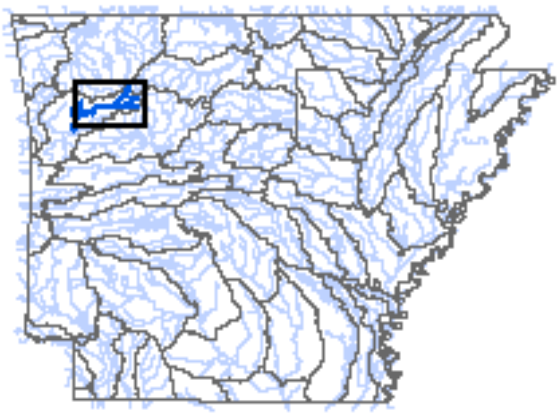
Total Maximum Daily Load (TMDL)
For pH
Mulberry River, Arkansas
(HUC 11110201-009)



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Draft Mulberry River pH TMDL

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1. MONITORED SEGMENT IDENTIFICATION

County	Johnson
Waterbody of Concern	Mulberry River
Basin Name	Arkansas River
USGS HUC	11110201
Water Quality Monitoring Station	ARK0138
Stream Reach	009
Planning Segment	3H
Ecoregion	Arkansas River Valley
Impaired Designated Use	Aquatic Life Use
Cause	pH
Source	Unknown
Stream Miles	9.1 miles
Size of Watershed	45,083 acres
Water Quality Standards	6.0 to 9.0 s.u with 1 unit variation
TMDL Target	6.0 to 9.0 s.u. with 1 unit variation
Wasteload Allocation	Not Applicable
Load Allocation	6.0 to 9.0 s.u with 1 unit variation
Margin of Safety	Not Applicable
NPDES discharge Permits (Point Source)	None

2. EXECUTIVE SUMMARY

One segment (009) of the Mulberry River has been placed on the Arkansas 2008 303(d) List (List of Impaired Waterbodies) because of low pH readings. pH is a measure of acidity and alkalinity of a solution that is a number on a 0-14 scale on which a value of 7 represents neutrality with lower numbers indicating increasing acidity and higher number indicating increasing alkalinity. Each unit of change on the scale represents a tenfold change in acidity or alkalinity that is calculated as the negative logarithm of the effective hydrogen-ion concentration, or hydrogen-ion activity, in gram equivalents per liter of solution ($pH = -\log [H+]$).

The applicable water quality criterion for pH, as described in Arkansas Pollution Control and Ecology (APCEC, 2007) Regulation No. 2, is 6.0 to 9.0 and shall not be caused to vary more than 1.0 unit as a result of waste discharges. A review of the available monitoring data for the watershed indicates that the levels of pH are sometimes below the standard. The specific cause(s) of the low pH for this water are not known. Presently, there are no permitted discharges to this segment of Mulberry River. Therefore, the low pH in this water must be attributed either to unknown non-point sources of pollution or to natural background conditions. Because pH is not a load, but rather a measure of acidity and/or alkalinity of a given solution, this TMDL uses the "other appropriate measure" approach (40 CFR § 130.2(i)) rather than an actual "mass-per-unit time" approach (i.e. lbs/day). The state's numeric pH criterion of 6.0 to 9.0 s.u. with 1 unit variation is used as the TMDL target (other appropriate measure). Thus, the final TMDL ensures both future point and unknown non-point sources activities (including natural background) meet the applicable state standard. However, should the natural background pH be outside the standard, it shall not be changed more than 1.0 unit unless after the change the pH will fall within the 6.0 to 9.0 standard.

Soils tend to become acidic as a result of (1) rainwater leaching away basic ions (calcium, magnesium, potassium, and sodium); (2) carbon dioxide from decomposing organic matter and root respiration dissolving in soil water to form a weak organic acid; and (3) the formation of strong organic and inorganic acids, such as nitric and sulfuric acid, from decaying organic matter, the oxidation of ammonium, and the oxidation of sulfur fertilizers.

There were only three exceedances of the pH standard during the period of record for which data exists for this waterbody segment. The lowest reading was 5.49 s.u. It is highly unlikely that this type of occasional exceedance is having any negative effect on the aquatic life communities in the stream. The purpose of this TMDL is to determine if the pH levels found in the stream are indeed caused by a point source or are a natural background condition. Low pH in this watershed indicates that the variance to the standard is due to natural, uncontrollable sources. Since these sources are considered uncontrollable, this TMDL does not attempt to address any type of controlling strategy for these sources.

The wasteload allocation for the proposed total maximum daily load (TMDL) requires that the pH in effluent from any future permitted point sources shall be within the range of 6.0 to 9.0 s.u. The load allocation for the proposed TMDL requires that the pH of waters originating from non-point sources shall be within the range of 6.0 to 9.0 s.u with 1 unit variation. These allocations provide for the year-round protection of water quality.

3. 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 develop total maximum daily loads (TMDLs) for waterbodies that are not meeting designated uses under technology-based controls for pollution. The TMDL process is designed to restore and maintain the quality of those impaired waterbodies through the establishment of pollutant specific allowable loads. This TMDL is for pH. The Arkansas Department of Environmental Quality (ADEQ) has listed a 1.9 mile segment of the Mulberry River (HUC11110201-009) as being impaired due to low pH on the 2008 303(d) List of Waterbodies. The section of the Mulberry River in Johnson County and Newton County is shown in Figure 1.

The purpose of this TMDL is to determine if the pH levels found in the stream segments are caused by a point source discharge, the result of pollution, or are the result of natural or background conditions. The term ''pollution'' as defined by Section 505(19) of the Clean Water Act means "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water".

Soils tend to become acidic as a result of: (1) rainwater leaching away basic ions (calcium, magnesium, potassium, and sodium); (2) carbon dioxide from decomposing organic matter and root respiration dissolving in soil water to form a weak organic acid; and (3) the formation of strong organic and inorganic acids, such as nitric and sulfuric acid, from decaying organic matter, the oxidation of ammonium, and the oxidation of fertilizers. If weak acids are formed from the reaction of hydrogen ions combining with carbon dioxide or other compounds, bases may be gradually leached from the soil as the water percolates through it, lowering the soil pH. Decomposition of coniferous vegetation, which produces more acids than either deciduous vegetation or grasses, also lowers soil pH.

The headwaters of ARK0138 and ARK0139, as well as the counties and tributaries upstream of those sites are shown in Figure 1. The sources of runoff and low pH in the Mulberry River Watershed were analyzed by treating the area as a single watershed. The monitoring station ARK0138 is on reach 009 and downstream of reaches 010 and 011. ARK0139 is below ARK0138 on reach 009 and downstream of reach 012. This segment of Mulberry River is in the Arkansas River Basin in northwest Arkansas. The drainage area of ARK0138 is approximately 45,083 acres within Johnson and Newton Counties entirely with the boundaries of the Ozark National Forest (Figure 1). The watershed is almost entirely forested, estimated to be more than 95%, with some grass lands (Figure 2). There is little to no active silviculture activities in the watershed.

Figure 1 Mulberry River Watershed Map

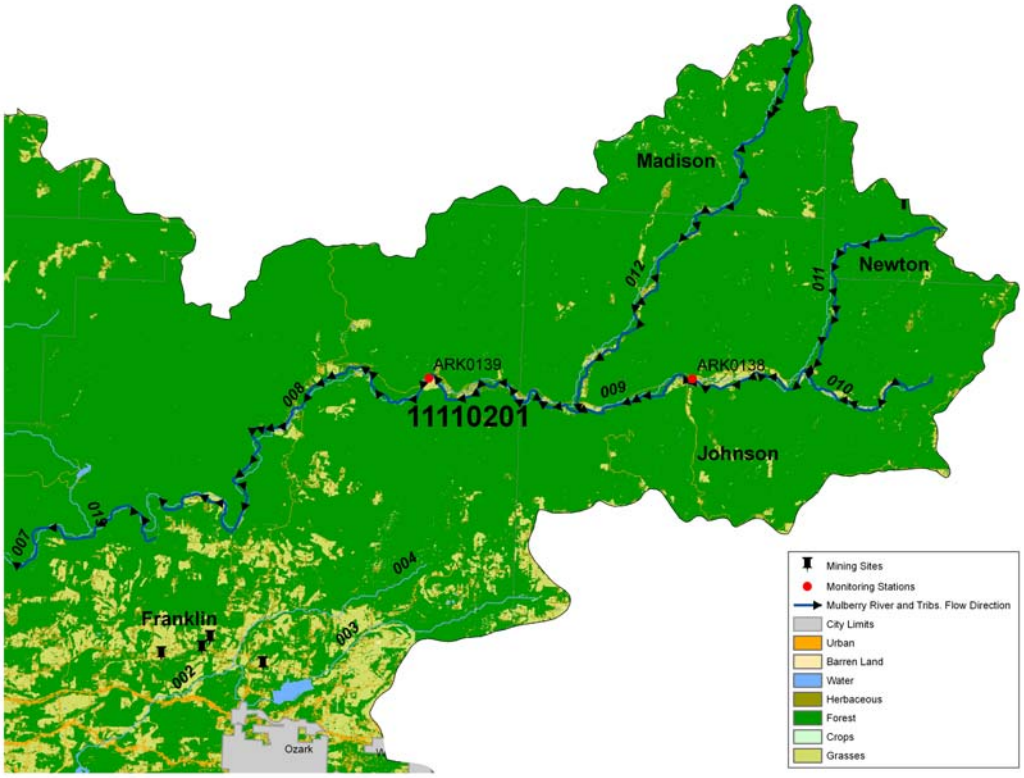


Figure 2-Landuse Distribution

4. pH

pH is a measure of the hydrogen ion concentration in water which is represented as a measure of the acidity or alkalinity. Specifically, the pH is defined as the negative logarithm of the hydrogen ion concentration in terms of moles per liter pH = -log [H+]. pH values can range from 1.0 standard units (s.u.) for a very acidic solution to 14.0 s.u. for a very basic solution. A pH equal to 7.0 s.u. represents neutrality. One of the most significant environmental impacts of pH is the effect that it has on the solubility and thus the bioavailability of potentially toxic substances that may be present in surface waters. As the pH in a waterbody becomes lower (i.e., the solution becomes more acidic) many insoluble toxic substances become more soluble and thus more likely to have toxic effects on fish and other aquatic life.

5. APPLICABLE WATERBODY SEGMENT USE

Designated beneficial uses and water quality standards are established by the State of Arkansas Water Quality Criteria Regulation No. 2. The waters within this segment have been designated as suitable for the propagation of fish and wildlife, primary and secondary contact recreation, and public, industrial, and agricultural water supply.

6. APPLICABLE WATERBODY SEGMENT STANDARD

The water quality standard applicable to the use of the waterbody and the pollutant of concern is defined in the APCEC Regulation No. 2. The standard states that the normal pH of the waters shall be 6.0 to 9.0 s.u. and shall not be caused to vary more than 1.0 unit over a 24-hour period as a result of a waste discharge.

7. SELECTION OF A TMDL ENDPOINT

A TMDL establishes the maximum amount of a pollutant a waterbody can assimilate without exceeding the applicable water quality standard. The TMDL allocates the total allowable load to individual sources or categories of pollution sources through wasteload allocations (WLAs) for point sources, regulated by the National Pollutant Discharge Elimination System (NPDES) program, and through load allocations (LAs) for non-point sources. The WLAs and LAs in the TMDL provide a basis for states to reduce pollution from both point and non-point sources that will lead to restoration of the quality of an impaired waterbody. The purpose of this TMDL is to identify the allowable load of pH that will result in attainment of the applicable water quality criterion.

One of the major components of a TMDL is the establishment of instream numeric endpoints which are used to evaluate the attainment of acceptable water quality. Instream numeric endpoints, therefore, represent the water quality goals that are to be achieved by implementing the load and wasteload reductions specified in the TMDL. The endpoints allow for a comparison between observed instream conditions, and conditions that are expected to restore designated uses. The instream target for pH is that the normal pH of the waters shall be 6.0 to 9.0 s.u and shall not fluctuate more than 1.0 standard unit over a 24-hour period because of a discharge. However, should the natural background pH be outside the 6.0 to 9.0 limits, it shall not be changed more than 1.0 unit unless after the change the pH will fall within the 6.0 to 9.0 limits. The language in Reg. 2.504 is difficult to interpret; however, the 1.0 unit allowance for natural

background should apply to each of these segments. Because pH variance may be attributed to both non-point and point sources, the critical condition used for studying the stream response was represented by a multi-year period (2003-2005). Critical conditions for waters impaired by non-point sources generally occur during periods of wet-weather and high surface runoff. But, critical conditions for point source dominated systems generally occur during low-flow, low-dilution conditions.

8. INVENTORY OF AVAILABLE MONITORING DATA

The State's 2008 305(b) Integrated Water Quality Monitoring and Assessment Report was reviewed to assess water quality conditions and data available for the watershed. There are two ambient stations operated by ADEQ that has pH monitoring data available. Stations ARK0138 and ARK0139 are located on Mulberry River in Johnson and Franklin Counties, respectively. Data collected from these stations are listed in Table 1 and Table 2. In addition, fish community data was collected at ARK0138 in 2006 by the Limnology Class at Arkansas Tech University under the direction of Dr. Charlie Gagen. In Table 3 Fishes collected April 28, 2006 from a riffle in the Mulberry River about one river mile downstream of the AR-Hwy. 103 bridge (ARK0138) by Dr. Gagen's limnology class from Arkansas Tech University. Three passes with an electro-seine, an ordinary seine, and six dip nets.

Table 1-ARK0138

Date Collected	pH	Temperature	D.O.	NH3-N
9/19/2005	6.56	28.2	7.13	BDL
7/11/2005	5.68	24.6	10.6	BDL
5/9/2005	6.51	15.5	9.88	BDL
3/7/2005	5.55	10.8	11	BDL
1/10/2005	5.49	8.8	11.7	BDL
10/11/2004	6.62	18.1	9.3	BDL
6/28/2004	6.16	21.9	8.35	BDL
5/17/2004	7.44	22.4	8.94	BDL
3/22/2004	6.55	10.6	11	BDL
1/13/2004	6.85	6.1	12.7	BDL
10/27/2003	7.09	17.2	8.2	BDL

Table 2-ARK0139

Date Collected	pH	Temperature	D.O.	NH3-N
9/19/2005	6.95	25.6	8.34	BDL
7/11/2005	6.14	27.4	7.82	BDL
5/9/2005	6.29	16.3	9.65	BDL
3/7/2005	5.5	11.5	10.8	BDL
1/10/2005	5.77	8.7	11.8	BDL
10/11/2004	6.89	17.9	9.35	BDL
6/28/2004	6.28	22.2	8.2	BDL
5/17/2004	6.81	18.3	9.26	BDL
3/22/2004	6.72	11.5	10.8	BDL
1/13/2004	7.08	5.9	13.9	BDL
10/27/2003	7.53	15.1	9.78	BDL

Table 3- Fishes collected April 28, 2006

Common name	**Count**	**Percent Community**
Bigeye shiner	79	20.8
Bluntnose minnow	69	18.2
Central stoneroller	115	30.3
Steelcolor shiner	2	0.5
Northern hogsucker	2	0.5
Slender madtom	51	13.4
Blackspotted topminnow	1	0.3
Bluegill sunfish	1	0.3
Longear sunfish	32	8.4
Green sunfish	1	0.3
Smallmouth bass*	1	0.3
Banded darter	4	1.1
Fantail darter	9	2.4
Greenside darter	1	0.3
Orangethroat darter	10	2.6
Redfin darter	1	0.3
Speckled darter	1	0.3
Total	380	
Total species	17	

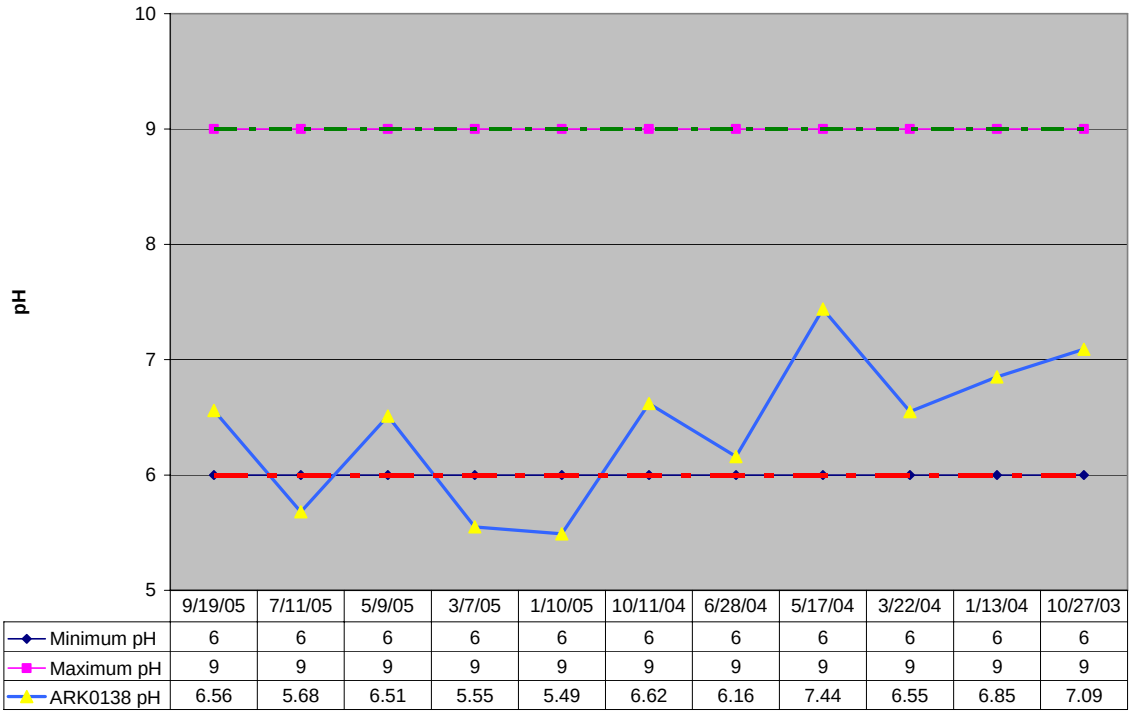
*Captured by hook and line.

9. ANALYSIS OF INSTREAM MONITORING DATA

A statistical summary of the water quality pH data discussed above is presented in Table 4. The percent exceedance was calculated by dividing the number of exceedances by the total number of samples and does not represent the amount of time that the water quality was in violation. These data are charted in Figure 3 and Figure 4. The line drawn on the chart at pH = 6.0 represents the lowest pH levels allowed by Arkansas's water quality standards. Based on the available data, 27% of the samples exceeded the pH criterion for ARK0138 and 18% for ARK0139. Although the available water quality data shows that the low pH criterion is exceeded, it is unknown what pollutant is causing the pH violations. Figures 3 and 4 shows that the pH violations in Mulberry River generally occurred during the late winter and spring when flows are naturally elevated.

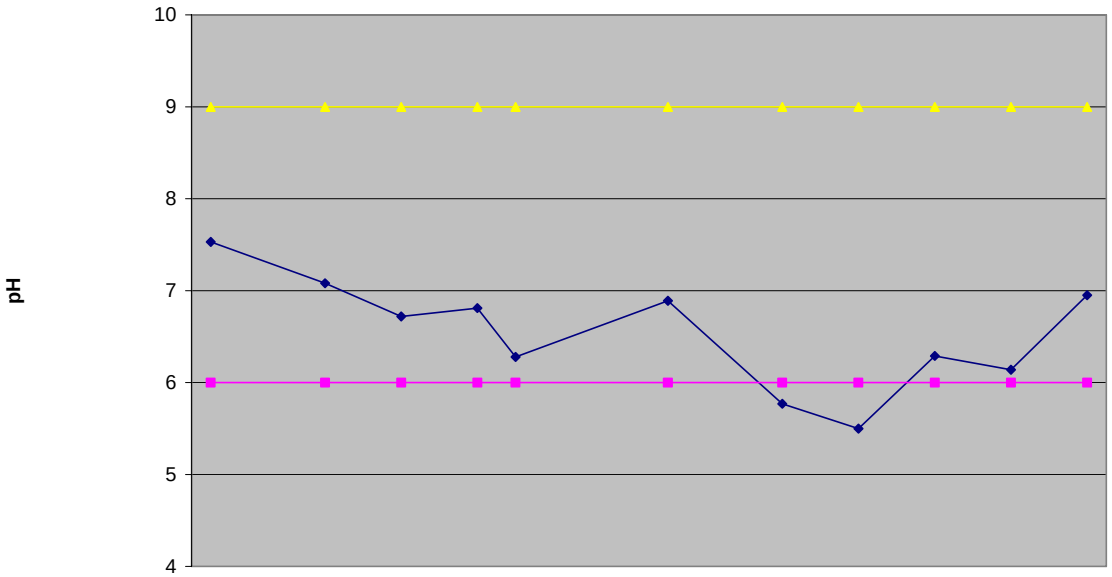
Table 4 - pH Exceedences

Station	Year	Number of Samples	Number of Exceedences	Percent Exceedence
ARK0138	2003-2005	11	3	27%
ARK0139	2003-2005	11	2	18%



	9/19/05	7/11/05	5/9/05	3/7/05	1/10/05	10/11/04	6/28/04	5/17/04	3/22/04	1/13/04	10/27/03
Minimum pH	6	6	6	6	6	6	6	6	6	6	6
Maximum pH	9	9	9	9	9	9	9	9	9	9	9
ARK0138 pH	6.56	5.68	6.51	5.55	5.49	6.62	6.16	7.44	6.55	6.85	7.09

Figure 3- pH violations in Mulberry River ARK0138



	9/19/2005	7/11/2005	5/9/2005	3/7/2005	1/10/2005	10/11/2004	6/28/2004	5/17/2004	3/22/2004	1/13/2004	10/27/2003
pH for ARK0139	6.95	6.14	6.29	5.5	5.77	6.89	6.28	6.81	6.72	7.08	7.53
Minimum pH	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Maximum pH	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0

Figure 4- pH violations in Mulberry River ARK0139

The fish community data (Table 5) was compared to fish community data from least disturbed Boston Mountains Ecoregion reference streams (Table 6). Analysis of the fish community data indicates that a large portion of the community was comprised of key and sensitive (39.6%) individuals (43.2%) (Table 6). Key individuals are those species that are typically found within an ecoregion. Sensitive individuals are those species that are very sensitive to environmental changes, such as water quality or habitat. In addition, the site scored as "generally similar" to other Boston Mountains Ecoregion streams (Table 6). The score was somewhat biased low because fish were sampled from only riffles. This possibly caused the Cyprinidae and Primary TFL (Trophic Feeding Level) scores to be lowered because of the number of stonerollers present in the sample. Both of these scores would probably have been lower, and the Centrarchidae score higher had a representative pool sample been collected. In addition, this would also have increased the Diversity Index score. Thus, by simply adding on unit score to each of these four metrics would raise the Degree of Similarity to "Highly Similar".

Table 5 - Fish Community Biocriteria Boston Mountains

Metric (% community, except Diversity Index)	SCORE		
	4	2	0
Cyprinidae	25 - 60	15 – 25 or 60 - 75	<15 or >75
Ictaluridae	>4[1]	2 – 4[1]	<2[1] or >1 bullheads
Centrarchidae	10 - 40[2]	6 - 10 or 40 - 55[2]	<6 or >55[2]
Percidae	>10	6 - 10	<6
Sensitive Individuals	>30	30 – 16	<16
Primary TFL	<35	35 - 45	>45
Key Individuals	>35	25 – 35	<25
Diversity Index	>3.15	3.15 - 2.85	<2.85

1 – no more that 1% bullheads 2 – no more than 18% Green sunfish

Table 6- Fish Community Structure Index

Parameter	Mulberry R	Score
Cyprinidae	69.8%	2
Ictaluridae	13.4	4
Centrarchidae	9.3	2
Percidae	7.0	2
% Sens. Inds.	39.6	4
% Primary Inds	48.5	0
% Key Inds.	43.2	4
Diversity Index	2.702	0
Total Score		18
Degree of Similarity		GS
Degree of Similarity	Boston Mountains	
Highly (HS)	25 – 32	
Generally (GS)	24 – 17	
Fairly (FS)	16 - 9	
Not (NS)	8 - 0	

10. DISCUSSION OF INSTREAM WATER QUALITY

Water quality data available for the monitored segments of Mulberry River show that on occasion, low levels of pH have been recorded in the stream. Runoff may contain iron, lead, chromium, ammonia, mercury or other elements. The pH of the water affects the toxicity of these substances. As the pH falls (solution becomes more acidic) many insoluble substances become more soluble and thus available for absorption. Each has measurements of pH, temperature (Temp), Dissolved Oxygen (DO), and Ammonia-Nitrogen (NH3-N) between September 2003 and October 2005 (Tables 1 and 2). All ammonia results were below the detection (BDL) limit of 0.03 mg/l. Additionally, there were no violations of the dissolved oxygen standard at either of the two stations. Therefore, there are no toxic effects associated with ammonia-nitrogen on the aquatic life community at the sites.

11. SOURCE IDENTIFICATION

It is recognized that all of the sources for low pH in the stream are natural. These sources are considered uncontrollable, and this TMDL does not attempt to address any type of controlling strategy for these sources. As discussed earlier, Figure 2, it is estimated that over 95% of the landuse in the watershed is silviculture. There are currently no point source discharges that are permitted to discharge to the stream segment or any upstream segment of ARK0138. Therefore, the low pH in this water must be attributed to unknown non-point sources of pollution, natural background conditions, or some combination of the two.

11.1. POINT SOURCES

There are no permitted point sources loads contributing to the existing pH violations in the watershed.

11.2. NON-POINT SOURCES

Non-point source pollution is described as "Pollution sources which generally are not controlled by establishing effluent limitations under sections 301, 302, and 402 of the Act. Non-point source pollutants are not traceable to a discrete identifiable origin, but generally result from land runoff, precipitation, drainage, or seepage" (40 CFR § 35.1605-4). Since over 95% of the watershed is Ozark National Forest with little to no man-made or man-induced alterations, only 5% of the watershed is contributing non-point source pollution to the Mulberry River.

12. TOTAL MAXIMUM DAILY LOAD (TMDL)

A TMDL establishes the total pollutant load a waterbody can receive and still achieve water quality standards. The components of a TMDL include a wasteload allocation (WLA) for point sources and a load allocation (LA) for non-point sources (including natural background) and a margin of safety (MOS) to account for uncertainty. Because pH is not a load, but rather a measure of acidity and/or alkalinity of a given solution, this TMDL uses an "other appropriate measure" (40 CFR § 130.2(i)) rather than an actual "mass-per-unit time" measure. For this TMDL, the State's numeric pH criterion (6.0 to 9.0 s.u.) is used as the TMDL target (other appropriate measure). Even though it has been determined that the low pH values in the Mulberry River are naturally occurring, wasteload and load allocation can be developed to

address any future development in the watershed. The wasteload allocation for the proposed total maximum daily load (TMDL) requires that the pH in effluent from any future permitted point sources shall be within the range of 6.0 to 9.0 s.u. The load allocation for the proposed TMDL requires that the pH of waters originating from non-point sources (including natural background) shall be within the range of 6.0 to 9.0 s.u with 1 unit variation. These allocations provide for the year-round protection of water quality.

$$TMDL = Sum\ (WLAs) + Sum\ (LAs) + MOS$$

12.1. POINT SOURCES

No point sources exist in the Mulberry River watershed. As a result, the wasteload allocations for the Mulberry River Watershed are assumed to be zero.

12.2. NON-POINT SOURCES

Only 5% of the watershed can be classified as potential sources of nonpoint source pollution. The other 95% of the land use in the river is in national forest with little to no man-induced alterations to the landscape.

12.3. MARGIN OF SAFETY

The margin of safety in TMDL development is used to account for the lack of knowledge concerning the relationship between the pollutant loads and the quality of the receiving waterbody. The targets used for this TMDL ensures that loads from the future point source and loads originating from non-point source activities must individually meet the pH target of 6.0 to 9.0 with 1 unit variation.

As long as pH from both future point source and non-point source are consistent with the TMDL target, the pH in the 303(d) listed segment of the Mulberry River will be consistent with water quality standards. Therefore, an additional consideration of a margin of safety for Mulberry River was determined unnecessary.

13. SEASONAL VARIATION

By looking at two years worth of data, a cycle or trend is established that shows lower pH in the winter time. This corresponds to early rainfall events in the winter bringing the first acidic load from decaying coniferous trees. It is our contention that this is a natural event and is uncontrollable. However, considering that this TMDL is protective during all seasons and environmental conditions, it will inherently be protective during critical conditions whenever they may occur.

14. CONCLUSION

Based on the information discussed in the previous section, it is concluded that the occasional low pH values that occur on a seasonal basis in the upper Mulberry River watershed are naturally occurring. There are no point source discharges and little to no non-point source in the

watershed above the sample sites. The fish community sampled from the site was evaluated as generally supporting. The exceedances in the pH standard generally occur during the late winter and spring when rainfall and instream productivity is low. This TMDL is for low pH. This is an indicator of water quality and is not in and of itself a pollutant. Manipulation of the pH value in the context of a TMDL calculation is meaningless. Therefore, as long as pH from both future point source and non-point source are consistent with the TMDL target, water quality standards in Mulberry River will be met

15. PUBLIC PARTICIPATION

The TMDL regulations require that each State/Tribe must subject calculations to establish TMDLs to public review consistent with its own continuing planning process (40 C.F.R. §130.7(c)(1)(ii)). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval should describe the State's/Tribe's public participation process, including a summary of significant comments and the State's/Tribe's responses to those omments. Provision of inadequate public participation may be a basis for disapproving a TMDL. If EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

A notice of this TMDL will be published in the county(ies) and statewide newspaper for a 30-day public notice and a copy of this TMDL will sent to EPA after PN for review. The public and EPA will be given an opportunity to review the TMDL and submit comments. At the end of the 30-day period, ADEQ will determine the level of interest in the TMDL and make a decision on the necessity of holding a public hearing. All comments received during the public notice period and at any public hearings become a part of the record of this TMDL. All comments will be considered in the ultimate approval of this TMDL and for submission of this TMDL to EPA Region VI for final approval.

16. DEFINITIONS

Ambient stations: a network of fixed monitoring stations established for systematic water quality sampling at regular intervals, and for uniform parametric coverage over a long-term period.
Assimilative capacity: the capacity of a body of water or soil-plant system to receive wastewater effluents or sludge without violating the provisions of the State of Arkansas Water Quality Criteria
Background: the condition of waters in the absence of man-induced alterations based on the best scientific information available to ADEQ. The establishment of natural background for an altered waterbody may be based upon a similar, unaltered or least impaired, waterbody or on historical pre-alteration data.
Calibrated model: a model in which reaction rates and inputs are significantly based on actual measurements using data from surveys on the receiving waterbody.
Controllable Sources: Sources of pollutants that can be modified or controlled with regulatory requirements and/or best management practices.
Critical Condition: hydrologic and atmospheric conditions in which the pollutants causing impairment of a waterbody have their greatest potential for adverse effects.
Daily discharge: the "discharge of a pollutant" measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the "daily average" is calculated as the average.
Designated Use: use specified in water quality standards for each waterbody or segment regardless of actual attainment.
Discharge monitoring report: report of effluent characteristics submitted by a NPDES Permitted facility.
Effluent standards and limitations: all State or Federal effluent standards and limitations on quantities, rates, and concentrations of chemical, physical, biological, and other constituents to which a waste or wastewater discharge may be subject under the Federal Act or the State law. This includes, but is not limited to, effluent limitations, standards of performance, toxic effluent standards and prohibitions, pretreatment standards, and schedules of compliance.
Effluent: treated wastewater flowing out of the treatment facilities.
Geometric mean: the *n*th root of the product of *n* numbers. A 30-day geometric mean is the 30th root of the product of 30 numbers.
Impaired Waterbody: any waterbody that does not attain water quality standards due to an individual pollutant, multiple pollutants, pollution, or an unknown cause of impairment.
Land Surface Runoff: water that flows into the receiving stream after application by rainfall or irrigation. It is a transport method for non-point source pollution from the land surface to the receiving stream.
Load allocation (LA): the portion of a receiving water's loading capacity attributed to or assigned to non-point sources (NPS) or background sources of a pollutant.
Loading: the total amount of pollutants entering a stream from one or multiple sources.
Non-point Source: pollution that is in runoff from the land. Rainfall, snowmelt, and other water that does not evaporate become surface runoff and either drains into surface waters or soaks into the soil and finds its way into groundwater. This surface water may contain pollutants that come

from land use activities such as agriculture; construction; silviculture; surface mining; disposal of wastewater; hydrologic modifications; and urban development.

NPDES permit: an individual or general permit issued by the ADEQ.

pH: a measure of acidity and alkalinity of a solution that is a number on a scale on which a value of 7 represents neutrality and lower numbers indicate increasing acidity and higher number increasing alkalinity and on which each unit of change represents a tenfold change in acidity or alkalinity and that is the negative logarithm of the effective hydrogen-ion concentration or hydrogen-ion activity in gram equivalents per liter of the solution.

Point Source: pollution loads discharged at a specific location from pipes, outfalls, and conveyance channels from either wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving stream.

Pollution: contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the State, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance, or leak into any waters of the State, unless in compliance with a valid permit issued by the ADEQ.

Publicly Owned Treatment Works (POTW): a waste treatment facility owned and/or operated by a public body or a privately owned treatment works which accepts discharges which would otherwise be subject to Federal Pretreatment Requirements.

Total Maximum Daily Load or TMDL: the calculated maximum permissible pollutant loading to a waterbody at which water quality standards can be maintained.

Regression Coefficient: an expression of the functional relationship between two correlated variables that is often empirically determined from data, and is used to predict values of one variable when given values of the other variable.

Waste: sewage, industrial wastes, oil field wastes, and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any waters of the State.

Wasteload allocation (WLA): the portion of a receiving water's loading capacity attributed to or assigned to point sources of a pollutant. It also contains a portion of the contribution from septic tanks

Water Quality Standards: the criteria and requirements set forth in *State of Arkansas Water Quality*. Water quality standards are standards composed of designated present and future most beneficial uses (classification of waters), the numerical and narrative criteria applied to the specific water uses or classification, and the Arkansas antidegradation policy.

Water quality criteria: elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports the present and future most beneficial uses.

Waters of the State: all waters within the jurisdiction of this State, including all streams, lakes, ponds, wetlands, impounding reservoirs, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, situated wholly or partly within or bordering upon the State, and such coastal waters as are within the jurisdiction of the State, except lakes, ponds, or other surface waters which are wholly landlocked and privately owned, and which are not regulated under the Federal Clean Water Act (33 U.S.C.1251 et seq.).

Watershed: the area of land draining into a stream at a given location.

17. ABBREVIATIONS

7Q10	Seven-Day Average Low Stream Flow with a Ten-Year Occurrence Period.
ac	Acre
ADEQ	Arkansas Department of Environmental Quality
BMP	Best Management Practice
CWA	Clean Water Act
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MOS	Margin of Safety
NPDES	National Pollution Discharge Elimination System
NPS	Non-point Source
s.u.	Standard Units
USGS	United States Geological Survey
WLA	Waste Load Allocation

18. REFERENCES

1. Metcalf and Eddy. 1991. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd Edition McGraw-Hill, Inc., New York.

2. http://www.esf.edu/pubprog/brochure/soilph/soilph.htm

3. EPA Guidelines for Reviewing TMDLs Under Existing Regulations Issued in 1992

4. http://www.epa.gov/owowwtr1/tmdl/guidance/final52002.html

5. 2008 ADEQ's Water Quality Monitoring Network

6. Arkansas Department of Environmental Quality, 2006 and 2008 303(d) List

7. 2008 305(b) Integrated Water Quality Monitoring and Assessment Report

8. Regulation No. 2, Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas as revised, effective November 25, 2007.

9. Total Maximum Daily Load (TMDL) For pH Exceedences in Kingwood Branch Creek, GA , February 2002.

10. LAND USE LAND COVER FALL 2006 (raster), Publisher:2007 Center for Advanced Spatial Technologies.

11. Mississippi Department of Environmental Quality, TMDL for Low pH in Turkey Creek, Coastal teams Basin, Harriston Counties, Mississippi.

12. Kentucky Total Maximum Daily Load (TMDL) Development - pH (H+ Ion Mass) For Brier Creek Watershed, (Muhlenberg County, Kentucky), May 2001.

13. Total Maximum Daily Load (TMDL) For pH Exceedences in Kingwood Branch Creek, GA , 2/2002.

14. Code of Federal Regulation Series 40 Part 130 (40 CFR 130)

19. TMDL REVIEW CHECKLIST

State: Arkansas

§303(d) Segment(s): HUC 11110201-009, 3H

Pollutant(s): pH

Date Submittal:

Date of EPA Action:

Date Entered into Tracking System:

EPA Reviewer:

Review Element	Required	Included (Yes/No)	Recommendations/ Comments
Submittal Letter	Yes	Yes	
Identification of Waterbody, Pollutant of Concern, Pollutant Sources, & Priority Ranking	Yes	Yes	
Applicable Water Quality Standards & Numeric Targets	Yes	Yes	
Loading Capacity	Yes	Yes	
Load Allocations (LAs)	Yes	Yes	
Wasteload Allocations (WLAs)	Yes	Yes	
Margin of Safety (MOS)	Yes	No	
Seasonal Variation	Yes	Yes	
Reasonable Assurances: through NPDES permits or if WLAs depend on LAs	Yes	Yes	
Public Participation	Yes	Yes	
Technical Analysis/Supporting Documentation	Yes	Yes	
Information entered into TMDL Tracking System	Yes	No	
Other Comments	Yes		

Public Notice of Availability of Proposed Total Maximum Daily Load for
Mulberry River Waterbody Located Within the State of Arkansas

Section §303(d)(1)(C) of the Clean Water Act (CWA), 33 U.S.C. §1313(d)(1)(C), and the U.S. Environmental Protection Agency (EPA) implementing regulation, 40 C.F.R. §130.7(c)(1), require the establishment of Total Maximum Daily Loads (TMDLs) for waters identified as being impaired pursuant to §303(d)(1)(A) of the CWA. Each TMDL is to be established at a level that will protect the designated and existing uses of the waterbody.

This is to give notice that the Water Division of the Arkansas Department of Environmental Quality (ADEQ), 5301 Northshore Drive, North Little Rock, Arkansas 72118-5317 at telephone number (501) 682-0663, is proposing a TMDL for the following water and pollutant located within the State of Arkansas:

Waterbody Name	River Basin	County	Pollutant of Concern	Action Being Proposed
Mulberry River	Arkansas River	Johnson	pH	TMDL

The proposed TMDL, including supporting documents, technical information, and data, are available for review during normal business hours of 8:00 a.m. to 4:30 p.m., Monday through Friday, at the Main Office located at the above address.

ADEQ's contact person for submitting written comments, requesting information regarding the draft TMDL, including supporting documents, technical information, and data is Mr. Jim Wise, at the above address and telephone number or by e-mail at Water-TMDL-Comments@adeq.state.ar.us.

For those with Internet access, a copy of the proposed draft TMDL may be found on the following ADEQ website: http://www.adeq.state.ar.us/water/branch_planning/default.htm.

Written comments and requests for public hearings and reasons for the necessity of a public hearing must be received by ADEQ prior to 4:30 p.m. on October 23, 2009. All persons who wish to comment on ADEQ's draft TMDL must submit written comments to ADEQ by mail or e-mail, along with their name and mailing address. Following the public comment period and public hearing, if one is held, ADEQ will submit to EPA for review and approval a copy of public notice, response to comments, TMDL, and the TMDL checklist. Wasteload allocations (WLAs) that are developed under the EPA approved TMDL will be included in a Water Quality Management Plan (WQMP) update. Changes to the WQMP will be published in a 30–day public notice. If there are no comments at the end of the notice period, the Director, on behalf of the Governor, will certify the revisions to the WQMP and it will be submitted to EPA. If there are comments that warrant a public hearing during the notice period, then the effluent limits involved may be reviewed and revised as necessary to be included in the next statewide WQMP update.

This notice is hereby published on The **Johnson County** Graphic and **Arkansas Democrat-Gazette** by authority of ADEQ. Following the close of the 30-day comment period, a written response to comments and petitions will be developed as soon as possible. All petitions and comments received during the public notice period will be considered. A Public Hearing will be held when ADEQ finds a significant degree of public interest. ADEQ will notify the applicant and each person who has submitted written comments or requested notice of the final permitting decision. Any interested person who has submitted comments may appeal a final decision by ADEQ in accordance with the APCEC Regulation No. 8 (Administrative Procedures).

Teresa Marks, Director