Alabama Department of Environmental Management

Final TMDL Development for
Crooked Creek AL/03160110-090_01
Low Dissolved Oxygen/Organic Loading
Ammonia as Nitrogen

Water Quality Branch
Water Division
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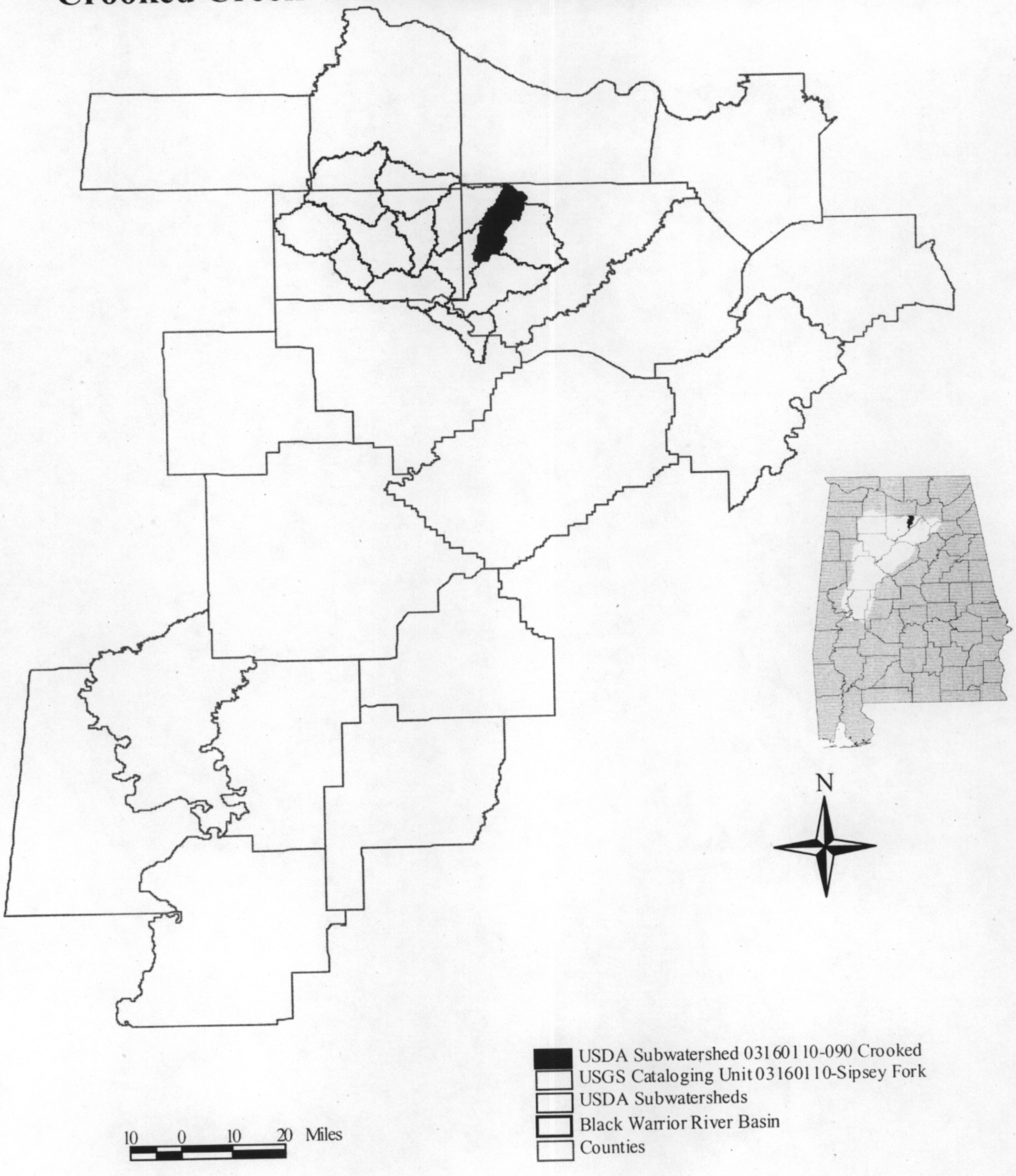
Crooked Creek Watershed in the Black Warrior Basin



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1.0 Executive Summary

This report contains one or more Total Maximum Daily Loads (TMDLs) for waterbody segments found on Alabama's 1996 and/or 1998 Section 303(d) List(s) of Impaired Waterbodies. Because of the accelerated schedule required by the consent decree, many of these TMDLs have been prepared out of sequence with the State's rotating basin approach. The implementation of the TMDLs contained herein will be prioritized within Alabama's rotating basin approach.

The amount and quality of data on which this report is based are limited. As additional information becomes available, the TMDLs may be updated. Such additional information may include water quality and quantity data, changes in pollutant loadings, or changes in land use within the watershed. In some cases, additional water quality data may indicate that no impairment exists.

Crooked Creek, a part of the Black Warrior basin, is located in Cullman County near West Point. It has been on the State of Alabama's §303(d) use impairment list since 1992 for organic enrichment/low dissolved oxygen (O.E./D.O.) and ammonia as nitrogen (NH_3-N). Its use classification is Fish and Wildlife.

Water quality data collected in 1988, 1991, and 1997 identified dissolved oxygen impairments for Crooked Creek. The stream flows during periods of impairment were typically at, or below, the $7Q_{10}$ (the minimum 7-day average flow that occurs once in 10 years on average). Since the D.O. impairments were clearly driven by low flows and high temperatures, occurring during the summer months, a steady state modeling approach was adopted as appropriate for the TMDL analysis.

The following report addresses the results of the TMDL analysis for O.E./D.O and ammonia as nitrogen (NH_3-N). In accordance with ADEM water quality standards, the minimum dissolved oxygen concentration in a stream classified as Fish and Wildlife is 5.0 mg/l. In the absence of a numerical state water quality standard for ammonia as nitrogen, the EPA's ambient water quality chronic criterion for ammonia as nitrogen in a stream classified as Fish and Wildlife at a pH of 7.33 s.u. and temperature of 28°C is 2.09 mg/l. For the purpose of this TMDL, a minimum dissolved oxygen level of 5.0 mg/l and an ammonia as nitrogen chronic toxicity criterion of 2.09 mg/l will be implemented allowing for an implicit margin of safety resulting from conservative assumptions used in the dissolved oxygen model.

A summary of the TMDL for the watershed is provided in the tables presented on the next page. The pollutants shown in the tables include ultimate carbonaceous biochemical oxygen demand ($CBOD_u$), nitrogenous biochemical oxygen demand (NBOD), and ammonia as nitrogen (NH_3-N). $CBOD_u$ and NBOD are the principle causes for observed low dissolved oxygen concentrations. $CBOD_u$ is a measure of the total amount of oxygen required to degrade the carbonaceous portion of the organic matter present in the water. NBOD is the amount of oxygen utilized by bacteria as they convert ammonia to nitrate.

Because organic nitrogen can be converted to ammonia, its potential oxygen demand is included in the NBOD component of the TMDL. The first table lists allowable pollutant loadings by source (point and non-point sources) for the summer season (May through November). The second table lists allowable pollutant loadings by source (point and non-point sources) for the winter season (December through April).

Table 1-1. Maximum Allowable Pollutant Loads by Source – Summer

Pollutant	Point Source Loads (lbs./day)	Non-point Source Loads (lbs./day)
$CBOD_u$	1.7	5.8
NBOD	2.6	3.2
Total	4.3	9.0
NH_3-N	0.2	0.2

Note: There is one point source discharge in this evaluation – West Point School. The school discharges to an unnamed tributary of Crook Creek. The unnamed tributary enters the modeled reach at the beginning of segment 4. The following procedure was employed to determine West Point School's loading contribution to Crooked Creek in the summer:

A separate model simulation was performed for the unnamed tributary and the West Point discharge. Pollutant loadings calculated at the mouth of the unnamed tributary were assumed to be West Point School's summer loading contributions to Crooked Creek.

Table 1-3. Maximum Allowable Pollutant Loads by Source – Winter

Pollutant	Point Source Loads (lbs./day)	Non-point Source Loads (lbs./day)
$CBOD_u$	9.7	255.2
NBOD	6.4	359.1
Total	16.1	614.3
NH_3-N	0.6	8.4

Note: Point source loadings for winter were determined in the following manner:

Two winter simulations were executed for the unnamed tributary – one with and the other without West Point School. The difference in pollutant loadings at the unnamed tributary's mouth was assigned to the point source loads.

2.0 *Basis for §303(d) Listing*

2.1 *Introduction*

Section 303(d) of the Clean Water Act (CWA) as amended by the Water Quality Act of 1987 and EPA's Water Quality Planning and Management Regulations [(Title 40 of the Code of Federal Regulations (CFR), Part 130)] require states to identify waterbodies which are not meeting water quality standards applicable to their designated use classifications. The identified waters are prioritized based on severity of pollution with respect to designated use classifications. Total maximum daily loads (TMDLs) for all pollutants causing violation of applicable water quality standards are established for each identified water. Such loads are established at levels necessary to implement the applicable water quality standards with seasonal variations and margins of safety. The TMDL process establishes the allowable loading of pollutants, or other quantifiable parameters for a waterbody, based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Alabama has identified Crooked Creek as being impaired by organic loading (i.e., $CBOD_u$ and NBOD) and ammonia as nitrogen for a length of 28.17 miles, as reported on the 1992, 1994, 1996, 1998, and the draft 2000 §303(d) lists of impaired waters. Crooked Creek has a priority ranking of medium. Crooked Creek is located in Cullman County.

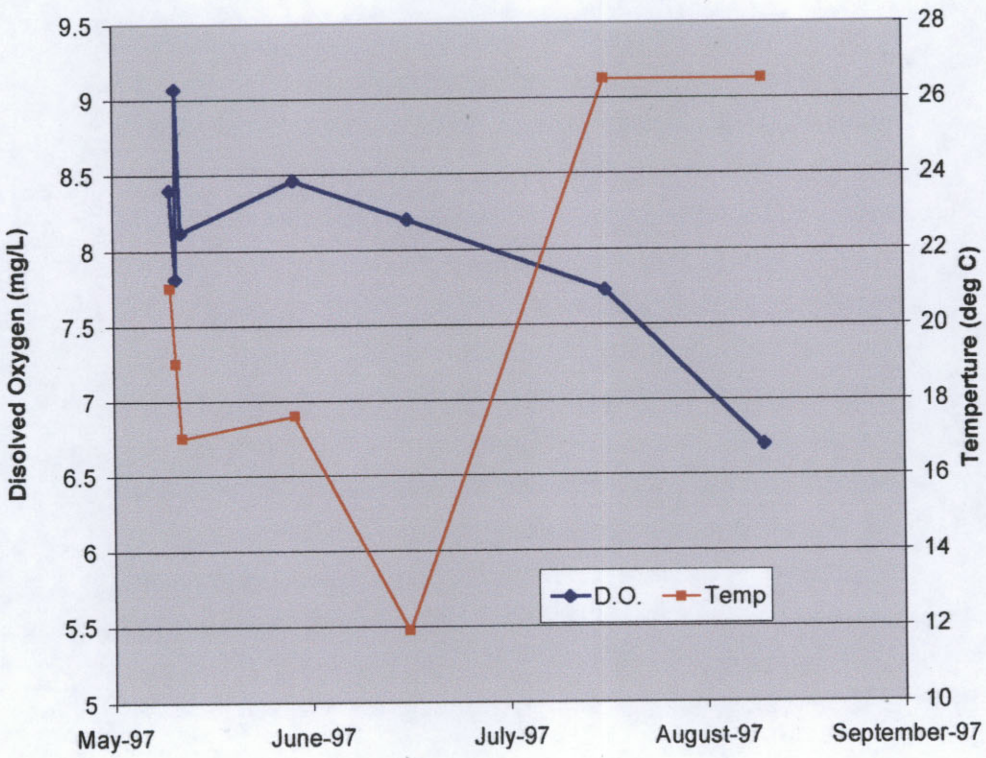
The TMDL developed for Crooked Creek illustrates the steps that can be taken to address a waterbody impaired by low dissolved oxygen levels and ammonia as nitrogen. The TMDL is consistent with a phased-approach: estimates are made of needed pollutant reductions, load reduction controls are implemented, and water quality is monitored for plan effectiveness. Flexibility is built into the plan so that load reduction targets and control actions can be reviewed if monitoring indicates continuing water quality problems.

2.2 *Problem Definition*

Crooked Creek has a drainage area of 58.1 sq. miles. Dry weather flows for the Crooked Creek watershed are relatively low, or zero. Water quality data collected for the watershed from May 1997 though September 1997 indicate that dissolved oxygen and ammonia as nitrogen impairments occurred primarily during the summer months (May through November). Generally, depressed in-stream D.O. concentrations may be caused by several sources including the decay of oxygen demanding waste from both point and non-point sources, algal respiration, sediment oxygen demand or other sources. It is believed based on available data that the low dissolved oxygen concentrations observed in this watershed are due to non point source run off combined with persistent flow conditions at or below the $7Q_{10}$ and high temperatures, occurring during summer months, and are not the result of algal dynamics.

Figure 2.1 below illustrates the dissolved oxygen versus temperature data available for Crooked Creek.

Figure 2.1 1997 Dissolved Oxygen vs. Temperature Data at Station CRK - 5



Waterbody Impaired: Crooked Creek – Smith Lake to its source

Water Quality Standard Violation: Dissolved Oxygen/Ammonia as Nitrogen

Pollutant of Concern: Organic Enrichment (CBODu + NBOD) and Ammonia as Nitrogen (NH_3-N)

Water Use Classification: Fish and Wildlife

The impaired stream segment, Crooked Creek, is classified as Fish and Wildlife. Usage of waters in this classification is described in ADEM Admin. Code R. 335-6-10-.09(5)(a), (b), (c), and (d).

(a) Best usage of waters:

Fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming and water-contact sports or as a source of water supply for drinking or food processing purposes.

(b) Conditions related to best usage:

The waters will be suitable for fish, aquatic life and wildlife propagation. The quality of salt and estuarine waters to which this classification is assigned will also be suitable for the propagation of shrimp and crabs.

(c) Other usage of waters:

It is recognized that the waters may be used for incidental water contact and recreation during June through September, except that water contact is strongly discouraged in the vicinity of discharges or other conditions beyond the control of the Department or the Alabama Department of Public Health.

(d) Conditions related to other usage:

The waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports.

Low D.O./Organic Loading Criteria:

Alabama's water quality criteria document (ADEM Admin. Code R. 335-6-10-.09-(5)(e)(4.)) states that for a diversified warm water biota, including game fish, daily dissolved oxygen concentrations shall not be less than 5 mg/l at all times; except under extreme conditions due to natural causes, it may range between 5 mg/l and 4 mg/l, provided that the water quality is favorable in all other parameters. The normal seasonal and daily fluctuations shall be maintained above these levels. In no event shall the dissolved oxygen level be less than 4 mg/l due to discharges from existing hydroelectric generation impoundments. All new hydroelectric generation impoundments, including addition of new hydroelectric generation units to existing impoundments, shall be designed so that the discharge will contain at least 5 mg/l dissolved oxygen where practicable and technologically possible. The Environmental Protection Agency, in cooperation with the State of Alabama and parties responsible for impoundments, shall develop a program to improve the design of existing facilities.

Ammonia as Nitrogen Criteria

Alabama's water quality criteria document (ADEM Admin. Code R. 335-6-10) does not contain a numeric water quality standard for ammonia as nitrogen. However, in applying the following narrative standard found at ADEM Admin. Code R. 335-6-10-.06(c), the Department has relied upon the United States Environmental Protection Agency's (EPA) latest water quality criteria for ammonia.

> (c) State waters shall be free from substances attributable to sewage, industrial wastes or other wastes in concentrations or combinations which are toxic or harmful to human, animal or aquatic life to the extent commensurate with the designated usage of such waters.

The Municipal Branch and the Industrial Section of the Water Division of ADEM have adopted as policy EPA's ammonia criteria for purposes of developing permit limits in National Pollutant Discharge Elimination System (NPDES) permits. The EPA's *1999 Update of Ambient Water Quality Criteria for Ammonia*, EPA 822-R-94-014, provides the following equation for calculating the chronic criterion, also known as the Criteria Continuous Concentration (CCC). This criterion is applied in streams with a designated use of Fish and Wildlife or higher.

$$CCC=[0.0577/(1+10^{(7.688-pH)}) + 2.487/(1+10^{(pH-7.688)})]*Min[2.85,1.45*10^{(0.028*(25-T))}].$$

For Crooked Creek, the maximum pH value measured was 7.33 s.u. which results in a CCC value of 2.09 mg/l NH_3-N at a temperature of 28°C.

Another consideration in establishing an allowable in-stream ammonia concentration is its effect on the stream's dissolved oxygen (D.O.) concentration due to ammonia being converted to nitrite and then to nitrate. Oxygen is consumed in the process. A water quality model that accounts for this process, known as nitrification, is used to ensure that

D.O. concentrations remain above the applicable water quality standard. For Crooked Creek the D.O. standard is 5.0 mg/l.

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

The minimum dissolved oxygen concentration in a stream classified as Fish and Wildlife is 5.0 mg/l. For the purpose of this TMDL, a minimum dissolved oxygen level of 5.0 mg/l will be implemented allowing for an implicit margin of safety resulting from conservative assumptions used in the dissolved oxygen model. The target $CBOD_u$ and NBOD concentrations are concentrations that, in concert with the nitrification of ammonia, will not deplete the dissolved oxygen concentration below this level as a result of the decaying process.

3.2 Source Assessment

3.2.1. General Sources of $CBOD_u$, NBOD, and NH_3-N

Both point and non-point sources may contribute $CBOD_u$ and NBOD, including the ammonia as nitrogen component, (i.e., organic loading) to a given waterbody. Potential sources of organic loading are numerous and often occur in combination. In rural areas, storm runoff from row crops, livestock pastures, animal waste application sites, and feedlots can transport significant loads of organic loading. Nationwide, poorly treated municipal sewage comprises a major source of organic compounds that are hydrolyzed to create additional organic loading. Urban storm water runoff, sanitary sewer overflows, and combined sewer overflows can be significant sources of organic loading.

All potential sources of organic loading in the watershed were identified based on an evaluation of current land use/cover information on watershed activities (e.g., agricultural management activities). The source assessment was used as the basis of development of the model and ultimate analysis of the TMDL allocations. The organic loading within the watershed included both point and non-point sources.

3.2.2. Point Sources in the Crooked Creek Watershed

ADEM maintains a database of current NPDES permits and GIS files that locate each permitted outfall. This database includes municipal, semi-public/private, industrial, mining, industrial storm water, and concentrated animal feeding operations (CAFOs) permits. Table 3-1, below, shows the permitted point sources in the watershed that discharge into or upstream of the impaired segment. Included in Table 3-1 is the relative magnitude of the facility wastewater flow to the $7Q_{10}$ flow (in terms of percentage). Table 3-2 contains the permit limitations for the significant point sources that were considered in the model development. Figure 3-1 shows the location of each facility relative to the impaired segment.

Table 3-1. Contributing Point Sources in the Crooked Creek Watershed.

NPDES Permit	Type of Facility (e.g., CAFO, Industrial, Municipal, Semi-Public/Private, Mining, Industrial Storm Water)	Facility Name	Significant Contributor (Yes/No) (% of $7Q_{10}$)
AL0051136	Municipal	West Point School	Yes 13%
ALA000233	CAFO	K & A Poultry	No 0%

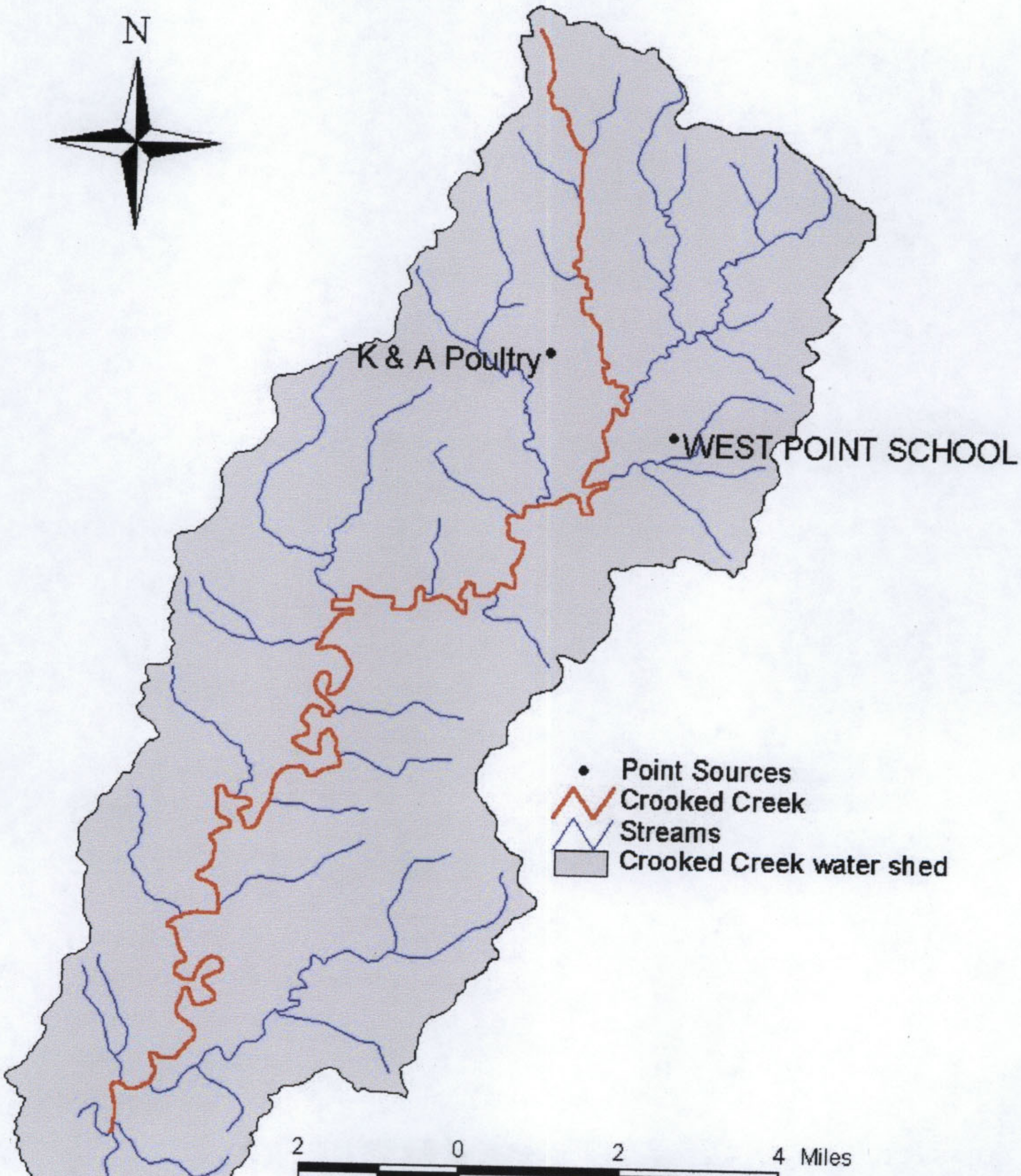
Note: Storm water discharges listed in the above table were marked as not being significant contributors since the discharge cannot cause nor contribute to a water quality violation. These dischargers also would not occur during low flow conditions. However, storm water contributions are taken into account indirectly through the SOD component of the model. Construction storm water discharges are not listed as these discharges do not occur during low flow and generally do not contribute directly to the organic loading. CAFO's were not considered significant contributors since they are permitted as zero discharge.

Table 3-2. NPDES Permit Limits for Significant Contributing Point Sources

NPDES Permit	Facility Name	Permit Limtations - Summer							Permit Limtations - Winter						
		Flow (MGD)		BOD_5 (MG/L)		NH_3-N (MG/L)		DO (MG/L)	Flow (MGD)		BOD_5 (MG/L)		NH_3-N (MG/L)		DO (MG/L)
		Max	Avg	Avg Weekly	Avg Monthly	Avg Weekly	Avg Monthly	Min	Max	Avg	Avg Weekly	Avg Monthly	Avg Weekly	Avg Monthly	Min
AL0051136	West Point School		0.045	37.5	25	1.8	1.2	6.0		0.045	37.5	25	3.1	2.1	5.0

Notes: n/a = not applicable. Flows listed for municipal and industrial permits are design flow and long term average flows, respectively. Flows are listed for industrial facilities in order to calculate their relative magnitudes with respect to the stream $7Q_{10}$ flow.

Figure 3-1. Location Map of Point Sources



3.2.3. Non-Point Sources in the Crooked Creek Watershed

Shown in Table 3-3, below, is a detailed summary of land usage in the Crooked Creek watershed. A land use map of the watershed is presented in Figure 3-2. The predominant land uses within the watershed are forest, pasture/hay, and row crops. Their respective percentages of the total watershed are 65.69%, 23.86%, and 9.52%.

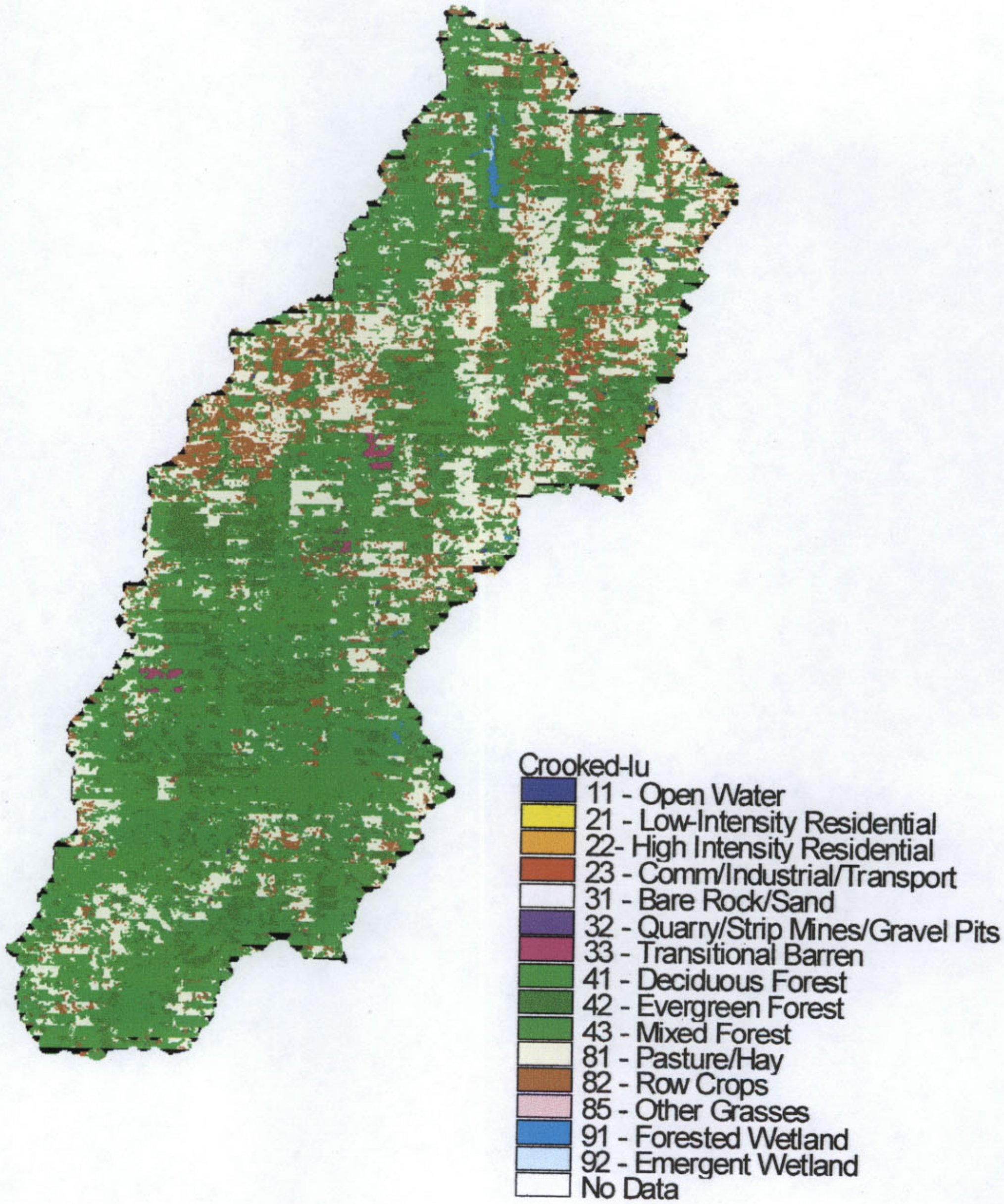
Table 3-3. Land Use in the Crooked Creek Watershed.

LAND USE	PERCENTAGE
Open Water	0.12
Low-Intensity Industrial Residential	0.04
Commercial/Industrial/Transport	0.22
Quarry/Strip Mine/Gravel Pits	0.00
Transitional Barren	0.29
Deciduous Forest	33.42
Evergreen Forest	11.43
Mixed Forest	20.84
Pasture/Hay	23.86
Row Crops	9.52
Wetland	0.26

The predominant land uses of forest, pasture/hay, and row crops make up 99.07% of the watershed. The other 0.93% of the land uses, except open water, were combined into one category (other) for modeling purposes. Each land use has the potential to contribute to the organic loading in the watershed due to organic material on the land surface that potentially can be washed off into the receiving waters of the watershed. Information on agricultural and management activities and watershed characteristics were obtained through coordination with the ADEM Mining and Non-Point Section, the Alabama Cooperative Extension System, and the USDA-Natural Resources Conservation Service (NRCS).

The major sources of organic enrichment from non-point sources within the Crooked Creek watershed are pasture/hay and row crops land uses. Compared to other land uses organic enrichment from forested land is normally considered to be small. This is because forested land tends to serve as a filter of pollution originating within its drainage areas. However, organic loading can originate from forested areas due to the presence of wild animals such as deer, raccoons, turkeys, waterfowl, etc. Control of these sources is usually limited to land management best management practices (BMPs) and may be impracticable in most cases. In contrast to forested land, agricultural land can be a major source of organic loading. Runoff from pastures, animal operations, improper land application of animal wastes, and animals with access to streams are all mechanisms that can introduce organic loading to waterbodies.

Figure 3-2. Land Use Map for the Crooked Creek Watershed.



3.3 Loading Capacity – Linking Numeric Water Quality Targets and Pollutant Sources

EPA regulations define loading, or assimilative capacity, as the greatest amount of pollutant loading that a waterbody can receive without violating water quality standards (40 CFR Part 130.2(f)).

Alabama's water quality criteria document (ADEM Admin. Code R. 335-6-10-.09-(4)(e)(4.)) states that for a diversified warm water biota, including game fish, daily dissolved oxygen concentrations shall not be less than 5 mg/l at all times; except under extreme conditions due to natural causes, it may range between 5 mg/l and 4 mg/l, provided that the water quality is favorable in all other parameters. The normal seasonal and daily fluctuations shall be maintained above these levels.

The EPA's ambient water quality chronic criterion for ammonia as nitrogen in a stream classified as Fish and Wildlife at a pH of 7.33 s.u. and temperature of 28°C is 2.09 mg/l. For the purposes of establishing a TMDL for ammonia as nitrogen both the CCC value and the ammonia as nitrogen concentration predicted by the dissolved oxygen model are considered and the lower concentration is used to compute allowable loading. For this TMDL the ammonia as nitrogen oxygen demand predicted by the D.O. model was the limiting factor.

Using the D.O. water quality criterion of 5.0 mg/l and the ammonia as nitrogen chronic criterion of 2.09 mg/l as the numerical targets, a TMDL model analysis was performed at critical conditions (i.e., summer) to determine the loading capacity for the watershed. This was accomplished through a series of simulations aimed at meeting the dissolved oxygen target limit by varying source contributions. The final acceptable simulation represented the TMDL (and loading capacity of the waterbody). If point sources were identified in the watershed, an additional model analysis was performed for the winter to determine the loading capacity during higher flow conditions.

In the TMDL model analysis, the pollutant concentrations from forestland were assumed to be at normal background concentrations. Specific values for background pollutant concentrations are as follows: 2 mg/l $CBOD_u$, 0.11 mg/l ammonia as nitrogen, and 0.22 mg/l total organic nitrogen (TON). Pollutant concentrations for the other land uses in the watershed were assigned in proportion to measured concentrations and were set in the TMDL model at levels necessary to maintain dissolved oxygen concentrations greater than, or equal to, 5 mg/l. The model predictions for in-stream pollutant concentrations were then compared to actual field data. The model velocities and reaeration coefficients were adjusted in those cases where the field data indicated significant discrepancies from the model predictions.

3.4 *Data Availability and Analysis*

3.4.1. Watershed Characteristics

A. General Description: Crooked Creek, located in Cullman County, is a tributary to Smith Lake. Crooked Creek is a part of the Black Warrior River basin. Crooked Creek is a part of the USGS (United States Geological Survey) 03160110 cataloging unit and the NRCS (Natural Resources Conservation Service) 090 sub-watershed. Cataloging unit 03160110 represents the Sipsey Fork Watershed of the Black Warrior basin. NRCS sub-watershed number 090 represents the Crooked Creek watershed.

   Crooked Creek begins approximately 4.0 miles north of the town of West Point in Section 32, Township 8S and Range 4W. It has a linear distance of 28.1 miles and a total drainage area of 58.1 square miles. Crooked Creek has a use classification of Fish & Wildlife (F&W).

B. Geological Description: The main rock types in the region are sand, conglomerate, shale, siltstone, and coal. There is a Pottsville Formation in the lower part of the region.

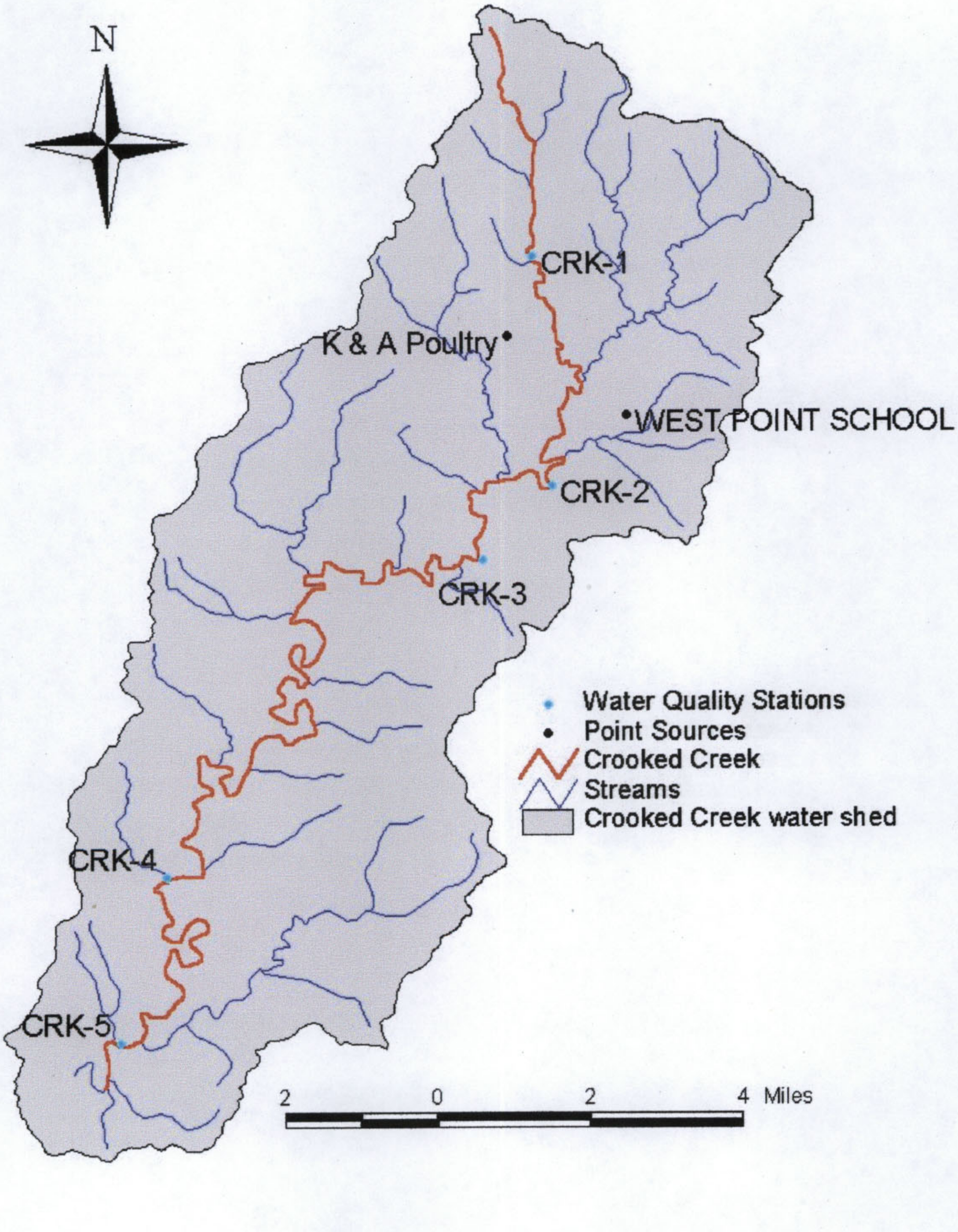
C. Eco-region Description: The **Dissected Plateau** is so strongly dissected that it no longer has a typical plateau appearance such as in 68a or 68d. The rugged, mostly forested region contains predominantly strongly sloping land, some steep-sided gorges and sandstone cliffs, and relief of 300-400 feet. The cool canyons and valleys often contain plant and animal species usually found further north. The Bankhead National Forest occupies a large portion of 68e, providing public recreation, wilderness, and forestry areas. Most of the region is drained by the Sipsey Fork of the Black Warrior River. The Sipsey Fork is a National Wild and Scenic River in its headwaters, and downstream is impounded to form Lewis Smith Lake, a hydroelectric generating reservoir, also popular for bass fishing.

D. Other Notable Characteristics: None

3.4.2 Available Water Quality and Biological Data

Water Quality and biological data for the Crooked Creek watershed are available for the years of 1988, 1991, and 1997. The Alabama Department of Environmental Management collected this data. The water quality stations are distributed throughout the Crooked Creek watershed. A map indicating the location of sampling points relative to applicable point source discharges is presented in Figure 3-3. A complete listing of the available data can be found in the appendix of this report. Data from 1988 and 1991 were collected as part of the state's Clean Water Strategy studies during those years. Data from 1997 were collected as a result of the stream's placement on the 1996 state 303(d) list.

Figure 3-3. Map of Sampling Locations and Point Source Discharges for the Crooked Creek Watershed.



3.4.3. Flow data

For the purpose of this TMDL, annual $7Q_{10}$ stream flows for the summer season and annual $7Q_2$ stream flows for the winter season are employed. These flows represent worst-case scenarios for seasonal model evaluations. The use of worst-case conditions, in turn, creates a margin of safety in the final results.

The $7Q_{10}$ flow represents the minimum 7-day flow that occurs, on average, over a 10-year recurrence interval. Likewise, the $7Q_2$ is the minimum 7-day flow that occurs, on average, over a 2-year period.

Both flows (i.e., $7Q_{10}$ and $7Q_2$) can be calculated for the model using gage data from the United States Geological Survey (USGS) or by using the Bingham Equation. The Bingham Equation can be found on page 3 of a publication from the Geological Survey of Alabama entitled, **Low-Flow Characteristics of Alabama Streams, Bulletin 117**.

The equations used to calculate the $7Q_{10}$ and $7Q_2$ flows based on continuous USGS gaging records for the stream and any associated tributaries are as follows:

$$7Q_{10}\,(\text{cfs}) = \frac{(7Q_{10}\ @\ \text{USGS Station (cfs)})}{(\text{Drainage Area @ USGS Station (mi}^2))} * (\text{Watershed Drainage Area (mi}^2))$$

$$7Q_2\,(\text{cfs}) = \frac{(7Q_2\ @\ \text{USGS Station (cfs)})}{(\text{Drainage Area @ USGS Station (mi}^2))} * (\text{Watershed Drainage Area (mi}^2))$$

The $7Q_{10}$ and $7Q_2$ flows can also be estimated using the Bingham equation. Low flow estimates employing this equation are based on the stream's recession index (G, no units), the stream's drainage area (A, mi^2), and the mean annual precipitation (P, inches):

$$7Q_{10}\ (\text{cfs}) = 0.15\text{x}10^{-5}(G-30)^{1.35}(A)^{1.05}(P-30)^{1.64}$$

$$7Q_2\ (\text{cfs}) = 0.24\text{x}10^{-4}(G-30)^{1.07}(A)^{0.94}(P-30)^{1.51}$$

Flow estimates ($7Q_{10}$ and $7Q_2$ values) for Crooked Creek were calculated using gage data from USGS station 02451580 (Crooked Creek near Logan). The resulting $7Q_{10}$ and $7Q_2$ flow estimates for Crooked Creek at its mouth are 0.54 and 2.10 cfs, respectively.

The calculated flows were distributed over Crooked Creek in the form of tributary flow or incremental inflow (identified on the modeled reach schematic as IF). The IF was distributed in proportion to the length of each segment.

3.5 Critical Conditions

Summer months (May – November) are generally considered critical conditions for dissolved oxygen in streams. This can be explained by the nature of storm events in the summer versus the winter. Periods of low precipitation allow for slower in-stream velocity, which increases the organic loading residence time and decreases stream re-aeration rates. This increased time permits more decay to occur which depletes the streams dissolved oxygen supply. Reaction rates for $CBOD_u$ and NBOD (i.e., organic loading) are temperature dependent and high summertime temperatures increase the decay process, which depletes the dissolved oxygen even further.

In winter, frequent low intensity rain events are more typical and do not allow for the build-up of organic loading on the land surface, resulting in a more uniform loading rate. Higher flows and lower temperatures create less residence time and lower decay rates. This pattern is evidenced in the output data of the model where the highest allowable loading achieved was for winter stream flows.

3.6 Margin of Safety (MOS)

There are two basic methods of incorporating the MOS (USEPA, 1991): 1) implicitly, using conservative model assumptions, or 2) explicitly specify a portion of the TMDL as the MOS.

The MOS is implicit in this TMDL process through the use of conservative model input parameters (temperature, flow and D.O. concentrations). Conservative temperature values are employed through the use of the highest average maximum temperature that would normally occur under critical stream flow conditions. The $7Q_{10}$ and $7Q_2$ stream flows employed for summer and winter, respectively, reflect the lowest flows that would normally occur under critical conditions. All point source discharges were assumed to be continuous at current NPDES permit limits. The TMDL D.O. concentration for incremental flow was set at 70% of the saturation concentration at the given temperature, which is 15% lower than the 85% normally assumed in a typical waste load allocation. Finally, the maximum pH value reported was used to determine the ammonia as nitrogen chronic criterion.

The following stream conditions also add to the MOS: 1) water depths are shallow, generally less than one foot, which exaggerates the effect of sediment oxygen demand (SOD); 2) water velocities are generally less than 0.5 fps or less, which intensifies the effect of SOD.

4.0 Water Quality Model Development

4.1 Water Quality Model Selection and Setup

Since the impairment noted by the available data occurred during periods of low flows, a steady-state modeling approach was adopted as appropriate to represent the relevant conditions in the impaired waterbody. The steady state TMDL spreadsheet water quality model (SWQM) developed by the ADEM was selected for the following reasons:

- It is a simplified approach without unnecessary complexity.
- It conforms to ADEM standard practices for developing wasteload allocations.
- It lends itself to being developed with limited data, which is the present situation for this waterbody.
- It has the ability to handle tributary inputs and both point and non-point source inputs.

The TMDL spreadsheet model also provides a complete spatial view of a stream, upstream to downstream, giving differences in stream behavior at various locations along the model reach. The model computes dissolved oxygen using a modified form of the Streeter-Phelps equation. The modified Streeter-Phelps equation takes into account the oxygen demand due to carbonaceous decay plus the oxygen demand generated from the nitrification process (ammonia decay). Each stream reach is divided into twenty elements, with each element assumed to be the functional equivalent of a completely mixed reactor.

The following assumptions were used in the spreadsheet TMDL model:

- D.O. concentrations for incremental flow were assumed @ 70% of the saturated value at the given temperature. (MOS)
- Incremental and tributary loadings were apportioned to correlate with the land usage of the drainage basin.
- Ratios for $CBOD_U/NH_3$-N and $CBOD_U$/TON were calculated using water quality data for the waterbody or estimated during the calibration process. These ratios were assigned in the estimation of loading parameters for incremental flow and tributaries for all land uses, except forest and open water.
- $CBOD_U/CBOD_5$ ratios used for point sources were assumed to be 1.5.
- NH_3OD_u is equal to 4.57 times the ammonia nitrogen concentration.
- $TONOD_u$ is equal to 4.57 times the organic nitrogen concentration.
- The ammonia as nitrogen concentration was determined at maximum reported pH.
- Background conditions were assumed for forest incremental flow. Background conditions are typically the following ranges: 2-3 mg/l $CBOD_u$, 0.11-0.22 mg/l NH_3-N, 0.22-0.44 mg/l TON.

4.1.1. SOD Representation: Sediment oxygen demand (SOD) can be an important part of the oxygen demand budget in shallow streams. However, for shallow streams with steep slopes and rocky substrate, the SOD component is generally small. These hydrogeological conditions are representative of the Crooked Creek. It is believed, therefore, that the SOD for this stream is minimal. In the absence of available field SOD measurements for the waterbody, SOD data was obtained from EPA Region IV's SOD database. The EPA SOD database represents mixed land uses and varying degrees of point source activity. A SOD value of 0.02 gm-O_2 ft^2/day was chosen based on similar bottom characteristics of sand, conglomerate, shale, siltstone, and coal

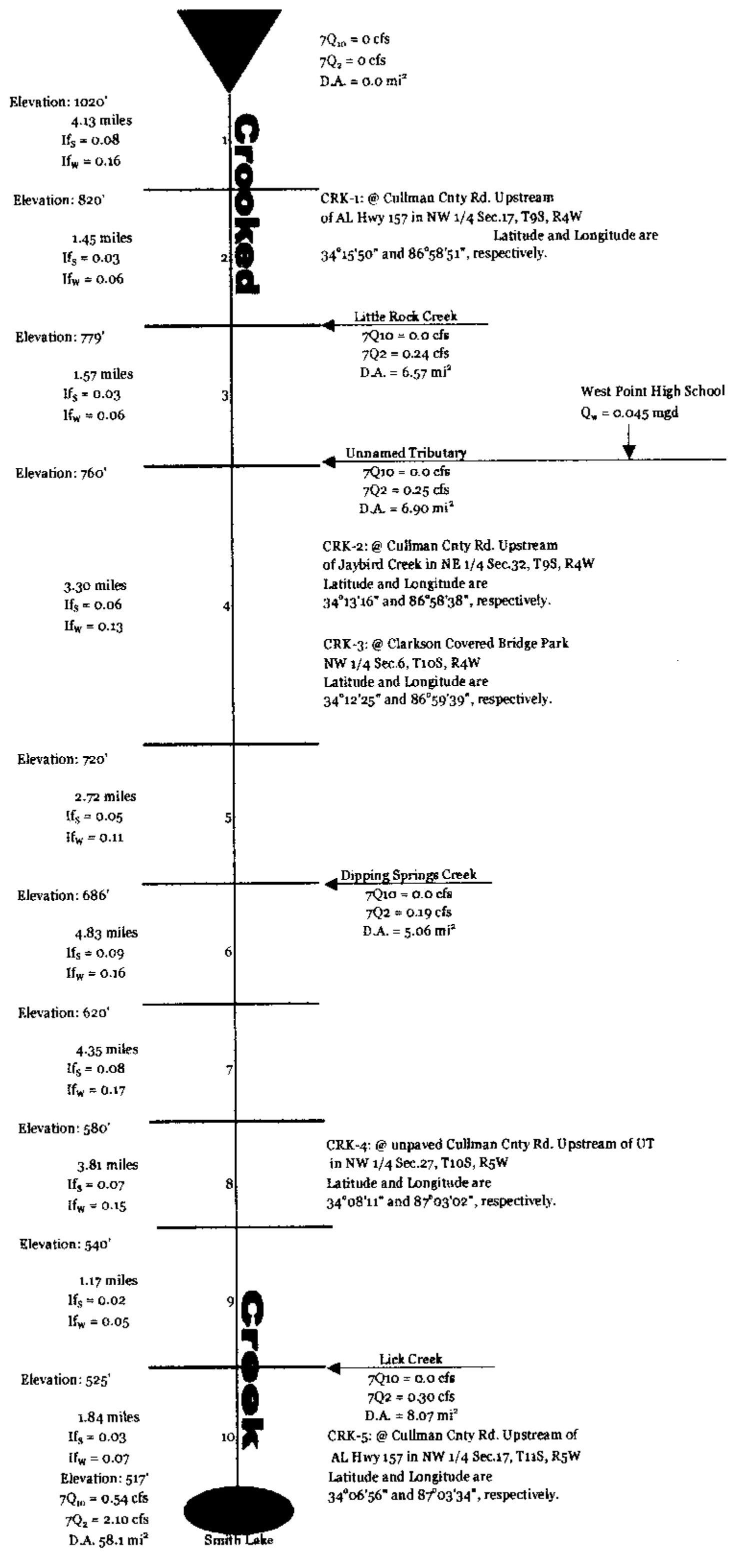
4.1.2. Calibration Data: The model calibration period was determined from an examination of the available field data (ref: Appendix) for the September 2, 1997 sampling event. The combination of the lowest, steady flow period with the lowest dissolved oxygen defined the critical modeling period. The stream conditions (i.e., D.O., temperature) during this period were incorporated into the calibrated TMDL spreadsheet model.

4.2 Water Quality Model Summary

The modeled reach and impaired portion of Crooked Creek are identical in length. The modeled reach extends from Smith Lake to Crooked Creek's source. It consists of 10 segments with a total length of 28.17 miles. A schematic diagram of the model is presented in Figure 4-1. Assumed in-stream seasonal temperatures are based on historical model development. A guide for use of ADEM's TMDL water quality model can be found in the appendix. The guide also explains the theoretical basis for the physical/chemical mechanisms and principles that form the foundation of the model.

The summer TMDL reflects a special situation in that all pollutant loadings were reduced to the maximum achievable. Nonpoint source concentrations were reduced to background values and point source concentrations were reduced to values associated with best conventional technology (BCT). Effluent values for West Point School were reduced from 25 mg/l $CBOD_5$ and 1.2 mg/l NH_3-N to 4 mg/l $CBOD_5$ and 1 mg/l NH_3-N. Normally, a Fish and Wildlife stream must be able to support a minimum instream D.O. concentration of 5 mg/l. An inspection of the summer D.O. TMDL chart in Figure 4.2 indicates a D.O. sag of approximately 3.4 mg/l at mile 8.6. This chart suggests that Crooked Creek cannot maintain a minimum instream D.O. value of 5 mg/l during the summer critical period (of high temperature and low flow) because of natural stream conditions.

Figure 4-1. Schematic of the Modeled Reach.



4.2.1. Summer (May – November) Model

Summer Stream Flow Parameters

Description	Flow (cfs)	DO (mg/l)	$CBOD_U$ (mg/l)	NH_3N (mg/l)	TON (mg/l)	Temp (°C)
Headwaters	0.00	6.65	2.00	0.04	0.18	28
Unnamed Tributary	0.07	7.11	4.44	0.57	0.95	28
Conditions @ Lowest D.O.	0.23	3.36	0.99	0.03	0.28	28
Flow @ End of Model	0.61	6.64	0.15	0.00	0.06	28

Summer Incremental Flow Parameters

Sections	$CBOD_U$ (mg/l)	NH_3N (mg/l)	TON (mg/l)	DO (mg/l)	Total Flow (cfs)	Temp. (°C)
1	2.00	0.04	0.18	5.48	0.08	28
2	2.00	0.04	0.18	5.48	0.03	28
3	2.00	0.04	0.18	5.48	0.03	28
4	2.00	0.04	0.18	5.48	0.06	28
5	2.00	0.08	0.18	5.48	0.05	28
6	2.00	0.08	0.18	5.48	0.09	28
7	2.00	0.08	0.18	5.48	0.08	28
8	2.00	0.08	0.18	5.48	0.07	28
9	2.00	0.08	0.18	5.48	0.02	28
10	2.00	0.08	0.18	5.48	0.03	28

4.2.2 Winter (December – April) Model

Winter Stream Flow Parameters

Description	Flow (cfs)	DO (mg/l)	CBOD (mg/l)	NH_3N (mg/l)	TON (mg/l)	Temp (°C)
Headwaters	0.00	8.05	21.83	0.70	5.82	18
Little Rock Creek	0.24	8.05	21.83	0.70	5.82	18
Unnamed Tributary	0.32	7.85	27.37	1.18	7.47	18
Dipping Springs Creek	0.19	8.05	21.83	0.70	5.82	18
Lick Creek	0.30	8.05	21.83	0.70	5.82	18
Conditions @ Lowest D.O.	0.88	5.02	12.45	0.94	6.00	18
Flow @ End of Model	2.21	7.33	4.57	0.76	4.07	18

Winter Incremental Flow Parameters

Sections	$CBOD_U$ (mg/l)	NH_3N (mg/l)	TON (mg/l)	DO (mg/l)	Total Flow (cfs)	Temp. (°C)
1	21.83	0.70	5.82	6.63	0.16	18
2	21.83	0.70	5.82	6.63	0.06	18
3	21.83	0.70	5.82	6.63	0.06	18
4	21.83	0.70	5.82	6.63	0.13	18
5	21.83	0.70	5.82	6.63	0.11	18
6	21.83	0.70	5.82	6.63	0.19	18
7	21.83	0.70	5.82	6.63	0.17	18
8	21.83	0.70	5.82	6.63	0.15	18
9	21.83	0.70	5.82	6.63	0.05	18
10	21.83	0.70	5.82	6.63	0.07	18

4.3 *Summer and Winter TMDL Predictions and Graphics*

Figure 4-2. Summer TMDL Predictions.

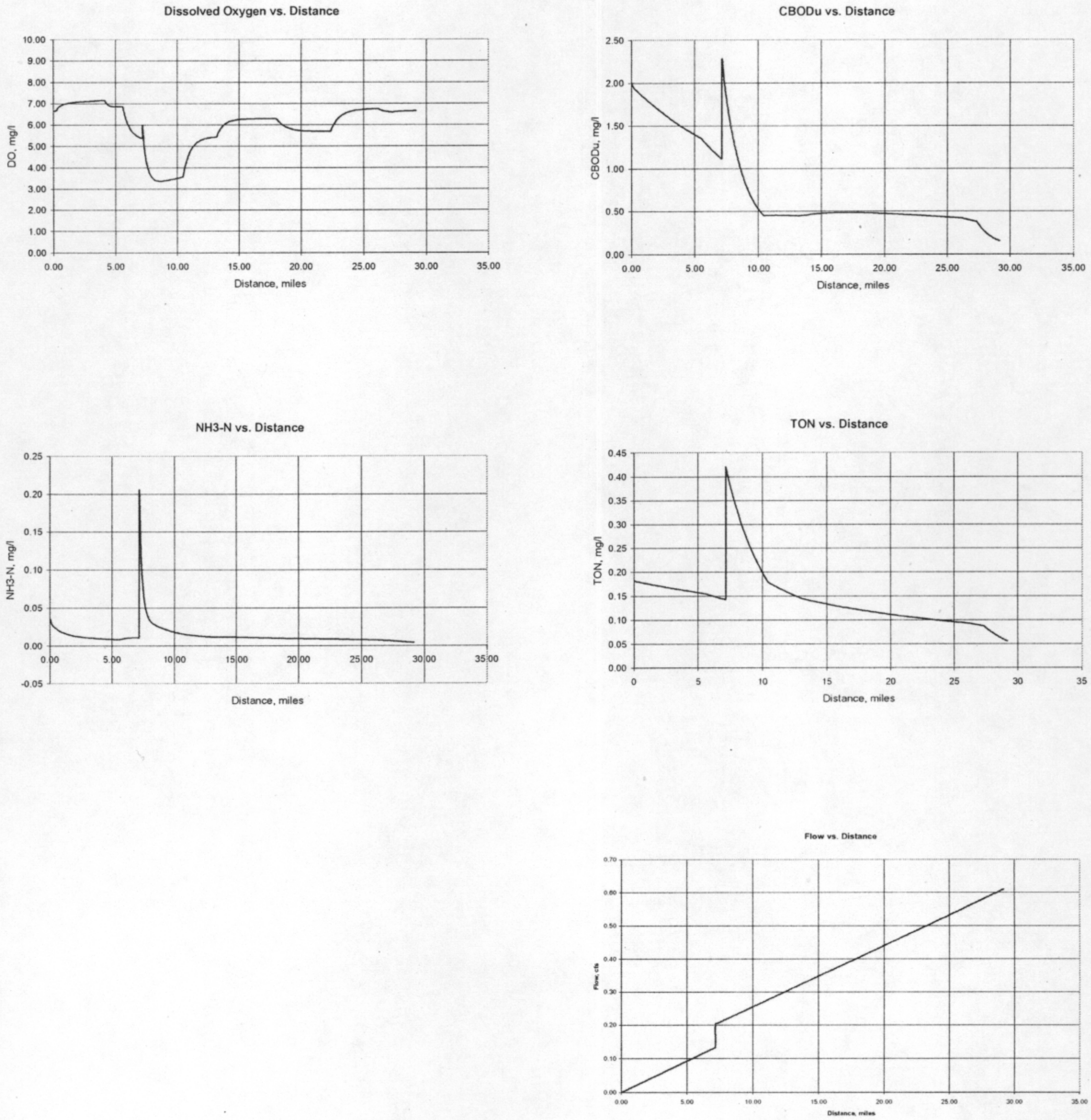
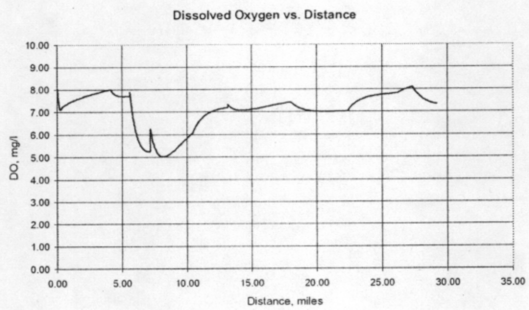
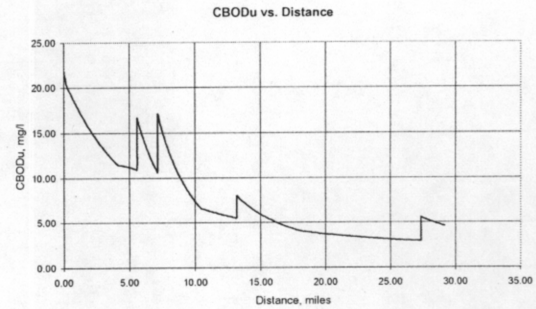
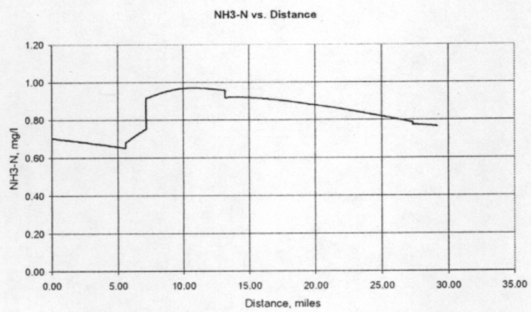
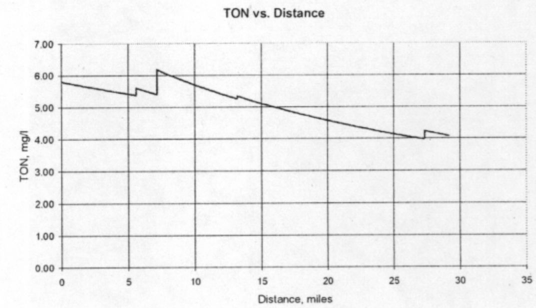


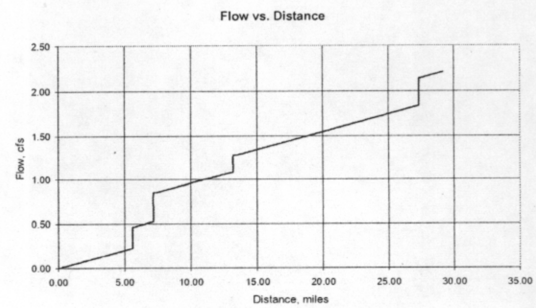
Figure 4-3. Winter TMDL Predictions.











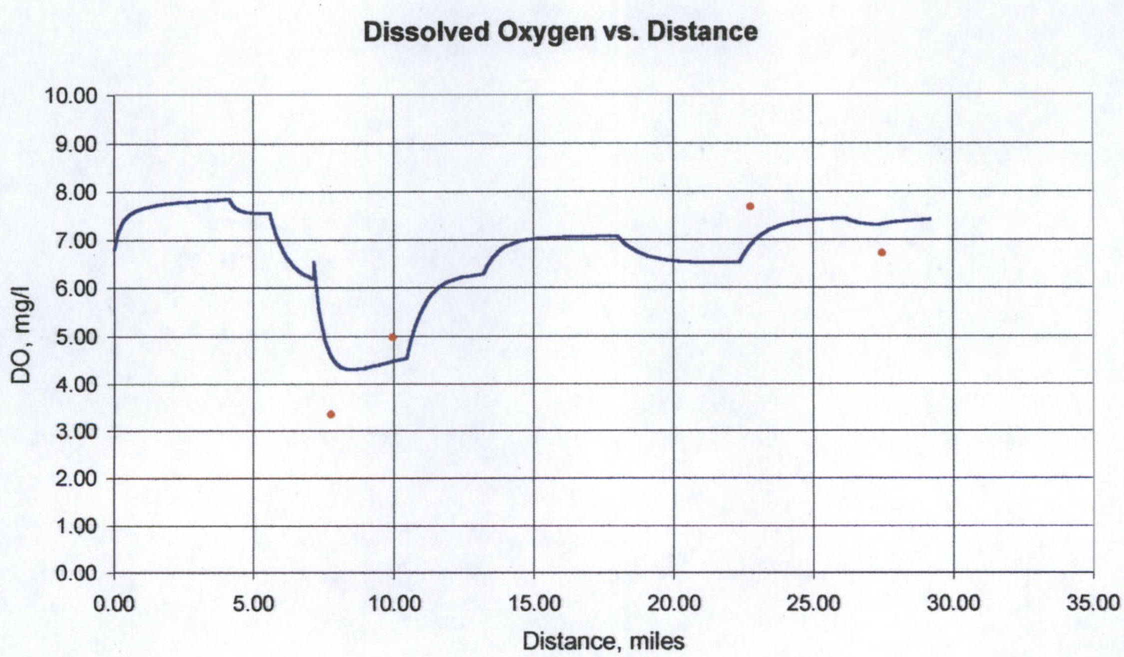
4.4 Loading Reduction Analysis

4.4.1. Calibrated Model

Of the instream D.O. values measured in 1997, three were below the Fish & Wildlife standard of 5 mg/l. The lowest value of 3.35 mg/l was measured at station CRK – 2 during the September 2, 1997, sampling event. Field data from this event were used as input into the summer TMDL model to perform a third simulation referred to as the calibrated model (the first and second simulations are the summer and winter TMDL, respectively). Non-point source loading was adjusted so that model predictions simulated the measured D.O. value as closely as possible at CRK – 2, while still providing a reasonable representation of water quality in the stream at the time of the sampling event.

Shown in Figure 4-4, below, is a plot of D.O. calibrated model predictions vs. actual D.O. field data. Flows employed in the calibration simulation were assumed to be the same as those in the summer TMDL.

Figure 4-4. Calibrated Model D.O. Predictions vs. Actual D.O. Field Data.



Calibrated Model Flow Parameters

Description	Flow (cfs)	DO (mg/l)	$CBOD_U$ (mg/l)	NH_3N (mg/l)	TON (mg/l)	Temp (°C)
Headwaters	0.00	6.79	2.83	0.39	0.21	23.4
Unnamed Tributary	0.03	7.75	5.02	1.14	1.63	23.4
Conditions @ Lowest D.O.	0.19	4.30	1.86	0.04	0.34	23.4
Flow @ End of Model	0.57	7.41	0.56	0.01	0.08	23.4

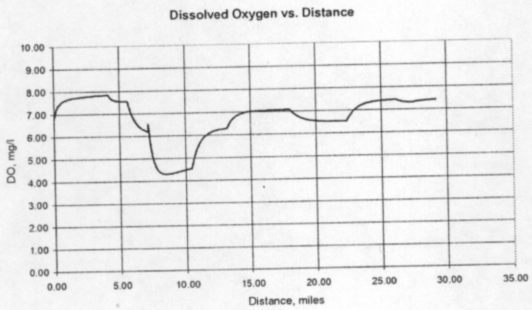
Calibrated Model Incremental Flow Parameters

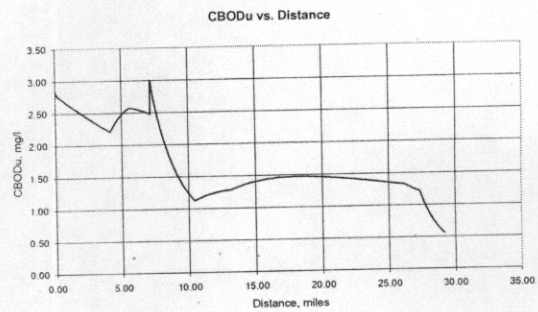
Sections	$CBOD_U$ (mg/l)	NH_3N (mg/l)	TON (mg/l)	DO (mg/l)	Total Flow (cfs)	Temp. (°C)
1	2.83	0.04	0.21	5.94	0.08	23.4
2	5.06	0.04	0.21	5.94	0.03	23.4
3	5.06	0.04	0.21	5.94	0.03	23.4
4	5.06	0.04	0.21	5.94	0.06	23.4
5	5.06	0.08	0.21	5.94	0.05	23.4
6	5.06	0.08	0.21	5.94	0.09	23.4
7	5.06	0.08	0.21	5.94	0.08	23.4
8	5.06	0.08	0.21	5.94	0.07	23.4
9	5.06	0.08	0.21	5.94	0.02	23.4
10	5.06	0.08	0.21	5.94	0.03	23.4

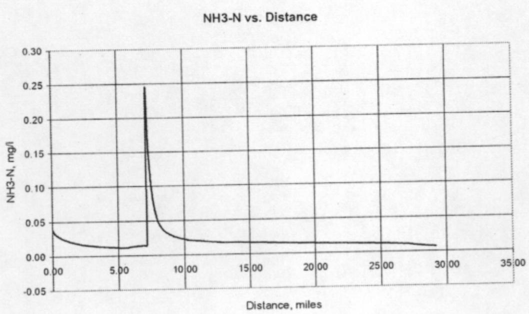
Comparison of Calibrated Model Flow Parameters to Actual Data

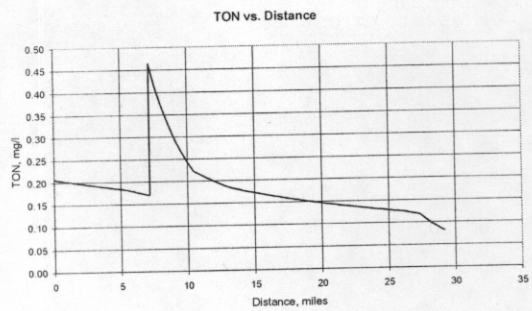
Description	Flow (cfs)	DO (mg/l)	$CBOD_U$ (mg/l)	NH_3N (mg/l)	TON (mg/l)	Temp (°C)
Actual Conditions @ Calibrated Point.	No Data	3.35	1.65	No Data	No Data	23.4
Model Conditions @ Calibrated Point	0.18	4.52	2.33	0.06	0.39	23.4

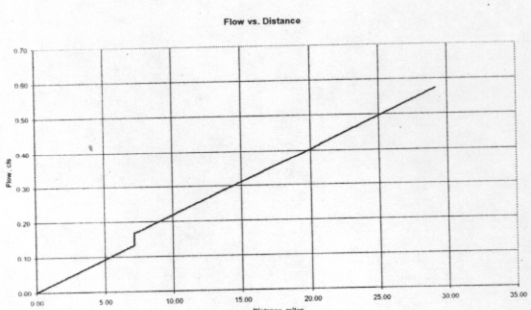
Figure 4-4. Calibrated Model Predictions and Graphics.











4.4.2. Load Reduction Model

The fourth simulation is referred to as the load reduction model. In this simulation, non-point pollutant concentrations using the calibrated model were reduced to similar concentrations found in the summer TMDL. Point source loadings from the unnamed tributary were reduced proportionally. An inspection of the D.O. chart in Figure 4.5 indicates a D.O. sag of approximately 4.7 mg/l at mile 8.6, once again suggesting that this waterbody is not capable of supporting a Fish and Wildlife D.O. standard of 5 mg/l during the summer critical period.

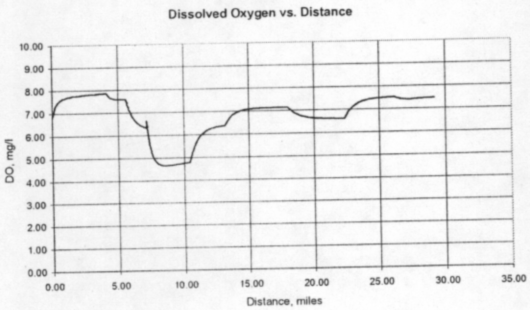
Load Reduction Model Flow Parameters

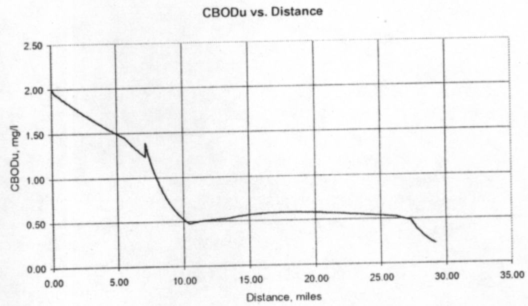
Description	Flow (cfs)	DO (mg/l)	$CBOD_U$ (mg/l)	NH_3N (mg/l)	TON (mg/l)	Temp (°C)
Headwaters	0.00	6.79	2.00	0.04	0.18	23.4
Unnamed Tributary	0.03	7.75	1.99	1.11	1.43	23.4
Conditions @ Lowest D.O.	0.19	4.66	0.79	0.03	0.29	23.4
Flow @ End of Model	0.57	7.45	0.22	0.01	0.07	23.4

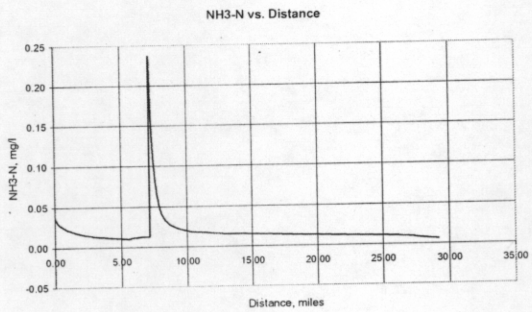
Load Reduction Model Incremental Flow Parameters

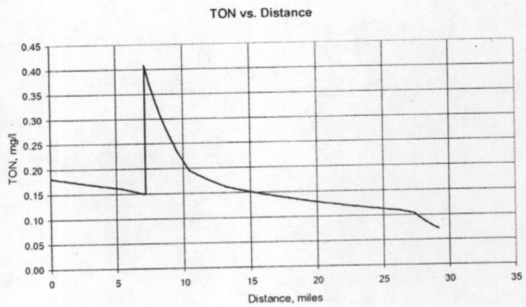
Sections	$CBOD_U$ (mg/l)	NH_3N (mg/l)	TON (mg/l)	DO (mg/l)	Total Flow (cfs)	Temp. (°C)
1	2.00	0.04	0.18	5.94	0.08	23.4
2	2.00	0.04	0.18	5.94	0.03	23.4
3	2.00	0.04	0.18	5.94	0.03	23.4
4	2.00	0.04	0.18	5.94	0.06	23.4
5	2.00	0.08	0.18	5.94	0.05	23.4
6	2.00	0.08	0.18	5.94	0.09	23.4
7	2.00	0.08	0.18	5.94	0.08	23.4
8	2.00	0.08	0.18	5.94	0.07	23.4
9	2.00	0.08	0.18	5.94	0.02	23.4
10	2.00	0.08	0.18	5.94	0.03	23.4

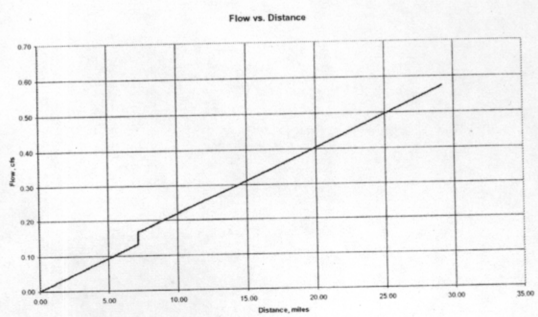
Figure 4-5. Load Reduction Model Predictions and Graphics.







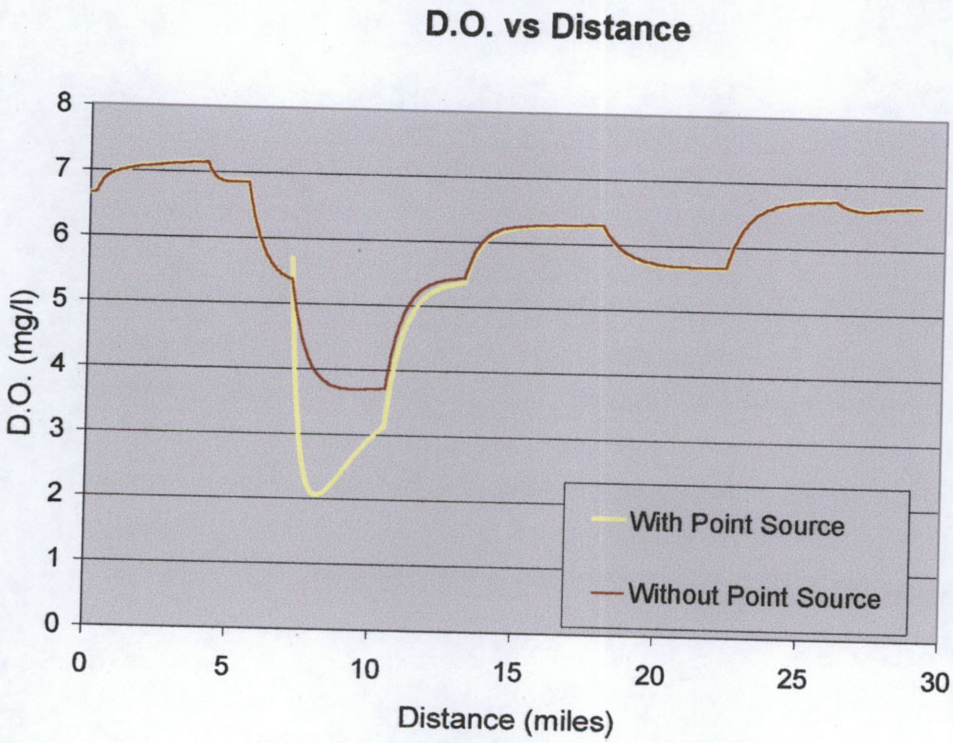




4.4.3 Point Source Sensitivity Analysis

The summer TMDL was rerun without any point sources to assess the magnitude of point source impacts on instream D.O. concentrations. Shown in figure 4-6 below is a chart depicting summer instream D.O. concentrations with and without point sources. It should be remembered that there is only one point source modeled in the Crooked Creek TMDL – West Point School.

Figure 4-6 Point Source Sensitivity Analysis



4.4.4. Required Reductions

Total organic loading (i.e., $CBOD_u$ and NBOD) was calculated at the end of the model for both the calibrated model and the load reduction model. The total organic loading for the calibrated model was 20.3 lbs./day. For the load reduction model, the total organic loading was 11.3 lbs./day. This would require a theoretical total organic loading reduction of 63% for point source loads and 47% for non-point source loads to bring Crooked Creek into compliance with its Fish & Wildlife use classification. Also, a load reduction estimate was calculated for non-point sources excluding forested land (since forest loadings remain constant in both models). That value was calculated to be 64%.

A summary of the required reductions for point and non-point source loads is presented in Tables 4-1 and 4-2. Percent reductions for non-point sources were determined using loadings from the calibration and load reduction simulations. Percent reductions for West Point school (the only point source) were determined using the school's current permit limits (see page 11) and the assumed limits in the summer TMDL of 4 mg/l $CBOD_5$ and 1 mg/l NH_3-N. Existing point source loadings listed in the tables below are calculated from loadings for the unnamed tributary of the calibration model. They are not employed in the point source percent reduction calculations of the tables below. Shown on the next page are the suggested revised permit limits for West Point School.

Table 4-1. Required Load Reductions for Point and Non-Point Sources Between the Calibration and Load Reduction Models

Existing Point Source Load[1]	Existing Non-Point Source Load[1]	Total Existing Load[1]	Reduced Load[1]	% Reduction	% Reduction	% Reduction
(lbs./day)	(lbs./day)	(lbs./day)	(lbs./day)	Point Sources	Non-Point Sources	Non-Forest Non-Point Sources
2.9	17.4	20.3	11.3	63%	47%	64%

Notes: 1 = $CBOD_u$ + NBOD

Table 4-2. Required Ammonia as Nitrogen Load Reductions for Point and Non-Point Sources Between the Calibration and Load Reduction Models

Existing Point Source Load[1]	Existing Non-Point Source Load[1]	Total Existing Load[1]	Reduced Load[1]	% Reduction	% Reduction	% Reduction
(lbs./day)	(lbs./day)	(lbs./day)	(lbs./day)	Point Sources	Non-Point Sources	Non-Forest Non-Point Sources
0.184	0.185	0.369	0.357	17%	4%	41%

Notes: 1 = $CBOD_u$ + NBOD

The required reductions will be sought through TMDL implementation with follow up monitoring to determine the effectiveness of implementation. Follow up monitoring as discussed further in this document will be conducted according to the state basin rotation program.

Table 5-2. Suggested Revised NPDES Permit Limits for Significant Contributing Point Sources.

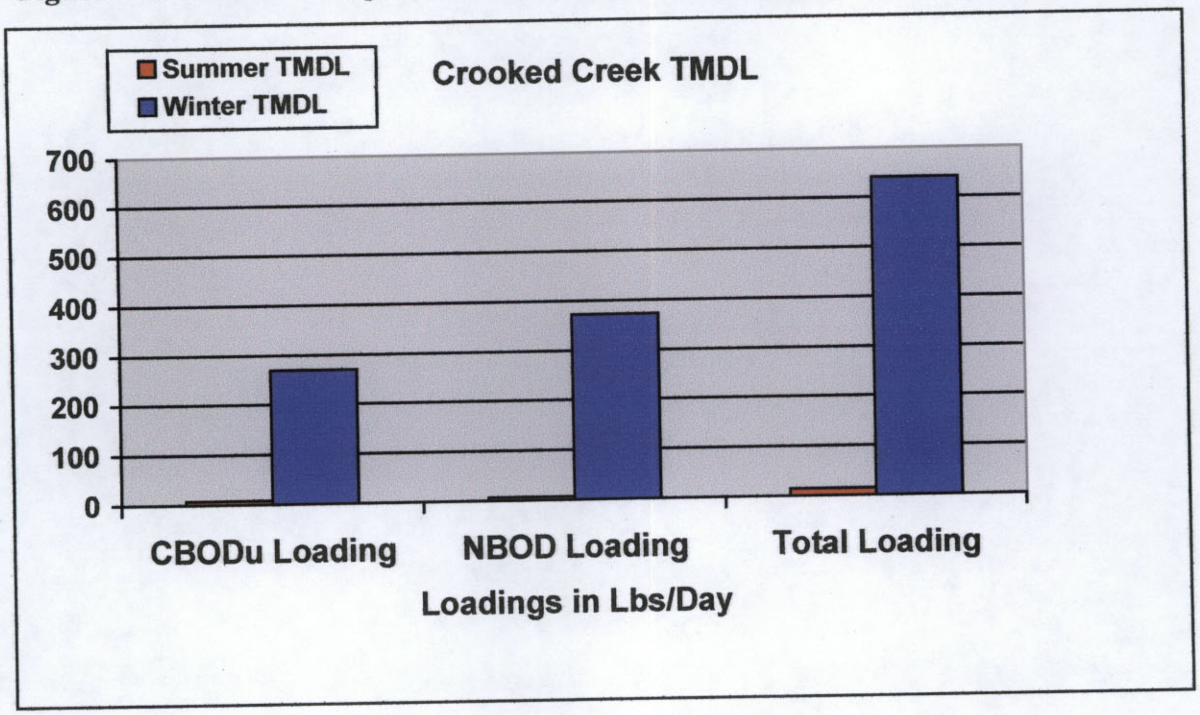
NPDES Permit	Facility Name	Permit Limtations - Summer							Permit Limtations - Winter						
		Flow (MGD)		BOD_5 (MG/L)		NH_3-N (MG/L)		DO (MG/L)	Flow (MGD)		BOD_5 (MG/L)		NH_3-N (MG/L)		DO (MG/L)
		Max	Avg	Avg Weekly	Avg Monthly	Avg Weekly	Avg Monthly	Min	Max	Avg	Avg Weekly	Avg Monthly	Avg Weekly	Avg Monthly	Min
AL0051136	West Point School		0.045	6	4	1.5	1	6.0		0.045	37.5	25	3.1	2.1	6.0

Notes: N/A = not applicable

4.5 *Seasonal Variation*

The regulations require that a TMDL be established with consideration of seasonal variations. As discussed previously, TMDLs have been estimated for the summer and winter. Figure 4-7, below, illustrates the effect that seasonal temperatures and stream flows have on CBODu, NBOD and total organic loading at the end of the model.

Figure 4-7. Seasonal Temperature and Stream Effects on the TMDLs



5.0 *Conclusions*

A loading summary of the TMDL for both summer and winter is presented in Table 5-1 below.

Table 5-1. Summer and Winter TMDLs Summary

	TMDL	
	Summer	**Winter**
$CBOD_u$ Loading (lbs./day)	7.5	264.9
NBOD Loading (lbs./day)	5.9	365.5
Total Loading (lbs./day)	13.4	630.4
NH3-N (lbs./day)	0.4	9.0

6.0 TMDL Implementation

6.1 Non-Point Source Approach

Crooked Creek is impaired primarily by nonpoint sources. For 303(d) listed waters impaired solely or primarily by nonpoint source (NPS) pollutants, necessary reductions will be sought during TMDL implementation using a phased approach. Voluntary, incentive-based mechanisms will be used to implement NPS management measures in order to assure that measurable reductions in pollutant loadings can be achieved for the targeted impaired water. Cooperation and active participation by the general public and various industry, business, and environmental groups is critical to successful implementation of TMDLs. Local citizen-led and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. Therefore, TMDL implementation activities will be coordinated through interaction with local entities in conjunction with Clean Water Partnership efforts.

The primary TMDL implementation mechanism used will employ concurrent education and outreach, training, technology transfer, and technical assistance with incentive-based pollutant management measures. The ADEM Office of Education and Outreach (OEO) will assist in the implementation of TMDLs in cooperation with public and private stakeholders. Planning and oversight will be provided by or coordinated with the Alabama Department of Environmental Management's (ADEM) Section 319 nonpoint source grant program in conjunction with other local, state, and federal resource management and protection programs and authorities. The CWA Section 319 grant program may provide limited funding to specifically ascertain NPS pollution sources and causes, identify and coordinate management programs and resources, present education and outreach opportunities, promote pollution prevention, and implement needed management measures to restore impaired waters.

Depending on the pollutant of concern, resources for corrective actions may be provided, as applicable, by the Alabama Cooperative Extension System (education and outreach); the USDA-Natural Resources Conservation Service (NRCS) (technical assistance) and Farm Services Agency (FSA) (federal cost-share funding); and the Alabama Soil and Water Conservation Committee (state agricultural cost share funding and management measure implementation assistance) through local Soil and Water Conservation Districts, or Resource Conservation and Development Councils (funding, project implementation, and coordination). Additional assistance from such agencies as the Alabama Department of Public Health (septic systems), Alabama Department of Agriculture and Industries (pesticides), and the Alabama Department of Industrial Relations and Dept of Interior - Office of Surface Mining (abandoned minelands), Natural Heritage Program and US Fish and Wildlife Service (threatened and endangered species), may also provide practical TMDL implementation delivery systems, programs, and information. Land use and urban sprawl issues will be addressed through the Nonpoint Source for Municipal

Officials (NEMO) education and outreach program. Memorandums of Agreements (MOAs) may be used as a tool to formally define roles and responsibilities.

Additional public/private assistance is available through the Alabama Clean Water Partnership (CWP) Program. The CWP program uses a local citizen-based environmental protection approach to coordinate efforts to restore and protect the state's resources in accordance with the goals of the Clean Water Act. Interaction with the state or river basin specific CWP will facilitate TMDL implementation by providing improved and timely communication and information exchange between community-based groups, units of government, industry, special interest groups, and individuals. The CWP can assist local entities to plan, develop, and coordinate restoration strategies that holistically meet multiple needs, eliminate duplication of efforts, and allow for effective and efficient use of available resources to restore the impaired waterbody or watershed.

Other mechanisms that are available and may be used during implementation of this TMDL include local regulations or ordinances related to zoning, land use, or storm water runoff controls. Local governments can provide funding assistance through general revenues, bond issuance, special taxes, utility fees, and impact fees. If applicable, reductions from point sources will be addressed by the NPDES permit program. The Alabama Water Pollution Control Act empowers ADEM to monitor water quality, issue permits, conduct inspections, and pursue enforcement of discharge activities and conditions that threaten water quality. In addition to traditional "end-of-pipe" discharges, the ADEM NPDES permit program addresses animal feeding operations and land application of animal wastes. For certain water quality improvement projects, the State Clean Water Revolving Fund (SRF) can provide low interest loans to local governments.

Long-term physical, chemical, and biological improvements in water quality will be used to measure TMDL implementation success. As may be indicated by further evaluation of stream water quality, the effectiveness of implemented management measures may necessitate revisions of this TMDL. The ADEM will continue to monitor water quality according to the rotational river basin monitoring schedule as allowed by resources. In addition, assessments may include local citizen-volunteer monitoring through the Alabama Water Watch Program and/or data collected by agencies, universities, or other entities using standardized monitoring and assessment methodologies. Core management measures will include, but not be limited to water quality improvements and designated use support, preserving and enhancing public health, enhancing ecosystems, pollution prevention and load reductions, implementation of NPS controls, and public awareness and attitude/behavior changes.

6.2 Point Source Approach

As previously discussed, load reductions for West Point School will be sought through the Department's municipal NPDES program.

7.0 Follow Up Monitoring

ADEM has adopted a basin approach to water quality management; an approach that divides Alabama's fourteen major river basins into five groups. Each year, the ADEM water quality resources are concentrated in one of the basin groups. One goal is to continue to monitor §303(d) listed waters. This monitoring will occur in each basin according to the following schedule:

River Basin Group	Schedule
Cahaba / Black Warrior	2002
Tennessee	2003
Choctawhatchee / Chipola / Perdido-Escambia / Chattahoochee	2004
Tallapoosa / Alabama / Coosa	2005
Escatawpa / Upper Tombigbee / Lower Tombigbee / Mobile	2006

Monitoring will help further characterize water quality conditions resulting from the implementation of best management practices in the watershed. If so indicated by future data collection, the TMDL will be revised.

8.0 Public Participation

A sixty-day public notice was provided for this TMDL. During this time, the availability of the TMDL was public noticed, a copy of the TMDL was provided as requested, and the public was invited to provide comments on the TMDL.

Appendix 9.1
References

References

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United States Environmental Protection Agency. 1991. Guidance for Water Quality-Based Decisions: The TMDL Process, Office of Water, EPA 440/4-91-00

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United States Environmental Protection Agency Region IV Sediment Oxygen Demand (SOD) Database

Appendix 9.2
Data

1997 Monthly Sampling Data

June 1997

STA. ID	DATE	TIME	T/A °C	T/W °C	pH	DO (mg/l)	F. COLI. (mg/l)	COND. (mg/l)	TURB. (mg/l)	HARD	$CBOD_5$ (mg/l)	TSS (mg/l)	TDS (mg/l)	ORTHO P (mg/l)	NO_2+N O_3-N (mg/l)	TKN (mg/l)	PO_4-P (mg/l)	DEPTH ft	WIDTH ft	FLOW (cfs)
CRK-1	6/11/97	12:15	26	17.1	5.59	7.22	210	33	6.3	44	0.8	5	49	<.005	0.627	0.403	0.064			14
CRK-2	6/11/97	11:35	26	17.8	6.4	8.19	880	55.2	13.6	40	0.9	9	82	0.016	1.009	0.55	0.06	10"		
CRK-3	6/11/97	10:45	23	17.3	6.23	8.4	560	44	10.3	30	0.9	13	58	0.023	1.263	0.488	0.047	1.5		92
CRK-4	6/11/97	9:50	22	17.3	5.66	8.21	190	35.2	25	30	0.6	73	52	0.011	0.978	0.683	0.103			
CRK-5	6/11/97	8:45	20	17.6	6.14	8.46	250	36.4	14.7	20	0.6	12	54	0.016	0.878	0.385	0.085	2.5		

July 1997

STA ID	DATE	TIME	T/A °C	T/W °C	pH	DO (mg/l)	F. COLI. (mg/l)	COND. (mg/l)	TURB. (mg/l)	HARD	$CBOD_5$ (mg/l)	TSS (mg/l)	TDS (mg/l)	ORTHO P (mg/l)	NO_2+N O_3-N (mg/l)	TKN (mg/l)	PO_4-P (mg/l)	DEPTH ft	WIDTH ft	FLOW (cfs)
CRK-1	7/1/97	12:00	31	13.2	6.05	7.1	430	35.3	9.4	22	1.2	8	37	0.006	0.54	0.386	0.42			45
CRK-2	7/1/97	12:30	30	20.6	6.58	9.69	720	48.1	19.6	26	1.7	19	50	0.02	0.897	0.552	0.068			
CRK-3	7/1/97	11:15	31	12.7	7.32	8.6	1220	47.9	18.6	30	1.7	34	54	0.031	1.011	0.654	0.102			286
CRK-4	7/1/97	10:30	31	21.8	5.98	8.37	3460	41	116	34	1.8	219	52	0.062	0.735	1.291	0.728			
CRK-5	7/1/97	9:00	28	11.9	5.95	8.2	>6000	42.9	135	38	2.3	227	59	0.094	0.665	1.325	0.482			385

August 1997

STA ID	DATE	TIME	T/A °C	T/W °C	pH	DO (mg/l)	F. COLI. (mg/l)	COND. (mg/l)	TURB. (mg/l)	HARD	$CBOD_5$ (mg/l)	TSS (mg/l)	TDS (mg/l)	ORTHO P (mg/l)	NO_2+N O_3-N (mg/l)	TKN (mg/l)	PO_4-P (mg/l)	DEPTH ft	WIDTH ft	FLOW (cfs)
CRK-1	8/5/97	9:50	30	21.7	6.49	4.81	82	99.6	2.1	68	0.6	1	85	0.006	0.249	0.055	0.051	0.75	12	0.1
CRK-2	8/5/97	10:30	28	23.7	6.56	6.35	25	74	2.8	42	0.7	5	72	<.005	0.304	0.457	0.081	1.2	20	
CRK-3	8/5/97	11:00	31	24.7	6.61	6.45	52	78.7	2.6	42	0.9	1	67	0.005	0.35	0.558	0.051	1	20	1.9
CRK-4	8/5/97	12:00	34	24.8	6.39	6.31	55	53.3	2.4	40	0.8	1	50	0.006	0.268	0.381	0.043	0.8	25	
CRK-5	8/5/97	12:40	34	26.5	6.62	7.73	650	49.4	3.6	24	1	3	49	0.005	0.298	0.436	0.046	1	40	5.4

1997 Monthly Sampling Data

September 1997

STA ID	DATE	TIME	T/A °C	T/W °C	pH	DO (mg/l)	F. COLI. (mg/l)	COND. (mg/l)	TURB. (mg/l)	HARD	$CBOD_5$ (mg/l)	TSS (mg/l)	TDS (mg/l)	ORTHO P (mg/l)	NO_2+NO_3-N (mg/l)	TKN (mg/l)	PO_4-P (mg/l)	DEPTH ft	WIDTH ft	FLOW (cfs)
CRK-1	9/2/97	10:10	no water																	
CRK-2	9/2/97	10:30	29	23.4	7	3.35	14	90.2	2	60	1.1	1	70	<.005	0.142	0.361	0.096	1	25	slow
CRK-3	9/2/97	10:45	28	23.7	7.04	4.97	104	90.2	2.7	60	1.4	<1	72	<.005	0.106	0.391	0.043	1	20	slow
CRK-4	9/2/97	11:20	31	23.2	7.33	7.67	204	37.6	2.2	32	1.2	1	27	<.005	0.329	0.257	0.035	0.5	10	mod
CRK-5	9/2/97	11:45	33	26.5	7.24	6.7	62	64.9	2.5	46	1.3	<1	54	<.005	0.071	0.299	0.04	2	50	normal

Station ID	Description
CRK – 1	Crooked Creek @ Cullman County RD. upstream of AL Hwy 157 NW ¼ Sec.17, T9S, R4W
CRK – 2	Crooked Creek @ Cullman County RD. upstream of Jaybird Creek NE ¼ Sec.32, T9S, R4W
CRK – 3	Crooked Creek @ Clarkson Covered Bridge Park NW ¼ Sec.6, T10S, R4W
CRK – 4	Crooked Creek @ unpaved Cullman County RD. upstream of UT NW ¼ Sec.27, T11S, R5W
CRK – 5	Crooked Creek @ Cullman County RD. upstream of US Hwy 278 NW ¼ Sec. 17, T11S, R5W

1997 Intensive Survey Sampling Data

Station	Date	Time	T/A C	T/W C	pH	DO mg/l	F. Coli org/100ml	Cond umho/cm	Turb NTUs	Hard mg/L	CBOD5 mg/L	TSS mg/L	TDS mg/L	Ortho P mg/L	PO4-P mg/L	Depth M	Flow cfs
CRK - 1	05/20/1997	15:59	25	20	6.1	5.76		50	8.47							0.5	
CRK - 2	05/20/1997	15:37	25	19	6.4	7.98		74	4.02							0.1	
CRK - 3	05/20/1997	15:01	23	20	6.5	8.19		76	3.63							0.1	
CRK - 4	05/20/1997	13:52	24	20	6.3	8.18		61	3.53							0.3	16.7
CRK - 5	05/20/1997	12:54	25	21	6.3	8.4		56	3.6							0.2	
CRK - 1	05/21/1997	8:31	17	18	6	6.21	190	51	7.4	26	2.2	5	69	0.004K	0.037	0.1	0.82
DUP - 1	05/21/1997	8:32	17	18	6.1	6.19	190	51	7.44	26	1.8	2	61	0.002	0.04	0.1	
CRK - 2	05/21/1997	8:10	16	18	6.4	7.31	78	78	5.74	38/36	1.9/2.0	3	73	0.005	0.042/0.04	0.1	5.45
CRK - 3	05/21/1997	7:50	15	18	6.5	7.65	60/56	78	4.25	34	2.1	2	74	0.004K	0.038	0.2	
CRK - 4	05/21/1997	7:11	15	19	6.3	7.76	32	62	2.79	24	2.3	2	68	0.004	0.037	0.3	
CRK - 5	05/21/1997	6:48	14	19	6.3	7.81	72	58	3.08	30	1.8	1K	59	0.003	0.035	0.2	
CRK - 1	05/21/1997	14:45	24	19	6.1	6.55		51	8.64							0.1	
CRK - 2	05/21/1997	14:24	27	18	6.5	8.6		78	3.7							0.2	
CRK - 3	05/21/1997	13:55	26	19	6.5	8.64		77	5.99							0.2	
CRK - 4	05/21/1997	14:17	23	20	6.6	8.91		63	2.86							0.1	
CRK - 5	05/21/1997	13:06	21	19	6.5	9.07		57	3.37							0.3	31
CRK - 1	05/22/1997	8:15	13	16	6.1	6.55	192	51	8.68	18	2.1	3	42	0.004K	0.038	0.2	0.53
DUP - 1	05/22/1997	8:16	13	16	6.1	6.54	144	51	7.89	14	2	1	40	0.004K	0.038	0.2	
CRK - 2	05/22/1997	7:55	12	16	6.5	7.86	118	78	4.2	24	1.7	3	59	0.005	0.04	0.2	
CRK - 3	05/22/1997	7:38	12	16	6.5	7.91	96	52	4.66	28	1.8	2	49	0.002	0.034	0.1	4.46
CRK - 4	05/22/1997	7:04	7.5	16	6.5	8.25	70	61	3.08	18	2.4	2	47	0.004	0.038	0.1	
CRK - 5	05/22/1997	6:35	6.5	17	6.4	8.12	68	58	3.52	20	2.1	2	41	0.005	0.035	0.4	14

Station ID	Description
CRK – 1	Crooked Creek @ Cullman County RD. upstream of AL Hwy 157 NW ¼ Sec.17, T9S, R4W
CRK – 2	Crooked Creek @ Cullman County RD. upstream of Jaybird Creek NE ¼ Sec.32, T9S, R4W
CRK – 3	Crooked Creek @ Clarkson Covered Bridge Park NW ¼ Sec.6, T10S, R4W
CRK – 4	Crooked Creek @ unpaved Cullman County RD. upstream of UT NW ¼ Sec.27, T10S, R5W
CRK – 5	Crooked Creek @ Cullman County RD. NW ¼ Sec. 4, T11S, R5W

1988 Storet Data

CROOKEDCREEK03

	AIR TEMP CENT	BOD 5 DAY MG/L	CNDUCTVYFIELD MICROMHO	DO MG/L	DO SATUR PERCENT	NH3+NH4- N TOTAL MG/L	NO2&NO3 N-TOTAL MG/L	ORG N N MG/L	PH SU	PHOS-TOT MG/L P	RESIDUE TOT MG/L	TOT KJEL N MG/L	TURB JKSN JTU	UN-IONZD MG/L	UN-IONZD NH3-NH3 MG/L	WATER TEMP CENT	WATER TEMP FAHN
04/20/1988		1	32.8	8.9	83.962	0.1	0.27	1.1	5.4	0.01	10	1.2	5.3	0	0	13	55.4
05/17/1988		2.2	49.3	4	44.444	0.2	0.05	1	5.5	0.02	26	1.2	18	0	0	21	69.8

CROOKEDCREEK04

	AIR TEMP CENT	BOD 5 DAY MG/L	CNDUCTVYFIELD MICROMHO	DO MG/L	DO SATUR PERCENT	NH3+NH4- N TOTAL MG/L	NO2&NO3 N-TOTAL MG/L	ORG N N MG/L	PH SU	PHOS-TOT MG/L P	RESIDUE TOT NFLT MG/L	TOT KJEL N MG/L	TURB JKSN JTU	UN-IONZD NH3-N MG/L	UN-IONZD NH3-NH3 MG/L	WATER TEMP CENT	WATER TEMP FAHN
04/20/1988		1	43.6	10	94.34	0.1	1.28	0.6	5.4	0.01	19	0.6	9	0	0	13	55.4
05/17/1988		1.3	53.1	6.4	68.085	0.1	0.66	1	5.6	0.03	14	1	8.5	0	0	19	66.2

CROOKEDCREEK05

	AIR TEMP CENT	BOD 5 DAY MG/L	CNDUCTVYFIELD MICROMHO	DO MG/L	DO SATUR PERCENT	NH3+NH4- N TOTAL MG/L	NO2&NO3 N-TOTAL MG/L	ORG N N MG/L	PH SU	PHOS-TOT MG/L P	RESIDUE TOT NFLT MG/L	TOT KJEL N MG/L	TURB JKSN JTU	UN-IONZD NH3-N MG/L	UN-IONZD NH3-NH3 MG/L	WATER TEMP CENT	WATER TEMP FAHN
04/20/1988		1	46.1	9.9	93.396	0.1	1.28	0.8	6	0.02	23	0.8	12	0	0	13	55.4
05/17/1988		1.6	49.9	6.7	72.826	0.1	0.54	8.5	5.8	0.02	11	8.6	9.7	0	0	20	68

CROOKEDCREEK06

	AIR TEMP CENT	BOD 5 DAY MG/L	CNDUCTVYFIELD MICROMHO	DO MG/L	DO SATUR PERCENT	NH3+NH4- N TOTAL MG/L	NO2&NO3 N-TOTAL MG/L	ORG N N MG/L	PH SU	PHOS-TOT MG/L P	RESIDUE TOT NFLT MG/L	TOT KJEL N MG/L	TURB JKSN JTU	UN-IONZD NH3-N MG/L	UN-IONZD NH3-NH3 MG/L	WATER TEMP CENT	WATER TEMP FAHN
04/20/1988		1.4	41	9.2	86.792	0.2	1	0.7	5.3	0.02	36	0.9	18	0	0	13	55.4
05/17/1988		1.2	49	7.6	84.444	0.1	0.6	2	5.9	0.02	6	2	8.7	0	0	21	69.8

Station ID	Description
CROOKEDCREEK03	Crooked Creek @ Cullman County RD. upstream of AL Hwy 157 NW ¼ Sec.17, T9S, R4W
CROOKEDCREEK04	Crooked Creek @ Cullman County RD. upstream of Jaybird Creek NE ¼ Sec.32, T9S, R4W
CROOKEDCREEK05	Crooked Creek @ US Hwy 278 NE ¼ Sec. 2, T10S, R5W
CROOKEDCREEK06	Crooked Creek @ Cullman County RD. NW ¼ Sec. 4, T11S, R5W

1997 Black Warrior NPS Screening Assessment

Table 3b. Habitat quality and aquatic macroinvertebrate assessments from the Sipsey Fork cataloging unit. In order to compare levels of habitat degradation between stations, values each of three major habitat parameters are presented as percent of maximum score.

Parameter	Station										
	WHOC-16a	WHEC-17a	ROCW-52b	SANW-12a	CRK-3	CANW-13a	MILW-18a	CLCW-53b	CLCW-53c	CROC-54a	TPSL-1
Habitat assessment form	RR	RR	RR	RR	GP	RR	RR	RR	RR	GP	RR
Instream habitat quality	92	85	93	75	70	38	53	25	22	77	75
Sediment deposition	93	78	90	35	37	40	25	8	10	74	69
% Sand	14	20	10	45	39	45	43	70	88	39	20
% Silt	10	8	5	2	5	10	10	2	3	5	2
Sinuosity	90	80	75	65	35	75	25	10	3	34	68
Bank and vegetative stability	65	65	48	75	68	50	15	60	43	68	67
Riparian zone measurements	65	65	48	75	68	50	15	60	43	80	93
% Canopy cover	70	90	50	50	30	50	20	50	70	30	30
% Maximum Score	78	73	73	66	63	49	42	34	28	72	74
Habitat Assessment Category	Excellent	Good	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Excellent
EPT Taxa Collected	13	14	12	14	----	11	3	8	8	9	16
Aq. Macroinvertebrate Assess.	Unimp.	Unimp.	Unimp.	Unimp.	----	Unimp.	Sev. Imp	Sl. Imp.	Sl. Imp.	Sl. Imp.	Unimp.

	BRUW-14f	CPSY-1	RUSW-1	BEEW-1	BRSH-1	SF-1	SF-2	Ryan-Aub	Crooked-Aub	Rock-Aub	Blevens-Aub
Habitat assessment form	RR	RR	RR	GP	GP	Original	Original	Original	Original	Original	Original
Instream habitat quality	79	85	61	62	68	31	73	83	83	83	83
Sediment deposition	70	80	63	55	60	52	45	96	100	90	92
% Sand	30	15	35	53	45	80	73	4	2	12	15
% Silt	5	5	2	5	2	1	2	2	0	2	2
Sinuosity	85	75	40	40	40	63	63	67	67	73	80
Bank and vegetative stability	48	70	65	68	60	78	80	100	100	100	100
Riparian zone measurements	93	90	93	90	88	80	80	100	100	100	90
% Canopy cover	90	90	90	30	70	70	30	30	50	10	30
% Maximum Score	73	80	64	66	65	53	63	80	91	81	90
Habitat Assessment Category	Good	Excellent	Good	Good	Good	Good	Good	Excellent	Excellent	Excellent	Excellent
EPT Taxa Collected	16	13	14	13	12	9	15	10	10	12	
Aq. Macroinvertebrate Assess.	Unimp.	Unimp	Unimp	Unimp	Unimp	Sl. Imp	Unimp.	Sl. Imp.	Unimp	Unimp.	Sl. Imp.

* 'original' from Plafkin et al (1989); RR (Riffle Run) or GP (Glide Pool) assessment from Barbour and Stribling (1994).

"-Aub" station data from Webber et al. (1994)

Station ID	Description
CROC – 54a	Crooked Creek @ Cullman County RD. 1043 NW ¼ Sec.6, T10S, R4W

1997 Black Warrior NPS Screening Assessment

Table 4b. Results of fish IBI assessments conducted within the Sipsey Fork cataloging unit by the GSA and the ADEM in September 1997 (O'Neil & Shepard 1998) and Auburn in 1993.

	Assessment Sites									
	ROCW-52a	CROC-54b	CLCW-53b	CLCW-53c	SANW-12a	Ryan-Aub*	Crooked-Aub*	Rock-Aub*	Blevens-Aub*	Rush-Aub*
Collection time (min.)	30	30	30	30	30					
Collection Date	09/09/1997	09/09/1997	09/10/1997	09/10/1997	09/10/1997	1993	1993	1993	1993	1993
Area (sq mi)	27	23	20	23	16					
Richness measures										
# total species	12	10	9	11	12	19	16	21	17	21
# darter species	1	1	1	1	3	2	2	3	3	4
# minnow species	5	4	4	4	4					
# sunfish species	3	2	1	1	2	4	4	4	3	3
# sucker species	0	0	2	1	1	2	1	2	1	3
Tolerance/ intolerance										
# intolerant species	0	0	0	0	0	0	0	2	2	2
Trophic measures										
# individuals	303	404	91	69	45	1684	896	1162	1035	151
% omnivores and herbivores	16	7	0	0	11	0	0	3	0	0
% top carnivores	18	3	6	13	2	2	4	2	3	7
Composition measures										
% insectivorous cyprinids	59	75	77	43	47	8	38	27	40	39
% sunfish	2	8	4	1	4					
Community health measures										
# collected/ hour	606	808	182	138	90					
% with disease/ anomalies	8	0	0	0	31	0	0	0	0	0
IBI Score	38	42	39	37	40	46	44	50	46	54
Assessment	Poor-Fair	Fair	Poor-Fair	Poor-Fair	Fair	Good-Fair	Fair	Good	Good-Fair	Excel-Good

* Webber et al (1994)

Station ID	Description
CROC – 54b	Crooked Creek @ US Hwy 278 NE ¼ Sec. 2, T10S, R5W

1991 Clean Water Strategy Study

Date	Time	T/W	pH	DO	Cond	CBOD5	NH3-N	TKN	NO2+NO3-N	T-PO4	bacteria
		C		mg/l	umho/cm	mg/L	mg/L	mg/L	mg/L	mg/L	org/100ml
06/04/1991	8:50	23	7.4	5.1	58	0.8	0.20	0.38	0.22	0.00	260
07/09/1991	11:30	24	6.6	2.6	76	2.8	0.10	0.64	0.10	0.01	130
08/08/1991	11:40	25	7.8	3.0	111	5.1	0.03	0.58	0.03	0.03	340
09/09/1991	13:00	23	7.4	3.9	170	2.4	0.07	0.57	0.00	0.01	140
10/07/1991	12:30	14	7.0	4.1	211	3.0	0.06	0.60	0.05	0.01	50

Station ID	Description
58	Crooked Creek @ Cullman County RD. upstream of AL Hwy 157 NW ¼ Sec.17, T9S, R4W

1988 Clean Water Strategy Study

Station	Date	Time	T/W C	pH	DO mg/l	CBOD5 mg/L	NH3+NH4-N mg/L	TOT mg/L	NO2+NO3-N mg/L	PHOS-TOT mg/L P	Flow cfs
59	06/29/1988	11:15	28	6.9	7.5	2.2	0.2	1.3	0.03	0.06	
60	06/29/1988	10:50	25	6.7	5.6	1.4	0.1	0.8	0.15	0.04	
61	06/29/1988	10:25	23	6.6	5.9	1.2	0.1	1	0.13	0.01	10.2
59	07/19/1988	8:45	24	7.1	3.9	1	0.3	0.9	0.2	0.04	0.2
60	07/19/1988	9:15	25	7.1	5.2	4.6	0.1	1.4	0.38	0.07	
61	07/19/1988	14:00	28	6.8	6.6	1	0.1	1.3	0.07	0.01	
60	08/31/1988	8:00	20	6.4	3.7	1.1	0.2	1.6	0.04	0.02	
61	08/31/1988	7:30	20	6.8	5.3	1	0.2	1	0.09	0.02	
58	09/28/1988	11:00	21	6.2	4.3	1.5	0.2	1	0.08	0.02	
59	09/28/1988	11:15	19	6.2	7.9	1	0.2	0.9	0.78	0.02	
60	09/28/1988	11:20	21	6.3	8	1	0.2	0.4	1.04	0.02	
61	09/28/1988	10:30	21	6.1	7.9	1	0.2	0.4	0.86	0.02	
58	10/26/1988	10:40	11	6.4	9.2	2.8	1.9	0.6	0.72	0.02	
59	10/26/1988	9:40	12	6.5	9.7	1.7	0.4	1.2	0.26	0.02	410.3

Station ID	Description
58	Crooked Creek @ Cullman County RD. upstream of AL Hwy 157 NW ¼ Sec.17, T9S, R4W
59	Crooked Creek @ Cullman County RD. upstream of Jaybird Creek NE ¼ Sec.32, T9S, R4W
60	Crooked Creek @ US Hwy 278 NE ¼ Sec. 2, T10S, R5W
61	Crooked Creek @ Cullman County RD. NW ¼ Sec. 4, T11S, R5W

Appendix 9.3
Water Quality Model
Input and Output Files

SUMMER TMDL MODEL

Spreadsheet Water Quality Model

Stream Name :	**Crooked Creek**
River Basin :	**Black Warroir**
County :	**Cullman County**

Modeled Reach :

Upstream Longitude	Upstream Latitude	Section	Township	Range
86° 59' 18"	34° 18' 25"	31	9 s	4 w
Downstream Longitude	Downstream Latitude	Section	Township	Range
87° 03' 44"	34° 06' 26"	9	11 s	5 w
Total Stream Length, miles	29.17			

Analysis Date :	**February 27, 2002**
Number of Sections :	**10**

Analysis Performed By :	**BCH**

Point Sources Included in the Model :

Applicable Season:

Annual	May - Nov. (Summer)	Dec. - Apr. (Winter)
	X	

Model Input :

Headwater Conditions :

CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
2.0022	0.0364	0.1825	6.65	0.0001	28

Tributary Conditions :

Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	0.0000	0.0000	0.0000			
2	0.0000	0.0000	0.0000			
3	0.0000	0.0000	0.0000			
4	4.4374	0.5689	0.9500	7.11	0.07	28.0
5	0.0000	0.0000	0.0000			
6	0.0000	0.0000	0.0000			
7	0.0000	0.0000	0.0000			
8	0.0000	0.0000	0.0000			
9	0.0000	0.0000	0.0000			
10	0.0000	0.0000	0.0000			
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Incremental Inflow Conditions :						
Section #	**CBODu, mg/l**	**NH3-N, mg/l**	**TON, mg/l**	**D.O., mg/l**	**Flow, cfs**	**Temp., °C**
1	**2.0022**	**0.0364**	**0.1825**	**5.4800**	**0.08**	**28.0**
2	**2.0022**	**0.0364**	**0.1825**	**5.4800**	**0.03**	**28.0**
3	**2.0022**	**0.0364**	**0.1825**	**5.4800**	**0.03**	**28.0**
4	**2.0022**	**0.0364**	**0.1825**	**5.4800**	**0.06**	**28.0**
5	**2.0022**	**0.0758**	**0.1825**	**5.4800**	**0.05**	**28.0**
6	**2.0022**	**0.0758**	**0.1825**	**5.4800**	**0.09**	**28.0**
7	**2.0022**	**0.0758**	**0.1825**	**5.4800**	**0.08**	**28.0**
8	**2.0022**	**0.0758**	**0.1825**	**5.4800**	**0.07**	**28.0**
9	**2.0022**	**0.0758**	**0.1825**	**5.4800**	**0.02**	**28.0**
10	**2.0022**	**0.0758**	**0.1825**	**5.4800**	**0.03**	**28.0**
11	**0.0000**	**0.0000**	**0.0000**			
12	**0.0000**	**0.0000**	**0.0000**			
13	**0.0000**	**0.0000**	**0.0000**			
14	**0.0000**	**0.0000**	**0.0000**			
15	**0.0000**	**0.0000**	**0.0000**			
16	**0.0000**	**0.0000**	**0.0000**			
17	**0.0000**	**0.0000**	**0.0000**			
18	**0.0000**	**0.0000**	**0.0000**			
19	**0.0000**	**0.0000**	**0.0000**			
20	**0.0000**	**0.0000**	**0.0000**			
21	**0.0000**	**0.0000**	**0.0000**			
22	**0.0000**	**0.0000**	**0.0000**			
23	**0.0000**	**0.0000**	**0.0000**			
24	**0.0000**	**0.0000**	**0.0000**			

Model Input : Continued

Effluent Conditions :

Section #	Discharger	Flow, MGD	Flow, cfs	$CBOD_5$, mg/l	$CBODu/CBOD_5$	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1			0.000			0.000				
2			0.000			0.000				
3			0.000			0.000				
4			0.000			0.000				
5			0.000			0.000				
6			0.000			0.000				
7			0.000			0.000				
8			0.000			0.000				
9			0.000			0.000				
10			0.000			0.000				
11			0.000			0.000				
12			0.000			0.000				
13			0.000			0.000				
14			0.000			0.000				
15			0.000			0.000				
16			0.000			0.000				
17			0.000			0.000				
18			0.000			0.000				
19			0.000			0.000				
20			0.000			0.000				
21			0.000			0.000				
22			0.000			0.000				
23			0.000			0.000				
24			0.000			0.000				

Model Input : Continued

Section Characteristics :								*Dam Characteristics :*		
Section #	Length, miles	Upstream Elevation, feet	Downstream Elevation, feet	Average Elev., feet	Slope, ft/mile	Calculated Velocity or User Input Velocity?	User Input Velocity, feet/sec	Dam Height, feet	Water Quality Factor	Weir Coefficient
1	4.13	1020	820	920	48.4262	Input	0.03			
2	1.45	820	779	799.5	28.2759	Input	0.03			
3	1.57	779	760	769.5	12.1019	Input	0.02			
4	3.3	760	720	740	12.1212	Input	0.00756			
5	2.72	720	686	703	12.5000	Input	0.02			
6	4.83	686	620	653	13.6646	Input	0.03			
7	4.35	620	580	600	9.1954	Input	0.03			
8	3.81	580	540	560	10.4987	Input	0.03			
9	1.17	540	525	532.5	12.8205	Input	0.02			
10	1.84	525	517	521	4.3478	Input	0.006			
11										
12										
13										
14										
15										
16										
17										
18										
19										
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23										
24										

Model Input : Continued

Reaction Rates :

	Reaction Rates at 20° C					Reaction Rates at Ambient Temperature				
Section #	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Computed Ka, 1/day	User Input Ka, 1/day	Ka, 1/day	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Average Temp., °C
1	0.05	0.5	0.02	2.6150		3.1614	0.0722	0.8995	0.0370	28.0000
2	0.05	0.5	0.02	1.5269		1.8459	0.0722	0.9116	0.0370	28.0000
3	0.05	0.3	0.02	0.4460		0.5392	0.0722	0.5427	0.0370	28.0000
4	0.05	0.3	0.02	0.1779		0.2150	0.0722	0.5283	0.0370	28.0000
5	0.05	0.3	0.02	0.4367		0.5279	0.0722	0.4632	0.0370	28.0000
6	0.05	0.3	0.02	0.7262		0.8779	0.0722	0.5175	0.0370	28.0000
7	0.05	0.3	0.02	0.4966		0.6003	0.0722	0.5340	0.0370	28.0000
8	0.05	0.3	0.02	0.5669		0.6854	0.0722	0.5228	0.0370	28.0000
9	0.05	0.3	0.02	0.4725		0.5713	0.0722	0.5411	0.0370	28.0000
10	0.05	0.3	0.02		0.4725	0.5712	0.0722	0.5387	0.0370	28.0000
11										
12										
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Model Input : Continued

Reaction Rates : Continued (OPTIONAL)

		Reaction Rates at 20° C			Reaction Rates at Ambient Temperature		
Section #	Stream Depth, feet	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day
1	1.0	0.020			0.032		
2	1.0	0.020			0.032		
3	1.0	0.020			0.032		
4	1.5	0.020			0.032		
5	1.0	0.020			0.032		
6	1.0	0.020			0.032		
7	1.0	0.020			0.032		
8	2.0	0.020			0.032		
9	2.0	0.020			0.032		
10	2.0	0.020			0.032		
11							
12							
13							
14							
15							
16							
17							
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20							
21							
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23							
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Model Output:

Minimum Dissolved Oxygen:	*3.3620 mg/l*
The Minimum DO occurs at:	*8.6350 miles*

Section Number	Increment Number	Distance, miles	Flow, cfs	Velocity, feet/sec	Total Travel Time, days	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1	1	0.0000	0.0001	0.0300	0.0000	2.0022	0.0364	0.1825	6.6500	28.0000
1	2	0.2065	0.0039	0.0300	0.4206	1.9423	0.0275	0.1803	6.6681	28.0000
1	3	0.4130	0.0077	0.0300	0.8413	1.9129	0.0242	0.1792	6.8283	28.0000
1	4	0.6195	0.0116	0.0300	1.2619	1.8843	0.0215	0.1782	6.9130	28.0000
1	5	0.8260	0.0154	0.0300	1.6826	1.8563	0.0195	0.1771	6.9636	28.0000
1	6	1.0325	0.0192	0.0300	2.1032	1.8290	0.0178	0.1760	6.9973	28.0000
1	7	1.2390	0.0230	0.0300	2.5239	1.8021	0.0164	0.1750	7.0216	28.0000
1	8	1.4455	0.0269	0.0300	2.9445	1.7759	0.0153	0.1739	7.0403	28.0000
1	9	1.6520	0.0307	0.0300	3.3652	1.7501	0.0144	0.1729	7.0553	28.0000
1	10	1.8585	0.0345	0.0300	3.7858	1.7248	0.0136	0.1719	7.0679	28.0000
1	11	2.0650	0.0383	0.0300	4.2065	1.7001	0.0129	0.1708	7.0787	28.0000
1	12	2.2715	0.0422	0.0300	4.6271	1.6758	0.0124	0.1698	7.0882	28.0000
1	13	2.4780	0.0460	0.0300	5.0478	1.6520	0.0119	0.1688	7.0967	28.0000
1	14	2.6845	0.0498	0.0300	5.4684	1.6287	0.0114	0.1678	7.1045	28.0000
1	15	2.8910	0.0536	0.0300	5.8891	1.6058	0.0111	0.1668	7.1116	28.0000
1	16	3.0975	0.0574	0.0300	6.3097	1.5833	0.0107	0.1658	7.1183	28.0000
1	17	3.3040	0.0613	0.0300	6.7304	1.5613	0.0104	0.1649	7.1246	28.0000
1	18	3.5105	0.0651	0.0300	7.1510	1.5397	0.0102	0.1639	7.1305	28.0000
1	19	3.7170	0.0689	0.0300	7.5717	1.5186	0.0099	0.1630	7.1362	28.0000
1	20	3.9235	0.0727	0.0300	7.9923	1.4978	0.0097	0.1620	7.1416	28.0000
1	21	4.1300	0.0766	0.0300	8.4130	1.4774	0.0095	0.1611	7.1469	28.0000
2	1	4.1300	0.0766	0.0300	8.4130	1.4774	0.0095	0.1611	7.1469	28.0000
2	2	4.2025	0.0779	0.0300	8.5606	1.4707	0.0094	0.1607	7.0642	28.0000
2	3	4.2750	0.0792	0.0300	8.7083	1.4640	0.0093	0.1604	7.0029	28.0000
2	4	4.3475	0.0806	0.0300	8.8560	1.4574	0.0092	0.1601	6.9577	28.0000
2	5	4.4200	0.0819	0.0300	9.0037	1.4507	0.0091	0.1598	6.9244	28.0000
2	6	4.4925	0.0833	0.0300	9.1514	1.4441	0.0090	0.1595	6.8999	28.0000
2	7	4.5650	0.0846	0.0300	9.2991	1.4376	0.0090	0.1592	6.8822	28.0000
2	8	4.6375	0.0860	0.0300	9.4468	1.4311	0.0089	0.1589	6.8694	28.0000
2	9	4.7100	0.0873	0.0300	9.5944	1.4246	0.0088	0.1585	6.8603	28.0000
2	10	4.7825	0.0886	0.0300	9.7421	1.4181	0.0088	0.1582	6.8540	28.0000
2	11	4.8550	0.0900	0.0300	9.8898	1.4117	0.0087	0.1579	6.8497	28.0000
2	12	4.9275	0.0913	0.0300	10.0375	1.4053	0.0087	0.1576	6.8469	28.0000
2	13	5.0000	0.0927	0.0300	10.1852	1.3990	0.0086	0.1573	6.8454	28.0000
2	14	5.0725	0.0940	0.0300	10.3329	1.3926	0.0085	0.1570	6.8446	28.0000
2	15	5.1450	0.0953	0.0300	10.4806	1.3864	0.0085	0.1567	6.8445	28.0000
2	16	5.2175	0.0967	0.0300	10.6282	1.3801	0.0084	0.1564	6.8448	28.0000
2	17	5.2900	0.0980	0.0300	10.7759	1.3739	0.0084	0.1561	6.8455	28.0000
2	18	5.3625	0.0994	0.0300	10.9236	1.3677	0.0083	0.1557	6.8465	28.0000
2	19	5.4350	0.1007	0.0300	11.0713	1.3616	0.0083	0.1554	6.8476	28.0000
2	20	5.5075	0.1021	0.0300	11.2190	1.3555	0.0082	0.1551	6.8488	28.0000
2	21	5.5800	0.1034	0.0300	11.3667	1.3494	0.0082	0.1548	6.8502	28.0000

3	1	5.5800	0.1034	0.0300	11.3667	1.3494	0.0082	0.1548	6.8502	28.0000
3	2	5.6585	0.1049	0.0200	11.6065	1.3351	0.0086	0.1541	6.6416	28.0000
3	3	5.7370	0.1063	0.0200	11.8464	1.3212	0.0090	0.1535	6.4606	28.0000
3	4	5.8155	0.1078	0.0200	12.0863	1.3075	0.0093	0.1528	6.3035	28.0000
3	5	5.8940	0.1092	0.0200	12.3261	1.2941	0.0095	0.1521	6.1671	28.0000
3	6	5.9725	0.1107	0.0200	12.5660	1.2811	0.0097	0.1515	6.0488	28.0000
3	7	6.0510	0.1121	0.0200	12.8058	1.2683	0.0099	0.1508	5.9461	28.0000
3	8	6.1295	0.1136	0.0200	13.0457	1.2557	0.0101	0.1502	5.8570	28.0000
3	9	6.2080	0.1150	0.0200	13.2856	1.2434	0.0102	0.1496	5.7797	28.0000
3	10	6.2865	0.1165	0.0200	13.5254	1.2314	0.0103	0.1489	5.7127	28.0000
3	11	6.3650	0.1179	0.0200	13.7653	1.2196	0.0104	0.1483	5.6545	28.0000
3	12	6.4435	0.1194	0.0200	14.0051	1.2080	0.0105	0.1477	5.6041	28.0000
3	13	6.5220	0.1208	0.0200	14.2450	1.1966	0.0106	0.1471	5.5605	28.0000
3	14	6.6005	0.1223	0.0200	14.4849	1.1855	0.0106	0.1465	5.5227	28.0000
3	15	6.6790	0.1237	0.0200	14.7247	1.1746	0.0107	0.1459	5.4899	28.0000
3	16	6.7575	0.1252	0.0200	14.9646	1.1639	0.0107	0.1453	5.4616	28.0000
3	17	6.8360	0.1266	0.0200	15.2044	1.1533	0.0107	0.1448	5.4371	28.0000
3	18	6.9145	0.1281	0.0200	15.4443	1.1430	0.0107	0.1442	5.4160	28.0000
3	19	6.9930	0.1296	0.0200	15.6842	1.1328	0.0107	0.1436	5.3978	28.0000
3	20	7.0715	0.1310	0.0200	15.9240	1.1229	0.0107	0.1430	5.3821	28.0000
3	21	7.1500	0.1325	0.0200	16.1639	1.1131	0.0107	0.1425	5.3687	28.0000
4	1	7.1500	0.2022	0.0200	16.1639	2.2592	0.2032	0.4209	5.9690	28.0000
4	2	7.3150	0.2052	0.0076	17.4977	2.0483	0.1150	0.4016	4.8776	28.0000
4	3	7.4800	0.2083	0.0076	18.8314	1.8597	0.0731	0.3833	4.2533	28.0000
4	4	7.6450	0.2113	0.0076	20.1652	1.6908	0.0522	0.3660	3.8812	28.0000
4	5	7.8100	0.2144	0.0076	21.4990	1.5396	0.0413	0.3497	3.6546	28.0000
4	6	7.9750	0.2174	0.0076	22.8328	1.4041	0.0352	0.3342	3.5165	28.0000
4	7	8.1400	0.2205	0.0076	24.1665	1.2828	0.0316	0.3196	3.4344	28.0000
4	8	8.3050	0.2235	0.0076	25.5003	1.1739	0.0291	0.3057	3.3888	28.0000
4	9	8.4700	0.2266	0.0076	26.8341	1.0763	0.0274	0.2925	3.3673	28.0000
4	10	8.6350	0.2297	0.0076	28.1679	0.9887	0.0260	0.2801	3.3620	28.0000
4	11	8.8000	0.2327	0.0076	29.5016	0.9100	0.0247	0.2683	3.3674	28.0000
4	12	8.9650	0.2358	0.0076	30.8354	0.8393	0.0236	0.2571	3.3797	28.0000
4	13	9.1300	0.2388	0.0076	32.1692	0.7757	0.0226	0.2464	3.3966	28.0000
4	14	9.2950	0.2419	0.0076	33.5030	0.7186	0.0217	0.2363	3.4160	28.0000
4	15	9.4600	0.2449	0.0076	34.8367	0.6672	0.0208	0.2268	3.4369	28.0000
4	16	9.6250	0.2480	0.0076	36.1705	0.6208	0.0199	0.2177	3.4583	28.0000
4	17	9.7900	0.2510	0.0076	37.5043	0.5791	0.0191	0.2090	3.4796	28.0000
4	18	9.9550	0.2541	0.0076	38.8381	0.5415	0.0183	0.2008	3.5003	28.0000
4	19	10.1200	0.2571	0.0076	40.1718	0.5075	0.0176	0.1930	3.5204	28.0000
4	20	10.2850	0.2602	0.0076	41.5056	0.4769	0.0169	0.1856	3.5395	28.0000
4	21	10.4500	0.2633	0.0076	42.8394	0.4492	0.0162	0.1786	3.5576	28.0000

5	1	10.4500	0.2633	0.0076	42.8394	0.4492	0.0162	0.1786	3.5576	28.0000
5	2	10.5860	0.2658	0.0200	43.2549	0.4502	0.0160	0.1765	3.9494	28.0000
5	3	10.7220	0.2683	0.0200	43.6705	0.4510	0.0157	0.1744	4.2588	28.0000
5	4	10.8580	0.2708	0.0200	44.0860	0.4517	0.0153	0.1724	4.5033	28.0000
5	5	10.9940	0.2733	0.0200	44.5016	0.4522	0.0150	0.1705	4.6967	28.0000
5	6	11.1300	0.2758	0.0200	44.9172	0.4525	0.0147	0.1685	4.8497	28.0000
5	7	11.2660	0.2784	0.0200	45.3327	0.4528	0.0144	0.1666	4.9708	28.0000
5	8	11.4020	0.2809	0.0200	45.7483	0.4528	0.0141	0.1648	5.0668	28.0000
5	9	11.5380	0.2834	0.0200	46.1638	0.4528	0.0138	0.1630	5.1430	28.0000
5	10	11.6740	0.2859	0.0200	46.5794	0.4527	0.0135	0.1612	5.2035	28.0000
5	11	11.8100	0.2884	0.0200	46.9949	0.4524	0.0133	0.1595	5.2516	28.0000
5	12	11.9460	0.2909	0.0200	47.4105	0.4521	0.0131	0.1578	5.2898	28.0000
5	13	12.0820	0.2935	0.0200	47.8260	0.4516	0.0129	0.1561	5.3204	28.0000
5	14	12.2180	0.2960	0.0200	48.2416	0.4511	0.0127	0.1545	5.3448	28.0000
5	15	12.3540	0.2985	0.0200	48.6572	0.4504	0.0125	0.1529	5.3643	28.0000
5	16	12.4900	0.3010	0.0200	49.0727	0.4497	0.0124	0.1513	5.3800	28.0000
5	17	12.6260	0.3035	0.0200	49.4883	0.4489	0.0122	0.1497	5.3927	28.0000
5	18	12.7620	0.3061	0.0200	49.9038	0.4480	0.0121	0.1482	5.4030	28.0000
5	19	12.8980	0.3086	0.0200	50.3194	0.4471	0.0119	0.1467	5.4113	28.0000
5	20	13.0340	0.3111	0.0200	50.7349	0.4461	0.0118	0.1453	5.4182	28.0000
5	21	13.1700	0.3136	0.0200	51.1505	0.4450	0.0117	0.1438	5.4238	28.0000
6	1	13.1700	0.3136	0.0200	51.1505	0.4450	0.0117	0.1438	5.4238	28.0000
6	2	13.4115	0.3181	0.0300	51.6424	0.4506	0.0118	0.1423	5.7335	28.0000
6	3	13.6530	0.3225	0.0300	52.1344	0.4557	0.0118	0.1409	5.9304	28.0000
6	4	13.8945	0.3270	0.0300	52.6263	0.4602	0.0118	0.1394	6.0558	28.0000
6	5	14.1360	0.3315	0.0300	53.1183	0.4642	0.0117	0.1380	6.1358	28.0000
6	6	14.3775	0.3360	0.0300	53.6102	0.4677	0.0116	0.1367	6.1871	28.0000
6	7	14.6190	0.3404	0.0300	54.1022	0.4709	0.0115	0.1353	6.2201	28.0000
6	8	14.8605	0.3449	0.0300	54.5941	0.4736	0.0114	0.1340	6.2415	28.0000
6	9	15.1020	0.3494	0.0300	55.0860	0.4759	0.0113	0.1328	6.2556	28.0000
6	10	15.3435	0.3538	0.0300	55.5780	0.4779	0.0112	0.1315	6.2650	28.0000
6	11	15.5850	0.3583	0.0300	56.0699	0.4796	0.0111	0.1303	6.2715	28.0000
6	12	15.8265	0.3628	0.0300	56.5619	0.4810	0.0110	0.1291	6.2761	28.0000
6	13	16.0680	0.3673	0.0300	57.0538	0.4821	0.0109	0.1279	6.2795	28.0000
6	14	16.3095	0.3717	0.0300	57.5458	0.4829	0.0108	0.1267	6.2822	28.0000
6	15	16.5510	0.3762	0.0300	58.0377	0.4835	0.0107	0.1256	6.2843	28.0000
6	16	16.7925	0.3807	0.0300	58.5297	0.4838	0.0106	0.1245	6.2863	28.0000
6	17	17.0340	0.3851	0.0300	59.0216	0.4839	0.0105	0.1234	6.2880	28.0000
6	18	17.2755	0.3896	0.0300	59.5135	0.4839	0.0104	0.1223	6.2896	28.0000
6	19	17.5170	0.3941	0.0300	60.0055	0.4836	0.0103	0.1213	6.2911	28.0000
6	20	17.7585	0.3985	0.0300	60.4974	0.4832	0.0102	0.1202	6.2926	28.0000
6	21	18.0000	0.4030	0.0300	60.9894	0.4826	0.0101	0.1192	6.2941	28.0000

7	1	18.0000	0.4030	0.0300	60.9894	0.4826	0.0101	0.1192	6.2941	28.0000
7	2	18.2175	0.4070	0.0300	61.4324	0.4819	0.0100	0.1183	6.1419	28.0000
7	3	18.4350	0.4111	0.0300	61.8755	0.4812	0.0099	0.1175	6.0268	28.0000
7	4	18.6525	0.4151	0.0300	62.3185	0.4803	0.0099	0.1166	5.9398	28.0000
7	5	18.8700	0.4191	0.0300	62.7616	0.4794	0.0098	0.1157	5.8740	28.0000
7	6	19.0875	0.4232	0.0300	63.2047	0.4783	0.0097	0.1149	5.8243	28.0000
7	7	19.3050	0.4272	0.0300	63.6477	0.4772	0.0097	0.1140	5.7868	28.0000
7	8	19.5225	0.4312	0.0300	64.0908	0.4759	0.0096	0.1132	5.7586	28.0000
7	9	19.7400	0.4352	0.0300	64.5338	0.4746	0.0096	0.1124	5.7375	28.0000
7	10	19.9575	0.4393	0.0300	64.9769	0.4732	0.0095	0.1116	5.7217	28.0000
7	11	20.1750	0.4433	0.0300	65.4199	0.4718	0.0094	0.1108	5.7099	28.0000
7	12	20.3925	0.4473	0.0300	65.8630	0.4703	0.0094	0.1101	5.7013	28.0000
7	13	20.6100	0.4513	0.0300	66.3060	0.4687	0.0093	0.1093	5.6949	28.0000
7	14	20.8275	0.4554	0.0300	66.7491	0.4671	0.0093	0.1086	5.6904	28.0000
7	15	21.0450	0.4594	0.0300	67.1922	0.4654	0.0092	0.1078	5.6872	28.0000
7	16	21.2625	0.4634	0.0300	67.6352	0.4637	0.0091	0.1071	5.6850	28.0000
7	17	21.4800	0.4674	0.0300	68.0783	0.4619	0.0091	0.1064	5.6836	28.0000
7	18	21.6975	0.4715	0.0300	68.5213	0.4601	0.0090	0.1057	5.6828	28.0000
7	19	21.9150	0.4755	0.0300	68.9644	0.4583	0.0089	0.1050	5.6824	28.0000
7	20	22.1325	0.4795	0.0300	69.4074	0.4564	0.0089	0.1043	5.6824	28.0000
7	21	22.3500	0.4835	0.0300	69.8505	0.4545	0.0088	0.1036	5.6826	28.0000
8	1	22.3500	0.4835	0.0300	69.8505	0.4545	0.0088	0.1036	5.6826	28.0000
8	2	22.5405	0.4871	0.0300	70.2385	0.4529	0.0088	0.1030	5.9318	28.0000
8	3	22.7310	0.4906	0.0300	70.6266	0.4512	0.0087	0.1024	6.1216	28.0000
8	4	22.9215	0.4941	0.0300	71.0147	0.4495	0.0086	0.1018	6.2662	28.0000
8	5	23.1120	0.4977	0.0300	71.4027	0.4478	0.0085	0.1013	6.3766	28.0000
8	6	23.3025	0.5012	0.0300	71.7908	0.4460	0.0084	0.1007	6.4608	28.0000
8	7	23.4930	0.5047	0.0300	72.1788	0.4443	0.0084	0.1002	6.5252	28.0000
8	8	23.6835	0.5082	0.0300	72.5669	0.4425	0.0083	0.0996	6.5744	28.0000
8	9	23.8740	0.5118	0.0300	72.9549	0.4407	0.0082	0.0991	6.6122	28.0000
8	10	24.0645	0.5153	0.0300	73.3430	0.4389	0.0082	0.0985	6.6412	28.0000
8	11	24.2550	0.5188	0.0300	73.7310	0.4371	0.0081	0.0980	6.6636	28.0000
8	12	24.4455	0.5223	0.0300	74.1191	0.4353	0.0080	0.0975	6.6809	28.0000
8	13	24.6360	0.5259	0.0300	74.5072	0.4335	0.0080	0.0969	6.6943	28.0000
8	14	24.8265	0.5294	0.0300	74.8952	0.4317	0.0079	0.0964	6.7048	28.0000
8	15	25.0170	0.5329	0.0300	75.2833	0.4299	0.0079	0.0959	6.7131	28.0000
8	16	25.2075	0.5364	0.0300	75.6713	0.4281	0.0078	0.0954	6.7196	28.0000
8	17	25.3980	0.5400	0.0300	76.0594	0.4262	0.0078	0.0949	6.7249	28.0000
8	18	25.5885	0.5435	0.0300	76.4474	0.4244	0.0077	0.0944	6.7292	28.0000
8	19	25.7790	0.5470	0.0300	76.8355	0.4226	0.0077	0.0939	6.7327	28.0000
8	20	25.9695	0.5506	0.0300	77.2235	0.4207	0.0076	0.0934	6.7356	28.0000
8	21	26.1600	0.5541	0.0300	77.6116	0.4189	0.0076	0.0930	6.7381	28.0000

9	1	26.1600	0.5541	0.0300	77.6116	0.4189	0.0076	0.0930	6.7381	28.0000
9	2	26.2185	0.5552	0.0200	77.7903	0.4166	0.0075	0.0926	6.7198	28.0000
9	3	26.2770	0.5562	0.0200	77.9691	0.4143	0.0074	0.0923	6.7033	28.0000
9	4	26.3355	0.5573	0.0200	78.1478	0.4120	0.0073	0.0920	6.6885	28.0000
9	5	26.3940	0.5584	0.0200	78.3266	0.4098	0.0072	0.0917	6.6753	28.0000
9	6	26.4525	0.5595	0.0200	78.5053	0.4076	0.0072	0.0914	6.6634	28.0000
9	7	26.5110	0.5606	0.0200	78.6841	0.4054	0.0071	0.0911	6.6527	28.0000
9	8	26.5695	0.5617	0.0200	78.8628	0.4032	0.0070	0.0909	6.6432	28.0000
9	9	26.6280	0.5627	0.0200	79.0416	0.4011	0.0070	0.0906	6.6346	28.0000
9	10	26.6865	0.5638	0.0200	79.2203	0.3990	0.0069	0.0903	6.6270	28.0000
9	11	26.7450	0.5649	0.0200	79.3991	0.3969	0.0069	0.0900	6.6201	28.0000
9	12	26.8035	0.5660	0.0200	79.5778	0.3948	0.0068	0.0897	6.6140	28.0000
9	13	26.8620	0.5671	0.0200	79.7566	0.3928	0.0068	0.0894	6.6086	28.0000
9	14	26.9205	0.5682	0.0200	79.9353	0.3908	0.0067	0.0891	6.6037	28.0000
9	15	26.9790	0.5692	0.0200	80.1141	0.3888	0.0067	0.0888	6.5994	28.0000
9	16	27.0375	0.5703	0.0200	80.2928	0.3869	0.0067	0.0886	6.5956	28.0000
9	17	27.0960	0.5714	0.0200	80.4716	0.3849	0.0066	0.0883	6.5922	28.0000
9	18	27.1545	0.5725	0.0200	80.6503	0.3830	0.0066	0.0880	6.5892	28.0000
9	19	27.2130	0.5736	0.0200	80.8291	0.3811	0.0066	0.0877	6.5865	28.0000
9	20	27.2715	0.5747	0.0200	81.0078	0.3792	0.0065	0.0875	6.5842	28.0000
9	21	27.3300	0.5757	0.0200	81.1866	0.3774	0.0065	0.0872	6.5821	28.0000
10	1	27.3300	0.5757	0.0200	81.1866	0.3774	0.0065	0.0872	6.5821	28.0000
10	2	27.4220	0.5774	0.0060	82.1236	0.3572	0.0064	0.0851	6.5936	28.0000
10	3	27.5140	0.5791	0.0060	83.0607	0.3383	0.0063	0.0831	6.6015	28.0000
10	4	27.6060	0.5808	0.0060	83.9977	0.3208	0.0061	0.0812	6.6073	28.0000
10	5	27.6980	0.5826	0.0060	84.9347	0.3044	0.0060	0.0793	6.6119	28.0000
10	6	27.7900	0.5843	0.0060	85.8718	0.2891	0.0059	0.0775	6.6155	28.0000
10	7	27.8820	0.5860	0.0060	86.8088	0.2748	0.0057	0.0757	6.6187	28.0000
10	8	27.9740	0.5877	0.0060	87.7459	0.2615	0.0056	0.0740	6.6215	28.0000
10	9	28.0660	0.5894	0.0060	88.6829	0.2491	0.0055	0.0723	6.6240	28.0000
10	10	28.1580	0.5911	0.0060	89.6199	0.2375	0.0054	0.0707	6.6263	28.0000
10	11	28.2500	0.5928	0.0060	90.5570	0.2267	0.0053	0.0691	6.6285	28.0000
10	12	28.3420	0.5945	0.0060	91.4940	0.2167	0.0052	0.0676	6.6305	28.0000
10	13	28.4340	0.5962	0.0060	92.4310	0.2073	0.0050	0.0661	6.6324	28.0000
10	14	28.5260	0.5979	0.0060	93.3681	0.1985	0.0049	0.0647	6.6342	28.0000
10	15	28.6180	0.5996	0.0060	94.3051	0.1903	0.0048	0.0633	6.6359	28.0000
10	16	28.7100	0.6013	0.0060	95.2422	0.1826	0.0047	0.0619	6.6375	28.0000
10	17	28.8020	0.6030	0.0060	96.1792	0.1755	0.0046	0.0606	6.6390	28.0000
10	18	28.8940	0.6047	0.0060	97.1162	0.1688	0.0045	0.0593	6.6404	28.0000
10	19	28.9860	0.6064	0.0060	98.0533	0.1626	0.0045	0.0581	6.6418	28.0000
10	20	29.0780	0.6081	0.0060	98.9903	0.1568	0.0044	0.0569	6.6430	28.0000
10	21	29.1700	0.6098	0.0060	99.9273	0.1513	0.0043	0.0557	6.6443	28.0000

Land Uses and Pollutant Concentrations for the Modeled Segment

Headwaters:

		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		

Tributaries:

Section #		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
1	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
2	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
3	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
4	%	100									100
	$CBOD_u$, mg/l	4.4374									
	NH_3-N, mg/l	0.5689									
	TON, mg/l	0.95									
5	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
6	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

7	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
8	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
9	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
10	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
11	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
12	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
13	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
14	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
15	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
16	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
17	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

18	**%**	**100**									**100**
	CBOD$_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
19	**%**	**100**									**100**
	CBOD$_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
20	**%**	**100**									**100**
	CBOD$_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
21	**%**	**100**									**100**
	CBOD$_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
22	**%**	**100**									**100**
	CBOD$_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
23	**%**	**100**									**100**
	CBOD$_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
24	**%**	**100**									**100**
	CBOD$_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

Incremental Inflow:

Section #		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
1	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
2	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
3	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
4	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
5	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
6	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
7	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
8	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
9	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		

10	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
11	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
12	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
13	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
14	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
15	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
16	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
17	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
18	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
19	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
20	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

21	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
22	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
23	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
24	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

Loading Summary

WLA				
Discharger	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd
Totals:	**0.0**	**0.0**	**0.0**	**0.0**

LA												
	Tributaries				***Incremental Inflow***				***Headwaters***			
Section #	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd
1	0.0	0.0	0.0	0.0	0.8	0.0	0.1	0.4	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1				
3	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.2				
4	1.7	0.2	0.4	2.6	0.7	0.0	0.1	0.3				
5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.3				
6	0.0	0.0	0.0	0.0	1.0	0.0	0.1	0.6				
7	0.0	0.0	0.0	0.0	0.9	0.0	0.1	0.5				
8	0.0	0.0	0.0	0.0	0.8	0.0	0.1	0.4				
9	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1				
10	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2				
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Totals:	**1.7**	**0.2**	**0.4**	**2.6**	**5.8**	**0.2**	**0.5**	**3.2**	**0.0**	**0.0**	**0.0**	**0.0**

Total Loading		
	WLA	LA
CBOD, ppd	**0.0**	**7.5**
NH_3-N, ppd	**0.0**	**0.4**
TON, ppd	**0.0**	**0.9**
NBOD, ppd	**0.0**	**5.9**

Spreadsheet Water Quality Model

Stream Name :	***Unnamed Tributary***
River Basin :	***Black Warrior***
County :	***Cullman County***

Modeled Reach :					
	Upstream Longitude	Upstream Latitude	Section	Township	Range
	Downstream Longitude	Downstream Latitude	Section	Township	Range
	Total Stream Length, miles	1.14			

Analysis Date :	**February 27, 2002**
Number of Sections :	**1**

Analysis Performed By :	**BCH**

Applicable Season:	Annual	May - Nov. (Summer)	Dec. - Apr. (Winter)
		X	

Point Sources Included in the Model :	
West Point	

Model Input :

Headwater Conditions :

CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
2.0022	0.0364	0.1825	6.65	0.0001	28

Tributary Conditions :

Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	0.0000	0.0000	0.0000			
2	0.0000	0.0000	0.0000			
3	0.0000	0.0000	0.0000			
4	0.0000	0.0000	0.0000			
5	0.0000	0.0000	0.0000			
6	0.0000	0.0000	0.0000			
7	0.0000	0.0000	0.0000			
8	0.0000	0.0000	0.0000			
9	0.0000	0.0000	0.0000			
10	0.0000	0.0000	0.0000			
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Incremental Inflow Conditions :

Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	0.0000	0.0000	0.0000	6.0000	0.00	28.0
2	0.0000	0.0000	0.0000			
3	0.0000	0.0000	0.0000			
4	0.0000	0.0000	0.0000			
5	0.0000	0.0000	0.0000			
6	0.0000	0.0000	0.0000			
7	0.0000	0.0000	0.0000			
8	0.0000	0.0000	0.0000			
9	0.0000	0.0000	0.0000			
10	0.0000	0.0000	0.0000			
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Effluent Conditions :

Section #	Discharger	Flow, MGD	Flow, cfs	$CBOD_5$, mg/l	$CBODu/CBOD_5$	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1	West Point	0.045	0.070	4	1.5	6.000	1	1	6	28.0
2			0.000			0.000				
3			0.000			0.000				
4			0.000			0.000				
5			0.000			0.000				
6			0.000			0.000				
7			0.000			0.000				
8			0.000			0.000				
9			0.000			0.000				
10			0.000			0.000				
11			0.000			0.000				
12			0.000			0.000				
13			0.000			0.000				
14			0.000			0.000				
15			0.000			0.000				
16			0.000			0.000				
17			0.000			0.000				
18			0.000			0.000				
19			0.000			0.000				
20			0.000			0.000				
21			0.000			0.000				
22			0.000			0.000				
23			0.000			0.000				
24			0.000			0.000				

Model Input : Continued

Section Characteristics :								*Dam Characteristics :*		
Section #	Length, miles	Upstream Elevation, feet	Downstream Elevation, feet	Average Elev., feet	Slope, ft/mile	Calculated Velocity or User Input Velocity?	User Input Velocity, feet/sec	Dam Height, feet	Water Quality Factor	Weir Coefficient
1	1.136	868.04	760	814.02	95.1056	Calculated				
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates :

	Reaction Rates at 20° C					Reaction Rates at Ambient Temperature				
Section #	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Computed Ka, 1/day	User Input Ka, 1/day	Ka, 1/day	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Average Temp., °C
1	0.3	0.5	0.05	17.1190		20.6956	0.4332	0.8814	0.0925	28.0000
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates : Continued (OPTIONAL)

		Reaction Rates at 20° C			Reaction Rates at Ambient Temperature		
Section #	Stream Depth, feet	SOD, gm-$O_2/ft^2/day$	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day	SOD, gm-$O_2/ft^2/day$	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day
1	0.5	0.050			0.080		
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							

Model Output:

Minimum Dissolved Oxygen:	*6.0009 mg/l*
The Minimum DO occurs at:	*0.0000 miles*

Section Number	Increment Number	Distance, miles	Flow, cfs	Velocity, feet/sec	Total Travel Time, days	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1	1	0.0000	0.0697	0.1000	0.0000	5.9943	0.9986	0.9988	6.0009	28.0000
1	2	0.0568	0.0697	0.1000	0.0347	5.9048	0.9710	0.9963	6.5020	28.0000
1	3	0.1136	0.0697	0.1000	0.0694	5.8167	0.9438	0.9938	6.7493	28.0000
1	4	0.1704	0.0697	0.1000	0.1041	5.7299	0.9172	0.9913	6.8737	28.0000
1	5	0.2272	0.0697	0.1000	0.1388	5.6443	0.8913	0.9889	6.9384	28.0000
1	6	0.2840	0.0697	0.1000	0.1736	5.5601	0.8662	0.9864	6.9742	28.0000
1	7	0.3408	0.0697	0.1000	0.2083	5.4771	0.8418	0.9839	6.9958	28.0000
1	8	0.3976	0.0697	0.1000	0.2430	5.3954	0.8181	0.9815	7.0105	28.0000
1	9	0.4544	0.0697	0.1000	0.2777	5.3149	0.7952	0.9790	7.0217	28.0000
1	10	0.5112	0.0697	0.1000	0.3124	5.2355	0.7729	0.9766	7.0311	28.0000
1	11	0.5680	0.0697	0.1000	0.3471	5.1574	0.7514	0.9741	7.0396	28.0000
1	12	0.6248	0.0697	0.1000	0.3818	5.0804	0.7305	0.9717	7.0476	28.0000
1	13	0.6816	0.0697	0.1000	0.4165	5.0046	0.7102	0.9692	7.0552	28.0000
1	14	0.7384	0.0697	0.1000	0.4512	4.9299	0.6906	0.9668	7.0626	28.0000
1	15	0.7952	0.0697	0.1000	0.4860	4.8563	0.6715	0.9644	7.0698	28.0000
1	16	0.8520	0.0697	0.1000	0.5207	4.7839	0.6531	0.9620	7.0768	28.0000
1	17	0.9088	0.0697	0.1000	0.5554	4.7125	0.6352	0.9596	7.0837	28.0000
1	18	0.9656	0.0697	0.1000	0.5901	4.6421	0.6178	0.9572	7.0905	28.0000
1	19	1.0224	0.0697	0.1000	0.6248	4.5728	0.6010	0.9548	7.0971	28.0000
1	20	1.0792	0.0697	0.1000	0.6595	4.5046	0.5847	0.9524	7.1036	28.0000
1	21	1.1360	0.0697	0.1000	0.6942	4.4374	0.5689	0.9500	7.1099	28.0000

WINTER TMDL MODEL

Spreadsheet Water Quality Model

Stream Name :	***Crooked Creek***
River Basin :	***Black Warroir***
County :	***Cullman County***

Modeled Reach :	Upstream Longitude	Upstream Latitude	Section	Township	Range
	86° 59' 18"	34° 18' 25"	31	9 s	4 w
	Downstream Longitude	Downstream Latitude	Section	Township	Range
	87° 03' 44"	34° 06' 26"	9	11 s	5 w
	Total Stream Length, miles	29.17			

Analysis Date :	**February 27, 2002**
Number of Sections :	10

Applicable Season:	Annual	May - Nov. (Summer)	Dec. - Apr. (Winter)
			X

Analysis Performed By :	**BCH**

Point Sources Included in the Model :	

Model Input :

Headwater Conditions :

CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
21.8290	0.7028	5.8190	8.04695	0.0001	18

Tributary Conditions :

Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	0.0000	0.0000	0.0000			
2	0.0000	0.0000	0.0000			
3	21.8290	0.7028	5.8190	8.05	0.24	18.0
4	27.3685	1.1797	7.4660	7.85	0.32	18.0
5	0.0000	0.0000	0.0000			
6	21.8290	0.7028	5.8190	8.05	0.19	18.0
7	0.0000	0.0000	0.0000			
8	0.0000	0.0000	0.0000			
9	0.0000	0.0000	0.0000			
10	21.8290	0.7028	5.8190	8.05	0.30	18.0
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Incremental Inflow Conditions :

Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	21.8290	0.7028	5.8190	6.6269	0.16	18.0
2	21.8290	0.7028	5.8190	6.6269	0.06	18.0
3	21.8290	0.7028	5.8190	6.6269	0.06	18.0
4	21.8290	0.7028	5.8190	6.6269	0.13	18.0
5	21.8290	0.7028	5.8190	6.6269	0.11	18.0
6	21.8290	0.7028	5.8190	6.6269	0.19	18.0
7	21.8290	0.7028	5.8190	6.6269	0.17	18.0
8	21.8290	0.7028	5.8190	6.6269	0.15	18.0
9	21.8290	0.7028	5.8190	6.6269	0.05	18.0
10	21.8290	0.7028	5.8190	6.6269	0.07	18.0
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Effluent Conditions :

Section #	Discharger	Flow, MGD	Flow, cfs	$CBOD_5$, mg/l	$CBODu/CBOD_5$	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1			0.000			0.000				
2			0.000			0.000				
3			0.000			0.000				
4			0.000			0.000				
5			0.000			0.000				
6			0.000			0.000				
7			0.000			0.000				
8			0.000			0.000				
9			0.000			0.000				
10			0.000			0.000				
11			0.000			0.000				
12			0.000			0.000				
13			0.000			0.000				
14			0.000			0.000				
15			0.000			0.000				
16			0.000			0.000				
17			0.000			0.000				
18			0.000			0.000				
19			0.000			0.000				
20			0.000			0.000				
21			0.000			0.000				
22			0.000			0.000				
23			0.000			0.000				
24			0.000			0.000				

Model Input : Continued

Section Characteristics :								*Dam Characteristics :*		
Section #	Length, miles	Upstream Elevation, feet	Downstream Elevation, feet	Average Elev., feet	Slope, ft/mile	Calculated Velocity or User Input Velocity?	User Input Velocity, feet/sec	Dam Height, feet	Water Quality Factor	Weir Coefficient
1	4.13	1020	820	920	48.4262	Calculated				
2	1.45	820	779	799.5	28.2759	Calculated				
3	1.57	779	760	769.5	12.1019	Calculated				
4	3.3	760	720	740	12.1212	Calculated				
5	2.72	720	686	703	12.5000	Calculated				
6	4.83	686	620	653	13.6646	Calculated				
7	4.35	620	580	600	9.1954	Calculated				
8	3.81	580	540	560	10.4987	Calculated				
9	1.17	540	525	532.5	12.8205	Calculated				
10	1.84	525	517	521	4.3478	Calculated				
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates :

	Reaction Rates at 20° C					Reaction Rates at Ambient Temperature				
Section #	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Computed Ka, 1/day	User Input Ka, 1/day	Ka, 1/day	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Average Temp., °C
1	0.6	0.5	0.05	8.7167		8.3129	0.5473	0.4309	0.0429	18.0000
2	0.4	0.5	0.05	5.0897		4.8539	0.3649	0.4305	0.0429	18.0000
3	0.6	0.3	0.05	2.1783		2.0774	0.5473	0.2576	0.0429	18.0000
4	0.6	0.3	0.05	2.1818		2.0807	0.5473	0.2469	0.0429	18.0000
5	0.3	0.3	0.05	2.2500		2.1458	0.2737	0.2455	0.0429	18.0000
6	0.4	0.3	0.05	2.4596		2.3457	0.3649	0.2544	0.0429	18.0000
7	0.3	0.3	0.05	1.6552		1.5785	0.2737	0.2550	0.0429	18.0000
8	0.3	0.3	0.05	1.8898		1.8022	0.2737	0.2525	0.0429	18.0000
9	0.3	0.3	0.05	2.4044		2.2930	0.2737	0.2573	0.0429	18.0000
10	0.3	0.3	0.05		1.5	1.4305	0.2737	0.2587	0.0429	18.0000
11										
12										
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Model Input : Continued

Reaction Rates : Continued (OPTIONAL)

		Reaction Rates at 20° C			Reaction Rates at Ambient Temperature		
Section #	Stream Depth, feet	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day
1	1.0	0.050			0.044		
2	1.0	0.050			0.044		
3	1.0	0.050			0.044		
4	1.5	0.050			0.044		
5	1.0	0.050			0.044		
6	1.0	0.050			0.044		
7	1.0	0.050			0.044		
8	2.0	0.050			0.044		
9	2.0	0.050			0.044		
10	2.0	0.050			0.044		
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							

Model Output:

Minimum Dissolved Oxygen:	*5.0163 mg/l*
The Minimum DO occurs at:	*8.1400 miles*

Section Number	Increment Number	Distance, miles	Flow, cfs	Velocity, feet/sec	Total Travel Time, days	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1	1	0.0000	0.0001	0.1000	0.0000	21.8290	0.7028	5.8190	8.0470	18.0000
1	2	0.2065	0.0083	0.1000	0.1262	20.3721	0.7002	5.7856	7.1211	18.0000
1	3	0.4130	0.0165	0.1000	0.2524	19.6882	0.6986	5.7689	7.2343	18.0000
1	4	0.6195	0.0247	0.1000	0.3786	19.0375	0.6970	5.7523	7.3202	18.0000
1	5	0.8260	0.0329	0.1000	0.5048	18.4163	0.6953	5.7358	7.3899	18.0000
1	6	1.0325	0.0412	0.1000	0.6310	17.8226	0.6936	5.7194	7.4500	18.0000
1	7	1.2390	0.0494	0.1000	0.7572	17.2550	0.6918	5.7030	7.5038	18.0000
1	8	1.4455	0.0576	0.1000	0.8834	16.7122	0.6900	5.6868	7.5531	18.0000
1	9	1.6520	0.0658	0.1000	1.0096	16.1928	0.6882	5.6705	7.5990	18.0000
1	10	1.8585	0.0740	0.1000	1.1358	15.6958	0.6864	5.6544	7.6421	18.0000
1	11	2.0650	0.0822	0.1000	1.2619	15.2199	0.6845	5.6383	7.6829	18.0000
1	12	2.2715	0.0904	0.1000	1.3881	14.7643	0.6827	5.6222	7.7216	18.0000
1	13	2.4780	0.0986	0.1000	1.5143	14.3278	0.6808	5.6062	7.7586	18.0000
1	14	2.6845	0.1069	0.1000	1.6405	13.9095	0.6789	5.5903	7.7939	18.0000
1	15	2.8910	0.1151	0.1000	1.7667	13.5087	0.6770	5.5745	7.8277	18.0000
1	16	3.0975	0.1233	0.1000	1.8929	13.1244	0.6751	5.5587	7.8601	18.0000
1	17	3.3040	0.1315	0.1000	2.0191	12.7558	0.6732	5.5429	7.8913	18.0000
1	18	3.5105	0.1397	0.1000	2.1453	12.4022	0.6713	5.5272	7.9212	18.0000
1	19	3.7170	0.1479	0.1000	2.2715	12.0629	0.6694	5.5116	7.9500	18.0000
1	20	3.9235	0.1561	0.1000	2.3977	11.7372	0.6675	5.4961	7.9778	18.0000
1	21	4.1300	0.1643	0.1000	2.5239	11.4245	0.6655	5.4806	8.0045	18.0000
2	1	4.1300	0.1643	0.1000	2.5239	11.4245	0.6655	5.4806	8.0045	18.0000
2	2	4.2025	0.1672	0.1000	2.5682	11.4178	0.6647	5.4753	7.9296	18.0000
2	3	4.2750	0.1701	0.1000	2.6125	11.4083	0.6639	5.4701	7.8709	18.0000
2	4	4.3475	0.1730	0.1000	2.6568	11.3963	0.6630	5.4648	7.8251	18.0000
2	5	4.4200	0.1759	0.1000	2.7011	11.3818	0.6622	5.4596	7.7896	18.0000
2	6	4.4925	0.1788	0.1000	2.7454	11.3651	0.6615	5.4544	7.7621	18.0000
2	7	4.5650	0.1816	0.1000	2.7897	11.3462	0.6607	5.4491	7.7410	18.0000
2	8	4.6375	0.1845	0.1000	2.8340	11.3254	0.6600	5.4439	7.7250	18.0000
2	9	4.7100	0.1874	0.1000	2.8783	11.3028	0.6592	5.4387	7.7131	18.0000
2	10	4.7825	0.1903	0.1000	2.9226	11.2785	0.6585	5.4334	7.7044	18.0000
2	11	4.8550	0.1932	0.1000	2.9669	11.2526	0.6577	5.4282	7.6983	18.0000
2	12	4.9275	0.1961	0.1000	3.0113	11.2252	0.6570	5.4230	7.6942	18.0000
2	13	5.0000	0.1989	0.1000	3.0556	11.1963	0.6563	5.4178	7.6918	18.0000
2	14	5.0725	0.2018	0.1000	3.0999	11.1663	0.6556	5.4125	7.6907	18.0000
2	15	5.1450	0.2047	0.1000	3.1442	11.1350	0.6549	5.4073	7.6906	18.0000
2	16	5.2175	0.2076	0.1000	3.1885	11.1025	0.6542	5.4021	7.6914	18.0000
2	17	5.2900	0.2105	0.1000	3.2328	11.0691	0.6535	5.3969	7.6929	18.0000
2	18	5.3625	0.2133	0.1000	3.2771	11.0346	0.6528	5.3917	7.6949	18.0000
2	19	5.4350	0.2162	0.1000	3.3214	10.9993	0.6521	5.3865	7.6974	18.0000
2	20	5.5075	0.2191	0.1000	3.3657	10.9631	0.6514	5.3813	7.7003	18.0000
2	21	5.5800	0.2220	0.1000	3.4100	10.9261	0.6507	5.3761	7.7034	18.0000

3	1	5.5800	0.4620	0.1000	3.4100	16.5900	0.6777	5.6062	7.8819	18.0000
3	2	5.6585	0.4651	0.1000	3.4580	16.1943	0.6818	5.5954	7.4800	18.0000
3	3	5.7370	0.4682	0.1000	3.5059	15.8112	0.6859	5.5846	7.1286	18.0000
3	4	5.8155	0.4714	0.1000	3.5539	15.4403	0.6899	5.5740	6.8222	18.0000
3	5	5.8940	0.4745	0.1000	3.6019	15.0811	0.6939	5.5634	6.5559	18.0000
3	6	5.9725	0.4776	0.1000	3.6499	14.7332	0.6979	5.5529	6.3253	18.0000
3	7	6.0510	0.4807	0.1000	3.6978	14.3963	0.7018	5.5425	6.1265	18.0000
3	8	6.1295	0.4839	0.1000	3.7458	14.0699	0.7057	5.5321	5.9561	18.0000
3	9	6.2080	0.4870	0.1000	3.7938	13.7537	0.7096	5.5219	5.8109	18.0000
3	10	6.2865	0.4901	0.1000	3.8418	13.4474	0.7134	5.5117	5.6880	18.0000
3	11	6.3650	0.4932	0.1000	3.8897	13.1506	0.7171	5.5016	5.5849	18.0000
3	12	6.4435	0.4963	0.1000	3.9377	12.8629	0.7208	5.4916	5.4995	18.0000
3	13	6.5220	0.4995	0.1000	3.9857	12.5842	0.7244	5.4816	5.4296	18.0000
3	14	6.6005	0.5026	0.1000	4.0336	12.3140	0.7280	5.4717	5.3735	18.0000
3	15	6.6790	0.5057	0.1000	4.0816	12.0521	0.7315	5.4619	5.3296	18.0000
3	16	6.7575	0.5088	0.1000	4.1296	11.7982	0.7349	5.4521	5.2964	18.0000
3	17	6.8360	0.5119	0.1000	4.1776	11.5520	0.7383	5.4425	5.2726	18.0000
3	18	6.9145	0.5151	0.1000	4.2255	11.3133	0.7416	5.4328	5.2571	18.0000
3	19	6.9930	0.5182	0.1000	4.2735	11.0818	0.7448	5.4233	5.2489	18.0000
3	20	7.0715	0.5213	0.1000	4.3215	10.8573	0.7480	5.4138	5.2470	18.0000
3	21	7.1500	0.5244	0.1000	4.3694	10.6395	0.7511	5.4044	5.2507	18.0000
4	1	7.1500	0.8441	0.1000	4.3694	16.9753	0.9134	6.1852	6.2355	18.0000
4	2	7.3150	0.8507	0.1000	4.4703	16.0993	0.9177	6.1540	5.7867	18.0000
4	3	7.4800	0.8573	0.1000	4.5711	15.2763	0.9221	6.1232	5.4688	18.0000
4	4	7.6450	0.8638	0.1000	4.6719	14.5032	0.9265	6.0928	5.2533	18.0000
4	5	7.8100	0.8704	0.1000	4.7728	13.7767	0.9308	6.0628	5.1174	18.0000
4	6	7.9750	0.8769	0.1000	4.8736	13.0940	0.9350	6.0331	5.0433	18.0000
4	7	8.1400	0.8835	0.1000	4.9744	12.4523	0.9390	6.0039	5.0163	18.0000
4	8	8.3050	0.8901	0.1000	5.0753	11.8491	0.9428	5.9750	5.0253	18.0000
4	9	8.4700	0.8966	0.1000	5.1761	11.2819	0.9464	5.9464	5.0612	18.0000
4	10	8.6350	0.9032	0.1000	5.2769	10.7487	0.9497	5.9182	5.1169	18.0000
4	11	8.8000	0.9097	0.1000	5.3778	10.2471	0.9527	5.8903	5.1869	18.0000
4	12	8.9650	0.9163	0.1000	5.4786	9.7754	0.9555	5.8628	5.2669	18.0000
4	13	9.1300	0.9229	0.1000	5.5794	9.3316	0.9579	5.8356	5.3534	18.0000
4	14	9.2950	0.9294	0.1000	5.6803	8.9140	0.9601	5.8087	5.4440	18.0000
4	15	9.4600	0.9360	0.1000	5.7811	8.5211	0.9621	5.7821	5.5364	18.0000
4	16	9.6250	0.9426	0.1000	5.8819	8.1512	0.9638	5.7558	5.6294	18.0000
4	17	9.7900	0.9491	0.1000	5.9828	7.8030	0.9652	5.7299	5.7216	18.0000
4	18	9.9550	0.9557	0.1000	6.0836	7.4752	0.9664	5.7042	5.8122	18.0000
4	19	10.1200	0.9622	0.1000	6.1844	7.1664	0.9674	5.6788	5.9007	18.0000
4	20	10.2850	0.9688	0.1000	6.2853	6.8756	0.9682	5.6537	5.9865	18.0000
4	21	10.4500	0.9754	0.1000	6.3861	6.6016	0.9688	5.6288	6.0693	18.0000

5	1	10.4500	0.9754	0.1000	6.3861	6.6016	0.9688	5.6288	6.0693	18.0000
5	2	10.5860	0.9808	0.1000	6.4692	6.5352	0.9691	5.6086	6.2453	18.0000
5	3	10.7220	0.9862	0.1000	6.5523	6.4702	0.9692	5.5885	6.3927	18.0000
5	4	10.8580	0.9916	0.1000	6.6354	6.4066	0.9691	5.5686	6.5164	18.0000
5	5	10.9940	0.9970	0.1000	6.7186	6.3443	0.9689	5.5489	6.6205	18.0000
5	6	11.1300	1.0024	0.1000	6.8017	6.2833	0.9686	5.5294	6.7082	18.0000
5	7	11.2660	1.0078	0.1000	6.8848	6.2236	0.9682	5.5100	6.7824	18.0000
5	8	11.4020	1.0132	0.1000	6.9679	6.1650	0.9677	5.4908	6.8453	18.0000
5	9	11.5380	1.0186	0.1000	7.0510	6.1077	0.9671	5.4717	6.8989	18.0000
5	10	11.6740	1.0240	0.1000	7.1341	6.0515	0.9664	5.4529	6.9447	18.0000
5	11	11.8100	1.0294	0.1000	7.2172	5.9964	0.9657	5.4342	6.9841	18.0000
5	12	11.9460	1.0349	0.1000	7.3003	5.9425	0.9649	5.4156	7.0181	18.0000
5	13	12.0820	1.0403	0.1000	7.3834	5.8896	0.9640	5.3972	7.0476	18.0000
5	14	12.2180	1.0457	0.1000	7.4666	5.8377	0.9631	5.3789	7.0733	18.0000
5	15	12.3540	1.0511	0.1000	7.5497	5.7869	0.9621	5.3608	7.0960	18.0000
5	16	12.4900	1.0565	0.1000	7.6328	5.7370	0.9610	5.3429	7.1160	18.0000
5	17	12.6260	1.0619	0.1000	7.7159	5.6881	0.9600	5.3251	7.1339	18.0000
5	18	12.7620	1.0673	0.1000	7.7990	5.6401	0.9589	5.3074	7.1500	18.0000
5	19	12.8980	1.0727	0.1000	7.8821	5.5931	0.9577	5.2899	7.1645	18.0000
5	20	13.0340	1.0781	0.1000	7.9652	5.5469	0.9565	5.2726	7.1778	18.0000
5	21	13.1700	1.0835	0.1000	8.0483	5.5016	0.9553	5.2553	7.1899	18.0000
6	1	13.1700	1.2735	0.1000	8.0483	7.9375	0.9176	5.3394	7.3178	18.0000
6	2	13.4115	1.2831	0.1000	8.1959	7.6199	0.9181	5.3072	7.1885	18.0000
6	3	13.6530	1.2927	0.1000	8.3435	7.3204	0.9185	5.2753	7.1124	18.0000
6	4	13.8945	1.3023	0.1000	8.4911	7.0380	0.9187	5.2439	7.0728	18.0000
6	5	14.1360	1.3119	0.1000	8.6387	6.7716	0.9187	5.2129	7.0578	18.0000
6	6	14.3775	1.3215	0.1000	8.7862	6.5203	0.9186	5.1823	7.0595	18.0000
6	7	14.6190	1.3312	0.1000	8.9338	6.2831	0.9182	5.1521	7.0721	18.0000
6	8	14.8605	1.3408	0.1000	9.0814	6.0592	0.9177	5.1223	7.0917	18.0000
6	9	15.1020	1.3504	0.1000	9.2290	5.8478	0.9170	5.0929	7.1158	18.0000
6	10	15.3435	1.3600	0.1000	9.3766	5.6482	0.9161	5.0638	7.1424	18.0000
6	11	15.5850	1.3696	0.1000	9.5242	5.4595	0.9151	5.0351	7.1703	18.0000
6	12	15.8265	1.3792	0.1000	9.6717	5.2813	0.9139	5.0067	7.1986	18.0000
6	13	16.0680	1.3888	0.1000	9.8193	5.1129	0.9125	4.9787	7.2269	18.0000
6	14	16.3095	1.3984	0.1000	9.9669	4.9536	0.9110	4.9510	7.2546	18.0000
6	15	16.5510	1.4080	0.1000	10.1145	4.8030	0.9094	4.9237	7.2816	18.0000
6	16	16.7925	1.4176	0.1000	10.2621	4.6604	0.9076	4.8967	7.3078	18.0000
6	17	17.0340	1.4272	0.1000	10.4097	4.5256	0.9058	4.8700	7.3330	18.0000
6	18	17.2755	1.4368	0.1000	10.5573	4.3979	0.9038	4.8436	7.3572	18.0000
6	19	17.5170	1.4464	0.1000	10.7048	4.2770	0.9017	4.8176	7.3804	18.0000
6	20	17.7585	1.4560	0.1000	10.8524	4.1625	0.8995	4.7918	7.4027	18.0000
6	21	18.0000	1.4656	0.1000	11.0000	4.0539	0.8973	4.7663	7.4240	18.0000

7	1	18.0000	1.4656	0.1000	11.0000	4.0539	0.8973	4.7663	7.4240	18.0000
7	2	18.2175	1.4743	0.1000	11.1329	4.0097	0.8951	4.7437	7.3191	18.0000
7	3	18.4350	1.4829	0.1000	11.2658	3.9667	0.8930	4.7212	7.2366	18.0000
7	4	18.6525	1.4916	0.1000	11.3988	3.9249	0.8909	4.6990	7.1723	18.0000
7	5	18.8700	1.5002	0.1000	11.5317	3.8842	0.8887	4.6770	7.1224	18.0000
7	6	19.0875	1.5089	0.1000	11.6646	3.8446	0.8866	4.6553	7.0841	18.0000
7	7	19.3050	1.5175	0.1000	11.7975	3.8061	0.8845	4.6337	7.0550	18.0000
7	8	19.5225	1.5261	0.1000	11.9304	3.7687	0.8823	4.6124	7.0334	18.0000
7	9	19.7400	1.5348	0.1000	12.0633	3.7322	0.8801	4.5913	7.0177	18.0000
7	10	19.9575	1.5434	0.1000	12.1963	3.6967	0.8779	4.5704	7.0067	18.0000
7	11	20.1750	1.5521	0.1000	12.3292	3.6620	0.8756	4.5497	6.9995	18.0000
7	12	20.3925	1.5607	0.1000	12.4621	3.6283	0.8734	4.5292	6.9952	18.0000
7	13	20.6100	1.5694	0.1000	12.5950	3.5954	0.8711	4.5089	6.9934	18.0000
7	14	20.8275	1.5780	0.1000	12.7279	3.5634	0.8687	4.4887	6.9934	18.0000
7	15	21.0450	1.5867	0.1000	12.8608	3.5321	0.8664	4.4688	6.9950	18.0000
7	16	21.2625	1.5953	0.1000	12.9938	3.5016	0.8640	4.4491	6.9977	18.0000
7	17	21.4800	1.6040	0.1000	13.1267	3.4718	0.8616	4.4295	7.0014	18.0000
7	18	21.6975	1.6126	0.1000	13.2596	3.4427	0.8592	4.4102	7.0057	18.0000
7	19	21.9150	1.6213	0.1000	13.3925	3.4143	0.8567	4.3910	7.0107	18.0000
7	20	22.1325	1.6299	0.1000	13.5254	3.3866	0.8542	4.3720	7.0161	18.0000
7	21	22.3500	1.6386	0.1000	13.6583	3.3595	0.8518	4.3531	7.0218	18.0000
8	1	22.3500	1.6386	0.1000	13.6583	3.3595	0.8518	4.3531	7.0218	18.0000
8	2	22.5405	1.6462	0.1000	13.7748	3.3365	0.8495	4.3368	7.1619	18.0000
8	3	22.7310	1.6537	0.1000	13.8912	3.3139	0.8472	4.3206	7.2757	18.0000
8	4	22.9215	1.6613	0.1000	14.0076	3.2918	0.8447	4.3045	7.3684	18.0000
8	5	23.1120	1.6689	0.1000	14.1240	3.2700	0.8423	4.2885	7.4440	18.0000
8	6	23.3025	1.6765	0.1000	14.2404	3.2487	0.8398	4.2727	7.5059	18.0000
8	7	23.4930	1.6840	0.1000	14.3568	3.2278	0.8372	4.2570	7.5568	18.0000
8	8	23.6835	1.6916	0.1000	14.4733	3.2073	0.8346	4.2414	7.5988	18.0000
8	9	23.8740	1.6992	0.1000	14.5897	3.1871	0.8321	4.2259	7.6337	18.0000
8	10	24.0645	1.7068	0.1000	14.7061	3.1673	0.8295	4.2106	7.6628	18.0000
8	11	24.2550	1.7143	0.1000	14.8225	3.1479	0.8269	4.1954	7.6873	18.0000
8	12	24.4455	1.7219	0.1000	14.9389	3.1288	0.8243	4.1803	7.7080	18.0000
8	13	24.6360	1.7295	0.1000	15.0553	3.1100	0.8217	4.1653	7.7257	18.0000
8	14	24.8265	1.7371	0.1000	15.1718	3.0916	0.8190	4.1504	7.7410	18.0000
8	15	25.0170	1.7446	0.1000	15.2882	3.0735	0.8164	4.1356	7.7543	18.0000
8	16	25.2075	1.7522	0.1000	15.4046	3.0556	0.8139	4.1209	7.7659	18.0000
8	17	25.3980	1.7598	0.1000	15.5210	3.0381	0.8113	4.1064	7.7763	18.0000
8	18	25.5885	1.7674	0.1000	15.6374	3.0208	0.8087	4.0919	7.7857	18.0000
8	19	25.7790	1.7750	0.1000	15.7538	3.0039	0.8061	4.0776	7.7941	18.0000
8	20	25.9695	1.7825	0.1000	15.8702	2.9872	0.8035	4.0634	7.8019	18.0000
8	21	26.1600	1.7901	0.1000	15.9867	2.9707	0.8010	4.0492	7.8091	18.0000

9	1	26.1600	1.7901	0.1000	15.9867	2.9707	0.8010	4.0492	7.8091	18.0000
9	2	26.2185	1.7924	0.1029	16.0214	2.9669	0.8001	4.0451	7.8335	18.0000
9	3	26.2770	1.7948	0.1031	16.0561	2.9631	0.7993	4.0410	7.8563	18.0000
9	4	26.3355	1.7971	0.1032	16.0907	2.9593	0.7985	4.0369	7.8775	18.0000
9	5	26.3940	1.7994	0.1034	16.1253	2.9556	0.7976	4.0329	7.8973	18.0000
9	6	26.4525	1.8017	0.1035	16.1598	2.9519	0.7968	4.0288	7.9157	18.0000
9	7	26.5110	1.8041	0.1037	16.1943	2.9483	0.7960	4.0248	7.9330	18.0000
9	8	26.5695	1.8064	0.1039	16.2287	2.9448	0.7951	4.0208	7.9491	18.0000
9	9	26.6280	1.8087	0.1040	16.2631	2.9413	0.7943	4.0168	7.9642	18.0000
9	10	26.6865	1.8110	0.1042	16.2974	2.9378	0.7935	4.0128	7.9783	18.0000
9	11	26.7450	1.8134	0.1043	16.3317	2.9344	0.7926	4.0089	7.9916	18.0000
9	12	26.8035	1.8157	0.1045	16.3659	2.9310	0.7918	4.0050	8.0040	18.0000
9	13	26.8620	1.8180	0.1046	16.4001	2.9277	0.7910	4.0010	8.0157	18.0000
9	14	26.9205	1.8203	0.1048	16.4342	2.9244	0.7901	3.9971	8.0267	18.0000
9	15	26.9790	1.8227	0.1049	16.4682	2.9212	0.7893	3.9932	8.0370	18.0000
9	16	27.0375	1.8250	0.1051	16.5023	2.9180	0.7885	3.9894	8.0467	18.0000
9	17	27.0960	1.8273	0.1053	16.5362	2.9149	0.7877	3.9855	8.0559	18.0000
9	18	27.1545	1.8296	0.1054	16.5701	2.9118	0.7868	3.9817	8.0646	18.0000
9	19	27.2130	1.8320	0.1056	16.6040	2.9087	0.7860	3.9779	8.0728	18.0000
9	20	27.2715	1.8343	0.1057	16.6378	2.9057	0.7852	3.9741	8.0806	18.0000
9	21	27.3300	1.8366	0.1059	16.6716	2.9027	0.7844	3.9703	8.0880	18.0000
10	1	27.3300	2.1366	0.1059	16.6716	5.5601	0.7729	4.2299	8.0822	18.0000
10	2	27.4220	2.1403	0.1000	16.7278	5.5026	0.7725	4.2217	7.9988	18.0000
10	3	27.5140	2.1439	0.1000	16.7840	5.4460	0.7721	4.2137	7.9230	18.0000
10	4	27.6060	2.1476	0.1000	16.8402	5.3904	0.7716	4.2056	7.8540	18.0000
10	5	27.6980	2.1513	0.1000	16.8965	5.3356	0.7712	4.1976	7.7915	18.0000
10	6	27.7900	2.1549	0.1000	16.9527	5.2817	0.7708	4.1896	7.7348	18.0000
10	7	27.8820	2.1586	0.1000	17.0089	5.2287	0.7703	4.1816	7.6834	18.0000
10	8	27.9740	2.1622	0.1000	17.0651	5.1765	0.7699	4.1736	7.6370	18.0000
10	9	28.0660	2.1659	0.1000	17.1214	5.1252	0.7695	4.1657	7.5951	18.0000
10	10	28.1580	2.1696	0.1000	17.1776	5.0746	0.7691	4.1578	7.5573	18.0000
10	11	28.2500	2.1732	0.1000	17.2338	5.0249	0.7686	4.1500	7.5233	18.0000
10	12	28.3420	2.1769	0.1000	17.2900	4.9760	0.7682	4.1421	7.4928	18.0000
10	13	28.4340	2.1805	0.1000	17.3462	4.9279	0.7677	4.1343	7.4655	18.0000
10	14	28.5260	2.1842	0.1000	17.4025	4.8805	0.7673	4.1266	7.4412	18.0000
10	15	28.6180	2.1878	0.1000	17.4587	4.8339	0.7668	4.1188	7.4195	18.0000
10	16	28.7100	2.1915	0.1000	17.5149	4.7880	0.7664	4.1111	7.4002	18.0000
10	17	28.8020	2.1952	0.1000	17.5711	4.7429	0.7659	4.1034	7.3833	18.0000
10	18	28.8940	2.1988	0.1000	17.6274	4.6985	0.7654	4.0957	7.3684	18.0000
10	19	28.9860	2.2025	0.1000	17.6836	4.6548	0.7649	4.0881	7.3553	18.0000
10	20	29.0780	2.2061	0.1000	17.7398	4.6117	0.7644	4.0805	7.3440	18.0000
10	21	29.1700	2.2098	0.1000	17.7960	4.5694	0.7639	4.0729	7.3343	18.0000

Land Uses and Pollutant Concentrations for the Modeled Segment

Headwaters:

		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		

Tributaries:

Section #		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
1	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
2	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
3	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		
4	%	100									100
	$CBOD_u$, mg/l	27.3685									
	NH_3-N, mg/l	1.1797									
	TON, mg/l	7.466									
5	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
6	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		

7	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
8	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
9	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
10	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		
11	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
12	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
13	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
14	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
15	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
16	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
17	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

18	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
19	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
20	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
21	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
22	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
23	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
24	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

Incremental Inflow:

Section #		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
1	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		
2	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		
3	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		
4	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		
5	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		
6	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		
7	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		
8	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		
9	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		

10	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	60	60	60	60	60	60	1		
	NH_3-N, mg/l	0.11	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	1.844093001	0.005		
	TON, mg/l	0.22	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	16.59683548	0.01		
11	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
12	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
13	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
14	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
15	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
16	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
17	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
18	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
19	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
20	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

21	%	100								100
	$CBOD_u$, mg/l									
	NH_3-N, mg/l									
	TON, mg/l									
22	%	100								100
	$CBOD_u$, mg/l									
	NH_3-N, mg/l									
	TON, mg/l									
23	%	100								100
	$CBOD_u$, mg/l									
	NH_3-N, mg/l									
	TON, mg/l									
24	%	100								100
	$CBOD_u$, mg/l									
	NH_3-N, mg/l									
	TON, mg/l									

Loading Summary

WLA				
Discharger	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd
Totals:	0.0	0.0	0.0	0.0

LA												
	Tributaries				*Incremental Inflow*				*Headwaters*			
Section #	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd
1	0.0	0.0	0.0	0.0	19.3	0.6	5.2	26.4	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	6.8	0.2	1.8	9.3				
3	28.2	0.9	7.5	38.6	7.3	0.2	2.0	10.0				
4	47.2	2.0	12.9	68.1	15.4	0.5	4.1	21.1				
5	0.0	0.0	0.0	0.0	12.7	0.4	3.4	17.4				
6	22.4	0.7	6.0	30.5	22.6	0.7	6.0	30.9				
7	0.0	0.0	0.0	0.0	20.4	0.7	5.4	27.8				
8	0.0	0.0	0.0	0.0	17.8	0.6	4.8	24.3				
9	0.0	0.0	0.0	0.0	5.5	0.2	1.5	7.5				
10	35.3	1.1	9.4	48.2	8.6	0.3	2.3	11.8				
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Totals:	133.1	4.8	35.8	185.4	136.5	4.4	36.4	186.4	0.0	0.0	0.0	0.0

Total Loading		
	WLA	LA
CBOD, ppd	0.0	269.6
NH_3-N, ppd	0.0	9.2
TON, ppd	0.0	72.2
NBOD, ppd	0.0	371.8

Spreadsheet Water Quality Model

Stream Name :	***Unnamed Tributary***
River Basin :	***Black Warrior***
County :	***Cullman County***

Modeled Reach :					
	Upstream Longitude	Upstream Latitude	Section	Township	Range
	Downstream Longitude	Downstream Latitude	Section	Township	Range
	Total Stream Length, miles	1.14			

Analysis Date :	**February 27, 2002**
Number of Sections :	**1**

Applicable Season:	Annual	May - Nov. (Summer)	Dec. - Apr. (Winter)
			X

Analysis Performed By :	**BCH**

Point Sources Included in the Model :

West Point	

Model Input :

Headwater Conditions :					
CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
33.7955	1.0705	9.1291	8.04695	0.0001	18

Tributary Conditions :						
Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	0.0000	0.0000	0.0000			
2	0.0000	0.0000	0.0000			
3	0.0000	0.0000	0.0000			
4	0.0000	0.0000	0.0000			
5	0.0000	0.0000	0.0000			
6	0.0000	0.0000	0.0000			
7	0.0000	0.0000	0.0000			
8	0.0000	0.0000	0.0000			
9	0.0000	0.0000	0.0000			
10	0.0000	0.0000	0.0000			
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Incremental Inflow Conditions :

Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	33.7955	1.0705	9.1291	6.63	0.25	18.0
2	0.0000	0.0000	0.0000			
3	0.0000	0.0000	0.0000			
4	0.0000	0.0000	0.0000			
5	0.0000	0.0000	0.0000			
6	0.0000	0.0000	0.0000			
7	0.0000	0.0000	0.0000			
8	0.0000	0.0000	0.0000			
9	0.0000	0.0000	0.0000			
10	0.0000	0.0000	0.0000			
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Effluent Conditions :

Section #	Discharger	Flow, MGD	Flow, cfs	$CBOD_5$, mg/l	CBODu/$CBOD_5$	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1	West Point	0.045	0.070	25	1.5	37.500	2.1	2.1	5	18.0
2			0.000			0.000				
3			0.000			0.000				
4			0.000			0.000				
5			0.000			0.000				
6			0.000			0.000				
7			0.000			0.000				
8			0.000			0.000				
9			0.000			0.000				
10			0.000			0.000				
11			0.000			0.000				
12			0.000			0.000				
13			0.000			0.000				
14			0.000			0.000				
15			0.000			0.000				
16			0.000			0.000				
17			0.000			0.000				
18			0.000			0.000				
19			0.000			0.000				
20			0.000			0.000				
21			0.000			0.000				
22			0.000			0.000				
23			0.000			0.000				
24			0.000			0.000				

Model Input : Continued

Section Characteristics :								*Dam Characteristics :*		
Section #	Length, miles	Upstream Elevation, feet	Downstream Elevation, feet	Average Elev., feet	Slope, ft/mile	Calculated Velocity or User Input Velocity?	User Input Velocity, feet/sec	Dam Height, feet	Water Quality Factor	Weir Coefficient
1	1.136	868.04	760	814.02	95.1056	Calculated				
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates :

	Reaction Rates at 20° C					Reaction Rates at Ambient Temperature				
Section #	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Computed Ka, 1/day	User Input Ka, 1/day	Ka, 1/day	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Average Temp., °C
1	0.6	0.5	0.05	17.1190		16.3260	0.5473	0.3922	0.0429	18.0000
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates : Continued (OPTIONAL)

		Reaction Rates at 20° C			Reaction Rates at Ambient Temperature		
Section #	Stream Depth, feet	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day
1	0.5	0.050			0.044		
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							

Model Output:

Minimum Dissolved Oxygen:	*5.0044 mg/l*
The Minimum DO occurs at:	*0.0000 miles*

Section Number	Increment Number	Distance, miles	Flow, cfs	Velocity, feet/sec	Total Travel Time, days	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1	1	0.0000	0.0697	0.1000	0.0000	37.4947	2.0985	2.1101	5.0044	18.0000
1	2	0.0568	0.0822	0.1000	0.0347	36.2372	1.9207	3.1722	6.2270	18.0000
1	3	0.1136	0.0947	0.1000	0.0694	35.2391	1.7891	3.9521	6.8311	18.0000
1	4	0.1704	0.1072	0.1000	0.1041	34.4108	1.6879	4.5485	7.1484	18.0000
1	5	0.2272	0.1197	0.1000	0.1388	33.7001	1.6078	5.0188	7.3268	18.0000
1	6	0.2840	0.1322	0.1000	0.1736	33.0748	1.5429	5.3989	7.4351	18.0000
1	7	0.3408	0.1447	0.1000	0.2083	32.5134	1.4891	5.7120	7.5066	18.0000
1	8	0.3976	0.1572	0.1000	0.2430	32.0015	1.4440	5.9742	7.5580	18.0000
1	9	0.4544	0.1697	0.1000	0.2777	31.5289	1.4055	6.1968	7.5979	18.0000
1	10	0.5112	0.1822	0.1000	0.3124	31.0881	1.3724	6.3878	7.6309	18.0000
1	11	0.5680	0.1947	0.1000	0.3471	30.6736	1.3435	6.5534	7.6593	18.0000
1	12	0.6248	0.2072	0.1000	0.3818	30.2811	1.3181	6.6982	7.6847	18.0000
1	13	0.6816	0.2197	0.1000	0.4165	29.9074	1.2957	6.8257	7.7079	18.0000
1	14	0.7384	0.2322	0.1000	0.4512	29.5499	1.2757	6.9387	7.7293	18.0000
1	15	0.7952	0.2447	0.1000	0.4860	29.2066	1.2577	7.0394	7.7494	18.0000
1	16	0.8520	0.2572	0.1000	0.5207	28.8758	1.2415	7.1296	7.7683	18.0000
1	17	0.9088	0.2697	0.1000	0.5554	28.5560	1.2268	7.2109	7.7863	18.0000
1	18	0.9656	0.2822	0.1000	0.5901	28.2463	1.2134	7.2843	7.8035	18.0000
1	19	1.0224	0.2947	0.1000	0.6248	27.9457	1.2012	7.3509	7.8200	18.0000
1	20	1.0792	0.3072	0.1000	0.6595	27.6533	1.1900	7.4115	7.8358	18.0000
1	21	1.1360	0.3197	0.1000	0.6942	27.3685	1.1797	7.4668	7.8511	18.0000

CALIBRATED MODEL

Spreadsheet Water Quality Model

Stream Name :	**Crooked Creek**
River Basin :	**Black Warroir**
County :	**Cullman County**

Modeled Reach :

Upstream Longitude	Upstream Latitude	Section	Township	Range
86° 59' 18"	34° 18' 25"	31	9 s	4 w
Downstream Longitude	Downstream Latitude	Section	Township	Range
87° 03' 44"	34° 06' 26"	9	11 s	5 w
Total Stream Length, miles	29.17			

Analysis Date :	**February 27, 2002**
Number of Sections :	10

Analysis Performed By :	**BCH**

Point Sources Included in the Model :

Applicable Season:	Annual	May - Nov. (Summer)	Dec. - Apr. (Winter)
	X		

Model Input :

Headwater Conditions :

CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
2.8327	0.0387	0.2076	6.79	0.0001	23.4

Tributary Conditions :

Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	0.0000	0.0000	0.0000			
2	0.0000	0.0000	0.0000			
3	0.0000	0.0000	0.0000			
4	5.0167	1.1410	1.6320	7.75	0.03	23.4
5	0.0000	0.0000	0.0000			
6	0.0000	0.0000	0.0000			
7	0.0000	0.0000	0.0000			
8	0.0000	0.0000	0.0000			
9	0.0000	0.0000	0.0000			
10	0.0000	0.0000	0.0000			
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Incremental Inflow Conditions :

Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	2.8327	0.0387	0.2076	5.9400	0.08	23.4
2	5.0580	0.0387	0.2076	5.9400	0.03	23.4
3	5.0580	0.0387	0.2076	5.9400	0.03	23.4
4	5.0580	0.0387	0.2076	5.9400	0.06	23.4
5	5.0580	0.0781	0.2076	5.9400	0.05	23.4
6	5.0580	0.0781	0.2076	5.9400	0.09	23.4
7	5.0580	0.0781	0.2076	5.9400	0.08	23.4
8	5.0580	0.0781	0.2076	5.9400	0.07	23.4
9	5.0580	0.0781	0.2076	5.9400	0.02	23.4
10	5.0580	0.0781	0.2076	5.9400	0.03	23.4
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Effluent Conditions :

Section #	Discharger	Flow, MGD	Flow, cfs	$CBOD_5$, mg/l	$CBODu/CBOD_5$	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1			0.000			0.000				
2			0.000			0.000				
3			0.000			0.000				
4			0.000			0.000				
5			0.000			0.000				
6			0.000			0.000				
7			0.000			0.000				
8			0.000			0.000				
9			0.000			0.000				
10			0.000			0.000				
11			0.000			0.000				
12			0.000			0.000				
13			0.000			0.000				
14			0.000			0.000				
15			0.000			0.000				
16			0.000			0.000				
17			0.000			0.000				
18			0.000			0.000				
19			0.000			0.000				
20			0.000			0.000				
21			0.000			0.000				
22			0.000			0.000				
23			0.000			0.000				
24			0.000			0.000				

Model Input : Continued

Section Characteristics :								*Dam Characteristics :*		
Section #	Length, miles	Upstream Elevation, feet	Downstream Elevation, feet	Average Elev., feet	Slope, ft/mile	Calculated Velocity or User Input Velocity?	User Input Velocity, feet/sec	Dam Height, feet	Water Quality Factor	Weir Coefficient
1	4.13	1020	820	920	48.4262	Input	0.03			
2	1.45	820	779	799.5	28.2759	Input	0.03			
3	1.57	779	760	769.5	12.1019	Input	0.02			
4	3.3	760	720	740	12.1212	Input	0.00756			
5	2.72	720	686	703	12.5000	Input	0.02			
6	4.83	686	620	653	13.6646	Input	0.03			
7	4.35	620	580	600	9.1954	Input	0.03			
8	3.81	580	540	560	10.4987	Input	0.03			
9	1.17	540	525	532.5	12.8205	Input	0.02			
10	1.84	525	517	521	4.3478	Input	0.006			
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates :

	Reaction Rates at 20° C					Reaction Rates at Ambient Temperature				
Section #	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Computed Ka, 1/day	User Input Ka, 1/day	Ka, 1/day	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Average Temp., °C
1	0.05	0.5	0.02	2.6150		2.8346	0.0585	0.6338	0.0260	23.4000
2	0.05	0.5	0.02	1.5269		1.6551	0.0585	0.6501	0.0260	23.4000
3	0.05	0.3	0.02	0.4460		0.4835	0.0585	0.3876	0.0260	23.4000
4	0.05	0.3	0.02	0.1779		0.1928	0.0585	0.3772	0.0260	23.4000
5	0.05	0.3	0.02	0.4367		0.4733	0.0585	0.3479	0.0260	23.4000
6	0.05	0.3	0.02	0.7262		0.7872	0.0585	0.3745	0.0260	23.4000
7	0.05	0.3	0.02	0.4966		0.5383	0.0585	0.3831	0.0260	23.4000
8	0.05	0.3	0.02	0.5669		0.6145	0.0585	0.3773	0.0260	23.4000
9	0.05	0.3	0.02	0.4725		0.5122	0.0585	0.3865	0.0260	23.4000
10	0.05	0.3	0.02		0.4725	0.5122	0.0585	0.3853	0.0260	23.4000
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates : Continued (OPTIONAL)

		Reaction Rates at 20° C			Reaction Rates at Ambient Temperature		
Section #	Stream Depth, feet	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day
1	1.0	0.020			0.024		
2	1.0	0.020			0.024		
3	1.0	0.020			0.024		
4	1.5	0.020			0.024		
5	1.0	0.020			0.024		
6	1.0	0.020			0.024		
7	1.0	0.020			0.024		
8	2.0	0.020			0.024		
9	2.0	0.020			0.024		
10	2.0	0.020			0.024		
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							

Model Output:

Minimum Dissolved Oxygen:	*4.2951 mg/l*
The Minimum DO occurs at:	*8.4700 miles*

Section Number	Increment Number	Distance, miles	Flow, cfs	Velocity, feet/sec	Total Travel Time, days	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1	1	0.0000	0.0001	0.0300	0.0000	2.8327	0.0387	0.2076	6.7900	23.4000
1	2	0.2065	0.0039	0.0300	0.4206	2.7639	0.0319	0.2055	7.2351	23.4000
1	3	0.4130	0.0077	0.0300	0.8413	2.7299	0.0290	0.2045	7.4340	23.4000
1	4	0.6195	0.0116	0.0300	1.2619	2.6967	0.0267	0.2035	7.5429	23.4000
1	5	0.8260	0.0154	0.0300	1.6826	2.6642	0.0247	0.2025	7.6090	23.4000
1	6	1.0325	0.0192	0.0300	2.1032	2.6322	0.0229	0.2015	7.6530	23.4000
1	7	1.2390	0.0230	0.0300	2.5239	2.6007	0.0215	0.2006	7.6846	23.4000
1	8	1.4455	0.0269	0.0300	2.9445	2.5698	0.0202	0.1996	7.7086	23.4000
1	9	1.6520	0.0307	0.0300	3.3652	2.5393	0.0191	0.1986	7.7279	23.4000
1	10	1.8585	0.0345	0.0300	3.7858	2.5093	0.0182	0.1977	7.7438	23.4000
1	11	2.0650	0.0383	0.0300	4.2065	2.4799	0.0174	0.1967	7.7574	23.4000
1	12	2.2715	0.0422	0.0300	4.6271	2.4509	0.0166	0.1958	7.7693	23.4000
1	13	2.4780	0.0460	0.0300	5.0478	2.4223	0.0160	0.1948	7.7798	23.4000
1	14	2.6845	0.0498	0.0300	5.4684	2.3942	0.0154	0.1939	7.7894	23.4000
1	15	2.8910	0.0536	0.0300	5.8891	2.3666	0.0149	0.1929	7.7981	23.4000
1	16	3.0975	0.0574	0.0300	6.3097	2.3394	0.0145	0.1920	7.8062	23.4000
1	17	3.3040	0.0613	0.0300	6.7304	2.3126	0.0141	0.1911	7.8138	23.4000
1	18	3.5105	0.0651	0.0300	7.1510	2.2862	0.0137	0.1902	7.8209	23.4000
1	19	3.7170	0.0689	0.0300	7.5717	2.2603	0.0133	0.1893	7.8276	23.4000
1	20	3.9235	0.0727	0.0300	7.9923	2.2347	0.0130	0.1884	7.8340	23.4000
1	21	4.1300	0.0766	0.0300	8.4130	2.2096	0.0127	0.1875	7.8402	23.4000
2	1	4.1300	0.0766	0.0300	8.4130	2.2096	0.0127	0.1875	7.8402	23.4000
2	2	4.2025	0.0779	0.0300	8.5606	2.2392	0.0126	0.1872	7.7678	23.4000
2	3	4.2750	0.0792	0.0300	8.7083	2.2673	0.0125	0.1869	7.7125	23.4000
2	4	4.3475	0.0806	0.0300	8.8560	2.2939	0.0124	0.1866	7.6703	23.4000
2	5	4.4200	0.0819	0.0300	9.0037	2.3191	0.0123	0.1863	7.6382	23.4000
2	6	4.4925	0.0833	0.0300	9.1514	2.3429	0.0122	0.1860	7.6138	23.4000
2	7	4.5650	0.0846	0.0300	9.2991	2.3655	0.0121	0.1857	7.5953	23.4000
2	8	4.6375	0.0860	0.0300	9.4468	2.3868	0.0121	0.1854	7.5814	23.4000
2	9	4.7100	0.0873	0.0300	9.5944	2.4070	0.0120	0.1851	7.5711	23.4000
2	10	4.7825	0.0886	0.0300	9.7421	2.4262	0.0119	0.1848	7.5634	23.4000
2	11	4.8550	0.0900	0.0300	9.8898	2.4442	0.0118	0.1845	7.5578	23.4000
2	12	4.9275	0.0913	0.0300	10.0375	2.4613	0.0117	0.1842	7.5538	23.4000
2	13	5.0000	0.0927	0.0300	10.1852	2.4774	0.0117	0.1839	7.5510	23.4000
2	14	5.0725	0.0940	0.0300	10.3329	2.4927	0.0116	0.1836	7.5492	23.4000
2	15	5.1450	0.0953	0.0300	10.4806	2.5070	0.0115	0.1833	7.5481	23.4000
2	16	5.2175	0.0967	0.0300	10.6282	2.5206	0.0114	0.1830	7.5476	23.4000
2	17	5.2900	0.0980	0.0300	10.7759	2.5334	0.0114	0.1827	7.5475	23.4000
2	18	5.3625	0.0994	0.0300	10.9236	2.5454	0.0113	0.1824	7.5477	23.4000
2	19	5.4350	0.1007	0.0300	11.0713	2.5567	0.0112	0.1821	7.5482	23.4000
2	20	5.5075	0.1021	0.0300	11.2190	2.5674	0.0112	0.1818	7.5489	23.4000
2	21	5.5800	0.1034	0.0300	11.3667	2.5773	0.0111	0.1815	7.5497	23.4000

3	1	5.5800	0.1034	0.0300	11.3667	2.5773	0.0111	0.1815	7.5497	23.4000
3	2	5.6585	0.1049	0.0200	11.6065	2.5754	0.0115	0.1809	7.3719	23.4000
3	3	5.7370	0.1063	0.0200	11.8464	2.5730	0.0118	0.1802	7.2154	23.4000
3	4	5.8155	0.1078	0.0200	12.0863	2.5702	0.0121	0.1796	7.0779	23.4000
3	5	5.8940	0.1092	0.0200	12.3261	2.5671	0.0124	0.1790	6.9568	23.4000
3	6	5.9725	0.1107	0.0200	12.5660	2.5636	0.0126	0.1783	6.8503	23.4000
3	7	6.0510	0.1121	0.0200	12.8058	2.5598	0.0128	0.1777	6.7566	23.4000
3	8	6.1295	0.1136	0.0200	13.0457	2.5556	0.0130	0.1771	6.6742	23.4000
3	9	6.2080	0.1150	0.0200	13.2856	2.5512	0.0132	0.1765	6.6017	23.4000
3	10	6.2865	0.1165	0.0200	13.5254	2.5466	0.0133	0.1759	6.5379	23.4000
3	11	6.3650	0.1179	0.0200	13.7653	2.5416	0.0134	0.1753	6.4818	23.4000
3	12	6.4435	0.1194	0.0200	14.0051	2.5364	0.0135	0.1747	6.4324	23.4000
3	13	6.5220	0.1208	0.0200	14.2450	2.5310	0.0136	0.1741	6.3890	23.4000
3	14	6.6005	0.1223	0.0200	14.4849	2.5254	0.0137	0.1735	6.3509	23.4000
3	15	6.6790	0.1237	0.0200	14.7247	2.5196	0.0138	0.1730	6.3174	23.4000
3	16	6.7575	0.1252	0.0200	14.9646	2.5136	0.0138	0.1724	6.2880	23.4000
3	17	6.8360	0.1266	0.0200	15.2044	2.5073	0.0138	0.1718	6.2621	23.4000
3	18	6.9145	0.1281	0.0200	15.4443	2.5010	0.0139	0.1713	6.2395	23.4000
3	19	6.9930	0.1296	0.0200	15.6842	2.4944	0.0139	0.1707	6.2196	23.4000
3	20	7.0715	0.1310	0.0200	15.9240	2.4877	0.0139	0.1702	6.2023	23.4000
3	21	7.1500	0.1325	0.0200	16.1639	2.4809	0.0139	0.1696	6.1871	23.4000
4	1	7.1500	0.1659	0.0200	16.1639	2.9916	0.2409	0.4641	6.5011	23.4000
4	2	7.3150	0.1689	0.0076	17.4977	2.8018	0.1576	0.4454	5.6012	23.4000
4	3	7.4800	0.1720	0.0076	18.8314	2.6287	0.1090	0.4276	5.0559	23.4000
4	4	7.6450	0.1750	0.0076	20.1652	2.4708	0.0799	0.4107	4.7237	23.4000
4	5	7.8100	0.1781	0.0076	21.4990	2.3265	0.0620	0.3948	4.5227	23.4000
4	6	7.9750	0.1811	0.0076	22.8328	2.1946	0.0508	0.3796	4.4041	23.4000
4	7	8.1400	0.1842	0.0076	24.1665	2.0740	0.0434	0.3652	4.3381	23.4000
4	8	8.3050	0.1872	0.0076	25.5003	1.9634	0.0385	0.3515	4.3057	23.4000
4	9	8.4700	0.1903	0.0076	26.8341	1.8621	0.0351	0.3384	4.2951	23.4000
4	10	8.6350	0.1934	0.0076	28.1679	1.7692	0.0325	0.3260	4.2985	23.4000
4	11	8.8000	0.1964	0.0076	29.5016	1.6838	0.0306	0.3142	4.3109	23.4000
4	12	8.9650	0.1995	0.0076	30.8354	1.6053	0.0290	0.3030	4.3288	23.4000
4	13	9.1300	0.2025	0.0076	32.1692	1.5331	0.0277	0.2923	4.3501	23.4000
4	14	9.2950	0.2056	0.0076	33.5030	1.4666	0.0265	0.2821	4.3732	23.4000
4	15	9.4600	0.2086	0.0076	34.8367	1.4052	0.0255	0.2724	4.3971	23.4000
4	16	9.6250	0.2117	0.0076	36.1705	1.3486	0.0245	0.2631	4.4211	23.4000
4	17	9.7900	0.2147	0.0076	37.5043	1.2962	0.0236	0.2543	4.4448	23.4000
4	18	9.9550	0.2178	0.0076	38.8381	1.2478	0.0228	0.2458	4.4679	23.4000
4	19	10.1200	0.2208	0.0076	40.1718	1.2030	0.0220	0.2378	4.4901	23.4000
4	20	10.2850	0.2239	0.0076	41.5056	1.1614	0.0213	0.2301	4.5115	23.4000
4	21	10.4500	0.2270	0.0076	42.8394	1.1228	0.0206	0.2227	4.5319	23.4000

5	1	10.4500	0.2270	0.0076	42.8394	1.1228	0.0206	0.2227	4.5319	23.4000
5	2	10.5860	0.2295	0.0200	43.2549	1.1380	0.0205	0.2204	4.8712	23.4000
5	3	10.7220	0.2320	0.0200	43.6705	1.1522	0.0204	0.2181	5.1449	23.4000
5	4	10.8580	0.2345	0.0200	44.0860	1.1655	0.0202	0.2159	5.3655	23.4000
5	5	10.9940	0.2370	0.0200	44.5016	1.1779	0.0200	0.2137	5.5435	23.4000
5	6	11.1300	0.2395	0.0200	44.9172	1.1894	0.0198	0.2116	5.6872	23.4000
5	7	11.2660	0.2421	0.0200	45.3327	1.2002	0.0195	0.2095	5.8031	23.4000
5	8	11.4020	0.2446	0.0200	45.7483	1.2101	0.0193	0.2075	5.8968	23.4000
5	9	11.5380	0.2471	0.0200	46.1638	1.2193	0.0191	0.2055	5.9725	23.4000
5	10	11.6740	0.2496	0.0200	46.5794	1.2279	0.0188	0.2035	6.0337	23.4000
5	11	11.8100	0.2521	0.0200	46.9949	1.2357	0.0186	0.2016	6.0832	23.4000
5	12	11.9460	0.2546	0.0200	47.4105	1.2430	0.0184	0.1997	6.1233	23.4000
5	13	12.0820	0.2572	0.0200	47.8260	1.2496	0.0182	0.1978	6.1558	23.4000
5	14	12.2180	0.2597	0.0200	48.2416	1.2556	0.0180	0.1960	6.1821	23.4000
5	15	12.3540	0.2622	0.0200	48.6572	1.2611	0.0178	0.1942	6.2036	23.4000
5	16	12.4900	0.2647	0.0200	49.0727	1.2661	0.0176	0.1925	6.2210	23.4000
5	17	12.6260	0.2672	0.0200	49.4883	1.2706	0.0174	0.1908	6.2352	23.4000
5	18	12.7620	0.2698	0.0200	49.9038	1.2746	0.0172	0.1891	6.2469	23.4000
5	19	12.8980	0.2723	0.0200	50.3194	1.2782	0.0171	0.1874	6.2565	23.4000
5	20	13.0340	0.2748	0.0200	50.7349	1.2813	0.0169	0.1858	6.2644	23.4000
5	21	13.1700	0.2773	0.0200	51.1505	1.2840	0.0167	0.1842	6.2709	23.4000
6	1	13.1700	0.2773	0.0200	51.1505	1.2840	0.0167	0.1842	6.2709	23.4000
6	2	13.4115	0.2818	0.0300	51.6424	1.3058	0.0168	0.1824	6.5319	23.4000
6	3	13.6530	0.2862	0.0300	52.1344	1.3257	0.0169	0.1807	6.7050	23.4000
6	4	13.8945	0.2907	0.0300	52.6263	1.3439	0.0169	0.1791	6.8200	23.4000
6	5	14.1360	0.2952	0.0300	53.1183	1.3605	0.0168	0.1775	6.8964	23.4000
6	6	14.3775	0.2997	0.0300	53.6102	1.3755	0.0167	0.1759	6.9474	23.4000
6	7	14.6190	0.3041	0.0300	54.1022	1.3891	0.0166	0.1743	6.9814	23.4000
6	8	14.8605	0.3086	0.0300	54.5941	1.4014	0.0165	0.1728	7.0043	23.4000
6	9	15.1020	0.3131	0.0300	55.0860	1.4124	0.0164	0.1713	7.0198	23.4000
6	10	15.3435	0.3175	0.0300	55.5780	1.4223	0.0163	0.1699	7.0305	23.4000
6	11	15.5850	0.3220	0.0300	56.0699	1.4310	0.0161	0.1684	7.0380	23.4000
6	12	15.8265	0.3265	0.0300	56.5619	1.4387	0.0160	0.1670	7.0433	23.4000
6	13	16.0680	0.3310	0.0300	57.0538	1.4454	0.0159	0.1657	7.0473	23.4000
6	14	16.3095	0.3354	0.0300	57.5458	1.4512	0.0157	0.1643	7.0503	23.4000
6	15	16.5510	0.3399	0.0300	58.0377	1.4562	0.0156	0.1630	7.0528	23.4000
6	16	16.7925	0.3444	0.0300	58.5297	1.4603	0.0155	0.1617	7.0549	23.4000
6	17	17.0340	0.3488	0.0300	59.0216	1.4638	0.0153	0.1605	7.0568	23.4000
6	18	17.2755	0.3533	0.0300	59.5135	1.4665	0.0152	0.1592	7.0586	23.4000
6	19	17.5170	0.3578	0.0300	60.0055	1.4685	0.0151	0.1580	7.0602	23.4000
6	20	17.7585	0.3622	0.0300	60.4974	1.4699	0.0149	0.1568	7.0619	23.4000
6	21	18.0000	0.3667	0.0300	60.9894	1.4708	0.0148	0.1556	7.0635	23.4000

7	1	18.0000	0.3667	0.0300	60.9894	1.4708	0.0148	0.1556	7.0635	23.4000
7	2	18.2175	0.3707	0.0300	61.4324	1.4711	0.0147	0.1546	6.9354	23.4000
7	3	18.4350	0.3748	0.0300	61.8755	1.4711	0.0146	0.1535	6.8360	23.4000
7	4	18.6525	0.3788	0.0300	62.3185	1.4706	0.0145	0.1525	6.7588	23.4000
7	5	18.8700	0.3828	0.0300	62.7616	1.4698	0.0144	0.1515	6.6989	23.4000
7	6	19.0875	0.3869	0.0300	63.2047	1.4686	0.0143	0.1505	6.6526	23.4000
7	7	19.3050	0.3909	0.0300	63.6477	1.4671	0.0142	0.1496	6.6168	23.4000
7	8	19.5225	0.3949	0.0300	64.0908	1.4653	0.0141	0.1486	6.5891	23.4000
7	9	19.7400	0.3989	0.0300	64.5338	1.4631	0.0140	0.1477	6.5679	23.4000
7	10	19.9575	0.4030	0.0300	64.9769	1.4607	0.0139	0.1467	6.5516	23.4000
7	11	20.1750	0.4070	0.0300	65.4199	1.4581	0.0138	0.1458	6.5392	23.4000
7	12	20.3925	0.4110	0.0300	65.8630	1.4552	0.0137	0.1449	6.5299	23.4000
7	13	20.6100	0.4150	0.0300	66.3060	1.4520	0.0137	0.1440	6.5229	23.4000
7	14	20.8275	0.4191	0.0300	66.7491	1.4487	0.0136	0.1431	6.5178	23.4000
7	15	21.0450	0.4231	0.0300	67.1922	1.4451	0.0135	0.1423	6.5141	23.4000
7	16	21.2625	0.4271	0.0300	67.6352	1.4413	0.0134	0.1414	6.5115	23.4000
7	17	21.4800	0.4311	0.0300	68.0783	1.4374	0.0133	0.1406	6.5099	23.4000
7	18	21.6975	0.4352	0.0300	68.5213	1.4333	0.0132	0.1397	6.5089	23.4000
7	19	21.9150	0.4392	0.0300	68.9644	1.4290	0.0131	0.1389	6.5085	23.4000
7	20	22.1325	0.4432	0.0300	69.4074	1.4246	0.0131	0.1381	6.5085	23.4000
7	21	22.3500	0.4472	0.0300	69.8505	1.4201	0.0130	0.1373	6.5088	23.4000
8	1	22.3500	0.4472	0.0300	69.8505	1.4201	0.0130	0.1373	6.5088	23.4000
8	2	22.5405	0.4508	0.0300	70.2385	1.4161	0.0129	0.1366	6.7057	23.4000
8	3	22.7310	0.4543	0.0300	70.6266	1.4119	0.0128	0.1359	6.8599	23.4000
8	4	22.9215	0.4578	0.0300	71.0147	1.4077	0.0127	0.1352	6.9807	23.4000
8	5	23.1120	0.4614	0.0300	71.4027	1.4034	0.0126	0.1346	7.0755	23.4000
8	6	23.3025	0.4649	0.0300	71.7908	1.3991	0.0125	0.1339	7.1499	23.4000
8	7	23.4930	0.4684	0.0300	72.1788	1.3946	0.0124	0.1332	7.2083	23.4000
8	8	23.6835	0.4719	0.0300	72.5669	1.3901	0.0123	0.1326	7.2544	23.4000
8	9	23.8740	0.4755	0.0300	72.9549	1.3855	0.0122	0.1319	7.2908	23.4000
8	10	24.0645	0.4790	0.0300	73.3430	1.3809	0.0122	0.1313	7.3195	23.4000
8	11	24.2550	0.4825	0.0300	73.7310	1.3762	0.0121	0.1307	7.3423	23.4000
8	12	24.4455	0.4860	0.0300	74.1191	1.3714	0.0120	0.1300	7.3605	23.4000
8	13	24.6360	0.4896	0.0300	74.5072	1.3666	0.0119	0.1294	7.3751	23.4000
8	14	24.8265	0.4931	0.0300	74.8952	1.3618	0.0118	0.1288	7.3868	23.4000
8	15	25.0170	0.4966	0.0300	75.2833	1.3569	0.0118	0.1282	7.3963	23.4000
8	16	25.2075	0.5001	0.0300	75.6713	1.3520	0.0117	0.1276	7.4041	23.4000
8	17	25.3980	0.5037	0.0300	76.0594	1.3470	0.0116	0.1270	7.4105	23.4000
8	18	25.5885	0.5072	0.0300	76.4474	1.3421	0.0116	0.1264	7.4159	23.4000
8	19	25.7790	0.5107	0.0300	76.8355	1.3370	0.0115	0.1258	7.4204	23.4000
8	20	25.9695	0.5143	0.0300	77.2235	1.3320	0.0114	0.1252	7.4243	23.4000
8	21	26.1600	0.5178	0.0300	77.6116	1.3269	0.0114	0.1247	7.4276	23.4000

9	1	26.1600	0.5178	0.0300	77.6116	1.3269	0.0114	0.1247	7.4276	23.4000
9	2	26.2185	0.5189	0.0200	77.7903	1.3208	0.0113	0.1243	7.4124	23.4000
9	3	26.2770	0.5199	0.0200	77.9691	1.3148	0.0112	0.1240	7.3985	23.4000
9	4	26.3355	0.5210	0.0200	78.1478	1.3089	0.0111	0.1236	7.3860	23.4000
9	5	26.3940	0.5221	0.0200	78.3266	1.3029	0.0110	0.1233	7.3747	23.4000
9	6	26.4525	0.5232	0.0200	78.5053	1.2971	0.0109	0.1229	7.3645	23.4000
9	7	26.5110	0.5243	0.0200	78.6841	1.2913	0.0108	0.1226	7.3553	23.4000
9	8	26.5695	0.5254	0.0200	78.8628	1.2856	0.0107	0.1223	7.3470	23.4000
9	9	26.6280	0.5264	0.0200	79.0416	1.2799	0.0106	0.1219	7.3396	23.4000
9	10	26.6865	0.5275	0.0200	79.2203	1.2743	0.0106	0.1216	7.3329	23.4000
9	11	26.7450	0.5286	0.0200	79.3991	1.2687	0.0105	0.1213	7.3269	23.4000
9	12	26.8035	0.5297	0.0200	79.5778	1.2632	0.0104	0.1209	7.3215	23.4000
9	13	26.8620	0.5308	0.0200	79.7566	1.2577	0.0104	0.1206	7.3167	23.4000
9	14	26.9205	0.5319	0.0200	79.9353	1.2523	0.0103	0.1203	7.3124	23.4000
9	15	26.9790	0.5329	0.0200	80.1141	1.2469	0.0103	0.1200	7.3086	23.4000
9	16	27.0375	0.5340	0.0200	80.2928	1.2416	0.0102	0.1196	7.3052	23.4000
9	17	27.0960	0.5351	0.0200	80.4716	1.2363	0.0102	0.1193	7.3022	23.4000
9	18	27.1545	0.5362	0.0200	80.6503	1.2311	0.0101	0.1190	7.2996	23.4000
9	19	27.2130	0.5373	0.0200	80.8291	1.2260	0.0101	0.1187	7.2972	23.4000
9	20	27.2715	0.5384	0.0200	81.0078	1.2209	0.0100	0.1184	7.2952	23.4000
9	21	27.3300	0.5394	0.0200	81.1866	1.2158	0.0100	0.1180	7.2935	23.4000
10	1	27.3300	0.5394	0.0200	81.1866	1.2158	0.0100	0.1180	7.2935	23.4000
10	2	27.4220	0.5411	0.0060	82.1236	1.1624	0.0097	0.1158	7.3071	23.4000
10	3	27.5140	0.5428	0.0060	83.0607	1.1121	0.0094	0.1135	7.3182	23.4000
10	4	27.6060	0.5445	0.0060	83.9977	1.0645	0.0092	0.1114	7.3275	23.4000
10	5	27.6980	0.5463	0.0060	84.9347	1.0195	0.0090	0.1092	7.3355	23.4000
10	6	27.7900	0.5480	0.0060	85.8718	0.9771	0.0088	0.1072	7.3427	23.4000
10	7	27.8820	0.5497	0.0060	86.8088	0.9370	0.0086	0.1051	7.3492	23.4000
10	8	27.9740	0.5514	0.0060	87.7459	0.8991	0.0084	0.1032	7.3551	23.4000
10	9	28.0660	0.5531	0.0060	88.6829	0.8633	0.0083	0.1013	7.3606	23.4000
10	10	28.1580	0.5548	0.0060	89.6199	0.8295	0.0081	0.0994	7.3657	23.4000
10	11	28.2500	0.5565	0.0060	90.5570	0.7975	0.0080	0.0976	7.3705	23.4000
10	12	28.3420	0.5582	0.0060	91.4940	0.7673	0.0078	0.0958	7.3751	23.4000
10	13	28.4340	0.5599	0.0060	92.4310	0.7388	0.0077	0.0940	7.3793	23.4000
10	14	28.5260	0.5616	0.0060	93.3681	0.7118	0.0075	0.0923	7.3834	23.4000
10	15	28.6180	0.5633	0.0060	94.3051	0.6863	0.0074	0.0907	7.3872	23.4000
10	16	28.7100	0.5650	0.0060	95.2422	0.6622	0.0073	0.0890	7.3909	23.4000
10	17	28.8020	0.5667	0.0060	96.1792	0.6394	0.0072	0.0875	7.3943	23.4000
10	18	28.8940	0.5684	0.0060	97.1162	0.6179	0.0070	0.0859	7.3976	23.4000
10	19	28.9860	0.5701	0.0060	98.0533	0.5975	0.0069	0.0844	7.4008	23.4000
10	20	29.0780	0.5718	0.0060	98.9903	0.5782	0.0068	0.0829	7.4037	23.4000
10	21	29.1700	0.5735	0.0060	99.9273	0.5600	0.0067	0.0815	7.4066	23.4000

Land Uses and Pollutant Concentrations for the Modeled Segment

Headwaters:

		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	3.333333333	3.333333333	50	50	50	50	1		
	NH_3-N, mg/l	0.05	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.005		
	TON, mg/l	0.22	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.01		

Tributaries:

Section #		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
1	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
2	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
3	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
4	%	100									100
	$CBOD_u$, mg/l	5.0167									
	NH_3-N, mg/l	1.141									
	TON, mg/l	1.632									
5	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
6	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

7	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
8	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
9	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
10	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
11	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
12	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
13	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
14	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
15	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
16	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
17	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

18	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
19	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
20	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
21	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
22	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
23	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
24	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

Incremental Inflow:

Section #		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
1	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	3.333333333	3.333333333	50	50	50	50	1		
	NH_3-N, mg/l	0.05	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.005		
	TON, mg/l	0.22	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.01		
2	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	10	10	50	50	50	50	1		
	NH_3-N, mg/l	0.05	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.005		
	TON, mg/l	0.22	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.01		
3	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	10	10	50	50	50	50	1		
	NH_3-N, mg/l	0.05	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.005		
	TON, mg/l	0.22	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.01		
4	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	10	10	50	50	50	50	1		
	NH_3-N, mg/l	0.05	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.005		
	TON, mg/l	0.22	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.01		
5	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	10	10	50	50	50	50	1		
	NH_3-N, mg/l	0.11	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.005		
	TON, mg/l	0.22	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.01		
6	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	10	10	50	50	50	50	1		
	NH_3-N, mg/l	0.11	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.005		
	TON, mg/l	0.22	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.01		
7	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	10	10	50	50	50	50	1		
	NH_3-N, mg/l	0.11	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.005		
	TON, mg/l	0.22	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.01		
8	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	10	10	50	50	50	50	1		
	NH_3-N, mg/l	0.11	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.005		
	TON, mg/l	0.22	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.01		
9	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	10	10	50	50	50	50	1		
	NH_3-N, mg/l	0.11	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.005		
	TON, mg/l	0.22	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.01		

10	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	10	10	50	50	50	50	1		
	NH_3-N, mg/l	0.11	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.017074935	0.005		
	TON, mg/l	0.22	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.184409283	0.01		
11	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
12	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
13	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
14	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
15	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
16	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
17	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
18	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
19	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
20	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

21	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
22	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
23	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
24	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

Loading Summary

WLA				
Discharger	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd
Totals:	0.0	0.0	0.0	0.0

LA												
	Tributaries				***Incremental Inflow***				***Headwaters***			
Section #	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd
1	0.0	0.0	0.0	0.0	1.2	0.0	0.1	0.5	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.2				
3	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.2				
4	0.9	0.2	0.3	2.3	1.7	0.0	0.1	0.4				
5	0.0	0.0	0.0	0.0	1.4	0.0	0.1	0.4				
6	0.0	0.0	0.0	0.0	2.4	0.0	0.1	0.6				
7	0.0	0.0	0.0	0.0	2.2	0.0	0.1	0.6				
8	0.0	0.0	0.0	0.0	1.9	0.0	0.1	0.5				
9	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.2				
10	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.2				
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Totals:	0.9	0.2	0.3	2.3	13.8	0.2	0.6	3.6	0.0	0.0	0.0	0.0

Total Loading		
	WLA	LA
CBOD, ppd	0.0	14.7
NH_3-N, ppd	0.0	0.4
TON, ppd	0.0	0.9
NBOD, ppd	0.0	5.9

Spreadsheet Water Quality Model

Stream Name :	*Unnamed Tributary*
River Basin :	*Black Warrior*
County :	*Cullman County*

Modeled Reach :	Upstream Longitude	Upstream Latitude	Section	Township	Range
	Downstream Longitude	Downstream Latitude	Section	Township	Range
	Total Stream Length, miles	1.14			

Analysis Date :	February 27, 2002
Number of Sections :	1

Analysis Performed By :	BCH

Applicable Season:	Annual	May - Nov. (Summer)	Dec. - Apr. (Winter)
	X		

Point Sources Included in the Model :	
West Point	

Model Input :

Headwater Conditions :

CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
5.0580	0.0504	0.3337	6.79	0.00001	23.4

Tributary Conditions :

Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	0.0000	0.0000	0.0000			
2	0.0000	0.0000	0.0000			
3	0.0000	0.0000	0.0000			
4	0.0000	0.0000	0.0000			
5	0.0000	0.0000	0.0000			
6	0.0000	0.0000	0.0000			
7	0.0000	0.0000	0.0000			
8	0.0000	0.0000	0.0000			
9	0.0000	0.0000	0.0000			
10	0.0000	0.0000	0.0000			
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Incremental Inflow Conditions :

Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	0.0000	0.0000	0.0000	6.0000	0.00	23.4
2	0.0000	0.0000	0.0000			
3	0.0000	0.0000	0.0000			
4	0.0000	0.0000	0.0000			
5	0.0000	0.0000	0.0000			
6	0.0000	0.0000	0.0000			
7	0.0000	0.0000	0.0000			
8	0.0000	0.0000	0.0000			
9	0.0000	0.0000	0.0000			
10	0.0000	0.0000	0.0000			
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Effluent Conditions :

Section #	Discharger	Flow, MGD	Flow, cfs	$CBOD_5$, mg/l	$CBODu/CBOD_5$	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1	West Point	0.0216	0.033	3.2	2	6.400	1.7	1.7	6	23.4
2			0.000			0.000				
3			0.000			0.000				
4			0.000			0.000				
5			0.000			0.000				
6			0.000			0.000				
7			0.000			0.000				
8			0.000			0.000				
9			0.000			0.000				
10			0.000			0.000				
11			0.000			0.000				
12			0.000			0.000				
13			0.000			0.000				
14			0.000			0.000				
15			0.000			0.000				
16			0.000			0.000				
17			0.000			0.000				
18			0.000			0.000				
19			0.000			0.000				
20			0.000			0.000				
21			0.000			0.000				
22			0.000			0.000				
23			0.000			0.000				
24			0.000			0.000				

Model Input : Continued

Section Characteristics :								*Dam Characteristics :*		
Section #	Length, miles	Upstream Elevation, feet	Downstream Elevation, feet	Average Elev., feet	Slope, ft/mile	Calculated Velocity or User Input Velocity?	User Input Velocity, feet/sec	Dam Height, feet	Water Quality Factor	Weir Coefficient
1	1.136	868.04	760	814.02	95.1056	Calculated				
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates :

	Reaction Rates at 20° C					Reaction Rates at Ambient Temperature				
Section #	Kd, 1/day	K_{NH3}, 1/day	K_{TOX}, 1/day	Computed Ka, 1/day	User Input Ka, 1/day	Ka, 1/day	Kd, 1/day	K_{NH3}, 1/day	K_{TOX}, 1/day	Average Temp., °C
1	0.3	0.5	0.05	17.1190		18.5566	0.3507	0.6186	0.0650	23.4000
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates : Continued (OPTIONAL)

		Reaction Rates at 20° C			Reaction Rates at Ambient Temperature		
Section #	Stream Depth, feet	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day
1	0.5	0.050			0.061		
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							

Model Output:

Minimum Dissolved Oxygen:	*6.0002 mg/l*
The Minimum DO occurs at:	*0.0000 miles*

Section Number	Increment Number	Distance, miles	Flow, cfs	Velocity, feet/sec	Total Travel Time, days	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1	1	0.0000	0.0334	0.1000	0.0000	6.3996	1.6995	1.6996	6.0002	23.4000
1	2	0.0568	0.0334	0.1000	0.0347	6.3222	1.6668	1.6961	6.7712	23.4000
1	3	0.1136	0.0334	0.1000	0.0694	6.2457	1.6340	1.6927	7.1771	23.4000
1	4	0.1704	0.0334	0.1000	0.1041	6.1701	1.6015	1.6893	7.3928	23.4000
1	5	0.2272	0.0334	0.1000	0.1388	6.0954	1.5696	1.6859	7.5094	23.4000
1	6	0.2840	0.0334	0.1000	0.1736	6.0217	1.5382	1.6824	7.5742	23.4000
1	7	0.3408	0.0334	0.1000	0.2083	5.9488	1.5075	1.6790	7.6119	23.4000
1	8	0.3976	0.0334	0.1000	0.2430	5.8769	1.4774	1.6756	7.6354	23.4000
1	9	0.4544	0.0334	0.1000	0.2777	5.8058	1.4480	1.6722	7.6513	23.4000
1	10	0.5112	0.0334	0.1000	0.3124	5.7355	1.4192	1.6688	7.6633	23.4000
1	11	0.5680	0.0334	0.1000	0.3471	5.6661	1.3911	1.6655	7.6732	23.4000
1	12	0.6248	0.0334	0.1000	0.3818	5.5975	1.3635	1.6621	7.6820	23.4000
1	13	0.6816	0.0334	0.1000	0.4165	5.5298	1.3366	1.6587	7.6900	23.4000
1	14	0.7384	0.0334	0.1000	0.4512	5.4629	1.3102	1.6553	7.6977	23.4000
1	15	0.7952	0.0334	0.1000	0.4860	5.3968	1.2844	1.6520	7.7051	23.4000
1	16	0.8520	0.0334	0.1000	0.5207	5.3315	1.2592	1.6486	7.7123	23.4000
1	17	0.9088	0.0334	0.1000	0.5554	5.2670	1.2345	1.6453	7.7194	23.4000
1	18	0.9656	0.0334	0.1000	0.5901	5.2033	1.2104	1.6420	7.7263	23.4000
1	19	1.0224	0.0334	0.1000	0.6248	5.1403	1.1867	1.6386	7.7332	23.4000
1	20	1.0792	0.0334	0.1000	0.6595	5.0781	1.1636	1.6353	7.7399	23.4000
1	21	1.1360	0.0334	0.1000	0.6942	5.0167	1.1410	1.6320	7.7466	23.4000

LOAD REDUCTION MODEL

Spreadsheet Water Quality Model

Stream Name :	Crooked Creek
River Basin :	Black Warroir
County :	Cullman County

Modeled Reach :	Upstream Longitude	Upstream Latitude	Section	Township	Range
	86° 59' 18"	34° 18' 25"	31	9 s	4 w
	Downstream Longitude	Downstream Latitude	Section	Township	Range
	87° 03' 44"	34° 06' 26"	9	11 s	5 w
	Total Stream Length, miles	29.17			

Analysis Date :	February 15, 2002
Number of Sections :	10

Analysis Performed By :	BCH

Applicable Season:	Annual	May - Nov. (Summer)	Dec. - Apr. (Winter)
	X		

Point Sources Included in the Model :	

Model Input :

Headwater Conditions :					
CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
2.0022	0.0364	0.1825	6.79	0.0001	23.4

Tributary Conditions :						
Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	0.0000	0.0000	0.0000			
2	0.0000	0.0000	0.0000			
3	0.0000	0.0000	0.0000			
4	1.9856	1.1075	1.4347	7.75	0.03	23.4
5	0.0000	0.0000	0.0000			
6	0.0000	0.0000	0.0000			
7	0.0000	0.0000	0.0000			
8	0.0000	0.0000	0.0000			
9	0.0000	0.0000	0.0000			
10	0.0000	0.0000	0.0000			
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Incremental Inflow Conditions :						
Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	2.0022	0.0364	0.1825	5.9400	0.08	23.4
2	2.0022	0.0364	0.1825	5.9400	0.03	23.4
3	2.0022	0.0364	0.1825	5.9400	0.03	23.4
4	2.0022	0.0364	0.1825	5.9400	0.06	23.4
5	2.0022	0.0758	0.1825	5.9400	0.05	23.4
6	2.0022	0.0758	0.1825	5.9400	0.09	23.4
7	2.0022	0.0758	0.1825	5.9400	0.08	23.4
8	2.0022	0.0758	0.1825	5.9400	0.07	23.4
9	2.0022	0.0758	0.1825	5.9400	0.02	23.4
10	2.0022	0.0758	0.1825	5.9400	0.03	23.4
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Effluent Conditions :

Section #	Discharger	Flow, MGD	Flow, cfs	$CBOD_5$, mg/l	$CBODu/CBOD_5$	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1			**0.000**			**0.000**				
2			**0.000**			**0.000**				
3			**0.000**			**0.000**				
4			**0.000**			**0.000**				
5			**0.000**			**0.000**				
6			**0.000**			**0.000**				
7			**0.000**			**0.000**				
8			**0.000**			**0.000**				
9			**0.000**			**0.000**				
10			**0.000**			**0.000**				
11			**0.000**			**0.000**				
12			**0.000**			**0.000**				
13			**0.000**			**0.000**				
14			**0.000**			**0.000**				
15			**0.000**			**0.000**				
16			**0.000**			**0.000**				
17			**0.000**			**0.000**				
18			**0.000**			**0.000**				
19			**0.000**			**0.000**				
20			**0.000**			**0.000**				
21			**0.000**			**0.000**				
22			**0.000**			**0.000**				
23			**0.000**			**0.000**				
24			**0.000**			**0.000**				

Model Input : Continued

Section Characteristics :								Dam Characteristics :		
Section #	Length, miles	Upstream Elevation, feet	Downstream Elevation, feet	Average Elev., feet	Slope, ft/mile	Calculated Velocity or User Input Velocity?	User Input Velocity, feet/sec	Dam Height, feet	Water Quality Factor	Weir Coefficient
1	4.13	1020	820	920	48.4262	Input	0.03			
2	1.45	820	779	799.5	28.2759	Input	0.03			
3	1.57	779	760	769.5	12.1019	Input	0.02			
4	3.3	760	720	740	12.1212	Input	0.00756			
5	2.72	720	686	703	12.5000	Input	0.02			
6	4.83	686	620	653	13.6646	Input	0.03			
7	4.35	620	580	600	9.1954	Input	0.03			
8	3.81	580	540	560	10.4987	Input	0.03			
9	1.17	540	525	532.5	12.8205	Input	0.02			
10	1.84	525	517	521	4.3478	Input	0.006			
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates :

	Reaction Rates at 20° C					Reaction Rates at Ambient Temperature				
Section #	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Computed Ka, 1/day	User Input Ka, 1/day	Ka, 1/day	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Average Temp., °C
1	0.05	0.5	0.02	2.6150		2.8346	0.0585	0.6338	0.0260	23.4000
2	0.05	0.5	0.02	1.5269		1.6551	0.0585	0.6503	0.0260	23.4000
3	0.05	0.3	0.02	0.4460		0.4835	0.0585	0.3879	0.0260	23.4000
4	0.05	0.3	0.02	0.1779		0.1928	0.0585	0.3784	0.0260	23.4000
5	0.05	0.3	0.02	0.4367		0.4733	0.0585	0.3527	0.0260	23.4000
6	0.05	0.3	0.02	0.7262		0.7872	0.0585	0.3756	0.0260	23.4000
7	0.05	0.3	0.02	0.4966		0.5383	0.0585	0.3837	0.0260	23.4000
8	0.05	0.3	0.02	0.5669		0.6145	0.0585	0.3783	0.0260	23.4000
9	0.05	0.3	0.02	0.4725		0.5122	0.0585	0.3872	0.0260	23.4000
10	0.05	0.3	0.02		0.4725	0.5122	0.0585	0.3861	0.0260	23.4000
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates : Continued (OPTIONAL)

		Reaction Rates at 20° C			Reaction Rates at Ambient Temperature		
Section #	Stream Depth, feet	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day
1	1.0	0.020			0.024		
2	1.0	0.020			0.024		
3	1.0	0.020			0.024		
4	1.5	0.020			0.024		
5	1.0	0.020			0.024		
6	1.0	0.020			0.024		
7	1.0	0.020			0.024		
8	2.0	0.020			0.024		
9	2.0	0.020			0.024		
10	2.0	0.020			0.024		
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							

Model Output:

Minimum Dissolved Oxygen:	***4.6580 mg/l***
The Minimum DO occurs at:	***8.6350 miles***

Section Number	Increment Number	Distance, miles	Flow, cfs	Velocity, feet/sec	Total Travel Time, days	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1	1	0.0000	0.0001	0.0300	0.0000	2.0022	0.0364	0.1825	6.7900	23.4000
1	2	0.2065	0.0039	0.0300	0.4206	1.9536	0.0298	0.1808	7.2482	23.4000
1	3	0.4130	0.0077	0.0300	0.8413	1.9296	0.0271	0.1799	7.4489	23.4000
1	4	0.6195	0.0116	0.0300	1.2619	1.9061	0.0249	0.1790	7.5585	23.4000
1	5	0.8260	0.0154	0.0300	1.6826	1.8831	0.0229	0.1781	7.6250	23.4000
1	6	1.0325	0.0192	0.0300	2.1032	1.8605	0.0213	0.1772	7.6691	23.4000
1	7	1.2390	0.0230	0.0300	2.5239	1.8383	0.0199	0.1764	7.7007	23.4000
1	8	1.4455	0.0269	0.0300	2.9445	1.8164	0.0187	0.1755	7.7247	23.4000
1	9	1.6520	0.0307	0.0300	3.3652	1.7949	0.0177	0.1747	7.7439	23.4000
1	10	1.8585	0.0345	0.0300	3.7858	1.7737	0.0168	0.1738	7.7597	23.4000
1	11	2.0650	0.0383	0.0300	4.2065	1.7528	0.0160	0.1730	7.7732	23.4000
1	12	2.2715	0.0422	0.0300	4.6271	1.7323	0.0153	0.1722	7.7849	23.4000
1	13	2.4780	0.0460	0.0300	5.0478	1.7122	0.0147	0.1713	7.7953	23.4000
1	14	2.6845	0.0498	0.0300	5.4684	1.6923	0.0141	0.1705	7.8047	23.4000
1	15	2.8910	0.0536	0.0300	5.8891	1.6728	0.0136	0.1697	7.8133	23.4000
1	16	3.0975	0.0574	0.0300	6.3097	1.6535	0.0132	0.1689	7.8212	23.4000
1	17	3.3040	0.0613	0.0300	6.7304	1.6346	0.0128	0.1681	7.8286	23.4000
1	18	3.5105	0.0651	0.0300	7.1510	1.6160	0.0125	0.1673	7.8356	23.4000
1	19	3.7170	0.0689	0.0300	7.5717	1.5976	0.0121	0.1665	7.8422	23.4000
1	20	3.9235	0.0727	0.0300	7.9923	1.5796	0.0118	0.1657	7.8485	23.4000
1	21	4.1300	0.0766	0.0300	8.4130	1.5618	0.0116	0.1649	7.8545	23.4000
2	1	4.1300	0.0766	0.0300	8.4130	1.5618	0.0116	0.1649	7.8545	23.4000
2	2	4.2025	0.0779	0.0300	8.5606	1.5559	0.0115	0.1646	7.7845	23.4000
2	3	4.2750	0.0792	0.0300	8.7083	1.5500	0.0114	0.1644	7.7313	23.4000
2	4	4.3475	0.0806	0.0300	8.8560	1.5442	0.0113	0.1641	7.6910	23.4000
2	5	4.4200	0.0819	0.0300	9.0037	1.5383	0.0112	0.1638	7.6605	23.4000
2	6	4.4925	0.0833	0.0300	9.1514	1.5325	0.0111	0.1636	7.6377	23.4000
2	7	4.5650	0.0846	0.0300	9.2991	1.5267	0.0110	0.1633	7.6206	23.4000
2	8	4.6375	0.0860	0.0300	9.4468	1.5210	0.0109	0.1630	7.6080	23.4000
2	9	4.7100	0.0873	0.0300	9.5944	1.5152	0.0109	0.1628	7.5988	23.4000
2	10	4.7825	0.0886	0.0300	9.7421	1.5095	0.0108	0.1625	7.5922	23.4000
2	11	4.8550	0.0900	0.0300	9.8898	1.5038	0.0107	0.1622	7.5877	23.4000
2	12	4.9275	0.0913	0.0300	10.0375	1.4982	0.0106	0.1620	7.5846	23.4000
2	13	5.0000	0.0927	0.0300	10.1852	1.4925	0.0106	0.1617	7.5828	23.4000
2	14	5.0725	0.0940	0.0300	10.3329	1.4869	0.0105	0.1615	7.5819	23.4000
2	15	5.1450	0.0953	0.0300	10.4806	1.4813	0.0104	0.1612	7.5816	23.4000
2	16	5.2175	0.0967	0.0300	10.6282	1.4758	0.0104	0.1609	7.5819	23.4000
2	17	5.2900	0.0980	0.0300	10.7759	1.4702	0.0103	0.1607	7.5825	23.4000
2	18	5.3625	0.0994	0.0300	10.9236	1.4647	0.0102	0.1604	7.5835	23.4000
2	19	5.4350	0.1007	0.0300	11.0713	1.4592	0.0102	0.1602	7.5847	23.4000
2	20	5.5075	0.1021	0.0300	11.2190	1.4538	0.0101	0.1599	7.5860	23.4000
2	21	5.5800	0.1034	0.0300	11.3667	1.4483	0.0101	0.1596	7.5875	23.4000

3	1	5.5800	0.1034	0.0300	11.3667	1.4483	0.0101	0.1596	7.5875	23.4000
3	2	5.6585	0.1049	0.0200	11.6065	1.4357	0.0104	0.1591	7.4207	23.4000
3	3	5.7370	0.1063	0.0200	11.8464	1.4234	0.0107	0.1585	7.2742	23.4000
3	4	5.8155	0.1078	0.0200	12.0863	1.4113	0.0110	0.1579	7.1455	23.4000
3	5	5.8940	0.1092	0.0200	12.3261	1.3994	0.0112	0.1574	7.0325	23.4000
3	6	5.9725	0.1107	0.0200	12.5660	1.3877	0.0114	0.1568	6.9331	23.4000
3	7	6.0510	0.1121	0.0200	12.8058	1.3762	0.0116	0.1563	6.8459	23.4000
3	8	6.1295	0.1136	0.0200	13.0457	1.3650	0.0117	0.1557	6.7692	23.4000
3	9	6.2080	0.1150	0.0200	13.2856	1.3539	0.0119	0.1552	6.7019	23.4000
3	10	6.2865	0.1165	0.0200	13.5254	1.3430	0.0120	0.1547	6.6428	23.4000
3	11	6.3650	0.1179	0.0200	13.7653	1.3323	0.0121	0.1542	6.5909	23.4000
3	12	6.4435	0.1194	0.0200	14.0051	1.3218	0.0122	0.1536	6.5454	23.4000
3	13	6.5220	0.1208	0.0200	14.2450	1.3115	0.0122	0.1531	6.5055	23.4000
3	14	6.6005	0.1223	0.0200	14.4849	1.3013	0.0123	0.1526	6.4705	23.4000
3	15	6.6790	0.1237	0.0200	14.7247	1.2913	0.0124	0.1521	6.4398	23.4000
3	16	6.7575	0.1252	0.0200	14.9646	1.2815	0.0124	0.1516	6.4129	23.4000
3	17	6.8360	0.1266	0.0200	15.2044	1.2718	0.0124	0.1511	6.3894	23.4000
3	18	6.9145	0.1281	0.0200	15.4443	1.2623	0.0124	0.1506	6.3689	23.4000
3	19	6.9930	0.1296	0.0200	15.6842	1.2529	0.0125	0.1501	6.3510	23.4000
3	20	7.0715	0.1310	0.0200	15.9240	1.2436	0.0125	0.1497	6.3354	23.4000
3	21	7.1500	0.1325	0.0200	16.1639	1.2345	0.0125	0.1492	6.3218	23.4000
4	1	7.1500	0.1659	0.0200	16.1639	1.3858	0.2330	0.4080	6.6087	23.4000
4	2	7.3150	0.1689	0.0076	17.4977	1.2922	0.1509	0.3916	5.8049	23.4000
4	3	7.4800	0.1720	0.0076	18.8314	1.2069	0.1030	0.3759	5.3249	23.4000
4	4	7.6450	0.1750	0.0076	20.1652	1.1292	0.0743	0.3611	5.0362	23.4000
4	5	7.8100	0.1781	0.0076	21.4990	1.0584	0.0567	0.3471	4.8632	23.4000
4	6	7.9750	0.1811	0.0076	22.8328	0.9937	0.0457	0.3337	4.7612	23.4000
4	7	8.1400	0.1842	0.0076	24.1665	0.9347	0.0386	0.3211	4.7032	23.4000
4	8	8.3050	0.1872	0.0076	25.5003	0.8807	0.0339	0.3090	4.6729	23.4000
4	9	8.4700	0.1903	0.0076	26.8341	0.8313	0.0307	0.2975	4.6600	23.4000
4	10	8.6350	0.1934	0.0076	28.1679	0.7861	0.0284	0.2867	4.6580	23.4000
4	11	8.8000	0.1964	0.0076	29.5016	0.7446	0.0266	0.2763	4.6629	23.4000
4	12	8.9650	0.1995	0.0076	30.8354	0.7066	0.0252	0.2664	4.6719	23.4000
4	13	9.1300	0.2025	0.0076	32.1692	0.6717	0.0240	0.2570	4.6835	23.4000
4	14	9.2950	0.2056	0.0076	33.5030	0.6396	0.0230	0.2480	4.6964	23.4000
4	15	9.4600	0.2086	0.0076	34.8367	0.6101	0.0221	0.2395	4.7100	23.4000
4	16	9.6250	0.2117	0.0076	36.1705	0.5829	0.0213	0.2313	4.7238	23.4000
4	17	9.7900	0.2147	0.0076	37.5043	0.5578	0.0205	0.2236	4.7375	23.4000
4	18	9.9550	0.2178	0.0076	38.8381	0.5347	0.0198	0.2161	4.7508	23.4000
4	19	10.1200	0.2208	0.0076	40.1718	0.5134	0.0192	0.2091	4.7637	23.4000
4	20	10.2850	0.2239	0.0076	41.5056	0.4937	0.0185	0.2023	4.7762	23.4000
4	21	10.4500	0.2270	0.0076	42.8394	0.4755	0.0179	0.1958	4.7880	23.4000

5	1	10.4500	0.2270	0.0076	42.8394	0.4755	0.0179	0.1958	4.7880	23.4000
5	2	10.5860	0.2295	0.0200	43.2549	0.4804	0.0179	0.1938	5.0941	23.4000
5	3	10.7220	0.2320	0.0200	43.6705	0.4850	0.0179	0.1918	5.3411	23.4000
5	4	10.8580	0.2345	0.0200	44.0860	0.4892	0.0177	0.1898	5.5404	23.4000
5	5	10.9940	0.2370	0.0200	44.5016	0.4932	0.0176	0.1879	5.7014	23.4000
5	6	11.1300	0.2395	0.0200	44.9172	0.4968	0.0175	0.1861	5.8314	23.4000
5	7	11.2660	0.2421	0.0200	45.3327	0.5002	0.0173	0.1842	5.9366	23.4000
5	8	11.4020	0.2446	0.0200	45.7483	0.5033	0.0171	0.1824	6.0216	23.4000
5	9	11.5380	0.2471	0.0200	46.1638	0.5061	0.0170	0.1807	6.0905	23.4000
5	10	11.6740	0.2496	0.0200	46.5794	0.5087	0.0168	0.1789	6.1463	23.4000
5	11	11.8100	0.2521	0.0200	46.9949	0.5110	0.0166	0.1772	6.1915	23.4000
5	12	11.9460	0.2546	0.0200	47.4105	0.5132	0.0164	0.1756	6.2282	23.4000
5	13	12.0820	0.2572	0.0200	47.8260	0.5151	0.0163	0.1739	6.2581	23.4000
5	14	12.2180	0.2597	0.0200	48.2416	0.5168	0.0161	0.1723	6.2824	23.4000
5	15	12.3540	0.2622	0.0200	48.6572	0.5183	0.0159	0.1708	6.3023	23.4000
5	16	12.4900	0.2647	0.0200	49.0727	0.5196	0.0158	0.1692	6.3185	23.4000
5	17	12.6260	0.2672	0.0200	49.4883	0.5208	0.0156	0.1677	6.3319	23.4000
5	18	12.7620	0.2698	0.0200	49.9038	0.5218	0.0155	0.1662	6.3429	23.4000
5	19	12.8980	0.2723	0.0200	50.3194	0.5226	0.0153	0.1648	6.3519	23.4000
5	20	13.0340	0.2748	0.0200	50.7349	0.5233	0.0152	0.1633	6.3595	23.4000
5	21	13.1700	0.2773	0.0200	51.1505	0.5239	0.0150	0.1619	6.3658	23.4000
6	1	13.1700	0.2773	0.0200	51.1505	0.5239	0.0150	0.1619	6.3658	23.4000
6	2	13.4115	0.2818	0.0300	51.6424	0.5318	0.0152	0.1604	6.6146	23.4000
6	3	13.6530	0.2862	0.0300	52.1344	0.5391	0.0152	0.1589	6.7800	23.4000
6	4	13.8945	0.2907	0.0300	52.6263	0.5456	0.0152	0.1575	6.8901	23.4000
6	5	14.1360	0.2952	0.0300	53.1183	0.5516	0.0152	0.1560	6.9635	23.4000
6	6	14.3775	0.2997	0.0300	53.6102	0.5570	0.0151	0.1546	7.0127	23.4000
6	7	14.6190	0.3041	0.0300	54.1022	0.5619	0.0150	0.1533	7.0458	23.4000
6	8	14.8605	0.3086	0.0300	54.5941	0.5662	0.0149	0.1519	7.0683	23.4000
6	9	15.1020	0.3131	0.0300	55.0860	0.5701	0.0148	0.1506	7.0837	23.4000
6	10	15.3435	0.3175	0.0300	55.5780	0.5735	0.0147	0.1494	7.0944	23.4000
6	11	15.5850	0.3220	0.0300	56.0699	0.5765	0.0146	0.1481	7.1020	23.4000
6	12	15.8265	0.3265	0.0300	56.5619	0.5792	0.0145	0.1469	7.1076	23.4000
6	13	16.0680	0.3310	0.0300	57.0538	0.5814	0.0144	0.1457	7.1118	23.4000
6	14	16.3095	0.3354	0.0300	57.5458	0.5833	0.0143	0.1445	7.1152	23.4000
6	15	16.5510	0.3399	0.0300	58.0377	0.5849	0.0141	0.1433	7.1179	23.4000
6	16	16.7925	0.3444	0.0300	58.5297	0.5862	0.0140	0.1422	7.1203	23.4000
6	17	17.0340	0.3488	0.0300	59.0216	0.5873	0.0139	0.1411	7.1224	23.4000
6	18	17.2755	0.3533	0.0300	59.5135	0.5880	0.0138	0.1400	7.1243	23.4000
6	19	17.5170	0.3578	0.0300	60.0055	0.5885	0.0137	0.1389	7.1262	23.4000
6	20	17.7585	0.3622	0.0300	60.4974	0.5888	0.0135	0.1379	7.1279	23.4000
6	21	18.0000	0.3667	0.0300	60.9894	0.5888	0.0134	0.1368	7.1296	23.4000

7	1	18.0000	0.3667	0.0300	60.9894	0.5888	0.0134	0.1368	7.1296	23.4000
7	2	18.2175	0.3707	0.0300	61.4324	0.5887	0.0133	0.1359	7.0084	23.4000
7	3	18.4350	0.3748	0.0300	61.8755	0.5885	0.0132	0.1350	6.9143	23.4000
7	4	18.6525	0.3788	0.0300	62.3185	0.5881	0.0131	0.1341	6.8413	23.4000
7	5	18.8700	0.3828	0.0300	62.7616	0.5875	0.0130	0.1332	6.7847	23.4000
7	6	19.0875	0.3869	0.0300	63.2047	0.5869	0.0129	0.1324	6.7408	23.4000
7	7	19.3050	0.3909	0.0300	63.6477	0.5861	0.0128	0.1315	6.7069	23.4000
7	8	19.5225	0.3949	0.0300	64.0908	0.5852	0.0128	0.1307	6.6808	23.4000
7	9	19.7400	0.3989	0.0300	64.5338	0.5841	0.0127	0.1298	6.6607	23.4000
7	10	19.9575	0.4030	0.0300	64.9769	0.5830	0.0126	0.1290	6.6453	23.4000
7	11	20.1750	0.4070	0.0300	65.4199	0.5818	0.0125	0.1282	6.6336	23.4000
7	12	20.3925	0.4110	0.0300	65.8630	0.5805	0.0124	0.1274	6.6247	23.4000
7	13	20.6100	0.4150	0.0300	66.3060	0.5791	0.0124	0.1266	6.6180	23.4000
7	14	20.8275	0.4191	0.0300	66.7491	0.5776	0.0123	0.1259	6.6131	23.4000
7	15	21.0450	0.4231	0.0300	67.1922	0.5760	0.0122	0.1251	6.6095	23.4000
7	16	21.2625	0.4271	0.0300	67.6352	0.5744	0.0121	0.1244	6.6070	23.4000
7	17	21.4800	0.4311	0.0300	68.0783	0.5727	0.0120	0.1236	6.6054	23.4000
7	18	21.6975	0.4352	0.0300	68.5213	0.5710	0.0120	0.1229	6.6043	23.4000
7	19	21.9150	0.4392	0.0300	68.9644	0.5692	0.0119	0.1222	6.6038	23.4000
7	20	22.1325	0.4432	0.0300	69.4074	0.5673	0.0118	0.1214	6.6036	23.4000
7	21	22.3500	0.4472	0.0300	69.8505	0.5654	0.0117	0.1207	6.6038	23.4000
8	1	22.3500	0.4472	0.0300	69.8505	0.5654	0.0117	0.1207	6.6038	23.4000
8	2	22.5405	0.4508	0.0300	70.2385	0.5637	0.0117	0.1201	6.7980	23.4000
8	3	22.7310	0.4543	0.0300	70.6266	0.5620	0.0116	0.1195	6.9501	23.4000
8	4	22.9215	0.4578	0.0300	71.0147	0.5602	0.0115	0.1189	7.0692	23.4000
8	5	23.1120	0.4614	0.0300	71.4027	0.5584	0.0114	0.1183	7.1625	23.4000
8	6	23.3025	0.4649	0.0300	71.7908	0.5566	0.0113	0.1177	7.2358	23.4000
8	7	23.4930	0.4684	0.0300	72.1788	0.5548	0.0112	0.1172	7.2933	23.4000
8	8	23.6835	0.4719	0.0300	72.5669	0.5529	0.0112	0.1166	7.3386	23.4000
8	9	23.8740	0.4755	0.0300	72.9549	0.5510	0.0111	0.1160	7.3743	23.4000
8	10	24.0645	0.4790	0.0300	73.3430	0.5491	0.0110	0.1155	7.4024	23.4000
8	11	24.2550	0.4825	0.0300	73.7310	0.5472	0.0109	0.1149	7.4248	23.4000
8	12	24.4455	0.4860	0.0300	74.1191	0.5452	0.0108	0.1143	7.4425	23.4000
8	13	24.6360	0.4896	0.0300	74.5072	0.5432	0.0108	0.1138	7.4566	23.4000
8	14	24.8265	0.4931	0.0300	74.8952	0.5413	0.0107	0.1133	7.4680	23.4000
8	15	25.0170	0.4966	0.0300	75.2833	0.5393	0.0106	0.1127	7.4771	23.4000
8	16	25.2075	0.5001	0.0300	75.6713	0.5373	0.0106	0.1122	7.4846	23.4000
8	17	25.3980	0.5037	0.0300	76.0594	0.5352	0.0105	0.1117	7.4906	23.4000
8	18	25.5885	0.5072	0.0300	76.4474	0.5332	0.0104	0.1111	7.4957	23.4000
8	19	25.7790	0.5107	0.0300	76.8355	0.5312	0.0104	0.1106	7.4999	23.4000
8	20	25.9695	0.5143	0.0300	77.2235	0.5291	0.0103	0.1101	7.5035	23.4000
8	21	26.1600	0.5178	0.0300	77.6116	0.5270	0.0103	0.1096	7.5065	23.4000

9	1	26.1600	0.5178	0.0300	77.6116	0.5270	0.0103	0.1096	7.5065	23.4000
9	2	26.2185	0.5189	0.0200	77.7903	0.5246	0.0102	0.1093	7.4927	23.4000
9	3	26.2770	0.5199	0.0200	77.9691	0.5222	0.0101	0.1090	7.4801	23.4000
9	4	26.3355	0.5210	0.0200	78.1478	0.5198	0.0100	0.1087	7.4687	23.4000
9	5	26.3940	0.5221	0.0200	78.3266	0.5175	0.0099	0.1084	7.4583	23.4000
9	6	26.4525	0.5232	0.0200	78.5053	0.5151	0.0098	0.1081	7.4490	23.4000
9	7	26.5110	0.5243	0.0200	78.6841	0.5128	0.0097	0.1078	7.4405	23.4000
9	8	26.5695	0.5254	0.0200	78.8628	0.5105	0.0097	0.1075	7.4329	23.4000
9	9	26.6280	0.5264	0.0200	79.0416	0.5083	0.0096	0.1072	7.4260	23.4000
9	10	26.6865	0.5275	0.0200	79.2203	0.5060	0.0095	0.1069	7.4198	23.4000
9	11	26.7450	0.5286	0.0200	79.3991	0.5038	0.0095	0.1066	7.4141	23.4000
9	12	26.8035	0.5297	0.0200	79.5778	0.5016	0.0094	0.1063	7.4091	23.4000
9	13	26.8620	0.5308	0.0200	79.7566	0.4994	0.0094	0.1061	7.4045	23.4000
9	14	26.9205	0.5319	0.0200	79.9353	0.4972	0.0093	0.1058	7.4004	23.4000
9	15	26.9790	0.5329	0.0200	80.1141	0.4951	0.0092	0.1055	7.3968	23.4000
9	16	27.0375	0.5340	0.0200	80.2928	0.4930	0.0092	0.1052	7.3935	23.4000
9	17	27.0960	0.5351	0.0200	80.4716	0.4909	0.0091	0.1049	7.3906	23.4000
9	18	27.1545	0.5362	0.0200	80.6503	0.4888	0.0091	0.1046	7.3879	23.4000
9	19	27.2130	0.5373	0.0200	80.8291	0.4867	0.0091	0.1044	7.3856	23.4000
9	20	27.2715	0.5384	0.0200	81.0078	0.4847	0.0090	0.1041	7.3835	23.4000
9	21	27.3300	0.5394	0.0200	81.1866	0.4827	0.0090	0.1038	7.3817	23.4000
10	1	27.3300	0.5394	0.0200	81.1866	0.4827	0.0090	0.1038	7.3817	23.4000
10	2	27.4220	0.5411	0.0060	82.1236	0.4615	0.0086	0.1018	7.3939	23.4000
10	3	27.5140	0.5428	0.0060	83.0607	0.4414	0.0084	0.0998	7.4027	23.4000
10	4	27.6060	0.5445	0.0060	83.9977	0.4225	0.0082	0.0979	7.4094	23.4000
10	5	27.6980	0.5463	0.0060	84.9347	0.4047	0.0080	0.0961	7.4146	23.4000
10	6	27.7900	0.5480	0.0060	85.8718	0.3878	0.0078	0.0942	7.4188	23.4000
10	7	27.8820	0.5497	0.0060	86.8088	0.3719	0.0076	0.0925	7.4224	23.4000
10	8	27.9740	0.5514	0.0060	87.7459	0.3568	0.0075	0.0907	7.4255	23.4000
10	9	28.0660	0.5531	0.0060	88.6829	0.3426	0.0073	0.0890	7.4283	23.4000
10	10	28.1580	0.5548	0.0060	89.6199	0.3292	0.0072	0.0874	7.4308	23.4000
10	11	28.2500	0.5565	0.0060	90.5570	0.3165	0.0070	0.0858	7.4332	23.4000
10	12	28.3420	0.5582	0.0060	91.4940	0.3045	0.0069	0.0842	7.4353	23.4000
10	13	28.4340	0.5599	0.0060	92.4310	0.2931	0.0068	0.0827	7.4374	23.4000
10	14	28.5260	0.5616	0.0060	93.3681	0.2824	0.0067	0.0812	7.4393	23.4000
10	15	28.6180	0.5633	0.0060	94.3051	0.2723	0.0066	0.0797	7.4411	23.4000
10	16	28.7100	0.5650	0.0060	95.2422	0.2627	0.0064	0.0783	7.4429	23.4000
10	17	28.8020	0.5667	0.0060	96.1792	0.2537	0.0063	0.0769	7.4445	23.4000
10	18	28.8940	0.5684	0.0060	97.1162	0.2451	0.0062	0.0756	7.4461	23.4000
10	19	28.9860	0.5701	0.0060	98.0533	0.2370	0.0061	0.0742	7.4476	23.4000
10	20	29.0780	0.5718	0.0060	98.9903	0.2294	0.0060	0.0729	7.4491	23.4000
10	21	29.1700	0.5735	0.0060	99.9273	0.2221	0.0059	0.0717	7.4504	23.4000

Land Uses and Pollutant Concentrations for the Modeled Segment

Headwaters:

		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		

Tributaries:

Section #		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
1	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
2	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
3	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
4	%	100									100
	$CBOD_u$, mg/l	1.98560986									
	NH_3-N, mg/l	1.1074546									
	TON, mg/l	1.4346912									
5	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
6	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

7	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
8	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
9	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
10	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
11	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
12	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
13	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
14	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
15	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
16	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
17	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

18	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
19	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
20	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
21	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
22	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
23	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
24	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

Incremental Inflow:

Section #		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
1	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
2	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
3	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
4	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
5	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
6	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
7	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
8	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
9	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		

10	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	CBOD$_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH$_3$-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
11	%	100									100
	CBOD$_u$, mg/l										
	NH$_3$-N, mg/l										
	TON, mg/l										
12	%	100									100
	CBOD$_u$, mg/l										
	NH$_3$-N, mg/l										
	TON, mg/l										
13	%	100									100
	CBOD$_u$, mg/l										
	NH$_3$-N, mg/l										
	TON, mg/l										
14	%	100									100
	CBOD$_u$, mg/l										
	NH$_3$-N, mg/l										
	TON, mg/l										
15	%	100									100
	CBOD$_u$, mg/l										
	NH$_3$-N, mg/l										
	TON, mg/l										
16	%	100									100
	CBOD$_u$, mg/l										
	NH$_3$-N, mg/l										
	TON, mg/l										
17	%	100									100
	CBOD$_u$, mg/l										
	NH$_3$-N, mg/l										
	TON, mg/l										
18	%	100									100
	CBOD$_u$, mg/l										
	NH$_3$-N, mg/l										
	TON, mg/l										
19	%	100									100
	CBOD$_u$, mg/l										
	NH$_3$-N, mg/l										
	TON, mg/l										
20	%	100									100
	CBOD$_u$, mg/l										
	NH$_3$-N, mg/l										
	TON, mg/l										

21	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
22	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
23	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
24	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

Loading Summary

WLA				
Discharger	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd
Totals:	**0.0**	**0.0**	**0.0**	**0.0**

LA												
	Tributaries				***Incremental Inflow***				***Headwaters***			
Section #	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd
1	0.0	0.0	0.0	0.0	0.8	0.0	0.1	0.4	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1				
3	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.2				
4	0.4	0.2	0.3	2.1	0.7	0.0	0.1	0.3				
5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.3				
6	0.0	0.0	0.0	0.0	1.0	0.0	0.1	0.6				
7	0.0	0.0	0.0	0.0	0.9	0.0	0.1	0.5				
8	0.0	0.0	0.0	0.0	0.8	0.0	0.1	0.4				
9	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1				
10	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2				
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Totals:	**0.4**	**0.2**	**0.3**	**2.1**	**5.8**	**0.2**	**0.5**	**3.2**	**0.0**	**0.0**	**0.0**	**0.0**

Total Loading		
	WLA	LA
CBOD, ppd	**0.0**	**6.2**
NH_3-N, ppd	**0.0**	**0.4**
TON, ppd	**0.0**	**0.8**
NBOD, ppd	**0.0**	**5.3**

Appendix 9.4

Water Quality Model Sensitivity Analysis

Spreadsheet Water Quality Model

Stream Name :	*Crooked Creek*
River Basin :	*Black Warroir*
County :	*Cullman County*

Modeled Reach :					
	Upstream Longitude	Upstream Latitude	Section	Township	Range
	86° 59' 18"	34° 18' 25"	31	9 s	4 w
	Downstream Longitude	Downstream Latitude	Section	Township	Range
	87° 03' 44"	34° 06' 26"	9	11 s	5 w
	Total Stream Length, miles	29.17			

Analysis Date :	February 27, 2002
Number of Sections :	10

Applicable Season:	Annual	May - Nov. (Summer)	Dec. - Apr. (Winter)
		X	

Analysis Performed By :	BCH

Point Sources Included in the Model :	

Model Input :

Headwater Conditions :					
CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
2.0022	**0.0364**	**0.1825**	**6.65**	**0.0001**	**28**

Tributary Conditions :						
Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	**0.0000**	**0.0000**	**0.0000**			
2	**0.0000**	**0.0000**	**0.0000**			
3	**0.0000**	**0.0000**	**0.0000**			
4	**0.0000**	**0.0000**	**0.0000**	**6.22**	**0.00**	**28.0**
5	**0.0000**	**0.0000**	**0.0000**			
6	**0.0000**	**0.0000**	**0.0000**			
7	**0.0000**	**0.0000**	**0.0000**			
8	**0.0000**	**0.0000**	**0.0000**			
9	**0.0000**	**0.0000**	**0.0000**			
10	**0.0000**	**0.0000**	**0.0000**			
11	**0.0000**	**0.0000**	**0.0000**			
12	**0.0000**	**0.0000**	**0.0000**			
13	**0.0000**	**0.0000**	**0.0000**			
14	**0.0000**	**0.0000**	**0.0000**			
15	**0.0000**	**0.0000**	**0.0000**			
16	**0.0000**	**0.0000**	**0.0000**			
17	**0.0000**	**0.0000**	**0.0000**			
18	**0.0000**	**0.0000**	**0.0000**			
19	**0.0000**	**0.0000**	**0.0000**			
20	**0.0000**	**0.0000**	**0.0000**			
21	**0.0000**	**0.0000**	**0.0000**			
22	**0.0000**	**0.0000**	**0.0000**			
23	**0.0000**	**0.0000**	**0.0000**			
24	**0.0000**	**0.0000**	**0.0000**			

Model Input : Continued

Incremental Inflow Conditions :

Section #	CBODu, mg/l	NH3-N, mg/l	TON, mg/l	D.O., mg/l	Flow, cfs	Temp., °C
1	2.0022	0.0364	0.1825	5.4800	0.08	28.0
2	2.0022	0.0364	0.1825	5.4800	0.03	28.0
3	2.0022	0.0364	0.1825	5.4800	0.03	28.0
4	2.0022	0.0364	0.1825	5.4800	0.06	28.0
5	2.0022	0.0758	0.1825	5.4800	0.05	28.0
6	2.0022	0.0758	0.1825	5.4800	0.09	28.0
7	2.0022	0.0758	0.1825	5.4800	0.08	28.0
8	2.0022	0.0758	0.1825	5.4800	0.07	28.0
9	2.0022	0.0758	0.1825	5.4800	0.02	28.0
10	2.0022	0.0758	0.1825	5.4800	0.03	28.0
11	0.0000	0.0000	0.0000			
12	0.0000	0.0000	0.0000			
13	0.0000	0.0000	0.0000			
14	0.0000	0.0000	0.0000			
15	0.0000	0.0000	0.0000			
16	0.0000	0.0000	0.0000			
17	0.0000	0.0000	0.0000			
18	0.0000	0.0000	0.0000			
19	0.0000	0.0000	0.0000			
20	0.0000	0.0000	0.0000			
21	0.0000	0.0000	0.0000			
22	0.0000	0.0000	0.0000			
23	0.0000	0.0000	0.0000			
24	0.0000	0.0000	0.0000			

Model Input : Continued

Effluent Conditions :

Section #	Discharger	Flow, MGD	Flow, cfs	$CBOD_5$, mg/l	$CBODu/CBOD_5$	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1			0.000			0.000				
2			0.000			0.000				
3			0.000			0.000				
4			0.000			0.000				
5			0.000			0.000				
6			0.000			0.000				
7			0.000			0.000				
8			0.000			0.000				
9			0.000			0.000				
10			0.000			0.000				
11			0.000			0.000				
12			0.000			0.000				
13			0.000			0.000				
14			0.000			0.000				
15			0.000			0.000				
16			0.000			0.000				
17			0.000			0.000				
18			0.000			0.000				
19			0.000			0.000				
20			0.000			0.000				
21			0.000			0.000				
22			0.000			0.000				
23			0.000			0.000				
24			0.000			0.000				

Model Input : Continued

Section Characteristics :								*Dam Characteristics :*		
Section #	Length, miles	Upstream Elevation, feet	Downstream Elevation, feet	Average Elev., feet	Slope, ft/mile	Calculated Velocity or User Input Velocity?	User Input Velocity, feet/sec	Dam Height, feet	Water Quality Factor	Weir Coefficient
1	4.13	1020	820	920	48.4262	Input	0.03			
2	1.45	820	779	799.5	28.2759	Input	0.03			
3	1.57	779	760	769.5	12.1019	Input	0.02			
4	3.3	760	720	740	12.1212	Input	0.00756			
5	2.72	720	686	703	12.5000	Input	0.02			
6	4.83	686	620	653	13.6646	Input	0.03			
7	4.35	620	580	600	9.1954	Input	0.03			
8	3.81	580	540	560	10.4987	Input	0.03			
9	1.17	540	525	532.5	12.8205	Input	0.02			
10	1.84	525	517	521	4.3478	Input	0.006			
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates :

	Reaction Rates at 20° C					Reaction Rates at Ambient Temperature				
Section #	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Computed Ka, 1/day	User Input Ka, 1/day	Ka, 1/day	Kd, 1/day	K_{NH3}, 1/day	K_{TON}, 1/day	Average Temp., °C
1	0.05	0.5	0.02	2.6150		3.1614	0.0722	0.8995	0.0370	28.0000
2	0.05	0.5	0.02	1.5269		1.8459	0.0722	0.9116	0.0370	28.0000
3	0.05	0.3	0.02	0.4460		0.5392	0.0722	0.5427	0.0370	28.0000
4	0.05	0.3	0.02	0.1779		0.2150	0.0722	0.5163	0.0370	28.0000
5	0.05	0.3	0.02	0.4367		0.5279	0.0722	0.4693	0.0370	28.0000
6	0.05	0.3	0.02	0.7262		0.8779	0.0722	0.5178	0.0370	28.0000
7	0.05	0.3	0.02	0.4966		0.6003	0.0722	0.5339	0.0370	28.0000
8	0.05	0.3	0.02	0.5669		0.6854	0.0722	0.5227	0.0370	28.0000
9	0.05	0.3	0.02	0.4725		0.5713	0.0722	0.5409	0.0370	28.0000
10	0.05	0.3	0.02		0.4725	0.5712	0.0722	0.5385	0.0370	28.0000
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

Model Input : Continued

Reaction Rates : Continued (OPTIONAL)

		Reaction Rates at 20° C			Reaction Rates at Ambient Temperature		
Section #	Stream Depth, feet	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day	SOD, gm-O_2/ft^2/day	$CBOD_{settling}$, 1/day	$TON_{settling}$, 1/day
1	1.0	0.020			0.032		
2	1.0	0.020			0.032		
3	1.0	0.020			0.032		
4	1.5	0.020			0.032		
5	1.0	0.020			0.032		
6	1.0	0.020			0.032		
7	1.0	0.020			0.032		
8	2.0	0.020			0.032		
9	2.0	0.020			0.032		
10	2.0	0.020			0.032		
11							
12							
13							
14							
15							
16							
17							
18							
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21							
22							
23							
24							

Model Output:

Minimum Dissolved Oxygen:	*3.6942 mg/l*
The Minimum DO occurs at:	*9.4600 miles*

Section Number	Increment Number	Distance, miles	Flow, cfs	Velocity, feet/sec	Total Travel Time, days	CBODu, mg/l	NH_3-N, mg/l	TON, mg/l	D.O., mg/l	Temp., °C
1	1	0.0000	0.0001	0.0300	0.0000	2.0022	0.0364	0.1825	6.6500	28.0000
1	2	0.2065	0.0039	0.0300	0.4206	1.9423	0.0275	0.1803	6.6681	28.0000
1	3	0.4130	0.0077	0.0300	0.8413	1.9129	0.0242	0.1792	6.8283	28.0000
1	4	0.6195	0.0116	0.0300	1.2619	1.8843	0.0215	0.1782	6.9130	28.0000
1	5	0.8260	0.0154	0.0300	1.6826	1.8563	0.0195	0.1771	6.9636	28.0000
1	6	1.0325	0.0192	0.0300	2.1032	1.8290	0.0178	0.1760	6.9973	28.0000
1	7	1.2390	0.0230	0.0300	2.5239	1.8021	0.0164	0.1750	7.0216	28.0000
1	8	1.4455	0.0269	0.0300	2.9445	1.7759	0.0153	0.1739	7.0403	28.0000
1	9	1.6520	0.0307	0.0300	3.3652	1.7501	0.0144	0.1729	7.0553	28.0000
1	10	1.8585	0.0345	0.0300	3.7858	1.7248	0.0136	0.1719	7.0679	28.0000
1	11	2.0650	0.0383	0.0300	4.2065	1.7001	0.0129	0.1708	7.0787	28.0000
1	12	2.2715	0.0422	0.0300	4.6271	1.6758	0.0124	0.1698	7.0882	28.0000
1	13	2.4780	0.0460	0.0300	5.0478	1.6520	0.0119	0.1688	7.0967	28.0000
1	14	2.6845	0.0498	0.0300	5.4684	1.6287	0.0114	0.1678	7.1045	28.0000
1	15	2.8910	0.0536	0.0300	5.8891	1.6058	0.0111	0.1668	7.1116	28.0000
1	16	3.0975	0.0574	0.0300	6.3097	1.5833	0.0107	0.1658	7.1183	28.0000
1	17	3.3040	0.0613	0.0300	6.7304	1.5613	0.0104	0.1649	7.1246	28.0000
1	18	3.5105	0.0651	0.0300	7.1510	1.5397	0.0102	0.1639	7.1305	28.0000
1	19	3.7170	0.0689	0.0300	7.5717	1.5186	0.0099	0.1630	7.1362	28.0000
1	20	3.9235	0.0727	0.0300	7.9923	1.4978	0.0097	0.1620	7.1416	28.0000
1	21	4.1300	0.0766	0.0300	8.4130	1.4774	0.0095	0.1611	7.1469	28.0000
2	1	4.1300	0.0766	0.0300	8.4130	1.4774	0.0095	0.1611	7.1469	28.0000
2	2	4.2025	0.0779	0.0300	8.5606	1.4707	0.0094	0.1607	7.0642	28.0000
2	3	4.2750	0.0792	0.0300	8.7083	1.4640	0.0093	0.1604	7.0029	28.0000
2	4	4.3475	0.0806	0.0300	8.8560	1.4574	0.0092	0.1601	6.9577	28.0000
2	5	4.4200	0.0819	0.0300	9.0037	1.4507	0.0091	0.1598	6.9244	28.0000
2	6	4.4925	0.0833	0.0300	9.1514	1.4441	0.0090	0.1595	6.8999	28.0000
2	7	4.5650	0.0846	0.0300	9.2991	1.4376	0.0090	0.1592	6.8822	28.0000
2	8	4.6375	0.0860	0.0300	9.4468	1.4311	0.0089	0.1589	6.8694	28.0000
2	9	4.7100	0.0873	0.0300	9.5944	1.4246	0.0088	0.1585	6.8603	28.0000
2	10	4.7825	0.0886	0.0300	9.7421	1.4181	0.0088	0.1582	6.8540	28.0000
2	11	4.8550	0.0900	0.0300	9.8898	1.4117	0.0087	0.1579	6.8497	28.0000
2	12	4.9275	0.0913	0.0300	10.0375	1.4053	0.0087	0.1576	6.8469	28.0000
2	13	5.0000	0.0927	0.0300	10.1852	1.3990	0.0086	0.1573	6.8454	28.0000
2	14	5.0725	0.0940	0.0300	10.3329	1.3926	0.0085	0.1570	6.8446	28.0000
2	15	5.1450	0.0953	0.0300	10.4806	1.3864	0.0085	0.1567	6.8445	28.0000
2	16	5.2175	0.0967	0.0300	10.6282	1.3801	0.0084	0.1564	6.8448	28.0000
2	17	5.2900	0.0980	0.0300	10.7759	1.3739	0.0084	0.1561	6.8455	28.0000
2	18	5.3625	0.0994	0.0300	10.9236	1.3677	0.0083	0.1557	6.8465	28.0000
2	19	5.4350	0.1007	0.0300	11.0713	1.3616	0.0083	0.1554	6.8476	28.0000
2	20	5.5075	0.1021	0.0300	11.2190	1.3555	0.0082	0.1551	6.8488	28.0000
2	21	5.5800	0.1034	0.0300	11.3667	1.3494	0.0082	0.1548	6.8502	28.0000

3	1	5.5800	0.1034	0.0300	11.3667	1.3494	0.0082	0.1548	6.8502	28.0000
3	2	5.6585	0.1049	0.0200	11.6065	1.3351	0.0086	0.1541	6.6416	28.0000
3	3	5.7370	0.1063	0.0200	11.8464	1.3212	0.0090	0.1535	6.4606	28.0000
3	4	5.8155	0.1078	0.0200	12.0863	1.3075	0.0093	0.1528	6.3035	28.0000
3	5	5.8940	0.1092	0.0200	12.3261	1.2941	0.0095	0.1521	6.1671	28.0000
3	6	5.9725	0.1107	0.0200	12.5660	1.2811	0.0097	0.1515	6.0488	28.0000
3	7	6.0510	0.1121	0.0200	12.8058	1.2683	0.0099	0.1508	5.9461	28.0000
3	8	6.1295	0.1136	0.0200	13.0457	1.2557	0.0101	0.1502	5.8570	28.0000
3	9	6.2080	0.1150	0.0200	13.2856	1.2434	0.0102	0.1496	5.7797	28.0000
3	10	6.2865	0.1165	0.0200	13.5254	1.2314	0.0103	0.1489	5.7127	28.0000
3	11	6.3650	0.1179	0.0200	13.7653	1.2196	0.0104	0.1483	5.6545	28.0000
3	12	6.4435	0.1194	0.0200	14.0051	1.2080	0.0105	0.1477	5.6041	28.0000
3	13	6.5220	0.1208	0.0200	14.2450	1.1966	0.0106	0.1471	5.5605	28.0000
3	14	6.6005	0.1223	0.0200	14.4849	1.1855	0.0106	0.1465	5.5227	28.0000
3	15	6.6790	0.1237	0.0200	14.7247	1.1746	0.0107	0.1459	5.4899	28.0000
3	16	6.7575	0.1252	0.0200	14.9646	1.1639	0.0107	0.1453	5.4616	28.0000
3	17	6.8360	0.1266	0.0200	15.2044	1.1533	0.0107	0.1448	5.4371	28.0000
3	18	6.9145	0.1281	0.0200	15.4443	1.1430	0.0107	0.1442	5.4160	28.0000
3	19	6.9930	0.1296	0.0200	15.6842	1.1328	0.0107	0.1436	5.3978	28.0000
3	20	7.0715	0.1310	0.0200	15.9240	1.1229	0.0107	0.1430	5.3821	28.0000
3	21	7.1500	0.1325	0.0200	16.1639	1.1131	0.0107	0.1425	5.3687	28.0000
4	1	7.1500	0.1325	0.0200	16.1639	1.1131	0.0107	0.1425	5.3687	28.0000
4	2	7.3150	0.1355	0.0076	17.4977	1.0291	0.0111	0.1380	4.9000	28.0000
4	3	7.4800	0.1386	0.0076	18.8314	0.9541	0.0112	0.1337	4.5550	28.0000
4	4	7.6450	0.1416	0.0076	20.1652	0.8870	0.0111	0.1297	4.3022	28.0000
4	5	7.8100	0.1447	0.0076	21.4990	0.8270	0.0110	0.1258	4.1180	28.0000
4	6	7.9750	0.1477	0.0076	22.8328	0.7731	0.0108	0.1222	3.9846	28.0000
4	7	8.1400	0.1508	0.0076	24.1665	0.7247	0.0107	0.1188	3.8889	28.0000
4	8	8.3050	0.1538	0.0076	25.5003	0.6812	0.0104	0.1155	3.8210	28.0000
4	9	8.4700	0.1569	0.0076	26.8341	0.6421	0.0102	0.1124	3.7735	28.0000
4	10	8.6350	0.1600	0.0076	28.1679	0.6067	0.0100	0.1094	3.7411	28.0000
4	11	8.8000	0.1630	0.0076	29.5016	0.5747	0.0098	0.1066	3.7196	28.0000
4	12	8.9650	0.1661	0.0076	30.8354	0.5458	0.0096	0.1039	3.7062	28.0000
4	13	9.1300	0.1691	0.0076	32.1692	0.5196	0.0094	0.1014	3.6985	28.0000
4	14	9.2950	0.1722	0.0076	33.5030	0.4958	0.0091	0.0989	3.6949	28.0000
4	15	9.4600	0.1752	0.0076	34.8367	0.4741	0.0089	0.0966	3.6942	28.0000
4	16	9.6250	0.1783	0.0076	36.1705	0.4544	0.0087	0.0944	3.6956	28.0000
4	17	9.7900	0.1813	0.0076	37.5043	0.4363	0.0085	0.0922	3.6983	28.0000
4	18	9.9550	0.1844	0.0076	38.8381	0.4198	0.0084	0.0902	3.7020	28.0000
4	19	10.1200	0.1874	0.0076	40.1718	0.4047	0.0082	0.0882	3.7062	28.0000
4	20	10.2850	0.1905	0.0076	41.5056	0.3908	0.0080	0.0863	3.7107	28.0000
4	21	10.4500	0.1936	0.0076	42.8394	0.3780	0.0078	0.0845	3.7153	28.0000

5	1	10.4500	0.1936	0.0076	42.8394	0.3780	0.0078	0.0845	3.7153	28.0000
5	2	10.5860	0.1961	0.0200	43.2549	0.3871	0.0082	0.0848	4.0864	28.0000
5	3	10.7220	0.1986	0.0200	43.6705	0.3955	0.0084	0.0850	4.3780	28.0000
5	4	10.8580	0.2011	0.0200	44.0860	0.4034	0.0086	0.0852	4.6070	28.0000
5	5	10.9940	0.2036	0.0200	44.5016	0.4106	0.0087	0.0854	4.7870	28.0000
5	6	11.1300	0.2061	0.0200	44.9172	0.4173	0.0087	0.0855	4.9285	28.0000
5	7	11.2660	0.2087	0.0200	45.3327	0.4236	0.0088	0.0856	5.0398	28.0000
5	8	11.4020	0.2112	0.0200	45.7483	0.4293	0.0088	0.0858	5.1274	28.0000
5	9	11.5380	0.2137	0.0200	46.1638	0.4346	0.0088	0.0859	5.1963	28.0000
5	10	11.6740	0.2162	0.0200	46.5794	0.4395	0.0088	0.0860	5.2505	28.0000
5	11	11.8100	0.2187	0.0200	46.9949	0.4439	0.0087	0.0860	5.2932	28.0000
5	12	11.9460	0.2212	0.0200	47.4105	0.4480	0.0087	0.0861	5.3268	28.0000
5	13	12.0820	0.2238	0.0200	47.8260	0.4518	0.0087	0.0861	5.3534	28.0000
5	14	12.2180	0.2263	0.0200	48.2416	0.4551	0.0086	0.0862	5.3743	28.0000
5	15	12.3540	0.2288	0.0200	48.6572	0.4582	0.0086	0.0862	5.3909	28.0000
5	16	12.4900	0.2313	0.0200	49.0727	0.4610	0.0086	0.0862	5.4040	28.0000
5	17	12.6260	0.2338	0.0200	49.4883	0.4635	0.0085	0.0862	5.4144	28.0000
5	18	12.7620	0.2364	0.0200	49.9038	0.4657	0.0085	0.0862	5.4226	28.0000
5	19	12.8980	0.2389	0.0200	50.3194	0.4676	0.0085	0.0862	5.4292	28.0000
5	20	13.0340	0.2414	0.0200	50.7349	0.4693	0.0084	0.0861	5.4345	28.0000
5	21	13.1700	0.2439	0.0200	51.1505	0.4708	0.0084	0.0861	5.4387	28.0000
6	1	13.1700	0.2439	0.0200	51.1505	0.4708	0.0084	0.0861	5.4387	28.0000
6	2	13.4115	0.2484	0.0300	51.6424	0.4810	0.0087	0.0866	5.7448	28.0000
6	3	13.6530	0.2528	0.0300	52.1344	0.4902	0.0089	0.0870	5.9385	28.0000
6	4	13.8945	0.2573	0.0300	52.6263	0.4984	0.0090	0.0874	6.0612	28.0000
6	5	14.1360	0.2618	0.0300	53.1183	0.5058	0.0091	0.0878	6.1390	28.0000
6	6	14.3775	0.2663	0.0300	53.6102	0.5124	0.0091	0.0881	6.1885	28.0000
6	7	14.6190	0.2707	0.0300	54.1022	0.5183	0.0091	0.0884	6.2202	28.0000
6	8	14.8605	0.2752	0.0300	54.5941	0.5234	0.0091	0.0887	6.2406	28.0000
6	9	15.1020	0.2797	0.0300	55.0860	0.5280	0.0091	0.0889	6.2539	28.0000
6	10	15.3435	0.2841	0.0300	55.5780	0.5320	0.0091	0.0891	6.2627	28.0000
6	11	15.5850	0.2886	0.0300	56.0699	0.5354	0.0091	0.0893	6.2686	28.0000
6	12	15.8265	0.2931	0.0300	56.5619	0.5383	0.0090	0.0894	6.2728	28.0000
6	13	16.0680	0.2976	0.0300	57.0538	0.5407	0.0090	0.0895	6.2759	28.0000
6	14	16.3095	0.3020	0.0300	57.5458	0.5427	0.0090	0.0896	6.2783	28.0000
6	15	16.5510	0.3065	0.0300	58.0377	0.5443	0.0089	0.0897	6.2803	28.0000
6	16	16.7925	0.3110	0.0300	58.5297	0.5456	0.0089	0.0898	6.2820	28.0000
6	17	17.0340	0.3154	0.0300	59.0216	0.5465	0.0089	0.0898	6.2836	28.0000
6	18	17.2755	0.3199	0.0300	59.5135	0.5470	0.0088	0.0898	6.2850	28.0000
6	19	17.5170	0.3244	0.0300	60.0055	0.5473	0.0088	0.0898	6.2864	28.0000
6	20	17.7585	0.3288	0.0300	60.4974	0.5473	0.0087	0.0898	6.2878	28.0000
6	21	18.0000	0.3333	0.0300	60.9894	0.5470	0.0087	0.0897	6.2892	28.0000

7	1	18.0000	0.3333	0.0300	60.9894	0.5470	0.0087	0.0897	6.2892	28.0000
7	2	18.2175	0.3373	0.0300	61.4324	0.5466	0.0086	0.0897	6.1363	28.0000
7	3	18.4350	0.3414	0.0300	61.8755	0.5460	0.0086	0.0896	6.0208	28.0000
7	4	18.6525	0.3454	0.0300	62.3185	0.5453	0.0086	0.0896	5.9337	28.0000
7	5	18.8700	0.3494	0.0300	62.7616	0.5444	0.0086	0.0895	5.8679	28.0000
7	6	19.0875	0.3535	0.0300	63.2047	0.5433	0.0085	0.0894	5.8183	28.0000
7	7	19.3050	0.3575	0.0300	63.6477	0.5421	0.0085	0.0893	5.7809	28.0000
7	8	19.5225	0.3615	0.0300	64.0908	0.5408	0.0085	0.0892	5.7529	28.0000
7	9	19.7400	0.3655	0.0300	64.5338	0.5394	0.0085	0.0891	5.7318	28.0000
7	10	19.9575	0.3696	0.0300	64.9769	0.5378	0.0084	0.0889	5.7161	28.0000
7	11	20.1750	0.3736	0.0300	65.4199	0.5362	0.0084	0.0888	5.7044	28.0000
7	12	20.3925	0.3776	0.0300	65.8630	0.5345	0.0084	0.0887	5.6958	28.0000
7	13	20.6100	0.3816	0.0300	66.3060	0.5326	0.0084	0.0885	5.6895	28.0000
7	14	20.8275	0.3857	0.0300	66.7491	0.5307	0.0083	0.0883	5.6850	28.0000
7	15	21.0450	0.3897	0.0300	67.1922	0.5287	0.0083	0.0882	5.6818	28.0000
7	16	21.2625	0.3937	0.0300	67.6352	0.5267	0.0083	0.0880	5.6796	28.0000
7	17	21.4800	0.3977	0.0300	68.0783	0.5246	0.0082	0.0878	5.6782	28.0000
7	18	21.6975	0.4018	0.0300	68.5213	0.5224	0.0082	0.0877	5.6774	28.0000
7	19	21.9150	0.4058	0.0300	68.9644	0.5202	0.0082	0.0875	5.6770	28.0000
7	20	22.1325	0.4098	0.0300	69.4074	0.5179	0.0081	0.0873	5.6769	28.0000
7	21	22.3500	0.4138	0.0300	69.8505	0.5156	0.0081	0.0871	5.6772	28.0000
8	1	22.3500	0.4138	0.0300	69.8505	0.5156	0.0081	0.0871	5.6772	28.0000
8	2	22.5405	0.4174	0.0300	70.2385	0.5135	0.0080	0.0869	5.9265	28.0000
8	3	22.7310	0.4209	0.0300	70.6266	0.5115	0.0080	0.0867	6.1162	28.0000
8	4	22.9215	0.4244	0.0300	71.0147	0.5094	0.0079	0.0866	6.2606	28.0000
8	5	23.1120	0.4280	0.0300	71.4027	0.5073	0.0079	0.0864	6.3706	28.0000
8	6	23.3025	0.4315	0.0300	71.7908	0.5051	0.0078	0.0862	6.4545	28.0000
8	7	23.4930	0.4350	0.0300	72.1788	0.5030	0.0078	0.0860	6.5185	28.0000
8	8	23.6835	0.4385	0.0300	72.5669	0.5008	0.0077	0.0858	6.5675	28.0000
8	9	23.8740	0.4421	0.0300	72.9549	0.4986	0.0077	0.0856	6.6050	28.0000
8	10	24.0645	0.4456	0.0300	73.3430	0.4964	0.0076	0.0854	6.6338	28.0000
8	11	24.2550	0.4491	0.0300	73.7310	0.4942	0.0076	0.0852	6.6560	28.0000
8	12	24.4455	0.4526	0.0300	74.1191	0.4920	0.0075	0.0850	6.6731	28.0000
8	13	24.6360	0.4562	0.0300	74.5072	0.4897	0.0075	0.0848	6.6864	28.0000
8	14	24.8265	0.4597	0.0300	74.8952	0.4875	0.0075	0.0846	6.6969	28.0000
8	15	25.0170	0.4632	0.0300	75.2833	0.4852	0.0074	0.0844	6.7051	28.0000
8	16	25.2075	0.4667	0.0300	75.6713	0.4830	0.0074	0.0842	6.7116	28.0000
8	17	25.3980	0.4703	0.0300	76.0594	0.4807	0.0073	0.0840	6.7168	28.0000
8	18	25.5885	0.4738	0.0300	76.4474	0.4784	0.0073	0.0838	6.7211	28.0000
8	19	25.7790	0.4773	0.0300	76.8355	0.4762	0.0073	0.0836	6.7246	28.0000
8	20	25.9695	0.4809	0.0300	77.2235	0.4739	0.0073	0.0834	6.7275	28.0000
8	21	26.1600	0.4844	0.0300	77.6116	0.4716	0.0072	0.0831	6.7301	28.0000

9	1	26.1600	0.4844	0.0300	77.6116	0.4716	0.0072	0.0831	6.7301	28.0000
9	2	26.2185	0.4855	0.0200	77.7903	0.4689	0.0071	0.0829	6.7117	28.0000
9	3	26.2770	0.4865	0.0200	77.9691	0.4663	0.0070	0.0827	6.6952	28.0000
9	4	26.3355	0.4876	0.0200	78.1478	0.4637	0.0070	0.0825	6.6804	28.0000
9	5	26.3940	0.4887	0.0200	78.3266	0.4611	0.0069	0.0823	6.6671	28.0000
9	6	26.4525	0.4898	0.0200	78.5053	0.4586	0.0068	0.0821	6.6552	28.0000
9	7	26.5110	0.4909	0.0200	78.6841	0.4560	0.0067	0.0819	6.6446	28.0000
9	8	26.5695	0.4920	0.0200	78.8628	0.4535	0.0067	0.0817	6.6350	28.0000
9	9	26.6280	0.4930	0.0200	79.0416	0.4511	0.0066	0.0815	6.6265	28.0000
9	10	26.6865	0.4941	0.0200	79.2203	0.4487	0.0066	0.0813	6.6189	28.0000
9	11	26.7450	0.4952	0.0200	79.3991	0.4463	0.0065	0.0811	6.6121	28.0000
9	12	26.8035	0.4963	0.0200	79.5778	0.4439	0.0065	0.0809	6.6060	28.0000
9	13	26.8620	0.4974	0.0200	79.7566	0.4415	0.0064	0.0807	6.6006	28.0000
9	14	26.9205	0.4985	0.0200	79.9353	0.4392	0.0064	0.0805	6.5958	28.0000
9	15	26.9790	0.4995	0.0200	80.1141	0.4369	0.0064	0.0803	6.5915	28.0000
9	16	27.0375	0.5006	0.0200	80.2928	0.4347	0.0063	0.0801	6.5877	28.0000
9	17	27.0960	0.5017	0.0200	80.4716	0.4325	0.0063	0.0799	6.5843	28.0000
9	18	27.1545	0.5028	0.0200	80.6503	0.4302	0.0063	0.0798	6.5814	28.0000
9	19	27.2130	0.5039	0.0200	80.8291	0.4281	0.0062	0.0796	6.5788	28.0000
9	20	27.2715	0.5050	0.0200	81.0078	0.4259	0.0062	0.0794	6.5765	28.0000
9	21	27.3300	0.5060	0.0200	81.1866	0.4238	0.0062	0.0792	6.5744	28.0000
10	1	27.3300	0.5060	0.0200	81.1866	0.4238	0.0062	0.0792	6.5744	28.0000
10	2	27.4220	0.5077	0.0060	82.1236	0.4010	0.0060	0.0774	6.5869	28.0000
10	3	27.5140	0.5094	0.0060	83.0607	0.3798	0.0058	0.0757	6.5956	28.0000
10	4	27.6060	0.5111	0.0060	83.9977	0.3600	0.0057	0.0740	6.6021	28.0000
10	5	27.6980	0.5129	0.0060	84.9347	0.3415	0.0056	0.0724	6.6071	28.0000
10	6	27.7900	0.5146	0.0060	85.8718	0.3243	0.0054	0.0708	6.6112	28.0000
10	7	27.8820	0.5163	0.0060	86.8088	0.3083	0.0053	0.0693	6.6147	28.0000
10	8	27.9740	0.5180	0.0060	87.7459	0.2933	0.0052	0.0678	6.6177	28.0000
10	9	28.0660	0.5197	0.0060	88.6829	0.2794	0.0051	0.0663	6.6205	28.0000
10	10	28.1580	0.5214	0.0060	89.6199	0.2664	0.0050	0.0649	6.6230	28.0000
10	11	28.2500	0.5231	0.0060	90.5570	0.2542	0.0049	0.0636	6.6253	28.0000
10	12	28.3420	0.5248	0.0060	91.4940	0.2429	0.0048	0.0623	6.6275	28.0000
10	13	28.4340	0.5265	0.0060	92.4310	0.2323	0.0047	0.0610	6.6295	28.0000
10	14	28.5260	0.5282	0.0060	93.3681	0.2224	0.0046	0.0597	6.6314	28.0000
10	15	28.6180	0.5299	0.0060	94.3051	0.2132	0.0045	0.0585	6.6332	28.0000
10	16	28.7100	0.5316	0.0060	95.2422	0.2046	0.0044	0.0573	6.6349	28.0000
10	17	28.8020	0.5333	0.0060	96.1792	0.1966	0.0044	0.0562	6.6365	28.0000
10	18	28.8940	0.5350	0.0060	97.1162	0.1891	0.0043	0.0551	6.6380	28.0000
10	19	28.9860	0.5367	0.0060	98.0533	0.1821	0.0042	0.0540	6.6394	28.0000
10	20	29.0780	0.5384	0.0060	98.9903	0.1756	0.0041	0.0530	6.6408	28.0000
10	21	29.1700	0.5401	0.0060	99.9273	0.1695	0.0040	0.0520	6.6420	28.0000

Land Uses and Pollutant Concentrations for the Modeled Segment

Headwaters:

		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		

Tributaries:

Section #		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
1	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
2	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
3	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
4	%	100									100
	$CBOD_u$, mg/l	20.522									
	NH_3-N, mg/l	1.0448									
	TON, mg/l	1.7098									
5	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
6	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

7	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
8	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
9	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
10	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
11	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
12	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
13	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
14	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
15	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
16	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
17	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

18	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
19	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
20	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
21	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
22	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
23	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
24	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

Incremental Inflow:

Section #		Forest	Pasture	Row Crop	Urban / Commercial	Open / Barren	Residential	Other	Open Water		Total Land Usage
1	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	CBOD$_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
2	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	CBOD$_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
3	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	CBOD$_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
4	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	CBOD$_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.05	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
5	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	CBOD$_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
6	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	CBOD$_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
7	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	CBOD$_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
8	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	CBOD$_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
9	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	CBOD$_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		

10	%	65.69	23.88	9.5	0.26	0.29	0.04	0.22	0.12		100
	$CBOD_u$, mg/l	2	2.01	2.01	2.01	2.01	2.01	2.01	1		
	NH_3-N, mg/l	0.11	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.010296186	0.005		
	TON, mg/l	0.22	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.111198798	0.01		
11	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
12	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
13	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
14	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
15	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
16	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
17	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
18	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
19	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
20	%	100									100
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

21	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
22	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
23	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										
24	**%**	**100**									**100**
	$CBOD_u$, mg/l										
	NH_3-N, mg/l										
	TON, mg/l										

Loading Summary

WLA

Discharger	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd
Totals:	**0.0**	**0.0**	**0.0**	**0.0**

LA

	Tributaries				*Incremental Inflow*				*Headwaters*			
Section #	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd	CBOD, ppd	NH_3-N, ppd	TON, ppd	NBOD, ppd
1	0.0	0.0	0.0	0.0	0.8	0.0	0.1	0.4	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1				
3	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.2				
4	0.0	0.0	0.0	0.0	0.7	0.0	0.1	0.3				
5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.3				
6	0.0	0.0	0.0	0.0	1.0	0.0	0.1	0.6				
7	0.0	0.0	0.0	0.0	0.9	0.0	0.1	0.5				
8	0.0	0.0	0.0	0.0	0.8	0.0	0.1	0.4				
9	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1				
10	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2				
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Totals:	**0.0**	**0.0**	**0.0**	**0.0**	**5.8**	**0.2**	**0.5**	**3.2**	**0.0**	**0.0**	**0.0**	**0.0**

Total Loading

	WLA	LA
CBOD, ppd	**0.0**	**5.8**
NH_3-N, ppd	**0.0**	**0.2**
TON, ppd	**0.0**	**0.5**
NBOD, ppd	**0.0**	**3.2**

9.5
Spreadsheet Water Quality Model (SWQM) User Guide

ADEM

The ADEM Spreadsheet Water Quality Model

Alabama Department of Environmental Management
Water Division – Water Quality Branch
September 2001

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Introduction

Water quality modeling is an attempt to relate specific water quality conditions to natural processes using mathematical relationships. A water quality model usually consists of a set of mathematical expressions relating one or more water quality parameters to one or more natural processes. Water quality models are most often used to predict how changes in a specific process or processes will change a specific water quality parameter or parameters.

Water quality models vary in complexity from simple relationships which attempt to model a few processes under specific conditions to very complex relationships which attempt to model many processes under a wide range of conditions. The simpler models are usually much easier to use and require only limited information about the system being modeled but are also limited in their applicability. Steady-state models in which certain relationships are assumed to be independent of time fall into this category. More complex models may relate many natural processes to several water quality parameters on a time-dependent basis. These models are usually harder to apply, require extensive information about the system being modeled, but also have a broader range of applicability. Dynamic models fall into this category.

One water quality model sometimes used by the Alabama Department of Environmental Management (ADEM) to develop waste load allocations (WLAs) and total maximum daily loads (TMDLs) for oxygen demanding wastes is the Spreadsheet Water Quality Model (SWQM). The model is derived from an earlier steady-state dissolved oxygen model used by ADEM and variously referred to as DOMOD2 and W2EL. The earlier versions of the model, still in use by ADEM and others, were written in the BASIC computer language and were executed in the Disk Operating System (DOS) for personal computers.

The version of SWQM sometimes used by ADEM in the development of TMDLs for dissolved oxygen is a steady-state model relating dissolved oxygen concentration in a flowing stream to carbonaceous biochemical oxygen demand (CBOD), nitrogenous biochemical oxygen demand (NBOD), sediment oxygen demand (SOD) and reaeration. The model allows the loading of CBOD, NBOD and SOD to the stream to be partitioned among different land uses (nonpoint sources) and wastewater treatment facilities (point sources).

Description of the Water Quality Model

The SWQM is based on the Streeter-Phelps dissolved oxygen deficit equation with modifications to account for the oxygen demand resulting from nitrification of ammonia (nitrogenous oxygen demand) and the organic demand found in the waterbody sediment. Equation (1) shows the Streeter-Phelps relationship with the additional components to account for nitrification and SOD.

$$(1) \qquad D = \frac{K_1 L_0}{K_2 - K_1}\left(e^{-K_1 t} - e^{-K_2 t}\right) + \frac{K_3 N_0}{K_2 - K_3}\left(e^{-K_3 t} - e^{-K_2 t}\right) + \frac{SOD}{K_2 H}(1 - e^{-K_2 t}) + D_0 e^{-K_2 t}$$

where: D = dissolved oxygen deficit at time t, mg/l
L_0 = initial CBOD, mg/l
N_0 = initial NBOD, mg/l (NBOD = NH_3-N x 4.57)
D_0 = initial dissolved oxygen deficit, mg/l
K_1 = CBOD decay rate, 1/day
K_2 = reaeration rate, 1/day
K_3 = nitrification rate, 1/day
SOD=sediment oxygen demand, g O_2/ft^2/day
H=average stream depth, ft
t = time, days

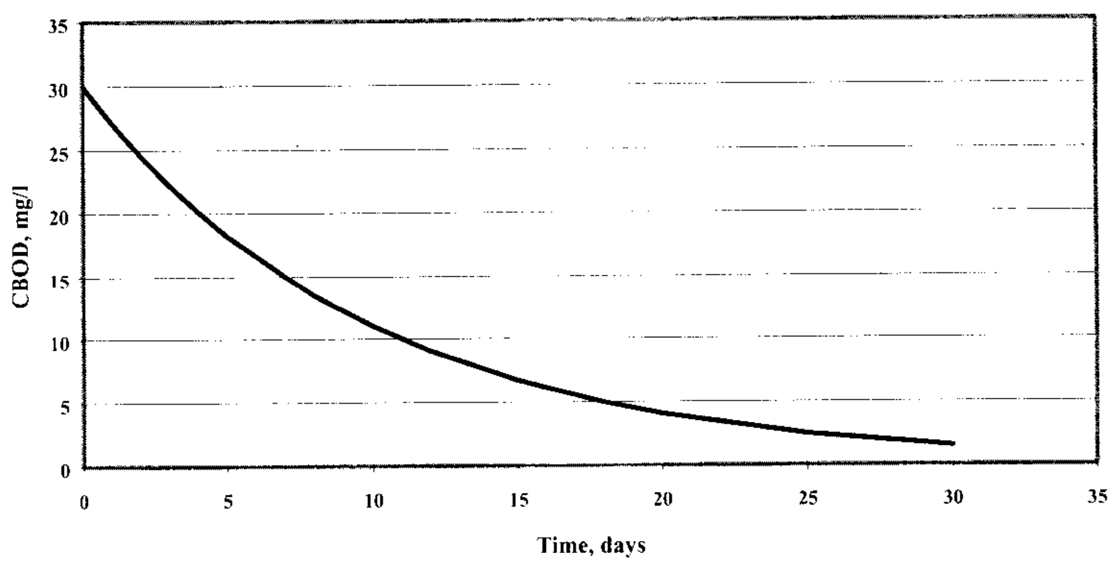
The CBOD concentration, expressed as L_0 in Equation (1), is the ultimate carbonaceous biochemical oxygen demand. The CBOD concentration remaining at any time, t, can be expressed by the following first-order equation.

(2) $$L = L_u e^{-K_1 t}$$

where: L = CBOD remaining at any time, t, mg/l
L_u = ultimate carbonaceous biochemical oxygen demand, mg/l = Lo (in Eqn 1)
K_1 = CBOD decay rate, 1/day
t = time, days

Figure 1 illustrates a typical CBOD curve described by Equation (2).

Figure 1
CBOD versus Time



In the presence of nitrifying bacteria, ammonia is oxidized first to nitrite, then to nitrate. The overall reaction is given in the following equation.

(3) $$NH_4^+ + 2O_2 \rightarrow NO_3^- + 2H^+ + H_2O$$

The stoichiometric requirement for oxygen in the above reaction is 4.57 mg of O_2 per mg of NH_4^+-N oxidized. The oxidation reaction is assumed to be first order and would have the form shown in Equation (4).

(4) $$N = N_0 e^{-K_3 t}$$

where: N = NBOD remaining at any time, t, mg/l
N_0 = initial NBOD, mg/l
K_3 = nitrification rate, 1/day
t = time, days

Organic nitrogen, primarily in the form of amino acids, is a potential source of ammonia as a result of deamination reactions that occur during the metabolism of organic material. Organic nitrogen does not exert a direct oxygen demand but an indirect demand as proteins are hydrolyzed and ammonium ions are released. The following example shows the deamination reaction for aspartic acid.

(5)

COOH		*COOH*		
|		|		
H-C-NH$_3$		*C=O*		
|	→	|	+	NH_4^+
CH$_2$	←	*CH$_2$*		
|		|		
COOH		*COOH*		

The conversion of organic nitrogen to ammonia is assumed to follow first-order kinetics and is represented by the following equation.

(6) $$NH_3 - N = ORG\left(1 - e^{K_4 t}\right)$$

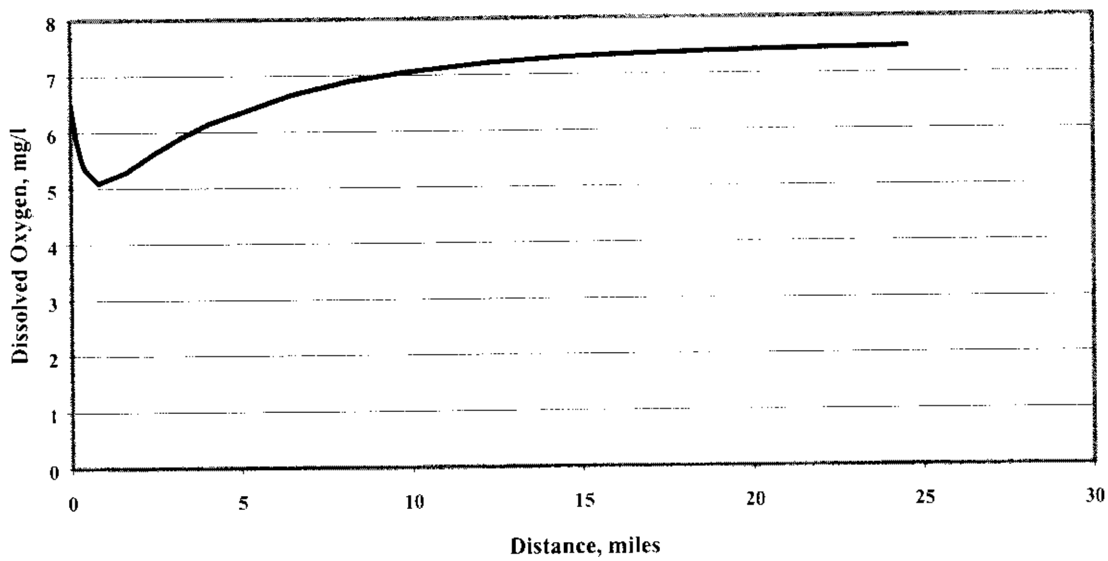
where: NH_3-N = ammonia nitrogen produced by hydrolysis of organic nitrogen, mg/l

ORG = initial organic nitrogen concentration, mg/l
K_4 = organic nitrogen hydrolysis rate, 1/day
t = time, days

Oxygen demand by benthic sediments and organisms can represent a significant portion of oxygen consumption in surface water systems. Benthic deposits at a given location in an aquatic system are the result of the transportation and deposition of organic material. The material may be from a source outside the system, such as leaf litter or wastewater particulate CBOD, or it may be generated inside the system as occurs with plant growth. In addition to oxygen demand caused by decay of organic matter, the indigenous invertebrate population can generate significant oxygen demand through respiration. The sum of oxygen demand due to organic matter decay plus demand from invertebrate respiration is equal to the sediment oxygen demand (SOD). SOD is averaged over the water column depth, as indicated by the third term (to the right of the equal sign) in equation 1.

The process by which oxygen enters a stream is known as reaeration. Equation (1) shows the net effect on dissolved oxygen concentration of the simultaneous processes of deoxygenation through the decay of carbonaceous organic matter, nitrification of ammonia, SOD and reaeration. The resulting pattern in dissolved oxygen concentration versus distance downstream from a waste source is known as the dissolved oxygen sag curve. Figure 2 shows a typical dissolved oxygen sag curve. The shape of the curve is dependent upon the magnitude of the reaeration rate relative to the concentration of oxygen demanding materials and the magnitude of their decay rates.

Figure 2
Dissolved Oxygen Versus Distance



Numerous equations for estimating a stream's reaeration rate have been developed and many are presented in *Rates, Constants, and Kinetic Formulations in Surface Water Quality Modeling*, 2nd edition, USEPA. Reaeration rates in the SWQM can be either entered directly or computed using the formula developed by E.C. Tsivoglou and shown in Equation (7).

(7) $$K_2 = C(Slope)(Velocity)$$

where: K_2 = reaeration rate at 20°C, 1/day
C = Tsivoglou Coefficient
C = 1.8 when stream flow < 10 cfs
C = 1.3 when stream flow > 10 cfs and < 25 cfs
C = 0.88 when stream flow > 25 cfs
Slope = water surface slope, feet/mile
Velocity = water velocity, feet/second

Another commonly used method for estimating a stream's reaeration rate is the O'Conner-Dobbins formulation shown in Equation (8). This formulation generally works best for streams with a depth of greater than 5 feet and a slope of less than 2 feet/mile.

(8) $$K_2 = \frac{12.9U^{0.5}}{H^{1.5}}$$

where: K_2 = reaeration rate at 20°C, 1/day
U = stream velocity, feet/second
H = stream depth, feet

Temperature affects the rate at which reactions proceed. Reaction rates are generally expressed with units of per day at 20°C. If the reactions are occurring at a temperature other than 20°C, then the reaction rates must be corrected for the new temperature. The most commonly used expression to adjust reaction rates for temperature is the modified Arrhenius relationship shown in Equation (9).

(9) $$K_{T_2} = (K_{20°C})\Theta^{(T_2 - 20)}$$

where: K_{T_2} = reaction rate at the new temperature, 1/day
$K_{20°C}$ = reaction rate at 20°C, 1/day

The Θ values for each of the reaction rates shown in Equation (1) vary slightly from reference to reference but those used in the SWQM are listed in the following table.

Table 1
Temperature Correction Factors Used in the SWQM

Rate, 1/day	*Temperature Correction Factor, Θ*
CBOD decay, K_1	1.047
Reaeration, K_2	1.024
Nitrification, K_3	1.080
Organic Nitrogen Hydrolysis, K_4	1.047
Sediment Oxygen Demand, SOD	1.060

The dissolved oxygen saturation concentration at a pressure of 1 atmosphere and a given temperature is computed using Equation (10) taken from Standard Methods for the Examination of Water and Wastewater, 16th Edition.

$$\ln C^* = -139.34411 + \left(\frac{1.575701X10^5}{T}\right) - \left(\frac{6.642308X10^7}{T^2}\right) + \left(\frac{1.243800X10^{10}}{T^3}\right) - \left(\frac{8.621949X10^{11}}{T^4}\right) \quad (10)$$

where: C^* = equilibrium oxygen concentration at 1 atm, mg/l
T = temperature, K

Table 2 shows the saturation concentration of dissolved oxygen in fresh water at various temperatures.

Table 2

Solubility of Oxygen in Fresh Water Exposed to Water-Saturated Air at Standard Pressure (101.3 kPa)*

Temperature, °C	Oxygen Solubility, mg/l
4.0	13.107
5.0	12.770
6.0	12.447
7.0	12.139
8.0	11.843
9.0	11.559
10.0	11.288
11.0	11.027
12.0	10.777
13.0	10.537
14.0	10.306
15.0	10.084
16.0	9.870
17.0	9.665
18.0	9.467
19.0	9.276
20.0	9.092
21.0	8.915
22.0	8.743
23.0	8.578
24.0	8.418
25.0	8.263
26.0	8.113
27.0	7.968
28.0	7.827
29.0	7.691
30.0	7.559
31.0	7.430
32.0	7.305
33.0	7.183
34.0	7.065
35.0	6.950
36.0	6.837
37.0	6.727
38.0	6.620

*From *Standard Methods for the Examination of Water and Wastewater*, 16th Edition.

The dissolved oxygen saturation concentration computed by Equation (10) and shown in Table 2 is also corrected for the effect that increasing altitude has on air pressure. Equation (11) estimates the change in atmospheric pressure as altitude increases and Equation (12) estimates the change in dissolved oxygen saturation concentration as atmospheric pressure changes.

(11) $$P = 1 - (3.78436X10^{-5})(A) + (6.17149X10^{-10})(A^2)$$

where: P = atmospheric pressure, atm
A = altitude above mean sea level, feet

(12) $$C_p = C^* P \left(\frac{1 - \frac{P_{wv}}{P}}{1 - P_{wv}} \right) \left(\frac{1 - \Theta P}{1 - \Theta} \right)$$

where: C_p = equilibrium oxygen concentration at nonstandard pressure, mg/l
C* = equilibrium oxygen concentration at standard pressure of 1 atm, mg/l
P = nonstandard pressure, atm
P_{wv} = partial pressure of water vapor, atm

The partial pressure of water vapor, P_{wv}, is computed using the following equation.

(13) $$\ln P_{wv} = 11.8571 - \left(\frac{3840.70}{T} \right) - \left(\frac{216961}{T^2} \right)$$

where: T = temperature, K

In Equation (12), Θ is computed using the following equation.

(14) $$\Theta = 0.000975 - (1.426X10^{-5} t) + (6.436X10^{-8} t^2)$$

where: t = temperature, °C

The velocity at which a stream is flowing is another important factor affecting the dissolved oxygen sag curve. Generally, higher velocities result in higher reaeration rates and a less pronounced "sag" in the dissolved oxygen sag curve. On the other hand, higher velocities may shift the location at which the minimum dissolved oxygen concentration occurs downstream as more organic material is transported downstream by the higher velocities. Velocity at any given point on a stream can be computed using the continuity equation shown in Equation (15).

(15) $$V = \frac{Q}{A}$$

where: V = velocity, feet/second
Q = stream flow, cubic feet/second
A = cross-sectional area, square feet

Velocity through any given stream reach is usually a function of stream flow and can be written in the form of Equation (16).

(16) $$V = aQ^b$$

where: V = velocity, feet/second
a = coefficient of velocity versus flow relationship
b = exponent of velocity versus flow relationship
Q = stream flow, cubic feet/second

The coefficient, a, and the exponent, b, in Equation (16) are estimated by plotting velocity versus flow on a log-log chart and computing the intercept (a) and slope (b) of the line. Velocity or time-of-travel measurements for a stream segment are usually estimated using a dye tracer, typically rhodamine WT dye. Flow measurements can be obtained directly from United States Geological Survey (USGS) stream gauges or measured directly using a current meter or dye tracer technique.

The SWQM has an option to compute stream velocity using an empirical relationship developed by EPA for streams in the Southeast. The equation has been used by ADEM for many years in "desk-top" water quality models and is shown as Equation (17).

$$V = 0.144Q^{0.4}(Slope)^{0.2} - 0.2 \quad (17)$$

where: V = velocity, feet/second
Q = stream flow, cubic feet/second
Slope = stream slope, feet/mile

Equation (1) presents a very simple approach to describing the relationship between factors that influence the dissolved oxygen deficit in a stream. It would be impossible to model all of the processes that affect a stream's dissolved oxygen concentration. In addition to carbonaceous BOD, ammonia, organic nitrogen, SOD and reaeration, many models include photosynthesis. However, for most small streams, Equation (1) describes the major processes affecting dissolved oxygen.

As discussed earlier, SWQM is based on the modified Streeter-Phelps equation shown as Equation (1). Mass balance calculations and the dissolved oxygen balance calculations are written in cells on a Microsoft™ Excel 97 spreadsheet. The spreadsheet is completely interactive and easily tailored to a particular application. Mass balance calculations are used to compute the concentration of a substance in the stream after two or more sources of the substance flow together and are completely mixed. Equation (18) shows the mass balance calculation for two sources.

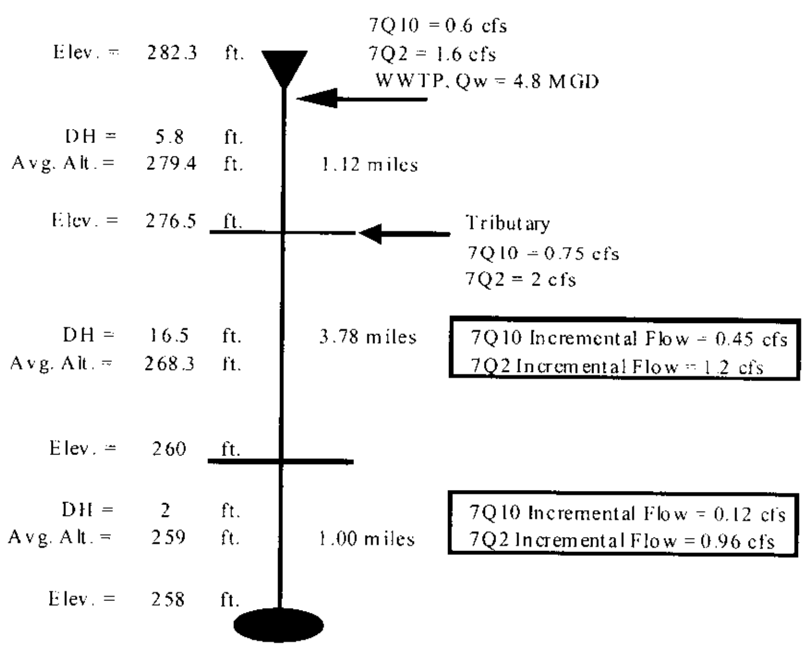
$$C_{mixed} = \frac{(C_1)(Q_1) + (C_2)(Q_2)}{Q_1 + Q_2} \quad (18)$$

where: C_{mixed} = concentration of the substance after mixing from two sources
C_1 = concentration of the substance from the first source
C_2 = concentration of the substance from the second source
Q_1 = flow of the first source
Q_2 = flow of the second source

The SWQM also allows the user to assign organic loadings on the basis of land use. The model assigns differing pollutant concentrations to flows from headwaters, tributaries, and incremental inflow according to the major land use percentages in the watershed. For example, if the land use in a given wateshed was 80% forest, then 80% of the flow would be from the forest land use and assigned CBOD, ammonia, organic nitrogen, and dissolved oxygen concentrations typical of forest runoff.

Once the stream reach to be modeled has been selected, the reach can be subdivided into individual segments. Subdivision of the reach allows for the model to account for changing physical features of the stream. These would include the addition of flow and pollutants from tributaries, incremental inflow, and point sources, changes in stream slope, velocity, and any of the reaction rates. Figure 3 illustrates an example of a reach with three sections.

Figure 3
Typical Modeled Reach Schematic



The first information required by the model concerns the headwater conditions. These are the physical and chemical stream characteristics immediately upstream of the reach to be modeled and include ultimate carbonaceous BOD, ammonia nitrogen, organic nitrogen, dissolved oxygen, stream flow, and water temperature. For each section the same information will be required for tributaries, incremental flow, and point sources.

Additional information required for each section includes section length, elevation at the beginning and end of each section, and decay rates for CBOD, ammonia nitrogen, organic nitrogen and SOD. The reaeration rate can be input directly or computed using Equation (7). Velocity can also be input directly or computed by Equation (17).

The SWQM can also account for reaeration that occurs as water flows over a small dam. Equation (19) developed by Gameson and discussed in EPA's *Rates, Constants, and Kinetic Formulations in Surface Water Quality Modeling* (Second Edition) is used to compute reaeration over a dam.

(19) $$r = 1 + 0.11(a)(b)(1 + 0.046(T))h$$

where: r = ratio of upstream dissolved oxygen deficit to downstream deficit
a = water quality factor (0.65 for grossly polluted streams; 1.8 for clean streams)
b = weir dam aeration coefficient (a function of the type of structure, see Table 3 below)
T = water temperature, °C
h = water level difference across the dam, feet

Table 3

Weir Dam Aeration Coefficients

Dam Type	Aeration Coefficient
Flat Broad-Crested Regular Step	0.70
Flat Broad-Crested Irregular Step	0.80
Flat Broad-Crested Vertical Face	0.80
Flat Broad-Crested Straight-Slope Face	0.90
Flat Broad-Crested Curved Face	0.75
Round Broad-Crested Curved Face	0.60
Sharp-Crested Straight-Slope Face	1.05
Sharp-Crested Vertical Face	0.80
Sluice Gates with Submerged Discharge	0.05

USING THE SPREADSHEET MODEL

The ADEM spreadsheet model has been incorporated into a Microsoft Excel workbook file named "WQ Tool.xls." The workbook consists of 12 worksheets. Four of the worksheets require input – WQ MODEL, Land Use, Chronic NH3 Tox, and Acute NH3 Tox. Cells in these worksheets requiring input are unlocked and available to the user. Those not requiring input are unavailable to the user and are locked and protected. WQ Model consists of both input and output areas. The output area lists instream model predictions for as many as 24 segments for the following parameters: CBODu, NH_3-N, TON, D.O., flow, temperature, velocity and travel time. The input area of WQ MODEL can be further subdivided into the following sections: headwaters conditions, tributary conditions, incremental inflow conditions, effluent conditions, section and dam characteristics, and reaction rates.

Input requirements for each section will be discussed separately below. It should be noted that the words "section" and "segment" are used interchangeably in the following discussion.

HEADWATERS SECTION

The headwaters section begins on the second page of WQ MODEL. Required input for the headwaters section includes flow, temperature and dissolved oxygen concentration (D.O.). Flow input will normally be the stream's $7Q_{10}$ and $7Q_2$ values for summer and winter TMDLs, respectively, at the headwaters location. Summer is typically defined as consisting of the time interval from May through November of each year; winter, the other five months. The $7Q_{10}$ flow represents the minimum 7-day flow that occurs, on average, over a 10-year interval. Likewise, the $7Q_2$ is the minimum 7-day flow that occurs, on average, over a 2-year period. The $7Q_{10}$ is typically assumed to be the critical condition flow for the summer season and the $7Q_2$ for winter. Where a continuous USGS gaging record is available, monthly $7Q_{10}$ flows can be computed. The minimum monthly $7Q_{10}$ during each season is used as headwaters flow in the model.

If a continuous USGS gaging record is not available, the $7Q_{10}$ and $7Q_2$ flows can be estimated by using one of two procedures. The first procedure employs use of the Bingham Equation. The Bingham Equation can be found on page 3 of a publication from the Geological Survey of Alabama entitled, **Low-Flow Characteristics of Alabama Streams, Bulletin 117**. Low flow estimates employing this equation are based on the stream's recession index (G, no units), the stream's drainage area (A, mi^2), and the mean annual precipitation (P, inches):

(19) $$7Q_2=0.24\times10^{-4}(G-30)^{1.07}(A)^{0.94}(P-30)^{1.51}$$

(20) $$7Q_{10}=0.15\times10^{-5}(G-30)^{1.35}(A)^{1.05}(P-30)^{1.64}.$$

The range of applicability of the Bingham Equation is 5-2,460 mi^2.

The second procedure makes use of statistical streamflow data from the State's network of USGS gages. If a USGS gage with similar streamflow characteristics exists in the area of the modeled reach, its $7Q_{10}$ and $7Q_2$ values can be employed to estimate the headwaters values by ratioing flows for the two respective drainage areas. If both procedures are employed, the value used in the TMDL is typically the most conservative value.

Temperature input is based on historical weather data, and is normally assumed to be equal to an average maximum value for each season (in °C).

Headwaters water quality characteristics include CBODu, NH_3-N, and TON. These parameters are model-calculated. CBODu represents ultimate carbonaceous biochemical oxygen demand and is a measure of the total amount of oxygen required to degrade the carbonaceous portion of the organic matter present in the stream. Before going further, an additional CBOD parameter should be explained – $CBOD_5$. $CBOD_5$ is the amount of oxygen required to degrade carbonaceous organic matter in the first five days. Though it is not a modeled pollutant, it is a required parameter for permitting purposes. The assignment of $CBOD_5$ limits in National Pollutant Discharge Elimination System (NPDES) permits requires a knowledge of the ultimate-to-five-day CBOD ratio ($CBODu/CBOD_5$). Once this ratio is known, the $CBOD_5$ value can be determined. Because organic nitrogen can be converted to ammonia, it represents a potential source of NH_3-N. Unless the headwater is known to be degraded, its water quality characteristics are typically assumed to be in the range of background conditions for unimpacted streams. Background conditions for unimpacted streams typically have the following ranges: 2-3 mg/l CBODu, 0.11-0.22 mg/l NH_3-N, 0.22-0.44 mg/l TON, and a D.O. concentration of 80-90% of the D.O. saturation value. Specific headwaters concentrations for unimpacted streams are normally assumed to be as follows: 2 mg/l CBODu, 0.11 mg/l NH_3-N, 0.22 mg/l TON, and 85% of the D.O. saturation value. If field data is available for these parameters, water quality inputs will normally be assumed to be average values of the available field data.

TRIBUTARY SECTION

The tributary section requires flow, temperature, and D.O. as inputs. Methodology employed for these inputs is similar to that used for headwaters.

INCREMENTAL INFLOW SECTION

Incremental inflow (IF) refers to all natural streamflow not considered by the other two sources of natural flow - headwaters and tributaries. It encompasses flows from groundwater recharge, small tributaries not considered in the model, and nonpoint source runoff. Required inputs for incremental flow are the same as those for tributaries (i.e., flow, temperature, and D.O.). D.O. is normally assumed to be 70% of its saturation value. This is 15% lower than what is normally assumed and creates an additional implicit margin of safety in the TMDL model.

The formula for calculation of **total** incremental inflow can be summarized as follows:

(21) Total IF = X - (Σtrib flows+HW flow),

Where Total IF=total incremental inflow (cfs),

X=total flow at end of modeled reach (cfs),

Σtrib flows=sum of all tributary flows (cfs), and,

HW flow=headwaters flow (cfs).

Incremental inflow for each reach is assumed to be proportional to the length of the reach.

POINT SOURCE SECTION

The point source section encompasses all treated wastewater discharges from point source facilities. Required input for point sources are pollutant concentrations, flows and temperatures.

Temperatures are normally assumed to be the same as those estimated for ambient conditions (i.e., the receiving stream). Pollutant concentrations are taken from the wastewater treatment facility's permit. A CBODu/$CBOD_5$ ratio must be known (or assigned) for each point source effluent in order to convert the $CBOD_5$ permit value to a CBODu model value. This ratio is determined experimentally through a time-series laboratory test on the treated effluent known as the longterm (or ultimate) CBOD test. If the ratio is not measured experimentally, then one must be assumed using typical literature values. In the absence of laboratory data, the value is assumed to be 1.5 for municipal effluents.

Wastewater flows for municipal facilities are assumed to be the design, or permitted, values. Flows for industrial facilities are based on either current production or production at the time of issuance of the current permit.

SECTION CHARACTERISTICS

Required input for section characteristics are segment lengths, upstream elevation for segment 1, and all segment downstream elevations. Upstream elevations for all other segments will be model-calculated once all downstream elevations have been entered. Elevations and lengths are typically estimated from USGS 7½-minute quadrangle maps. The user has the option of inputting velocity values directly or allowing the model to calculate them.

RATES SECTION

The rates section consists of two parts – a mandatory input section and an optional one. Input requirements for the mandatory section are the CBOD, NH_3-N and TON decay rates, all assumed to be at 20°C. The 20°C reaeration rate may be calculated by the model, or input manually by the user. The user may input the following parameters in the optional portion of the rates section: average stream depth, SOD, CBOD settling rate, and

TON settling rate. SOD, CBOD settling and TON settling should be the 20°C values. If SOD is being simulated, then average stream depth must also be included as an input.

LAND USE

Land usage is entered as a percentage of total watershed drainage area. Nonpoint source impacts from different land uses are broken down into three groups – headwaters, tributary and incremental inflow impacts. Eight categories of land usage are included. They are forest, pasture, row crops, urban/commercial, open/barren, residential, open water, and "other". The model also has the capability to include one additional land use. It is shown as a blank column on the Land Use worksheet and is adjacent to the open water land use column. The "other" land use is employed to include all uses not listed in the other categories and is typically a very small percentage of the total.

In addition to percentages, pollutant concentrations for CBODu, NH3-N and TON are required as inputs for each land use. Background concentrations are normally assumed for the forest land use since forests typically have a good filtering mechanism with respect to runoff. A small level of pollutant concentrations are normally assumed for open water. This is because an open water area can contribute a small amount of pollutant loading by way of two mechanisms – groundwater recharge and waste from waterfowl. Pollutant concentrations assumed for open water are typically 1 mg/l CBODu, 0.005 mg/l NH_3-N, and 0.01 mg/l TON. The relative concentrations of pollutants for the other land uses are assigned on the basis of available field data.