FINAL REPORT
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Total Maximum Daily Load

For pH

Senatobia Creek
Yazoo River Basin
Mississippi

Prepared By

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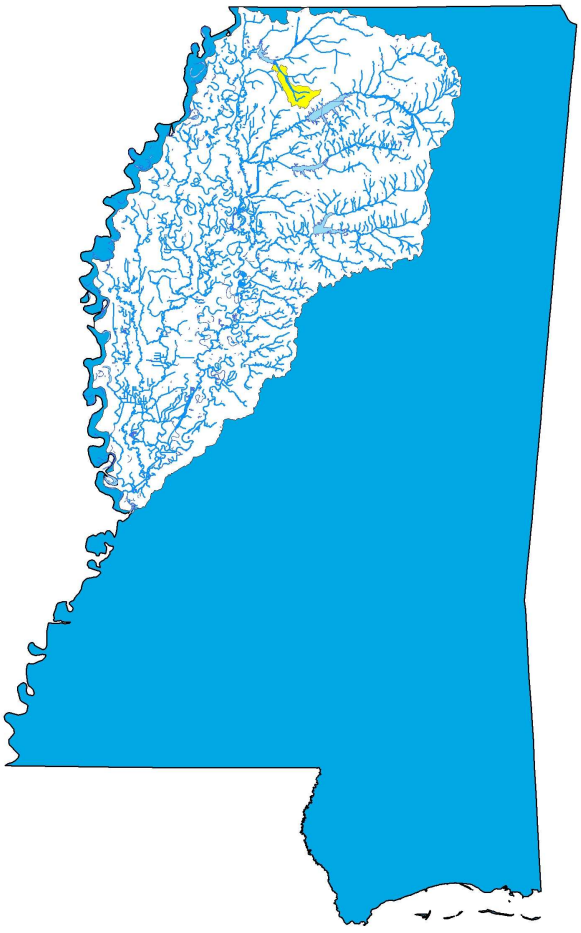

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Executive Summary

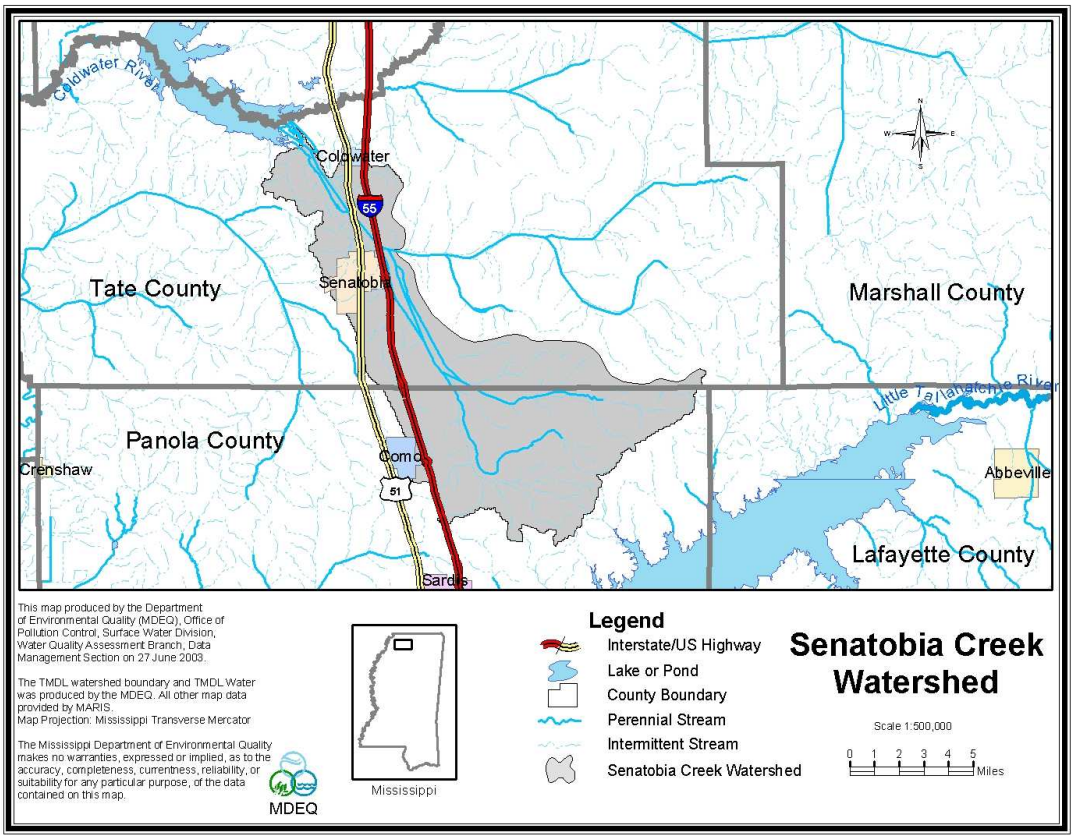
Senatobia Creek (MS304M1), from its headwaters to its confluence with Mattie Creek, has been identified by the Mississippi Department of Environmental Quality (MDEQ) as not supporting its designated uses for the pH criteria on the State's 1998 Section 303(d) list of impaired waters. This water quality limited segment is located in the Yazoo River Basin in Panola and Tate Counties near Como, Mississippi. The applicable water quality criteria, as described in the State of Mississippi's *Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*, requires that the pH shall be within the range of 6.0 to 9.0 standard units (s.u.).

The specific cause(s) of the low pH for this water are not known. There are currently no point sources that are permitted to discharge to this segment of Senatobia Creek or to the watershed that drains to this segment. Therefore, the low pH in this water must be attributed either to unknown nonpoint sources of pollution or to natural background conditions. Although there is information that suggests that several waters in the Yazoo River Basin exhibit low pH due to natural conditions, there is currently not enough information readily available to determine whether the low pH in Senatobia Creek is attributed to natural conditions. 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 nonpoint sources shall be within the range of 6.0 to 9.0 s.u. These allocations provide for the year-round protection of water quality.

Introduction

Senatobia Creek segment MS304M1, from its headwaters to its confluence with Mattie Creek, has been identified by the Mississippi Department of Environmental Quality (MDEQ) as not supporting its designated uses for the pH criteria on the State•s 1998 Section 303(d) list of impaired waters. TMDLs are required for impaired waters on a State•s Section 303(d) list as required by the Federal Clean Water Act Section 303(d) and the implementing regulations in accordance with 40 CFR •130. A TMDL establishes the maximum amount of a pollutant a waterbody can assimilate without exceeding the applicable water quality standard. The TMDL also allocates the total allowable load to individual sources or categories of sources through wasteload allocations (WLAs) for point sources, 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 source activities that will lead to the attainment of water quality standards and protection of the beneficial use.

This TMDL proposal satisfies the consent decree obligation established in Sierra Club v. John Hankinson et al., Civil Action No: 1-97-CV-3683-MHS. The Consent Decree requires TMDLs to be developed for all waters on Mississippi•s most current Section 303(d) list consistent with the schedule established by Mississippi for its rotating basin management approach.



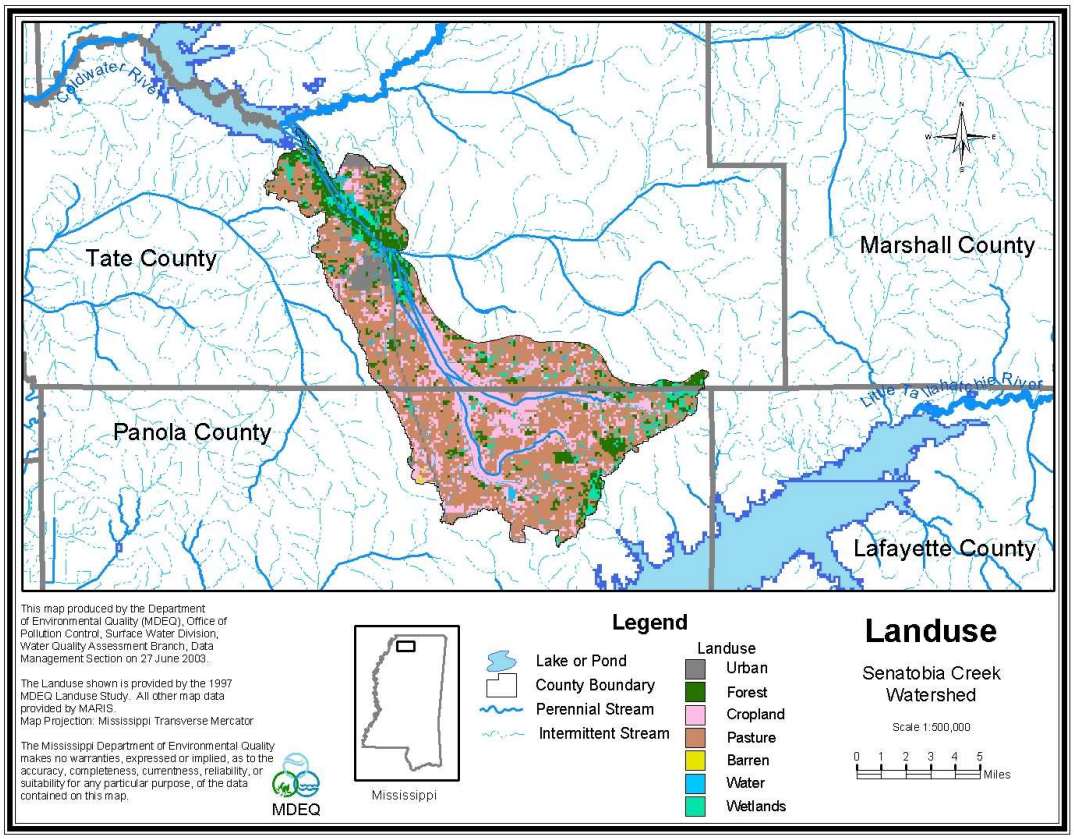
Watershed Characterization

Senatobia Creek, a tributary to Hickahala Creek, is located in the Coldwater River watershed of the Yazoo River Basin and flows through portions of Tate and Panola counties in Mississippi (Figure 1). Populated areas near Senatobia Creek include the cities of Senatobia and Como. Landuse in the Senatobia Creek watershed is predominantly pasture/grassland and cropland (Table 1 and Figure 2). The landuse distributions presented in Table 1 and Figure 2 were derived from the State of Mississippi's Automated Resource Information System (MARIS), which is based on Landsat Thematic Mapper digital images taken between 1992 and 1993.

Senatobia Creek is within the Loess Plains (74b; Level IV) component of the Level III Mississippi Valley Loess Plains Ecoregion (Figure 1). The Loess Plains Ecoregion is characterized by gently rolling, irregular plains with considerable loess deposits. Soils of the flat bottomlands and floodplains are mostly silty Entisols and Inceptisols, with Alfisols at the higher elevations. Streams are generally low gradient, with silt and sand bottoms. The streams are typically murky, and downstream reaches may carry high sediment loads. Many streams have been channelized. The natural vegetation was oak-hickory and oak-hickory-pine forest, with some southern floodplain forests and bottomland hardwoods, although this region has been used extensively for agriculture in Mississippi.

Table 1. Landuse in the Senatobia Creek Watershed

Landuse	Percent Area
AQUACULTURE WATER	0.2%
BOTTOMLAND HARDWOOD FOREST	0.4%
CROPLAND	29.2%
DECIDUOUS FOREST	4.7%
FRESHWATER	0.5%
LOW DENSITY URBAN	0.03%
MIXED FOREST	2.6%
PALUSTRINE EMERGENT (MARSH)	0.1%
PALUSTRINE NON-VEGETATED	0.2%
PASTURE/GRASSLAND	55.2%
PINE FOREST	2.2%
RIVERINE SWAMP	0.2%
TRANSPORTATION	0.1%
UPLAND SCRUB/SHRUB	4.6%
TOTAL	**100.0%**



The National Sedimentation Laboratory (NSL) in Oxford, Mississippi has reported that acidic soils are prevalent in the Delta and loess hill lands of the Yazoo River basin (Cooper, 2000). Relying on historic data of soil pH, accounts of agricultural practices, and water quality data, the NSL contends that soil acidity has been a long-standing issue in the basin, and that this acidity is the result of natural leaching processes. Due to high humidity in the southeast, large amounts of rainwater, which is naturally slightly acidic, move through the soil. 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 fulvic acids than either deciduous vegetation or grasses, is another process that lowers soil pH. While this mechanism is potentially important in forested parts of the Yazoo River basin, the Senatobia watershed currently has a relatively low percentage of coniferous cover. The NSL also notes that acid-forming fertilizers may be applied to cultivated fields, which may be a significant factor given the presence of cropland in the basin.

There are currently no National Pollutant Discharge Elimination System (NPDES) permitted point sources that discharge to the segment of Senatobia Creek that is impaired from low pH. It is also not expected that there will be any point source discharges permitted in the near future that would cause or contribute to pH violations in Senatobia Creek.

Problem Definition

pH is a measure of the hydrogen ion concentration in water as well 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.

Source Identification

At this time, there is insufficient information to determine the exact nature of the pollutant sources causing low pH in the Senatobia basin. There are currently no point sources that are permitted to discharge to this segment of Senatobia Creek or to the watershed that drains to this segment. Therefore, the low pH in this water must be attributed to unknown nonpoint sources of pollution, natural background conditions, or some combination of the two.

Instantaneous pH measurements were made in Senatobia Creek from January 1992 to December 2000 (Figure 3). As shown in this figure, the large majority of water quality standards excursions (or violations) were attributed to low pH. As summarized in Table 3 below, 12.5% of the pH measurements did not meet water quality standards.

Table 3. pH measured in Senatobia Creek

	Number of Samples	Number of samples not meeting water quality standards	Percentage of data not meeting water quality standards
1992-2000	376	47	12.5%

Applicable Water Quality Standard

The TMDL for Senatobia Creek segment MS304M1 will be established at a level to ensure consistency with the applicable water quality criteria and protection of its designated use (i.e., Fish and Wildlife). The State of Mississippi's *Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* includes numeric water quality criteria for pH of 6.0 to 9.0 s.u. for waters with these designated uses. Although there is information that suggests that several waters in the Yazoo River Basin exhibit low pH due to natural conditions, there is currently not enough information readily available to determine whether the low pH in Senatobia Creek is attributed to natural conditions. Therefore, the applicable pH criteria for Senatobia Creek are the allowable range of 6.0 to 9.0 s.u.

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 WLA for point sources, a LA for non-point sources, and a margin of safety (MOS) to account for uncertainty. 40 CRF •130.2(i) provides flexibility concerning how TMDLs are expressed and suggests that they may be expressed in terms of ■mass per time, toxicity, or other appropriate measure.• For this TMDL as well as other pH TMDLs that have been established by MDEQ, it has been determined that the appropriate measure for the allocation should be in terms of pH standard units.

Wasteload Allocation

There are currently no point sources that discharge to this segment of Senatobia Creek or to tributaries in the watershed that drain to this segment. For future dischargers to this segment of Senatobia Creek or to tributaries in the watershed that drain to this segment of Senatobia Creek, effluent pH levels shall be no less than 6.0 s.u. and no greater than 9.0 s.u.

Load Allocation

The nonpoint sources causing or contributing to pH violations are unknown. The potential nonpoint sources include, but are not limited to, low pH in stormwater runoff, groundwater infiltration, and acid rain deposition. The load allocation for this TMDL requires that the pH of waters originating from any nonpoint sources in the watershed shall be no less than 6.0 s.u. and no greater than 9.0 s.u.

Margin of Safety

The margin of safety in TMDLs is used to account for the lack of knowledge concerning the relationship between the pollutant loads and the resulting quality of the receiving waterbody. The allocations used in this TMDL ensure that loads from any point source(s) and loads originating from any non-point source activities must individually meet the pH target of 6.0 to 9.0 s.u. before entering the stream. As long as pH from both point and non-point source activities are consistent with the allocations in this TMDL, water quality standards in Senatobia Creek are certain to be met. Therefore, an additional consideration of a margin of safety for Senatobia Creek was determined to be unnecessary.

Seasonal Variation

The allocation proposed for this TMDL provides for year-round protection (i.e., protection during all seasons and environmental conditions) of the pH criteria. Based on the available data and information, critical conditions for this TMDL could not be determined. 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.

Recommendations

The wasteload allocation for this TMDL should be considered and used by MDEQ through its NPDES permitting process. Achieving the load allocation will require a better understanding of the causes and sources of the low pH in Senatobia Creek. Future monitoring and data collection should provide insight regarding the potential causes of the low pH in Senatobia Creek. If the low pH in Senatobia Creek is determined in the future to be attributed to natural conditions, the load allocation presented in this TMDL could not be reasonably expected to be achieved. If such a determination were to be made, revision of the TMDL and the water quality criteria for this segment of Senatobia Creek may be appropriate.

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