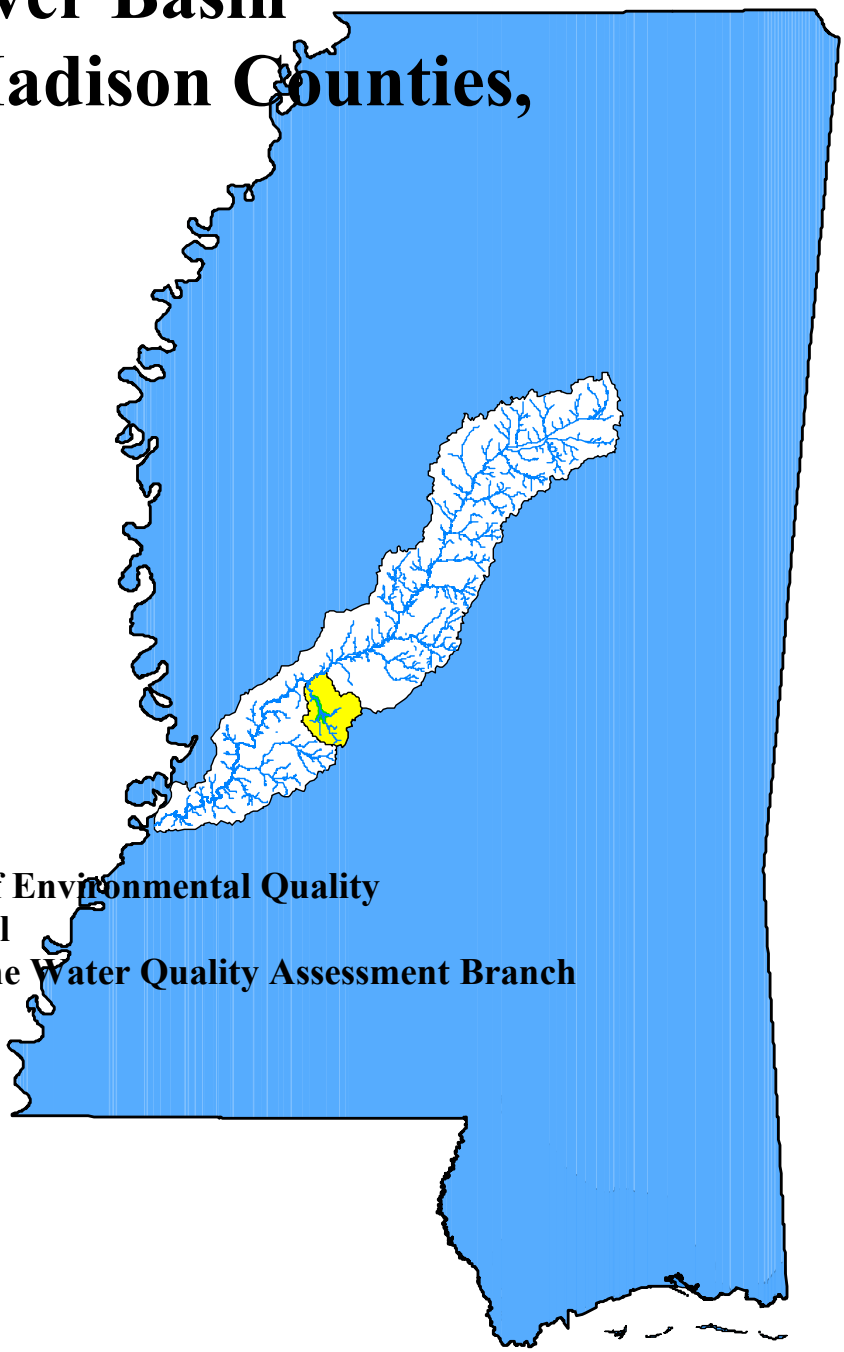
FINAL TMDL
July 2002

TMDL For Low pH in Bogue Chitto Creek Big Black River Basin Hinds and Madison Counties, Mississippi



Prepared by
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FOREWORD

This report has been prepared in accordance with the schedule contained within the federal consent decree dated December 22, 1998. *(Sierra Club v. Hankinson, No. 97-CV-3683 (N.D> Ga.)*) The report contains one or more Total Maximum Daily Loads (TMDLs) for waterbody segments found on Mississippi's 1996 Section 303(d) List of Impaired Waterbodies. Because of the accelerated schedule required by the consent decree, many of these TMDLs have been prepared out of sequence with the State's rotating basin approach. The segments addressed are comprised of monitored segments that have data indicating impairment. The implementation of the TMDLs contained herein will be prioritized within Mississippi's rotating basin approach.

The amount and quality of the data on which this report is based are limited. As additional information becomes available, the TMDLs may be updated. Such additional information may include water quality and quantity data, changes in pollutant loadings, or changes in landuse within the watershed. In some cases, additional water quality data may indicate that no impairment exists.

Prefixes for fractions and multiples of SI units

Fraction	Prefix	Symbol	Multiple	Prefix	Symbol
10^{-1}	deci	d	10	deka	da
10^{-2}	centi	c	10^{2}	hecto	h
10^{-3}	milli	m	10^{3}	kilo	k
10^{-6}	micro	μ	10^{6}	mega	M
10^{-9}	nano	n	10^{9}	giga	G
10^{-12}	pico	p	10^{12}	tera	T
10^{-15}	femto	f	10^{15}	peta	P
10^{-18}	atto	a	10^{18}	exa	E

Conversion Factors

To convert from	To	Multiply by	To Convert from	To	Multiply by
Acres	Sq. miles	0.0015625	Days	Seconds	86400
Cubic feet	Cu. Meter	0.028316847	Feet	Meters	0.3048
Cubic feet	Gallons	7.4805195	Gallons	Cu feet	0.133680555
Cubic feet	Liters	28.316847	Hectares	Acres	2.4710538
cfs	Gal/min	448.83117	Miles	Meters	1609.344
cfs	MGD	.6463168	Mg/l	ppm	1
Cubic meters	Gallons	264.17205	μg/l * cfs	Gm/day	2.45

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TMDL Information Page

Listing Information

Name	ID	County	HUC	Cause	Mon/Eval
Bogue Chitto Creek	MS463M	Hinds and Madison	08060202	pH	Monitored
Location – Near Flora: From Tinnin Road including parts of Limekiln and Straight Fence West Ditch to Confluence with Spring Creek					

Water Quality Standard

Parameter	Beneficial Use	Water Quality Criteria
pH	Aquatic Life Support	The normal pH of the waters shall be 6.5 to 9.0 and shall not be caused to vary more than 1.0 unit; however, should the natural background pH be outside the 6.5 to 9.0 limits, it shall not be changed more than 1.0 unit unless after the change the pH will fall within the 6.5 to 9.0 limits, and the Commission on Environmental Quality determines that there will be no detrimental effect on stream usage as a result of the greater pH change.

NPDES Facilities

NPDES ID	Facility Name	County	Receiving Water	Flow (cfs)
MS0021849	Baptist Children's Village	Hinds	An Unnamed Tributary of Bogue Chitto Creek	0.093
MS0044644	Catfish Haven Restaurant	Hinds	Limekiln Creek	0.004
MS0047619	City of Clinton – Briars POTW	Hinds	An Unnamed Tributary of Bogue Chitto Creek	0.975
MS0023230	City of Clinton – Lovett POTW	Hinds	An Unnamed Tributary of Straight Fence Creek	0.427
MS0021164	City of Clinton – Northeast POTW	Hinds	Straight Fence Creek	0.464
MS0046647	Southern Oaks Subdivision	Hinds	An Unnamed Tributary of Bogue Chitto Creek	0.062
MS0030295	Jackson POTW (Presidential Hills Subdivision)	Hinds	Bogue Chitto Creek	1.160
MS0043401	Lake Lorman Utility District	Madison	An Unnamed Tributary of Limekiln Creek	0.099

Total Maximum Daily Load

Type	
WLA	Effluent pH levels from each point source in the Bogue Chitto Creek shall be 6.5 to 9.0 standard units and shall not cause the pH in the receiving waters to vary more than 1.0 standard unit
LA	The pH of waters originating from controllable nonpoint sources shall be 6.5 to 9.0 standard units and shall not cause the receiving waters to vary more than 1.0 standard unit.
MOS	N/A
TMDL	**The pH of waters originating from all sources shall be 6.5 to 9.0 standard units. No significant reduction of sources is necessary because existing monitoring data show that water quality standards for pH are consistently met.**

EXECUTIVE SUMMARY

Bogue Chitto Creek along with portions of Limekiln and Straight Fence Creeks, have been placed on the Mississippi 1998 Section 303(d) List of Waterbodies as impaired waterbodies due to low pH. The parameter pH is defined as a measure of acidity and alkalinity of a solution that is a number on a scale on which a value of 7 represents neutrality. Lower numbers indicate increasing acidity and higher number increasing alkalinity. Each unit of change represents a tenfold change in acidity or alkalinity, which is the negative logarithm of the effective hydrogen-ion concentration or hydrogen-ion activity in gram equivalents per liter of solution. The applicable state standard specifies the normal pH of the waters shall be 6.5 to 9.0 and shall not be caused to vary more than 1.0 unit. A review of the available monitoring data for the watershed indicates that there was one data point for pH that was below the normal pH. However, all remaining data indicate that the pH standard is consistently met in Bogue Chitto Creek.

Bogue Chitto Creek flows in a northwestern direction from its headwaters near Clinton, Mississippi to its confluence with the Big Black River. The impaired segment is in Hinds and Madison Counties near Flora from Tinnin Road to the confluence with Spring Creek. The impaired segment also includes parts of Limekiln Creek, which flows into Bogue Chitto Creek from the east, and Straight Fence Creek, which flows into Bogue Chitto Creek from the west. The watershed of the impaired segment includes urban areas near Jackson and Clinton, Mississippi as well as rural, agricultural areas near Flora and Pocahontas, Mississippi.

This TMDL is based on pH loading estimates from nonpoint sources in the watershed from the watershed runoff, the soil acidity, and the acidic contribution from pine needles. There are several active NPDES Permitted discharge located in the watershed and included in the study. Each of these permitted facilities is currently meeting pH limit requirement in their NPDES Permit. The purpose of this TMDL is to report all available pH data for the Bogue Chitto Creek Watershed. The report indicates that the waterbody is consistently meeting water quality standards for pH, and that the single variance to the standard was due to natural, uncontrollable sources.

INTRODUCTION

1.1 Background

The identification of waterbodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those waterbodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR part 130). The TMDL process is designed to restore and maintain the quality of those impaired waterbodies through the establishment of pollutant specific allowable loads. The pollutant of concern for this TMDL is slightly acidic water as indicated by a single measurement of low pH in Bogue Chitto Creek.

The Mississippi Department of Environmental Quality (MDEQ) has listed a segment of Bogue Chitto Creek as being impaired due to low pH as reported in the Mississippi 1998 Section 303(d) List of Waterbodies, Fig 1.1. The segment was originally listed because monitoring data showed that one pH measurement was not within the water quality standards approved range. The measurement of low pH may have been due to natural conditions. However, for this indicator, natural background contributions do not necessarily indicate impairment. The purpose of this TMDL is to report on the study to determine if the pH levels found in the stream segments are indeed caused by a controllable source or by natural background.

The Big Black River Basin lies totally within the state and is composed of 3,400 square miles. The basin is 155 miles long, averages 22 miles in width, and has approximately 6,360 linear miles of river and streams. This basin originates in north central Mississippi and flows southwesterly to the Mississippi River. The Big Black River itself enters the Mississippi River just south of Vicksburg, MS. Major tributaries to the Big Black River include Big Bywy Ditch, Zilpha Creek, Apookta Creek, Doaks Creek, Bear Creek, Bogue Chitto Creek, and Fourteen Mile Creek. The basin is sparsely populated and is hilly to gently rolling and largely forested. However, significant amounts of cattle ranching and farming are present. Oil and gas production is a major industry in the area. The Big Black River Basin does not have large-scale development and most of its tributaries are wild and undeveloped, and thus are in a relatively natural condition.[1]

Generally, the Big Black River and most of its tributaries, especially in the northern part of the basin, carry large amounts of suspended sediment and are very turbid most of the time. Some of the streams in the basin are muddy and slow flowing, while others have relatively clear water and are swift with sandy bottoms. Overall, the water quality in the basin is rated as fair.[2]

1 Mississippi 1998 Water Quality Assessment, Federal Clean Water Act Section 305(b) Report, p. 169.
2 Ibid.

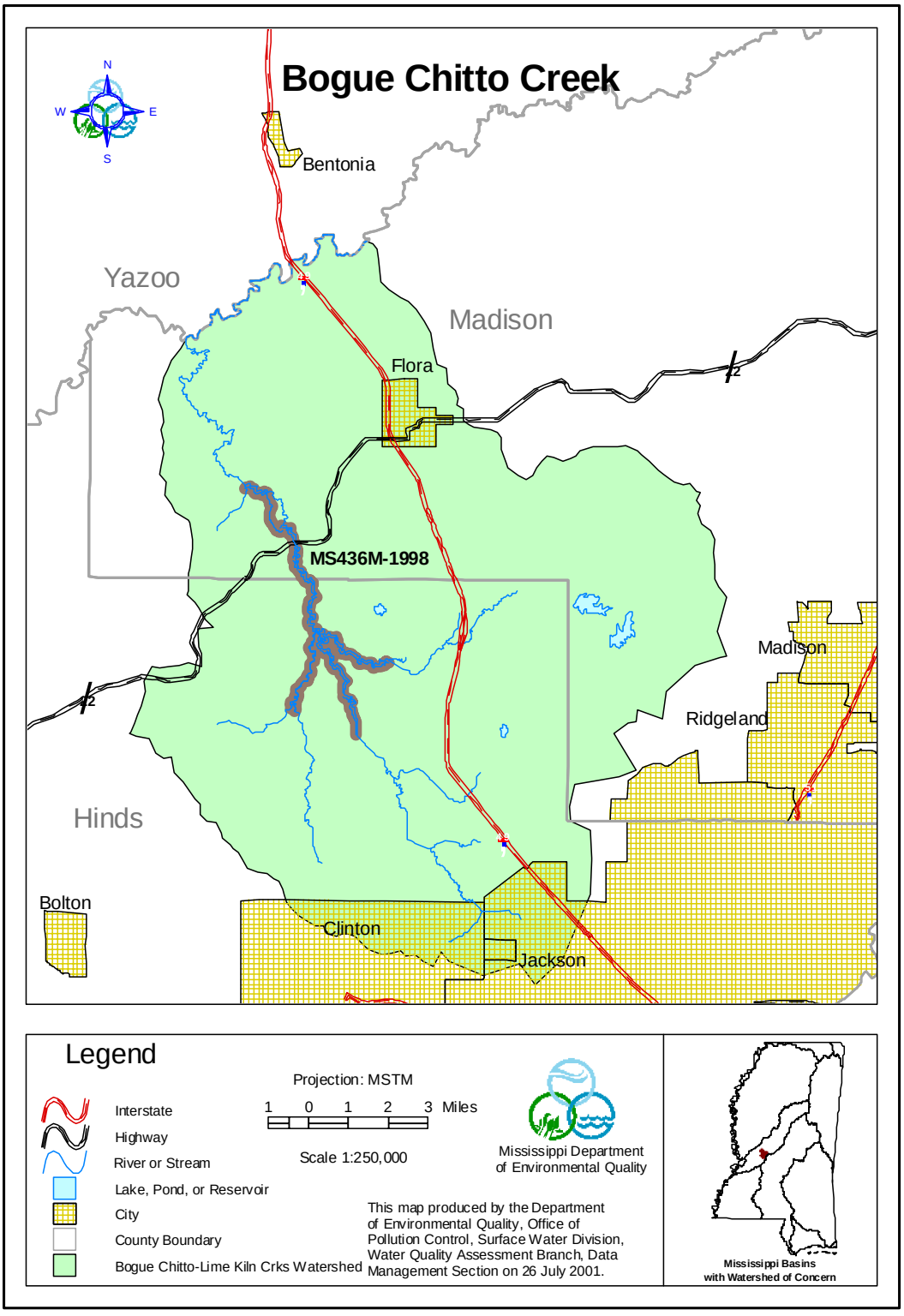
Bogue Chitto Creek
N
W
E
S
Bentonia
Yazoo
Madison
Flora
MS436M-1998
Madison
Ridgeland
Hinds
Bolton
Clinton
Jackson
Legend
Interstate
Highway
River or Stream
Lake, Pond, or Reservoir
City
County Boundary
Bogue Chitto-Lime Kiln Crks Watershed
Projection: MSTM
1 0 1 2 3 Miles
Scale 1:250,000
Mississippi Department of Environmental Quality
This map produced by the Department of Environmental Quality, Office of Pollution Control, Surface Water Division, Water Quality Assessment Branch, Data Management Section on 26 July 2001.
Mississippi Basins with Watershed of Concern

Figure 1.1

1.2Applicable Waterbody Segment Use

Designated beneficial uses and water quality standards are established by the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* regulations. The designated use for Bogue Chitto Creek as defined by the regulations is Fish and Wildlife.

1.3 Applicable Waterbody Segment Standard

The water quality standard applicable to the use of the waterbody and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. The standard states that the normal pH of the waters shall be 6.5 to 9.0 and shall not be caused to vary more than 1.0 unit. However, should the natural background pH be outside the 6.5 to 9.0 limits, it shall not be changed more than 1.0 unit unless after the change the pH will fall within the 6.5 to 9.0 limits. The Commission determines that there will be no detrimental effect on stream usage as a result of the greater pH change.

2.0 TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

2.1 Selection of a TMDL Endpoint and Critical Condition

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 low pH is that the normal pH of the waters shall be 6.5 to 9.0 and shall not be caused to vary more than 1.0 unit. However, should the natural background pH be outside the 6.5 to 9.0 limits, it shall not be changed more than 1.0 unit unless after the change the pH will fall within the 6.5 to 9.0 limits. The language in our standard 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 nonpoint and point sources, the critical condition used for studying the stream response was represented by a multi-seasonal period. Critical conditions for waters impaired by nonpoint 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. Natural variance in pH also occurs on a diurnal cycle due to the production of carbon dioxide during algal respiration and removal of carbon dioxide during photosynthesis. Diurnal variation of up to several pH units can occur as a result of algal activity3.

2.2 Discussion of Instream Water Quality

The State's 1998 Section 305(b) Water Quality Assessment Report was reviewed to assess water quality conditions and data available for the watershed. According to the report, Bogue Chitto Creek is partially supporting the use of Aquatic Life Support for low pH in one segment. This conclusion was based on limited water quality data available for the monitored segment of Bogue Chitto Creek. These data show that, with the exception of one data point, low levels of pH have not been found in the stream. These data were collected in conjunction with the Bogue Chitto Creek Watershed Nonpoint Source Project conducted in 1991 through 1995. This monitoring project was designed to assess the effectiveness and overall benefits of best management practices (BMPs) installed in the watershed. Water quality monitoring was conducted at one location in Bogue Chitto Creek. As part of this study, MDEQ collected six pH readings in the creek. One of the six data points was not within the current pH standard. These original data, however, no longer exist. Only the score card used in the 305(b) assessment is available. There is not enough information available to specifically determine the cause of the single low pH measurement in Bogue Chitto Creek. However, it is our contention that the natural processes and soil conditions could cause low pH conditions.

Additional water quality samples and biological assessments were collected as part of a 303(d) study for Bogue Chitto Creek in August of 1999. During this study, data were collected on Bogue Chitto

3 Sawyer, Clair, Perry McCarty, and Gene Parkin. *Chemistry for Environmental Engineering, Fourth Edition*. McGraw Hill, 1994.

Creek near Flora at Highway 22, Photo 2.1. The objectives of this study were to confirm water quality impairment in Bogue Chitto Creek near Flora and to identify the specific cause and sources of impairment. Chemical monitoring included field and laboratory analysis of surface water. In-situ water quality measurements were made using multi-parameter water quality instruments. Calibrated field instruments were utilized to measure DO, DO saturation, water temperature, specific conductivity, pH, and total dissolved solids. Instruments were continuously deployed for 24 hours during the study for diurnal measurement of these water quality parameters. All of the data collected in 1999 show there is no impairment for pH in the stream, Table 2.1. The data show a typical diurnal variation, with the lowest pH values occurring in the early morning hours, just before sunrise, when algae are not taking up carbon dioxide for photosynthesis. A statistical summary of the pH data is shown in Table 2.2.

Photo 2.1. Bogue Chitto Creek at Highway 22

Table 2.1. pH Data collected on Bogue Chitto Creek at Highway 22

Date	Time	Temp (C)	Depth (feet)	pH
82599	8:00	25.81	0.36	7.38
82599	8:30	25.83	0.36	7.38
82599	9:00	25.86	0.35	7.38
82599	9:30	25.94	0.36	7.38
82599	10:00	26.07	0.36	7.39
82599	10:30	26.26	0.35	7.39
82599	11:00	26.41	0.36	7.39
82599	11:30	26.52	0.34	7.4
82599	12:00	26.8	0.34	7.4
82599	12:30	26.97	0.32	7.41
82599	13:00	27.24	0.32	7.42
82599	13:30	27.27	0.31	7.42
82599	14:00	27.58	0.29	7.43
82599	14:30	27.7	0.28	7.44
82599	15:00	27.78	0.27	7.44
82599	15:30	27.96	0.26	7.45
82599	16:00	28.06	0.25	7.45
82599	16:30	28.12	0.24	7.45
82599	17:00	28.21	0.24	7.45
82599	17:30	28.31	0.25	7.45
82599	18:00	28.39	0.26	7.45
82599	18:30	28.42	0.25	7.45
82599	19:00	28.39	0.25	7.45
82599	19:30	28.34	0.26	7.44
82599	20:00	28.26	0.28	7.43
82599	20:30	28.16	0.31	7.41
82599	21:00	28.08	0.32	7.38
82599	21:30	27.99	0.32	7.36
82599	22:00	27.9	0.32	7.34
82599	22:30	27.81	0.32	7.32
82599	23:00	27.71	0.33	7.3
82599	23:30	27.6	0.32	7.29
82699	0:00	27.48	0.33	7.26
82699	0:30	27.35	0.34	7.25
82699	1:00	27.21	0.33	7.23
82699	1:30	27.07	0.34	7.21
82699	2:00	26.94	0.33	7.19
82699	2:30	26.8	0.32	7.17
82699	3:00	26.66	0.34	7.16
82699	3:30	26.54	0.31	7.15
82699	4:00	26.42	0.32	7.14
82699	4:30	26.28	0.33	7.12
82699	5:00	26.15	0.33	7.11
82699	5:30	26.03	0.34	7.1
82699	6:00	25.92	0.34	7.09
82699	6:30	25.8	0.35	7.09
82699	7:00	25.69	0.37	7.08

82699	7:30	25.6	0.38	7.07
82699	8:00	25.54	0.38	7.07
82699	8:30	25.51	0.39	7.07
82699	9:00	25.5	0.39	7.08
82699	9:30	25.54	0.4	7.08
82699	10:00	25.68	0.4	7.09
82699	10:30	25.83	0.41	7.13
82699	11:00	26.06	0.41	7.17
82699	11:30	26.38	0.4	7.26

Table 2.2. Statistical Summary

Average pH	Maximum pH	Minimum pH	Number of pH readings below 6.5
7.29	7.45	7.07	0

3.0 SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known controllable and uncontrollable pH-altering sources in the Bogue Chitto Creek Watershed. The sources were characterized by the best available information, monitoring data, literature values, and local management activities. This section documents the available information and interpretation for the analysis. It is recognized that many 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.

3.1 Assessment of Point Sources

Point sources have their greatest potential impact on water quality during periods of low-flow. Thus, an evaluation of point sources was necessary in order to quantify the degree of impairment present during the low-flow, critical-condition period. There are eight point sources permitted to discharge treated wastewater into Bogue Chitto Creek or its tributaries. These wastewater treatment facilities serve a variety of uses within the watershed including residential areas, childcare facilities, and restaurants. The effluent from each facility was characterized based on all available data including information on each facility's wastewater treatment system, permit limits, and discharge monitoring reports. Table 3.1 lists the all of the dischargers in the watershed, along with the NPDES Permit number. All NPDES Permits shown in the table include requirements for pH limits to meet water quality standards. A review of available DMR data showed that the pH limits are being met consistently. Any future NPDES permits will also include this pH requirement.

Table 3.1. NPDES Permitted Facilities

Name	NPDES Permit	Treatment Type	Receiving Waterbody
Baptist Children's Village	MS0021849	Conventional Lagoon	An Unnamed Tributary of Bogue Chitto Creek
Catfish Haven Restaurant	MS0044644	Aerated Lagoon	Limekiln Creek
City of Clinton – Briars POTW	MS0047619	Activated Sludge	An Unnamed Tributary of Bogue Chitto Creek
City of Clinton – Lovett POTW	MS0023230	Activated Sludge	An Unnamed Tributary of Straight Fence Creek
City of Clinton – Northeast POTW	MS0021164	Activated Sludge	Straight Fence Creek
Southern Oaks Subdivision	MS0046647	Aerated Lagoon	An Unnamed Tributary of Bogue Chitto Creek
Jackson POTW (Presidential Hills Subdivision)	MS0030295	Aerated Lagoon	Bogue Chitto Creek
Lake Lorman Utility District	MS0043401	Conventional Lagoon with Wetlands	An Unnamed Tributary of Limekiln Creek

3.2 Assessment of Nonpoint Sources

There are potential nonpoint sources from storm water runoff that could contribute to an alteration of pH in Bogue Chitto Creek, including:

- Land Application of Chicken Litter
- Acidic Soil
- Pine Needle Decay
- Urban Development

The 103,833-acre drainage area of the Bogue Chitto Creek contains many different landuse types, including urban, forests, cropland, pasture, barren, and wetlands. The watershed is very rural in nature however; it contains a portion of the city of Jackson and several smaller cities. Agriculture is the dominant landuse within this watershed. The most current landuse information available for the watershed is based on data collected by the State of Mississippi's Automated Resource Information System (MARIS). This data set is based on Landsat Thematic Mapper digital images taken between 1992 and 1993. The landuse within the Bogue Chitto Creek watershed is shown in Table 3.2 and Figure 3.1.

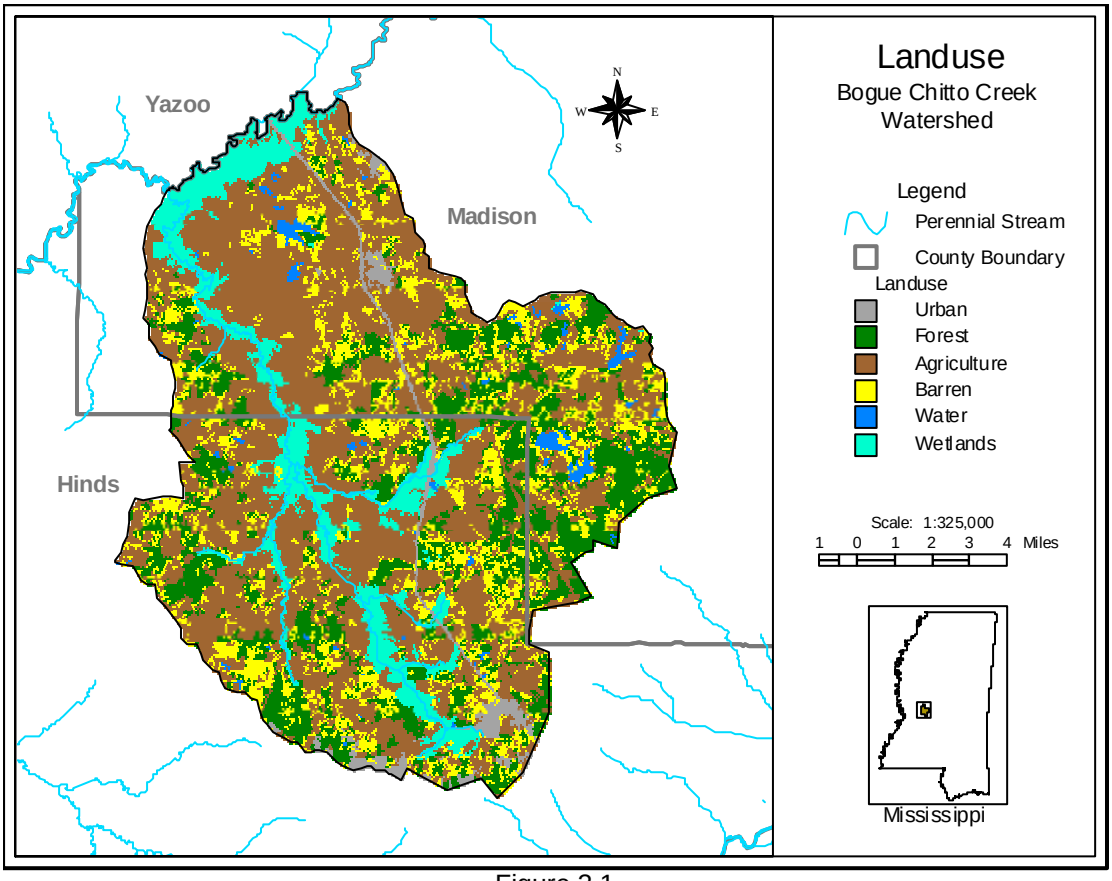

Figure 3.1

Table 3.2. Landuse Distribution

Urban	Forest	Agriculture	Barren	Water	Wetlands	Total
2,352	33,786	54,611	647	2,482	9,955	103,833
2%	32%	53%	1%	2%	10%	100%

Septic systems have a potential to deliver pH-altering loads (either higher pH or lower pH) to surface waters due to malfunctions, failures, and direct pipe discharges. Household chemicals and waste products could be introduced into the environment by a failing septic system. Properly operating septic systems treat wastewater and dispose of the water through a series of underground field lines. The water is applied through these lines into a rock substrate, thence into underground absorption. The systems can fail when the field lines are broken, or when the underground substrate is clogged or flooded. A failing septic system's discharge can reach the surface, where it becomes available for wash-off into the stream. Another potential problem is a direct bypass from the system to a stream. In an effort to keep the water off the land, pipes are occasionally placed from the septic tank or the field lines directly to the creek, which can be represented as a point source. The nonpoint source contribution from septic tanks is un-quantifiable for pH; however, controlling this source of pollution is a goal of this TMDL.

3.2.1 Land Application of Chicken Litter

In the Big Black River Basin processed manure from chicken houses could be a source of pH alteration in the stream when a rain event washes a portion of it to a receiving waterbody. It is assumed that poultry litter from chicken houses is applied to the available pastureland. While there are some alternative uses of poultry litter, such as utilization as cattle feed, almost all of the litter in the state is currently used for fertilizer.

3.2.2 Acidic Soil

Soil acidity has long been reported as a major fertility problem in the southeastern United States. To combat this problem, farmers typically apply appropriate amounts of lime to counteract the acidity, in order to increase crop production. In 1957, 216,012 tons of lime were used in Mississippi; however, by 1979, 800,000 tons of lime were used on agricultural fields in Mississippi (Vanderford, 1975). Still, this was only 40% of the amount of lime necessary to adequately combat the historically acid soils for increased crop production.

A great deal of water infiltrates through the soils of humid regions such as the coastal areas of Mississippi. As water moves through the soils, hydrogen ions combine with carbon dioxide and other compounds to form weak acids, such as carbonic acid. When rainfall events occur, these weak acids will leach the lime from the soils. As this leaching from rain water occurs, calcium and other bases are gradually removed, leaving soils more acidic than before.[4]

3.2.3 Pine Needle Decay

Vast numbers of coniferous trees within the basin also contribute to the acidity of surrounding waterbodies due to the decay of the pine needles. Duffy *et al.* (1989) examined the nutrient flux in a

4 National Sedimentation Laboratory, Water Quality and Ecological Processes Research Unit, Report on the Causes of acid pH in the Yazoo Basin, Dr. Charles Cooper, 2000.

pine forest following simulated rainfall. The pH of their simulated rainfall ranged from 3.94 – 5.18 on four different plots; however, the pH of the ensuing runoff water ranged from 4.34 – 5.0. Assuming rainfall itself is slightly acidic, encountering acidic pine needles, which then travels though acidic soils, it can be assumed that the surrounding receiving water will likewise be acidic in nature. When rainfall events occur, these weak acids will leach the lime from the soils. As this leaching from rain water occurs, calcium and other bases are gradually removed, leaving soils more acidic than before. These sources are considered uncontrollable and are not accounted for in this TMDL.[5]

3.2.4 Urban Development

Urban areas include land classified as urban and barren. Even though only a small percentage of the watershed is classified as urban, the contribution of the urban areas to pH alteration in Bogue Chitto Creek was considered. Stormwater runoff contributions from urban areas may come from construction sites, residential subdivisions, and runoff contribution from improper disposal of materials such as household toxic materials. Due to the low percentage of urban area in the watershed, this potential source of lower pH is considered to be very minor. The Bogue Chitto Creek watershed contains many small urban areas. However, overall the area remains sparsely populated.

5 Ibid.

4.0 ALLOCATION

The allocation for this TMDL involves a wasteload allocation for NPDES point sources and a load allocation for nonpoint sources necessary for attainment of water quality standards in Bogue Chitto Creek. Point source contributions enter the stream directly. Nonpoint sources contributions occur as a result of rainfall events. This TMDL will only consider allocations for controllable sources of low pH.

4.1 Wasteload Allocations

The contribution of point sources was considered on a watershed basis. Effluent pH levels from each point source in the Bogue Chitto Creek watershed shall be 6.5 to 9.0 standard units and shall not cause the pH in the receiving waters to vary more than 1.0 standard unit.

4.2 Load Allocations

This TMDL has been completed for the acidic property of the water. pH is an indicator of the acidic or alkalinity properties of water, and cannot be quantified with loading terms applied to typical pollutants. For the 303(d) listed segment of the Bogue Chitto Creek, the pH of waters originating from nonpoint sources shall be 6.5 to 9.0 standard units and shall not cause the receiving waters to vary more than 1.0 standard unit. Nonpoint loading due to acidic soil, pine needle decay, and urban development are included in the load allocation. Control of the pH range can be achieved by dilution or by source load manipulation.

One step that should be encouraged by this TMDL is the reduction of failing septic tanks in the watershed. This reduction in septic tank failures will lead to a reduction in the overall pollution reaching Bogue Chitto Creek and its tributaries. This might be achieved by supporting BMP projects that promote education projects that encourage homeowners to properly maintain their septic tanks by routinely pumping them out, ensuring that improper chemicals are not disposed of in the septic tank, repairing broken field lines, and properly maintaining the effluent from individual onsite wastewater treatment plants.

4.3 Incorporation of a Margin of Safety

The margin of safety accounts for any lack of knowledge concerning the relationship between pollutant loads and the quality of the receiving waterbody. The wasteload allocation and load allocation suggested in sections 5.1 and 5.2 of this report establish that effluent from all point sources and waters originating from all nonpoint sources must individually meet the water quality standards for pH. As long as pH levels from point sources and nonpoint sources are consistent with the specified wasteload allocation and load allocation, the pH in the 303(d) listed segment of Bogue Chitto Creek will be consistent with water quality standards. Therefore, a margin of safety for this pH TMDL has been considered. However, it was determined to be unnecessary, because there is no lack of knowledge concerning the relationship between the allocations to pollutant loads and the resulting quality of the receiving waters.

5.0 CONCLUSION

This TMDL has been developed for low pH, which 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. However, the effort to reduce controllable sources of lower pH producing pollution in the stream wherever possible is meaningful. That controllable source reduction is the goal for this TMDL. However, current data indicate that extensive efforts to control the pH in Bogue Chitto Creek are not necessary. This is because the waterbody is consistently meeting water quality standards for pH, and that the single, historic variation to the standard was likely due to natural, uncontrollable sources.

This TMDL includes requiring all NPDES Permitted dischargers to meet water quality standards for pH. The TMDL will not impact existing or future NPDES Permits as long as the effluents meet water quality standards for pH. MDEQ will not approve any NPDES Permit application that does not plan to meet water quality standards for pH. Also, another goal of the TMDL is reducing the pollution load from failing septic tanks in the watershed. CWA Section 319 Nonpoint Source (NPS) Grants may fund these projects. MDEQ produced guidance for future Section 319 project funding will encourage NPS restoration projects that attempt to address TMDL related issues within Section 303(d)/TMDL watersheds in Mississippi.

5.1 Future Monitoring

MDEQ has adopted the Basin Approach to Water Quality Management, a plan that divides Mississippi's major drainage basins into five groups. During each yearlong cycle, MDEQ resources for water quality monitoring will be focused on one of the basin groups. During the next monitoring phase in the Big Black Basin, Bogue Chitto Creek will receive additional monitoring to identify any change in water quality. Additionally, by completion of this TMDL, NPS projects proposed for this watershed that address pH may receive priority consideration for future Section 319 funding.

5.2 Public Participation

This TMDL will be published for a 30-day public notice. During this time, the public will be notified by publication in the statewide newspaper. The public will be given an opportunity to review the TMDL and submit comments. MDEQ also distributes all TMDLs at the beginning of the public notice to those members of the public who have requested to be included on a TMDL mailing list. TMDL mailing list members may request to receive the TMDL reports through either, email or the postal service. Anyone wishing to be included on the TMDL mailing list should contact Linda Burrell at (601) 961-5062 or Linda_Burrell@deq.state.ms.us. At the end of the 30-day period, MDEQ will determine the level of interest in the TMDL and make a decision on the necessity of holding a public meeting.

All written comments received during the public notice period and at any public meeting become a part of the record of this TMDL. All comments will be considered in the ultimate completion of this TMDL for submission of this TMDL to EPA Region 4 for final approval.

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 Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters and Water Quality regulations.

Background: the condition of waters in the absence of man-induced alterations based on the best scientific information available to MDEQ. 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.

Coniferous: an order (Coniferales) of mostly evergreen trees and shrubs including forms (as pines) with true cones and other (as yews) with an arillate fruit.

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 nonpoint 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 nonpoint sources (NPS) or background sources of a pollutant.

Loading: the total amount of pollutants entering a stream from one or multiple sources.

Nonpoint 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 Mississippi Environmental Quality Permit Board pursuant to regulations adopted by the Mississippi Commission on Environmental Quality under Mississippi Code Annotated (as amended) §§ 49-17-17 and 49-17-29 for discharges into State waters.

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 Permit Board.

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.

Scientific Notation (Exponential Notation): mathematical method in which very large numbers or very small numbers are expressed in a more concise form. The notation is based on powers of ten. Numbers in scientific notation are expressed as the following: *4.16 x 10^(+b)* and *4.16 x 10^(-b) [same as 4.16E4 or4.16E-4]*. In this case, *b* is always a positive, real number. The *10^(+b)* tells us that the decimal point is *b* places to the right of where it is shown. The *10^(-b)* tells us that the decimal point is *b* places to the left of where it is shown.
For example: $2.7X10^{4} = 2.7E+4 = 27000$ and $2.7X10^{-4} = 2.7E-4 = 0.00027$.

Sigma (Σ): shorthand way to express taking the sum of a series of numbers. For example, the sum or total of three amounts 24, 123, 16, ($\mathbf{d}_1$, $\mathbf{d}_2$, $\mathbf{d}_3$) respectively could be shown as:

$$\sum_{i=1}^{3} d_i = d_1+d_2+d_3 = 24 + 123 + 16 = 163$$

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.

Water Quality Standards: the criteria and requirements set forth in *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. 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 Mississippi 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.).

ABBREVIATIONS

7Q10.....Seven-Day Average Low Stream Flow with a Ten-Year Occurrence Period

BASINS.....Better Assessment Science Integrating Point and Nonpoint Sources

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

MARIS ..... State of Mississippi Automated Information System

MDEQ..... Mississippi Department of Environmental Quality

MOS .....Margin of Safety

NRCS ..... National Resource Conservation Service

NPDES .....National Pollution Discharge Elimination System

NPSM.....Nonpoint Source Model

RF3.....Reach File 3

USGS..... United States Geological Survey

WLA..... Waste Load Allocation

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