FINAL REPORT
February 2003
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# Phase One Fecal Coliform TMDL for Moon Lake

## Yazoo River Basin

## Coahoma County, Mississippi


**Prepared By**

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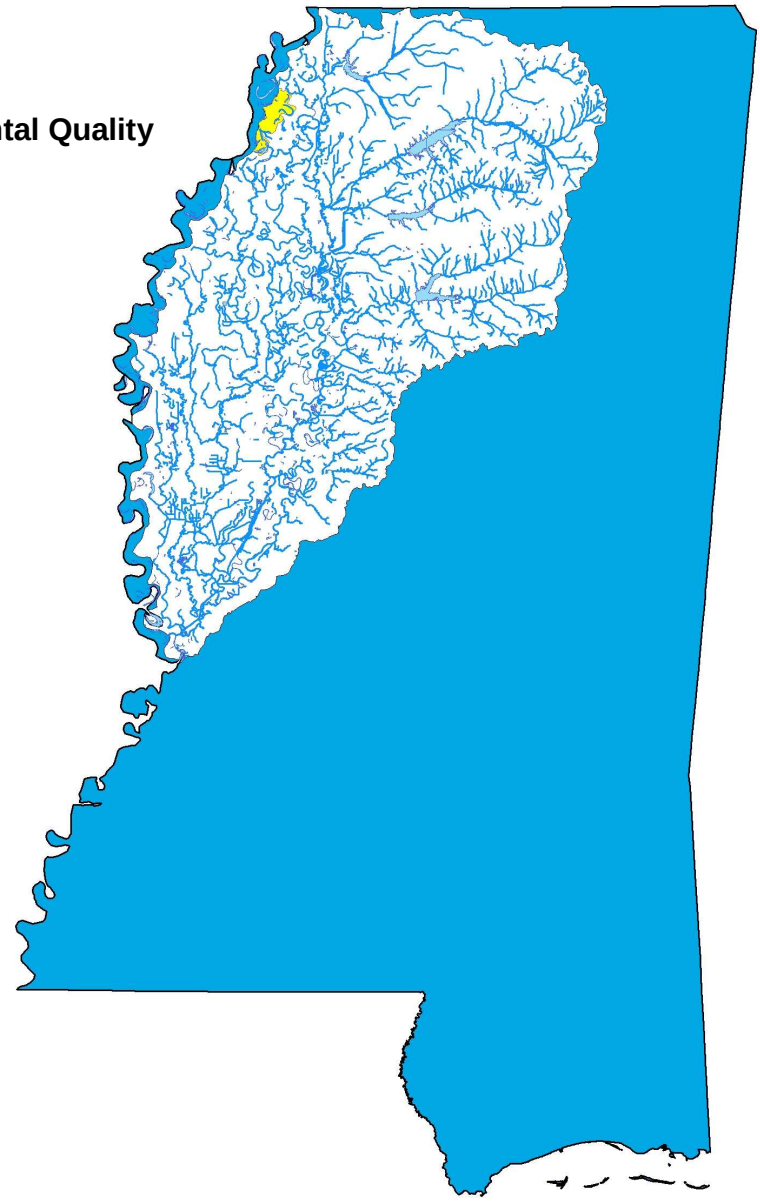

MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY

# FOREWORD

This report has been prepared in accordance with the schedule contained within the federal consent decree dated December 22, 1998. 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 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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# PHOTOS



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# TMDL INFORMATION PAGE

**Listing Information**

| Name | ID | County | HUC | Cause | Mon/Eval |
|---|---|---|---|---|---|
| Moon Lake | MS320MLM | Coahoma | 08030204 | Pathogens | Evaluated |
| Near Lula | | | | | |

**Water Quality Standard**

| Parameter | Beneficial use | Water Quality Criteria |
|---|---|---|
| Fecal Coliform | Contact Recreation | Fecal coliform colony counts not to exceed a geometric mean of 200 per 100ml, nor shall more than 10 percent of samples examined during any month exceed a colony count of 400 per 100ml. |

**NPDES Facilities**

There are no NPDES facilities in the Moon Lake Watershed.

**Phase One Total Maximum Daily Load**

| Component | Value | Unit | MOS Type |
|---|---|---|---|
| WLA | 0 | counts/30 day | |
| LA | 1.80 E+13 | counts/30 day | |
| MOS | 0.20 E+13 | counts/30 day | Explicit |
| TMDL | 2.00 E+13 | counts/30 day | |

# EXECUTIVE SUMMARY

Moon Lake was placed on the Mississippi 1998 Section 303(d) List of Waterbodies as an evaluated waterbody segment, due to fecal coliform bacteria. The applicable state standard specifies that the maximum allowable level of fecal coliform shall not exceed a geometric mean of 200 colonies per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml.

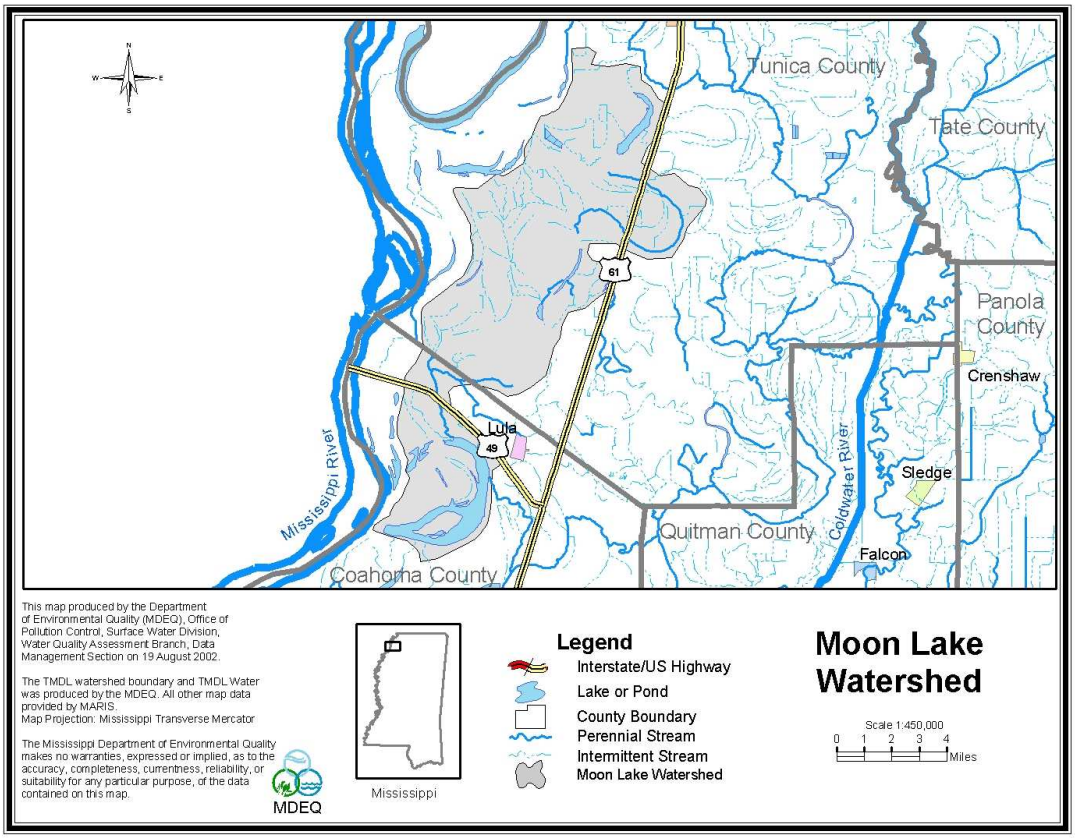
Moon Lake, shown in Photo 1, is located in Coahoma County near the Mississippi River. Lula, Mississippi is the nearest municipality. Helena, Arkansas and Clarksdale, Mississippi are also within 30 miles of Moon Lake. Figure 1 shows Moon Lake, which is an oxbow lake formed in abandoned meander of the Mississippi River.

**Photo 1. Moon Lake**

A mass balance approach was used to calculate this Phase One TMDL. This method of analysis was selected due to the complex hydrology of the oxbow lake system and the absence of water quality data. After using this approach, a TMDL was determined to be 2.00E+13 counts per 30 days.

The limited data available for Moon Lake indicate no violation of the geometric mean fecal coliform standards. Therefore, an existing condition load was not calculated. No percent reduction could be calculated. However, as a part of this Phase One TMDL, MDEQ recommends that a reduction in the observed potential pollutant load be achieved through the elimination of all open pipes and inadequate individual wastewater treatment systems. The installation of a centralized wastewater collection and treatment system would be an effective means to achieve these recommendations. Also, a lake association is critical to enhance restoration efforts and to sustain improvements through education. Fortunately, there is a Moon Lake Improvement Association, which has regular meetings and is working towards improving the water quality of Moon Lake.

**Figure 1. Location of the Moon Lake Watershed**



# 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 fecal coliform. Fecal coliform bacteria are used as indicator organisms. They are readily identifiable and indicate the possible presence of other pathogenic organisms in the waterbody. The TMDL process can be used to establish water quality based controls to reduce pollution from nonpoint sources, maintain permit requirements for point sources, and restore and maintain the quality of water resources.

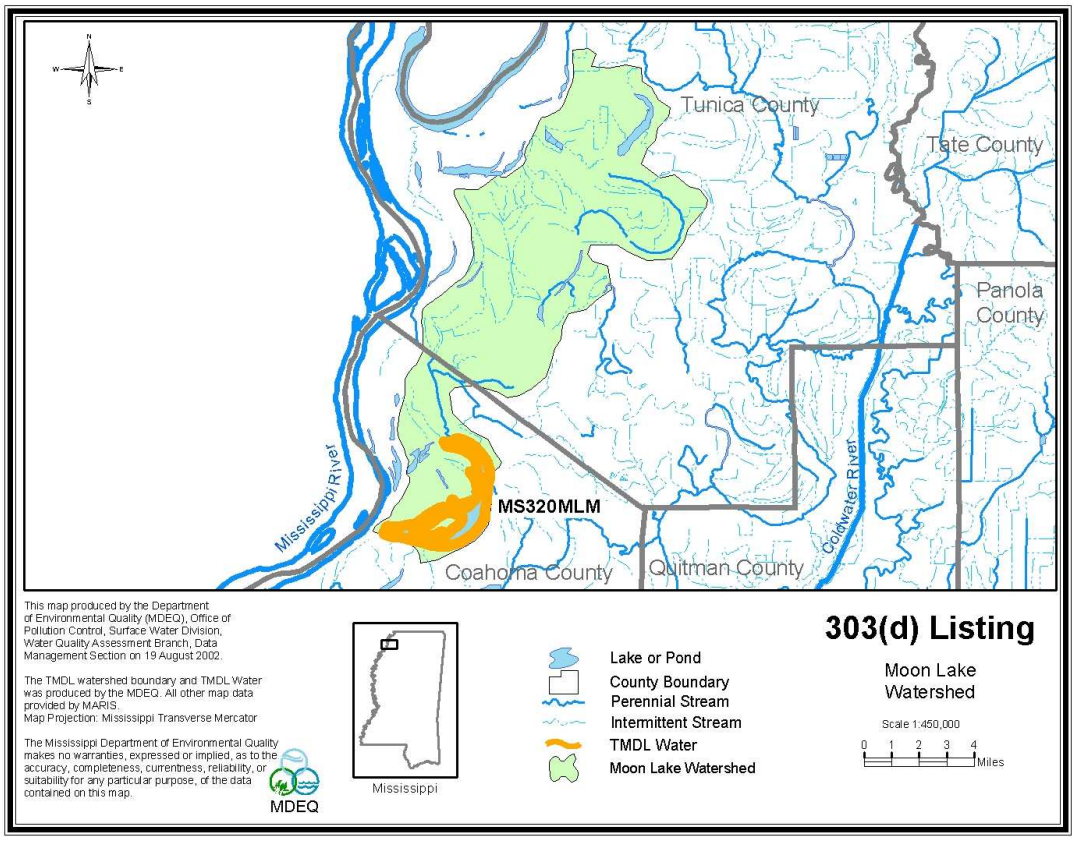
Mississippi Department of Environmental Quality (MDEQ) placed Moon Lake on the Mississippi 1998 Section 303(d) List of Waterbodies. The 303(d) listed section is shown in Figure 2. The original listing was based on information provided in the Final Report for Moon Lake – Phase 1 Diagnostic/Feasibility Study that was conducted by FTN (1991).

Moon Lake is in the Yazoo River Basin Hydrologic Unit Code (HUC) 08030204 in northwest Mississippi. The Moon Lake Watershed is approximately 52,798 acres; and lies within Coahoma, and Tunica Counties. The watershed is primarily rural with cropland being the dominant landuse. The landuse distribution is shown below in Table 1.

**Table 1. Landuse Distribution for the Moon Lake Watershed**

| | Urban | Forest | Cropland | Pasture | Barren | Wetland | Aquaculture | Water | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Area (acres)** | 94 | 0 | 40,822 | 1,986 | 0 | 6,260 | 687 | 2,949 | 52,798 |
| **% Area** | 0% | 0% | 77% | 4% | 0% | 12% | 1% | 6% | 100% |

**Figure 2. Moon Lake 303(d) Listed Segment**




Moon Lake is an oxbow lake formed in abandoned meander of the Mississippi River. Inflow to Moon Lake enters from Phillips Bayou to the north. Moon Lake drains through the Yazoo Pass to the east (FTN, 1991). The Moon Lake Watershed is a small part of an immense flood plain that is nearly level. The drainage area, or watershed, was not divided into subwatersheds. There are no Reach File 1 segments within the watershed.

## 1.2 Applicable Waterbody Segment Use

The water use classification for the listed segment of the Moon Lake, as established by the State of Mississippi in the *Water Quality Criteria for Intrastate, Interstate and Coastal Waters* regulation, is Recreation. The designated beneficial use for the Moon Lake is Contact Recreation.

## 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 fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml. The water quality standard should be used to assess the data to determine impairment in the waterbody. The geometric mean portion of this water quality standard will be used as the targeted endpoint to establish this TMDL.

# TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

## 2.1 Selection of a TMDL Endpoint and Critical Condition

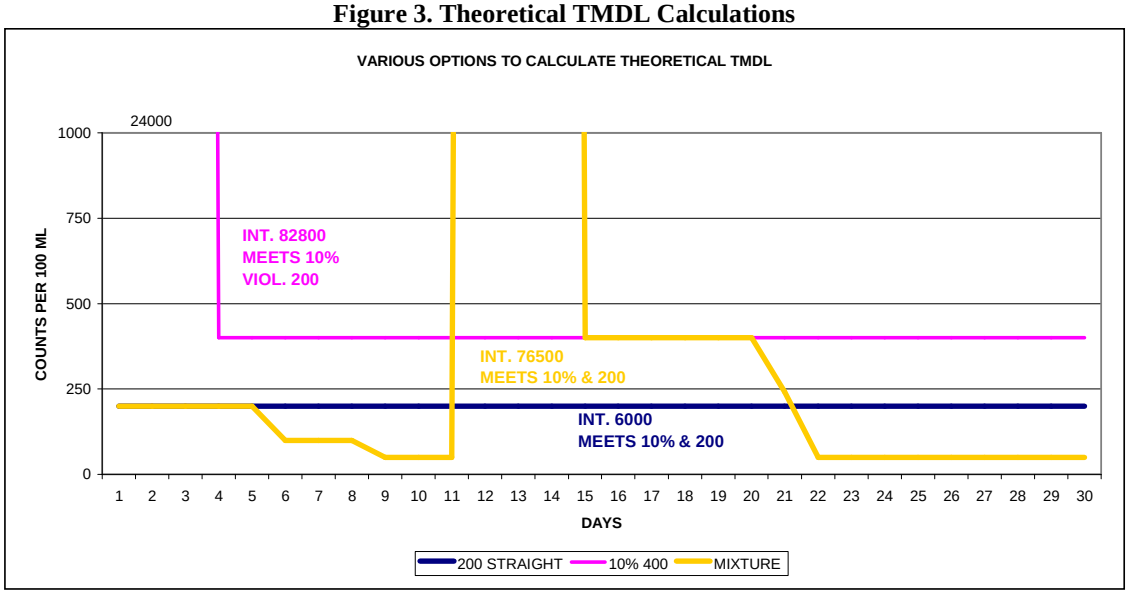
One of the major components of a TMDL is the establishment of instream numeric endpoints, which are used to evaluate the attainment of acceptable water quality. Instream numeric endpoints, therefore, represent the water quality goals that are to be achieved by implementing the load and waste load reductions 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 fecal coliform target for this TMDL is a 30-day geometric mean of 200 colony counts per 100 ml.

While the endpoint of a TMDL calculation is similar to a standard for a pollutant, the endpoint is not the standard. Currently MDEQ's standard for fecal coliform states that the fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml. For calculating this TMDL, MDEQ will use the geometric mean portion of the standard exclusively.

Figure 3 and the explanation below are provided to support MDEQ's use of the geometric mean portion of the standard as the most protective and appropriate. All three lines meet the 10% section of the standard. The blue line represents a constant 200 counts for 30 days. The geometric mean of the blue line is 200 counts for 30 days. The integral of the area below the blue line is 6000 counts. The purple line represents 3 days reading 24,000 counts and 27 days reading 400 counts, which is a maximum load that meets the 10% section of the standard. However, the geometric mean of the purple line is 602 counts for 30 days. The integral of the area below the purple line is 82,800 counts. While the purple line data meet the 10% section of the standard, they do not meet the geometric mean section of the standard. The yellow line represents a data set that is a mixture of the above examples with the same 3-day readings of 24,000 counts and 27 days below 400 counts. While the yellow line data set meets the 10% section of the standard as well as the geometric mean section, the integral of the area below the yellow line is 76,500, which is well above the integral for the blue line data set. Therefore, MDEQ believes the comparison of the data sets supports the selection of calculating the load by multiplying 30 days by the 200 count is the more appropriate of the approaches. Additionally, a 10 percent margin of safety provides further protection.

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 periods of low-flow, low-dilution conditions. Due to lack of water quantity and quality data suitable for establishing a critical condition, a normal year flow was used to calculate this Phase One TMDL. The normal year flow was estimated as the total sources minus the other sinks on a monthly basis (FTN, 1991). The sources include direct precipitation, which is based on the average from 1951 through 1980, inlet flow, and other inflow. The other sinks include direct evaporation and surface withdrawal.

**Figure 3. Theoretical TMDL Calculations**

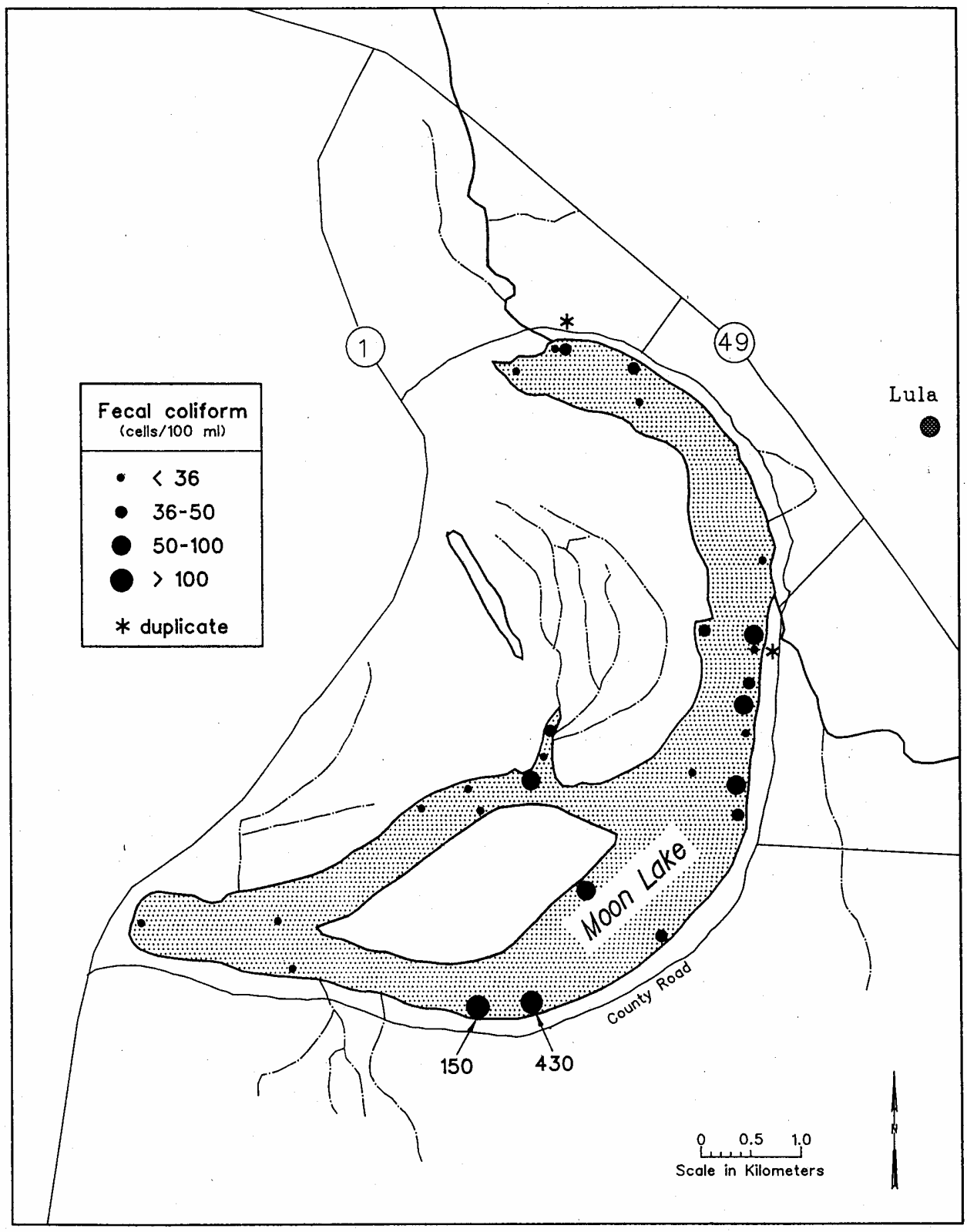



## 2.2 Discussion of Instream Water Quality

Limited data were collected at stations on Moon Lake during a fecal coliform intensive survey on September 5, 1989 (FTN, 1991). While only one data point exceeded Mississippi's water quality standard (less than 10 percent), Moon Lake was listed because the potential to exceed the standard was observed based on a septic survey that identified direct pipes and failing septic tanks (FTN, 1991). No other fecal coliform data have been identified for Moon Lake.

Figure 4 shows the data from the fecal coliform intensive survey graphically. The data were not provided explicitly, but the figure indicates that there was one violation out of 28 samples, which is less than 10 percent violation. Because no other data is available the existing conditions are unknown. This Phase One TMDL was calculated based on the water quality standard, but no percent reduction could be estimated without more data to determine the existing conditions.

**Figure 4. Fecal Coliform Concentration Locations (FTN, 1991)**



# SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known potential fecal coliform sources in the Moon Lake Watershed. The source assessment is provided as an indication of what sources might be reduced to reach the goals outlined in this report. In evaluation of the sources, loads 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.

## 3.1 Assessment of Point Sources

Point sources of fecal coliform bacteria have their greatest potential impact on water quality during periods of low flow. No permitted dischargers were located in the Moon Lake Watershed

## 3.2 Assessment of Nonpoint Sources

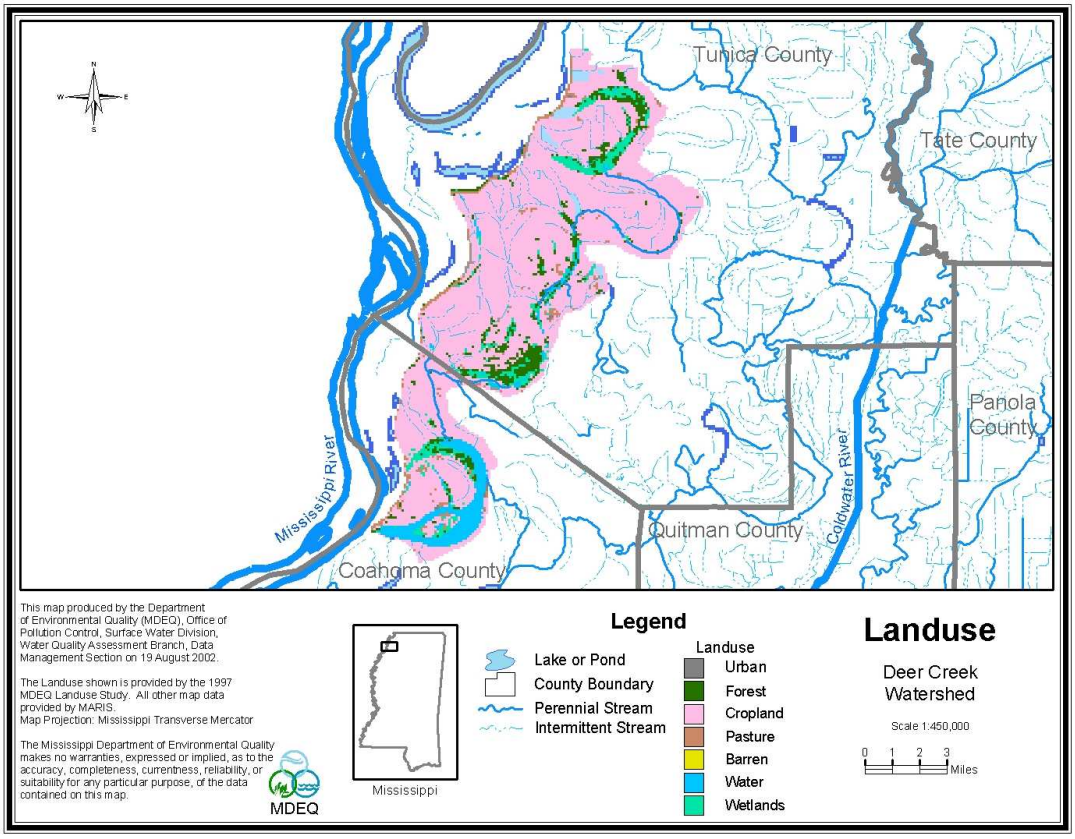
The potential nonpoint sources of fecal coliform bacteria for the Moon Lake include failing septic systems, wildlife, and direct inputs, such as direct pipes. Human contributions from failing septic systems and direct pipes are the primary source in Moon Lake and will be the focus of this section.

The 52,798 acre drainage area of Moon Lake contains many different landuse types, including cropland, pasture, wetlands, and aquaculture. The landuse distribution for the watershed is provided in Table 2 and displayed in Figure 5. The landuse information for the watershed is based on the State of Mississippi's Automated Resource Information System (MARIS) coverage that was published in 1997. This data set is based Landsat Thematic Mapper digital images taken between 1992 and 1993. The MARIS data are classified on a modified Anderson level one and two system with additional level two wetland classifications.

**Table 2. Landuse Distribution for Subwatershed (acres)**

| Subwatershed | Urban | Forest | Cropland | Pasture | Barren | Wetland | Aquaculture | Water | Total |
|---|---|---|---|---|---|---|---|---|---|
| 080302040ML | 94 | 0 | 40,822 | 1,986 | 0 | 6,260 | 687 | 2,949 | 52,798 |
| Percent | 0% | 0% | 77% | 4% | 0% | 12% | 1% | 6% | 100% |

**Figure 5. Landuse Distribution Map for the Moon Lake Watershed**




Septic systems have a potential to deliver fecal coliform bacteria loads to surface waters due to malfunctions, failures, and direct pipe discharges. 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.

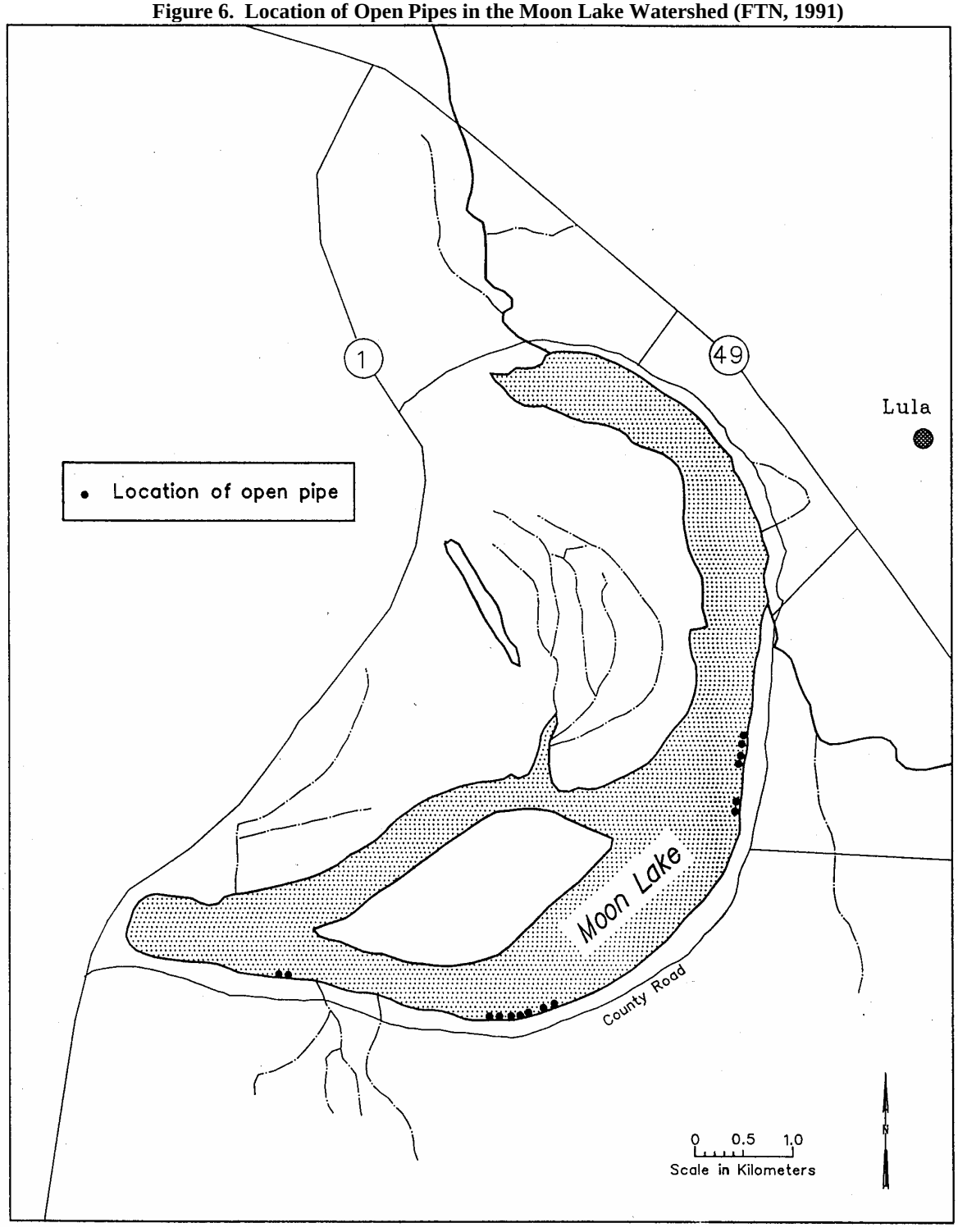
Another consideration is the use of individual onsite wastewater treatment plants. These treatment systems are in wide use in Mississippi. They can adequately treat wastewater when properly maintained. However, these systems may not receive the maintenance needed for proper, long-term operation. These systems require some sort of disinfection to properly operate. When this expense is ignored, the water does not receive adequate disinfection prior to release.

The Mississippi State Department of Health conducted a septic tank survey of Moon Lake in September of 1989 (FTN, 1991). The map presented in Figure 6 indicates the location of open pipes transporting sewage directly to the lake. The results of the 1989 survey indicated (FTN, 1991):

- There were a total of 235 septic tank systems around the lake;
- 9% of the septic tank systems were failing (i.e., 19);
- At least 15 pipes were transporting sewage directly to the lake;
- Many of the landowners had no idea where their sewage systems were located;
- Many houses were built at or over the edge of the water. There may be some outlets underwater that could only be located during low water levels or by dye testing;
- In areas south of Alcorn Island, the septic systems are underwater at certain times of the year; and
- The soil is suitable for septic tanks and drain fields. However, many lots are too small for proper systems. It was recommended that a central sewage collection system be built for houses and businesses around Moon Lake.

The limited amount of information provided in Figures 4 and 6 seem to indicate a correlation between the location of the open pipes and the elevated fecal levels. This correlation supports the necessity of the elimination of the open pipes. While Phillips Bayou, the main tributary to Moon Lake, was found to be the major source of some pollutants, such as nutrients and suspended solids, by FTN, the open pipes and failing septic systems around the lake appear to be the major source of fecal coliform. The correlation of the location of the open pipes and the elevated fecal levels further supports this since the highest fecal levels are at the opposite end of the lake from the entrance of the tributary.

**Figure 6. Location of Open Pipes in the Moon Lake Watershed (FTN, 1991)**



# MASS BALANCE PROCEDURE

Establishing the relationship between the instream water quality target and the source loading is a critical component of TMDL development. It allows for the evaluation of management options that will achieve the desired source load reductions. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain waterbody responses to flow and loading conditions. In this section, the selection of the modeling tools, setup, and model application are discussed.

## 4.1 Calculation Framework Selection

A mass balance approach was used to calculate this Phase One TMDL. This method of analysis was selected due to the complexity needed to accurately model an oxbow lake system. Also, the absence of water quantity and quality data available for calibration made Moon Lake a poor choice for the development of a complex model. The mass balance approach is suitable for a Phase One TMDL.

## 4.2 Calculation of Load

The mass balance approach utilizes the conservation of mass principle. Loads can be calculated by multiplying the fecal coliform concentration versus the flow. The principle of the conservation of mass allows for the addition and subtraction of those loads to determine the appropriate numbers necessary for the TMDL. The loads can be calculated using the following relationship:

**Load** (counts/30days) = [**Concentration** (counts/ 100 ml)] * [**Flow** (cfs)] * (Conversion Factor)

where (Conversion Factor) = [(28316.8 ml/1 $ft^3$)*(1 (100 ml)/100 (1 ml))*(60 s/1 min)*
(60 min/1 hour)*(24 hour/1 day)*(30 days/1 (30 days)]
= 7.34 E+08 ((100 ml * s)/($ft^3$ *30 days))

For the calculation of this TMDL the appropriate concentration used was the geometric mean standard. While MDEQ realizes it would be most appropriate to use the geometric mean flow corresponding to the period of violation, the only flow information available was the outflow from Moon Lake for a normal year. The normal year outflow was estimated as the total sources minus the other sinks on a monthly basis (FTN, 1991). The outflow from Moon Lake for a normal year was estimated to be 121.5 E+06 $m^3$/year, which is 136 cfs. While Moon Lake is an oxbow lake system with more dilution available in the lake than that at the outflow, the outflow was used to calculate this Phase One TMDL. It was assumed that if the standard was met there that it would be met in the lake as well.

## 4.3 Waterbody Characteristics

The surface area of Moon Lake is approximately 2,308 acres, and the mean depth is 5.5 meters (FTN, 1991). Inflow to Moon Lake enters from Phillips Bayou to the north. Moon Lake drains through the Yazoo Pass to the east. The Moon Lake Watershed is a small part of an immense flood plain that is nearly level.

# ALLOCATION

The allocation for this Phase One TMDL could include a wasteload allocation (WLA) for point sources, a load allocation (LA) for nonpoint sources, and a margin of safety (MOS). This Phase One TMDL is comprised of the LA and MOS.

## 5.1 Wasteload Allocations

There are no point sources currently within the Moon Lake Watershed.

## 5.2 Load Allocations

The LA for Moon Lake is calculated using the water quality criterion and the normal flow. In calculating the LA component, the water quality is reduced by a 10 percent MOS. For this Phase One Moon Lake TMDL, the LA is based on a fecal coliform concentration of 180 counts per 100 ml and the normal flow of 136 cfs. The resulting LA is estimated to be 1.80E+13 counts for 30 days. Currently, no percent reduction can be calculated due to a lack of adequate data to characterize the existing conditions. However, MDEQ recommends a reduction in this load be achieved through the elimination of failing septic tanks and direct pipes that potentially pollute the waterbody.

LA = 180 (counts/100 ml) * 136 (cfs) * 7.34E+08 ((100 ml * s)/($ft^3$ *30 days))

LA = 1.80E+13 counts for 30 days

## 5.3 Incorporation of a Margin of Safety (MOS)

The two types of MOS development are to implicitly incorporate the MOS using conservative assumptions or to explicitly specify a portion of the total TMDL as the MOS. For this study, reducing the instream target concentration by 10 percent from 200 counts per 100 ml to 180 counts per 100 ml explicitly specifies the MOS. Using the normal flow and 10 percent of the target, which is 20 counts per 100 ml, the load attributed to the MOS is 2.00E+12 counts for 30 days.

MOS = 20 (counts/100ml) * 136 (cfs) * 7.34E+08 ((100 ml * s)/($ft^3$ *30 days))

MOS = 2.00E+12 counts for 30 days

## 5.4 Calculation of the TMDL

This TMDL is calculated based on the following equation where WLA is the wasteload allocation (the load from the point sources), the LA is the load allocation (the load from nonpoint sources), and MOS is the margin of safety:

**TMDL = WLA + LA + MOS**

**WLA** = NPDES Permitted Facilities

**LA** = Surface Runoff + Other Direct Inputs

**MOS** = Explicit

The TMDL was calculated based on the normal flow and the target, which is 200 counts per 100 ml. Table 3 gives the Phase One TMDL for Moon Lake.

TMDL = 200 (counts/100ml) * 136 (cfs) * 7.34E+08 ((100 ml * s)/($ft^3$ *30 days ))

TMDL = 2.00E+13 counts for 30 days

**Table 3. TMDL Components**

| Component | Value | Unit | MOS Type |
|---|---|---|---|
| WLA | 0 | counts/30 day | |
| LA | 1.80 E+13 | counts/30 day | |
| MOS | 0.20 E+13 | counts/30 day | Explicit |
| TMDL | 2.00 E+13 | counts/30 day | |

## 5.5 Seasonality

For many streams in the state, fecal coliform limits vary according to the seasons. However, Moon Lake is designated for the use of contact recreation. For this use, the pollutant standard is constant throughout the year.

## 5.6 Reasonable Assurance

This component of TMDL development does not apply to this TMDL Report. There are no point sources (WLA) requesting a reduction based on promised Load Allocation components and reductions. The point sources are required to discharge effluent treated and disinfected that will be below the 200 colony counts per 100 ml target at the end of the pipe.

# CONCLUSION

MDEQ recommends an overall reduction in the load be achieved through the elimination of failing septic tanks and direct pipes that potentially pollute the waterbody. A centralized wastewater collection and treatment system would be an effective means to achieve these recommendations.

This is a phased TMDL using the best information available at the time to establish the TMDL at levels necessary to implement applicable water quality standards and to make the allocations to the pollution sources. However, the phased TMDL approach recognizes that additional data and information may be necessary to validate the assumptions of the TMDL and to provide greater certainty that the TMDL will achieve the applicable water quality standard.

## 6.1 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 Yazoo River Basin, Moon Lake may receive additional monitoring to identify any change in water quality. 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.

Due to interest in Moon Lake by stakeholders, the Mississippi State Department of Health will be conducting surveys for failing or inadequate septic systems in the Moon Lake Watershed attempting to identify the sources of the potential pollution.

## 6.2 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 and a newspaper in the area of the watershed. The public will be given an opportunity to review the TMDL and submit comments. MDEQ also plans to share the TMDL and alternative treatment scenarios with the Moon Lake Improvement Association during the public notice period.

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.

**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.

**Fecal coliform bacteria:** a group of bacteria that normally live within the intestines of mammals, including humans. Fecal coliform bacteria are used as an indicator of the presence of pathogenic organisms in natural water.

**Geometric mean:** the *n*th root of the product of *n* numbers. A 30-day geometric mean is the $30^{th}$ 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. The load allocation is the value assigned to the summation of all direct sources and land applied fecal coliform that enter a receiving waterbody. It also contains a portion of the contribution from septic tanks.

**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.

**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.

**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.

**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.

**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 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.).

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

# 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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