TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT

For

Dissolved Oxygen

In the

Ogeechee River

(HUC 03060109)

Effingham County, Georgia

EPA United States Environmental Protection Agency

Region 4 serving the southeast

APPROVAL PAGE

for *OXYGEN DEMANDING MATERIAL* in

Ogeechee River, GA

Georgia's final 1998 303(d) list identified Ogeechee River, 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 there are no known point sources of BOD in this listed segment of the Ogeechee River, a load allocation (LA) will be developed. 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.

TMDL (kg/day)	**WLA (kg/day)**	**LA (kg/day)**	**MOS**
4125.6	0	4125.6	Implicit

APPROVED BY:

_____ _____

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 a segment of the Ogeechee River (US 301 to Highway 119) 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. This segment of the Ogeechee River does not have a direct NPDES discharger; three tributaries to this segment have permitted dischargers though the tributaries are not listed. This TMDL will establish a maximum total daily load of oxygen demanding material that may enter the upstream of the listed segment while allowing water quality standards to be met.

Target Identification

The target level for the development of the Dissolved Oxygen TMDL in the Ogeechee River 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 Regulations establishes the freshwater criteria 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 dissolved oxygen 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. The Ogeechee River is a warm water stream.

Background

The Ogeechee River flows from middle Georgia to the southeastern coast. The segment listed on the State of Georgia's 303(d) list is located southeast of Millen starting at US Highway 301 to Highway 119. The Ogeechee River is on the State of Georgia's §303 (d) list for violating the dissolved oxygen standard for the State of Georgia. There is very little water quality data that has been collected for this segment of the Ogeechee River. The Georgia Environmental Protection Division (EPD) at the request of the Ogeechee River Basin Association conducted a water quality survey to assess the conditions of the Ogeechee River. Two surveys were conducted by EPD, the first survey was during a low flow year and the second survey during a high flow year. In both surveys, EPD concluded that the water quality was impaired mainly to nonpoint sources within the basin. Water quality standards violations typically did not occur during low flow summer time conditions. Additional surveys and water quality data will need to be collected and a basin-wide TMDL will need to be developed. In the interim, this TMDL is being developed in response to requirements of the Georgia TMDL Lawsuit Consent Decree.

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 the Ogeechee River for oxygen demanding materials. An 80% saturation of dissolved oxygen was assumed for the upstream boundary.

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 the Ogeechee River. The model was parameterized using critical low flow conditions (7Q10 Flow) and summer time temperatures. The model included biological oxygen demand, nitrification and reaeration on predicted instream dissolved oxygen concentrations. A maximum load allocation for this segment of the river was determined iteratively using the WASP5 model.

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	174 cfs
Dissolved Oxygen	6.15 mg/l
BOD	9.8 mg/l
Water Temperature	26 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

This TMDL addresses low flow as a critical condition for this segment of the Ogeechee River. Low flow is when point source influences on dissolved oxygen are the greatest. 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 the Ogeechee River that will allow it to achieve water quality standards. For the Ogeechee River segment, the critical flow will be considered 4.873 cubic meters per second (cms). This flow represents the Seven Day Low Flow that occurs once every Ten Years (7Q10) on record for the segment of Ogeechee River, 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 there are no known point sources of BOD in this listed segment of the Ogeechee River, a load allocation (LA) will be developed. 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 that will maintain the dissolved oxygen standard in this segment is calculated as follows:

Load Allocation = BOD Concentration * Flow (4.873 cms)

Table 3 TMDL Calculation

Pollutant	Boundary DO	TMDL (kg/day)	WLA (kg/day)	LA (kg/day)	MOS
BOD 9.8 mg/l	6.15	4125.6	0	4125.6	Implicit

Seasonal Variation

The low flow condition represents the most critical design condition for determining the impact of oxygen demanding materials on dissolved oxygen. Evidence indicates that wet weather impacts can be contributing the majority of the oxygen demanding material to the Ogeechee River.

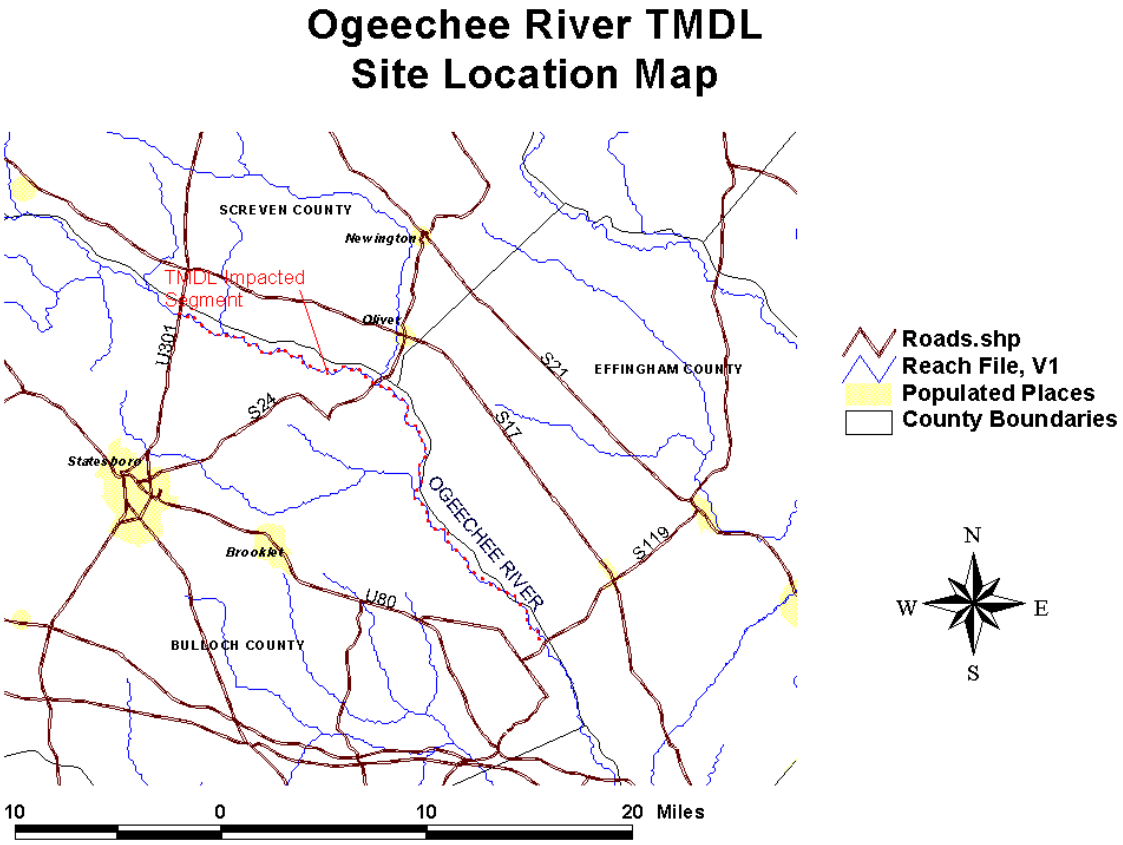
Allocation of Responsibility and Recommendations

For a potential future point or nonpoint source of BOD loadings introduced into the system, the total of the WLA (wasteload allocations for 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 Ogeechee River. Because this segment does not achieve water quality standards during dry weather, the wasteload allocation will be 0 kg/day.

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 (US 301 to Highway 119) and upstream of this segment indicate that additional loads and processes are occurring that have not been addressed in this dry weather 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 surveys and water quality data will need to be collected and a basin-wide TMDL developed to more comprehensively address point and nonpoint sources contributions to the dissolved oxygen impairment.

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

1. 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. Model available from http://www.epa.gov
2. Compilation of Georgia's Current Modeling Guidelines for the Development of Wasteload Allocations and NPDES Permit Limitations. January 1991
3. Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, Water Use Classifications and Water Quality Standards
4. STORET Water Quality Data
5. Georgia Environmental Protection Division Stream Monitoring Data
6. On Disk: WASP Input Datasets m:\apps32\tmdl\ogeechee
7. On Disk: Excel Spreadsheet to calculate TMDL m:\apps32\tmdl\ogeechee

Response to Public Comment on Proposed TMDL

COMMENT

The TMDL notes that a basin-wide TMDL will need to be developed to more comprehensively address point and nonpoint source contributions to the dissolved oxygen impairment. Please advise on when and on what schedule that TMDL will be done as it might obviate a need for further action or review of this particular initial TMDL.

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

RESPONSE

EPA cannot commit to a time schedule for when the detailed basin analysis will be conducted. This will have to be done in conjunction with GAEPD.

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

There exist modeling techniques that allow for the simulation and prediction of diurnal effects on dissolved oxygen. There was not enough data available to adequately calibrate and apply a time variable model for this TMDL development.

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

SOD is not considered to be an external load and therefore is not part of the load allocation. As noted by the commenter, however, SOD was simulated in the model as a sink for dissolved oxygen.

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 a NPDES permitted facility this TMDL determines the amount of oxygen demanding material that can be assimilated by the Ogeechee River and still maintain the water quality standard. For this calculation 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

Metric units will be used to report all calculations. A units conversion table is provided in the appendix of the TMDL. There are no permits evaluated in this TMDL.

COMMENT

The cover page shows this to be in the Savannah River basin, but this river does not flow into the Savannah.

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

RESPONSE

This is corrected in the final TMDL.

COMMENT

At the bottom of page 1, there is mention of 3 tributaries to this segment with permitted dischargers. It is unclear why these segments are not listed if they are WQLSs for DO, and if/how they are accounted for in this TMDL.

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

RESPONSE

This TMDL is being developed for the listed segment only. None of the tributaries that flow into this segment are on Georgia's 303(d) list.

COMMENT

On page 2 in the Background section of the TMDL, it is stated that violations did not usually occur during low flow (based on filed surveys). If the problem is with higher flows and runoff, why is the modeling done with low flow? If the DO problem is at higher flows, that's when it would have the lowest assimilative capacity and this should be addressed by a higher input value for background or runoff in the modeling.

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

RESPONSE

A TMDL will need to be developed to more comprehensively address point and nonpoint source contributions to the dissolved oxygen impairment throughout the basin.

COMMENT

On page 3, it is stated that a range is being used for upstream DO. What does this mean and how is it being used?

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

RESPONSE

This language was corrected for the final TMDL.

COMMENT

In Table 1, does the STORET data account for possible diurnal DO impacts? If the model includes nitrification, why is there not a stream value for ammonia? Is it included in the BOD ? If so, then the BOD terms used in Tables 1 and 2 are not consistent.

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 wasteload to a NPDES permitted facility this TMDL determines the amount of oxygen demanding material that can be assimilated by the Ogeechee River and still maintain the water quality standard. For this calculation, all oxygen demanding material was represented to the model as ultimate BOD.

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 Ogeechee River. The units are $g/m^2/day$.

COMMENT

Pages 2 and 4 have conflicting statements - page 4 states that there is one critical condition - low flow and page 2 indicates the problem or limitation is not during low flow. This TMDL would seem to be inadequate in addressing the reason for listing.

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

RESPONSE

This TMDL was developed for critical (7Q10) flow condition.

COMMENT

On page 4 in the second line of the last paragraph, should be A...condition addressed.

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

RESPONSE

This has been corrected in the final TMDL.

COMMENT

There appears to be no margin of safety or seasonal variation consideration if the low flow is being used and the problem is at higher flows.

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

RESPONSE

Because of the limited data available and no point source dischargers to this segment of the river, this TMDL was developed to determine maximum load this segment of the Ogeechee River could assimilate under low flow. Any other flow would yield a higher load calculation.

COMMENT

In the TMDL Calculation section of the TMDL, the flow is given in CMS while it is given in cfs on previous pages. Consistency is needed for units in order to aid understanding.

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

On page 6, it is stated that the segment does not meet DO standards in dry weather, but this conflicts with page 2 statement regarding no violations during low flow. The DO value of 6.15 in Table 3 is not a violation as is suggested in the text. The statement in the Allocation of Responsibility and Recommendations section of the TMDL about the loads being from background and nonpoint does not seem consistent with the value in Table 3, or the fact that this is only being done for low flow when there would be nonpoint contributions.

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 wasteload to a NPDES permitted facility, this TMDL determines the amount of oxygen demanding material that can be assimilated by the Ogeechee River and still maintain the water quality standard at low flow.

COMMENT

Three tributaries to the segment have permitted dischargers, but these dischargers do not seem to be identified or named in the TMDL document and no wasteload allocation is made to them. Thus, the TMDL is not set at a level which allows obtaining water quality standards.

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 for the listed segment only. None of the tributaries that flow into this segment are on Georgia's 303(d) list.

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.

Better Assessment Science Integrating Point and Nonpoint Sources, BASINS, Version 2, User's Manual. EPA-823-B-98-006

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Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, Water Use Classifications and Water Quality Standards, July 1999.

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

USEPA. 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.

Water Quality Investigation of Ogeechee River, Ogeechee River Basin 1992-1993, Georgia Department of Natural Resources.