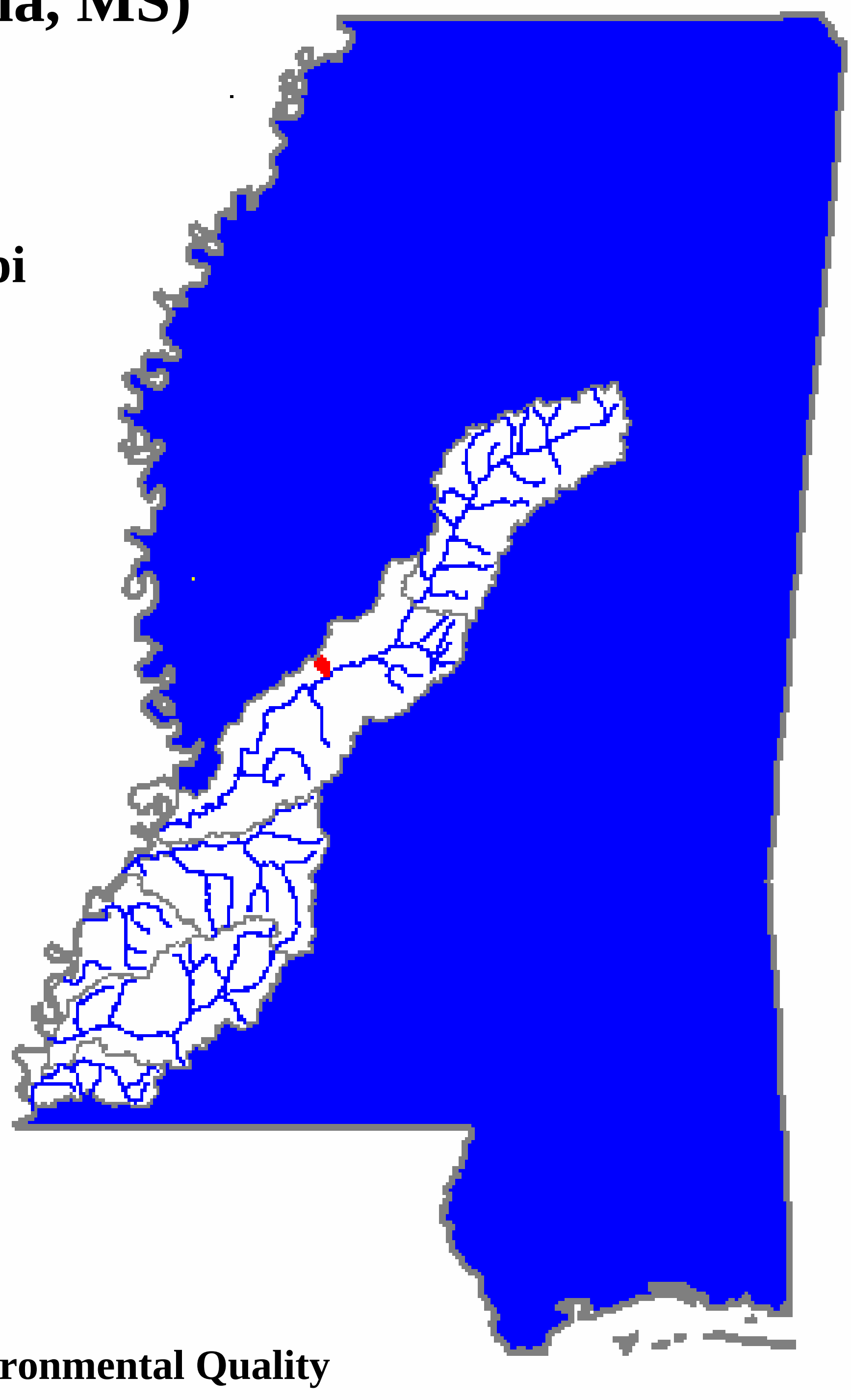
FINAL REPORT
June 2002
ID: 102062801

Organic Enrichment - Low Dissolved Oxygen Total Maximum Daily Load
for
Town Creek (Bentonia, MS)

Big Black River Basin

Yazoo County, Mississippi



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FOREWORD

The report contains one or more Total Maximum Daily Loads (TMDLs) for waterbody segments found on Mississippi's 1996 Section 303(d) List of Impaired Waterbodies. Because of the accelerated schedule required by the consent decree, many of these TMDLs have been prepared out of sequence with the State's rotating basin approach. The segments addressed are comprised of monitored segments that have data indicating impairment. The implementation of the TMDLs contained herein will be prioritized within Mississippi's rotating basin approach.

The amount and quality of the data on which this report is based are limited. As additional information becomes available, the TMDLs will 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	0.6463168	mg/l	ppm	1
cubic meters	gallons	264.17205	μg/l * cfs	gm/day	2.45
cubic meters	liters	1000	μg/l * MGD	gm/day	3.79

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FIGURES

TABLES

MONITORED SEGMENT IDENTIFICATION

Name:	Town Creek segment 1
Waterbody ID:	MS435M1
Location:	From headwaters including Dalton Creek to Bentonia POTW outfall
County:	Yazoo County, Mississippi
USGS HUC Code:	08060202
NRCS Watershed:	090
Length:	7 miles
Use Impairment:	Aquatic Life Support
Cause Noted:	Biological Impairment due to Organic Enrichment
Priority Rank:	121
NPDES Permits:	There are no NPDES Permits issued for facilities that discharge into this segment.
Pollutant Standard:	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 in streams.

MONITORED SEGMENT IDENTIFICATION

Name:	Town Creek segment 2
Waterbody ID:	MS435M2
Location:	From Bentonia POTW outfall to mouth at Bluff Creek
County:	Yazoo County, Mississippi
USGS HUC Code:	08060202
NRCS Watershed:	090
Length:	2 miles
Use Impairment:	Aquatic Life Support
Cause Noted:	Biological Impairment due to Organic Enrichment
Priority Rank:	122
NPDES Permits:	There are two NPDES Permits issued for facilities that discharge into this waterbody.
Pollutant Standard:	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 in streams.
Wasteload Allocation:	**26.44** pounds per day $TBOD_U$ during summer conditions (May – October) **37.82** pounds per day $TBOD_U$ during winter conditions (November – April)
Load Allocation:	**1.06** pounds per day $TBOD_U$ during summer and winter conditions
TMDL:	**27.50** pounds per day $TBOD_U$ during summer conditions (May – October) **38.88** pounds per day $TBOD_U$ during winter conditions (November – April)

EXECUTIVE SUMMARY

Two segments of Town Creek near Bentonia have been placed on the Mississippi 1998 Section 303(d) List of Waterbodies as impaired waterbodies. In 1994, personnel from the Water Quality Assessment Branch of the Mississippi Department of Environmental Quality (MDEQ) Office of Pollution Control conducted a lagoon upgrade study at the Bentonia Wastewater Treatment Plant (WWTP). The physical, chemical, and biological data from this study suggested that Town Creek was impaired to some degree. Following assessment of the data collected through this project, Town Creek was placed on the 1998 303(d) List for biological impairment.

In May 2001, a water quality study was conducted in order to document and assess the respective water quality of the 303(d) listed segments of this waterbody. Physical, chemical, and biological parameters were collected to characterize the current conditions of the waterbody. The main objectives of the study were (1) verification that the two segments of Town Creek are impaired, and if so, (2) determination of the causes(s) of impairment for TMDL development. This study confirmed that the creek was biologically impaired due to organic enrichment/low dissolved oxygen.

Figure ES.1 Town Creek below Highway 433

The predictive model used to calculate this 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 for this study. The model was developed to account for seasonal variations in stream temperature, dissolved oxygen saturation, and biochemical oxygen demand decay rate. The model used in developing this TMDL includes both point and nonpoint sources of oxygen demanding material.

There are two National Pollution Discharge Elimination System (NPDES) permitted point sources in the watershed which were included in the model. Nonpoint sources in the watershed were quantified using an assumed background concentration of organic material in the stream.

Wasteload allocations of organic material for the Town Creek Watershed were developed using the model. The point source loads of organic material in the watershed are greater than the wasteload allocation. Thus, a reduction in these loads will be necessary in order to achieve water quality standards in Town Creek.

1.0 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 TMDL process can be used to establish water quality based controls to reduce pollution from both point and nonpoint sources, and restore and maintain the quality of water resources. MDEQ has identified Town Creek as being impaired for a length of nine miles as reported in the Mississippi 1998 Section 303(d) List of Waterbodies. The impairment is caused by reduced levels of dissolved oxygen (DO) in the creek due to oxidation of organic material. Thus, this TMDL has been developed for organic enrichment.

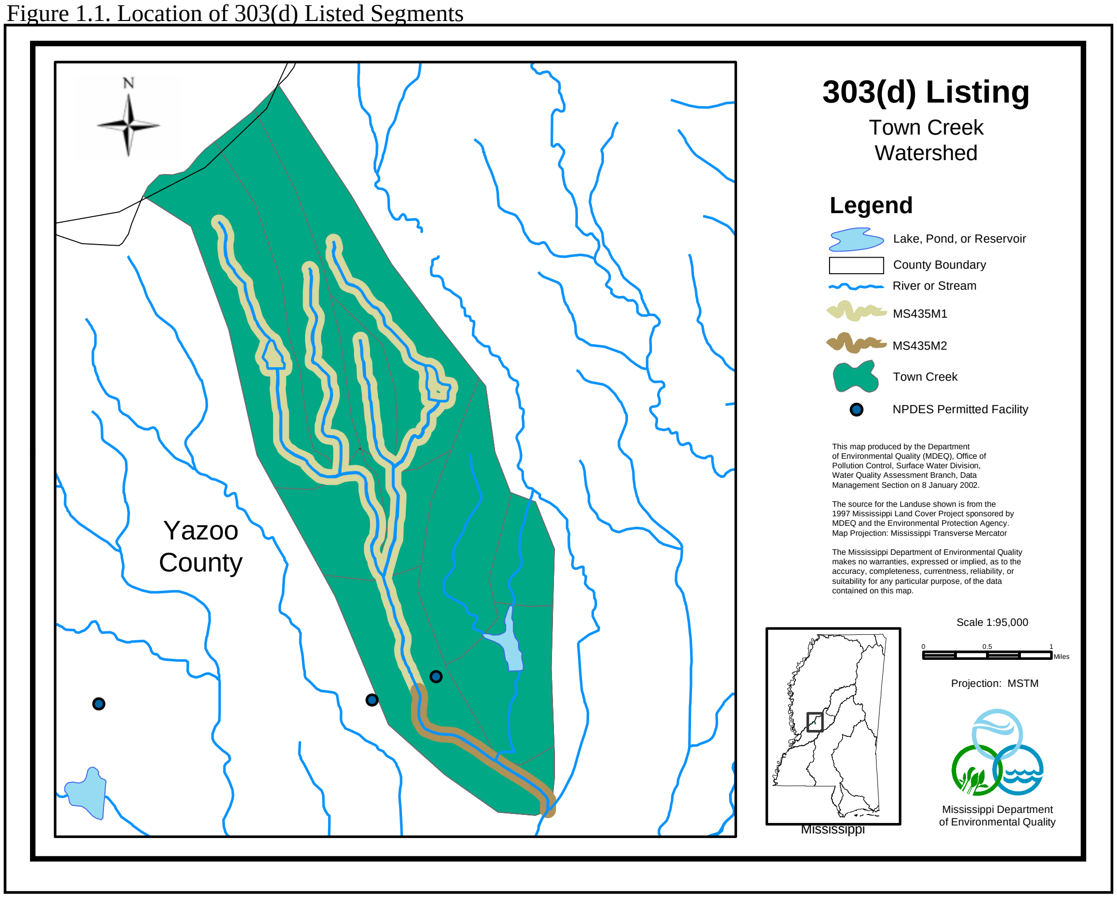
Organic enrichment is measured in terms of total ultimate biochemical oxygen demand ($TBOD_U$). $TBOD_U$ represents the oxygen consumed by microorganisms while stabilizing or degrading carbonaceous and nitrogenous compounds under aerobic conditions over an extended time period. The carbonaceous compounds are referred to as $CBOD_U$, and the nitrogenous compounds are referred to as $NBOD_U$. $TBOD_U$ is equal to the sum of $NBOD_U$ and $CBOD_U$, Equation 1.1.

$$\mathbf{TBOD_U = CBOD_U + NBOD_U} \qquad \text{(Equation 1.1)}$$

1.2 Segment Location

Town Creek flows in a southeastern direction from its headwaters near Anding, Mississippi to its confluence with Bluff Creek. The impaired segments are in Yazoo County from the headwaters, including Dalton Creek, to its mouth at Bluff Creek. Dalton Creek flows into Town Creek from the northwest, see Figure 1.1. The watershed of the impaired segments includes both urban and agricultural areas near Bentonia, Mississippi.

Figure 1.1. Location of 303(d) Listed Segments



1.3 Discussion of Instream Water Quality Data

The State's 1998 Section 305(b) Water Quality Assessment Report was reviewed to assess water quality conditions and data available for the watershed. Limited water quality data are available for the monitored segments of Town Creek and its tributary, Dalton Creek. According to the report, Town Creek is partially supporting for the use of aquatic life support. These conclusions were based on physical, chemical, and biological data collected during the 1994 lagoon upgrade study at the Bentonia WWTP. The data from this study indicated that Town Creek was impaired to some degree, both upstream and downstream of the WWTP outfall.

Additional water quality sampling and biological assessments were collected as part of a 303(d) study for Town Creek in May of 2001. During this study, data were collected at two locations on Town Creek: (1) TWN2, Town Creek above Highway 433 and (2) TWN3, Town Creek below Highway 433. The objectives of this study were to confirm biological and water quality impairment in Town Creek and to identify the specific cause(s) and source(s) of biological impairment.

Chemical monitoring included field and laboratory analysis of surface water. In-situ water quality measurements were made using multi-parameter water quality instruments. Calibrated field instruments were utilized to measure DO, DO saturation, water temperature, specific conductivity, pH, and total dissolved solids. Instruments were continuously deployed for 24-48 hour periods during the study for diurnal measurement of these water quality parameters. A summary of in-situ data collected during the project is given in Tables 1.1 and 1.2.

Table 1.1. In-Situ Water Quality Data for Town Creek above Highway 433 (TWN2)

Parameter	Average	Maximum	Minimum
Water Temperature (°C)	22.02	23.74	20.17
pH	7.47	7.62	7.38
Dissolved Oxygen (mg/l)	6.58	9.45	4.67
Dissolved Oxygen Saturation (%)	75.68	110.90	52.40
Conductivity (µs/cm)	438.52	448.00	427.00
Total Dissolved Solids (mg/l)	285.00	291.00	278.00

Table 1.2. In-Situ Water Quality Data for Town Creek below Highway 433 (TWN3)

Parameter	Average	Maximum	Minimum
Water Temperature (°C)	21.85	23.35	20.46
pH	7.53	7.67	7.45
Dissolved Oxygen (mg/l)	4.78	7.15	3.37
Dissolved Oxygen Saturation (%)	54.72	83.30	37.40
Conductivity (µs/cm)	433.29	438.00	428.00
Total Dissolved Solids (mg/l)	282.00	285.00	278.00

Surface water samples were collected by grab sampling. Grab samples were collected eight times during the study. Water chemistry parameters selected for laboratory analysis and laboratory results are given in Tables 1.3 and 1.4. The date and times of the sample collection are also shown in the tables.

Table 1.3 Water Chemistry Data for Town Creek above Highway 433 (TWN2)

Parameter	05/14/01 15:10	05/14/01 15:30	05/15/01 14:30	05/15/01 14:45	05/16/01 09:45	05/16/01 15:10	05/17/01 10:35	05/17/01 10:45
Sample Depth (ft)	1.0	1.0	1.0	1.0	1.5	1.0	1.5	1.5
Total Organic Carbon (TOC) (mg/l)	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Chemical Oxygen Demand (mg/l)	41.00	13.00	10.00	19.00	20.00	<10.00	17.00	16.00
Total Phosphorus(as P) (mg/l)	0.23	0.16	0.17	0.34	0.13	0.10	0.59	0.18
Total Kjeldahl Nitrogen (TKN) (mg/l)	1.27	1.02	0.51	1.26	1.08	0.52	1.48	1.25
Ammonia Nitrogen (as N) (mg/l)	0.27	0.27	0.24	0.27	0.32	0.26	0.24	0.25
Nitrite + Nitrate (mg/l)	0.21	0.23	0.20	0.19	0.18	0.15	0.15	0.15
Total Alkalinity (as $CaCO_3$) (mg/l)	192.0	198.0	199.0	216.0	205.0	201.0	205.0	201.0
Turbidity (NTU) (mg/l)	36.0	37.0	26.0	32.0	22.0	22.0	17.0	20.0
Chlorides (mg/l)	15.8	15.4	16.0	16.1	16.2	16.4	16.8	16.7

Table 1.4 Water Chemistry Data for Town Creek below Highway 433 (TWN3)

Parameter	05/14/01 15:45	05/14/01 15:55	05/15/01 13:50	05/15/01 14:00	05/16/01 10:10	05/16/01 14:00	05/17/01 10:00	05/17/01 10:10
Sample Depth (ft)	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.5
Total Organic Carbon (TOC) (mg/l)	5.00	5.00	5.00	6.00	5.00	6.00	6.00	5.00
Chemical Oxygen Demand (mg/l)	11.00	13.00	<10.00	<10.00	<10.00	<10.00	<10.00	17.00
Total Phosphorus(as P) (mg/l)	0.13	0.14	0.10	0.10	0.11	0.13	0.08	0.21
Total Kjeldahl Nitrogen (TKN) (mg/l)	0.91	0.89	1.00	0.76	1.04	1.12	1.20	1.37
Ammonia Nitrogen (as N) (mg/l)	0.30	0.29	0.27	0.28	0.25	0.22	0.28	0.34
Nitrite + Nitrate (mg/l)	0.09	0.09	0.08	0.08	0.06	0.07	0.07	0.05
Total Alkalinity (as $CaCO_3$) (mg/l)	194.0	192.0	192.0	193.0	189.0	197.0	185.0	201.0
Turbidity (NTU) (mg/l)	29.0	29.0	51.0	18.0	19.0	19.0	22.0	21.0
Chlorides (mg/l)	15.7	15.4	15.4	15.8	15.7	15.9	15.6	16.2

1.4 Cause of Impairment

Two segments of Town Creek are listed on the 1998 Section 303(d) list for biological impairment. The term biological impairment describes impairment to waterbodies in which at least one biological assemblage (fish, macroinvertabrates, or algae) indicates less than full support with moderate modification of the biological community noted. Current sampling methods allow MDEQ to make an accurate determination of whether or not the biological community in a specific waterbody is impaired. However, biological sampling often does not identify the specific pollutant or pollutants that are the cause of biological impairment.

As a result, MDEQ uses a process-of-elimination approach to identify the pollutants causing biological impairment. For the Town Creek watershed, all available data were analyzed, including water chemistry and in-situ data, photographs of the waterbody, and inventories of landuse and point source dischargers. Analysis of these data eliminated causes such as erosion and sedimentation because evidence of stream bank erosion was not visible and water chemistry did not show elevated levels of turbidity or dissolved solids. Because neither significant levels of nitrogen and phosphorous species nor an overabundance of algae were found in the waterbody, nutrients were eliminated as a direct cause of impairment. Also, levels of ammonia nitrogen in the waterbody were not above standards for ammonia toxicity. Measurements of pH, alkalinity, and hardness were all within the expected range for waterbodies in Mississippi. However, measurements of DO collected during the study in May 2001 showed that DO levels in Town Creek were below the levels in Mississippi's Water Quality Standards. In addition, diurnal variations in the creek's DO levels ranged from 3.37 to 9.45 mg/l, indicating that the levels of organic material in the creek were elevated. The source assessment revealed that the organic material is likely due to the point source discharges located in the headwater reaches of the watershed.

This evidence indicates the biological impairment found in Town Creek is due to elevated amounts of organic material in the creek which result in decreased DO levels. Subsequently, this TMDL was developed for Town Creek for organic enrichment/low DO.

2.0 TMDL ENDPOINT

2.0 Segment Use and Applicable State Standards

Designated beneficial uses and water quality standards are established by the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* regulations. The designated use for Town Creek as defined by the regulations is Fish and Wildlife Support. Waters designated for use as Fish and Wildlife Support must also be suitable for Secondary Contact, which is defined as incidental contact with the water. 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 applicable standard specifies that the 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.

2.1 Selection of TMDL Endpoint and Critical Conditions

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.

Low DO typically occurs during seasonal low-flow periods of 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 low-flow, high-temperature period is referred to as the critical condition. The maximum impact of oxidation of organic material is generally not at the location of the point source discharge, but at some distance downstream, where the maximum DO deficit occurs. The DO deficit is defined as the difference between the DO concentration at 100% saturation and the actual DO. The point of maximum DO deficit, also called the DO sag, will be use to define the endpoint required for this TMDL. The TMDL will be based on a daily average of not less than 5.0 mg/l DO at the DO sag during critical conditions in Town Creek.

3.0 Source Assessment

This TMDL Report includes the identification of all known potential pollutant sources in the Town Creek Watershed and an analysis of available water quality data. The source assessment was used as the basis of development for the model and analysis of the TMDL allocation. The potential point and nonpoint pollutant sources were characterized by the best available information, monitoring data, and literature values. This section documents all available information.

3.1 Assessment of Point Sources

The first step in assessing pollutant sources in the Town Creek watershed was locating the NPDES permitted sources. There are two sources permitted to discharge into Town Creek, Table 3.1. The effluent from each facility was characterized based on all available data including information on each facility's wastewater treatment system, permit limits, and discharge monitoring reports. Discharge monitoring data are vital to characterizing effluent from each facility.

Table 3.1. Identified NPDES Permitted Facilities

Name	NPDES Permit	Discharge	Receiving Waterbody
Town of Bentonia	MS0020478	Effluent from WWTP (Sand Filter)	Town Creek
Memphis Hardwood Flooring Co.	MS0046213	Overflow from log spray recirculation pond, well water overflow, boiler blowdown, and steam condensate	Town Creek

3.2 Assessment of Nonpoint Sources

Nonpoint loading of $TBOD_U$ in a waterbody results from the transport of the pollutants into receiving waters by overland surface runoff and groundwater infiltration. Landuse activities within the drainage basin, such as agriculture, silvaculture, and urbanization contribute to nonpoint source loading. Other nonpoint pollution sources include atmospheric deposition and natural weathering of rocks and soil.

The 5,205 acre drainage area of Town Creek contains many different landuse types, including urban, forest, cropland, pasture, water, and wetlands. The landuse information is based on data collected by the State of Mississippi's Automated Resource Information System (MARIS) 1997. This data set is based on Landsat Thematic Mapper digital images taken between 1992 and 1993. Agriculture and forest are the dominant landuses within this watershed. The landuse within the Town Creek Watershed is shown in Table 3.2 and Figure 3.1.

Figure 3.1 Landuse Distribution

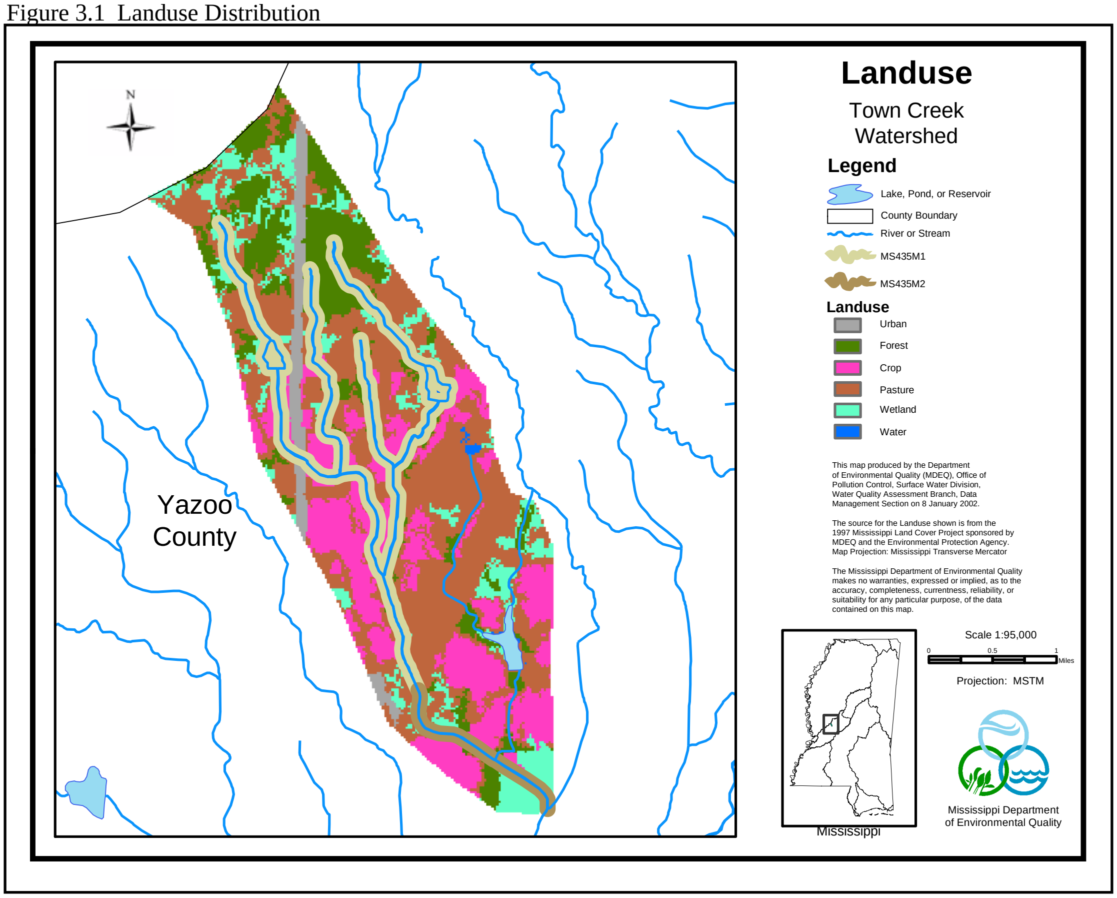


Table 3.2 Landuse Distribution

	Urban	Forest	Agriculture	Barren	Water	Wetlands	Total
Area (acres)	214	915	3379	0	67	630	5205
Percentage	4%	18%	65%	0%	1%	12%	100%

In addition to the nonpoint sources of pollution related to landuse activities in the watershed, a man-made channel obstruction was found within Town Creek. This obstruction (see Figure 3.2) blocks the flow of water within segment 2 of Town Creek and causes further problems for the waterbody. This TMDL calls for removal of this structure and other flow altering structures to provide adequate flow in the waterbody.

Figure 3.2 Channel Obstruction within Town Creek segment 2

4.0 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 waterbody responses to flow and loading conditions. In this section, the selection of the modeling tools, setup, and model application are discussed.

4.1 Modeling Framework Selection

A mathematical model, named AWFWUL1, for DO distribution in freshwater streams was used for developing the TMDL. 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 AWFWUL1 model in TMDL development is its ability to assess instream water quality conditions in response to point and nonpoint source loadings.

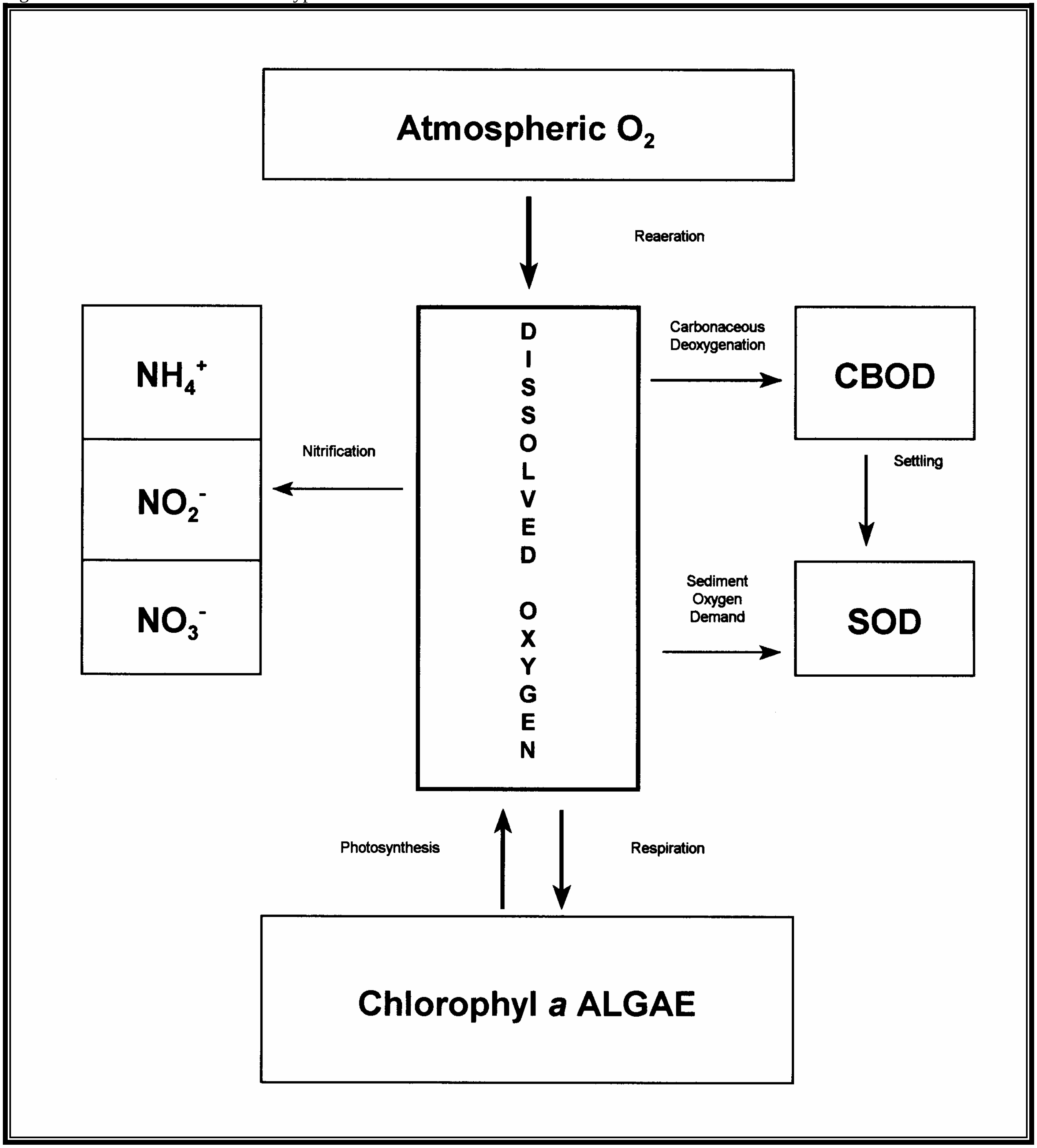
The model is a steady-state, daily average computer model that utilizes a modified Streeter-Phelps DO sag equation. Instream processes simulated by the model include $CBOD_U$ decay, nitrification, reaeration, sediment oxygen demand, and respiration and photosynthesis of algae. Figure 4.1 shows how these 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, $CBOD_U$, 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, which is recommended for small streams with flow less than 10 cfs. The Tsivoglou formulation calculates reaeration (Ka) within each reach according to Equation 4.1.

$$\mathbf{Ka = CSU} \quad \text{(Equation 4.1)}$$

S is the slope in ft/mile, U is the reach velocity in mile/day, and C is the escape coefficient, which is 0.11 for streams with flow less than 10 cfs.

Figure 4.1 Instream Processes in a Typical DO Model



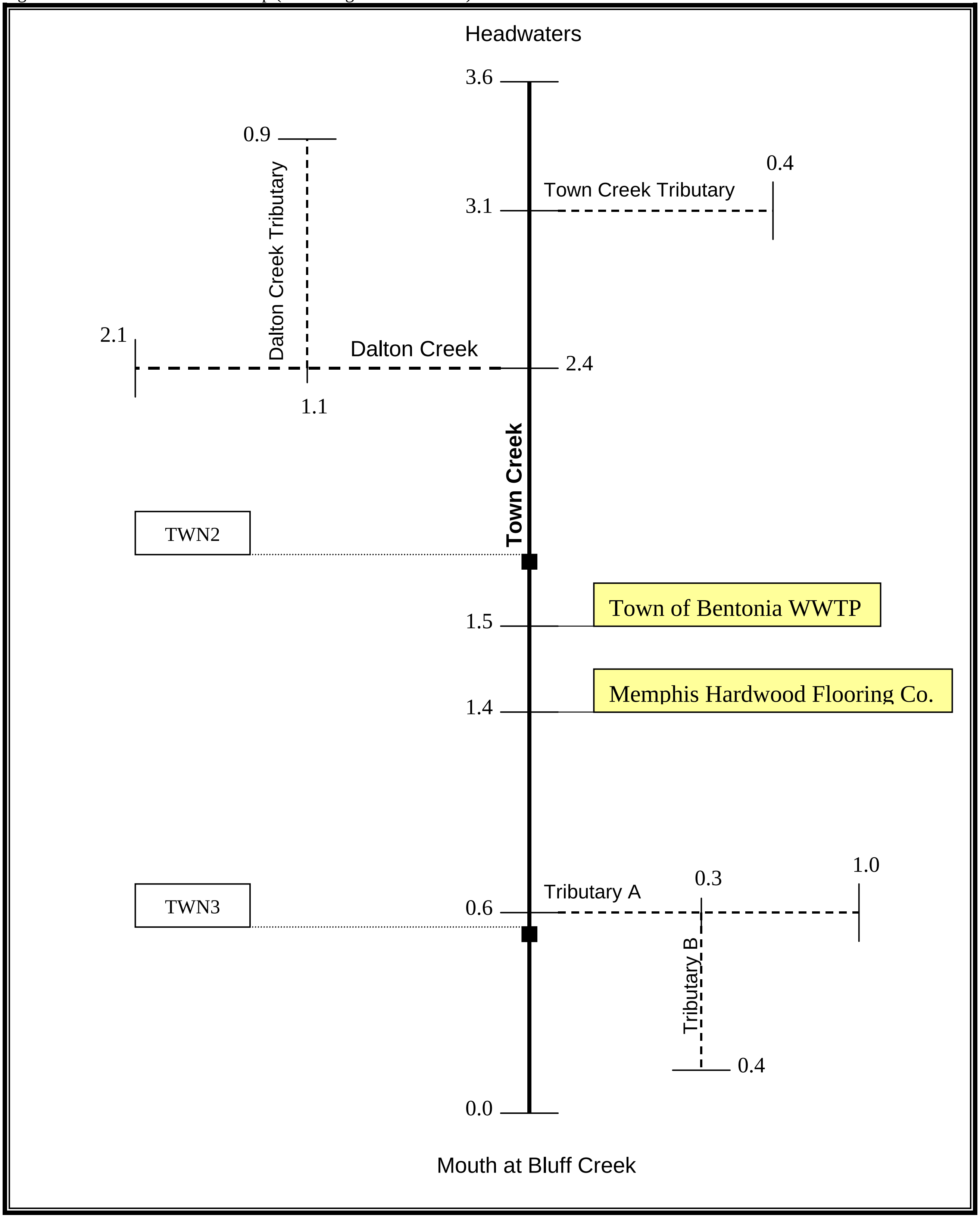
4.2 Model Setup

The Town Creek TMDL model includes the 303(d) listed portions of Town Creek, from the headwaters including Dalton Creek to the mouth at Bluff Creek, as well as all the drainage areas that are upstream of the segments. The modeled waterbodies were divided into reaches for input into the AWFWUL1 model. Reach divisions were made at any major change in the hydrology of the waterbody, such as a significant change in slope or the confluence of a tributary or point source discharge. The watershed was modeled according to the diagram shown in Figure 4.2.

The slope of each reach was estimated from USGS quad maps and input into the model in units of feet/mile. Within each reach, the modeled segments were divided into computational elements of 0.1 mile. The hydrological and water quality characteristics are calculated and output by the model for each computational element.

As shown in Figure 4.2, there are two NPDES permitted point sources that discharge into Town Creek. The unnamed tributaries are shown as dashed lines in the figure. The numbers on the figure represent river miles at which point sources discharges or confluence of the creeks are located. River miles are assigned to waterbodies, beginning with zero at the mouth.

Figure 4.2 Town Creek Model Setup (Note: Figure not to Scale)



4.3 Source Representation

Both point and nonpoint sources were represented in the model. The loads from NPDES permitted sources were added as direct inputs into the appropriate reach of the waterbody as a flow in cfs and a load of $CBOD_U$ and ammonia nitrogen in lbs/day. Spatially distributed loads, which represent nonpoint sources of flow, $CBOD_{U,}$ and ammonia nitrogen were distributed evenly into each computational element of Town Creek, Dalton Creek, and their tributaries.

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 predictive models used for TMDL development are typically developed using $CBOD_U$, a ratio between the two terms is needed, Equation 4.2.

$$\mathbf{CBOD_U = CBOD_5 * Ratio} \qquad \text{(Equation 4.2)}$$

The $CBOD_U$ to $CBOD_5$ ratios are given in *Empirical Stream Model Assumptions for Conventional Pollutants and Conventional Water Quality Models* (MDEQ, 1995). 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. A ratio of 2.3:1 was used for the Bentonia WWTP sand filter operation (MS0020478). Representatives of the Weyerhaeuser Company were consulted to determine the appropriate ratio for wood processors. Based on their studies, a ratio of 1.5:1 was used for the Memphis Hardwood Flooring Company (MS0046213).

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 (NO_3) was used. Using this factor is a conservative modeling assumption because it assumes that all of the ammonia is converted to nitrate through nitrification, which is not necessarily accurate. The oxygen demand caused by nitrification of ammonia is equal to the $NBOD_U$ load. The sum of $CBOD_U$ and $NBOD_U$ is equal to the point source load of $TBOD_U$. The loads of $TBOD_U$ from each of the existing point sources are given in Table 4.1. The loads were based on the maximum allowable loads according to NPDES permits and data from discharge monitoring reports (another conservative assumption). The same loading was assumed year round for the Bentonia facility. However, due to variations within the Memphis Hardwood Flooring Company's discharge throughout the year, both summer and winter existing scenarios were modeled.

Table 4.1 Point Source Loads as Input into the Model

Facility	Flow (cfs)	$CBOD_5$ (mg/l)	$CBOD_U$:$CBOD_5$ Ratio	$CBOD_U$ (lbs/day)	NH_3-N (mg/l)	$NBOD_U$ (lbs/day)	$TBOD_U$ (lbs/day)
Town of Bentonia WWTP (Sand Filter)	0.135	16.69	2.3:1	27.85	5.12	16.98	44.83
Memphis Hardwood Flooring Co. (summer)	0.011	23.00	1.5:1	2.07	2.0	0.55	2.62
Memphis Hardwood Flooring Co. (winter)	0.011	29.93	1.5:1	2.70	2.0	0.55	3.25
Total (summer)				**29.92**		**17.53**	**47.45**
Total (winter)				**30.55**		**17.53**	**48.08**

Table 4.2 Point Source Load for Town of Bentonia at Current Permit Limits (assume 2.0 mg/l ammonia nitrogen & 6.0 mg/l DO)

Facility	Flow (cfs)	$CBOD_5$ (mg/l)	$CBOD_U$:$CBOD_5$ Ratio	$CBOD_U$ (lbs/day)	NH_3-N (mg/l)	$NBOD_U$ (lbs/day)	$TBOD_U$ (lbs/day)
Town of Bentonia (Sand Filter)	0.135	10	2.3:1	16.74	2.0	6.65	23.39

The Bentonia facility was modeled at values higher than their existing permit limits. The current permit states a monthly average limit of 10 mg/l for $CBOD_5$. However, according to the discharge monitoring reports for this facility, this limit is not being met. In order to properly characterize the discharge from this facility, an average of the values reported on the discharge monitoring reports was used as input into the model. Averages from the discharge monitoring reports were also used to describe the typical ammonia nitrogen and dissolved oxygen in the effluent. In addition, the Bentonia facility is currently in the process of moving their discharge from Town Creek to the Big Black River. Appendix B includes documentation regarding the removal of this discharge.

Direct measurements of nonpoint source loads of $CBOD_U$ and NH_3-N were not available for the Town Creek Watershed. The background contributions of $CBOD_U$ and total ammonia as nitrogen (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 concentrations used in modeling are $CBOD_U$ = 2.0 mg/l and NH_3-N = 0.1 mg/l.

4.4 Selection of Representative Modeling Periods

In order to account for seasonal variations in stream temperature and the stream temperature's effect on the $CBOD_U$ decay rate and dissolved oxygen saturation, the model was run for both summer and winter temperature conditions. The temperatures used in the model are 26°C in the summer (May through October) and 20°C in the winter (November through April). The headwater instream DO was assumed to be 85% of saturation at the stream temperature. The instream $CBOD_U$ decay rate is dependent on temperature, according to Equation 4.3.

$$Kd_{(T)} = Kd_{(20°C)}(1.047)^{T-20}$$ (Equation 4.3)

Where Kd is the $CBOD_U$ decay rate and T is the assumed instream temperature. The assumptions regarding the instream temperatures, background DO saturation, and $CBOD_U$ decay rate are required by the *Empirical Stream Model Assumptions for Conventional Pollutants and Conventional Water Quality Models* (MDEQ, 1994). The temperatures, $CBOD_U$ decay rates, and DO saturation values used in the model are given in Table 4.3.

Table 4.3 Seasonal Model Inputs

Season	Temperature (°C)	$CBOD_U$ Decay Rate (Day^{-1})	85% DO Saturation (mg/l)
Summer (May – Oct)	26	0.39	7.0
Winter (Nov – April)	20	0.30	7.7

4.5 Model Calibration Process

Calibration of the water quality component of the model was limited due to the lack of water quality monitoring data in the headwater reaches of the modeled creeks. The model was adjusted to simulate the conditions at the time the data were collected at stations TWN2 and TWN3 (Tables 1.1 and 1.2). This model output was compared to the water quality data collected at these stations. At TWN2 (above the discharge points) the measured average DO concentration was 6.58 mg/l. The model predicted a DO concentration of 8.7 mg/l (32% error). At TWN3 the measured average DO concentration was 4.78 mg/l. The model predicted a DO concentration of 4.7 mg/l (2% error).

The model inputs were based on assumptions found in *Empirical Stream Model Assumptions for Conventional Pollutants and Conventional Water Quality Models* (MDEQ, 1994). The hydrological portion of the model was calibrated to simulate low-flow, critical conditions. 7Q10 flow is the lowest 7-day average flow expected to occur within a 10-year time period. There were no USGS flow gages available for Town Creek or Dalton Creek. Therefore, no gaged 7Q10 values were available for these waterbodies.

According to *Techniques for Estimating 7-Day, 10-Year Low Flow Characteristics for Ungaged Sites on Streams in Mississippi*, the 7Q10 flow coefficient for the Town Creek Watershed is 0.01 cfs/square mile of drainage area. After determining the drainage area of the Town Creek Watershed, the 7Q10 flow coefficient (7Q10 value in cfs/drainage area in square miles) was used to estimate the amount of water draining into Town Creek and its tributaries during low-flow conditions. The 7Q10 for Town Creek was estimated to be 0.08 cfs.

4.6 Model Results

Once the model setup was complete, the model was used to predict water quality conditions in Town Creek and its tributaries. The model was first run under baseline conditions. Under baseline conditions, the loads from NPDES permitted point sources were set at their existing load scenarios as determined from the discharge monitoring reports, Table 4.1. Thus, baseline model runs reflect the current condition of Town Creek without any reduction of $TBOD_U$ loads. The model was then run using a trial-and-error process to determine the maximum $TBOD_U$ loads from the point source facilities which would not violate water quality standards for DO. These model runs are called load reduction scenarios.

4.6.1 Baseline Model Runs

Figures 4.3 through 4.4 show the model results from the baseline model runs. The baseline model runs were used to simulate both summer and winter temperature conditions. Since the summer scenario represents conditions when the dissolved oxygen saturation is lower and the $CBOD_U$ decay rates are greater, it is the critical scenario. The figures show the modeled daily average DO in Town Creek. The red line on each figure represents the DO standard of 5.0 mg/l. Figure 4.3 shows the daily average instream DO concentrations in Town Creek under existing summer conditions, beginning with river mile 3.6 and ending with river mile 0.0 (the mouth of Town Creek at Bluff Creek). The DO sag, or maximum DO deficit, occurs in Town Creek below the discharges from the NPDES Permitted facilities around river mile 1.5.

Figure 4.4 shows the daily average instream DO concentrations in Town Creek under existing winter conditions, beginning with river mile 3.6 and ending with river mile 0.0 (the mouth of Town Creek at Bluff Creek). The DO sag, or maximum DO deficit, again occurs in Town Creek below the discharges from the NPDES Permitted facilities around river mile 1.5.

The data show that the DO standard is violated in this reach as a result of the effluent from the Bentonia WWTP. As shown, the model does predict that the DO in this tributary goes to below the standard of a minimum of 5.0 mg/l of dissolved oxygen.

Figure 4.3 Baseline Model Output for Town Creek - Summer

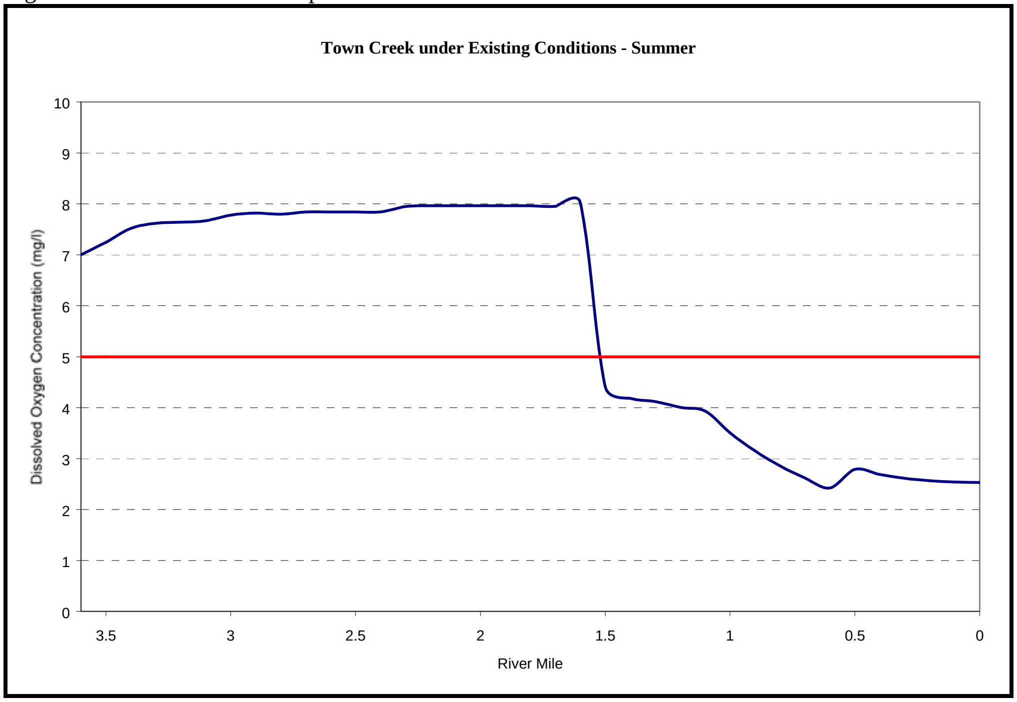
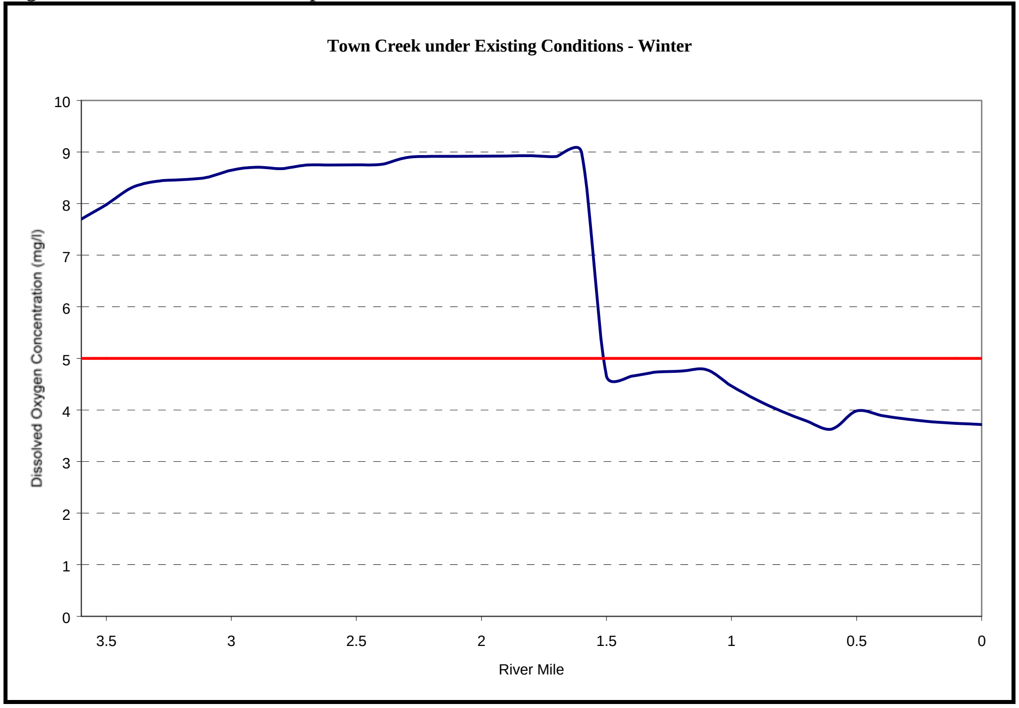


Figure 4.4 Baseline Model Output for Town Creek - Winter



4.6.2 Load Reduction Scenarios

The graphs of baseline model output show that the predicted DO falls below the DO standard in Town Creek during critical conditions. As a result, reductions from the baseline loads of $TBOD_U$ are necessary in order to maintain a daily average DO of at least 5.0 mg/l. Figures 4.5 and 4.6 show model results from the load reduction scenario model runs. The load reduction scenarios were developed for both summer and winter conditions. This is because the assimilative capacity of a waterbody is generally greater in the winter season, when temperatures are lower and DO saturation of the water is greater. The load reduction scenarios involved running the model for each season using a trial-and-error process. The minimum load reductions, that allowed the maintenance of water quality standards, were selected. The selected load reduction scenarios were used to develop the seasonal waste load allocations proposed in this TMDL.

Figure 4.5 shows the daily average instream DO concentrations in Town Creek after application of the selected load reduction scenario for the summer condition. The lowest DO concentration in the creek, approximately 5.0 mg/l occurs near river miles 0.75 and 0.25. Figure 4.6 shows the daily average DO in concentrations in Town Creek during winter conditions. The lowest DO concentration in the creek, approximately 5.0 mg/l occurs near river miles 0.60 and 0.25. The $TBOD_U$ loads from each of the point source facilities included in the load reduction scenario for summer and winter conditions are given in Tables 4.4 and 4.5 respectively. The percent reduction for each facility is based on a reduction from the current point source $TBOD_U$ loads given in Table 4.1.

As stated earlier, the Bentonia facility is currently in the process of moving their discharge from Town Creek to the Big Black River. An additional modeling scenario was performed where this source was completely removed from the model. After removal of the Bentonia facility from the model, there was no impairment of the minimum DO standard of 5.0 mg/l (see Figure 4.7). However, the facility is still currently discharging into Town Creek. Therefore, the TMDL was established in that same manner.

Figure 4.5 Model Output for Town Creek after Application of Load Reduction Scenario - Summer

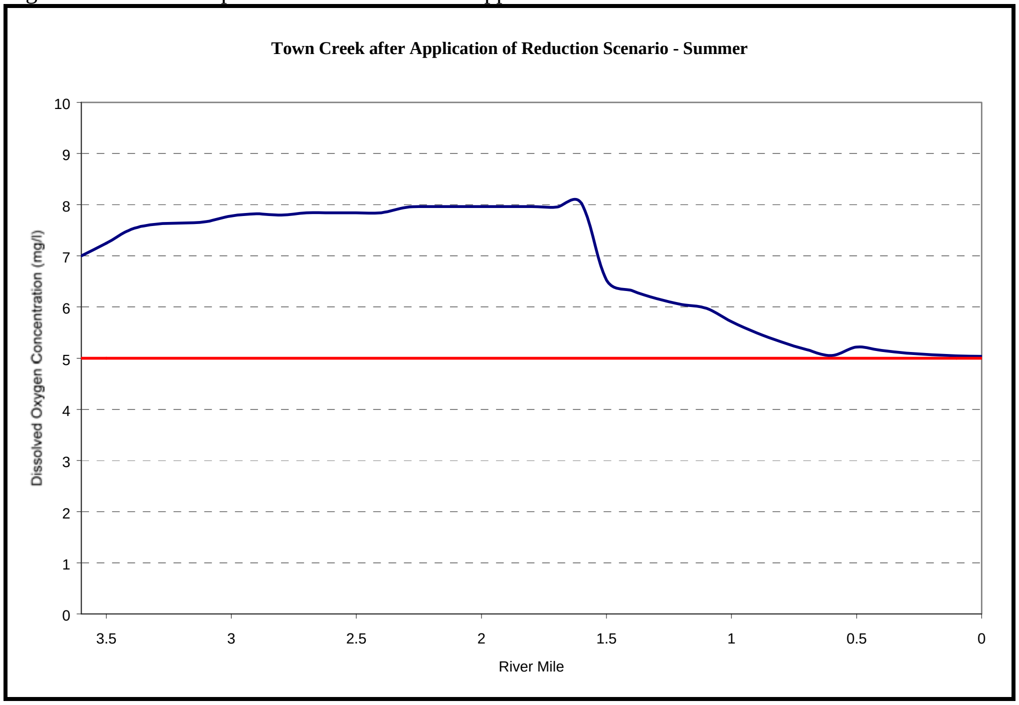


Figure 4.6 Model Output for Town Creek after Application of Load Reduction Scenario - Winter

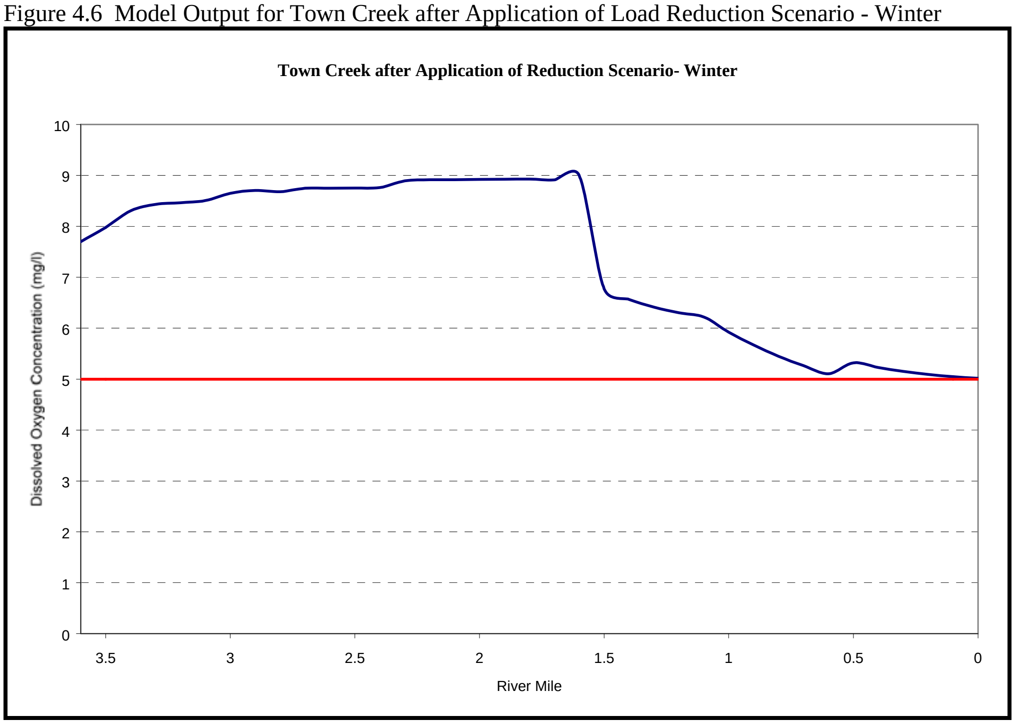


Figure 4.7 Model Output for Town Creek after the Removal of the Bentonia Facility – Summer

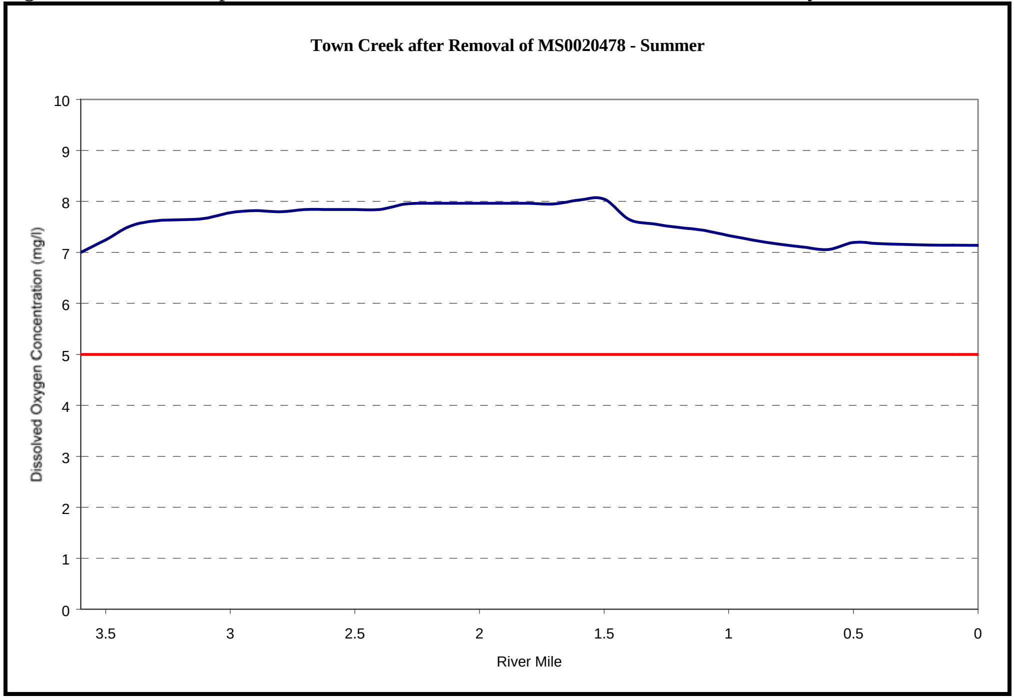


Table 4.4 Load Reduction Scenario, Summer Conditions

Facility	Flow (cfs)	$CBOD_5$ (mg/l)	$CBOD_U$:$CBOD_5$ Ratio	$CBOD_U$ (lbs/day)	NH_3-N (mg/l)	$NBOD_U$ (lbs/day)	$TBOD_U$ (lbs/day)	Percent Reduction
Town of Bentonia (Sand Filter)	0.135	10.30	2.3:1	17.19	2.0	6.63	23.82	47%
Memphis Hardwood Flooring Co.	0.011	23.00	1.5:1	2.07	2.0	0.55	2.62	0%
Total				**19.26**		**7.18**	**26.44**	**44%**

Table 4.5 Load Reduction Scenario, Winter Conditions

Facility	Flow (cfs)	$CBOD_5$ (mg/l)	$CBOD_U$:$CBOD_5$ Ratio	$CBOD_U$ (lbs/day)	NH_3-N (mg/l)	$NBOD_U$ (lbs/day)	$TBOD_U$ (lbs/day)	Percent Reduction
Town of Bentonia (Sand Filter)	0.135	15.75	2.3:1	26.28	2.5	8.29	34.57	23%
Memphis Hardwood Flooring Co.	0.011	29.93	1.5:1	2.70	2.0	0.55	3.25	0%
Total				**28.98**		**8.84**	**37.82**	**21%**

The Bentonia WWTP facility has a much larger discharge flow than the Memphis Hardwood Flooring facility. Therefore, the total load coming from the WWTP is more significant to the water quality of Town Creek. When reductions were made to the Memphis Hardwood Flooring Company's discharge concentrations, almost no change is dissolved oxygen concentrations within the waterbody according to the model. For these reasons, the Bentonia WWTP facility was the focus for reductions is this TMDL.

As shown in the above tables, the load reductions necessary during the winter season are less than those needed during the summer season in order to meet water quality standards for DO. Reductions were not as great during the winter season, because the waterbody has a greater assimilative capacity when temperatures are lower and DO saturation is higher.

5.0 Allocation

The allocation for this TMDL involves a wasteload allocation for point sources and a load allocation for nonpoint sources necessary for attainment of water quality standards in segment MS463M. Seasonality was addressed in the TMDL by running the model for both summer and winter conditions. The load and wasteload allocations for Town Creek and its tributaries were developed as seasonal loads, based on the model results for summer and winter conditions.

5.1 Wasteload Allocation

Two NPDES Permitted facilities in the Town Creek watershed are included in the wasteload allocation. The wasteload allocation in this TMDL includes seasonal loads for $TBOD_U$, Table 5.1. The loads given in Table 5.1 are equal to the load reduction scenarios for the summer and winter seasons given in Tables 4.4 and 4.5. As discussed in Section 4.6, a total reduction of 44% of the permitted $TBOD_U$ load is needed in the summer and 21% of the $TBOD_U$ load is needed in the winter.

Table 5.1 Wasteload Allocations

Season	$CBOD_U$ (lbs/day)	$NBOD_U$ (lbs/day)	$TBOD_U$ (lbs/day)
Summer (May – October)	19.26	7.18	26.44
Winter (November – April)	28.98	8.84	37.82

5.2 Load Allocation

The headwater and spatially distributed loads are included in the load allocation. The $TBOD_U$ concentrations of these loads were determined by using an assumed $CBOD_5$ concentration of 1.33 mg/l and an NH_3-N concentration of 0.1 mg/l. These concentrations should be assumed when reliable field data are not available, according to *Empirical Stream Model Assumptions for Conventional Pollutants and Conventional Water Quality Models* (MDEQ, 1994). The headwater and spatially distributed flows were calculated for the Town Creek Watershed by delineating the drainage area into subwatersheds for Town Creek, Dalton Creek, and their tributaries. Flows from each subwatershed were based on the 7Q10 flow coefficient for the watershed and the watershed size. Then, the load allocations were calculated to determine the $CBOD_U$ and $NBOD_U$ loads in lbs/day, Table 5.2. Because the load allocation does not vary by season, it is given on an annual basis.

Table 5.2 Load Allocations

Subwatershed	Flow (cfs)	$CBOD_5$ (mg/l)	$CBOD_U$:$CBOD_5$ Ratio	$CBOD_U$ (lbs/day)	NH_3-N (mg/l)	$NBOD_U$ (lbs/day)	$TBOD_U$ (lbs/day)
Tributary A	0.0145	1.33	1.5:1	0.16	0.10	0.04	0.20
Tributary B	0.0055	1.33	1.5:1	0.06	0.10	0.01	0.07
Dalton Creek Tributary	0.0093	1.33	1.5:1	0.10	0.10	0.02	0.12
Dalton Creek	0.0207	1.33	1.5:1	0.22	0.10	0.05	0.27
Town Creek Tributary	0.0030	1.33	1.5:1	0.03	0.10	0.01	0.04
Town Creek segment 1	0.0160	1.33	1.5:1	0.17	0.10	0.04	0.21
Town Creek segment 2	0.0110	1.33	1.5:1	0.12	0.10	0.03	0.15
Total				**0.86**		**0.20**	**1.06**

5.3 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 waterbody. 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 model is implicit.

Conservative assumptions which place a higher demand of DO on the waterbody than may actually be present are considered part of the margin of safety. The assumption that all of the ammonia nitrogen present in the waterbody is oxidized to nitrate nitrogen, for example, is a conservative assumption. In addition, the TMDL is based on the critical condition of the waterbody which is represented by the 7Q10 flow. The 7Q10 for Town Creek is very small (0.08 cfs). Therefore, modeling the waterbody at this flow provides protection in the worst-case scenario.

5.4 Calculation of the TMDL

The TMDL was calculated based on Equation 5.1.

$$\textbf{TMDL = WLA + LA + MOS} \qquad \text{(Equation 5.1)}$$

Where WLA is the wasteload allocation, LA is the load allocation, and MOS is the margin of safety. All units are in lbs/day of $TBOD_U$. The TMDLs for $TBOD_U$ were calculated on a seasonal basis, based on the maximum allowable loading of the pollutants in Town Creek and its tributaries, according to the model. The TMDL calculations are shown in Tables 5.3 through 5.6. As shown in the tables, $TBOD_U$ is the sum of $CBOD_U$ and $NBOD_U$. The wasteload allocations incorporate the $CBOD_U$ and NH_3-N contributions from identified NPDES Permitted facilities. The load allocations include the headwaters and spatially distributed $TBOD_U$ and NH_3-N contributions 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.

Table 5.3. TMDL for $TBOD_U$, for Summer Conditions (May – October) for Town Creek

	WLA (lbs/day)	**LA (lbs/day)**	**MOS**	**TMDL (lbs/day)**
$CBOD_U$	19.26	0.86	Implicit	**20.12**
$NBOD_U$	7.18	0.20	Implicit	**7.38**
$TBOD_U$	**26.44**	**1.06**	**Implicit**	**27.50**

Table 5.4. TMDL for $TBOD_U$, for Winter Conditions (November - April) for Town Creek

	WLA (lbs/day)	**LA (lbs/day)**	**MOS**	**TMDL (lbs/day)**
$CBOD_U$	28.98	0.86	Implicit	**29.84**
$NBOD_U$	8.84	0.20	Implicit	**9.04**
$TBOD_U$	**37.82**	**1.06**	**Implicit**	**38.88**

6.0 CONCLUSION

This TMDL, will place restrictions on NPDES permitting activities in Town Creek and its tributaries, including Dalton Creek, such that the loading specified in this TMDL will not be exceeded. Steps need to be taken to ensure that the overall load of $TBOD_U$ placed in this waterbody from point and nonpoint sources does not exceed the waterbody's assimilative capacity. The maximum load of $TBOD_U$, as determined by this TMDL, is 27.50 lbs/day in the summer and 38.88 lbs/day in the winter.

The NPDES Permitted facilities currently discharging into Town Creek will not exceed this assimilative capacity as long as the current permit limits are enforced. As stated earlier, the Bentonia WWTP has a history of permit violations which is contributing to the impairment of this waterbody. This facility is currently in the process of moving its discharge to the Big Black River (see Appendix B). However, until this move occurs, the current permit limits must be enforced. This TMDL also calls for the removal of the channel obstructions within Town Creek segment 2 to allow for unimpeded flow of the waterbody (see Figure 3.2).

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's resources for water quality monitoring will be focused on one of the basin groups. During the next monitoring phase in the Big Black Basin, Town Creek will receive additional monitoring to identify any change in water quality. The additional monitoring may allow confirmation of the assumptions used in the model used for calculating the TMDL. If the additional data show that the assumptions used were not accurate, the model as well as the TMDL will be updated.

6.2 Public Participation

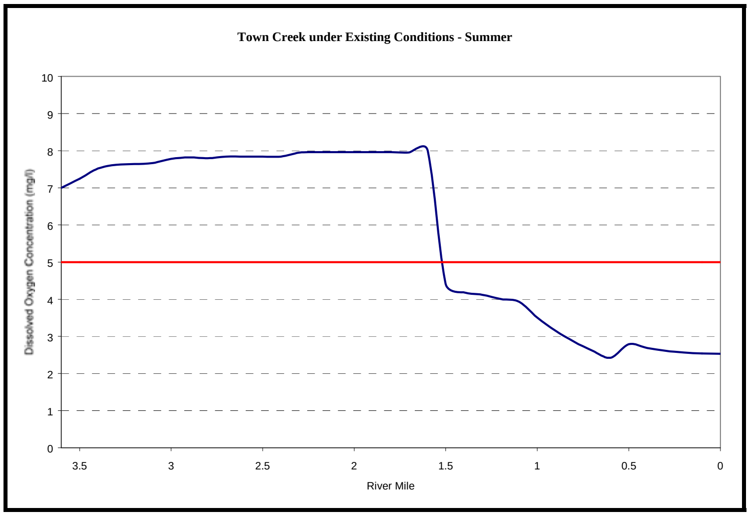
This TMDL will be published for a 30-day public notice. During this time, the public will be notified by publication in the statewide newspaper. The public will be given an opportunity to review the TMDL and submit comments. MDEQ also distributes all TMDLs at the beginning of the public notice to those members of the public who have requested to be included on a TMDL mailing list. TMDL mailing list members may request to receive the TMDL reports through either, email or the postal service. Anyone wishing to become a member of 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 hearing. If a public hearing is deemed appropriate, the public will be given a 30-day notice of the hearing to be held at a location near the watershed. That public hearing would be an official hearing of the Mississippi Commission on Environmental Quality, and would be transcribed.

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

APPENDIX A

Appendix A includes the model output graphs for all modeled segments under baseline conditions, after the application of the reduction scenario, and after the removal of the Bentonia facility. As seen in the graphs, only the Town Creek segment was affected by the reduction scenario and the removal of the Bentonia facility. See figure 4.2 for segment location.


Town Creek under Existing Conditions - Summer
Dissolved Oxygen Concentration (mg/l)
River Mile
10
9
8
7
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4
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3.5
3
2.5
2
1.5
1
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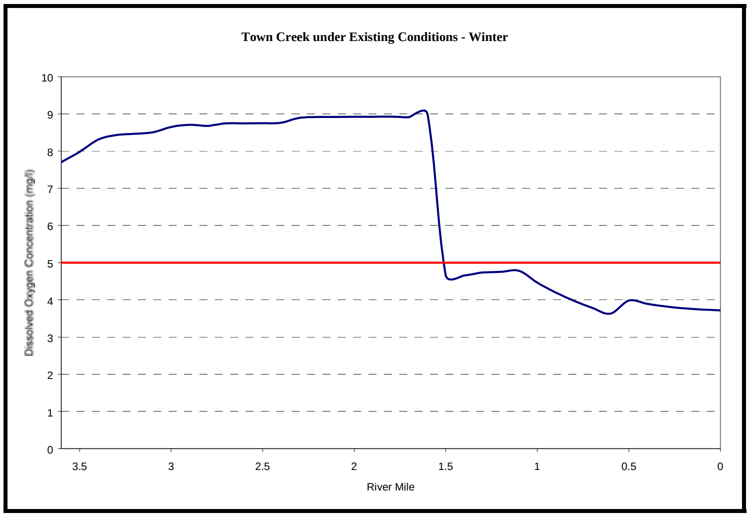
Town Creek under Existing Conditions - Winter
Dissolved Oxygen Concentration (mg/l)
River Mile
10
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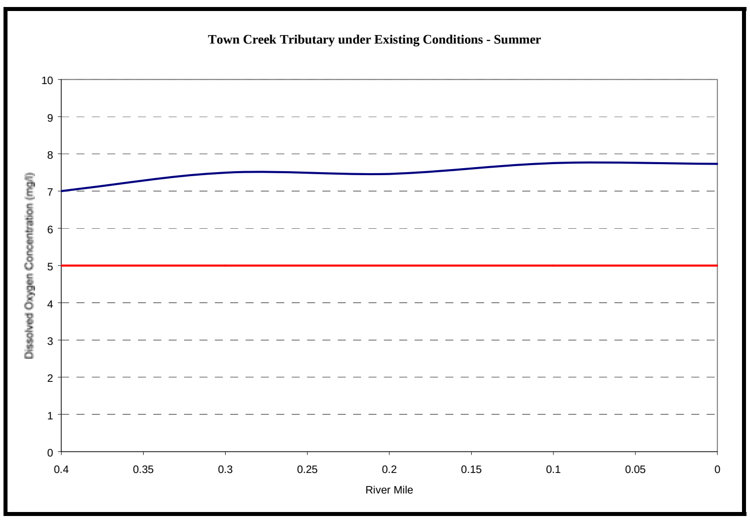
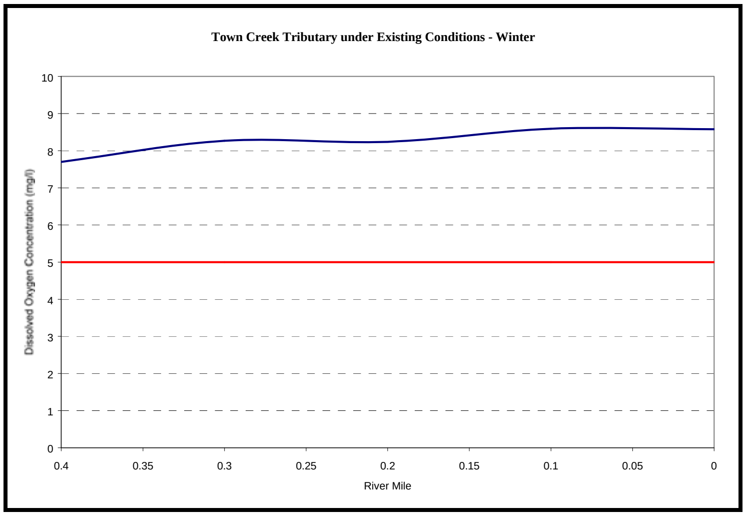

Town Creek Tributary under Existing Conditions - Summer
Dissolved Oxygen Concentration (mg/l)
River Mile
10
9
8
7
6
5
4
3
2
1
0
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0


Town Creek Tributary under Existing Conditions - Winter
Dissolved Oxygen Concentration (mg/l)
10
9
8
7
6
5
4
3
2
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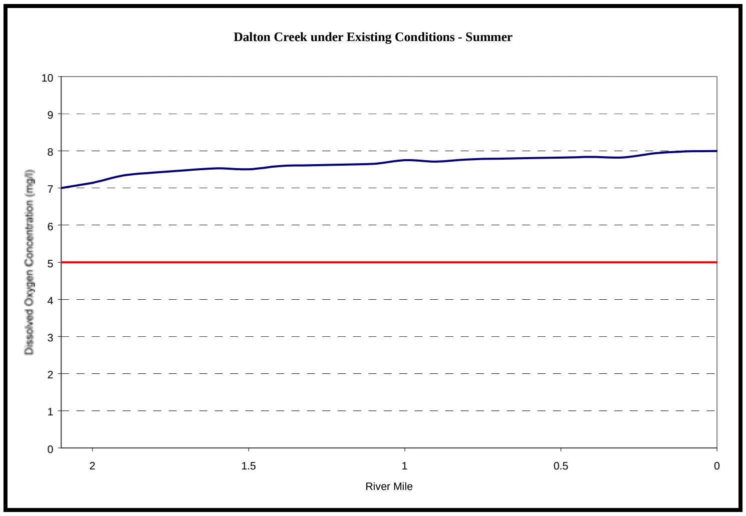
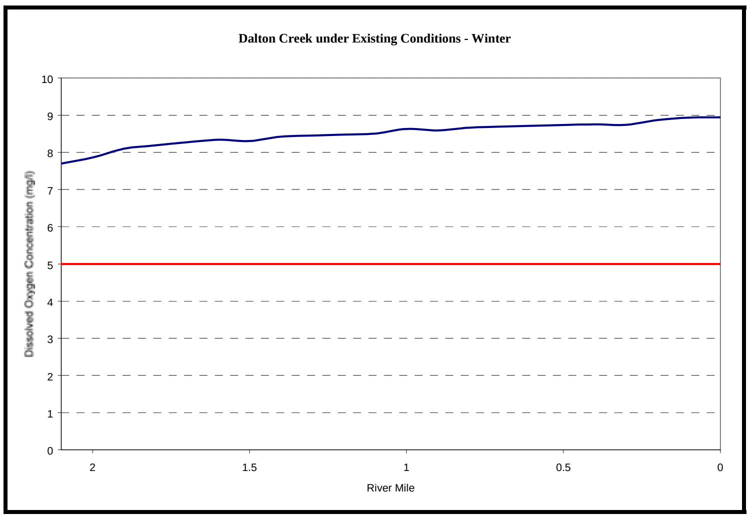
0
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
River Mile


Dalton Creek under Existing Conditions - Summer
Dissolved Oxygen Concentration (mg/l)
10
9
8
7
6
5
4
3
2
1
0
2
1.5
1
0.5
0
River Mile


Dalton Creek under Existing Conditions - Winter
Dissolved Oxygen Concentration (mg/l)
10
9
8
7
6
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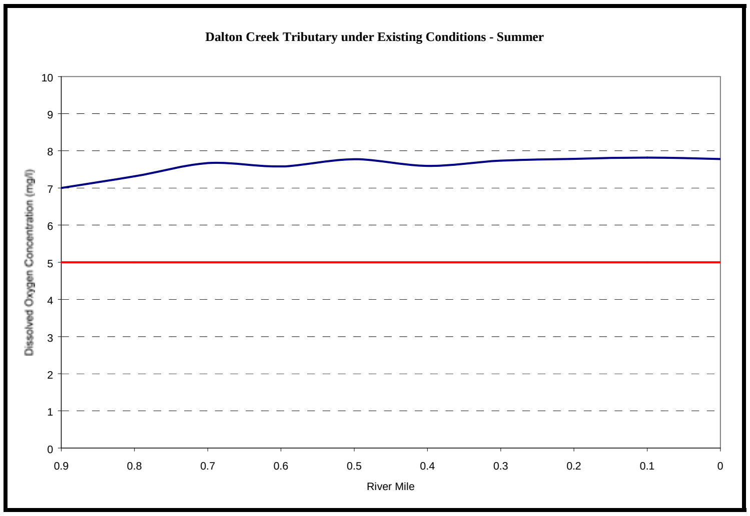
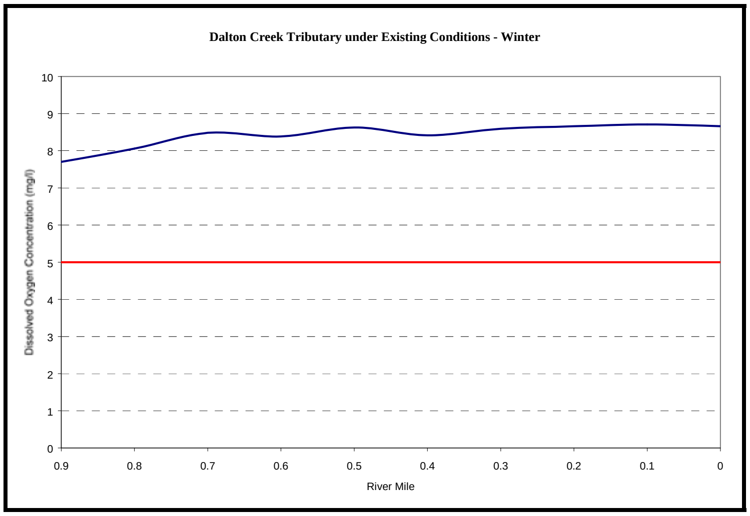
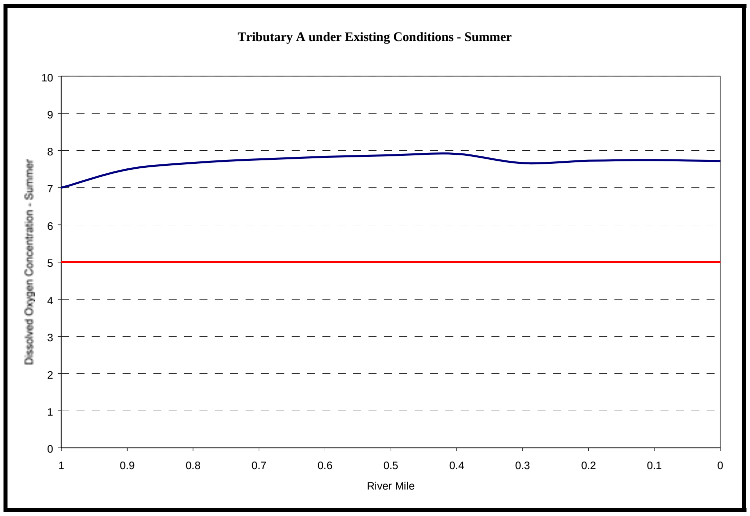
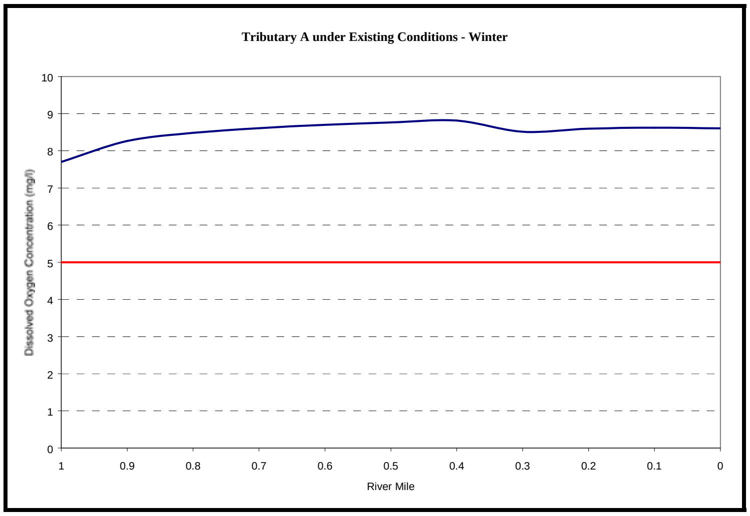
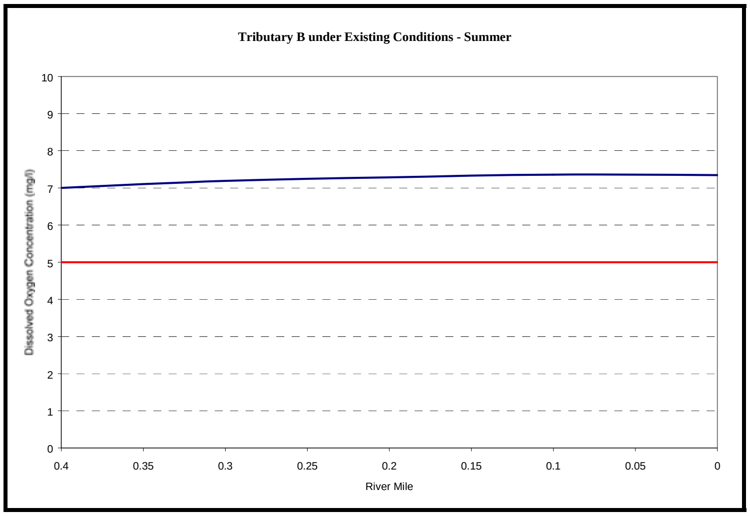
4
3
2
1
0
2
1.5
1
0.5
0
River Mile

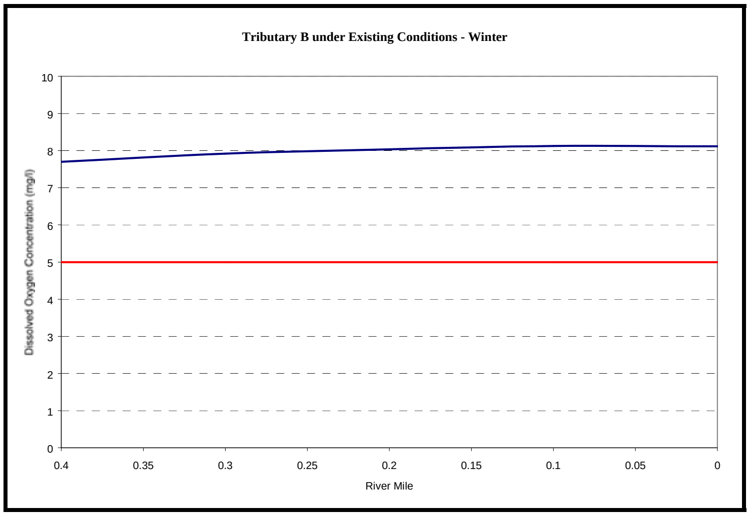

Dalton Creek Tributary under Existing Conditions - Summer
Dissolved Oxygen Concentration (mg/l)
River Mile
10
9
8
7
6
5
4
3
2
1
0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


Dalton Creek Tributary under Existing Conditions - Winter
Dissolved Oxygen Concentration (mg/l)
River Mile
10
9
8
7
6
5
4
3
2
1
0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


Tributary A under Existing Conditions - Summer
Dissolved Oxygen Concentration - Summer
River Mile
10
9
8
7
6
5
4
3
2
1
0
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


Tributary A under Existing Conditions - Winter
Dissolved Oxygen Concentration (mg/l)
10
9
8
7
6
5
4
3
2
1
0
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
River Mile


Tributary B under Existing Conditions - Summer
Dissolved Oxygen Concentration (mg/l)
10
9
8
7
6
5
4
3
2
1
0
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
River Mile


Tributary B under Existing Conditions - Winter
Dissolved Oxygen Concentration (mg/l)
10
9
8
7
6
5
4
3
2
1
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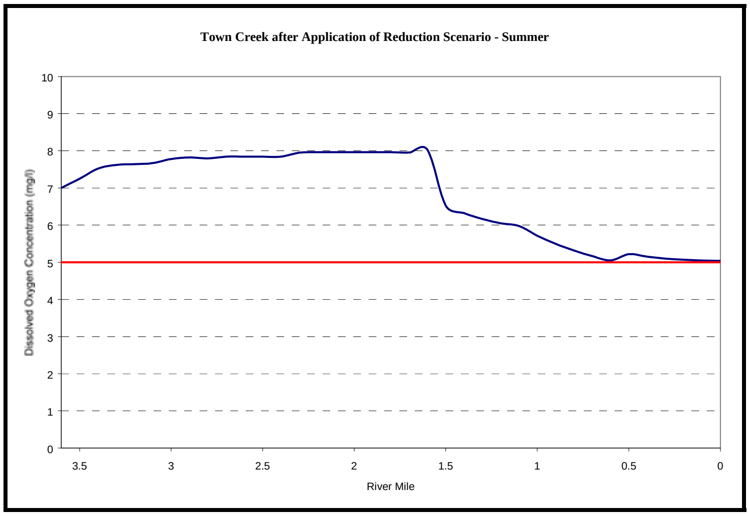
Town Creek after Application of Reduction Scenario - Summer
Dissolved Oxygen Concentration (mg/l)
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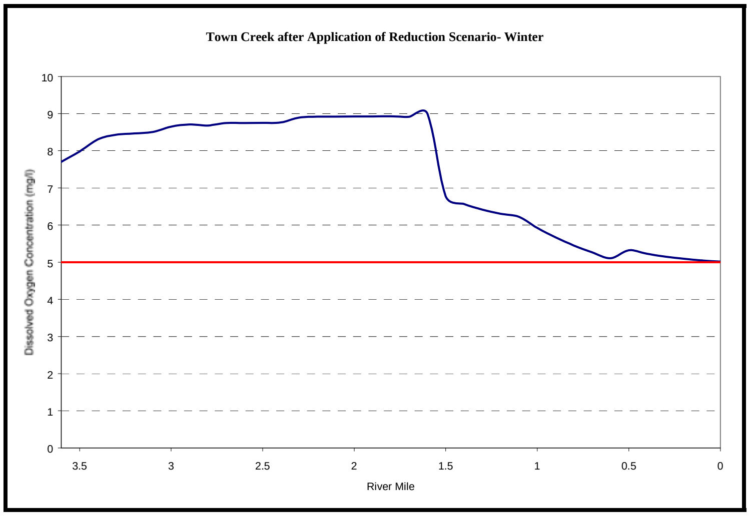
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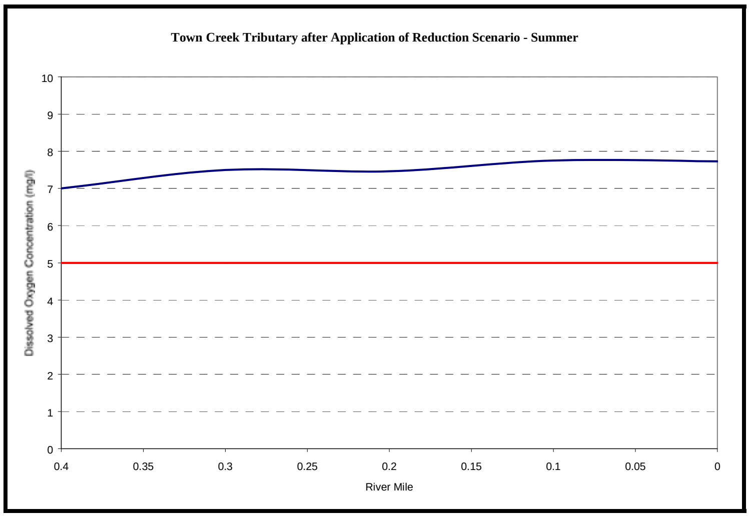
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Dissolved Oxygen Concentration (mg/l)
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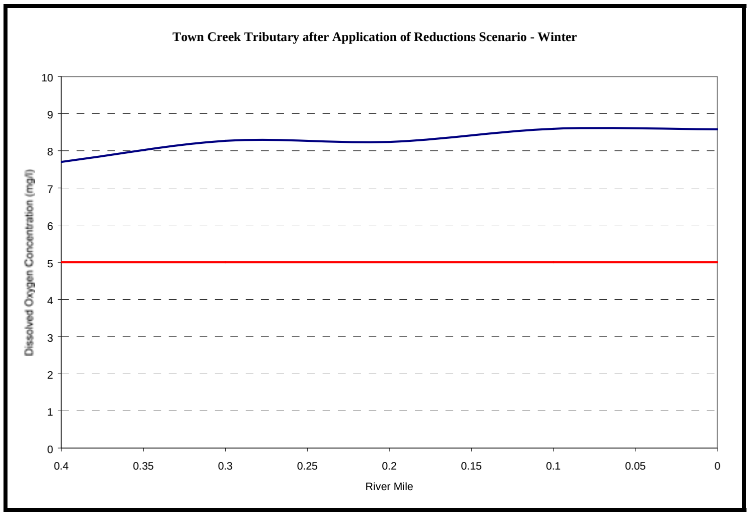
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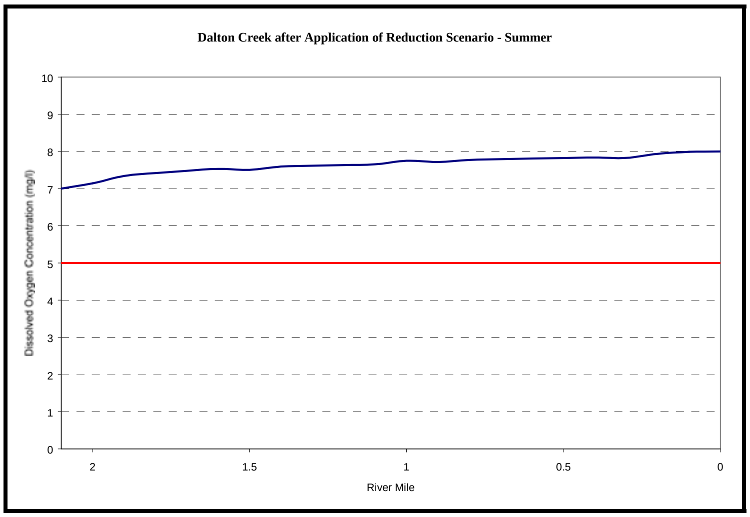
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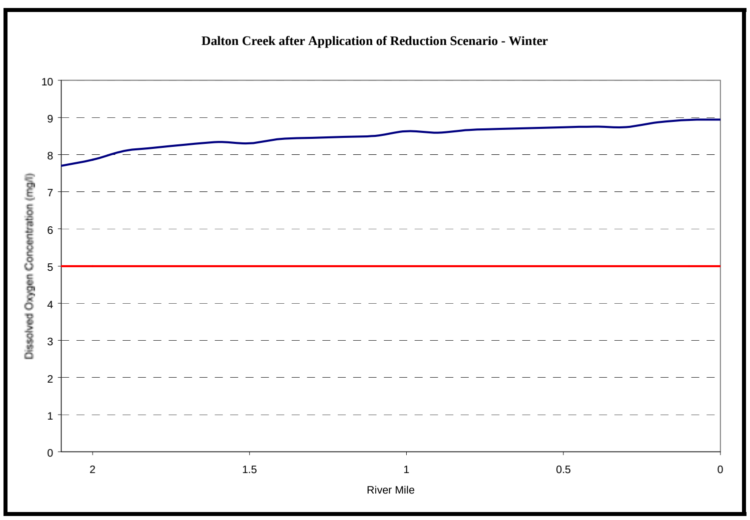
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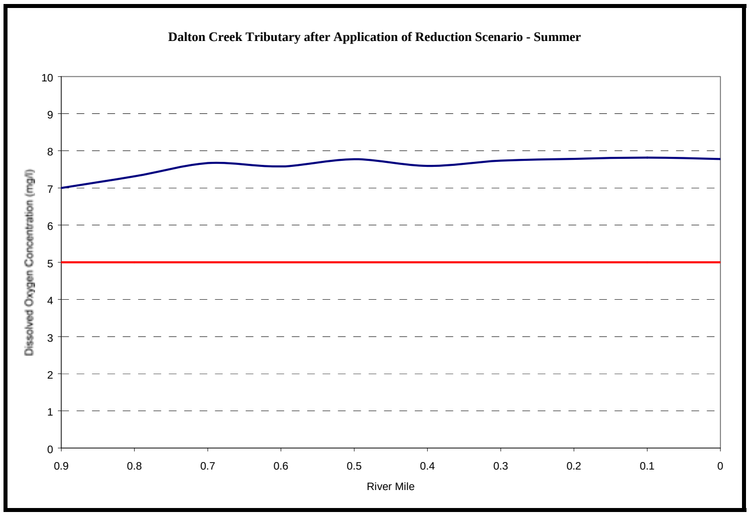
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Dissolved Oxygen Concentration (mg/l)
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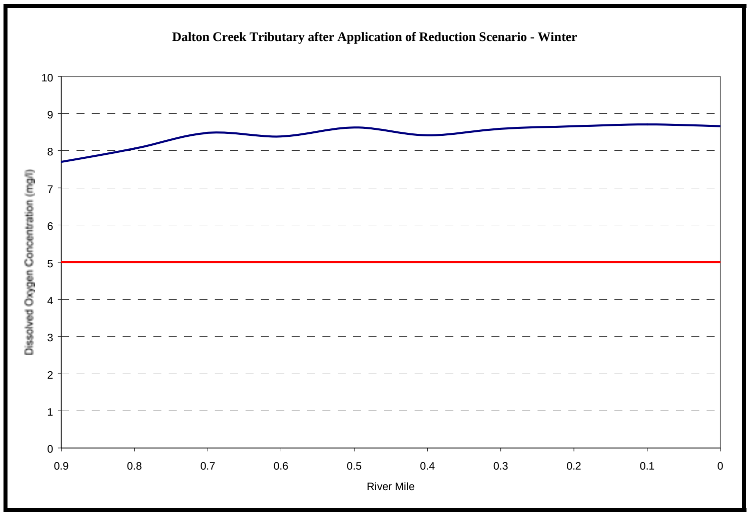
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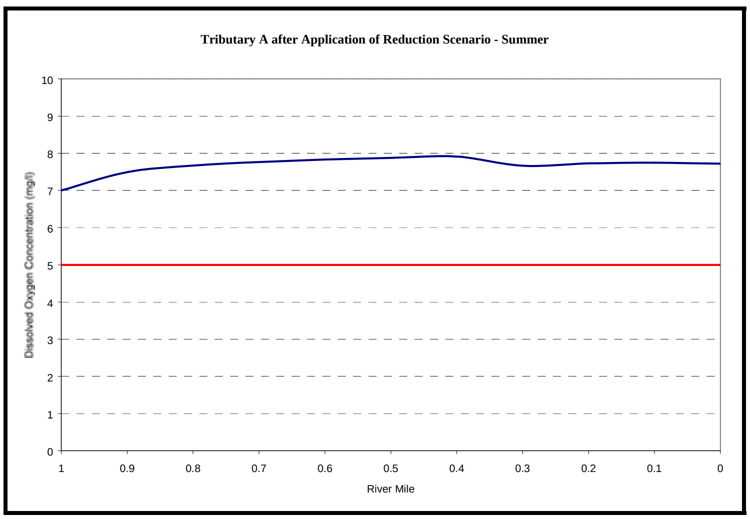
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Dissolved Oxygen Concentration (mg/l)
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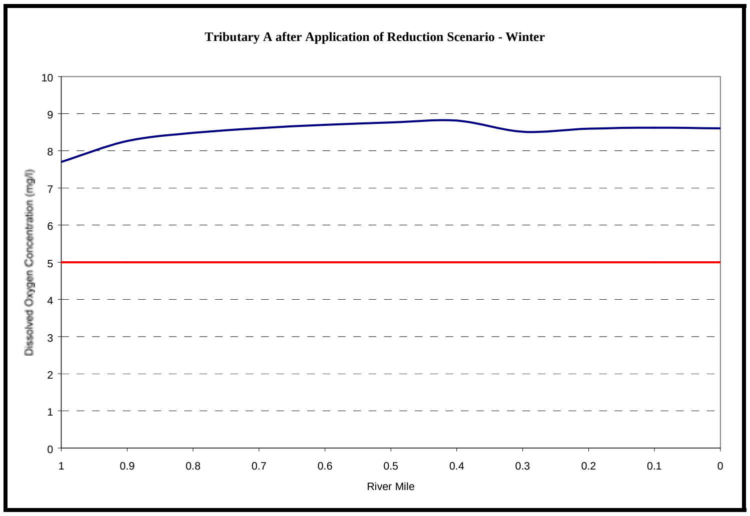
Tributary A after Application of Reduction Scenario - Winter
Dissolved Oxygen Concentration (mg/l)
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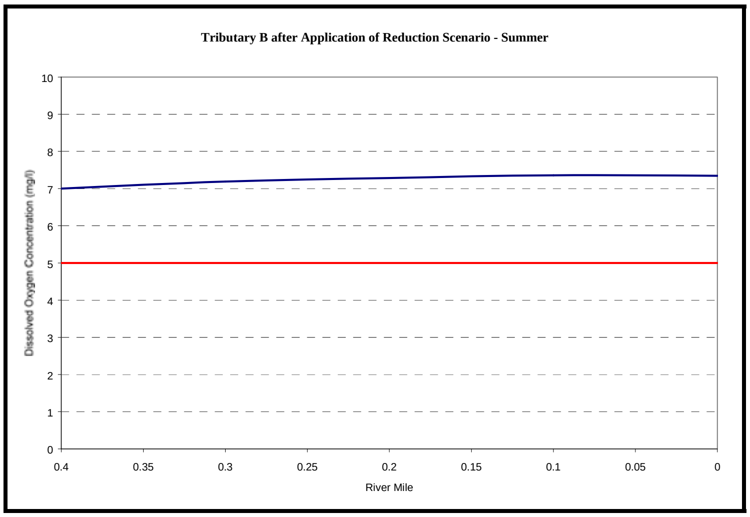
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Dissolved Oxygen Concentration (mg/l)
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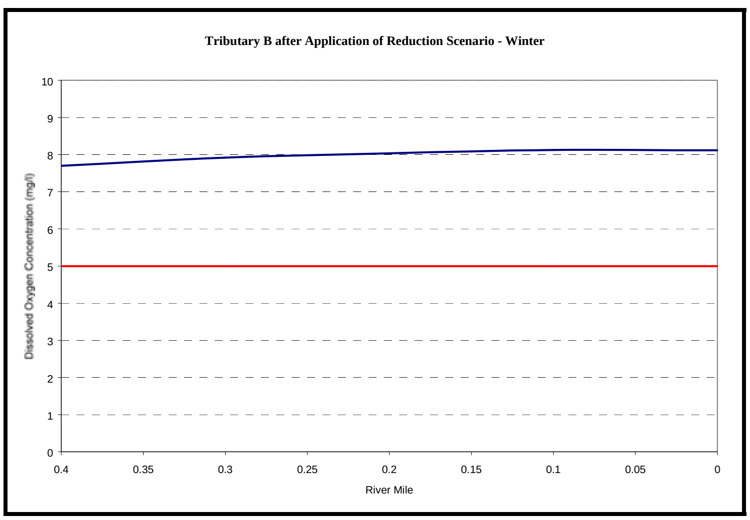
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Dissolved Oxygen Concentration (mg/l)
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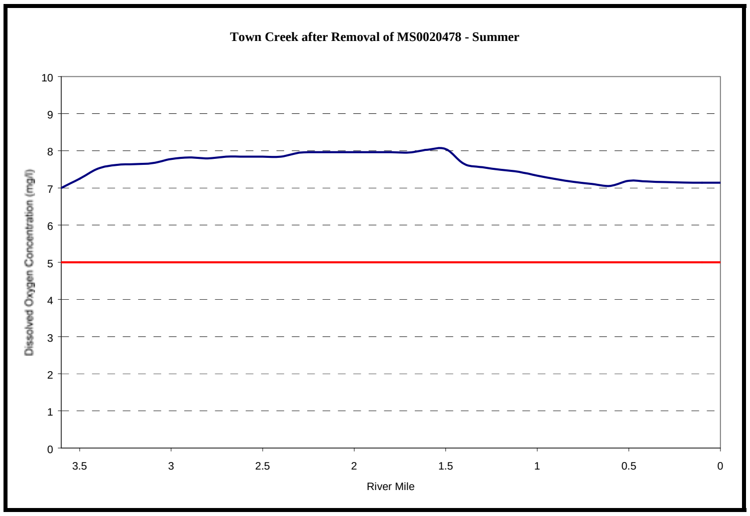
Town Creek after Removal of MS0020478 - Summer
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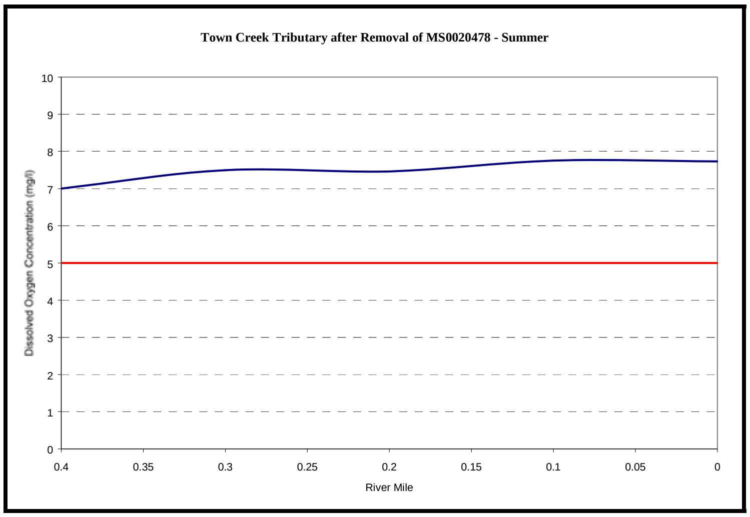
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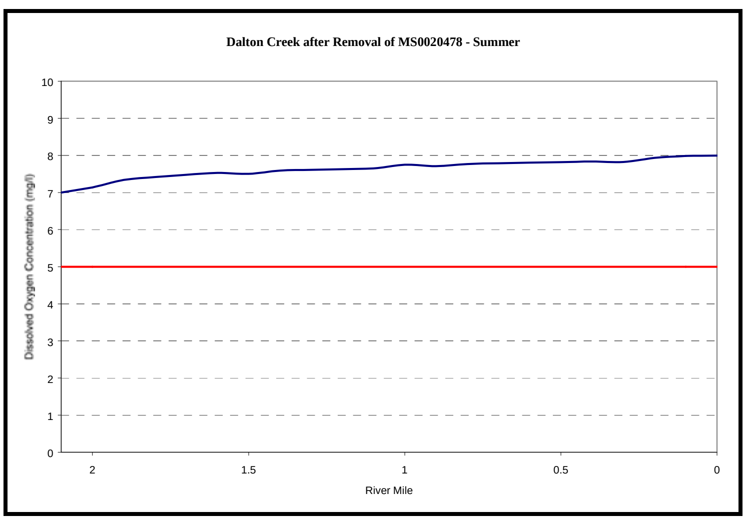
Dalton Creek after Removal of MS0020478 - Summer
Dissolved Oxygen Concentration (mg/l)
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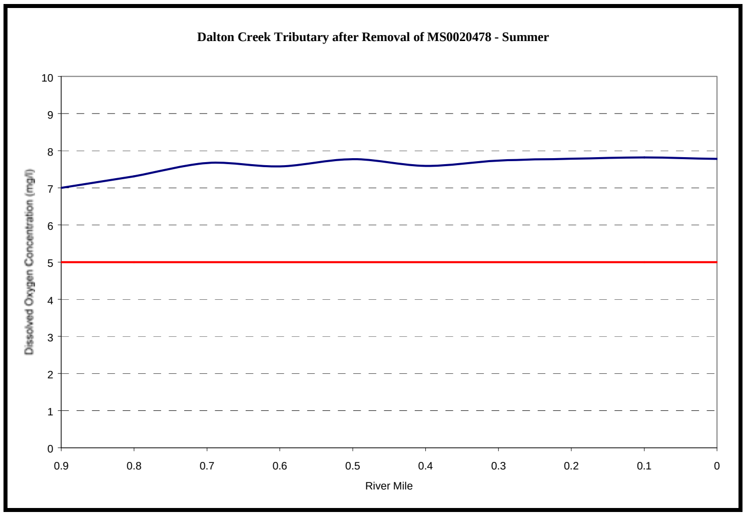

Dalton Creek Tributary after Removal of MS0020478 - Summer
Dissolved Oxygen Concentration (mg/l)
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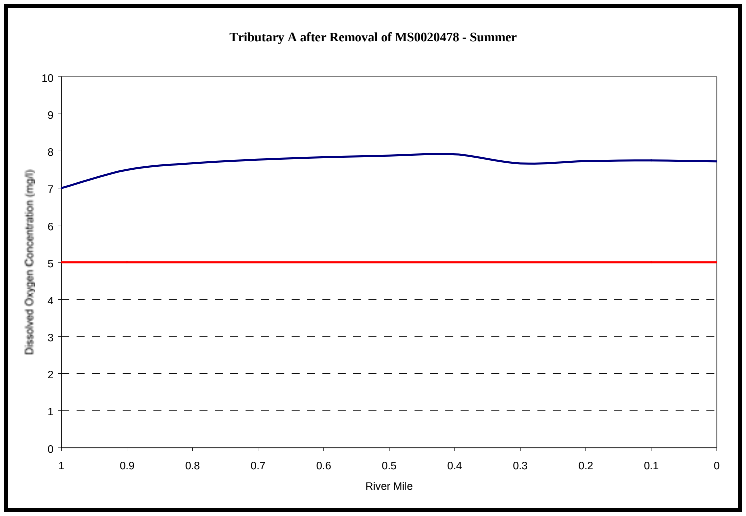

Tributary A after Removal of MS0020478 - Summer
Dissolved Oxygen Concentration (mg/l)
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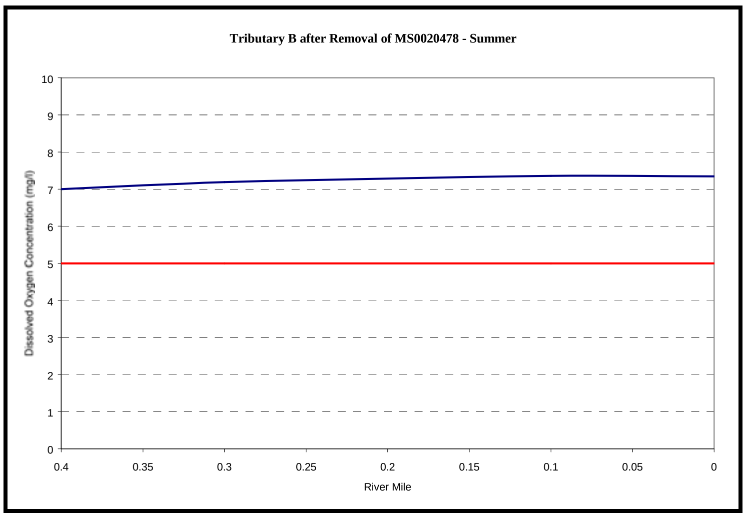

Tributary B after Removal of MS0020478 - Summer
Dissolved Oxygen Concentration (mg/l)
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River Mile

APPENDIX B

Appendix B contains copies of documentation regarding the move of the Bentonia WWTP discharge from Town Creek to the Big Black River. This information was provided by the Compliance/Enforcement Division of MDEQ.

Log to FP

7/24

WILLIAMS, WILLIAMS & CLARK | CONSULTING ENGINEERS

J. B. WILLIAMS (1897-1988) J. B. WILLIAMS, JR., P.E., PLS FREDERICK R. CLARK, P.E., PLS
JAMES H. BIGFORD, PLS J. WAYNE MORRISON, P.E., PLS

213 South Main Street
Post Office Box 567
YAZOO CITY, MISSISSIPPI 39194

Phone (601) 746-1863
Fax (601) 746-1864

DRAINAGE
FLOOD PREVENTION
HIGHWAYS and STREETS
LAND SURVEYS
MUNICIPAL WORKS

July 18, 2000

Mr. Michael McNair
Department of the Army
Corps of Engineers
4155 Clay Street
Vicksburg, MS 39180-3435

Re: Sewer force main outflow to Big Black River
C.D.B.G. Project No. 97-119-PF-01
Town of Bentonia, MS

Dear Mr. McNair,

The Town of Bentonia is moving its discharge location from Town Creek (near its existing wastewater treatment plant) by pumping to a point near the intersection of Bluff Creek and Big Black River (in the NW 1/4 of Section 24, T-9-N, R-2-W, Yazoo County). The attached maps are an effort to describe the nature of this work by giving location and quantities of the work proposed. The Sewer effluent is pumped thru a six inch force main at a rate of 200 gpm to the river. It is proposed to build an energy dissipater at the end of this line then by rip rap- lined ditch to the low water line of the Big Black River. If you need any additional information, please don't hesitate to call me at 662.746.1863.

Sincerely,
WILLIAMS, WILLIAMS & CLARK
Consulting Engineers

J. Wayne Morrison

by: J. Wayne Morrison, P.E., P.L.S.

Enclosures: (7)

cc: Ms. Mesha Williams-Jones, MDEQ Office of Pollution Control
File

20001125O

STATE OF MISSISSIPPI
DAVID RONALD MUSGROVE, GOVERNOR
MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY
CHARLES H. CHISOLM, EXECUTIVE DIRECTOR

FILE COPY

October 18, 2000

Mr. J. Wayne Morrison
Williams, Williams and Clark
213 South Main Street
Yazoo, MS 39194

m-6969

Re: CDBG Project No. 97-119-PF-01
Town of Bentonia
Plans, Specifications and Data
Yazoo County

Review of the plans for the above referenced system has been completed and preliminary approval is hereby indicated.

When this project has been completed, it will be necessary that your engineer notify this office by letter and certify that construction and installation were performed in accordance with these approved plans. "As Built" plans and specifications must also be submitted if any changes in the approved plans were made. Finally, we must receive written notification from officials that the system has been accepted "As Built".

If substantial construction is not commenced within twelve (12) months, this approval is void. It will be necessary to submit this project for review once again after that time. Please contact us if we can be of any further assistance on this project.

Sincerely,

Mesha Williams-Jones
Municipal and Private facilities Branch

CC: Mrs. Wendy Steffe, State Department of Health

OFFICE OF POLLUTION CONTROL
POST OFFICE BOX 10385 • JACKSON, MISSISSIPPI 39289-0385 • TEL: (601) 961-5171 • FAX: (601) 354-6612 • www.deq.state.ms.us
AN EQUAL OPPORTUNITY EMPLOYER

REFERENCES

MDEQ. 1994. *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.* Office of Pollution Control.

MDEQ. 1995. *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. Office of Pollution Control.

MDEQ. 1998. *Mississippi List of Waterbodies, Pursuant to Section 303(d) of the Clean Water Act*. Office of Pollution Control.

MDEQ. 1998. *Mississippi 1998 Water Quality Assessment, Pursuant to Section 305(b) of the Clean Water Act*. Office of Pollution Control.

Metcalf and Eddy, Inc. 1991. *Wastewater Engineering: Treatment, Disposal, and Reuse 3rd ed*. New York: McGraw-Hill.

Telis, Pamela A. 1992. *Techniques for Estimating 7-Day, 10-Year Low Flow Characteristics for Ungaged Sites on Streams in Mississippi*. U.S. Geological Survey, Water Resources Investigations Report 91-4130.

USEPA. 1997. *Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2: Streams and Rivers, Part 1: Biochemical Oxygen Demand/Dissolved Oxygen and Nutrients/ Eutrophication*. United States Environmental Protection Agency, Office of Water, Washington, D.C. EPA 823-B-97-002.

DEFINITIONS

5-Day Biochemical Oxygen Demand: Also called BOD_5, the amount of oxygen consumed by microorganisms while stabilizing or degrading carbonaceous or nitrogenous compounds under aerobic conditions over a period of 5 days.

Activated Sludge: A secondary wastewater treatment process that removes organic matter by mixing air and recycled sludge bacteria with sewage to promote decomposition

Aerated Lagoon: A relatively deep body of water contained in an earthen basin of controlled shape which is equipped with a mechanical source of oxygen and is designed for the purpose of treating wastewater.

Ammonia: Inorganic form of nitrogen (NH_3); product of hydrolysis of organic nitrogen and denitrification. Ammonia is preferentially used by phytoplankton over nitrate for uptake of inorganic nitrogen.

Ammonia Nitrogen: The measured ammonia concentration reported in terms of equivalent ammonia concentration; also called total ammonia as nitrogen (NH_3-N)

Ammonia Toxicity: Under specific conditions of temperature and pH, the unionized component of ammonia can be toxic to aquatic life. The unionized component of ammonia increases with pH and temperature.

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.

Biological Impairment: Condition in which at least one biological assemblages (e.g. , fish, macroinvertabrates, or algae) indicates less than full support with moderate to severe modification of biological community noted.

Carbonaceous Biochemical Oxygen Demand: Also called CBODu, the amount of oxygen consumed by microorganisms while stabilizing or degrading carbonaceous compounds under aerobic conditions over an extended time period.

Calibrated Model: A model in which reaction rates and inputs are significantly based on actual measurements using data from surveys on the receiving waterbody.

Conventional Lagoon: An un-aerated, relatively shallow body of water contained in an earthen basin of controlled shape and designed for the purpose of treating water.

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.

Dissolved Oxygen: The amount of oxygen dissolved in water. It also refers to a measure of the amount of oxygen that is available for biochemical activity in a water body. The maximum concentration of dissolved oxygen in a waterbody depends on temperature, atmospheric pressure, and dissolved solids.

Dissolved Oxygen Deficit: The saturation dissolved oxygen concentration minus the actual dissolved oxygen concentration.

DO Sag: Longitudinal variation of dissolved oxygen representing the oxygen depletion and recovery following a waste load discharge into a receiving water.

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.

First Order Kinetics: Describes a reaction in which the rate of transformation of a pollutant is proportional to the amount of that pollutant in the environmental system.

Groundwater: Subsurface water in the zone of saturation. Groundwater infiltration describes the rate and amount of movement of water from a saturated formation.

Impaired Waterbody: Any waterbody that does not attain water quality standards due to an individual pollutant, multiple pollutants, pollution, or an unknown cause of impairment.

Land Surface Runoff: Water that flows into the receiving stream after application by rainfall or irrigation. It is a transport method for nonpoint source pollution from the land surface to the receiving stream.

Load Allocation (LA): The portion of a receiving water's loading capacity attributed to or assigned to nonpoint sources (NPS) or background sources of a pollutant

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

Mass Balance: An equation that accounts for the flux of mass going into a defined area and the flux of mass leaving a defined area, the flux in must equal the flux out.

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; silvaculture; surface mining; disposal of wastewater; hydrologic modifications; and urban development.

Nitrification: The oxidation of ammonium salts to nitrites via *Nitrosomonas* bacteria and the further oxidation of nitrite to nitrate via *Nitrobacter* bacteria.

Nitrogenous Biochemical Oxygen Demand: Also called NBODu, the amount of oxygen consumed by microorganisms while stabilizing or degrading nitrogenous compounds under aerobic conditions over an extended time period.

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.

Photosynthesis: The biochemical synthesis of carbohydrate based organic compounds from water and carbon dioxide using light energy in the presence of chlorophyll.

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.

Reaeration: The net flux of oxygen occurring from the atmosphere to a body of water across the water surface.

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.

Respiration: The biochemical process by means of which cellular fuels are oxidized with the aid of oxygen to permit the release of energy required to sustain life. During respiration, oxygen is consumed and carbon dioxide is released.

Sediment Oxygen Demand: The solids discharged to a receiving water are partly organics, which upon settling to the bottom decompose aerobically, removing oxygen from the surrounding water column.

Storm Runoff: Rainfall that does not evaporate or infiltrate the ground because of impervious land surfaces or a soil infiltration rate than rainfall intensity, but instead flows into adjacent land or waterbodies or is routed into a drain or sewer system.

Streeter-Phelps DO Sag Equation: An equation which uses a mass balance approach to determine the DO concentration in a waterbody downstream of a point source discharge. The equation assumes that the stream flow is constant and that CBODu exertion is the only source of DO deficit while reaeration is the only sink of DO deficit.

Total Ultimate Biochemical Oxygen Demand: Also called TBODu, the amount of oxygen consumed by microorganisms while stabilizing or degrading carbonaceous or nitrogenous compounds under aerobic conditions over an extended time period.

Total Kjeldahl Nitrogen: Also called TKN, organic nitrogen plus ammonia nitrogen.

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.

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

$CBOD_5$ .... 5-Day Carbonaceous Biochemical Oxygen Demand

$CBOD_U$ .... Carbonaceous Ultimate Biochemical Oxygen Demand

CWA .... Clean Water Act

DMR .... Discharge Monitoring Report

DO .... Dissolved Oxygen

EPA .... Environmental Protection Agency

GIS .... Geographic Information System

HUC .... Hydrologic Unit Code

LA .... Load Allocation

MARIS .... Mississippi Automated Resource Information System

MDEQ .... Mississippi Department of Environmental Quality

MGD .... Million Gallons per Day

MOS .... Margin of Safety

$NBOD_U$ .... Nitrogenous Ultimate Biochemical Oxygen Demand

NH_3 .... Total Ammonia

NH_3-N .... Total Ammonia as Nitrogen

NO_2+ NO_3 .... Nitrite Plus Nitrate

NPDES .... National Pollution Discharge Elimination System

RBA .... Rapid Biological Assessment

$TBOD_5$ .... 5-Day Total Biochemical Oxygen Demand

$TBOD_U$ .... Total Ultimate Biochemical Oxygen Demand

TKN .... Total Kjeldahl Nitrogen

TN .... Total Nitrogen

TOC .... Total Organic Carbon

TP .... Total Phosphorous

USGS .... United States Geological Survey

WLA .... Waste Load Allocation

WWTP .... Wastewater Treatment Plant