FINAL REPORT
December 2011

Total Maximum Daily Load

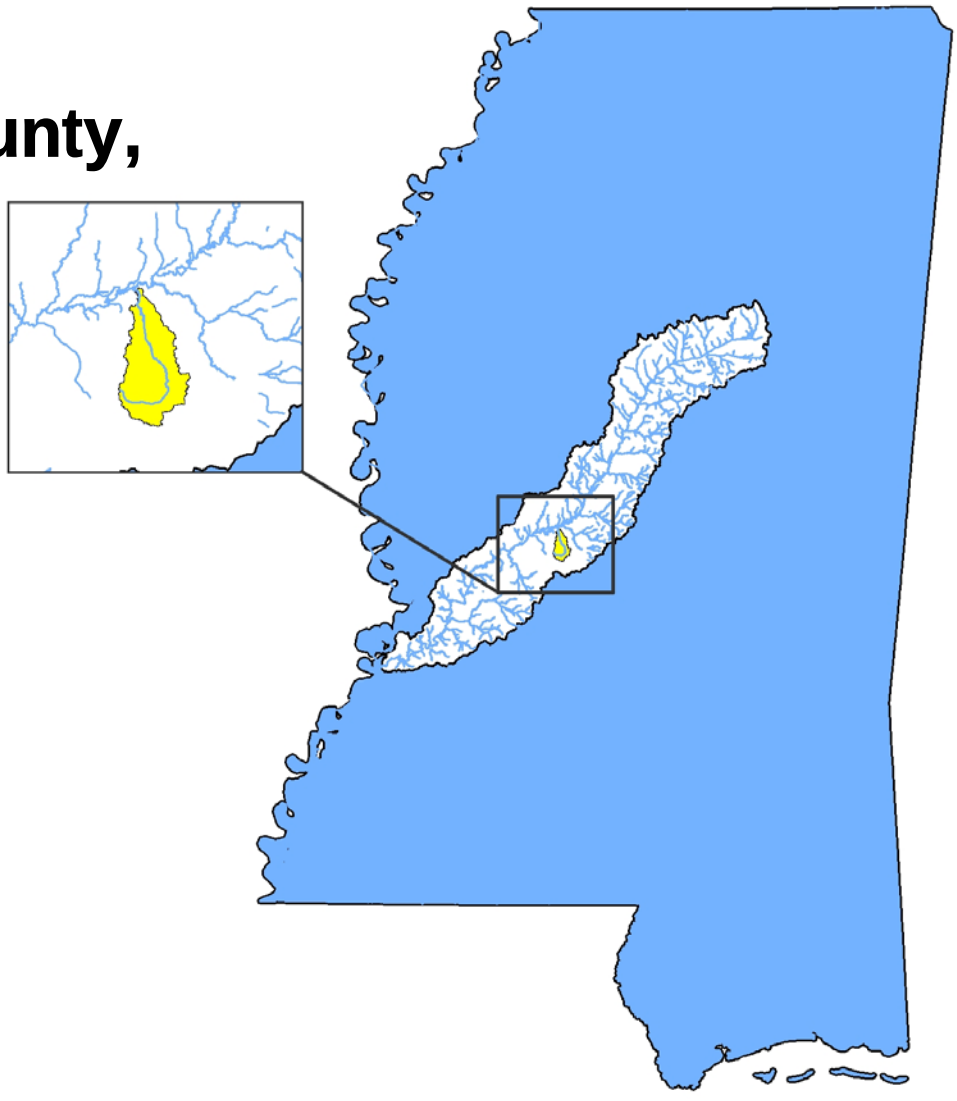
Organic Enrichment / Low Dissolved Oxygen

For

Panther Creek

Big Black River Basin

Madison County, Mississippi



Prepared By

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FOREWORD

The report contains one or more Total Maximum Daily Loads (TMDLs) for water body segments found on Mississippi's current 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 TMDLs 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.

Conversion Factors

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

Fraction	Prefix	Symbol	Multiple	Prefix	Symbol
10^{-1}	deci	d	10	deka	da
10^{-2}	centi	c	10^2	hecto	h
10^{-3}	milli	m	10^3	kilo	k
10^{-6}	micro	:	10^6	mega	M
10^{-9}	nano	n	10^9	giga	G
10^{-12}	pico	p	10^{12}	tera	T
10^{-15}	femto	f	10^{15}	peta	P
10^{-18}	atto	a	10^{18}	exa	E

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TMDL INFORMATION PAGE

Table 1. Listing Information

Name	ID	County	HUC	Stressors
Panther Creek	104611	Madison	08060202	Organic Enrichment / Low Dissolved Oxygen
Near Canton from headwaters to confluence with Big Black River				

Table 2. 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

Table 3. Total Maximum Daily Load

Pollutant	WLA (lbs/day)	LA (lbs/day)	MOS	TMDL (lbs/day)
TBODu	**0**	**4016**	**Implicit**	**4016**

EXECUTIVE SUMMARY

This TMDL has been developed for Panther Creek which was placed on the Mississippi 2010 Section 303(d) List of Impaired Water Bodies due to monitoring data collected during the 2002 study of the Big Black River. These data were collected in a ponded non-flowing section of the stream and indicated impairment for organic enrichment / low dissolved oxygen. This TMDL will provide an allocation for TBODu in the watershed. There are no permitted point sources in the watershed, nor will any be permitted due to the adjacent Madison County POTW.

The Panther Creek Watershed is located in HUC 08060202 near Canton. Panther Creek flows for 15.6 miles in a in a northerly direction from its headwaters near Canton through plantation lands to the confluence with the Big Black River.

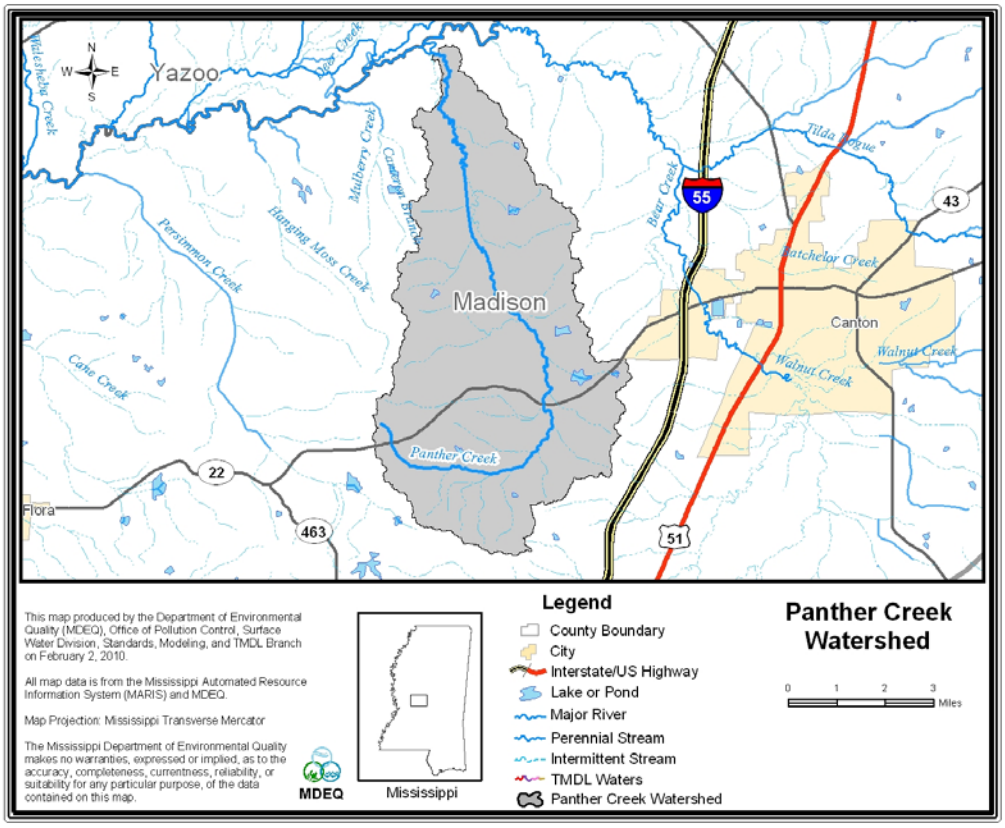


Figure 1. Panther Creek

INTRODUCTION

1.1 Background

The identification of water bodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those water bodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR part 130). The TMDL process is designed to restore and maintain the quality of those impaired water bodies through the establishment of pollutant specific allowable loads. This TMDL has been developed for the 2010 §303(d) listed segment 104611 shown in Figure 2.

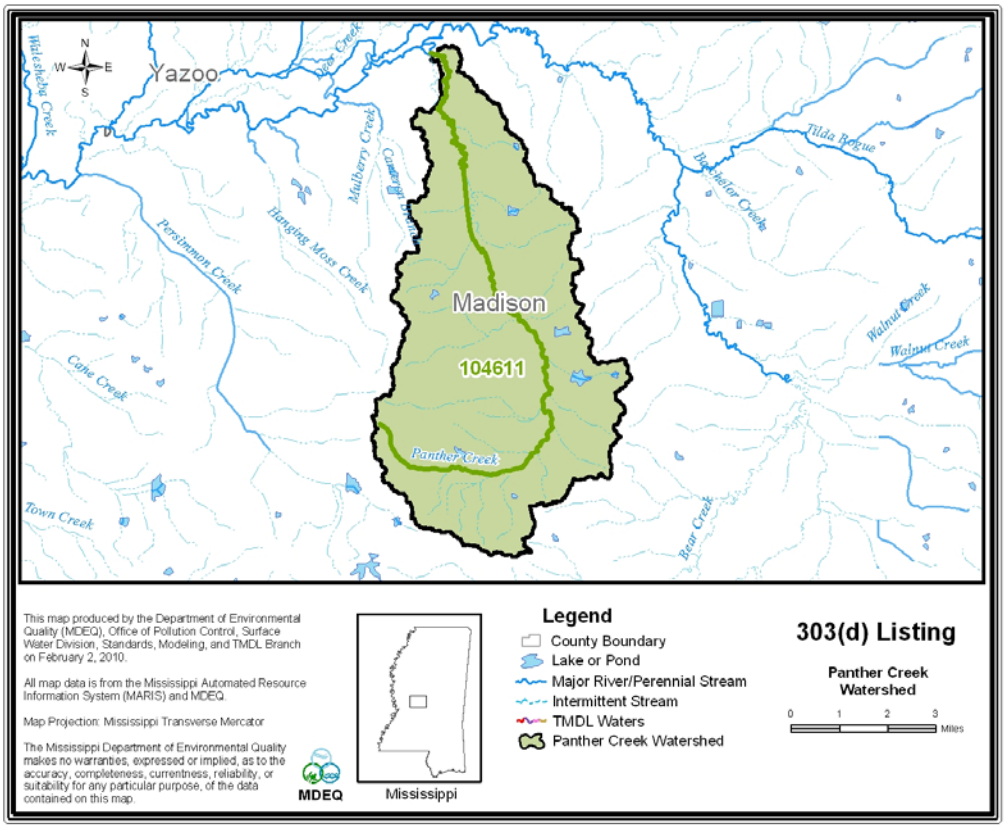


Figure 2. Panther Creek §303(d) Segment

The Panther Creek segment is in Hydrologic Unit Code (HUC) 08060202 in central Mississippi. The watershed is approximately 83.7 square kilometers (32.3 square miles) and is primarily rural. Forest and pasture are the dominant land uses within the watershed. The National Hydrology Dataset has the average flow in the watershed at 42.82 cfs. The data that show impairment were collected with an estimated flow of 0.01 cfs at River Mile 1.6 located just north of Mt. Elam Road.

1.2 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, 2007). The designated beneficial use for the listed segment is fish and wildlife.

1.3 Applicable Water Body Segment Standard

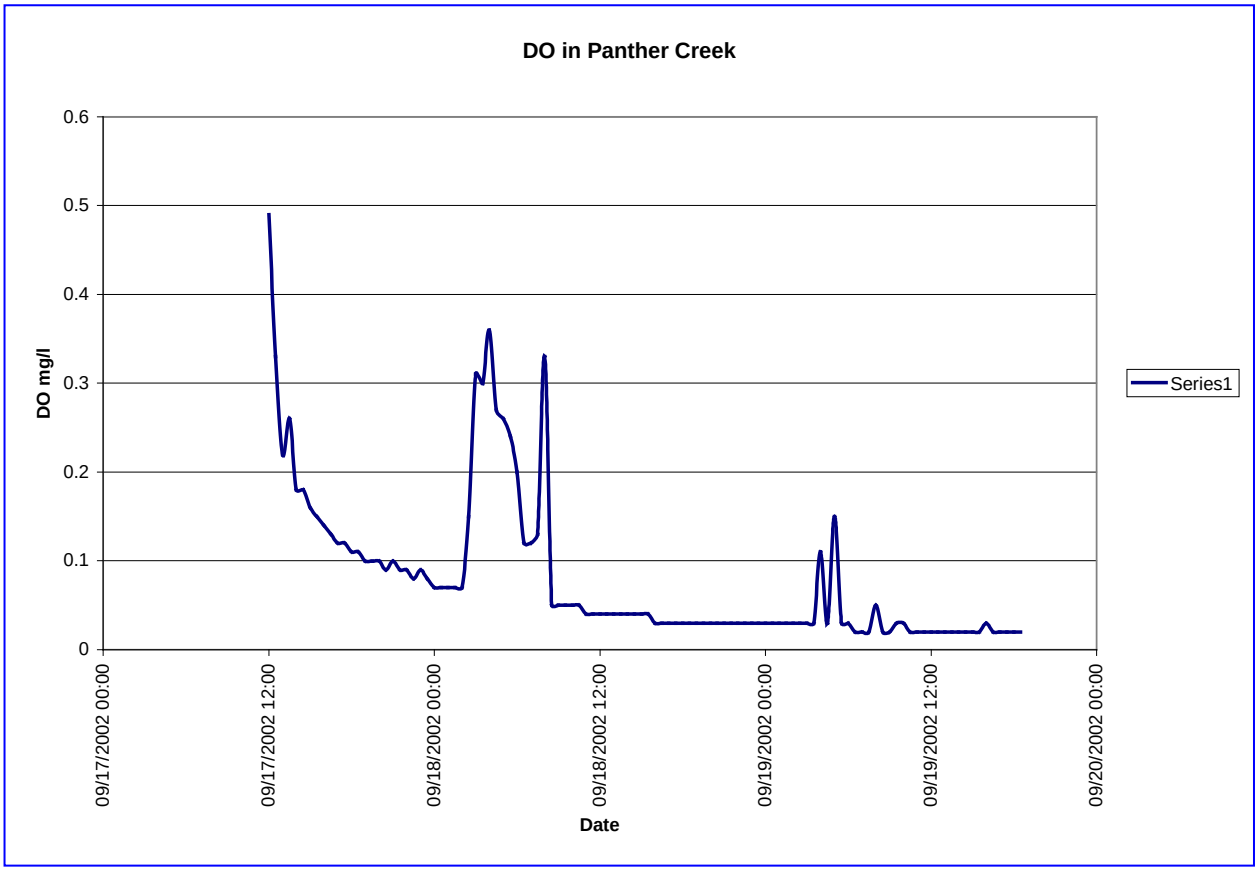
The water quality standard applicable to the use of the water body and the pollutant of concern is defined in *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (WPC-2)(MDEQ, 2007).

Figure 3. Panther Creek at Virillia Road August, 2011

WATER BODY ASSESSMENT

2.1 Panther Creek Water Quality Data

Dissolved oxygen data for the Panther Creek Watershed were collected as part of a study on the Big Black River in 2002. The data are graphed in Figure 4 below. The picture to the right shows the condition of the stream where the data were collected. The estimated flow for the 2 days was 0.01 cfs. These data were gathered in a non flowing, trapped, ponded section of the stream and do not exemplify a DO reading in a flowing stream of this type. These data were used for assessment and the listing of this segment on the §303(d) list.



2.2 Assessment of Point Sources

Previously one NPDES permitted facility was in the watershed. Canton Utilities had a facility serving the Lake Caroline Development. However, this treatment plant was taken off line and no longer discharges in the watershed. There are now no point sources in the Panther Creek Watershed.

2.3 Assessment of Non-Point Sources

Non-point 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 20,690 acre watershed contains mainly pastureland & forest but also has different landuse types, including urban, water, and wetlands. The land use information for the watershed is based on the National Land Cover Database (NLCD). The landuse distribution for the Panther Creek Watershed is shown in Table 4 and Figure 4.

Table 4. Land Use Distribution (acres)

	Urban	Forest	Cropland	Pasture	Scrub/Barren	Water	Wetland
Area (acres)	857.8	6,061.8	3,321.5	6,092.5	1,617.5	1,125.5	1,613.3
% Area	4.2%	29.3%	16.1%	29.4%	7.8%	5.4%	7.8%

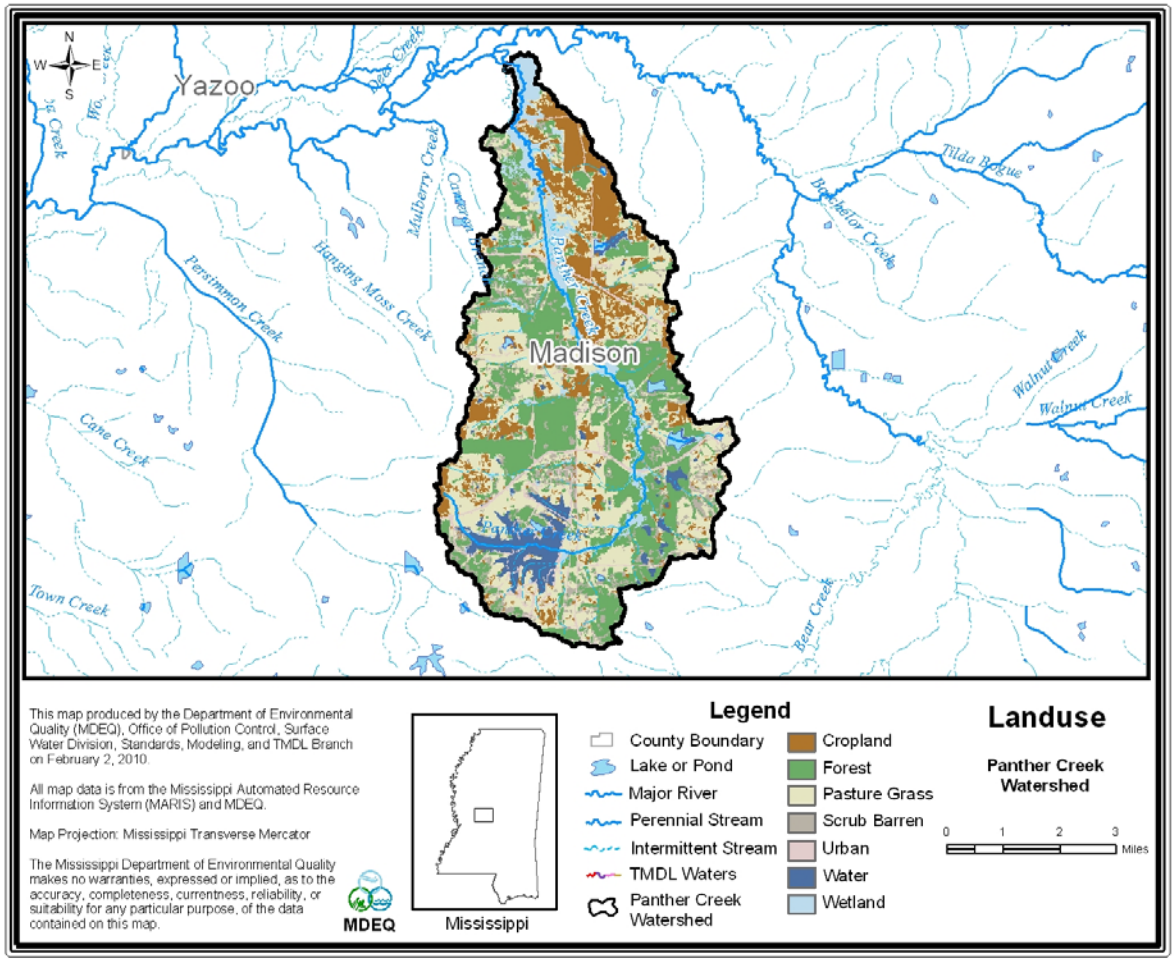


Figure 4. Landuse in the Panther Creek Watershed

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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. In this section, the selection of the modeling tools, setup, and model application are discussed.

3.1 Modeling Framework Selection

MDEQ's mathematical 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 was approved by EPA and is used extensively at MDEQ. A key reason for using the STREAM model in TMDL development is its ability to assess instream water quality conditions in response to point and non-point source loadings.

STREAM is a steady-state, daily average computer model that utilizes a modified Streeter-Phelps DO sag equation. Instream processes simulated by the model may include CBODu decay, nitrification, reaeration, sediment oxygen demand, and respiration and photosynthesis of algae. Figure 5 shows how these processes are related in a typical DO model. Reaction rates for the instream processes are input by the user and corrected for temperature by the model. The model output includes water quality conditions in each computational element for DO, CBODu, and NH_3-N concentrations. The hydrological processes simulated by the model include stream velocity and flow from point sources and spatially distributed inputs.

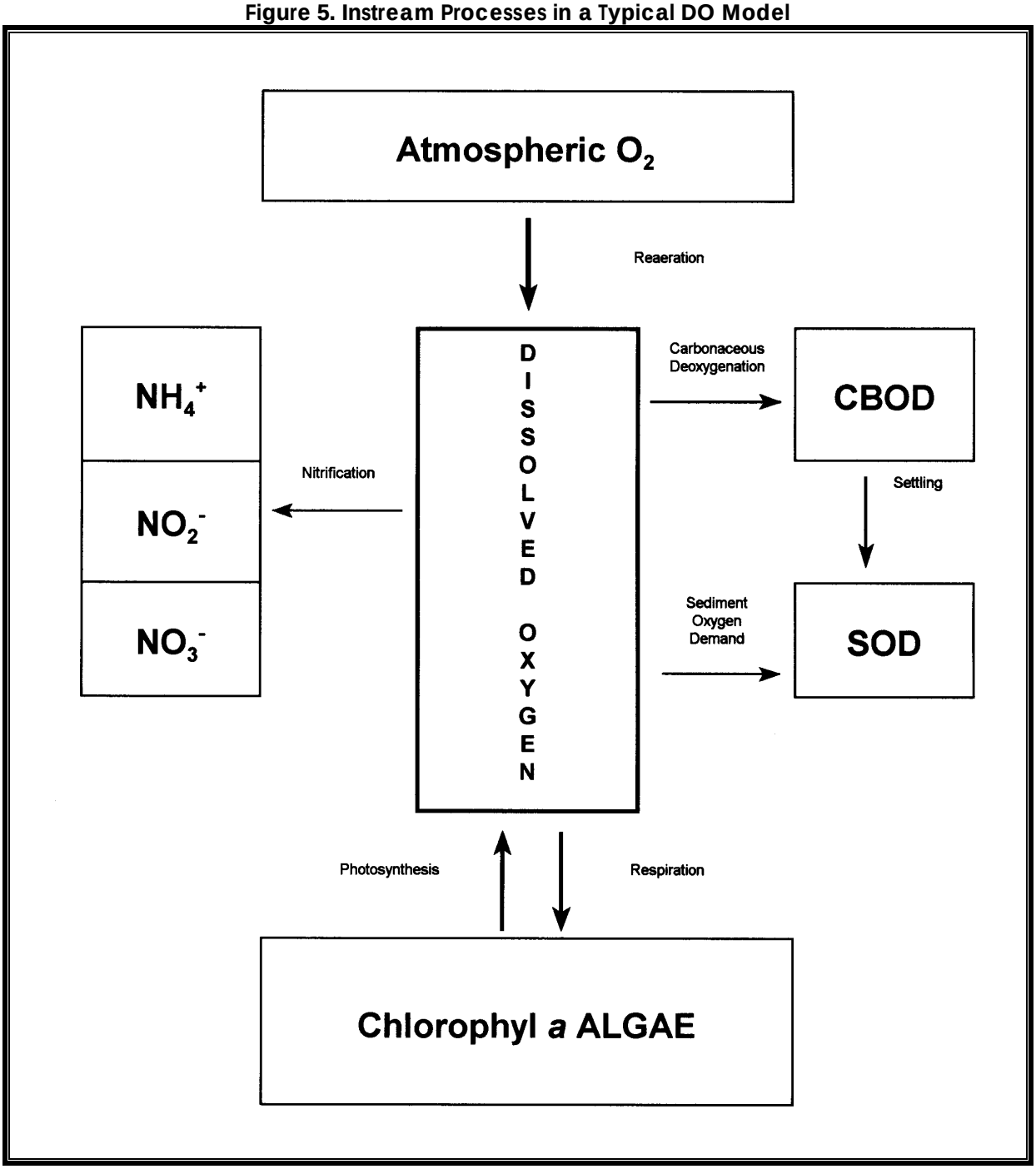
The model was set up to calculate reaeration within each reach using the Tsivoglou formulation. The Tsivoglou formulation calculates the reaeration rate, K_a (day^{-1} base *e*), within each reach according to Equation 1.

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

C is the escape coefficient, U is the reach velocity in mile/day, and S is the average reach slope in ft/mile. The value of the escape coefficient is assumed to be 0.11 for streams with flows less than 10 cfs and 0.0597 for stream flows equal to or greater than 10 cfs. Reach velocities were estimated using an

equation based on slope. The slope of each reach was found in the NHD Plus GIS coverage and input into the model in units of feet/mile. See Appendix 1.

Figure 5. Instream Processes in a Typical DO Model



3.2 Model Setup

The model for this TMDL includes the §303(d) listed segment of Panther Creek, beginning at the headwaters. A diagram showing the model setup is shown in Figure 6.

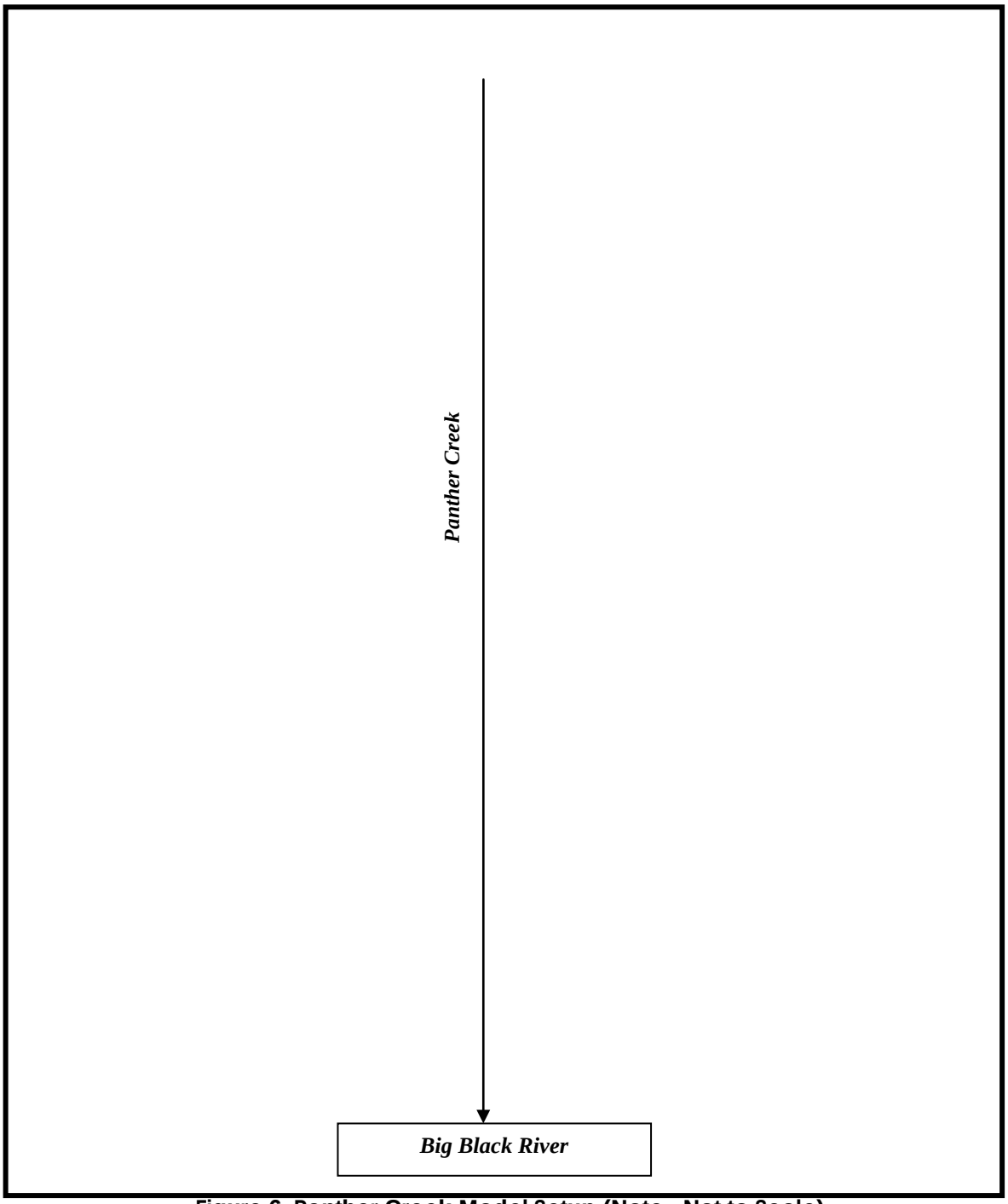


Figure 6. Panther Creek Model Setup (Note: Not to Scale)

The water body was divided into reaches for modeling purposes. Reach divisions were made at locations where there is a significant change in hydrological and water quality characteristics, such as the confluence of a point source or tributary. Within each reach, the modeled segments were divided into computational elements of 0.1 mile. The simulated hydrological and water quality characteristics were calculated and output by the model for each computational element. See Appendix 1.

The STREAM model was setup to simulate flow and temperature conditions, which were determined to be the annual average condition for this TMDL. MDEQ Regulations state that when the flow in a water body is less than 50 cfs, the temperature used in the model is 26°C. The headwater instream DO was assumed to be 85% of saturation at the stream temperature. The instream CBODu decay rate at K_d at 20°C was input as 0.15 day^{-1} (base e) as specified in MDEQ regulations. The model adjusts the K_d rate based on temperature, according to Equation 2.

$$K_{d(T)} = K_{d(20^oC)}(1.047)^{T-20} \quad \textbf{(Eq. 2)}$$

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 *Empirical Stream Model Assumptions for Conventional Pollutants and Conventional Water Quality Models* (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.

Panther Creek has no USGS flow gage. The flow in Panther Creek watershed was modeled at conditions based on an annual average of 42.8 cfs based on input from the National Hydrology Dataset. The flow was distributed evenly in the model along with the pollutant loads within the length of the stream segments.

3.3 Source Representation

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.

$CBODu = CBOD_5 * Ratio$ (Eq. 3)

The CBODu to $CBOD_5$ ratios are given in *Empirical Stream Model Assumptions for Conventional Pollutants and Conventional Water Quality Models* (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 2002 study of the Big Black River included a test of the CBODu for this water body. The f ratio is 6.852. The $CBOD_5$ was 2.29 mg/l.

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

The background concentrations of CBODu and NH_3-N were estimated based on *Empirical Stream Model Assumptions for Conventional Pollutants and Conventional Water Quality Models* (WPC-1)(MDEQ, 2010). The background concentration used in modeling for BOD_5 is 2.0 lbs./day and for NH_3-N is 0.1 lbs./day. Non-point source flows are included in the model to account for water entering due to groundwater infiltration, overland flow, and small, unmeasured tributaries.

3.4 Model Results

Once the model setup was complete, the model was used to predict water quality conditions in Panther Creek. The model was run under regulatory load conditions. The results of the model run indicate a dip in the dissolved oxygen where the slope in the stream approaches zero. This segment is a swamp most likely created by beaver activity hindering the constant flow. The creek was channelized below the swamp area to help with flood prevention.

3.5.1 Regulatory Load Scenario

As shown in the figure 7, the model predicts that the DO approaches the standard of 5.0 mg/l in Panther Creek. The existing 2002 data are not predictive of the DO in a flowing stream and should not be compared to the model results.

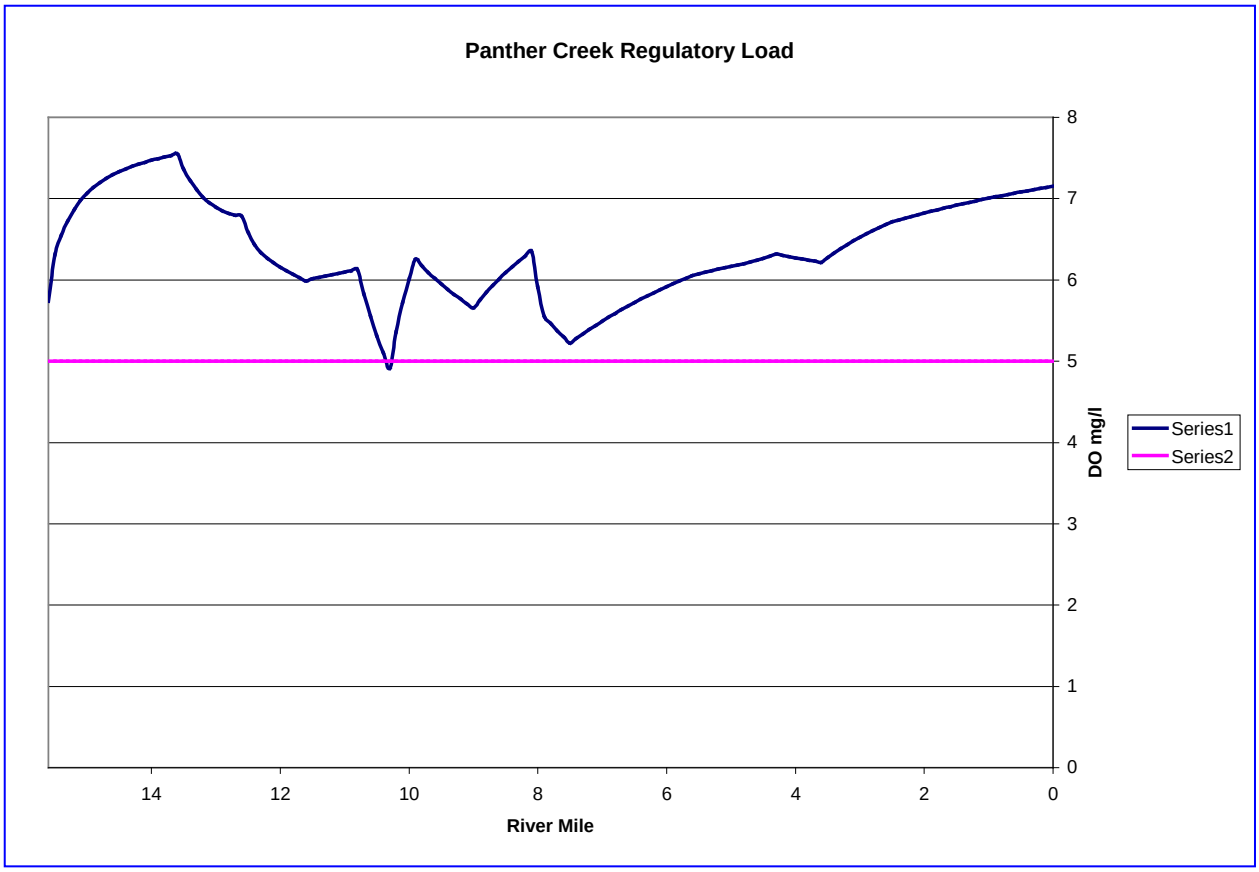


Figure 7. Model Output for Panther Creek, Regulatory Load Scenario

3.5.2 Maximum Load Scenario

The model was modified to determine the maximum load allowable as distributed loads within the watershed for the 42.8 cfs flow. The loading was input by segment, and adjusted to determine the total maximum. The results approach the standard at river mile 10.3, 7.5, and 0.0. The total CBODu load is 4005 lbs./day. The TMDL will be calculated for TBODu. This is the sum of CBODu and NBODu. NBODu is the load requirement in oxygen created by the nitrogen changing in the stream. Each gram of nitrogen requires 4.57 grams of oxygen in the nitrification process. The model results of the maximum load are shown in Figure 8. By representing the load in this manner, the LA for the TMDL is determined. The loading per segment for the maximum load is shown in Figure 9.

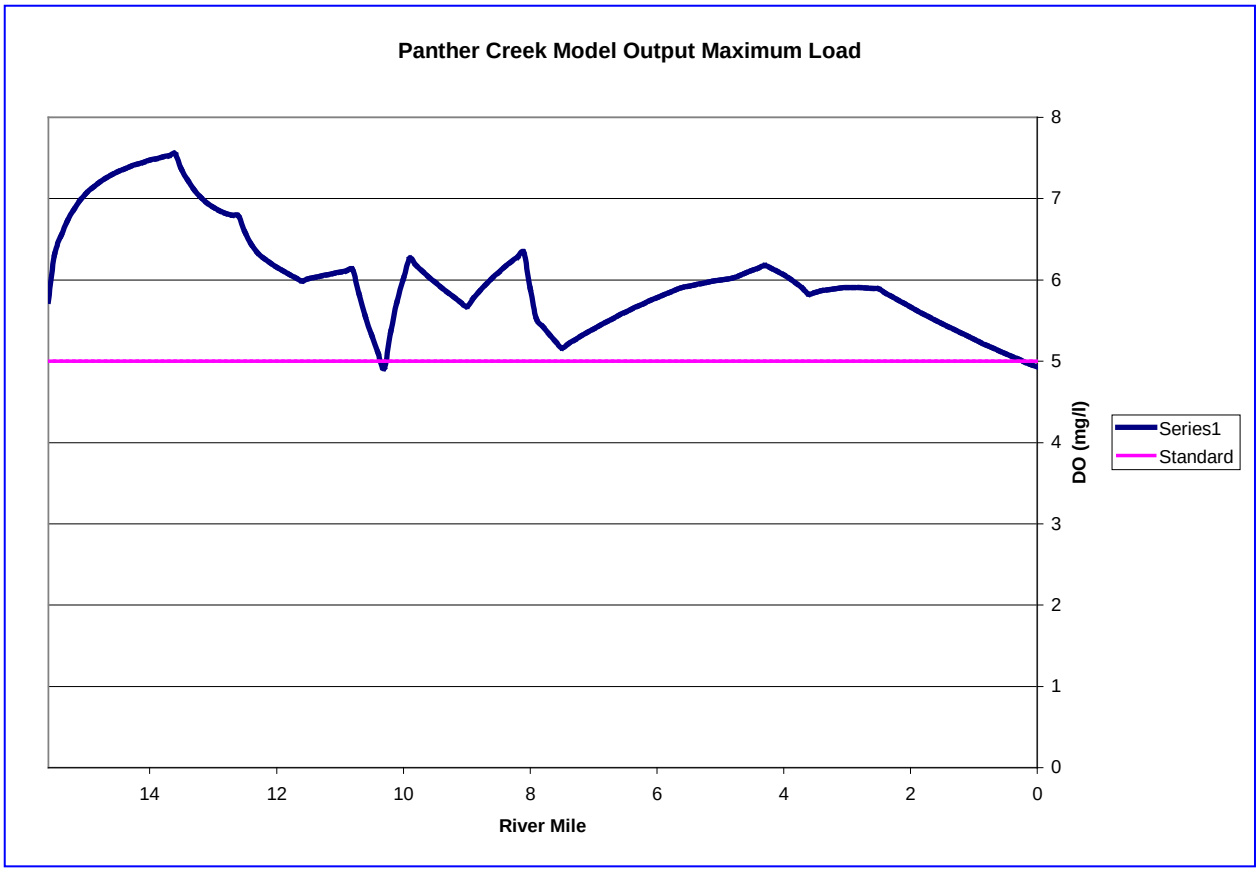


Figure 8. Model Output for Panther Creek, Maximum Load Scenario

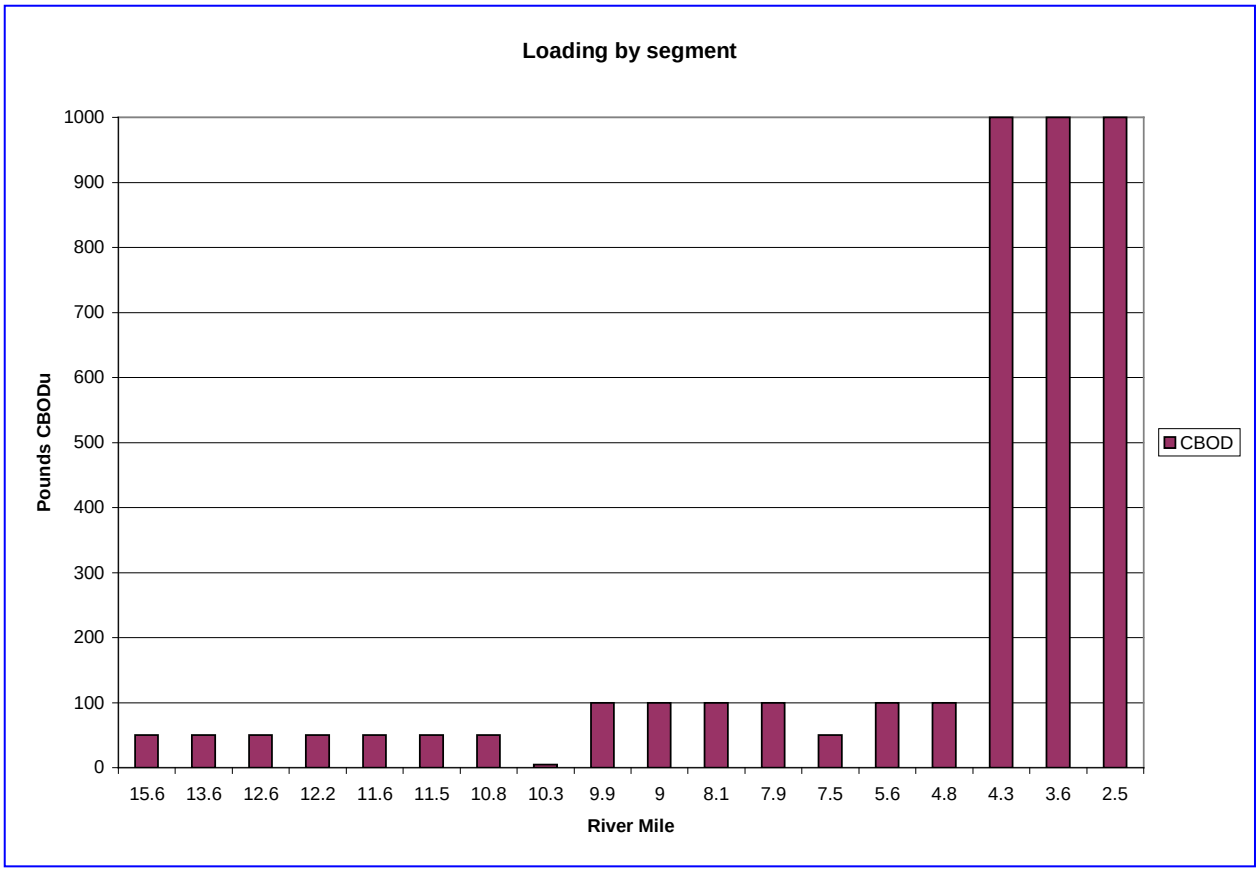


Figure 9. Model Loading by Segment

ALLOCATION

4.1 Wasteload Allocation

There are no POTWs in the watershed. The new Canton Municipal POTW is located adjacent to this watershed, and all future point sources in this watershed will be connected to this treatment facility. Therefore the WLA for this TMDL is zero.

4.2 Load Allocation

The load allocation is estimated by determining the maximum load of TBODu in the model. The CBODu is 4005 lbs./day. The NBODu is 11 lbs/day. Therefore the TBODu Load Allocation (LA) in the model is 4016 lbs./day.

$$TBOD_u = CBOD_u + NBOD_u \qquad \textbf{(Eq. 4)}$$

4.3 Incorporation of a Margin of Safety

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

4.4 Calculation of the TMDL

The STREAM model was used to calculate the TBODu TMDL. The allocations for TBODu are given in Table 5. These allocations are established to attain the applicable water quality standards.

Table 5. TMDL Loads

	WLA lbs/day	LA lbs/day	MOS	TMDL lbs/day
TBODu	**0**	**4016**	**Implicit**	**4016**

4.5 Seasonality and Critical Condition

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

CONCLUSION

The model results indicate that Panther Creek is approaching the limits of water quality standards for dissolved oxygen naturally. The watershed is adjacent to an existing POTW and no future NPDES point sources will be allowed in this watershed. Non-point sources of organic enrichment / low dissolved oxygen are most likely created by low flow conditions from the swamp area or beaver dam activity. This natural activity will sometimes depress the flow and oxygen naturally. The flat slope of the stream near this area also reduces the natural reaeration available to the stream.

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 Big Black 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 available around $1.6M each grant year for restoration and protections efforts by providing a 60% cost share for eligible projects.

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.

Mississippi Forestry Commission (MFC), in cooperation with the Mississippi Forestry Association (MFA) and Mississippi State University (MSU), have taken a leadership

role in the development and promotion of the forestry industry Best Management Practices (BMPs) in Mississippi. MDEQ is designated as the lead agency for implementing an urban polluted runoff control program through its Stormwater Program. Through this program, MDEQ regulates most construction activities. Mississippi Department of Transportation (MDOT) is responsible for implementation of erosion and sediment control practices on highway construction.

Due to this TMDL, projects within this watershed will receive a higher score and ranking for funding through the basin team process and Nonpoint Source Program described above.

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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Appendix 1 STREAM Model Output

panther BEGINNING AT RIVER MILE 15.6

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
HEADWATER	1.700	6.000	1.00	.50
WASTE SOURCE	.001	6.000	1.00	.05
DIST. INPUT	2.389	2.000	50.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .50 /DAY KA= 4.44 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 21.4 FT/MILE ESCAPE COEF= .11 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
15.600	1.815	5.749	2.471	.447	.057	.100
15.500	1.815	6.322	1.898	.442	.054	.100
15.400	1.929	6.563	1.657	.637	.050	.100
15.300	2.042	6.747	1.474	.808	.046	.100
15.200	2.156	6.889	1.332	.959	.042	.100
15.100	2.270	7.000	1.220	1.092	.039	.100
15.000	2.384	7.090	1.131	1.211	.036	.100
14.900	2.497	7.162	1.058	1.317	.033	.100
14.800	2.611	7.222	.998	1.412	.031	.100
14.700	2.725	7.273	.948	1.498	.029	.100
14.600	2.839	7.316	.905	1.575	.027	.100
14.500	2.952	7.353	.867	1.644	.025	.100
14.400	3.066	7.386	.834	1.707	.024	.100
14.300	3.180	7.416	.805	1.764	.022	.100
14.200	3.294	7.442	.779	1.816	.021	.100
14.100	3.407	7.466	.755	1.863	.020	.100
14.000	3.521	7.488	.733	1.906	.019	.100
13.900	3.635	7.508	.713	1.945	.018	.100
13.800	3.749	7.527	.694	1.980	.017	.100
13.700	3.862	7.544	.677	2.013	.016	.100
13.600	3.976	7.560	.660	2.042	.015	.100

panther BEGINNING AT RIVER MILE 13.6

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	3.976	7.560	43.85	.32
DIST. INPUT	1.985	2.000	50.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= 1.90 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 9.2 FT/MILE ESCAPE COEF= .11 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
13.600	4.157	7.319	.902	2.156	.015	.100
13.500	4.157	7.393	.828	2.131	.014	.100
13.400	4.337	7.258	.963	2.211	.014	.100
13.300	4.518	7.150	1.071	2.282	.013	.100
13.200	4.698	7.064	1.157	2.347	.013	.100
13.100	4.879	6.996	1.225	2.404	.012	.100
13.000	5.059	6.943	1.278	2.456	.012	.100
12.900	5.239	6.902	1.318	2.503	.012	.100
12.800	5.420	6.872	1.348	2.546	.011	.100
12.700	5.600	6.850	1.370	2.584	.011	.100
12.600	5.781	6.836	1.385	2.618	.011	.100
12.600	5.961	6.689	1.531	2.680	.011	.100

panther BEGINNING AT RIVER MILE 12.6

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	5.961	6.689	86.28	.34
DIST. INPUT	1.993	2.000	50.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= 1.87 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 9.0 FT/MILE ESCAPE COEF= .11 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
12.600	6.360	6.395	1.825	2.803	.011	.100
12.500	6.360	6.560	1.660	2.771	.010	.100
12.400	6.758	6.467	1.754	2.849	.010	.100
12.300	7.157	6.400	1.820	2.915	.010	.100
12.200	7.556	6.355	1.865	2.972	.010	.100
12.200	7.954	6.137	2.083	3.055	.009	.100

panther BEGINNING AT RIVER MILE 12.2

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	7.954	6.137	131.24	.41
DIST. INPUT	1.067	2.000	50.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= .60 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 2.9 FT/MILE ESCAPE COEF= .11 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
12.200	8.107	6.059	2.161	3.161	.010	.100
12.100	8.107	6.100	2.120	3.125	.009	.100
12.000	8.259	6.066	2.155	3.190	.009	.100
11.900	8.412	6.034	2.186	3.252	.009	.100
11.800	8.564	6.005	2.216	3.310	.009	.100
11.700	8.716	5.977	2.243	3.364	.009	.100
11.600	8.869	5.952	2.269	3.416	.009	.100

panther BEGINNING AT RIVER MILE 11.6

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	8.869	5.952	163.60	.43
DIST. INPUT	1.175	2.000	50.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= 3.57 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 17.2 FT/MILE ESCAPE COEF= .11 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
11.600	9.456	5.706	2.514	3.693	.009	.100
11.500	9.456	6.159	2.062	3.651	.009	.100
11.500	10.044	5.915	2.305	3.898	.010	.100

panther BEGINNING AT RIVER MILE 11.5

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	10.044	5.915	211.43	.52
DIST. INPUT	1.583	2.000	50.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= 1.08 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 9.6 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
11.500	10.242	5.840	2.381	3.936	.010	.100
11.400	10.242	5.947	2.274	3.891	.009	.100
11.300	10.440	5.977	2.243	3.883	.009	.100
11.200	10.637	6.006	2.214	3.874	.009	.100
11.100	10.835	6.035	2.186	3.865	.009	.100
11.000	11.033	6.062	2.159	3.856	.009	.100
10.900	11.231	6.088	2.132	3.846	.009	.100
10.800	11.429	6.114	2.107	3.836	.009	.100

panther BEGINNING AT RIVER MILE 10.8

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	11.429	6.114	236.76	.52
DIST. INPUT	4.030	2.000	50.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= .02 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= .2 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
10.800	12.101	5.886	2.335	3.751	.008	.100
10.700	12.101	5.844	2.376	3.708	.008	.100
10.600	12.772	5.603	2.618	3.592	.008	.100
10.500	13.444	5.385	2.836	3.486	.007	.100
10.400	14.116	5.187	3.034	3.390	.007	.100
10.300	14.787	5.007	3.214	3.302	.007	.100

panther BEGINNING AT RIVER MILE 10.3

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	14.787	5.007	263.70	.55
DIST. INPUT	2.332	2.000	5.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .50 /DAY KA= 3.10 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 27.4 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
10.300	15.254	4.915	3.306	3.214	.007	.100
10.200	15.254	5.449	2.772	3.177	.007	.100
10.100	15.720	5.808	2.413	3.058	.006	.100
10.000	16.186	6.100	2.121	2.947	.006	.100
9.900	16.653	6.339	1.882	2.843	.006	.100
9.900	17.119	6.220	2.000	2.776	.006	.100

panther BEGINNING AT RIVER MILE 9.9

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	17.119	6.220	256.65	.56
DIST. INPUT	3.018	2.000	100.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= .26 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 2.3 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
9.900	17.421	6.147	2.073	2.835	.006	.100
9.800	17.421	6.147	2.074	2.802	.006	.100
9.700	17.723	6.077	2.144	2.826	.006	.100
9.600	18.025	6.010	2.211	2.848	.006	.100
9.500	18.326	5.946	2.275	2.869	.006	.100
9.400	18.628	5.884	2.336	2.888	.005	.100
9.300	18.930	5.826	2.395	2.906	.005	.100
9.200	19.232	5.770	2.451	2.923	.005	.100
9.100	19.534	5.717	2.504	2.938	.005	.100
9.000	19.835	5.666	2.555	2.952	.005	.100

panther BEGINNING AT RIVER MILE 9.0

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	19.835	5.666	316.25	.53
DIST. INPUT	.667	2.000	100.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= .94 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 8.3 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
9.000	19.902	5.653	2.567	3.036	.005	.100
8.900	19.902	5.762	2.459	3.001	.005	.100
8.800	19.969	5.852	2.368	3.048	.005	.100
8.700	20.036	5.936	2.284	3.094	.005	.100
8.600	20.102	6.015	2.205	3.140	.005	.100
8.500	20.169	6.089	2.131	3.184	.005	.100
8.400	20.236	6.158	2.062	3.227	.005	.100
8.300	20.302	6.223	1.998	3.270	.005	.100
8.200	20.369	6.283	1.937	3.312	.005	.100
8.100	20.436	6.340	1.881	3.352	.005	.100

panther BEGINNING AT RIVER MILE 8.1

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	20.436	6.340	369.94	.51
DIST. INPUT	4.707	2.000	100.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= .10 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= .9 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
8.100	22.005	6.030	2.190	3.394	.005	.100
8.000	22.005	6.004	2.217	3.355	.005	.100
7.900	23.574	5.713	2.507	3.354	.004	.100
7.900	25.143	5.481	2.739	3.390	.004	.100

panther BEGINNING AT RIVER MILE 7.9

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	25.143	5.481	460.33	.59
DIST. INPUT	2.871	2.000	100.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= .21 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 1.8 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
7.900	25.717	5.404	2.817	3.459	.004	.100
7.800	25.717	5.399	2.822	3.419	.004	.100
7.700	26.291	5.321	2.900	3.445	.004	.100
7.600	26.865	5.247	2.974	3.469	.004	.100
7.500	27.440	5.176	3.045	3.491	.004	.100
7.500	28.014	5.111	3.110	3.551	.004	.100

panther BEGINNING AT RIVER MILE 7.5

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	28.014	5.111	537.23	.63
DIST. INPUT	2.790	2.000	50.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= .57 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 5.1 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
7.500	28.153	5.095	3.125	3.550	.004	.100
7.400	28.153	5.163	3.058	3.509	.004	.100
7.300	28.293	5.213	3.008	3.468	.004	.100
7.200	28.432	5.262	2.959	3.427	.004	.100
7.100	28.572	5.309	2.912	3.387	.004	.100
7.000	28.711	5.355	2.866	3.348	.004	.100
6.900	28.851	5.400	2.821	3.309	.004	.100
6.800	28.990	5.443	2.777	3.271	.004	.100
6.700	29.130	5.486	2.735	3.234	.004	.100
6.600	29.269	5.527	2.694	3.197	.004	.100
6.500	29.409	5.567	2.653	3.161	.003	.100
6.400	29.548	5.606	2.614	3.125	.003	.100
6.300	29.688	5.644	2.576	3.090	.003	.100
6.200	29.827	5.681	2.539	3.056	.003	.100
6.100	29.967	5.717	2.503	3.022	.003	.100
6.000	30.106	5.752	2.468	2.988	.003	.100
5.900	30.246	5.786	2.434	2.956	.003	.100
5.800	30.385	5.820	2.401	2.923	.003	.100
5.700	30.525	5.852	2.368	2.891	.003	.100
5.600	30.664	5.884	2.337	2.860	.003	.100
5.600	30.804	5.866	2.354	2.862	.003	.100

panther BEGINNING AT RIVER MILE 5.6

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	30.804	5.866	476.08	.49
DIST. INPUT	1.127	2.000	100.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= .48 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 4.3 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
5.600	30.929	5.851	2.370	2.917	.003	.100
5.500	30.929	5.886	2.335	2.883	.003	.100
5.400	31.054	5.905	2.316	2.904	.003	.100
5.300	31.179	5.923	2.298	2.925	.003	.100
5.200	31.305	5.940	2.281	2.944	.003	.100
5.100	31.430	5.956	2.264	2.964	.003	.100
5.000	31.555	5.972	2.248	2.982	.003	.100
4.900	31.680	5.987	2.233	3.001	.003	.100
4.800	31.806	6.002	2.219	3.018	.003	.100

panther BEGINNING AT RIVER MILE 4.8

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	31.806	6.002	518.39	.49
DIST. INPUT	5.560	2.000	100.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= 1.42 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 12.6 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
4.800	32.732	5.889	2.332	3.027	.003	.100
4.700	32.732	6.049	2.172	2.992	.003	.100
4.600	33.659	6.094	2.127	2.967	.003	.100
4.500	34.586	6.137	2.083	2.943	.003	.100
4.400	35.512	6.179	2.042	2.919	.003	.100
4.300	36.439	6.218	2.002	2.895	.003	.100

panther BEGINNING AT RIVER MILE 4.3

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	36.439	6.218	569.75	.51
DIST. INPUT	.599	2.000	1000.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= .16 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 1.4 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
4.300	36.514	6.210	2.011	3.524	.003	.100
4.200	36.514	6.188	2.032	3.483	.003	.100
4.100	36.589	6.152	2.068	4.061	.003	.100
4.000	36.663	6.110	2.111	4.630	.003	.100
3.900	36.738	6.061	2.159	5.191	.003	.100
3.800	36.813	6.007	2.213	5.742	.003	.100
3.700	36.888	5.947	2.273	6.285	.003	.100
3.600	36.963	5.882	2.339	6.819	.003	.100
3.600	37.038	5.874	2.346	7.430	.003	.100

panther BEGINNING AT RIVER MILE 3.6

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	37.038	5.874	1486.05	.53
DIST. INPUT	3.214	2.000	1000.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= .94 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 8.3 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
3.600	37.306	5.846	2.374	7.790	.003	.100
3.500	37.306	5.891	2.329	7.701	.003	.100
3.400	37.574	5.904	2.316	7.964	.003	.100
3.300	37.841	5.914	2.307	8.220	.003	.100
3.200	38.109	5.920	2.300	8.468	.002	.100
3.100	38.377	5.924	2.297	8.710	.002	.100
3.000	38.645	5.924	2.296	8.945	.002	.100
2.900	38.913	5.923	2.298	9.173	.002	.100
2.800	39.181	5.919	2.302	9.395	.002	.100
2.700	39.448	5.913	2.308	9.610	.002	.100
2.600	39.716	5.905	2.316	9.820	.002	.100
2.500	39.984	5.896	2.325	10.023	.002	.100

panther BEGINNING AT RIVER MILE 2.5

*** LOADS ***

	FLOW (CFS)	DISSOLVED OXYGEN (MG/L)	CARBONACEOUS BOD (LBS/DAY)	TKN (LBS/DAY)
UPSTREAM	39.984	5.896	2164.17	.49
DIST. INPUT	.010	2.000	1000.00	.10

*** PARAMETERS ***

CS= 8.22 MG/L PA= .00 MG/L RA= .00 MG/L S= .00 MG/L

KR= .15 /DAY KD= .15 /DAY KN= .30 /DAY KA= .49 /DAY

TEMP=26.00 C

REAERATION BY TSIVOGLOU SLOPE= 4.3 FT/MILE ESCAPE COEF= .06 /DAY

*** STREAM CONDITION ***

RIVER MILE	FLOW CFS	DO MG/L	DEFICIT MG/L	CBOD MG/L	TKN MG/L	VEL FPS
2.500	39.984	5.896	2.325	10.201	.002	.100
2.400	39.984	5.848	2.373	10.084	.002	.100
2.300	39.985	5.800	2.420	10.144	.002	.100
2.200	39.985	5.754	2.467	10.203	.002	.100
2.100	39.986	5.708	2.513	10.262	.002	.100
2.000	39.986	5.663	2.558	10.320	.002	.100
1.900	39.986	5.618	2.602	10.377	.002	.100
1.800	39.987	5.575	2.646	10.433	.002	.100
1.700	39.987	5.531	2.689	10.489	.002	.100
1.600	39.987	5.489	2.732	10.545	.002	.100
1.500	39.988	5.447	2.774	10.599	.002	.100
1.400	39.988	5.406	2.815	10.653	.002	.100
1.300	39.989	5.365	2.856	10.707	.002	.100
1.200	39.989	5.325	2.896	10.759	.002	.100
1.100	39.989	5.285	2.935	10.812	.002	.100
1.000	39.990	5.246	2.974	10.863	.002	.100
.900	39.990	5.208	3.013	10.914	.002	.100
.800	39.991	5.170	3.051	10.964	.002	.100
.700	39.991	5.133	3.088	11.014	.002	.100
.600	39.991	5.096	3.125	11.063	.002	.100
.500	39.992	5.059	3.161	11.112	.002	.100
.400	39.992	5.024	3.197	11.160	.002	.100
.300	39.992	4.988	3.232	11.208	.002	.100
.200	39.993	4.954	3.267	11.255	.002	.100
.100	39.993	4.919	3.301	11.301	.002	.100
.000	39.994	4.885	3.335	11.347	.002	.100

HEADWATER

RIVER	MILE	Q	DO	CBOD	TKN	TYPE	DESCRIPTION
panther	15.60	1.70	6.00	1.0	.5		

WASTE SOURCE

RIVER	MILE	Q	DO	CBOD	TKN	TYPE	DESCRIPTION
panther	15.60	.00	6.00	1.0	.1	.00	

SPECIFIC INPUT

RIVER	MILE	Q	DO	CBOD	TKN	TYPE	DESCRIPTION
panther	15.60	2.39	2.00	50.0	.1	1.00	
panther	13.60	1.99	2.00	50.0	.1	1.00	
panther	12.60	1.99	2.00	50.0	.1	1.00	
panther	12.20	1.07	2.00	50.0	.1	1.00	
panther	11.60	1.18	2.00	50.0	.1	1.00	
panther	11.50	1.58	2.00	50.0	.1	1.00	
panther	10.80	4.03	2.00	50.0	.1	1.00	
panther	10.30	2.33	2.00	5.0	.1	1.00	
panther	9.90	3.02	2.00	100.0	.1	1.00	
panther	9.00	.67	2.00	100.0	.1	1.00	
panther	8.10	4.71	2.00	100.0	.1	1.00	
panther	7.90	2.87	2.00	100.0	.1	1.00	
panther	7.50	2.79	2.00	50.0	.1	1.00	
panther	5.60	1.13	2.00	100.0	.1	1.00	
panther	4.80	5.56	2.00	100.0	.1	1.00	
panther	4.30	.60	2.00	1000.0	.1	1.00	
panther	3.60	3.21	2.00	1000.0	.1	1.00	
panther	2.50	.01	2.00	1000.0	.1	1.00	

REACH PARAMETER

RIVER	MILE	CD	ND	CV	NV	DEPTH	VEL	C	S	KA
panther	15.60						.10	.11	21.39	
panther	13.60						.10	.11	9.16	
panther	12.60						.10	.11	9.00	
panther	12.20						.10	.11	2.89	
panther	11.60						.10	.11	17.19	
panther	11.50						.10	.06	9.55	
panther	10.80						.10	.06	.17	
panther	10.30						.10	.06	27.37	
panther	9.90						.10	.06	2.29	
panther	9.00						.10	.06	8.31	
panther	8.10						.10	.06	.88	
panther	7.90						.10	.06	1.83	
panther	7.50						.10	.06	5.08	
panther	5.60						.10	.06	4.26	
panther	4.80						.10	.06	12.58	
panther	4.30						.10	.06	1.40	
panther	3.60						.10	.06	8.30	
panther	2.50						.10	.06	4.30	

REACH RATE

RIVER	MILE	TEMP	KR	KD	KN	PA	RA	S
panther	15.60	26.00	.15	.15	.50	.00	.00	.00
panther	13.60	26.00	.15	.15	.30	.00	.00	.00
panther	12.60	26.00	.15	.15	.30	.00	.00	.00
panther	12.20	26.00	.15	.15	.30	.00	.00	.00
panther	11.60	26.00	.15	.15	.30	.00	.00	.00
panther	11.50	26.00	.15	.15	.30	.00	.00	.00
panther	10.80	26.00	.15	.15	.30	.00	.00	.00
panther	10.30	26.00	.15	.15	.50	.00	.00	.00
panther	9.90	26.00	.15	.15	.30	.00	.00	.00
panther	9.00	26.00	.15	.15	.30	.00	.00	.00
panther	8.10	26.00	.15	.15	.30	.00	.00	.00
panther	7.90	26.00	.15	.15	.30	.00	.00	.00
panther	7.50	26.00	.15	.15	.30	.00	.00	.00
panther	5.60	26.00	.15	.15	.30	.00	.00	.00
panther	4.80	26.00	.15	.15	.30	.00	.00	.00
panther	4.30	26.00	.15	.15	.30	.00	.00	.00
panther	3.60	26.00	.15	.15	.30	.00	.00	.00
panther	2.50	26.00	.15	.15	.30	.00	.00	.00

SEQUENCE TABLE

RIVER	TRIBUTARY	TRIBUTARY	ORGIN	TERMINUS
panther			15.60	13.60
panther			13.60	12.60
panther			12.60	12.20
panther			12.20	11.60
panther			11.60	11.50
panther			11.50	10.80
panther			10.80	10.30
panther			10.30	9.90
panther			9.90	9.00
panther			9.00	8.10
panther			8.10	7.90
panther			7.90	7.50
panther			7.50	5.60
panther			5.60	4.80
panther			4.80	4.30
panther			4.30	3.60
panther			3.60	2.50
panther			2.50	.00

DELTA= .10