Final REPORT
August 2013

Organic Enrichment / Low DO TMDL for Wild Bill Bayou Watershed

Yazoo River Basin
Sunflower County, Mississippi

Prepared By

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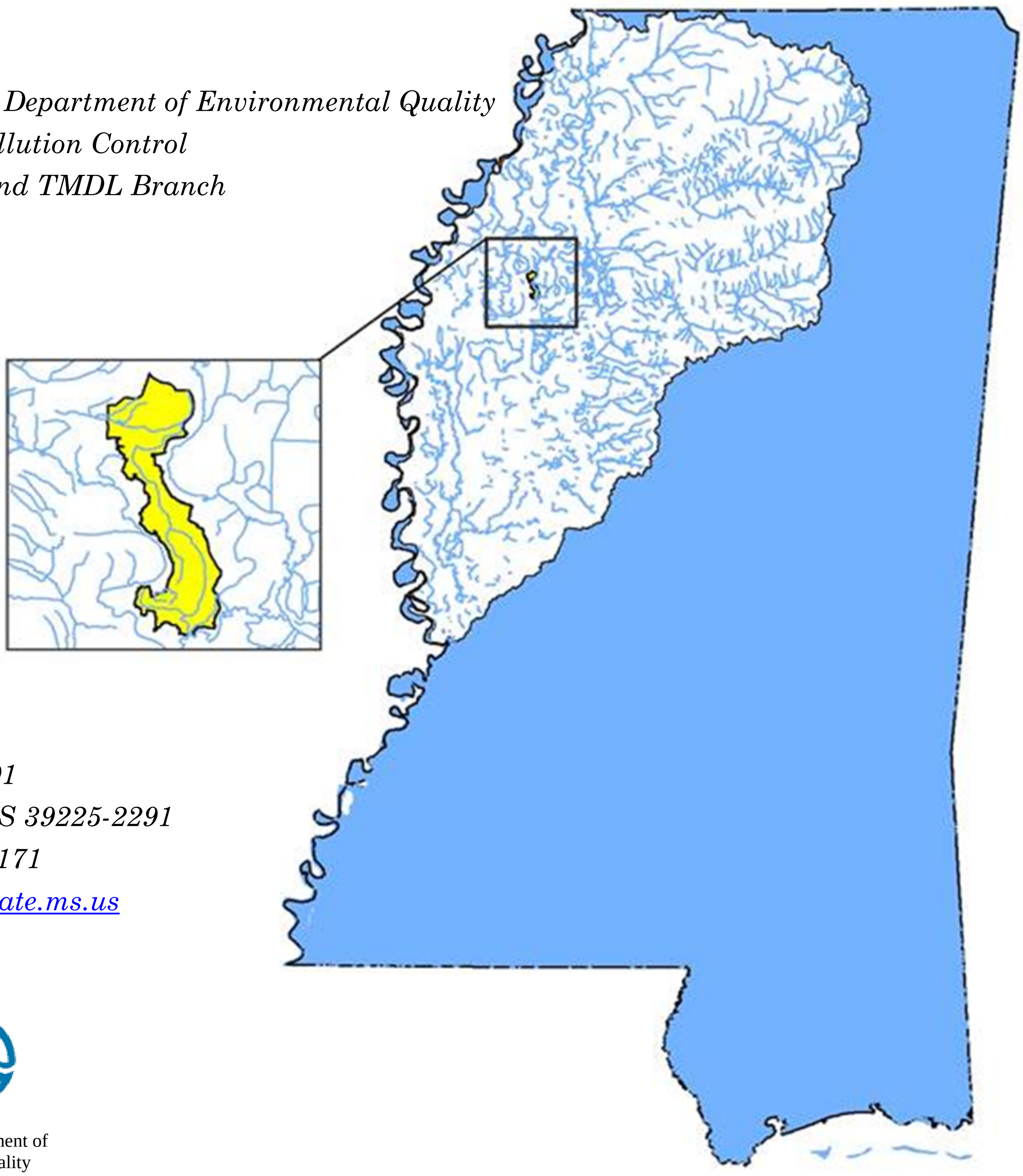
Office of Pollution Control
Modeling and TMDL Branch



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FOREWORD

This report contains a Total Maximum Daily Loads (TMDL) for a water body segment found on Mississippi's 2012 Section 303(d) List of Impaired Water Bodies. The implementation of the TMDLs contained herein will be prioritized within Mississippi's rotating basin approach.

As additional information becomes available, the TMDL may be updated. Such additional information may include water quality and quantity data, changes in pollutant loadings, modifications to the water quality standards or criteria, or changes in landuse within the watershed. In some cases, additional water quality data may indicate that no impairment exists.

Table 1 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

Table 2 Fraction Prefixes

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

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EXECUTIVE SUMMARY

Wild Bill Bayou is a Mississippi Delta stream located east of Drew, Mississippi in Sunflower County, Figure 1. The length of the water body is approximately 11.5 miles from the headwaters to the Quiver River. There are no NPDES permitted point sources or MS4s in the watershed. The landuse of the watershed is predominantly (84.8%) agriculture.

Table 3 Listing Information

Name	ID	County	Impaired Use	Impairment
Wild Bill Bayou	951411	Sunflower	Fish and Wildlife	Organic Enrichment / Low Dissolved Oxygen

MDEQ collected water quality monitoring data in 2007 and 2008 which indicate impairment of the dissolved oxygen water quality standard. This TMDL will provide an allocation for Total Biochemical Oxygen Demand ultimate (TBODu) for the watershed to meet the current water quality standard. According to the data, the TBODu load in the water body exceeds the assimilative capacity of Wild Bill Bayou for organic material at critical conditions. Therefore, either reductions in TBODu are required, or the designated use classification of the stream could be modified.

Table 4 Water Quality Standards

Parameter	Beneficial use	Water Quality Criteria
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

MDEQ will model this water body with the STREAM model to determine the reductions needed for this Delta stream to meet the water quality standards. MDEQ will also consider modification of the designated use classification of this and similar Delta streams based in part on this analysis.

Changes to water quality standards would require Commission Action, public review, and EPA approval. This document will inform that process should MDEQ proceed toward water quality standards modification.

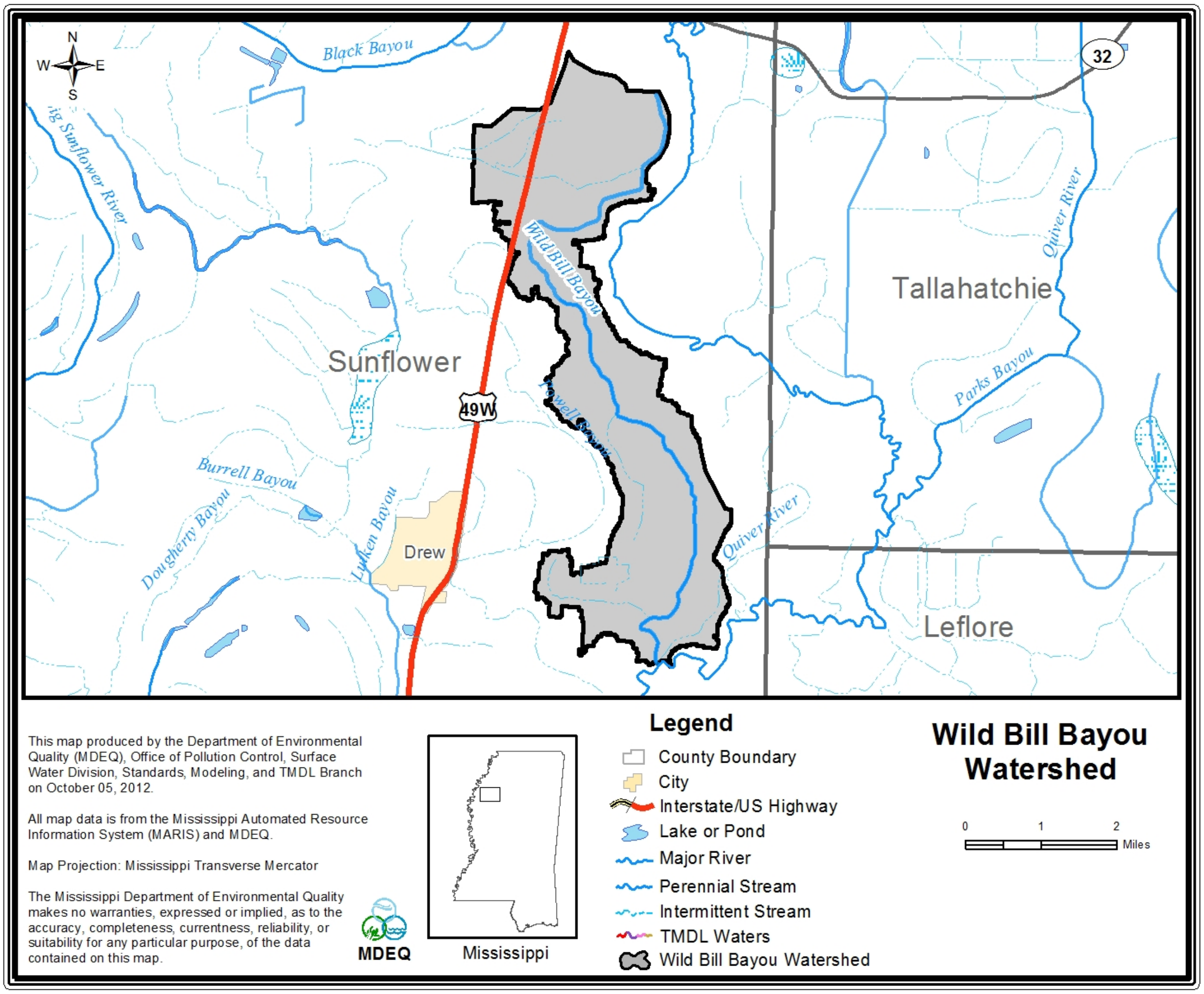

Figure 1 Wild Bill Bayou Watershed

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 identify impairment and restoration alternatives, and maintain the quality of those impaired water bodies through the establishment of pollutant specific allowable loads. This TMDL is for the 2012 §303(d) listed segment shown in Figure 2. The impaired segment of the stream is shown in green.

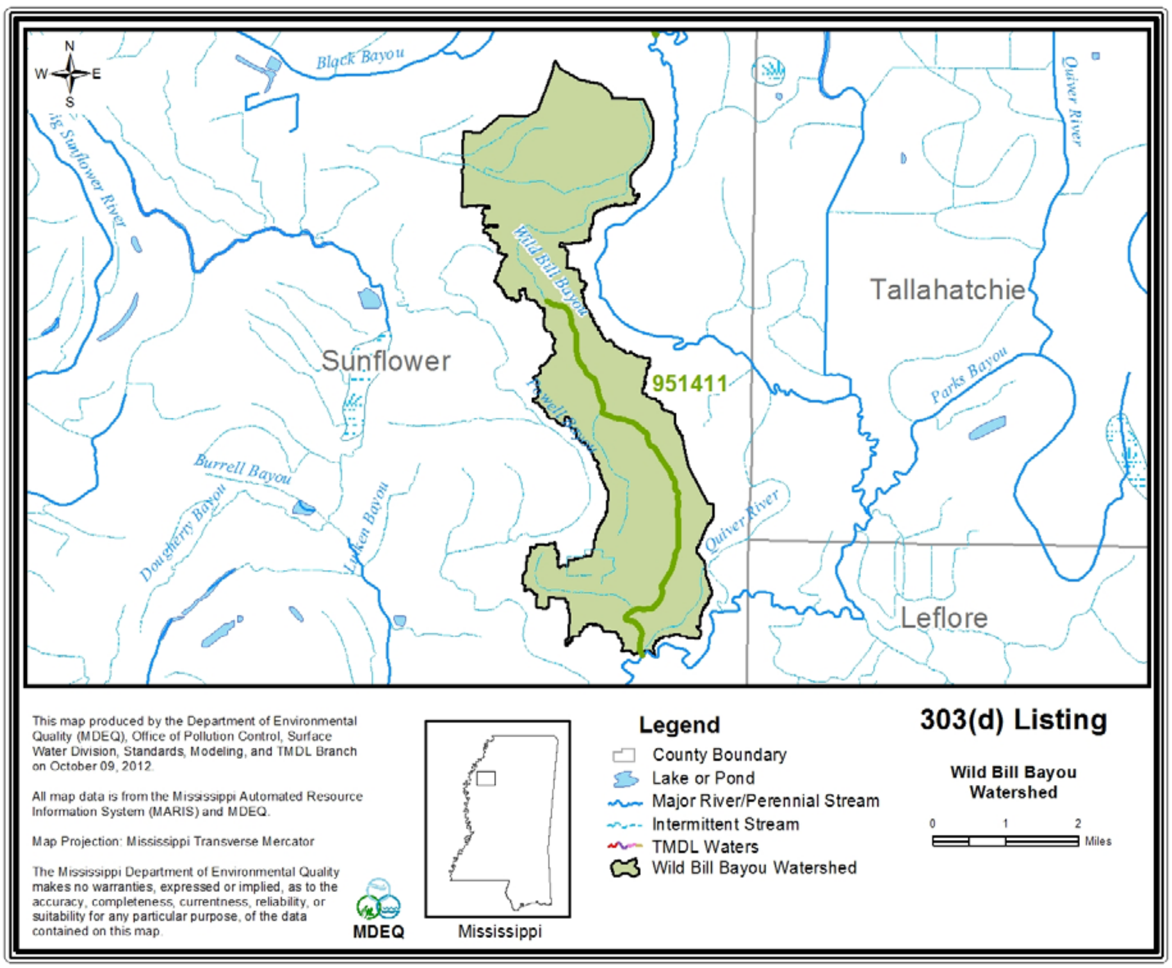

Figure 2 Wild Bill Bayou Impaired Segment

1.2 Listing History

The impaired segment was first listed on the 2010 Section 303(d) List of Impaired Water Bodies. The organic enrichment / low dissolved oxygen impairment was assessed based on diel DO data collected during a water quality study on Wild Bill Bayou in 2007. There are also 4 quarterly grab samples from the 2008 Nutrient Monitoring Study available for this study.

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 WPC-2* (MDEQ, 2012). The designated beneficial use for the listed segment 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 WPC-2* (MDEQ, 2012).

The applicable standard specifies:

> *"Dissolved Oxygen: Dissolved oxygen 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. When possible, samples should be taken from ambient sites according to the following guidelines:*
> *For water bodies that are not stratified, samples should be taken: At mid-depth if the total water column depth is 10 feet or less. At 5 feet from the water surface if the total water column depth is greater than 10 feet.*
>
> *For water bodies that are stratified, samples should be taken: At mid-depth of the epilimnion if the epilimnion depth is 10 feet or less; At 5 feet from the water surface if the epilimnion depth is greater than 10 feet."*[1]

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1 (Mississippi Department of Environmental Quality, June 28, 2012), page 8.

This TMDL will investigate the natural condition clause within WPC-2 to consider the site specific modification of the designated use for this stream. It may be feasible to modify the water quality standards for dissolved oxygen based on the natural dissolved oxygen levels found in this stream. The natural conditions statement says:

> "Natural conditions are defined as background water quality conditions due only to non-anthropogenic sources. The criteria herein apply specifically with regard to substances attributed to sources (discharges, nonpoint sources, or instream activities) as opposed to natural phenomena. Waters may naturally have characteristics outside the limits established by these criteria. Therefore, naturally occurring conditions that fail to meet criteria should not be interpreted as violations of these criteria."[2]

Figure 3 Wild Bill Bayou

2 Ibid. page 3

WATER BODY ASSESSMENT

2.1 Wild Bill Bayou Water Quality Data

Water quality data for Wild Bill Bayou were gathered in 2007 and 2008. This water body was not supporting the use of aquatic life support and indicates violations of the dissolved oxygen (DO) standard. This conclusion was based on data collected at station A1330007 Delta Nutrient Project 2007 (Brooks Road near Drew). The data are shown in Tables 5, 6, and 7, and Figure 3. Figure 4 shows the location of the monitoring station.

Table 5 Water Quality Data

Date	Time	Temp (°C)	Sp Cond (uS/cm)	DO (%sat)	DO (mg/L)
9/11/2007	13:30:40	26.6	337	100.3	8.05
9/11/2007	14:00:40	26.76	339	111.6	8.92
9/11/2007	14:30:40	26.74	341	112.2	8.97
9/11/2007	15:00:40	26.73	343	114.8	9.19
9/11/2007	15:30:40	26.76	345	117.6	9.41
9/11/2007	16:00:40	26.73	347	120.9	9.67
9/11/2007	16:30:40	26.7	350	118.5	9.48
9/11/2007	17:00:40	26.65	352	113.6	9.1
9/11/2007	17:30:40	26.59	354	115.7	9.28
9/11/2007	18:00:40	26.53	357	114	9.15
9/11/2007	18:30:40	26.43	359	109.5	8.81
9/11/2007	19:00:40	26.34	362	104	8.38
9/11/2007	19:30:40	26.22	364	98.6	7.96
9/11/2007	20:00:40	26.11	366	93.3	7.55
9/11/2007	20:30:40	26.01	368	88.5	7.17
9/11/2007	21:00:40	25.87	370	84.1	6.83
9/11/2007	21:30:40	25.73	372	79.9	6.51
9/11/2007	22:00:40	25.58	374	76.1	6.22
9/11/2007	22:30:40	25.43	376	72.6	5.95
9/11/2007	23:00:40	25.28	378	69	5.67
9/11/2007	23:30:40	25.13	379	65.4	5.39

9/12/2007	0:00:40	24.99	381	62.2	5.14
9/12/2007	0:30:40	24.86	382	58.9	4.88
9/12/2007	1:00:40	24.72	383	56.1	4.65
9/12/2007	1:30:40	24.58	384	53.6	4.46
9/12/2007	2:00:40	24.45	385	51.4	4.29
9/12/2007	2:30:40	24.31	386	49.3	4.12
9/12/2007	3:00:40	24.18	387	47.4	3.98
9/12/2007	3:30:40	24.05	387	45.7	3.84
9/12/2007	4:00:40	23.92	388	44.2	3.73
9/12/2007	4:30:40	23.78	390	42.9	3.62
9/12/2007	5:00:40	23.66	390	41.6	3.52
9/12/2007	5:30:40	23.52	391	40.5	3.43
9/12/2007	6:00:40	23.4	391	39	3.32
9/12/2007	6:30:40	23.28	391	37.5	3.2
9/12/2007	7:00:40	23.16	391	36.9	3.16
9/12/2007	7:30:40	23.08	391	38.6	3.31
9/12/2007	8:00:40	23.03	391	42.6	3.65
9/12/2007	8:30:40	22.99	390	45.5	3.9
9/12/2007	9:00:40	23.02	389	49.7	4.26
9/12/2007	9:30:40	23.15	389	58.6	5.01
9/12/2007	10:00:40	23.37	388	70.4	5.99
9/12/2007	10:30:40	23.72	387	85.5	7.23
9/12/2007	11:00:40	24.09	385	101.2	8.5
9/12/2007	11:30:40	24.55	383	116.9	9.73
9/12/2007	12:00:40	25.05	381	132	10.89
9/12/2007	12:30:40	25.54	379	145.1	11.86
9/12/2007	13:00:40	26.03	376	155	12.56
9/12/2007	13:30:40	26.49	373	162.4	13.05
9/12/2007	14:00:40	26.93	369	167.7	13.37
9/12/2007	14:30:40	27.29	367	172.5	13.67
9/12/2007	15:00:40	27.54	364	182.2	14.37
9/12/2007	15:30:40	27.69	364	178.6	14.05
9/12/2007	16:00:40	27.64	362	179.3	14.12
9/12/2007	16:30:40	27.44	359	174.4	13.78

9/12/2007	17:00:40	27.17	358	166.1	13.19
9/12/2007	17:30:40	26.89	357	158.7	12.66
9/12/2007	18:00:40	26.64	356	151.5	12.14
9/12/2007	18:30:40	26.45	353	145.2	11.67
9/12/2007	19:00:40	26.3	351	139.6	11.25
9/12/2007	19:30:40	26.18	350	133.3	10.77
9/12/2007	20:00:40	26.05	351	126.6	10.25
9/12/2007	20:30:40	25.88	359	118.1	9.59
9/12/2007	21:00:40	25.66	375	109.2	8.9
9/12/2007	21:30:40	25.38	396	99	8.12
9/12/2007	22:00:40	25.07	415	88.2	7.27
9/12/2007	22:30:40	24.77	431	77.3	6.4
9/12/2007	23:00:40	24.49	441	67.4	5.62
9/12/2007	23:30:40	24.24	448	59.2	4.96

Table 6 Quarterly Chemical Data 2008

Date	Depth Feet	TOC Mg/L	COD Mg/L	Chlorophyll A Ug/L	Conductivity Umhos/Cm@25c	DO % Sat	DO Mg/L	pH S.U.	Temp °C
09/11/2007 13:30	0.8	7	26	1.4	336	175.9	14.07	7.89	26.51
03/26/2008 15:00	1	10	27	1.5	188	150.2	12.96		22.97
07/08/2008 20:30	2	9	< 10	8	403	63.3	4.63	7.25	30.94
09/24/2008 09:20	0.5	7	17	2.7	226	86.9	7.81	7.77	21.58

Table 7 Nutrient Data 2008

Date	TN, Ammonia Mg/L	Nitrite-Nitrate Mg/L	TKN Mg/L	TP Mg/L	Ortho Mg/L
09/11/2007 13:30	< MDL (0.04)	0.07	0.9	0.17	0.148
03/26/2008 15:00	< MDL (0.04)	0.07	1.32	0.08	0.049
07/08/2008 20:30	0.39	0.43	1.81	0.17	
09/24/2008 09:20	< MDL (0.04)	< MDL (0.02)	0.72	0.12	0.038

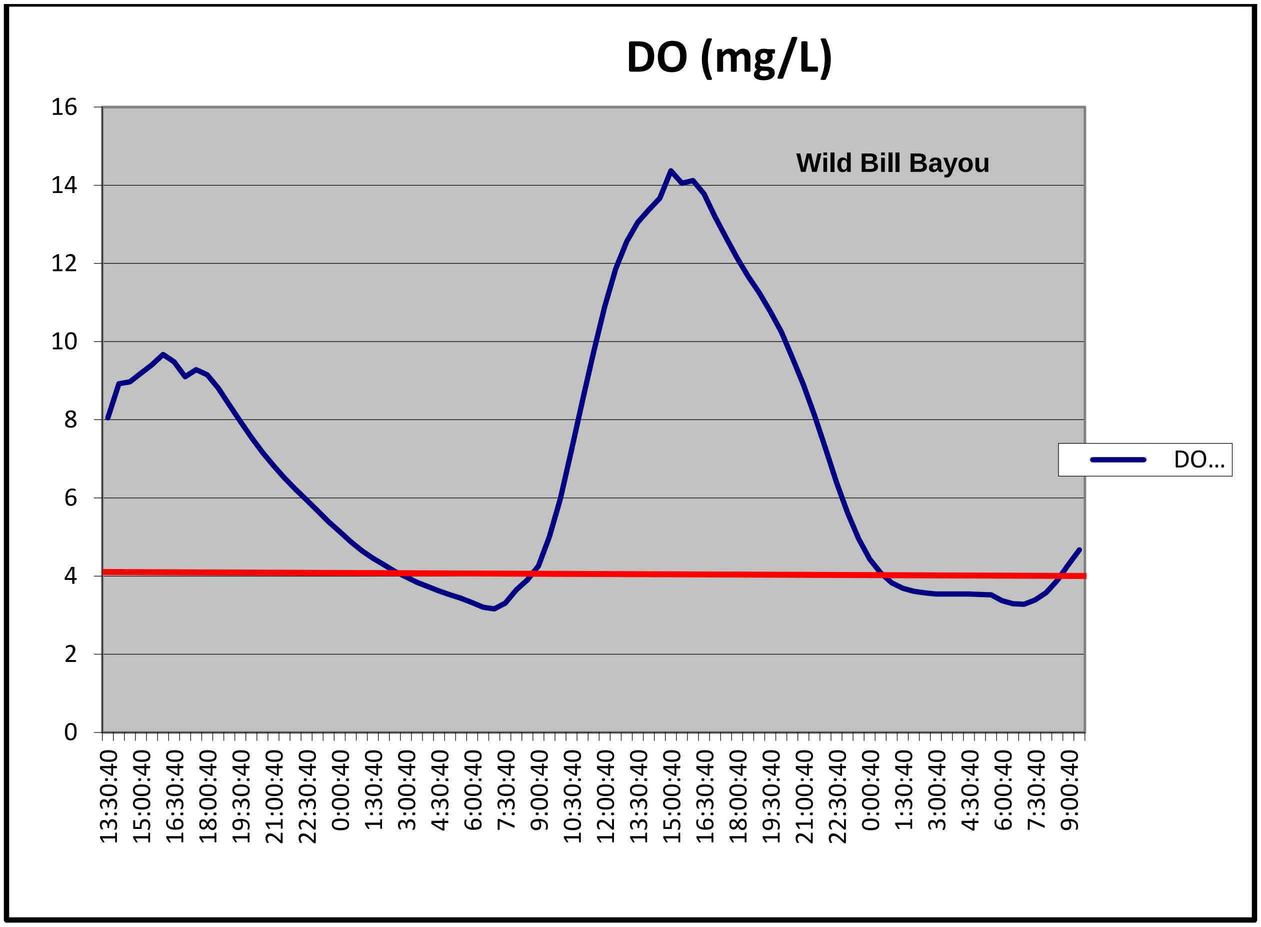

Figure 4 Diel DO Data

2.2 Assessment of Data

The diel DO data show the water body went below the 4.0 mg/l water quality standard for minimum DO in the stream in the early morning. In combination with the very high DO levels during the afternoon indicates eutrophication of this water body. The data suggest photosynthesis produced very high DO saturation in the afternoon, and during the night, respiration exerted a load sufficient to fall below the minimum DO standard.

The nutrient data measured in 2008 are within the targets established for this ecoregion by MDEQ for the Yazoo Delta nutrient TMDLs established in 2009. The nitrogen levels were higher in the summer than in the other seasons.

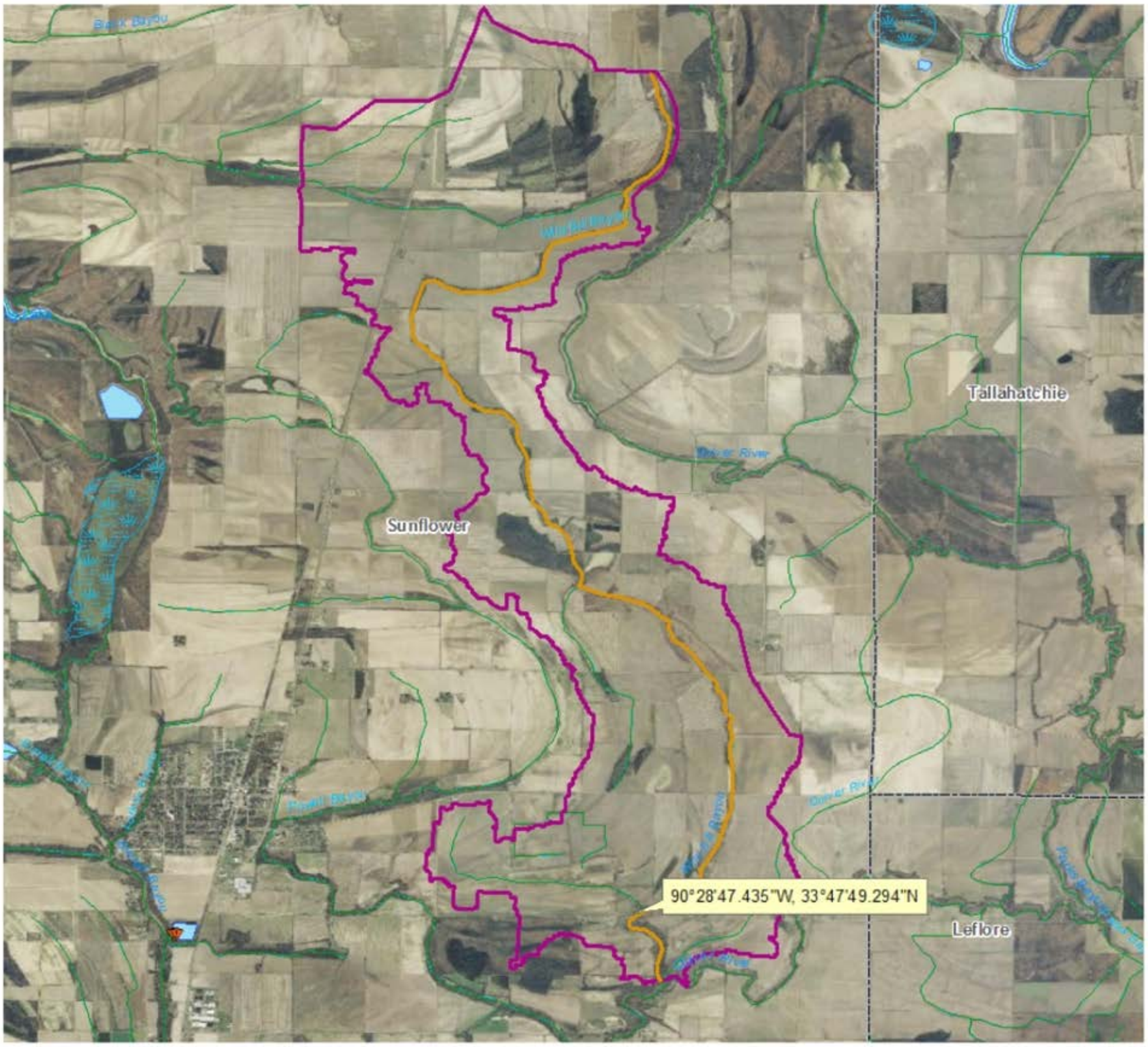

Figure 5 Satellite Image Showing Sample Sation

2.3 Assessment of Point Sources

An important part of the TMDL analysis is the identification of individual sources, source categories, or source subcategories in the watershed and the amount of pollutant loading contributed by each of these sources. Under the CWA, sources are broadly classified as either point or nonpoint sources. Under 40 CFR §122.2, a point source is defined as a discernible, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters.

The National Pollutant Discharge Elimination System (NPDES) program regulates point source discharges. Point sources can be described by two broad categories: 1) NPDES regulated municipal, commercial, and industrial wastewater treatment plants (WWTPs) and 2) NPDES regulated activities, which include construction activities and municipal storm water discharges (Municipal Separate Storm Sewer Systems [MS4s]).

The Wild Bill Bayou Watershed has no NPDES permitted point sources. There are no MS4s in this area. Therefore the WLA will be set to zero for this TMDL. This WLA may be revised based on new information in the future.

2.3 Assessment of Nonpoint Sources

Nonpoint loading of 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 Wild Bill Bayou watershed landuse is primarily agricultural. The land use information for the watershed is based on the 2006 National Land Cover Database (NLCD). The landuse distribution for the Wild Bill Bayou Watershed is shown in Table 8 and Figure 6.

Table 8 Landuse Distribution

Area	Water	Urban	Forest	Pasture	Cropland	Wetland	Total
Acres	36.25	496.83	4.23	128.54	6395.41	642.5	7,703.76
Percentage	0.5	6.4	0.1	1.7	83.0	8.3	100.0

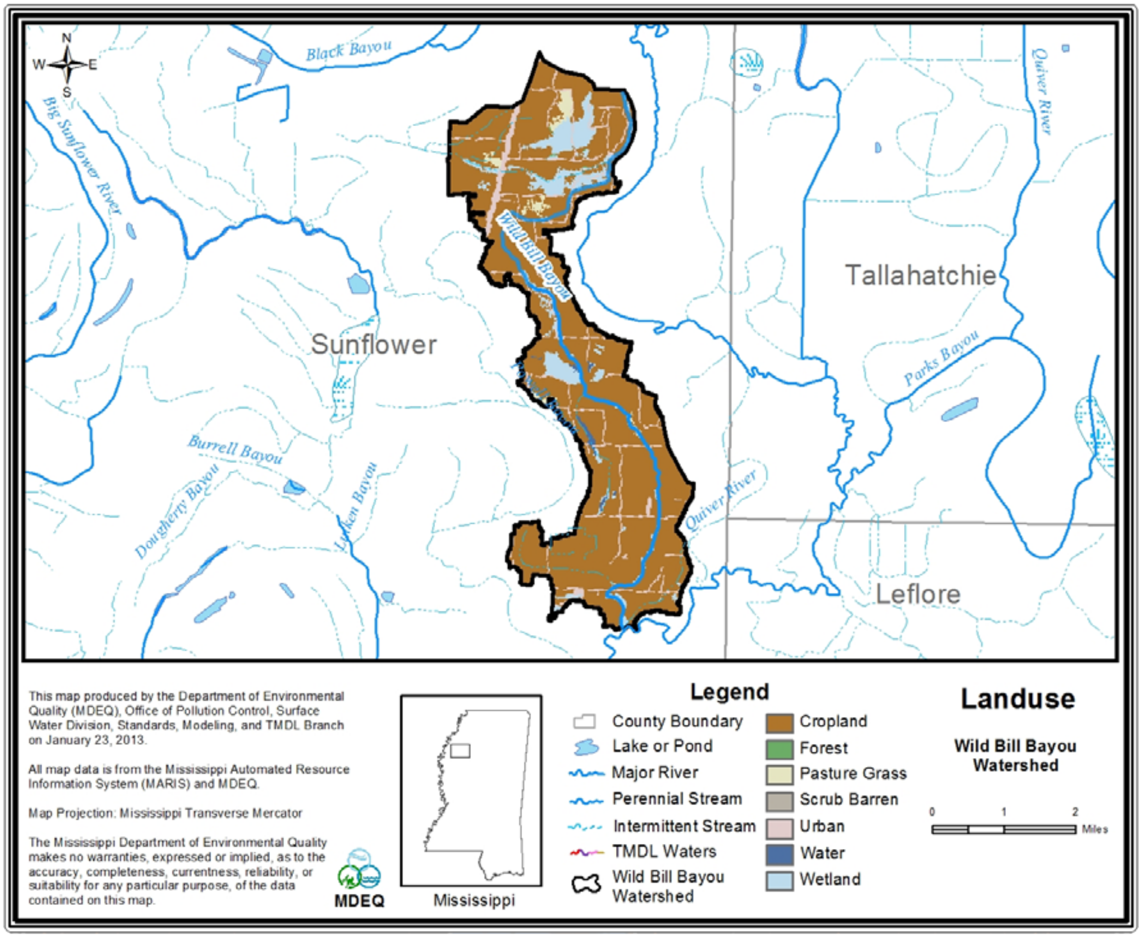

Figure 6 Landuse in Wild Bill Bayou Watershed

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

MDEQ's steady state water quality model, STeady Riverine Environmental Assessment Model (STREAM), for DO distribution in freshwater streams was used for developing the TMDL. The use of STREAM 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 WPC-1* (MDEQ, 2010). This model is approved by EPA and 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 nonpoint source loadings.

3.2 Model Setup

The STREAM model for this TMDL was created with 5 stream segments based on the NHDplus stream coverage. A diagram showing the model setup is shown in Figure 8. The model segments are identified by the river mile at the head of the segment. Table 9 STREAM Model Variables below provides the model inputs used.

Segment divisions were made at locations where there is a change in hydrological and water quality characteristics, such as the confluence of a point source or tributary or change in slope. 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.

3.2.1 Base Equations

STREAM is a steady-state, daily average computer model that solves the partial differential modified Streeter-Phelps DO sag equation. Instream processes simulated by the model include CBODu decay, nitrification (NBODu load expresses as oxygen), reaeration, sediment oxygen demand, and respiration and photosynthesis of algae. Figure 7 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.

3.2.2 Reaeration

The model calculates 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 1.

$$K_a = C*S*U \quad \textbf{(Eq. 1)}$$

C is the escape coefficient, U is the reach velocity in mile/day, and S is the average reach slope in feet per mile. The value of the Tsivoglou escape coefficient is assumed to be 0.11 for streams with flows less than 10 cfs and 0.0597 for stream flows equal to or greater than 10 cfs.

Reach velocities were calculated using an empirical equation based on stream slope and flow. The slope of each reach was measured with 2010 LIDAR coverage and input into the model in units of feet per mile.

3.2.3 Temperature and Flow

The STREAM model simulates the critical 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. However, to match the measured data, 30.94 °C was used. 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 2.

$$K_{d(T)} = K_{d(20^{\circ}C)}(1.047)^{T-20} \qquad \textbf{(Eq. 2)}$$

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 *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 WPC-1* (MDEQ, 2010). 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.

There are no USGS gages located on Wild Bill Bayou. The flow for the model was taken from average flow estimates for incremental flow in the NHDplus database.

3.2.4 Organic Enrichment Loading

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 $CBOD_5$ while TMDLs are typically developed using CBODu, a ratio between the two terms is needed, Equation 3.

$$\mathbf{CBODu = CBOD_5 * f\ Ratio} \qquad \textbf{(Eq.3)}$$

The CBODu to $CBOD_5$ ratios are given in *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 WPC-1* (MDEQ, 2010). These values are recommended for use by MDEQ regulations when actual field data are not available. The value of the ratio depends on the wastewater treatment type. The f ratios were not used in this model.

Organic enrichment sources were represented in the model by adding CBODu and NBODu loads. The spatially distributed loads were distributed evenly into each computational element of the modeled water body. The dissolved oxygen level was initiated at 6.0 mg/l but was lowered to match the 4.63 measured in the stream for the spatially distributed loads.

Direct measurements of background concentrations of CBODu were not available for the Wild Bill Bayou Watershed. Because there were no background data available, the background concentrations of CBODu and NH_3-N were estimated based on the measured data.

3.2.5 Nitrogen Loading

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 load of TBODu. The loads of TBODu from the calibrated STREAM model are given in Table 10 Calibrated Model Loads .

$$\mathbf{TBODu = CBODu + NBODu} \qquad \textbf{(Eq. 4)}$$

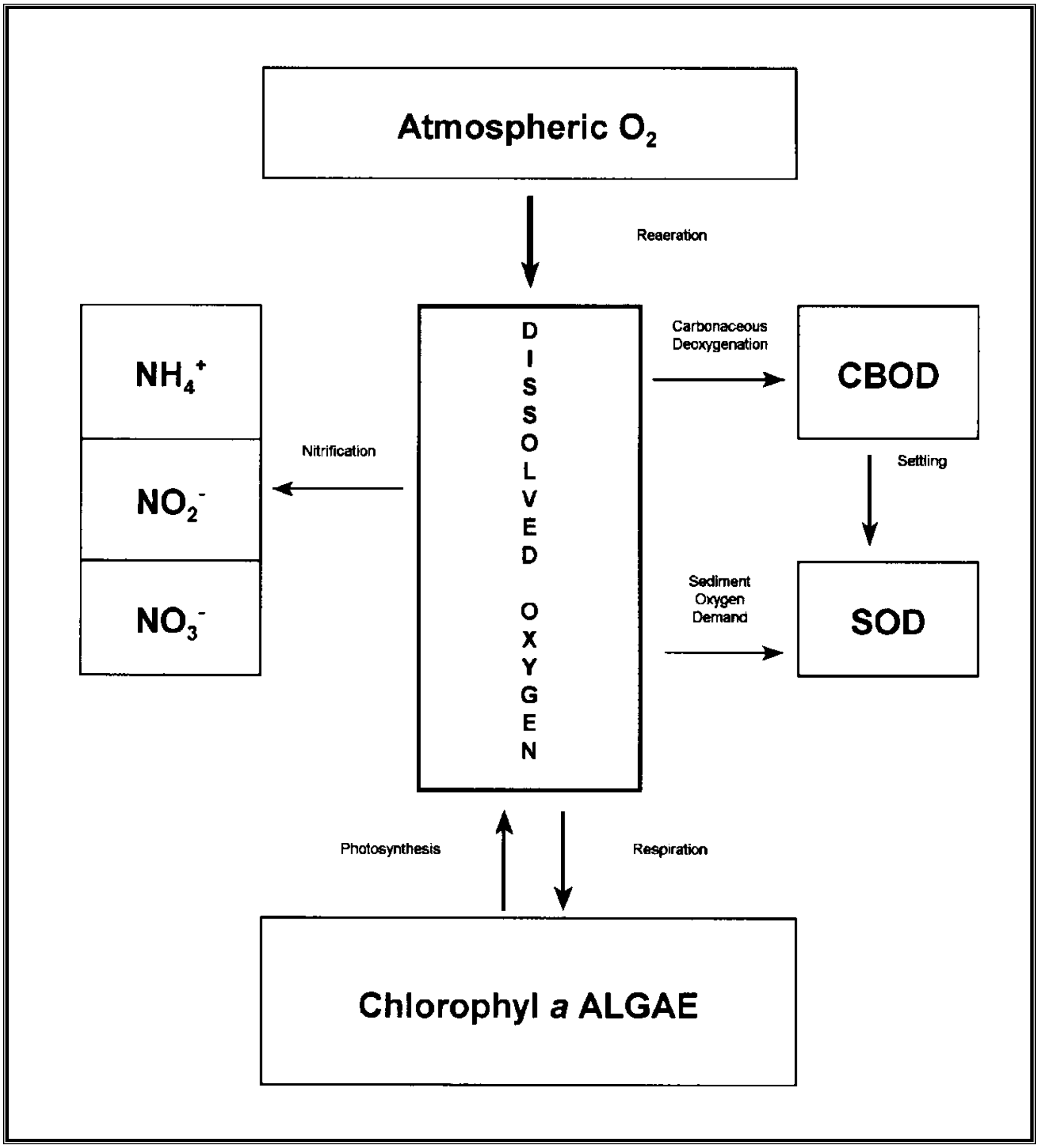

Figure 7 Instream Processes in a Typical DO Model

3.2.6 STREAM Model Identification

There are two STREAM models in this study. The first is the calibrated model. The calibrated model setup was based on the critical condition measured on 7/8/2008. See Table 6 Quarterly Chemical Data 2008. The measured dissolved oxygen value of 4.6 was matched with the data output of the model at river mile 0.8 where the monitoring station is located.

The second model takes the conditions established in the calibrated model and adjusts the loads to meet the water quality standard. This second model is the reduced model. The loads used are displayed in
Figure 9 Model **Output**.

Table 9 STREAM Model Variables

River Mile	Temp °C	Slope Ft/mile	Kr Day^{-1}	Kd Day^{-1}	Kn Day^{-1}	Escape Coeff	Velocity fps
11.5	30.94	1.02	0.3	0.3	0.3	0.11	0.1
9.4	30.94	0.68	0.3	0.3	0.3	0.11	0.1
6.3	30.94	2.33	0.3	0.3	0.3	0.11	0.1
4.4	30.94	1.93	0.3	0.3	0.3	0.11	0.1
0.8	30.94	11.29	0.3	0.3	0.3	0.11	0.1

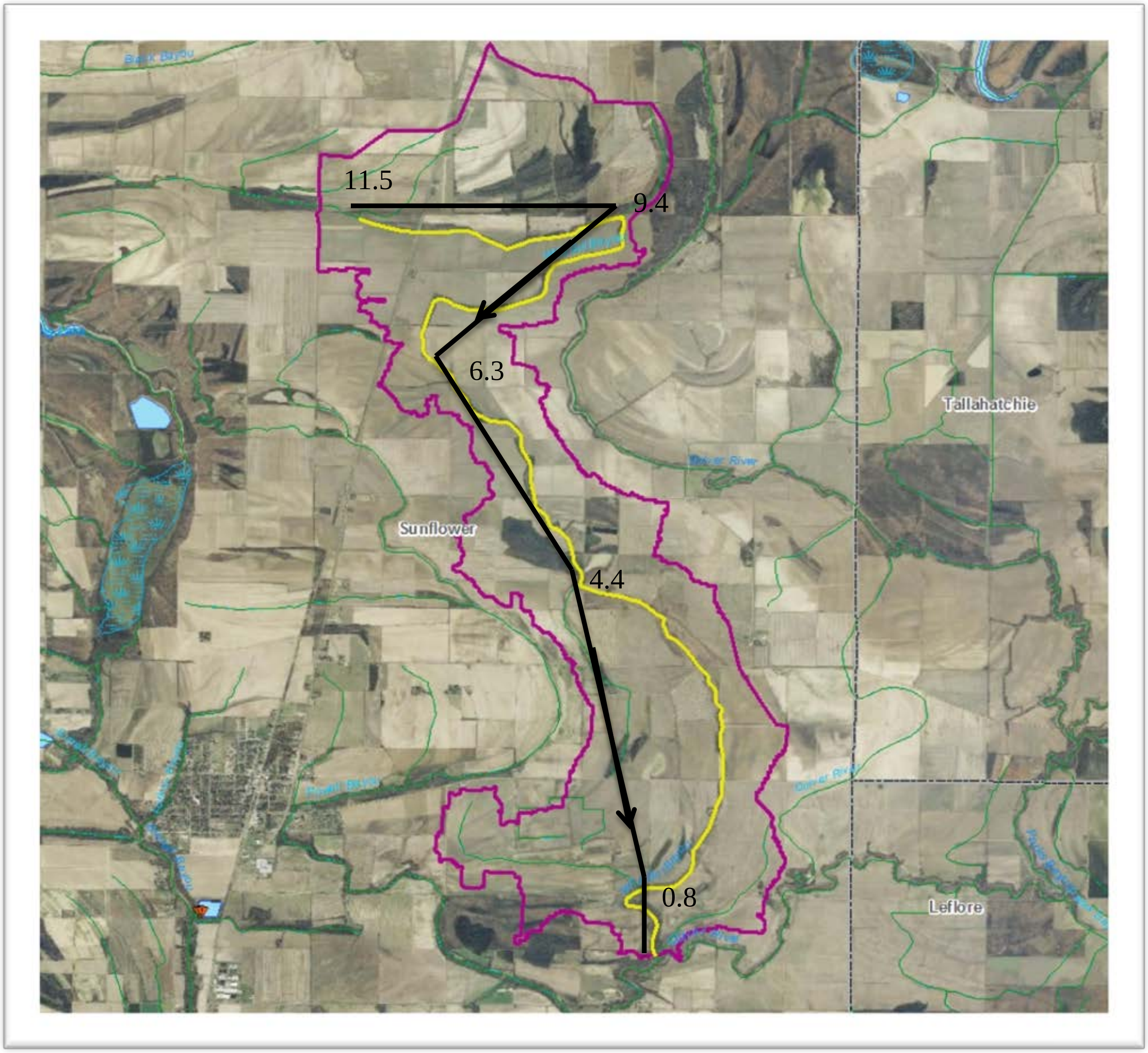

Figure 8 Model Segment with River Mile shown

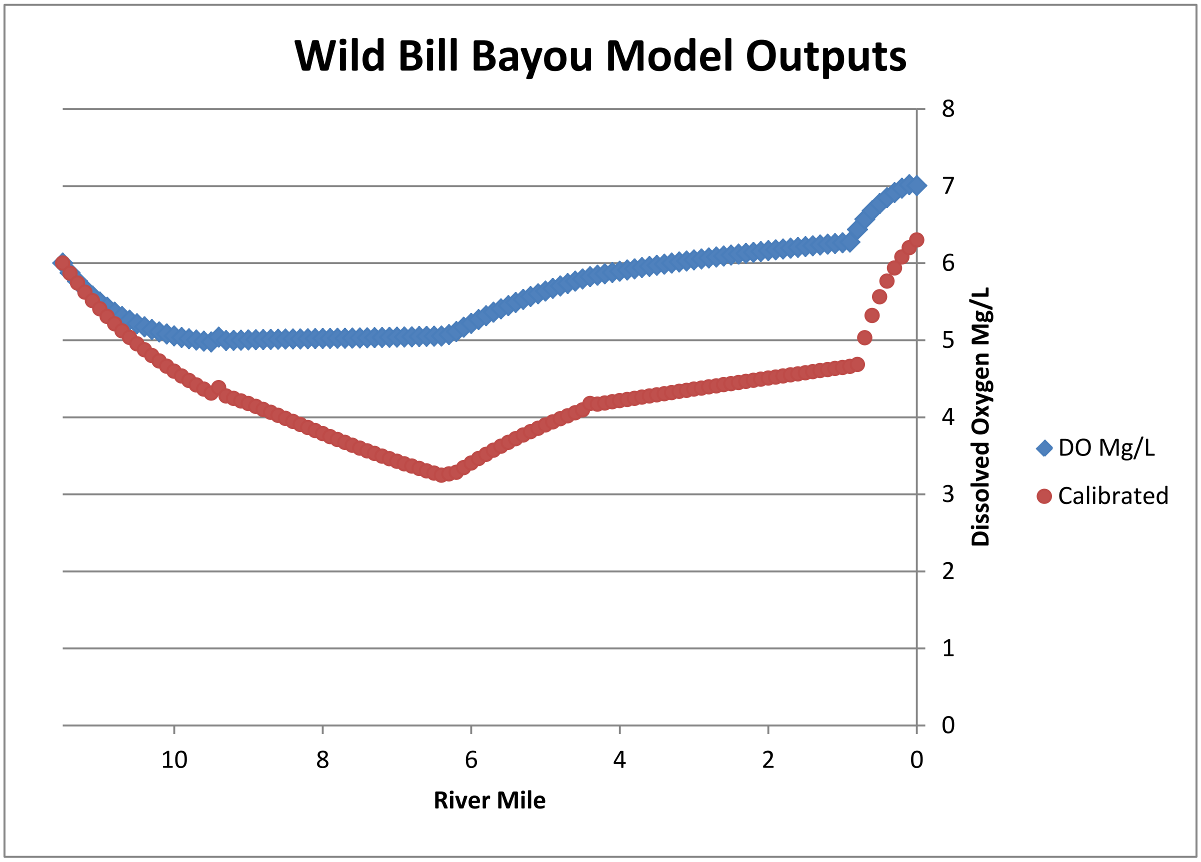

Figure 9 Model Output

3.3 Source Representation

The background concentration used in modeling for $CBOD_5$ is 1.33 mg/l and for NH_3-N is 0.1 mg/l. These concentrations are used as estimates for the $CBOD_5$ and NH_3-N levels of water entering the water bodies through nonpoint source flow and tributaries. It is noted that because there were DO violations indicated, higher values of $CBOD_5$ and NH_3-N for the nonpoint source concentrations were used to reflect the measured instream average DO value. This was done to calibrate the model to the data.

Nonpoint source flows were included in the model to account for water entering due to groundwater infiltration, overland flow, and small, unmeasured tributaries. The nonpoint source loads were assumed to be distributed evenly on a river mile basis throughout the modeled reaches.

3.4 Model Results

As shown in Figure 9 above the calibrated model was below the water quality standard target of 5.0 mg/l of dissolved oxygen. A second model was constructed to match the standard. Table 10 shows the loads used in this model. The TBODu shown in Table 10 is the TMDL for this stream, 27.2 lbs. per day. The percent reduction in the loads from Table 9 to Table 10 is 60.4%. This is the targeted reduction for this TMDL.

CBODu is calculated by multiplying the concentration in mg/L by the flow in cfs and a conversion factor of 5.39.

CBODu (lbs/day) = CBODu mg/L * Flow (cfs) * 5.39 (Eq. 4)

NBODu is similarly calculated with the addition of a multiplier of 4.57 which converts the equivalent oxygen load.

NBODu (lbs/day) = NBODu mg/L * Flow (cfs) * 5.39 * 4.57 lbs O_2 (Eq. 5)

Table 10 Calibrated Model Loads

Segment	Flow (cfs)	CBODu (lbs/day)	NH3-N (mg/L)	NBODu (lbs/day)	TBODu (lbs/day)
11.5	.10	2.05	.39	0.96	3.01
9.4	.32	20.86	.39	3.07	23.93
6.3	.17	5.86	.39	1.63	7.49
4.4	.35	25.08	.39	3.36	28.44
0.8	.15	4.44	.39	1.44	5.89
	1.11	58.29		10.47	68.76

Table 11 TMDL Loads

Segment	Flow (cfs)	CBODu (lbs/day)	NH3-N (mg/L)	NBODu (lbs/day)	TBODu (lbs/day)
11.5	.10	0.59	.39	0.96	1.55
9.4	.32	6.03	.39	3.07	9.11
6.3	.17	1.65	.39	1.63	3.28
4.4	.35	7.17	.39	3.36	10.53
0.8	.15	1.29	.39	1.44	2.73
	1.11	16.73		10.47	**27.20**

ALLOCATION

The allocation for this TMDL involves the load reduction necessary for attainment of water quality standards in the Wild Bill Bayou Watershed.

4.1 Wasteload Allocation

There is no point source included in the model for the Wild Bill Bayou Watershed. The WLA is therefore zero.

4.2 Wasteload Allocation Stormwater

There is no MS4 designation in this watershed. Stormwater NPDES permits require the establishment of controls or BMPs to reduce the pollutants entering the environment. The WLA for stormwater is zero.

4.3 Load Allocation

The load allocation for the TBODu TMDL is shown in Table 11 TMDL Loads. Because the water body indicates DO standard violations, loadings should be reduced to meet the standard.

4.4 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 selected for this TMDL is implicit.

4.5 Calculation of the TMDL

The TMDL is calculated based on the following equation.

$$TMDL = WLA + WLA_{SW} + LA + MOS \qquad \textbf{(Eq. 6)}$$

where WLA is the Wasteload Allocation, WLAsw is Wasteload Allocation from stormwater activities, LA is the Load Allocation, and MOS is the Margin of Safety.

Table 12 TBODu TMDL

	WLA (lbs/day)	WLAsw (lbs/day)	LA (lbs/day)	MOS (lbs/day)
CBODu	0	0	16.73	Implicit
NBODu	0	0	10.47	Implicit
TBODu	0	0	27.20	Implicit

4.6 Seasonality and Critical Condition

This TMDL accounts for seasonal variability by requiring allocations that ensure year-round protection of water quality standards, including during critical conditions.

CONCLUSION

A 60.4% reduction from organic enrichment loading is necessary to meet the dissolved oxygen water quality standard based on the STREAM model. This reduction may not be possible due to the land use in this agricultural watershed. There are no point sources to be reduced. The reduction has to come from nonpoint sources. Best management practices are encouraged to reduce sediment and nutrients from leaving the fields. These will help reduce the organic load as well.

The natural condition of this watershed may be better defined in the future with a modified designated use for this stream. It is believed that the stream is supportive of aquatic life in its current condition, but due to MDEQ's water quality standard, the stream will be unable to ever meet a minimum of 4.0 mg/l of dissolved oxygen during the hot summer conditions. Recognition of this fact and a more appropriate designation of this stream as an agricultural drainage stream may return this stream to a fully supporting designation.

5.1 Next Steps

MDEQ's Basin Management Approach and Nonpoint Source Program emphasize restoration of impaired waters with developed TMDLs. During the watershed prioritization process to be conducted by the Yazoo River Basin Team, this TMDL will be considered as a basis for implementing possible restoration projects. The basin team is made up of state and federal resource agencies and stakeholder organizations and provides the opportunity for these entities to work with local stakeholders to achieve quantifiable improvements in water quality. Together, basin team members work to understand water quality conditions, determine causes and sources of problems, prioritize watersheds for potential water quality restoration and protection activities, and identify collaboration and leveraging opportunities. The Basin Management Approach and the Nonpoint Source Program work together to facilitate and support these activities.

The Nonpoint Source Program provides financial incentives to eligible parties to implement appropriate restoration and protection projects through the Clean

Water Act's Section 319 Nonpoint Source (NPS) Grant Program. This program makes grants each year for restoration and protections efforts.

Mississippi Soil and Water Conservation Commission (MSWCC) is the lead agency responsible for abatement of agricultural NPS pollution through training, promotion, and installation of BMPs on agricultural lands. USDA Natural Resource Conservation Service (NRCS) provides technical assistance to MSWCC through its conservation districts located in each county. NRCS assists animal producers in developing nutrient management plans and grazing management plans. MDEQ, MSWCC, NRCS, and other governmental and nongovernmental organizations work closely together to reduce agricultural runoff through the Section 319 NPS Program. (Natural Resources Conservation Service, 2000)

5.2 Public Participation

This TMDL will be published for a 30-day public notice. During this time, the public will be notified by publication in the statewide newspaper. The public will be given an opportunity to review the 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 Greg Jackson at Greg_Jackson@deq.state.ms.us.

All comments should be directed to Greg_Jackson@deq.state.ms.us or Greg Jackson, MDEQ, PO Box 2261, Jackson, MS 39225. 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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