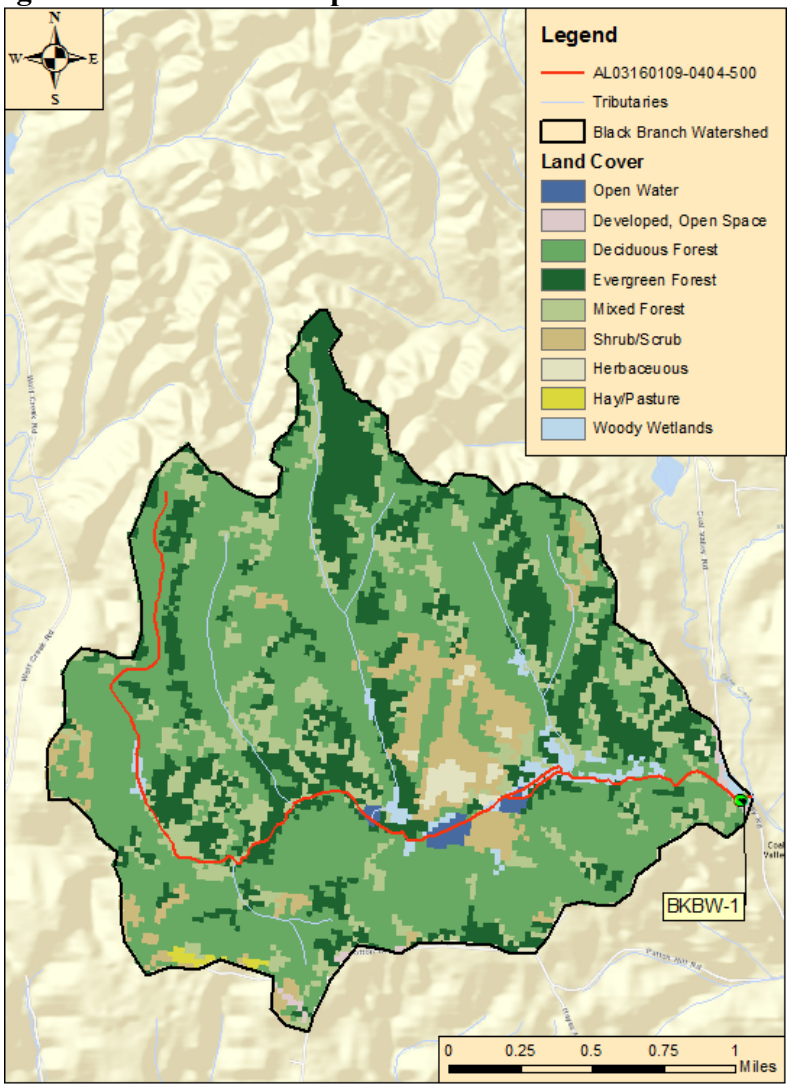
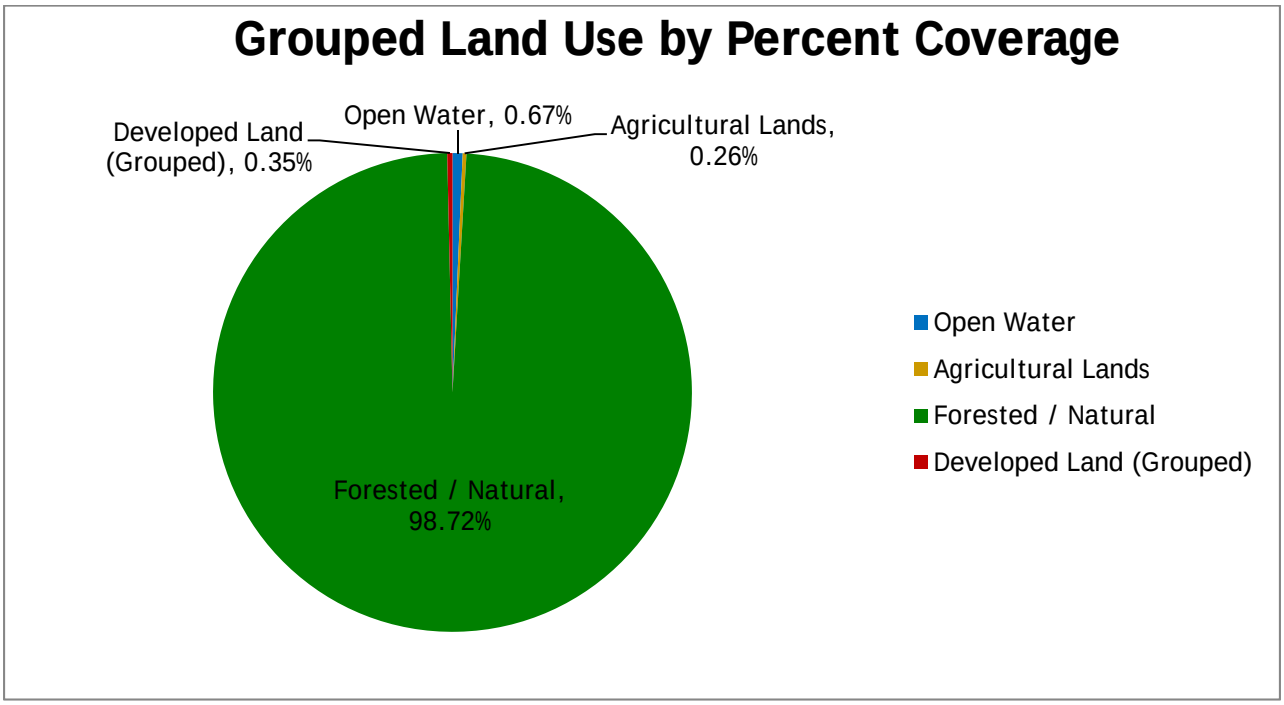


Table 3-1. Land Use Areas for the Black Branch Watershed

Class Description	Mi²	Acres	Percent
Open Water	0.02	14.46	0.67%
Developed, Open Space	0.01	7.56	0.35%
Deciduous Forest	1.85	1181.58	55.03%
Evergreen Forest	0.70	448.79	20.90%
Mixed Forest	0.45	285.78	13.31%
Shrub/Scrub	0.22	143.89	6.70%
Herbaceous	0.03	21.13	0.98%
Hay/Pasture	0.01	5.56	0.26%
Woody Wetlands	0.06	38.25	1.78%
TOTALS →	**3.35**	**2147.00**	**100.00%**
Class Description	**Mi²**	**Acres**	**Percent**
Open Water	0.02	14.46	0.67%
Agricultural Lands	0.01	5.56	0.26%
Forested / Natural	3.31	2119.42	98.72%
Developed Land (Grouped)	0.01	7.56	0.35%
TOTALS →	**3.35**	**2147.00**	**100.00%**

Figure 3-2. Graph of the Primary Land Uses in the Black Branch Watershed



3.5 Linkage Between Numeric Targets and Sources

There is a long history of surface and deep mining activities in the Black Branch watershed. Based on the identification of a number of abandoned mining sites in the Black Branch watershed, abandoned mine lands represent a critical nonpoint source. Abandoned mines can contribute significant amounts of acid mine drainage, which causes low pH and high metals concentrations in surface and subsurface water in areas where mining activities are or once were present. Depending on geological factors, metal found in mining waste may include significant concentrations of trace metals such as aluminum (Lee et al. 2002).

3.6 Data Availability and Analysis

In 2012, ADEM collected chemical, physical, and biological data on Black Branch at BKBW-1 to more fully evaluate existing conditions as related to the previous listing decision. There were 9 pH samples collected and 8 total aluminum samples collected. Of the 9 pH samples collected, 8 of those samples were in violation of Alabama's water quality standards. Of the 8 total aluminum samples collected, there were 6 samples which exceeded the total aluminum target value of 0.3055 mg/L set by Alabama's Eco-regional Reference Guidelines. These pH and aluminum exceedances are shown in Table 3-2.

Table 3-2. pH and Total Aluminum Exceedances on Black Branch

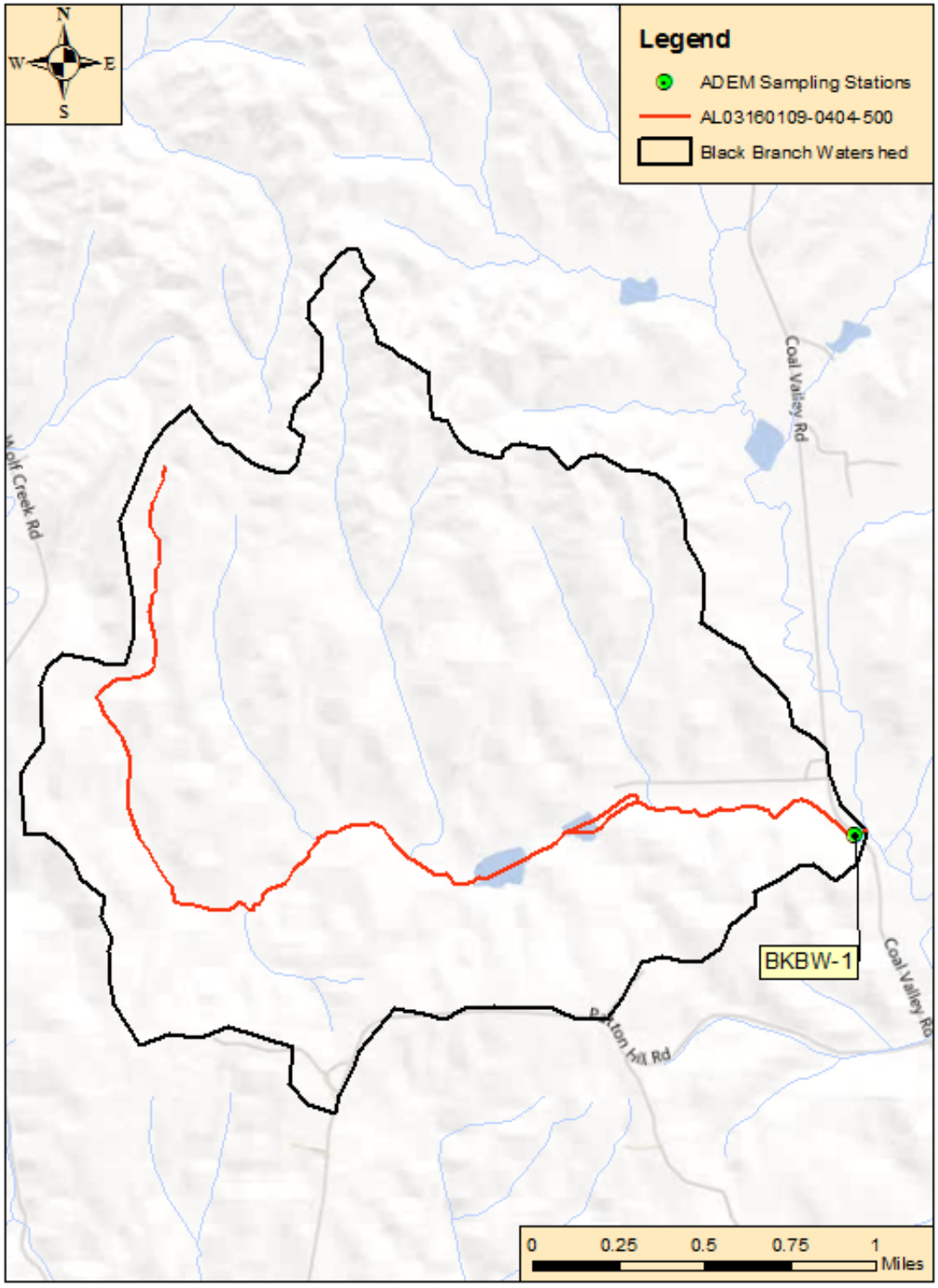
Station ID	Visit Date	pH (SU)	pH Detect Condition	Al Total* (mg/L)	Al Total Detect Condition	Flow (cfs)	Flow Measured?
BKBW-1	4/11/2012	6.66		0.073		1.435	YES-ADEM
BKBW-1	5/2/2012	5.14		0.396			NO-VISIBLE, BUT NOT MEASURABLE WITH METER
BKBW-1	5/8/2012	5.72				2.324	YES-ADEM
BKBW-1	6/6/2012	5.19		0.516			NO-VISIBLE, BUT NOT MEASURABLE WITH METER
BKBW-1	7/18/2012	4.66		2.08			NO-FLOW CONDITIONS HAZARDOUS
BKBW-1	8/15/2012	4.28		2.42		0.3491	YES-ADEM
BKBW-1	9/12/2012	4.71		0.831			NO-VISIBLE, BUT NOT MEASURABLE WITH METER
BKBW-1	10/3/2012	5.74		0.174	JI	1.7142	YES-ADEM
BKBW-1	11/6/2012	4.73		1.62			NO-VISIBLE, BUT NOT MEASURABLE WITH METER

JI: The identification of the analyte is acceptable; the reported value is an estimate. The reported value is between the MDL (method detection limit) and the RL (Reporting Limit).

Table 3-3. Location Description of ADEM Sampling Station

Station ID	Stream	Station Description	Latitude	Longitude	County	Ecoregion/ Sub region
BKBW-1	Black Branch	Black Branch at Coal Valley Road	33.73807°	-87.41524°	Walker	68f

Figure 3-3. Map of Sampling Locations for Black Branch



3.7 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the analysis: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations, or 2) by explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations.

For pH, a margin of safety was not considered necessary since the established TMDL was equal to the pH water quality criteria. For the aluminum TMDL, both an explicit and implicit MOS were incorporated. The MOS accounts for the uncertainty associated with the limited availability of aluminum data used in this analysis. An explicit MOS was applied to the TMDL by reducing the target aluminum concentration by ten percent and calculating a mass loading target with the measured flow. The aluminum eco-reference value of 0.3055 mg/L was reduced by 10% to 0.2750 mg/L. An implicit MOS was also incorporated in the TMDL by basing the existing condition on the highest measured total aluminum concentration that was collected.

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 both implicit and 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 a 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). Aluminum is such a case. However, because pH is not a load, but rather a measure of acidity and/or alkalinity of a given solution, Alabama's numeric pH standard is used as the TMDL target. 40 CFR § 130.2(i) provides rationale for TMDLs to be expressed in terms of *other appropriate measure.*

4.2 Load Calculations

As previously stated, pH is not a load but rather a measure of acidity and/or alkalinity of a given solution; therefore, Alabama's numeric pH criteria is used as the TMDL target. As for the aluminum TMDL, a mass balance approach was utilized to calculate the TMDL target. The mass balance approach utilizes the conservation of mass principle. Total mass loads can be calculated by multiplying the aluminum concentration times the instream flow times a

conversion factor. An existing load was calculated for the highest aluminum single sample exceedance. In the same manner, an allowable load was calculated using Alabama's Eco-regional Reference Guideline for aluminum.

Existing Conditions

The aluminum mass loading was calculated by multiplying the highest single sample exceedance concentration of 2.42 mg/L times the measured flow of 0.3491 cfs (0.226 MGD). This concentration was calculated based on the measurements collected at BKBW-1 on August 15, 2012. The product of these two values and a conversion factor gives the total mass loading of total aluminum to Black Branch for a single sample exceedance condition. Sample calculations can be found below.

Aluminum Concentration = 2.42 mg/L
Flow = 0.3491 cfs = 0.226 MGD

$$\frac{2.42\ mg}{L} \times \frac{0.226\ million\ gallons}{day} \times \frac{8.34\ lb * L}{million\ gallons * mg} = 4.56\ {}^{lbs}/_{day}$$

Allowable Conditions

The allowable load to the watershed was calculated under the same physical conditions as discussed above for the existing loading. This was done by taking the product of the measured flow used for the violation event times the allowable concentration times a conversion factor. Sample calculations are shown below.

Allowable Aluminum Concentration = 0.3055 mg/L – (10% * 0.3055 mg/L) = 0.2750 mg/L
Flow = 0.3491 cfs = 0.226 MGD

$$\frac{0.2750\ mg}{L} \times \frac{0.226\ million\ gallons}{day} \times \frac{8.34\ lb * L}{million\ gallons * mg} = 0.5182\ {}^{lbs}/_{day}$$

The explicit margin of safety of 0.03055 mg/L equals a daily loading of:

MOS Aluminum Concentration = 0.3055 mg/L * 10% = 0.03055 mg/L
Flow = 0.3491 cfs = 0.226 MGD

$$\frac{0.03055\ mg}{L} \times \frac{0.226\ million\ gallons}{day} \times \frac{8.34\ lb * L}{million\ gallons * mg} = 0.0576\ {}^{lbs}/_{day}$$

The difference in the aluminum 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 target aluminum concentration. The TMDL was calculated as the total daily aluminum load to Black Branch as evaluated at station BKBW-1. Table 4-1 shows a summary of the existing, allowable, and percent reduction for aluminum.

Table 4-1. Total Aluminum Load and Required Reduction for Black Branch at BKBW-1

Source	Existing Load (lbs/day)	Allowable Load (lbs/day)	Required Reduction (lbs/day)	% Reduction
Nonpoint Source	4.56	0.52	4.04	89%
Point Source	N/A	N/A	N/A	N/A

4.3 TMDL Summary

Black Branch was placed on Alabama's §303(d) list in 1998 based on data collected by the Auburn Fisheries Cooperative Research Center in 1996 and 1997. In 2007 and 2012, ADEM collected additional water quality data to fully analyze Black Branch for the listed impairments. The data collected by ADEM confirmed the pH and aluminum impairment on AL03160109-0404-500, and the most recent data (collected in 2012) provided the basis for TMDL development.

Since pH is not a load but rather a measure of acidity and/or alkalinity of a given solution, Alabama's numeric pH standard (6.0 – 8.5 SU) is used as the TMDL target. This target is considered protective of water quality standards. A summary of the load allocations and TMDL for pH in Black Branch is provided below in Table 4-2.

A mass balance approach was used to calculate the aluminum TMDL for Black Branch. Based on the TMDL analysis, it was determined that an 89% reduction in aluminum is necessary. A summary of the load allocations, MOS, and TMDL for aluminum in Black Branch is provided below in Table 4-3. It is believed that correcting the pH impairment will also correct the aluminum impairment.

Table 4-2. pH TMDL for Black Branch

Waste Load Allocations (WLA)	Load Allocations (LA)	Margin of Safety (MOS)	TMDL
N/A[a]	6.0 - 8.5 SU	N/A[b]	6.0 - 8.5 SU

a. N/A=not applicable, no point sources. Future point sources must meet the pH criteria of 6.0-8.5 SU.
b. A Margin of Safety (MOS) was not considered necessary due to the TMDL being established equal to the pH water quality criterion

Table 4-3. Total Aluminum TMDL for Black Branch

TMDL[b]	Margin of Safety	Wasteload Allocations (WLA)		Load Allocations (LA)	
		Point Sources[a]	% Reduction	Nonpoint Sources	% Reduction
lbs/day	lbs/day	lbs/day	%	lbs/day	%
0.576	0.058	N/A	N/A	0.518	89%

a. N/A= not applicable, no point sources. Future point sources must meet the applicable eco-regional reference value at the point of discharge.
b. TMDL was established using the eco-regional reference value of 0.3055 mg/L

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. It is noted that load reductions in the LA portion of this TMDL are in the process of being implemented through CWA §319 projects which are already in place. Noticeable increases in pH and decreases in aluminum concentrations have been observed, and it is the hope of the Department that the water quality in Black Branch will continue to improve as these projects are in place.

The Department recognizes that adaptive implementation of the TMDL will be needed to achieve applicable water quality criteria, and we are committed to targeting the load reductions to improve the water quality in the Black Branch watershed.

5.0 Follow Up Monitoring

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

6.0 Public Participation

As part of the public participation process, this TMDL was placed on public notice and made available for review and comment. The public notice was prepared and published in the major daily 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 document was made available on ADEM's Website: www.adem.state.al.us. The public could also request paper or electronic copies of the report by contacting Ms. Kimberly Minton at 334-271-7826 or kminton@adem.state.al.us. The public was given an opportunity to review the TMDL and submit comments to the Department in writing. At the end of the public review period, all written comments received during the public notice period became part of the administrative record. ADEM considered all comments received by the public prior to finalization of this TMDL and subsequent submission to EPA Region 4 for final review and approval.

7.0 Appendices

7.1 References

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7.2 ADEM Water Quality Data and Listing Data

Table 7-1. ADEM pH Data at Station BKBW-1

Station ID	Visit Date	pH (SU)	pH Detect Condition
BKBW-1	3/14/2007	3.85	
BKBW-1	4/3/2007	3.64	
BKBW-1	5/8/2007	3.45	
BKBW-1	7/10/2007	3.3	
BKBW-1	10/2/2007	3.2	
BKBW-1	4/11/2012	6.66	
BKBW-1	5/2/2012	5.14	
BKBW-1	5/8/2012	5.72	
BKBW-1	6/6/2012	5.19	
BKBW-1	7/18/2012	4.66	
BKBW-1	8/15/2012	4.28	
BKBW-1	9/12/2012	4.71	
BKBW-1	10/3/2012	5.74	
BKBW-1	11/6/2012	4.73	

Table 7-2. ADEM Aluminum Data at Station BKBW-1

Station ID	Visit Date	Al Dissolved (mg/L)	Al Dissolved Detect Condition	Al Total (mg/L)	Al Total Detect Condition	Flow (cfs)
BKBW-1	3/14/2007	3.2		3.2		
BKBW-1	4/3/2007	4.4		4.4		
BKBW-1	5/8/2007	6.3		6.3		
BKBW-1	7/10/2007	11		11.3		
BKBW-1	4/11/2012	0.044	JI	0.073	JI	1.435
BKBW-1	5/2/2012	0.317		0.396		
BKBW-1	6/6/2012	0.438		0.516		
BKBW-1	7/18/2012	2.03		2.08		
BKBW-1	8/15/2012	2.4		2.42		0.3491
BKBW-1	9/12/2012	0.812		0.831		
BKBW-1	10/3/2012	0.093	JI	0.174	JI	1.7142
BKBW-1	11/6/2012	1.56		1.62		

JI: The identification of the analyte is acceptable; the reported value is an estimate. The reported value is between the MDL (method detection limit) and the RL (reporting limit).

Table 7-3. Habitat Assessment at Station BKBW-1

Table 3. Results of the habitat assessment conducted on Black Br at BKBW-1, May 8, 2012. Macroinvertebrates were also collected.

Habitat Assessment	%Maximum Score	Rating
RR		
Instream Habitat Quality	63	Sub-optimal (59-70)
Sediment Deposition	75	Optimal >70
Sinuosity	85	Optimal >84
Bank and Vegetative Stability	69	Sub-optimal (60-74)
Riparian Buffer	33	Poor <50
Habitat Assessment Score	**157**	
% Maximum Score	**65**	Sub-optimal (59-70)

Table 7-4. Macroinvertebrate Assessment at Station BKBW-1

Macroinvertebrate Assessment (Completed 5/8/2012 10:55)		
	Results	**Scores**
Taxa richness measures		**(0-100)**
# EPT taxa	7	13
Taxonomic composition measures		
% Non-insect taxa	4	92
% Dominant taxon	36	30
% EPC taxa	15	25
Functional feeding group measures		
% Predators	21	91
Tolerance measures		
% Taxa as Tolerant	29	57
WMB-I Assessment Score	**---**	**51**
WMB-I Assessment Rating		**Fair (39-58)**

Table 7-5. Listing Data Collected by Auburn Fisheries Cooperative Research Center

Station ID	Date	Water Temp (°C)	pH (SU)	DO (mg/L)	Al [unfiltered] (mg/L)	Al [filtered] (mg/L)
B1	6/24/1996	27.3	2.96	7.8	12.2	.
B1	7/12/1996	22.4	3	8	12.8	12.9
B1	8/8/1996	25.7	3.1	.	5.51	4.14
B1	9/10/1996	26	3	7.9	6.93	5.8
B1	10/11/1996	15	3.1	9.1	15.64	12.03
B1	11/30/1996	12	3.8	.	4193	3850
B1	12/23/1996	9	4	8	2497	2510
B1	1/15/1997	8	4	8	2.519	2.26
B1	2/9/1997	10	4.2	.	.	.
B1	3/19/1997	14.2	3.9	8	.	.
B1	4/25/1997	17.6	3.43	8.85	6.917	7.82
B1	5/2/1997	19.1	3.93	8.6	6289	6250
B1	6/16/1997	25.2	4.2	7.4	.	.
B1	7/21/1997	28.8	3	7.4	.	.
B1	8/7/1997	25.3	3.03	7.9	1.18	.
B1	9/4/1997	25.1	2.9	7.5	.	.
B1	10/14/1997	18	4.5	7.9		
B1	11/18/1997	6.8	3.55	8		
B1	12/18/1997	7.1	3.9	8		
B1	1/30/1998	10.7	4.01	8	4.55	3.99
B1	3/19/1998	16.8	4.27	8.5		
B1	4/21/1998	16.3	5.8	8.2	0.79	0.01
B1	5/29/1998	24.9	3.7	7.9	4.32	4.11
B1	7/9/1998	27.3	3.46	.		
B1	8/28/1998					8.59

Table 7-6 Alabama's 2010 Eco-regional Reference Guidelines

Alabama's 2010 Ecoregional Reference Guidelines																			
			Level 4	Level 4	Level 3	Level 4	Level 4	Level 4	Level 4	Level 4	Level 4	Level 4	Level 4	Level 3	Level 4	Level 4	Level 3	Level 4	Level 3
Parameters	Basis of comparison	Result to compare	45a	45d	45	65a/b	65f	65g	65i	65j	65q	67f	67h	67	68d	68e	68	71f	71
Physical																			
Temperature (°C)	90th %ile	Median	24.656	25	25	27	24.6	27	25	24	27	24	26	25.7	25	23.48	24	22.12	22.586
Turbidity (NTU)	90th %ile	INDIVIDUAL	21.7	6.823	15	49.56	9.7	13.05	26.21	10.73	42.3	6.622	10.787	8.824	9.667	9.025	10.1	3.693	11.1
Total Dissolved Solids (mg/L)	90th %ile	Median	67.9	85.4	80	162.8	53.4	97.4	63.3	167.6	103.4	165	79.4	151.2	118	84.8	97.2	79.6	150.5
Total Suspended Solids (mg/L)	90th %ile	Median	16	12	15	45	13.2	16.3	27.5	26.9	104.6	11.3	12.7	12.4	27	10	14	9.6	8.9
Specific Conductance (µmhos)	Median	Median	40.1	37	39.05	129.7	20.4	53.4	25.8	70	72.5	207	34.35	86	49.5	37	39.15	96	109
Hardness (mg/L)	Median	Median	10.65	11.1	11	56	14	14.2	6.52	82.1	34.6	94.05	8.56	42.3	16.2	10	12.15	47.2	56
Alkalinity (mg/L)	90th %ile	Median	21.8	23.5	23.01	84.41	11.8	21.85	21.05	130.64	36.36	121.73	16.54	117.716	21	44.2	42.2	57.492	109.4
Stream Flow (cfs)																			
Chemical																			
Dissolved Oxygen (mg/L)	10th %ile	Median	7.665	7.6	7.6	5.1	6.94	4.484	6.692	7.64	6.8	7.44	7	7	5.609	7.51	6.79	8.113	7.61
pH (su)	10th %ile	Median	6.5	6.787	6.64	6.758	4.436	5.69	5.82	6.31	6.6	6.938	6.69	6.768	6.482	6.522	6.5	7.162	7.345
pH (su)	90th %ile	Median	7.68	7.679	7.7	8.052	6.55	6.815	7.18	8.1	7.74	8.294	8	8.278	7.352	7.852	7.84	8.35	8.34
Ammonia Nitrogen (mg/L)	90th %ile	Median	0.0078	0.0105	0.0105	0.04802	0.046	0.0203	0.0905	0.0932	0.074	0.0228	0.031	0.0346	0.119	0.0945	0.1007	0.023	0.023
Nitrate+Nitrite Nitrogen (mg/L)	90th %ile	Median	0.1241	0.0718	0.0974	0.286	0.3258	0.2432	0.2764	0.3436	0.0634	0.261	0.0888	0.2403	1.202	0.456	0.6191	0.6895	1.42
Total Kjeldahl Nitrogen (mg/L)	90th %ile	Median	0.40482	0.2598	0.28448	0.887	0.4176	0.583	0.6782	0.4858	0.6346	0.431	0.5107	0.5826	1.46	0.6595	0.733	0.624	0.466
Total Nitrogen (mg/L)	90th %ile	Median	0.53114	0.3224	0.40016	1.1634	0.6396	0.773	0.8512	0.8064	0.69205	0.6836	0.69365	0.7109	2.269	0.9185	1.41685	1.295	1.57
Dissolved Reactive Phosphorus (mg	90th %ile	Median	0.0214	0.027	0.0243	0.0618	0.0264	0.0236	0.023	0.0167	0.0193	0.0174	0.0162	0.017	0.0109	0.019	0.0182	0.017	0.0155
Total Phosphorus (mg/L)	90th %ile	Median	0.0663	0.0537	0.0599	0.201	0.04	0.0698	0.0682	0.0577	0.064	0.0514	0.0429	0.0566	0.0491	0.0501	0.05	0.1059	0.0497
CBOD-5 (mg/L)	90th %ile	Median	2.57	2.37	2.4	3.2	1.96	2.65	2	2.53	2.3	1.78	2.58	2.3	1.86	1.9	1.9	1.1	1.1
Chlorides (mg/L)	90th %ile	Median	4.778	4.029	4.495	12.032	6.692	6.066	4.2852	5.247	5.95	4.266	3.61	3.89	9.118	1.051	6.37	2.4112	2.622
Total Metals																			
Aluminum (mg/L)	90th %ile	Median	0.2437	0.1558	0.1954	1.181	0.4886	0.2732	0.801	0.4045	1.561	0.2104	0.356	0.4114	0.155	0.265	0.3055	0.1954	0.127
Iron (mg/L)	90th %ile	Median	1.094	0.5648	0.8722	2.362	1.352	3.976	3.548	0.839	2.13	0.893	0.733	0.9803	0.6855	1.047	1.046	0.4085	0.4294
Manganese (mg/L)	90th %ile	Median	0.0554	0.0647	0.057	0.215	0.0436	0.7372	0.8094	0.081	0.113	0.067	0.052	0.0628	0.184	0.0563	0.1553	0.025	0.025
Dissolved Metals																			
Aluminum (mg/L)	90th %ile	Median	0.05485	0.0545	0.0545	0.1365	0.2242	0.0545	0.1	0.11	0.193	0.1	0.1	0.1	0.1	0.1	0.1	0.03	0.03
Antimony (µg/L)	90th %ile	Median	1	1	1	1	3.75	1	5	5	3.75	5	1	5		14	14	5	5
Arsenic (µg/L)	90th %ile	Median	5	5	5	5	5	5	5	5	5	3.2	5	5		5	5	12.1	12
Cadmium (mg/L)	90th %ile	Median	0.0435	0.0435	0.0435	0.0435	0.0394	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435	0.0435		0.0448	0.04415	0.0075	0.0075
Chromium (mg/L)	90th %ile	Median	0.0395	0.0395	0.0395	0.0395	0.0321	0.0395	0.0395	0.0395	0.0395	0.0395	0.0395	0.0395		0.0416	0.04055	0.025	0.025
Copper (mg/L)	90th %ile	Median	0.043	0.043	0.043	0.043	0.0349	0.043	0.043	0.075	0.043	0.043	0.043	0.043	0.0298	0.043	0.043	0.1	0.1
Iron (mg/L)	90th %ile	Median	0.292	0.2248	0.256	0.503	0.6132	0.8042	0.5392	0.2445	1.255	0.1218	0.1885	0.2428	0.1552	0.588	0.588	0.025	0.0579
Lead (µg/L)	90th %ile	Median	1	1	1	1	2.5	1	5	5	2.5	5	1	5	1	5	5	5	5
Manganese (mg/L)	90th %ile	Median	0.02665	0.0235	0.0253	0.1224	0.0328	0.7886	0.8218	0.025	0.1084	0.025	0.0235	0.025		0.05	0.05	0.025	0.025
Mercury (µg/L)	90th %ile	Median	0.15	0.15	0.15	0.15	0.25	0.15	0.25	0.2	0.25	0.2	0.2	0.2	0.18	0.2	0.2	0.15	0.15
Nickel (mg/L)	90th %ile	Median	0.114	0.114	0.114	0.114	0.0936	0.114	0.05	0.114	0.114	0.0884	0.114	0.114		0.114	0.114	0.025	0.025
Selenium (µg/L)	90th %ile	Median	5	5	5	5	5	5	25	23	5	23	5	5		50	50	15	25
Silver (mg/L)	90th %ile	Median	0.058	0.058	0.058	0.058	0.0467	0.058	0.05	0.058	0.058	0.0548	0.058	0.058		0.058	0.058	0.025	0.025
Thallium (µg/L)	90th %ile	Median	0.5	0.5	0.5	0.5	4.5	0.5	5	5	4.5	5	0.5	5		18.5	18.5	5	5
Zinc (mg/L)	90th %ile	Median	0.0345	0.0345	0.0345	0.0345	0.0294	0.0345	0.0345	0.0345	0.0345	0.0345	0.0345	0.0345	0.0267	0.0438	0.0345	0.03	0.0285
Biological																			
Chlorophyll a (µg/L)	90th %ile	Median	5.019	2.14	2.67	5.181	1.755	1.282	4.732	3.31	3.949	2.562	2.086	2.322	1.392	2.458	2.67	3.044	4.255
Fecal Coliform (col/100 mL)	90th %ile	Median	332	116	201.2	1564	400	234	620	582	1025	141.6	152.2	197	829	252	320	200	435

7.3 Black Branch Watershed Photos

Photo 1 – BKBW-1 Looking Upstream (Photo Taken 10/2/2007)

Photo 2 – BKBW-1 Looking Downstream (Photo Taken 10/2/2007)

Photo 3 – BKBW-1 Looking Upstream (Photo Taken 8/15/2012)

Photo 4 – BKBW-1 Looking Downstream (Photo Taken 8/15/2012)