FINAL REPORT
April 2007
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Total Maximum Daily Load
Biological Impairment Due to Nutrients and Organic Enrichment / Low Dissolved Oxygen For McCrary Creek

Tombigbee River Basin
Lowndes County, 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. The report contains one or more Total Maximum Daily Loads (TMDLs) for water body segments found on Mississippi's 1996 Section 303(d) List of Impaired Water bodies. 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.

Conversion Factors

To convert from	To	Multiply by	To convert from	To	Multiply by
$mile^2$	acre	640	acre	ft^2	43560
km^2	acre	247.1	days	seconds	86400
m^3	ft^3	35.3	meters	feet	3.28
ft^3	gallons	7.48	ft^3	gallons	7.48
ft^3	liters	28.3	hectares	acres	2.47
cfs	gal/min	448.8	miles	meters	1609.3
cfs	MGD	0.646	tonnes	tons	1.1
m^3	gallons	264.2	μg/l * cfs	gm/day	2.45
m^3	liters	1000	μg/l * MGD	gm/day	3.79

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	:	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

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Table 1. Listing Information

Name	ID	County	HUC	Cause	Stressors
McCrary Creek	MS030E	Lowndes	03160105	Biological Impairment	Nutrients and Organic Enrichment / Low Dissolved Oxygen
Near Columbus from Alabama to Luxapalila Creek					

Table 2. Water Quality Standards

Parameter	Beneficial use	Water Quality Criteria
Nutrients	Aquatic Life Support	Waters shall be free from materials attributable to municipal, industrial, agricultural, or other dischargers producing color, odor, taste, total suspended solids, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated uses.
Dissolved Oxygen	Aquatic Life Support	DO concentrations shall be maintained at a daily average of not less than 5.0 mg/l with an instantaneous minimum of not less than 4.0 mg/l

Table 3. Total Maximum Daily Load for McCrary Creek

	WLA lbs/day	LA lbs/day	MOS	TMDL lbs/day
TBODu	59.4	6.8	69.44	135.6
Total Nitrogen	11.9	104.6 – 124.0	Implicit	116.5 – 135.9
Total Phosphorous	5.3	6.3 – 14.1	Implicit	11.6 – 19.4

Table 4. Identified NPDES Permitted Facilities

Name	NPDES Permit
ABC and Me Preschool	MS0049441
Mount Vernon Baptist Church	MS0053422
OMNOVA Solutions, Inc.	MS0003140
Wilco Properties Inc, Beersheba Hills Subdivision	MS0038954
Wilco Properties Inc, Kerry Estates, New Hope Garden Apartments	MS0036609

EXECUTIVE SUMMARY

This TMDL has been developed for McCrary Creek which was placed on the Mississippi 1996 Section 303(d) List of Impaired Water Bodies due to evaluated causes of nutrients and organic enrichment / low dissolved oxygen. MDEQ completed biological monitoring on McCrary Creek, which indicated biological impairment. A stressor identification report was developed (MDEQ, 2006). It was determined that nutrients, organic enrichment / low dissolved oxygen and sediment are probable primary stressors. Sediment will be addressed in a separate TMDL report. This TMDL will provide an estimate of the total nitrogen (TN) and total phosphorus (TP) and organic material allowable in the stream.

Mississippi does not have numeric criteria in its water quality standards for allowable nutrient concentrations. MDEQ currently has a Nutrient Task Force (NTF) working on the development of criteria for nutrients. An annual concentration range of 0.6 to 0.7 mg/l is an applicable target for TN and 0.06 to 0.10 mg/l for TP for water bodies located in Ecoregion 65. MDEQ is presenting these ranges as preliminary target values for TMDL development which is subject to revision after the development of numeric nutrient criteria.

The McCrary Creek Watershed is located in HUC 03160105. The listed portion of McCrary Creek begins at the Alabama state line and flows for approximately 8 miles to Luxapalila Creek. The location of the watershed for the listed segment is shown in Figure 1.

The predictive model used to calculate the dissolved oxygen TMDL is based primarily on assumptions described in MDEQ Regulations. A modified Streeter-Phelps dissolved oxygen sag model was selected as the modeling framework for developing the TMDL allocations. The critical modeling period occurs during the hot, dry summer period. The TMDL for organic enrichment was quantified in terms of total ultimate biochemical oxygen demand (TBODu). The model used in developing this TMDL included both non-point and point sources of TBODu in the McCrary Creek Watershed. TBODu loading from background and non-point sources in the watershed was accounted for by using an estimated concentration of TBODu and flows based on 7Q10 conditions. There are five NPDES permitted dischargers located in the watershed that are included as point sources in the model.

According to the model, the current TBOD load in the water body does not exceed the assimilative capacity of McCrary Creek for organic material. Therefore, no reductions in the current permitted loads of organic material are needed for this TMDL report in order to meet water quality limits.

Mass balance calculations showed that the nutrient levels are predominantly from non-point sources. The limited nutrient data and estimated existing ecoregion concentrations indicates reductions of nutrients are needed.

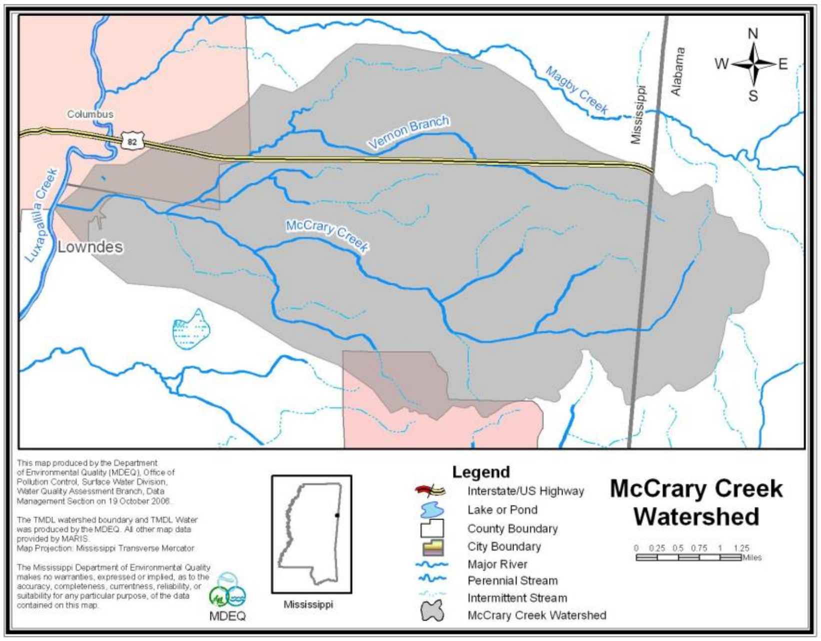

Figure 1. McCrary Creek

INTRODUCTION

1.1 Background

The identification of water bodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those water bodies 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 water bodies through the establishment of pollutant specific allowable loads. This TMDL has been developed for the 2004 §303(d) listed segment shown in Figure 2.

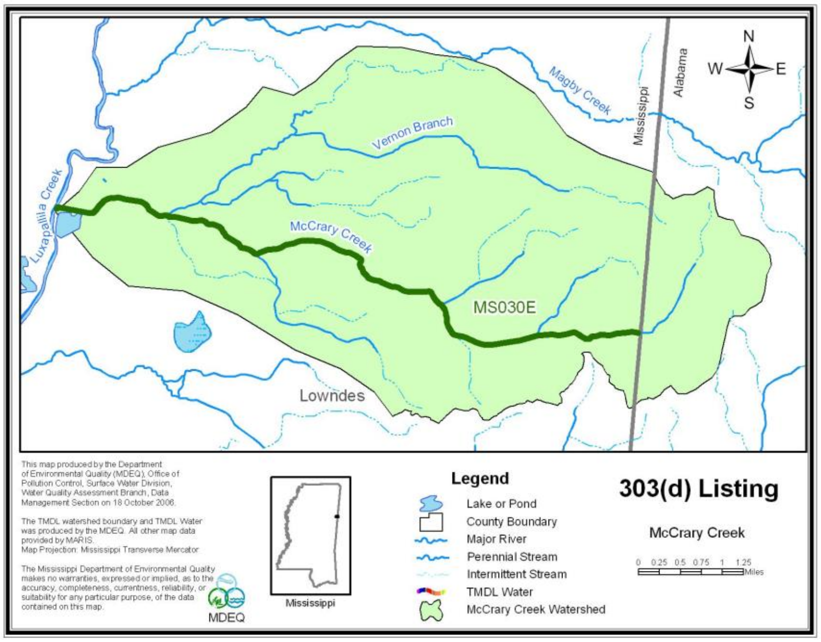

Figure 2. McCrary Creek §303(d) Listed Segment

The original listing was for the McCrary Creek drainage area, MS030E. MDEQ began a biological monitoring program, the M-BISQ, to monitor this and other evaluated streams to confirm water quality based on the health of the biology in the stream. McCrary Creek, MS030E, was confirmed as impaired based on the biology.

1.2 Stressor Identification

The impaired segments were listed due to failure to meet minimum water quality criteria for aquatic use support based on biological sampling (MDEQ, 2003). Because of these results, a detailed assessment of the watershed and potential pollutant sources, called a stressor identification report, was developed for the stream. The purpose of a stressor identification report is to identify the stressors and their sources most likely causing degradation of instream biological conditions. The report indicated that sediment, nutrients, and organic enrichment were probable primary stressors for McCrary Creek (MDEQ, 2006).

1.3 Applicable Water Body Segment Use

The water use classifications are established by the State of Mississippi in the document *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2003). The designated beneficial use for the listed segments is fish and wildlife.

1.4 Applicable Water Body Segment Standard

The water quality standard applicable to the use of the water body and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2003).

The applicable standard specifies that the dissolved oxygen (DO) concentrations shall be maintained at a daily average of not less than 5.0 mg/l with an instantaneous minimum of not less than 4.0 mg/l. This water quality standard will be used as a targeted endpoint to evaluate impairments and establish this TBODu TMDL.

Mississippi's current standards contain a narrative criteria that can be applied to nutrients which states "*Waters shall be free from materials attributable to municipal, industrial, agricultural, or other discharges producing color, odor, taste, total suspended or dissolved solids, sediment, turbidity, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated use* (MDEQ, 2002)." In the 1999 Protocol for Developing Nutrient TMDLs, EPA suggests several methods for the development of numeric criteria for nutrients (USEPA, 1999). In accordance with the 1999 Protocol, "The target value for the chosen indicator can be based on: comparison to similar but unimpaired waters; user surveys; empirical data summarized in classification systems; literature values; or professional judgment." MDEQ believes the most economical and scientifically defensible method for use in Mississippi is a comparison between similar but unimpaired waters within the same region. This method is dependent on adequate data which are being collected in accordance with the EPA approved plan. The initial phase of the data collection process for wadeable streams is complete.

1.5 Nutrient Target Development

Nutrient data were collected quarterly at 99 discrete sampling stations state wide where biological data already existed. These stations were identified and used to represent a range of stream reaches according to biological health status, geographic location (selected to account for ecoregion, bioregion, basin and geologic variability) and streams that potentially receive non-point source pollution from urban, agricultural, and silviculture lands as well as point source pollution from NPDES permitted facilities.

Nutrient concentration data were not normally distributed; therefore, data were log transformed for statistical analyses. Data were evaluated for distinct patterns of various data groupings (stratification) according to natural variability. Only stations that were characterized as "least disturbed" through a defined process in the M-BISQ process (M-BISQ 2003) or stations that resulted in a biological impairment rating of "fully attaining" were used to evaluate natural variability of the data set. Each of these two groups was evaluated separately ("least disturbed sites" and "fully attaining sites). Some stations were used in both sets, in other words, they were considered "least disturbed" and "fully attaining". The number of stations considered "least disturbed" was 30 of 99, and the number of stations considered "fully attaining" was 53 of 99.

Several analysis techniques were used to evaluate nutrient data. Graphical analyses were used as the primary evaluation tool. Specific analyses used included; scatter plots, box plots, Pearson's correlation, and general descriptive statistics.

In general, natural nutrient variability was not apparent based on box plot analyses according to the 4 stratification scenarios. Bioregions were selected as the stratification scheme to use for TMDLs in the Pascagoula Basin. However, this was not appropriate for some water bodies in smaller bioregions. Therefore, MDEQ now uses ecoregions as a stratification scheme for the water bodies in the remainder of the state.

In order to use the data set to determine possible nutrient thresholds, nutrient concentrations were evaluated as to their correlation with biological metrics. That thorough evaluation was completed prior to the Pascagoula River Basin TMDLs. The methodology and approach were verified. The same methodology was applied to the subsequent ecoregions.

For the preliminary target concentration range for each ecoregion, the 75th and 90th percentiles were derived from the mean nutrient value at each site found to be fully supporting of aquatic life support according to the M-BISQ scores. For the estimate of the existing concentrations the 50th percentile (median) was derived from the mean nutrient value at each site of sites that were not attaining and had nutrient concentrations greater than the target.

1.6 Selection of a Critical Condition

Low DO typically occurs during seasonal low-flow, high-temperature periods during the late summer and early fall. Elevated oxygen demand is of primary concern during low-flow periods because the effects of minimum dilution and high temperatures combine to produce the worst-case potential effect on water quality (USEPA, 1997). The flow at critical conditions is typically defined as the 7Q10 flow, which is the lowest flow for seven consecutive days expected during a 10-year period. The low flow condition for Big ByWy Creek was determined based on two partial record stations listed in *Low-Flow and Flow-Duration Charactersitics of Mississippi Streams* (Telis, 1991).

1.7 Selection of a TMDL Endpoint

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 meeting the load and wasteload allocations 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 DO target for this TMDL is a daily average of not less than 5.0 mg/l. The instantaneous minimum portion of the DO standard was considered when establishing the instream target for this TMDL. However, it was determined that using the daily average standard with the conservative modeling assumptions would protect the instantaneous minimum standard. The daily average choice is supported by the use of the existing modeling tools in a desktop modeling exercise such as this. More specific modeling and calibration are needed in order to obtain accurate diurnal oxygen levels. Therefore, based on the limited data available and the relative simplicity of the model, the daily average target is appropriate.

The TMDL for DO will be quantified in terms of organic enrichment. Organic enrichment is measured in terms of total ultimate biochemical oxygen demand (TBODu). TBODu represents the oxygen consumed by microorganisms while stabilizing or degrading carbonaceous and nitrogenous compounds under aerobic conditions over an extended time period. The carbonaceous compounds are referred to as CBODu, and the nitrogenous compounds are referred to as NBODu. TBODu is equal to the sum of NBODu and CBODu, Equation 1.

$$\textbf{TBODu = CBODu + NBODu} \qquad \textbf{(Equation 1)}$$

There are no state criteria in Mississippi for nutrients. These criteria are currently being developed by the Mississippi Nutrient Task Force in coordination with EPA Region 4. MDEQ proposed a work plan for nutrient criteria development that has been approved by EPA and is on schedule according to the approved plan in development of nutrient criteria (MDEQ, 2004). Data were collected for wadeable streams to calculate the nutrient criteria.

For this TMDL, MDEQ is presenting preliminary target ranges for TN and TP. The limited data available are greater than these ranges for TN with TP also showing some elevation. An annual concentration range of 0.6 to 0.7 mg/l is an applicable target for TN and 0.06 to 0.10 mg/l for TP for water bodies located in Ecoregion 65. However, MDEQ is presenting these ranges as preliminary target values for TMDL development which is subject to revision after the development of nutrient criteria, when the work of the NTF is complete.

WATER BODY ASSESSMENT

2.1 McCrary Creek Water Quality Data

Nutrient and dissolved oxygen data for the McCrary Creek Watershed were gathered and reviewed. Data exist for the §303(d)-listed segment of McCrary Creek based on samples collected in the creek during the §303(d)/M-BISQ monitoring project at site #209 in 2001 given in Table 5. Site #209 is located at Columbus near Highway 69 in Lowndes County. Data also exist at the ambient monitoring station #TB031 in 1999 located on McCrary Creek at Columbus on Highway 69 given in Table 6. Additionally, a WLA study was done in 1999 and 2001 with three water quality sampling stations: MCR1, MCR2, and MCR3. WLA station MCR1 had 24 hour dissolved oxygen data collected every 30 minutes in 2001 for a three day period. The instantaneous data from the WLA study in 1999 and 2001 is given in Table 7 and summary of the dissolved oxygen data collected at station MCR1 is given in Table 8. The locations of MBISQ Station #209, ambient station #TB031, and the three stations from the WLA study are shown in Figure 3. The average TN concentration is 0.62 mg/l and the average TP concentration is 0.05 mg/l.

Table 5. Water Quality Data Collected at McCrary Creek, MBISQ Station #209

Sample Date	Time	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Dissolved Oxygen (mg/L)
3/9/2001	15:40	0.02	0.63	11.66

Table 6. Water Quality Data Collected at McCrary Creek, Ambient Station #TB031

Sample Date	Time	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Dissolved Oxygen (mg/L)
6/15/1999	14:50	0.10	0.66	8.93

Table 7. Water Quality Data Collected at McCrary Creek, WLA Study, Instantaneous Data

Station	Sample Date	Time	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Dissolved Oxygen (mg/L)
MCR1	8/9/1999	08:20			6.21
MCR1	5/7/2001	15:30	0.05	0.57	9.34
MCR1	5/8/2001	14:00	0.04	0.54	8.95
MCR1	5/8/2001	14:10	0.07	0.61	8.98
MCR1	5/8/2001	20:15	0.04	0.67	7.60
MCR1	5/8/2001	20:35	0.04	0.65	7.47
MCR1	5/9/2001	11:30	0.04	0.65	7.63
MCR1	5/9/2001	11:40	0.07	0.65	7.67
MCR1	5/10/2001	16:30	0.06	0.54	
MCR2	8/9/1999	08:00			6.80
MCR3	8/9/1999	09:10			3.85

Table 8. Water Quality Data Collected at McCrary Creek, WLA Study, 24 hr Data

Station	Beginning Date and Time	Ending Date and Time	Minimum DO (mg/L)	Maximum DO (mg/L)	Average DO (mg/L)
MCR1	5/7/2001 15:30	5/8/2001 15:30	6.67	9.22	7.67
MCR1	5/8/2001 15:30	5/9/2001 15:30	6.66	8.72	7.48
MCR1	5/9/2001 15:30	5/10/2001 15:30	6.83	8.72	7.59

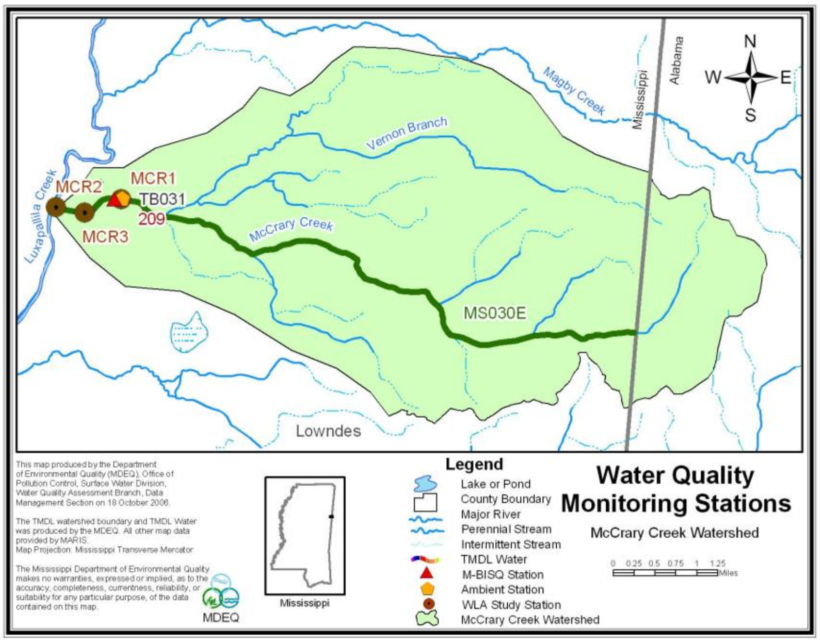

Figure 3. McCrary Creek Water Quality Monitoring Stations

2.2 Assessment of Point Sources

An important step in assessing pollutant sources in the McCrary Creek watershed is locating the NPDES permitted sources. There are five facilities permitted to discharge organic material into the McCrary Creek watershed, Table 9. The locations of the facilities are shown in Figure 4.

Table 9. NPDES Permitted Facilities Treatment Types

Name	NPDES Permit	Treatment Type
ABC and Me Preschool	MS0049441	Aerobic treatment unit
Mount Vernon Baptist Church	MS0053422	Package plant
OMNOVA Solutions, Inc.	MS0003140	Sedimentation, oil skimming, and aeration
Wilco Properties Inc, Beersheba Hills Subdivision	MS0038954	Aerated lagoon
Wilco Properties Inc, Kerry Estates, New Hope Garden Apartments	MS0036609	Activated sludge plant

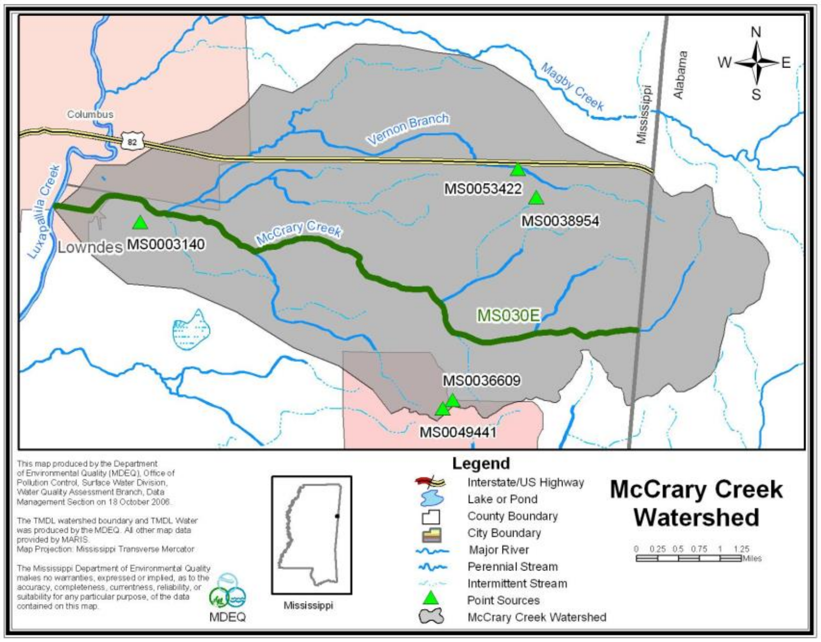

Figure 4. McCrary Creek Point Source

The effluent from the facilities was characterized based on all available data including information on its wastewater treatment system, permit limits, and discharge monitoring reports. The permit limits are given in Table 10.

Table 10. Identified NPDES Permitted Facilities

Name	NPDES Permit	Permitted Discharge (MGD)	Permitted Average BOD_5 (mg/l)
ABC and Me Preschool	MS0049441	0.032	30
Mount Vernon Baptist Church	MS0053422	0.0005	30
OMNOVA Solutions, Inc.	MS0003140	0.032 (report)	20
Wilco Properties Inc, Beersheba Hills Subdivision	MS0038954	0.032	30
Wilco Properties Inc, Kerry Estates, New Hope Garden Apartments	MS0036609	0.0186	30

2.3 Assessment of Non-Point Sources

Non-point loading of nutrients and organic material in a water body results from the transport of the pollutants into receiving waters by overland surface runoff, groundwater infiltration, and atmospheric deposition. The two primary nutrients of concern are nitrogen and phosphorus. Total nitrogen is a combination of many forms of nitrogen found in the environment. Inorganic nitrogen can be transported in particulate and dissolved phases in surface runoff. Dissolved inorganic nitrogen can be transported in groundwater and may enter a stream from groundwater infiltration. Finally, atmospheric gaseous nitrogen may enter a stream from atmospheric deposition.

Unlike nitrogen, phosphorus is primarily transported in surface runoff when it has been sorbed by eroding sediment. Phosphorus may also be associated with fine-grained particulate matter in the atmosphere and can enter streams as a result of dry fallout and rainfall (USEPA, 1999). However, phosphorus is typically not readily available from the atmosphere or the natural water supply (Davis and Cornwell, 1988). As a result, phosphorus is typically the limiting nutrient in most non-point source dominated rivers and streams, with the exception of watersheds which are dominated by agriculture and have high concentrations of phosphorus contained in the surface runoff due to fertilizers and animal excrement or watersheds with naturally occurring soils which are rich in phosphorus (Thomann and Mueller, 1987).

Watersheds with a large number of failing septic tanks may also deliver significant loadings of phosphorus to a stream. All domestic wastewater contains phosphorus which comes from humans and the use of phosphate containing detergents. Table 11 presents typical nutrient loading ranges for various land uses.

Table 11. Nutrient Loadings for Various Land Uses

Landuse	Total Phosphorus [lb/acre-y]			Total Nitrogen [lb/acre-y]		
	Minimum	**Maximum**	**Median**	**Minimum**	**Maximum**	**Median**
Roadway	0.53	1.34	0.98	1.2	3.1	2.1
Commercial	0.61	0.81	0.71	1.4	7.8	4.6
Single Family-Low Density	0.41	0.57	0.49	2.9	4.2	3.6
Single Family-High Density	0.48	0.68	0.58	3.6	5.0	5.2
Multifamily Residential	0.53	0.72	0.62	4.2	5.9	5.0
Forest	0.09	0.12	0.10	1.0	2.5	1.8
Grass	0.01	0.22	0.12	1.1	6.3	3.7
Pasture	0.01	0.22	0.12	1.1	6.3	3.7

Source: Horner et al., 1994 in Protocol for Developing Nutrient TMDLs (USEPA 1999)

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The drainage area of McCrary Creek is approximately 14,678 acres or 22.94 square miles. The watershed contains many different landuse types, including urban, forest, cropland, pasture, water, and wetlands. The landuse information given below is based on data collected by the Multi-Resolution Land Characteristics (MRLC) Consortium. This data set is the National Land Cover Database (NLCD) 2001 and is based on satellite imagery from 2001. Forest is the dominant landuse within this watershed. The landuse distribution for the McCrary Creek Watershed is shown in Table 12 and Figure 5.

Table 12. Landuse Distribution for the McCrary Creek Watershed

In Acres	Urban	Forest	Cropland	Pasture	Scrub/Barren	Water	Wetlands
McCrary Creek	2,779	5,522	1,851	1,251	959	190	2,125
Percentage	19%	38%	13%	8%	7%	1%	14%

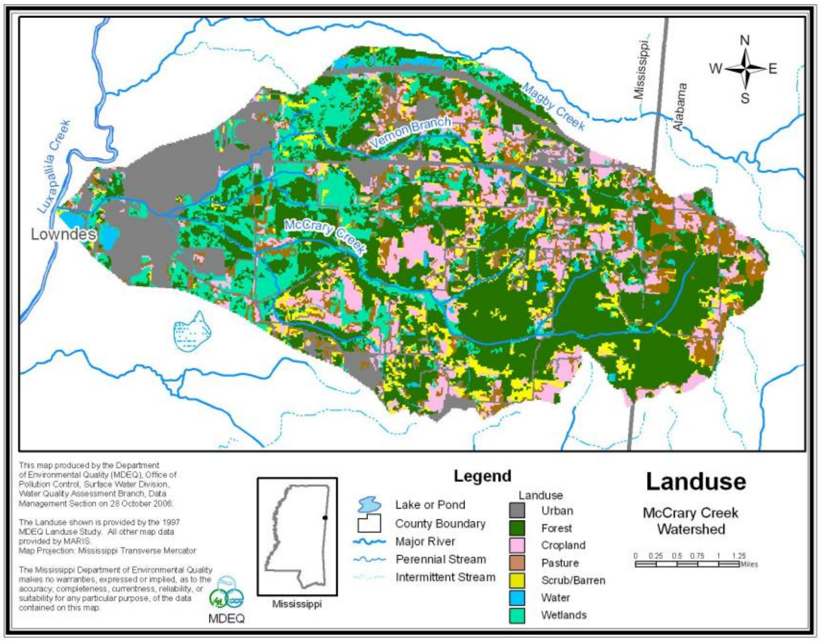


Figure 5. McCrary Creek Watershed Landuse

MODELING PROCEDURE: LINKING THE SOURCES TO THE ENDPOINT

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. The link can be established through a range of techniques, from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain water body responses to flow and loading conditions. In this section, the selection of the modeling tools, setup, and model application are discussed.

3.1 Modeling Framework Selection

A mathematical model, STeady Riverine Environmental Assessment Model (STREAM), for DO distribution in freshwater streams was used for developing the TMDL. STREAM is an updated version of the AWFWUL1 model, which had been used by MDEQ for many years. The use of AWFWUL1 is promulgated in the *Wastewater Regulations for National Pollutant Discharge Elimination System (NPDES) Permits, Underground Injection Control (UIC) Permits, State Permits, Water Quality Based Effluent Limitations and Water Quality Certification* (MDEQ, 1994). This model has been approved by EPA and has been used extensively at MDEQ. A key reason for using the STREAM model in TMDL development is its ability to assess instream water quality conditions in response to point and non-point source loadings.

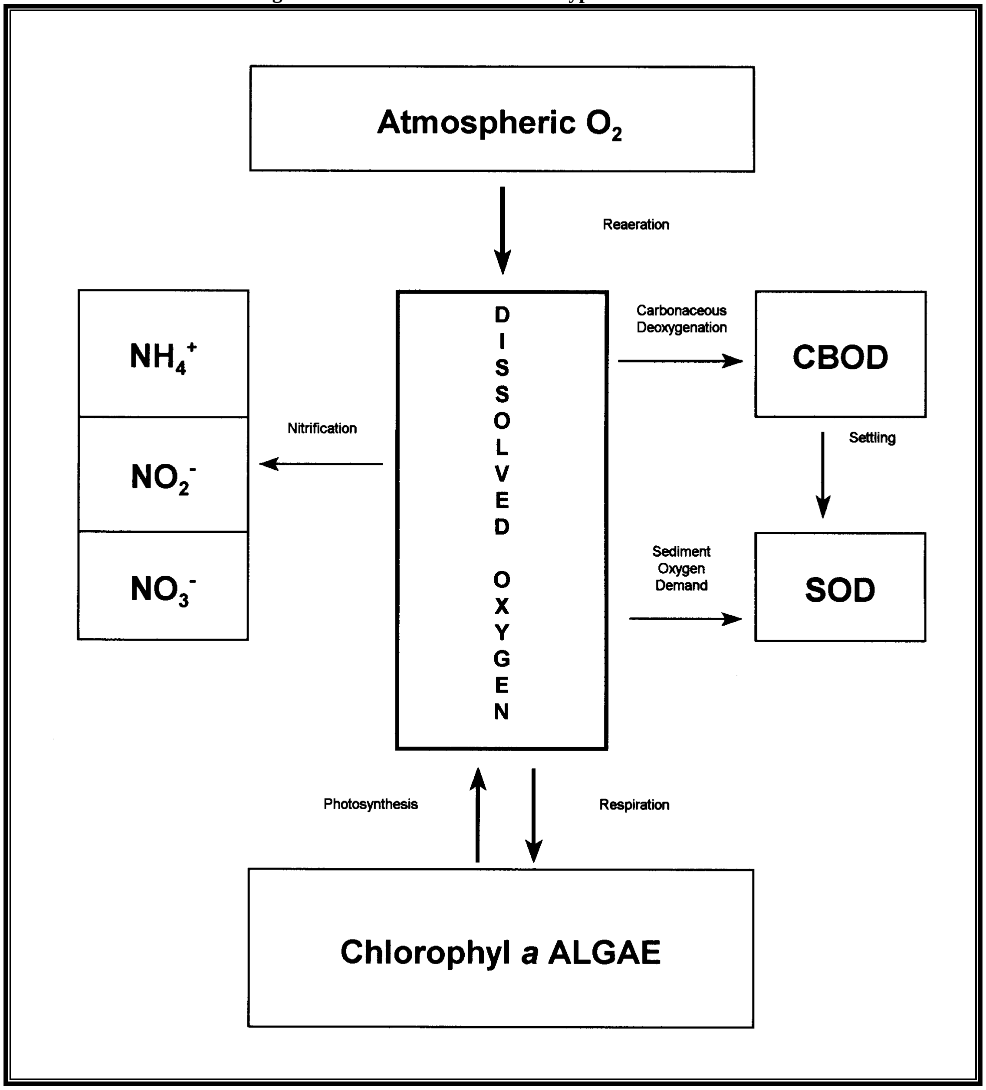
STREAM is a steady-state, daily average computer model that utilizes a modified Streeter-Phelps DO sag equation. Instream processes simulated by the model include CBODu decay, nitrification, reaeration, sediment oxygen demand, and respiration and photosynthesis of algae. Figure 6 shows how these processes are related in a typical DO model. Reaction rates for the instream processes are input by the user and corrected for temperature by the model. The model output includes water quality conditions in each computational element for DO, CBODu, and NH_3-N concentrations. The hydrological processes simulated by the model include stream velocity and flow from point sources and spatially distributed inputs.

The model was set up to calculate reaeration within each reach using the Tsivoglou formulation. The Tsivoglou formulation calculates the reaeration rate, K_a (day^{-1} base e), within each reach according to Equation 2.

$$\mathbf{K_a = C*S*U} \qquad \textbf{(Eq 2)}$$

C is the escape coefficient, U is the reach velocity in mile/day, and S is the average reach slope in ft/mile. The value of the escape coefficient is assumed to be 0.11 for streams with flows less than 10 cfs. Reach velocities were calculated using an equation based on slope. The slope of each reach was estimated electronically and input into the model in units of feet/mile.

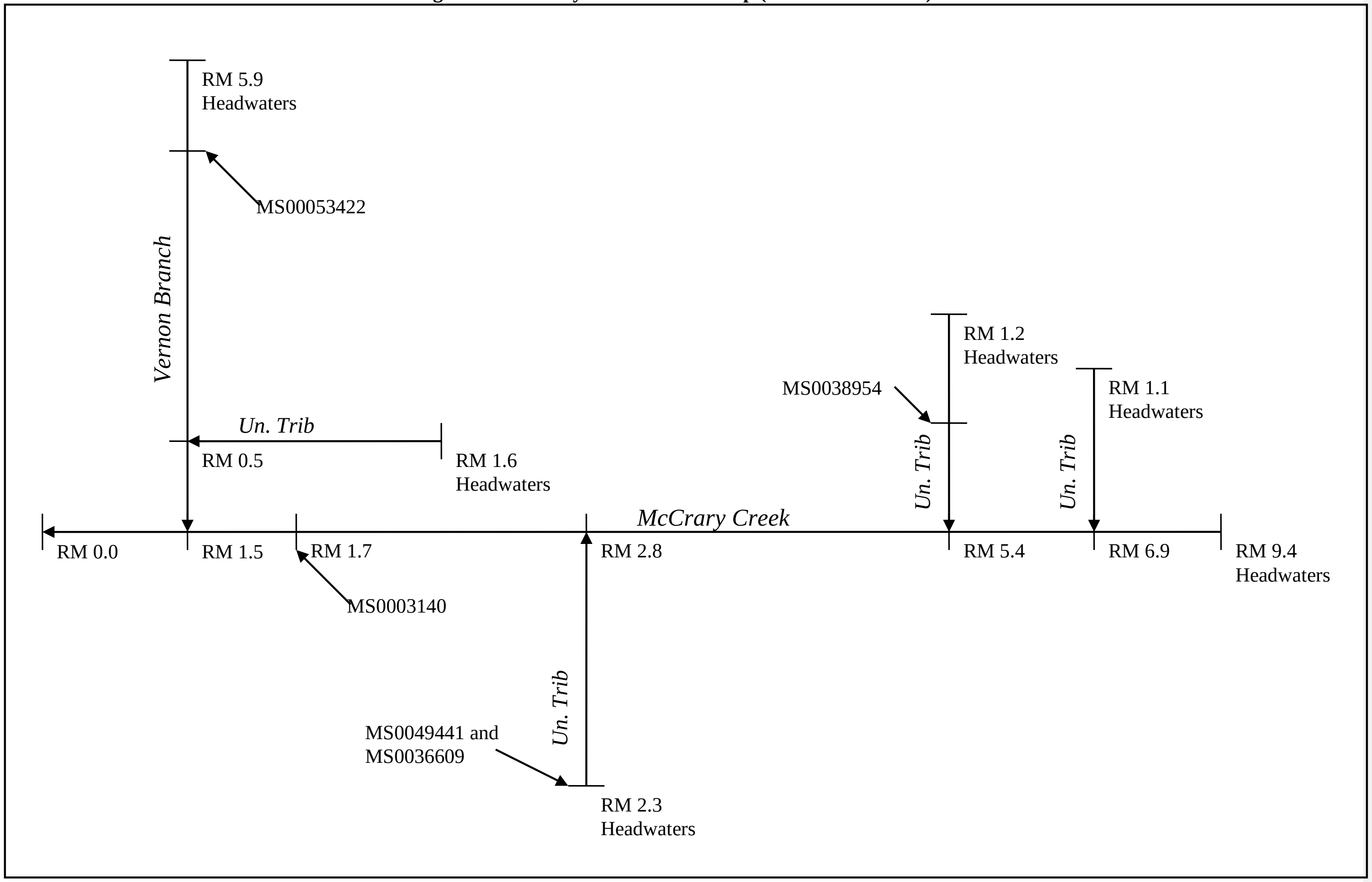
Figure 6. Instream Processes in a Typical DO Model



3.2 Model Setup

The model for this TMDL includes the §303(d) listed segment of McCrary Creek, beginning at the headwaters and ending at Luxapalila Creek. A diagram showing the model setup is shown in Figure 7. The locations of the confluence of point sources and significant tributaries are shown. Arrows represent the direction of flow in each segment. The numbers on the figure represent approximate river miles (RM). River miles are assigned to water bodies, beginning with zero at the mouth.

Figure 7. McCrary Creek Model Setup (Note: Not to Scale)



The water body was divided into reaches for modeling purposes. Reach divisions were made at locations where there is a significant change in hydrological and water quality characteristics, such as the confluence of a point source or tributary. Within each reach, the modeled segments were divided into computational elements of 0.1 mile. The simulated hydrological and water quality characteristics were calculated and output by the model for each computational element.

The STREAM model was setup to simulate flow and temperature conditions, which were determined to be the critical condition for this TMDL. MDEQ Regulations state that when the flow in a water body is less than 50 cfs, the temperature used in the model is 26°C. The headwater instream DO was assumed to be 85% of saturation at the stream temperature. The instream CBODu decay rate at K_d at 20°C was input as 0.3 day^{-1} (base e) as specified in MDEQ regulations. The model adjusts the K_d rate based on temperature, according to Equation 3.

$$\mathbf{K_{d(T)} = K_{d(20°C)}(1.047)^{T-20}} \qquad \textbf{(Eq. 3)}$$

Where K_d is the CBODu decay rate and T is the assumed instream temperature. The assumptions regarding the instream temperatures, background DO saturation, and CBODu decay rate are required by the *Empirical Stream Model Assumptions for Conventional Pollutants and Conventional Water Quality Models* (MDEQ, 1994). Also based on MDEQ Regulations, the rates for photosynthesis, respiration, and sediment oxygen demand were set to zero because data for these model parameters are not available.

McCrary Creek has no USGS flow gages. The flow in the McCrary Creek watershed was modeled at 7Q10 conditions based on data available from the USGS (Telis, 1991) with an estimated 7Q10 for the watershed of 0.69 cfs.

3.3 Source Representation

Both point and non-point sources were represented in the model. The loads from the NPDES permitted sources were added as direct inputs into the appropriate reaches as a flow in MGD and concentration of $CBOD_5$ and ammonia nitrogen in mg/l. Spatially distributed loads, which represent non-point sources of flow, $CBOD_5$, and ammonia nitrogen were distributed evenly into each computational element of the modeled water body.

Organic material discharged to a stream from an NPDES permitted point source is typically quantified as 5-day biochemical oxygen demand (BOD_5). BOD_5 is a measure of the oxidation of carbonaceous and nitrogenous material over a 5-day incubation period. However, oxidation of nitrogenous material, called nitrification, usually does not take place within the 5-day period because the bacteria that are responsible for nitrification are normally not present in large numbers and have slow reproduction rates (Metcalf and Eddy, 1991). Thus, BOD_5 is generally considered equal to $CBOD_5$. Because permits for point source facilities are written in terms of BOD_5 while TMDLs are typically developed using CBODu, a ratio between the two terms is needed, Equation 4.

$$\mathbf{CBODu = CBOD_5 * Ratio} \qquad \textbf{(Eq. 4)}$$

The CBODu to $CBOD_5$ ratios are given in *Empirical Stream Model Assumptions for*

Conventional Pollutants and Conventional Water Quality Models (MDEQ, 1994). These values are recommended for use by MDEQ regulations when actual field data are not available. The value of the ratio depends on the treatment type of wastewater. For secondary treatment systems (conventional and aerated lagoons) this ratio is 1.5.

In order to convert the ammonia nitrogen (NH_3-N) loads to an oxygen demand, a factor of 4.57 pounds of oxygen per pound of ammonia nitrogen (NH_3-N) oxidized to nitrate nitrogen (NO_3-N) was used. Using this factor is a conservative modeling assumption because it assumes that all of the ammonia is converted to nitrate through nitrification. The oxygen demand caused by nitrification of ammonia is equal to the NBODu load. The sum of CBODu and NBODu is equal to the point source load of TBODu. The maximum permitted loads of TBODu from the existing point source is given in Table 13.

Table 13. Point Sources, Maximum Permitted Loads

NPDES	Flow (MGD)	$CBOD_5$ (mg/l)	NH_3-N (mg/l)	$CBOD_u$: $CBOD_5$ Ratio	CBODu (lbs/day)	NH_3-N (lbs/day)	NBODu (lbs/day)	TBODu (lbs/day)
MS0049441	0.032	30	2	2.3	18.41	0.53	2.42	20.83
MS0053422	0.0005	30	2	2.3	0.29	0.01	0.05	0.34
MS0003140	0.032	20	3	1.5	8.01	0.80	3.66	11.67
MS0038954	0.032	30	2	1.5	12.01	0.53	2.42	14.43
MS0036609	0.0186	30	2	2.3	10.70	0.31	1.42	12.12
					49.42		**9.97**	**39.45**

Direct measurements of background concentrations of CBODu were not available for McCrary Creek. Because there were no data available, the background concentrations of CBODu and NH_3-N were estimated based on *Empirical Stream Model Assumptions for Conventional Pollutants and Conventional Water Quality Models* (MDEQ, 1994). According to these regulations, the background concentration used in modeling for BOD_5 is 1.33 mg/l and for NH_3-N is 0.1 mg/l. These concentrations were also used as estimates for the CBODu and NH_3-N levels of water entering the water bodies through non-point source flow and tributaries.

Non-point source flows were included in the model to account for water entering due to groundwater infiltration, overland flow, and small, unmeasured tributaries. These flows were estimated based on USGS data for the 7Q10 flow condition in the McCrary Creek watershed. The non-point source loads were assumed to be distributed evenly on a river mile basis throughout the modeled reaches as shown in Table 14.

Table 14. Non-Point Source Loads Input into the Model

	Flow (cfs)	$CBOD_5$ (mg/l)	CBODu (lbs/day)	NH_3-N (mg/l)	NBODu (lbs/day)	TBODu (lbs/day)
McCrary Background Load	0.01	1.33	0.108	0.1	0.025	0.133
McCrary RM 9.4 – RM 8.4	0.02	1.33	0.218	0.1	0.050	0.268
McCrary RM 8.4 – RM 6.9	0.03	1.33	0.336	0.1	0.077	0.413
McCrary RM 6.9 – RM 5.4	0.03	1.33	0.332	0.1	0.076	0.408
McCrary RM 5.4 – RM 4.6	0.02	1.33	0.190	0.1	0.043	0.233
McCrary RM 4.6 – RM 2.8	0.04	1.33	0.413	0.1	0.094	0.507
McCrary RM 2.8 – RM 1.7	0.02	1.33	0.248	0.1	0.057	0.305
McCrary RM 1.7 – RM 1.5	0.00	1.33	0.038	0.1	0.009	0.047
McCrary RM 1.5 – RM 0.0	0.03	1.33	0.337	0.1	0.077	0.414
Unnamed Trib A Background Load	0.01	1.33	0.108	0.1	0.025	0.133
Unnamed Trib A RM 2.3 – RM 2.1	0.00	1.33	0.032	0.1	0.007	0.039
Unnamed Trib A RM 2.1 – RM 0.0	0.04	1.33	0.480	0.1	0.110	0.590
Unnamed Trib B Background Load	0.01	1.33	0.108	0.1	0.025	0.133
Unnamed Trib B RM 1.2 – RM 0.6	0.01	1.33	0.155	0.1	0.035	0.190
Unnamed Trib B RM 0.6 – RM 0.0	0.01	1.33	0.124	0.1	0.028	0.152
Unnamed Trib C Background Load	0.01	1.33	0.108	0.1	0.025	0.133
Unnamed Trib C RM 1.1 – RM 0.0	0.02	1.33	0.257	0.1	0.059	0.316
Unnamed Trib D Background Load	0.01	1.33	0.108	0.1	0.025	0.133
Unnamed Trib D RM 1.6 – RM 0.0	0.03	1.33	0.359	0.1	0.082	0.441
Vernon Branch Background Load	0.01	1.33	0.108	0.1	0.025	0.133
Vernon Branch RM 5.9 – RM 5.7	0.00	1.33	0.041	0.1	0.009	0.050
Vernon Branch RM 5.7 – RM 5.0	0.02	1.33	0.164	0.1	0.037	0.201
Vernon Branch RM 5.0 – RM 4.3	0.02	1.33	0.162	0.1	0.037	0.199
Vernon Branch RM 4.3 – RM 2.4	0.04	1.33	0.415	0.1	0.095	0.510
Vernon Branch RM 2.4 – RM 0.5	0.04	1.33	0.448	0.1	0.102	0.550
Vernon Branch RM 0.5 – RM 0.0	0.01	1.33	0.103	0.1	0.024	0.127
			5.50		**1.26**	**6.76**

3.4 Model Calibration

The model used to develop the McCrary Creek TMDL was not calibrated due to lack of instream monitoring data collected during critical conditions. Future monitoring is essential to improve the accuracy of the model and the results.

3.5 Model Results

Once the model setup was complete, the model was used to predict water quality conditions in McCrary Creek. The model was first run under regulatory load conditions. Under regulatory load conditions, the load from the NPDES permitted point source was set at its current location and maximum permit limits, Table 13.

3.5.1 Regulatory Load Scenario

The regulatory load scenario model results are shown in Figure 8. Figure 8 shows the modeled daily average DO with the NPDES permit at its maximum allowable loads and with estimated non-point source loads. The figure shows the daily average instream DO concentrations, beginning with the headwaters at river mile 9.4 and ending at river mile 0.0 at the confluence with Luxapalila Creek. As shown in the figure, the model does not predict that the DO goes below the standard of 5.0 mg/l using the maximum allowable loads.

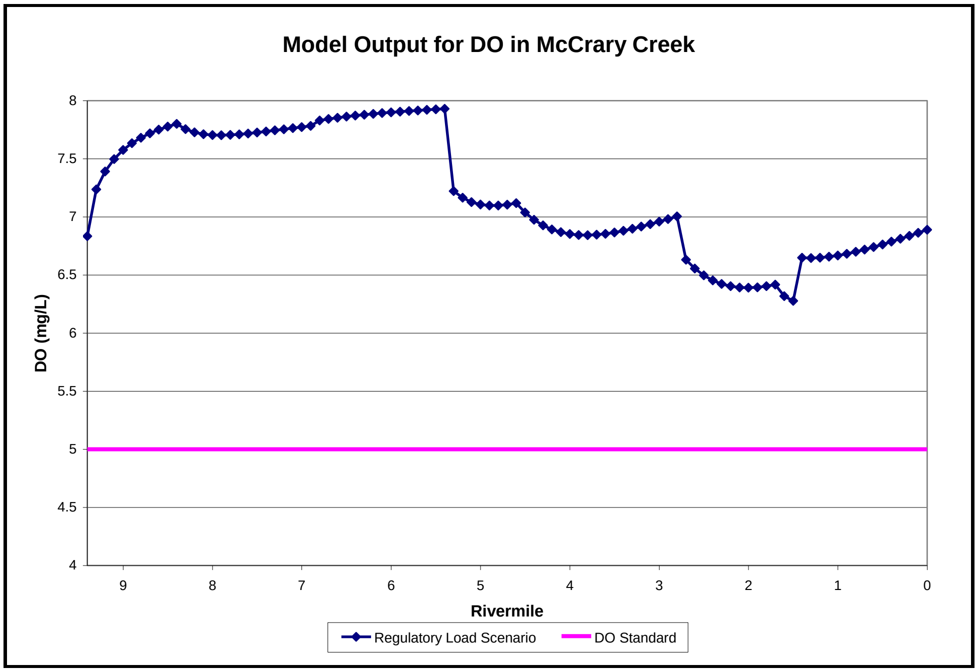


Figure 8. Model Output for DO in McCrary Creek, Regulatory Load Scenario

3.5.2 Maximum Load Scenario

The graph of the regulatory load scenario output shows that the predicted DO does not fall below the DO standard in McCrary Creek during critical conditions. Thus, reductions from the loads of TBODu are not necessary. Calculating the maximum allowable load of TBODu involved increasing the non-point source loads only and running the model using a trial-and-error process until the modeled DO was just above 5.0 mg/l. The non-point source loads were increased by a factor of 12.65 in this process. The increased loads were used to develop the allowable maximum daily load for this report. The model output for DO with the increased loads is shown in Figure 10.

Figure 10 shows the modeled instream DO concentrations in McCrary Creek after application of the selected maximum load scenario at critical conditions. The model results for the maximum load scenario show that the water body does have additional assimilative capacity.

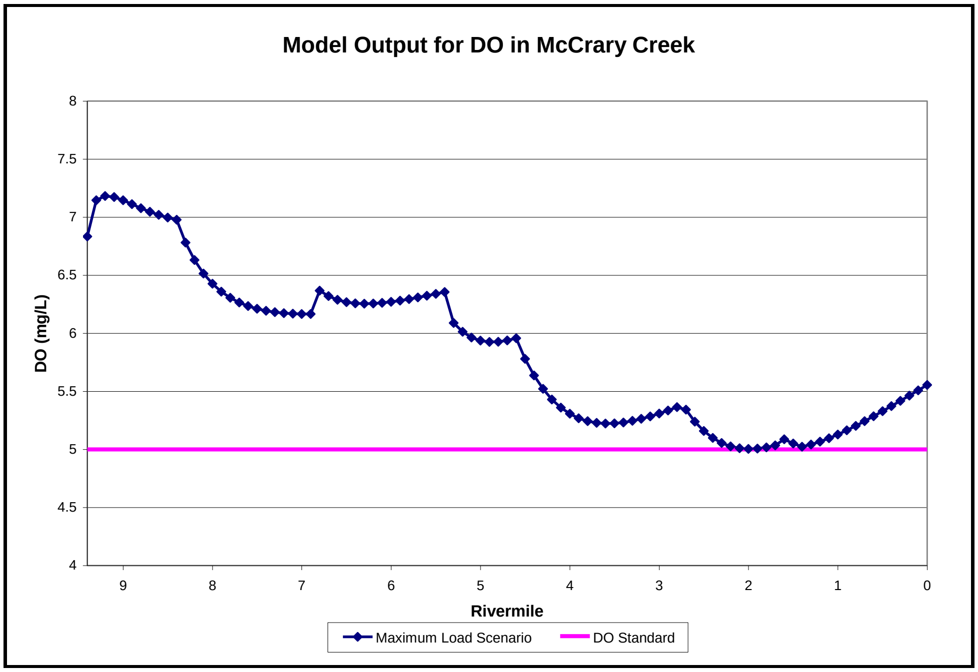


Figure 9. Model Output for McCrary Creek for DO, Maximum Load Scenario

3.6 Estimated Existing Load for Total Nitrogen

The estimated existing total nitrogen concentration is based on the median total nitrogen concentrations measured in wadeable streams in Ecoregion 65 with impaired biology and elevated nutrients, which is 1.38 mg/l. The average of the available McCrary Creek data for TN is 0.62 mg/l. However, due to the limited amount of data, the targeted reductions will be based on the estimated total nitrogen level for impaired streams in Ecoregion 65.

To convert the estimated existing total nitrogen concentration to a total nitrogen load, the average annual flow for McCrary Creek was estimated based on USGS monitoring station 02443500 on Luxapallila Creek near Columbus, Mississippi. The annual average flow for Luxapallila Creek near Columbus, Mississippi is 1121.5 cfs, with a drainage area of 715 square miles. To estimate the amount of flow in McCrary Creek, a drainage area ratio for the 02443500 gage watershed was calculated (1121.5 cfs / 715 square miles = 1.569 cfs/square mile). The ratio was then multiplied by the drainage area in square miles of the impaired segment. Thus, the annual average flow in McCrary Creek is estimated as 35.99 cfs. The existing TN load was then calculated, using Equation 5 and the results are shown in Table 15.

Nutrient Load (lb/day) = Flow (cfs) * 5.394 (conversion factor)* Nutrient Concentration (mg/L) (Eq. 5)

Table 15. Estimated Existing Total Nitrogen Load for McCrary Creek

Stream	Area (sq miles)	Average Annual Flow (cfs)	TN (mg/L)	TN (lbs/day)
McCrary Creek	22.94	35.99	1.38	267.9

Table 16. NPDES Permitted Facilities Treatment Types with Nitrogen Estimates

Facility Name	NPDES	Treatment Type	Permitted Discharge (MGD)	TN concentration estimate (mg/l)	TN Load estimate (lbs/day)
ABC and Me Preschool	MS0049441	Aerobic treatment unit	0.032	13.6	3.63
Mount Vernon Baptist Church	MS0053422	Package plant	0.0005	13.6	0.06
OMNOVA Solutions, Inc.	MS0003140	Sedimentation, oil skimming, and aeration	0.032	11.5	3.07
Wilco Properties Inc, Beersheba Hills Subdivision	MS0038954	Aerated lagoon	0.032	11.5	3.07
Wilco Properties Inc, Kerry Estates, New Hope Garden Apartments	MS0036609	Activated sludge plant	0.0186	13.6	2.11
		Total	**0.1151**		**11.94**

The TN point source load is estimated to be 11.94 lbs/day, Table 16. The annual average total load based on the estimated total nitrogen concentration of 1.38 mg/l and an annual average flow of 35.99 cfs is 267.9 lbs/day. The point source load is 4.5% of the total load. Therefore, 95.5% of the estimated existing TN load is from non-point sources.

3.7 Estimated Existing Load for Total Phosphorous

The estimated existing total phosphorous concentration is based on the median total phosphorous concentrations measured in wadeable streams in Ecoregion 65 with impaired biology and elevated nutrients, which is 0.18 mg/l. The average of the available McCrary Creek data for TP is 0.05 mg/l. However, due to limited amount of available data, the targeted reductions will be based on the estimated total phosphorous level for impaired streams in Ecoregion 65.

To convert the estimated existing total phosphorus concentration to a total phosphorus load, the average annual flow for McCrary Creek was estimated based on USGS monitoring station 02443500 on Luxapallila Creek near Columbus, Mississippi. As previously described, the annual average flow in McCrary Creek is estimated as 35.99 cfs. The existing TP load was then calculated, using Equation 5 and the results are shown in Table 17.

Table 17. Estimated Existing Total Phosphorous Load for McCrary Creek

Stream	Area (sq miles)	Average Annual Flow (cfs)	TP (mg/L)	TP (lbs/day)
McCrary Creek	22.94	35.99	0.18	34.9

Table 18. NPDES Permitted Facilities Treatment Types with Phosphorus Estimates

Facility Name	NPDES	Treatment Type	Permitted Discharge (MGD)	TP concentration estimate (mg/l)	TP Load estimate (lbs/day)
ABC and Me Preschool	MS0049441	Aerobic treatment unit	0.032	5.8	1.55
Mount Vernon Baptist Church	MS0053422	Package plant	0.0005	5.8	0.02
OMNOVA Solutions, Inc.	MS0003140	Sedimentation, oil skimming, and aeration	0.032	5.2	1.39
Wilco Properties Inc, Beersheba Hills Subdivision	MS0038954	Aerated lagoon	0.032	5.2	1.39
Wilco Properties Inc, Kerry Estates, New Hope Garden Apartments	MS0036609	Activated sludge plant	0.0186	5.8	0.90
		Total	**0.1151**		**5.25**

The TP point source load is estimated to be 5.25 lbs/day, Table 18. The annual average total load based on the estimated total phosphorus concentration of 0.18 mg/l and an annual average flow of 35.99 cfs is 34.9 lbs/day. The point source load is 15.0% of the total load. Therefore, 85.0% of the estimated existing TP load is from non-point sources.

ALLOCATION

The allocation for this TMDL involves a wasteload allocation and a load allocation for non-point sources necessary for attainment of water quality standards in McCrary Creek. The nutrient portion of this TMDL is addressed through initial estimates of the existing and target TN and TP concentrations.

4.1 Wasteload Allocation

There are currently five NPDES permits issued for the McCrary Creek watershed. Although this wasteload allocation is based on the current condition of McCrary Creek, it is not intended to prevent the issuance of permits for future facilities. This is because the model results show that McCrary Creek has additional assimilative capacity for organic material. Future permits will be considered in accordance with Mississippi's *Wastewater Regulations for National Pollutant Discharge Elimination System (NPDES) Permits, Underground Injection Control (UIC) Permits, State Permits, Water Quality Based Effluent Limitations and Water Quality Certification*.

The NPDES permitted facilities are included in the wasteload allocation, Table 19. Table 20 gives the estimated load of TN from the point sources which is 4.5% of the total existing load as described in Section 3.6. Table 20 also gives the estimated load of TP from the point sources which is 15.0% of the total existing load as described in Section 3.7. Because the nutrient estimates are based on literature values, this TMDL recommends quarterly nutrient monitoring for these facilities.

Table 19. Wasteload Allocation

Facility Name	CBODu (lbs/day)	NBODu (lbs/day)	TBODu (lbs/day)
ABC and Me Preschool	18.41	2.42	20.83
Mount Vernon Baptist Church	0.29	0.05	0.34
OMNOVA Solutions, Inc.	8.01	3.66	11.67
Wilco Properties Inc, Beersheba Hills Subdivision	12.01	2.42	14.43
Wilco Properties Inc, Kerry Estates, New Hope Garden Apartments	10.70	1.42	12.12
	49.42	**9.97**	**59.39**

Table 20. Nutrient Wasteload Allocation

Facility Name	Existing Estimated TN Point Source Load (lbs/day)	Allocated Average TN Point Source Load (lbs/day)	Existing Estimated TP Point Source Load (lbs/day)	Allocated Average TP Point Source Load (lbs/day)	Percent Reduction
ABC and Me Preschool	3.63	3.63	1.55	1.55	0
Mount Vernon Baptist Church	0.06	0.06	0.02	0.02	0
OMNOVA Solutions, Inc.	3.07	3.07	1.39	1.39	0
Wilco Properties Inc, Beersheba Hills Subdivision	3.07	3.07	1.39	1.39	0
Wilco Properties Inc, Kerry Estates, New Hope Garden Apartments	2.11	2.11	0.90	0.90	0
Total	**11.94**	**11.94**	**5.25**	**5.25**	**0**

4.2 Load Allocation

The headwater and spatially distributed loads are included in the load allocation. The TBODu concentrations of these loads were determined by using an assumed BOD_u concentration of 1.33 mg/l and an NH_3-N concentration of 0.1 mg/l. This TMDL does not require a reduction of the load allocation. In Table 21, the load allocation is shown as the non-point sources (the spatially distributed flow entering each reach in the model).

Table 21. Load Allocation, Maximum Scenario

	CBODu (lbs/day)	NBODu (lbs/day)	TBODu (lbs/day)
Background	0.54	0.13	0.67
Non-Point Source	61.49	14.04	75.53
	62.03	**14.17**	**76.20**

Based on initial estimates in Sections 3.6 and 3.7, most of the TN and TP loads in this watershed come from non-point sources. Therefore, best management practices (BMPs) should be encouraged in the watershed to reduce potential nutrient loads from non-point sources The watershed should be considered a priority for riparian buffer zone restoration and any nutrient reduction BMPs. For land disturbing activities related to silviculture, construction, and agriculture, it is recommended that practices, as outlined in "Mississippi's BMPs: Best Management Practices for Forestry in Mississippi" (MFC, 2000), "Planning and Design Manual for the Control of Erosion, Sediment, and Stormwater" (MDEQ, et. al, 1994), and "Field Office Technical Guide" (NRCS, 2000), be followed, respectively. Table 22 shows the load allocation for TN and TP.

Table 22. Load Allocation for Estimated TN and TP

Nutrient	Estimated Nutrient Nonpoint Source Load (lbs/day)	Allocated Nutrient Nonpoint Source Load (lbs/day)
TN	256.0	104.5 – 124.0
TP	29.7	6.4 – 14.2

4.3 Incorporation of a Margin of Safety

The margin of safety is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving water body. The two types of MOS development are to implicitly incorporate the MOS using conservative model assumptions or to explicitly specify a portion of the total TMDL as the MOS. The MOS for this TMDL is both implicit and explicit.

Conservative assumptions which place a higher demand of DO on the water body than may actually be present are considered part of the margin of safety. The assumption that all of the ammonia nitrogen present in the water body is oxidized to nitrate nitrogen, for example, is a conservative assumption. In addition, the TMDL is based on the critical condition of the water body represented by the low-flow, high-temperature condition. Modeling the water body at this flow provides protection during the worst-case scenario.

The explicit MOS for this report is the difference between the non-point loads calculated in the maximum load scenario and the regulatory load scenario non-point loads. The regulatory load scenario non-point source loads represent an approximation of the loads currently going into McCrary Creek at the critical conditions. The maximum non-point source loads are the maximum TBODu loads with a 12.65 increase that allow maintenance of water quality standards. MDEQ has set the explicit MOS as the difference in these loads. The calculated MOS is in Table 23.

Table 23. Calculation of Explicit MOS

	Maximum Non-Point Load	Regulatory Non-Point Load	Margin of Safety
CBODu (lbs/day)	62.03	5.50	56.53
NBODu (lbs/day)	14.17	1.26	12.91
TBODu (lbs/day)	**76.20**	**6.76**	**69.44**

4.4 Seasonality

Seasonal variation may be addressed in the TMDL by using seasonal water quality standards or developing model scenarios to reflect seasonal variations in temperature and other parameters. Mississippi's water quality standards for dissolved oxygen, however, do not vary according to the seasons. This model was set up to simulate dissolved oxygen during the critical condition period, the low-flow, high-temperature period that typically occurs during the summer season. Since the critical condition represents the worst-case scenario, the TMDL developed for critical conditions is protective of the water body at all times. Thus, this TMDL will ensure attainment of water quality standards for each season.

4.5 Calculation of the TMDL

The TMDL was calculated based on Equation 6.

TMDL = WLA + LA + MOS **(Eq. 6)**

The TMDL for TBODu was calculated based on the current loading of pollutant in McCrary Creek, according to the model. The TMDL calculations are shown in Tables 24 and 25. As shown in Table 23 TBODu is the sum of CBODu and NBODu. The wasteload allocations incorporate the CBODu contributions from identified NPDES Permitted facilities. The load allocations include the background and non-point sources of TBODu from surface runoff and groundwater infiltration. The implicit margin of safety for this TMDL is derived from the conservative assumptions used in setting up the model, while the explicit margin of safety is calculated based on the maximum loads scenario explained in Section 3.5.2.

Equation 5 was used to calculate the TMDL for TP and TN. The target concentration ranges, presented in Section 1.7, were used with the average flow for the watershed to determine the TMDLs. The TMDLs, given in Table 25, were then compared to the estimated existing load for the ecoregion, presented in Sections 3.6 and 3.7. The estimated existing TP concentration indicates needed reductions of 44% to 67%. The TMDL for TP is 11.6 – 19.4 lbs/day. The estimated existing total nitrogen concentration indicates needed reductions of 49% to 56%. The TMDL for TN is 116.5 – 135.9 lbs/day.

Table 24. TMDL for TBODu in the McCrary Creek Watershed

	WLA (lbs/day)	LA (lbs/day)	MOS (lbs/day)	TMDL (lbs/day)
CBODu	49.42	5.50	56.53	111.45
NBODu	9.97	1.26	12.91	24.14
TBODu	**59.39**	**6.76**	**69.44**	**135.59**

Table 25. TMDL for Nutrients in the McCrary Creek Watershed

	WLA (lbs/day)	LA (lbs/day)	MOS (lbs/day)	TMDL (lbs/day)
TN	**11.94**	**104.5 – 124.0**	**Implicit**	**116.5 – 135.9**
TP	**5.25**	**6.4 – 14.2**	**Implicit**	**11.6 – 19.4**

The TMDL presented in this report represents the current load of a pollutant allowed in the water body. Although it has been developed for critical conditions in the water body, the allowable load is not tied to any particular combination of point and non-point source loads. The LA given in the TMDL applies to all non-point sources, and does not assign loads to specific sources.

CONCLUSION

This TMDL is based on a desktop model using MDEQ's regulatory assumptions and literature values in place of actual field data. The model results indicate that McCrary Creek is meeting the water quality standard for dissolved oxygen at the present loading of TBODu. Thus, this TMDL does not limit the issuance of new permits in the watershed as long as new facilities do not cause impairment in McCrary Creek. Nutrients were addressed through an estimate of a preliminary total phosphorous concentration target range and a preliminary total nitrogen concentration target range. Based on the estimated existing and target total phosphorous concentrations, this TMDL recommends a 44% - 67% reduction of the phosphorous loads entering these streams to meet the preliminary target range of 0.06 to 0.10 mg/l. Based on the estimated existing and target total nitrogen concentrations, this TMDL recommends a 49% - 56% reduction of the nitrogen loads entering these streams to meet the preliminary target range of 0.6 to 0.7 mg/l. Because only 15.0% of the existing TN load and 4.5% of the TP load are estimated to be due to point sources, this TMDL does not recommend percent reductions from the NPDES permits. It is also recommended that the McCrary Creek Watershed be considered as a priority watershed for riparian buffer zone restoration and any nutrient reduction BMPs. The implementation of these BMP activities should reduce the nutrient load entering the creeks. This will provide improved water quality for the support of aquatic life in the water bodies and will result in the attainment of the applicable water quality standards.

5.1 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 TMDLs 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. Anyone wishing to become a member of the TMDL mailing list should contact Kay Whittington at Kay_Whittington@deq.state.ms.us.

All comments should be directed to Kay Whittington at Kay_Whittington@deq.state.ms.us or Kay Whittington, MDEQ, PO Box 10385, Jackson, MS 39289. All comments received during the public notice period and at any public hearings become a part of the record of this TMDL and will be considered in the submission of this TMDL to EPA Region 4 for final approval.

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