TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT

For

Dissolved Oxygen

In

Ebenezer Creek

(HUC 03060109)

Effingham County, Savannah River Basin, Georgia

APPROVAL PAGE

for Oxygen Demanding Material in

Ebenezer Creek, GA

Georgia=s final 1998 303(d) list identified Ebenezer Creek, Springfield, GA as not supporting its designated use, with the pollutant of concern being oxygen demanding material and its impact on dissolved oxygen. This total maximum daily load (TMDL) is being established pursuant to the 1998 Georgia 303(d) list and the Consent Decree in the Georgia TMDL Lawsuit.

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while achieving water quality standards. Since the only known point source of BOD in this listed segment of Ebenezer Creek is the Springfield facility, the BOD load from the plant will be evaluated in the TMDL calculation. This TMDL will be expressed as a loading capacity. If in the future, a point or nonpoint source load of BOD is introduced in the system, the total of the WLA (wasteload allocations for point source loadings) and LA (load allocation for nonpoint source loadings) shall not exceed this loading capacity.

Pollutant	**TMDL (kg/day)**	**WLA (kg/day)**	**LA (kg/day)**	**MOS**
BOD	1175	0	1175	Implicit

APPROVED BY:

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Robert F. McGhee, Director Date

Water Management Division

EPA-Region 4

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Introduction

Section 303(d) of the Clean Water Act (CWA) as Amended by the Water Quality Act of 1987, Public Law 100-4, and the United States Environmental Protection Agency's (USEPA/EPA) Water Quality Planning and Management Regulations [Title 40 of the Code of Federal Regulation (40 CFR), Part 130] require each State to identify those waters within its boundaries not meeting water quality standards applicable to the waters' designated uses. Total maximum daily loads (TMDLs) for all pollutants violating or 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 consideration given to seasonal variations and margins of safety. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body, 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 nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991).

Problem Definition

Georgia's final 1998 Section 303(d) list identified Ebenezer Creek, which eventually flows into the Savannah River, as not supporting its designated use as a fishing water, with the pollutant of concern being biological oxygen demand (BOD) causing depressed levels of dissolved oxygen.

The TMDL is being established pursuant to EPA commitments in the October 1997 Consent Decree in the Georgia TMDL lawsuit. These conditions include a requirement that TMDLs be proposed by August 30, 1999, for each water on the 1998 303(d) list that is impacted by a National Pollutant Discharge Elimination System (NPDES) permitted point source or point sources, and is located in the Savannah/Ogeechee Basins. The Springfield Wastewater Control Plant (NPDES Permit # GA0020770) has outfalls that discharge to Ebenezer Creek. Springfield has a NPDES permit & Land Application System (LAS) permit.

Currently, the Springfield plant is utilizing its LAS for treatment of effluent. There exists a potential for a discharge of effluent during wet weather conditions into Ebenezer Creek. Wet weather conditions do not represent the critical conditions for Ebenezer Creek. No discharges occur during critical low flow conditions. The Springfield LAS site is capable of handling 355,000 gallons per day. The wastewater treatment plant capacity is for 500,000 gallons/day. Average 1999 flows for the facility are approximately 250,000 gallons/day according to the City. The only discharge to Ebenezer Creek occurred from March 10 - March 16, 1999.

Target Identification

The target level for the development of the Dissolved Oxygen TMDL in the Ebenezer Creek segment is the numeric criterion established in Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6, Revised July 6, 1999. Georgia Regulation 391-306-.03(6)(c)(1) establishes the freshwater criterion for Dissolved Oxygen as the daily average of 6.0 mg/l and no less than 5.0 mg/l at all times for designated trout streams by the Wildlife Resource Division. A daily average of 5.0 mg/l and no less than 4.0 mg/l at all times for waters supporting warm water species of fish is required. Ebenezer Creek is a warm water stream.

Background

Ebenezer Creek is a State Scenic River and a National Natural Landmark. It is a backwater, black water creek in Effingham County, Georgia. It has ancient cypress and water tupelo and extensive swamps. Currently, there is limited water quality available for this complex system. Additional surveys and data collection will be necessary to support the development of a comprehensive TMDL that addresses both point and nonpoint source impacts on dissolved oxygen.

The segment of Ebenezer Creek that is being considered in this TMDL is from the Springfield facility to the confluence with the Savannah River. The Springfield plant represents the only point source discharge to Ebenezer Creek and will be considered the only source of oxygen demanding material. Uncontrollable

sources of oxygen demanding materials that are not considered in this TMDL is stormwater runoff and low dissolved oxygen water draining from the swamp. Ebenezer Creek is on the State of Georgia's 1998 §303 (d) list for violating the dissolved oxygen standard for the State of Georgia.

Numeric Targets and Sources - Model Development

The steady-state model provides predictions for only a single set of environmental conditions. For permitting purposes, steady-state models are applied for "critical" environmental conditions that represent extremely low assimilative capacity. For discharges to riverine systems, critical environmental conditions correspond to drought upstream flows. The assumption behind steady-state modeling is that permit limits that protect water quality during critical conditions will be protective for the large majority of environmental conditions that occur. For this model development, only dry weather conditions will be evaluated to determine the assimilative capacity of Ebenezer Creek for oxygen demanding materials because this represents the critical conditions.

The USEPA's Water Quality Analysis Simulation Program (WASP5) was used to calculate the total maximum daily load of biological oxygen demanding (BOD) materials to this segment of Ebenezer Creek. The model was parameterized using critical low flow conditions (7Q10 Flow) and summer time temperatures. The model included sediment oxygen demand, biological oxygen demand, nitrification and reaeration on predicted in-stream dissolved oxygen concentrations. The stream was parameterized as illustrated in Table 1. The upstream BOD, Dissolved Oxygen and water temperature were obtained by reviewing STORET data.

Table 1 Stream Parameterization

Parameter	Input Value

Stream Flow	10.28 cfs
Dissolved Oxygen	5.0 mg/l
BOD	3.3 mg/l
Water Temperature	24 Degrees C

The WASP model kinetics and environmental parameters are given in Table 2. The BOD decay rate and temperature correction coefficient (THETA) were obtained from: Compilation of Georgia's Current Modeling Guidelines for the Development of Wasteload Allocations and NPDES Permit Limitations dated January 1991. This publication was developed by EPD and provides state approved rates for developing permits when site-specific data is not available.

Table 2 WASP Kinetics and Environmental Parameters

Parameter	Input Value
BOD Decay	0.3 per day
BOD Theta	1.047
SOD	0.50 g/m^2/day
Nitrification	0.30 per day
Nitrification Theta	1.05
Reaeration (Calculated By Model)	1.01 per day

For permitting purposes, steady-state models are applied for "critical" environmental conditions that represent extremely low assimilative capacity. For discharges to riverine systems, critical environmental conditions correspond to drought upstream flows. The assumption behind steady-state modeling is that permit limits that protect water quality during critical conditions will be protective for the large majority of environmental conditions that occur. The WASP model was executed in steady-state mode to develop the

TMDL given the above-described critical conditions.

Critical Condition Determination

Critical conditions for this segment of Ebenezer Creek will be used to determine the TMDL. Instream dissolved oxygen concentrations are influenced by biological oxygen demanding materials, water temperature, river flow and reaeration. A water quality model will be used to determine the maximum daily load of oxygen demanding materials to this segment of Ebenezer Creek that will allow it to achieve water quality standards. For the Ebenezer Creek segment, the critical flow will be considered to be 10.28 cubic feet per second (cfs). This flow represents the Seven Day Low Flow that occurs once every Ten Years (7Q10) on record for the segment of Ebenezer Creek, which is required by Georgia State law for regulated waters.

Total Maximum Daily Load (TMDL)

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while achieving water quality standards. Since the only known point source of BOD in this listed segment of Ebenezer Creek is the Springfield facility, the BOD load from the plant will be evaluated in the TMDL calculation. This TMDL will be expressed as a loading capacity. If in the future, a point or nonpoint source load of BOD is introduced in the system, the total of the WLA (wasteload allocations for point source loadings) and LA (load allocation for nonpoint source loadings) shall not exceed this loading capacity.

Margin of Safety

The margin of safety (MOS) is part of the TMDL development process. There are two basic methods for incorporating the MOS (USEPA, 1991a):

- Implicitly incorporating the MOS using conservative model assumptions to develop allocations, or
- Explicitly specifying a portion of the total TMDL as the MOS; using the remainder for allocations.

The MOS is incorporated implicitly into this modeling process by selecting the 7Q10 critical low flow.

TMDL Calculation

The TMDL calculation will utilize the conservation of mass principle, where the load can be calculated by using the following relationship:

Concentration = Load / Flow

Rearranging this equation the maximum load can be calculated as follows:

Load = Concentration (BOD) * Flow

Table 3 TMDL Calculation

Pollutant	TMDL (kg/day)	WLA (kg/day)	LA (kg/day)	MOS
BOD	1175	0	1175	Implicit

Seasonal Variation

The low flow condition represents the most critical design condition for determining the impact of the Springfield WPCP and will provide year round protection.

Allocation of Responsibility and Recommendations

For a potential future point or nonpoint source of BOD loadings introduced into the system, the total of the WLA (wasteload allocations, point source loadings) and LA (load allocation for nonpoint source loadings), shall not exceed this TMDL. Table 3 provides the allocation of BOD to this segment of Ebenezer Creek. Because this segment does not achieve water quality standards the wasteload allocation to Springfield WPCP is 0 kg/day during dry weather.

The development of this TMDL used the dry weather condition to determine the maximum daily load of BOD that could occur in this segment to achieve water quality standards. Reviews of available data taken

from within this segment (Springfield WPCP to Savannah River) and upstream of this segment indicate that additional loads and processes are occurring that have not been quantified in this TMDL. These additional loads are a combination of natural background and nonpoint source BOD contributions, both of which are a component of the existing nonpoint source load in this TMDL. Since these nonpoint sources of BOD are undefined and, therefore, uncontrolled at this time, and since these nonpoint sources of BOD exceed the assimilative capacity of this water, the entire loading capacity of the water during critical conditions has been assigned to the load allocation.

Additional information needs to be collected to determine all sources of oxygen demanding materials in this water. EPA intends to do additional data collection on this segment and expects, based on that data, to revisit this TMDL. There exists the potential that this waterbody is a naturally occurring low dissolved oxygen system. The allocations of responsibility and recommendations contained in this TMDL may change in a future TMDL based on that additional data analysis.

Dissolved Oxygen

Figure 1 illustrates dissolved oxygen measurements taken at an upstream (above Springfield WPCP) and downstream (below Springfield WPCP) location for 1997. The upstream station is not influenced by any NPDES permitted facilities and represents the background conditions for Ebenezer Creek. While the dissolved oxygen concentrations are somewhat higher at the upstream sampling station, they do represent a water quality standard violation. The downstream station shows a greater decline in dissolved oxygen. It is doubtful that this decline can be fully attributed to the Springfield WPCP, which is located between the two stations. The Springfield WPCP has been utilizing a Land Application System (LAS) the past three years. The LAS was operational during this sampling period. It is believed that Ebenezer Creek is a naturally low dissolved oxygen system, but further investigations need to be made to substantiate this claim.

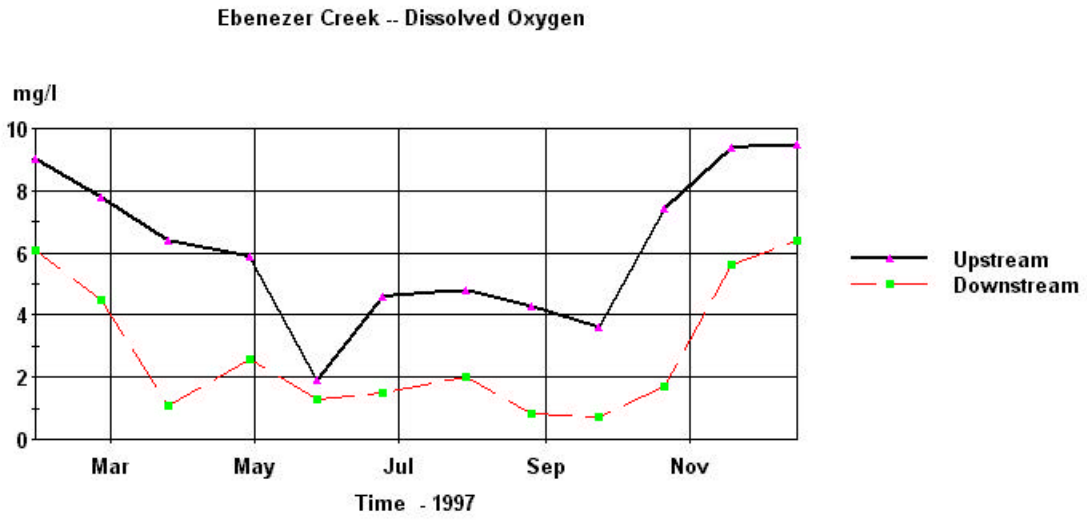


Figure 1 Dissolved Oxygen

Biological Oxygen Demand

Figure 2 illustrates the differences in BOD between the upstream and downstream segment. BOD represents the largest oxygen demanding material released from the Springfield WPCP. This graph indicates a small difference between instream BOD concentrations between the two stations. This further substantiates that other sources are impacting dissolved oxygen in the creek.

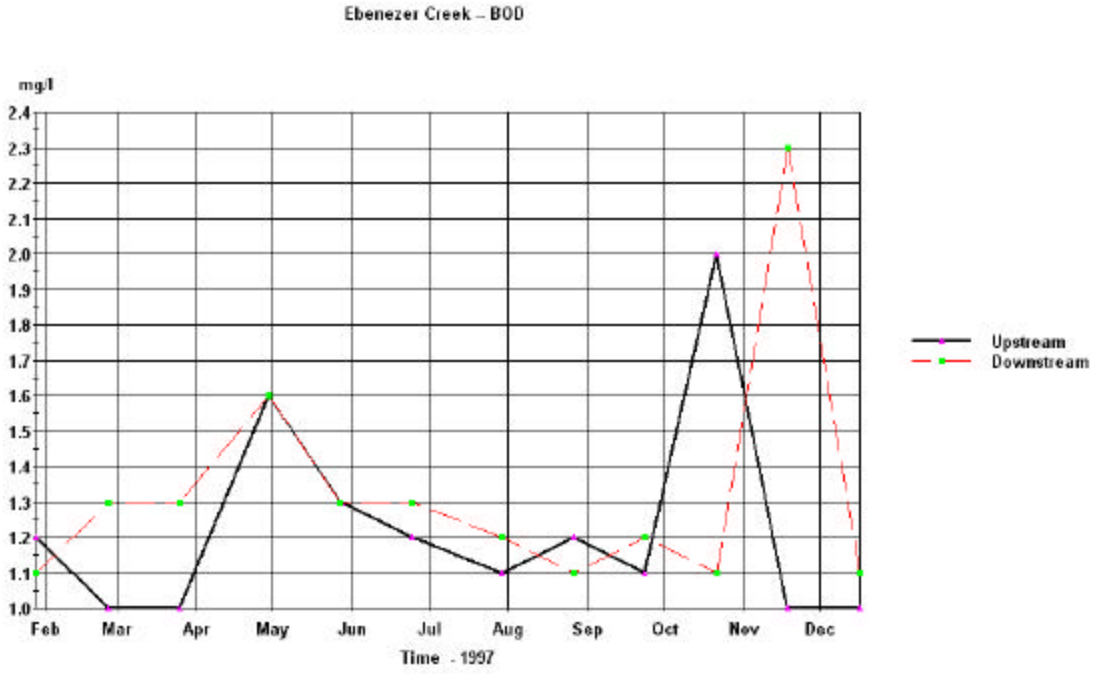


Figure 2 Biological Oxygen Demand

Fecal Coliform

Figure 3 provides additional insight into the dynamics of Ebenezer Creek. The fecal coliform concentrations are consistently higher at the upstream station compared to the downstream station. This indicates possible nonpoint source runoff and contributions from surrounding swamps and marshes that may be impacting water quality.

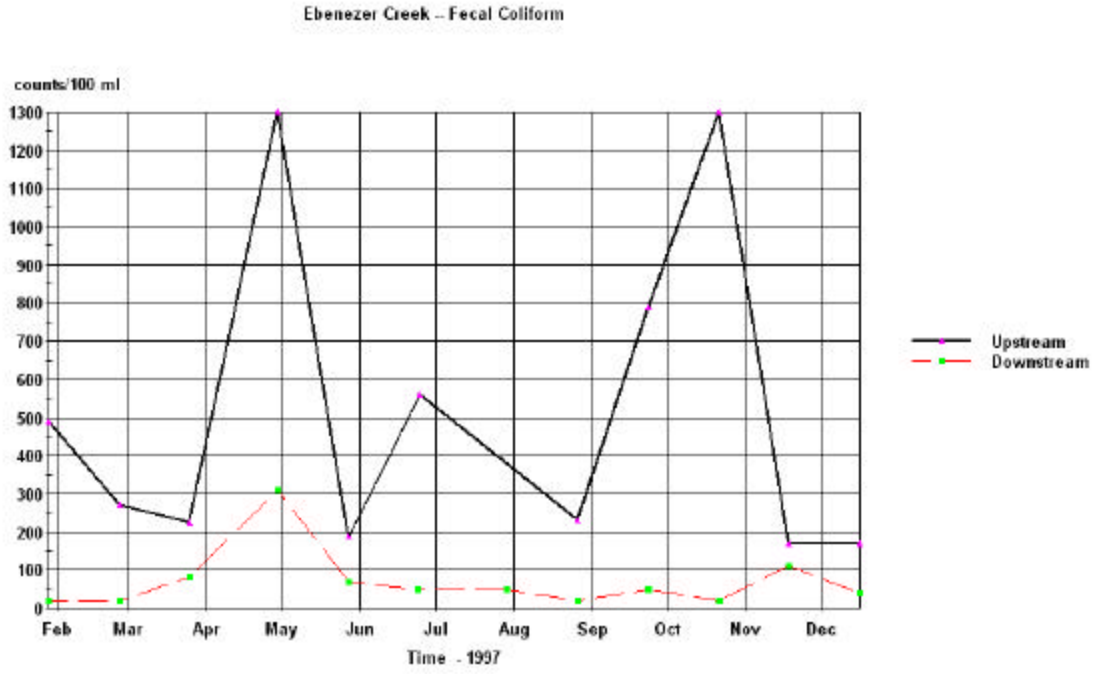
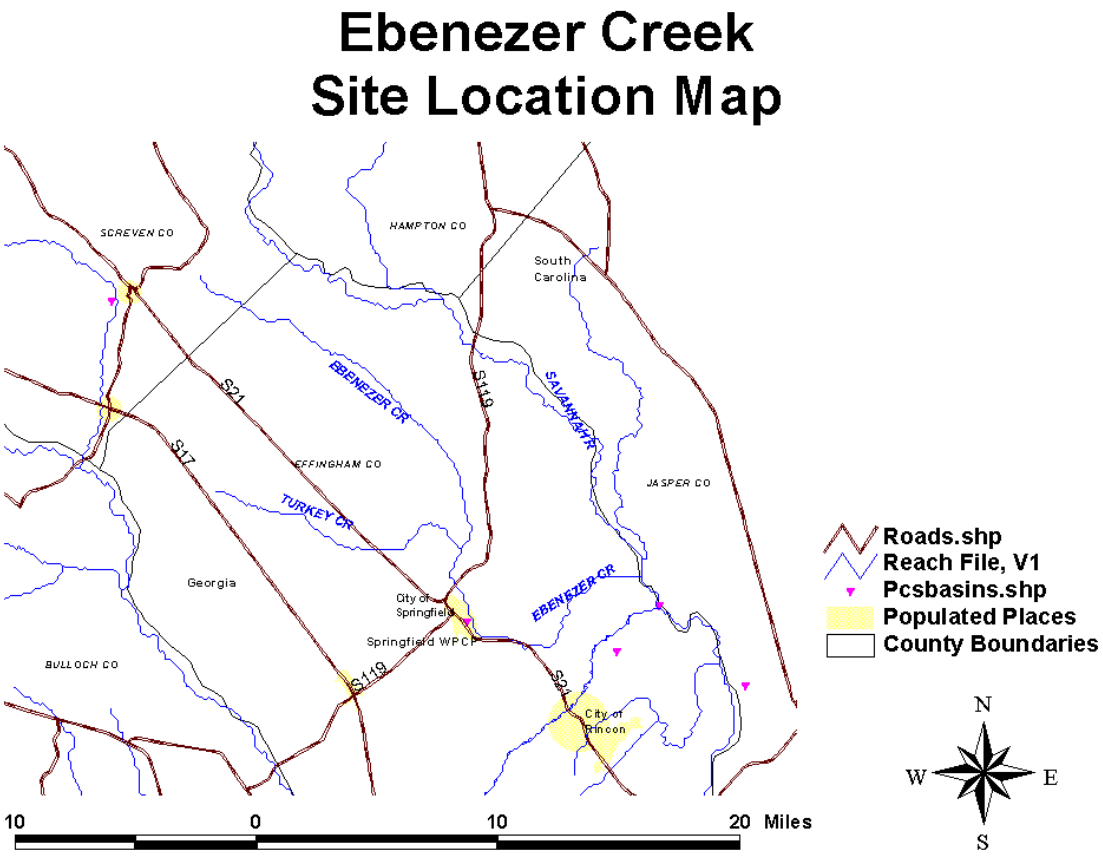


Figure 3 Fecal Coliform

Future TMDL Development

Because of the complexities associated with this low dissolved oxygen waterbody, it is necessary to collect additional information to support the assumptions needed to develop a comprehensive TMDL that addresses both point and nonpoint source impacts on dissolved oxygen. Ebenezer Creek needs to be evaluated to determine if the low dissolved oxygen concentrations are due to natural background conditions.

Appendix A -- Site Map



Appendix B – Units Conversion Table

From	To	Multiply by:
Million Gallons per Day (MGD)	Cubic Meters per Second (cms)	0.04381
Cubic Feet per Second (cfs)	Cubic Meters per Second (cms)	0.02832
Pounds (lbs)	Kilograms (Kg)	0.4536
Tons (Short)	Kilograms (Kg)	907.1848
Tons (Long)	Kilograms (Kg)	1016.00

Administrative Record Index

1. Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, Water Use Classifications and Water Quality Standards
2. STORET Water Quality Data
3. Georgia Environmental Protection Division Stream Monitoring Data
4. On Disk: Excel Spreadsheet to calculate TMDL
5. File Location m:\apps32\tmdl\phinizy

Response to Public Comment on Proposed TMDL

COMMENT

The proposed TMDL does not address wet weather conditions even though the Springfield Land Application System is noted as a potential discharger of effluent during wet weather conditions. This is objectionable. Is there actual water quality data that says that discharge of effluent during wet weather has no impact on dissolved oxygen levels in Ebenezer Creek ? It is not a valid assumption in the absence of such data that storm events do not impact dissolved oxygen.

Mr. Eric E. Huber, EarthJustice Legal Defense Fund, 400 Magazine Street, Suite 401, New Orleans, Louisiana 70130-2453, December 7, 1999

RESPONSE

This TMDL is being developed as part of the Georgia TMDL Lawsuit Consent Decree that requires TMDL's to be developed for listed segments that are impacted by point source dischargers. The Springfield wastewater treatment plant successfully converted to a land application system. According to GAEPD files the facility had only a couple of days in which discharge occurred since switching to LAS. Reviewing other water quality stations located upstream of the Springfield LAS indicates additional water quality impairment. That is why it is suggested that a basin wide investigation occur to determine sources of pollutants.

COMMENT

Please advise of the schedule for additional data collection and revisit of the TMDL, since that might obviate a need for further action or review of this TMDL.

Mr. Eric E. Huber, EarthJustice Legal Defense Fund, 400 Magazine Street, Suite 401, New Orleans, Louisiana 70130-2453, December 7, 1999

RESPONSE

EPA is committed to the additional data collection. Because of the size and complexity of Ebenezer Creek and EPA's work load the GAEPD will have to cooperate in the study.

COMMENT

A more robust time varying model would simulate the diurnal temperature and loading effects.

Mr. Michael E. Wilder, Water Resources Workgroup Chair, and Mr. James R. Baker, Chair, Georgia Industry Environmental Coalition, 112 Town Park Drive, Kennesaw, Georgia 30144, December 14, 1999

RESPONSE

EPA agrees that this would be the better approach. Unfortunately there is a limited data available for this listed segment. When additional data is available this TMDL will be re-visited.

COMMENT

There are sinks of dissolved oxygen, other than biochemical oxygen demand, in natural systems. Sediment oxygen demand (SOD) was simulated but the resulting daily SOD deficit load was not included in the load allocation portion of the TMDL.

Mr. Michael E. Wilder, Water Resources Workgroup Chair, and Mr. James R. Baker, Chair, Georgia Industry Environmental Coalition, 112 Town Park Drive, Kennesaw, Georgia 30144, December 14, 1999

RESPONSE

Sediment oxygen demand is an internal process to the waterbody and therefore has not been assigned a load allocation.

COMMENT

It was not clear if the TMDLs represented a 5-day or an ultimate biochemical oxygen demand (BOD) load. Can the upstream and tributary loadings (BOD, ultimate carbonaceous oxygen demand, $NBOD_u$) be reduced or can the downstream creek channels be enhanced to increase the assimilative capacity?

Mr. Michael E. Wilder, Water Resources Workgroup Chair, and Mr. James R. Baker, Chair, Georgia Industry Environmental Coalition, 112 Town Park Drive, Kennesaw, Georgia 30144, December 14, 1999

RESPONSE

Because this TMDL is not being used to a assign a waste load to NPDES permitted facility this TMDL determines the amount of oxygen demanding material that can be assimilated by Ebenezer Creek and still maintain the water quality standard. For this exercise all oxygen demanding material was represented to the model as ultimate BOD.

COMMENT

There is a need for consistency in EPA's use of units and time scale of the loads and permit limits. It does not appear that the TMDL results in a determination of a daily load for the waterbody or permit, but rather average monthly loads. The implied MOS is of concern especially if daily maximum loads are not being considered.

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

EPA will express all of its calculations in metric units. A units conversion table is included as an appendix to the TMDL.

COMMENT

The pollutant of concern is stated on page 1 as being BOD. Does this include ammonia ?

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

Because this TMDL is not being used to a assign a waste load to NPDES permitted facility this TMDL determines the amount of oxygen demanding material can be assimilated by Ebenezer Creek and still maintain the water quality standard. For this exercise all oxygen demanding material was represented to the model as ultimate BOD. When additional information is collected in the future, ammonia will also be considered.

COMMENT

Since the LAS is only able to handle 355,000 gpd and the wastewater plant has a capacity of 500,000 gpd, there may be a need to discharge to the stream during low flows.

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

GAEPD permit information for this facility documents that no discharges have occurred during low flow.

COMMENT

The Background section of the TMDL suggests that this TMDL is not accounting for all significant factors.

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

Influences of residential and agricultural practices in the watershed have not been parameterized in this modeling effort.

COMMENT

Since this is described as a backwater, black water stream, the background DO in Table 1 may be too high. Is any diurnal DO accounted for ?

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

Diurnal variations in dissolved oxygen are not considered in this TMDL. Given the limited data, it would be difficult to select a background dissolved oxygen concentration.

COMMENT

The SOD in Table 2 looks low compared to the value used for the Butler Creek model, and it is assumed that the units should include per day.

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

There is no site-specific SOD data for Ebenezer Creek. The units are $g/m^2/day$.

COMMENT

The 7Q10 of 10.28 cfs seems high for this stream. Is this an estimated or gaged flow ?

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

The 7Q10 flow was obtained from USGS published data.

COMMENT

Is the plant BOD used in the TMDL as CBOD, and is the load daily maximum or average ?

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

The plant data is not used in the TMDL determination because it does not discharge at low flow. The TMDL exercise determines the maximum load of oxygen demanding material (as ultimate BOD).

COMMENT

The implicit MOS is inadequate if there are problems at higher flows.

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

At higher flows the TMDL calculation would yield a higher daily load.

COMMENT

In the equation at the top of page 9, it appears that the concentration would not be the water quality standard but the calculated load of BOD (or CBD plus ammonia ? 5-day or ultimate ?) from the model. This should be changed and there needs to be a better explanation of how the standards and loads are related.

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

The model was used to calculate the assimilative capacity of Ebenezer Creek. The calculation is made independent of current conditions, but instead uses conditions that would be considered natural.

COMMENT

Is the allocation of zero to the wastewater plant consistent with the permit limits for dry weather flows, or does the permit need to be modified ?

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

The plant does not have an effluent limit for dry weather flows. The facility has never discharged during low flow.

COMMENT

When does EPA plan to do additional field work and revise the TMDL ?

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

EPA is committed to the additional data collection. Because of the size and complexity of Ebenezer Creek and EPA's work load the GAEPD will have to cooperate in the study.

COMMENT

The DO data in Figure 1 shows an upstream DO of 2 mg/l in about June 1997. Why was 5 mg/l used instead for the stream DO as shown in Table 1 ?

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

The model was used to calculate the assimilative capacity of Ebenezer Creek. The calculation is made independent of current conditions, but instead uses conditions that would be considered natural.

COMMENT

The fecal data in Figure 9 show high counts at the upstream location. Why was this segment not listed for fecal ? This suggests that there is a source of fecal that could contribute BOD. Are there any sewers in this reach that could be leaking or overflowing ? Is the fecal believed to be coming from runoff ?

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

RESPONSE

The upper segment was not listed by the State of Georgia for fecal coliforms. Initial survey of the landuses in the upper portion of the watershed indicates agriculture and low-density residential areas. EPA believes a large portion of the oxygen demanding material and fecal coliform is coming from nonpoint source runoff.

References:

Ambrose Jr R.B., Wool, T.A., Connolly J.P. and Schanz R.W. (1988) *WASP4, A Hydrodynamic and Water Quality Model – Model Theory, User's Manual, and Programmer's Guide*. U.S. Environmental Protection Agency. Environmental Research Laboratory, Athens, Georgia. EPA/600/3-87/039.

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Sierra Club v. EPA & Hankinson USDC-ND-GA Atlanta Div. #1: 94-CV-2501-MHS

USEPA 1991a. Guidance for Water Quality-based Decisions: The TMDL Process. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA/440/4-91-001, April 1991.