Big Creek Dissolved Oxygen TMDL

Proposed by:

U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

February 2002

In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et.seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S Environmental Protection Agency is hereby establishing a Total Maximum Daily Load (TMDL) for dissolved oxygen for Big Creek. Subsequent actions must be consistent with this TMDL.

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Beverly H. Banister, Director
Water Management Division

Date

Table of Contents

1.0 TMDL Executive Summary

Basin Name: Big Creek Watershed in the Lower Ocmulgee River

Table 1-1. EPA Listed Segment for Dissolved Oxygen in the Big Creek Watershed.

STREAM	SEGMENT LENGTH, (Miles)	1999 WQ STATION	USGS FLOW STATION	12 DIGIT HUC ID
Big Creek	33	02215165	02215100	030701040401, 030701040402, 030701040403, 030701040404, 030701040405

Description of Analysis
USGS water quality data collected in 1999 identified 2 out of 20 dissolved oxygen (DO) measurements did not meet the water quality standard of 5.0 mg/L daily average and 4.0 mg/L minimum. The 2 impairments occurred on August 12 and 19 during a period of low flow. The data further indicated that these impairments occurred during, and were limited to, summer months, low flow and high temperature conditions. Stream flows during periods of impairment were at 7Q10 (the minimum 7-day average flow that occurs once in 10 years on the average), which is consistent with the 3-year drought experienced in Georgia from 1998 to 2000. Since the observed dissolved oxygen impairments were clearly driven by persistent low flows and high temperatures, occurring over the summer months, a steady state modeling approach was adopted as appropriate for dissolved oxygen TMDL analysis.

Applicable Water Quality Standards
The applicable dissolved oxygen water quality standards for waters in the Big Creek Watershed are as follows:

Numeric - GAEPD. 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. 391-3-6-.03 (c) (I). (GAEPD, 2000)

Natural Water Quality – GAEPD. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and best management practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation. 391-3-6-.03 (7). (GAEPD, 2000)

Natural Water Quality – EPA. Where natural conditions alone create dissolved oxygen concentrations less than 110 percent of the applicable criteria means or minima or both, the minimum acceptable concentration is 90 percent of the natural concentration. (USEPA, 1986).

Due to naturally occurring low dissolved oxygen in the impaired segment, the EPA natural water quality standard was appropriate to support the proposed allocations. That is, if a model result showed a natural dissolved oxygen less than 5.0 mg/L, the natural model result would define the DO standard to be applied. In this case, the standard would become 90 percent of the computed natural DO.

Technical Approach

Model Adopted: Georgia DoSag – steady-state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from August 1999.

Calibration Conditions: (1) USGS flows measured in August 1999 (same as 7Q10 flow computed from historical record – April 1986 through December 1999).
(2) USGS temperatures measured in August 1999.
(3) Point sources at permit limits because DMR data were not available. Two discharges were not required to monitor under the existing permits.
(4) SOD values for 'mixed land uses' based on year-2000 TMDLs for the South 4 Basins.
(5) Depths, velocities, kinetic rates, reaeration, and boundary conditions based on 1999 USGS field data and/or GAEPD standard modeling practices.

Critical Conditions: After comparing the flow and temperature conditions in August 1999 to the historical data, it was determined that August 1999 was the critical time period for dissolved oxygen in Big Creek. Therefore, the calibration conditions and critical conditions are equivalent.

Natural Conditions: (1) Same flows as critical conditions.
(2) Same temperatures as critical conditions.
(3) All point sources completely removed.
(4) SOD for natural (i.e., fully forested) land use based on year-2000 TMDLs for the South 4 Basins.
(5) Same depths, velocities, kinetic rates, reaeration, and boundary conditions as calibration conditions.

MOS: Implicit, based on the following conservative assumptions:
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) All point sources discharge continuously at their NPDES permit limits for the same critical period.
(4) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 1999.
(5) Water depths are shallow, generally less than one foot, which aggravates the effect of SOD.
(6) Water velocities are sluggish, generally 0.5 fps or less, which intensifies the effect of BOD decay.

Seasonality: Dissolved oxygen data showed no impairments outside of the high-temperature, low-flow conditions which occur during the summer months.
Monitoring: Follow-up monitoring according to 5-year River Basin Planning cycle (Georgia EPD, 1996)
Approach: NPDES Permits for point sources; Best management practices for nonpoint sources.
Date Submitted: Proposed on August 30, 2001.

Table 1-2. Summary of the Big Creek TMDL for Dissolved Oxygen.

STREAM	TMDL (lbs/day)*
Big Creek	169

*** lbs/day of Oxygen Demanding Material**

2.0 TMDL Background

The State of Georgia is required to develop Total Maximum Daily Loads (TMDLs) for waters not meeting water quality standards, in accordance with Section 303(d) of the Clean Water Act and the U. S. Environmental Protection Agency (EPA) Water Quality Planning and Management Regulations (40 CFR Part 130). Water quality data collected by the United States Geological Survey (USGS) in 1999 and by EPA in March 2001 indicated that Big Creek in the Lower Ocmulgee River Basin did not achieve water quality standards for dissolved oxygen.

The Lower Ocmulgee River Basin is part of the Middle Three Basins in Georgia. The three river basins, the Altamaha, Ocmulgee, and Oconee, were required by the consent decree to have TMDLs developed by June 30, 2001 (Sierra Club v. Hankinson 1997). The dissolved oxygen TMDLs for 38 impaired streams in the Middle Three Basins in Georgia were proposed by GAPED on June 30, 2001. EPA Region 4 added the Big Creek segment after they performed a habitat assessment, also required by the consent decree, in March 2001. EPA is required to propose the dissolved oxygen TMDL by August 30, 2001. The Big Creek Watershed is shown in Figure 2-1 as part of the Lower Ocmulgee River Basin (HUC 03070104).

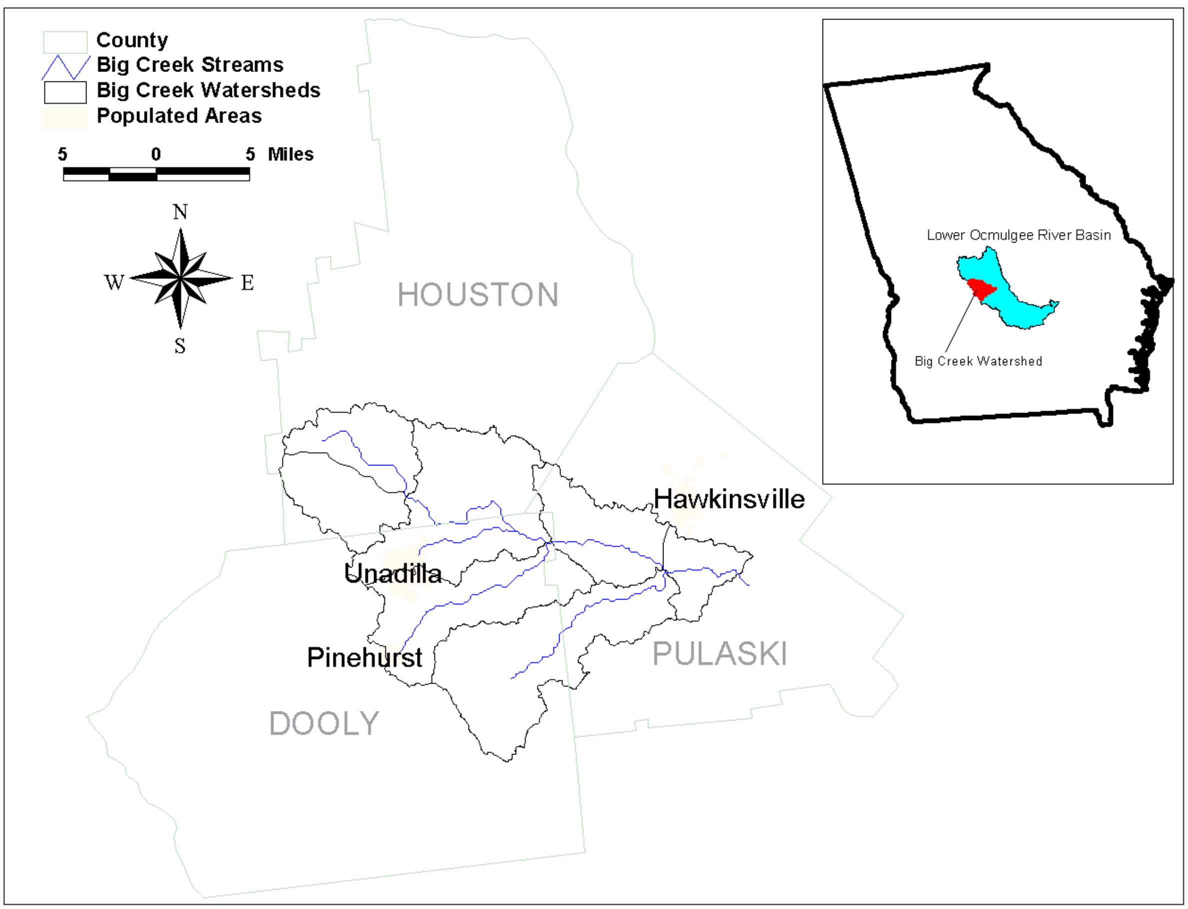

Figure 2-1. Location Map of the Big Creek Watershed.

3.0 Problem Understanding

The Big Creek Watershed is approximately 233 square miles in central Georgia. It is located in the Lower Ocmulgee River Basin and lies in the Coastal Plain Province. Big Creek flows to the east into the Ocmulgee River near Hawkinsville, Georgia. The major tributaries to Big Creek are Elko Creek, Burnham Branch, Camp Creek, South Prong Creek, and Cedar Creek as shown in Figure 3-1. There are 2 minor facilities in the watershed that discharge into Big Creek tributaries. The populated areas in the watershed are Unadilla and Pinehurst with Hawkinsville located nearby. There is a water quality station on Big Creek at USGS02215165 and a flow gage at USGS02215100, also shown in Figure 3-1.

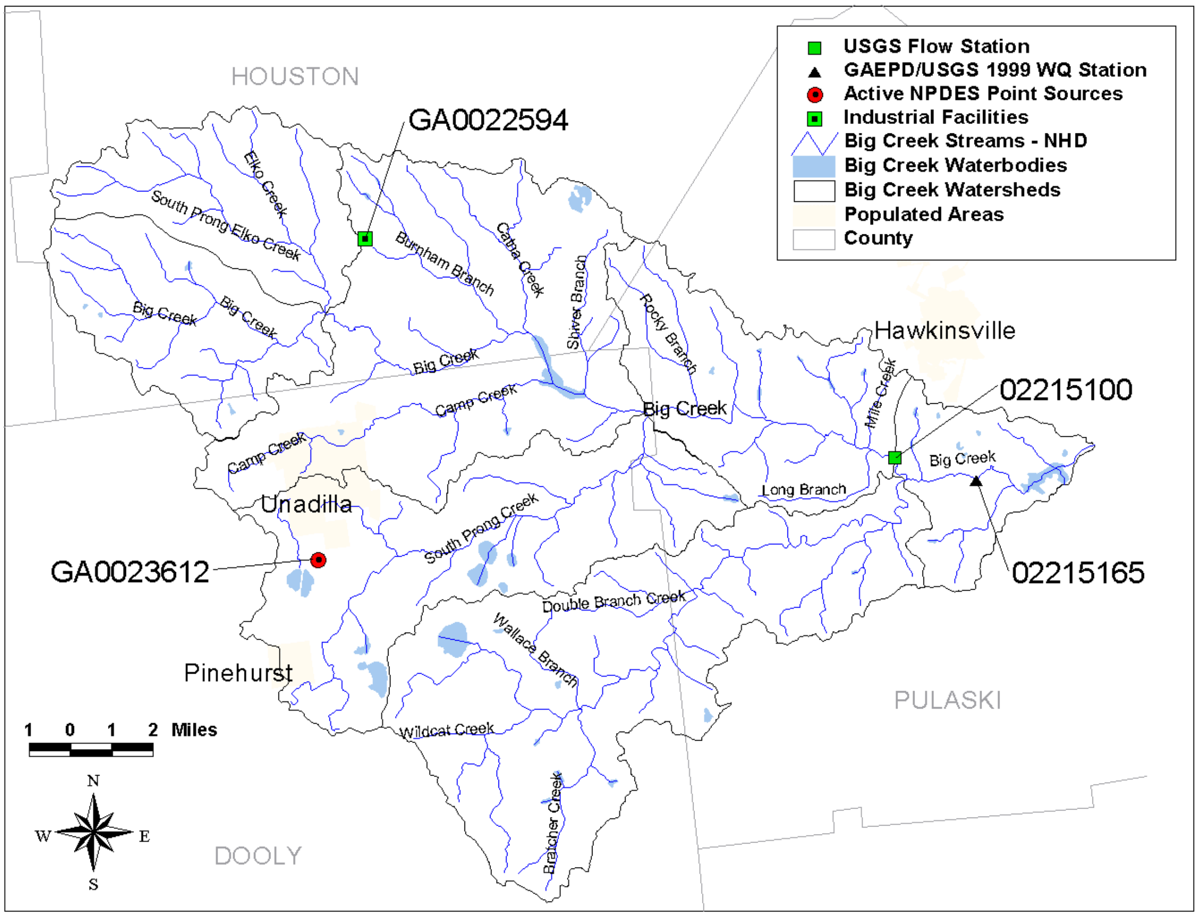

Figure 3-1. Points of Reference in the Big Creek Watershed.

USGS collected water quality data in the Middle Three River Basins, and hence the Big Creek Watershed, during 1999. These data showed that dissolved oxygen impairments occurred exclusively during August. There were only 2 impairments of 2.2 and 2.7 mg/L that occurred on August 12 and August 19, respectively. Figure 3-2 plots the dissolved oxygen data versus temperature at USGS 02215165.

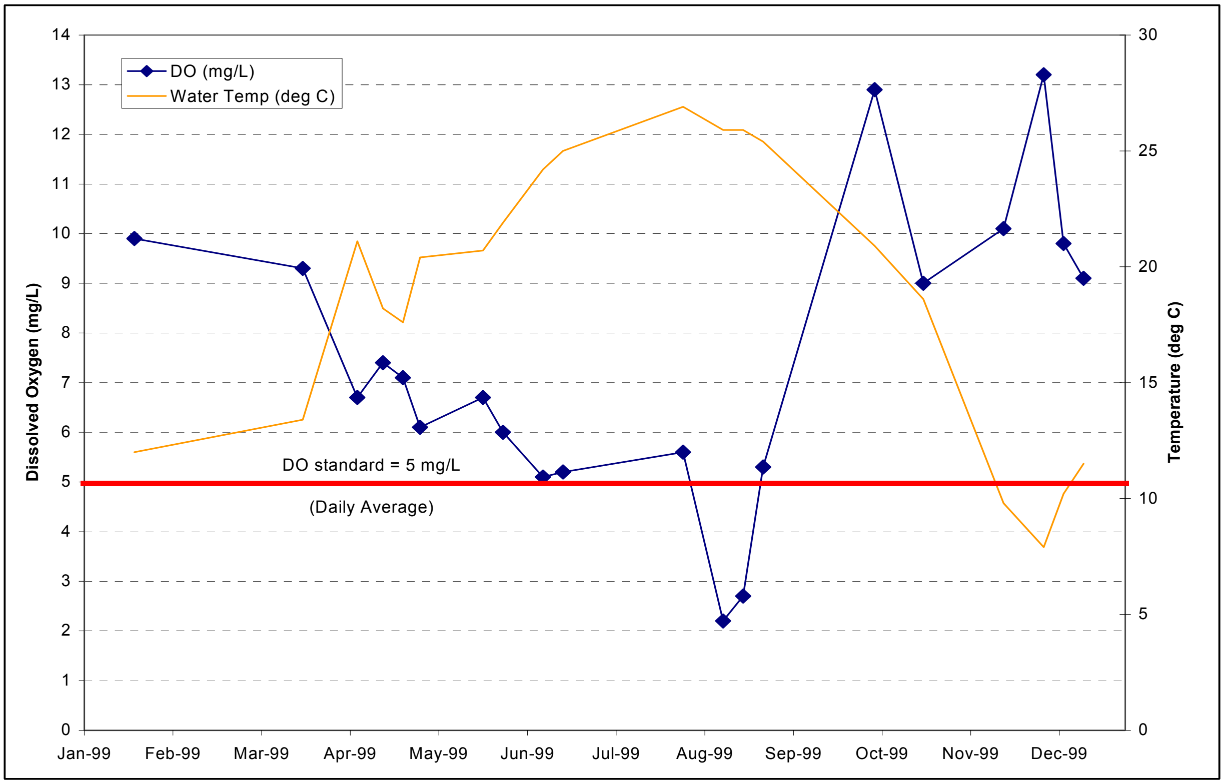

Figure 3-2. Dissolved Oxygen and Temperature Data at USGS02215165.

There is also a USGS flow gage located in the Big Creek Watershed just upstream from the water quality station shown in Figure 3-1. The historical flow data were examined from April 1986 through December 1999. A combination of programs called from the USGS was used to compute the recurrence intervals of 7-day average flow data. The Input and Output to a Watershed Data Management File (IOWDM) version 4.0 was used to convert the daily flow record into a WDM file. The Surface Water Statistics (SWSTAT) version 4.0 was used to calculate minimum 7-day averages and the 10-year recurrence interval. This analysis was used to develop an annual and monthly 7Q10 values. Table 3-1 summarizes the findings and compares to the 1999 flow record.

Table 3-1. Summary of Historical Flows and 7Q10 for USGS02215100.

Time Period	7Q10 (cfs)	1999 Minimum 7-Day Average (cfs)	1999 Daily Average (cfs)
Annual	4.5	3.8	57.3
June	8.3	6.9	9.3
July	4.2	13.7	51.3
August	3.5	3.8	6.0
September	5.8	4.9	13.2

Figure 3-3 is a plot of the daily average flows from April 1 through October 31, 1999. It is apparent from the plot that June and August were extremely dry time periods with a few thunderstorms scattered through July. Figure 3-4 is a plot of the 7-day running average flows for the same time period. The annual and monthly 7Q10 values are also shown on the plot. From this analysis and plot in Figure 3-4, it was determined that August was at the critical time period for flow in the Big Creek.

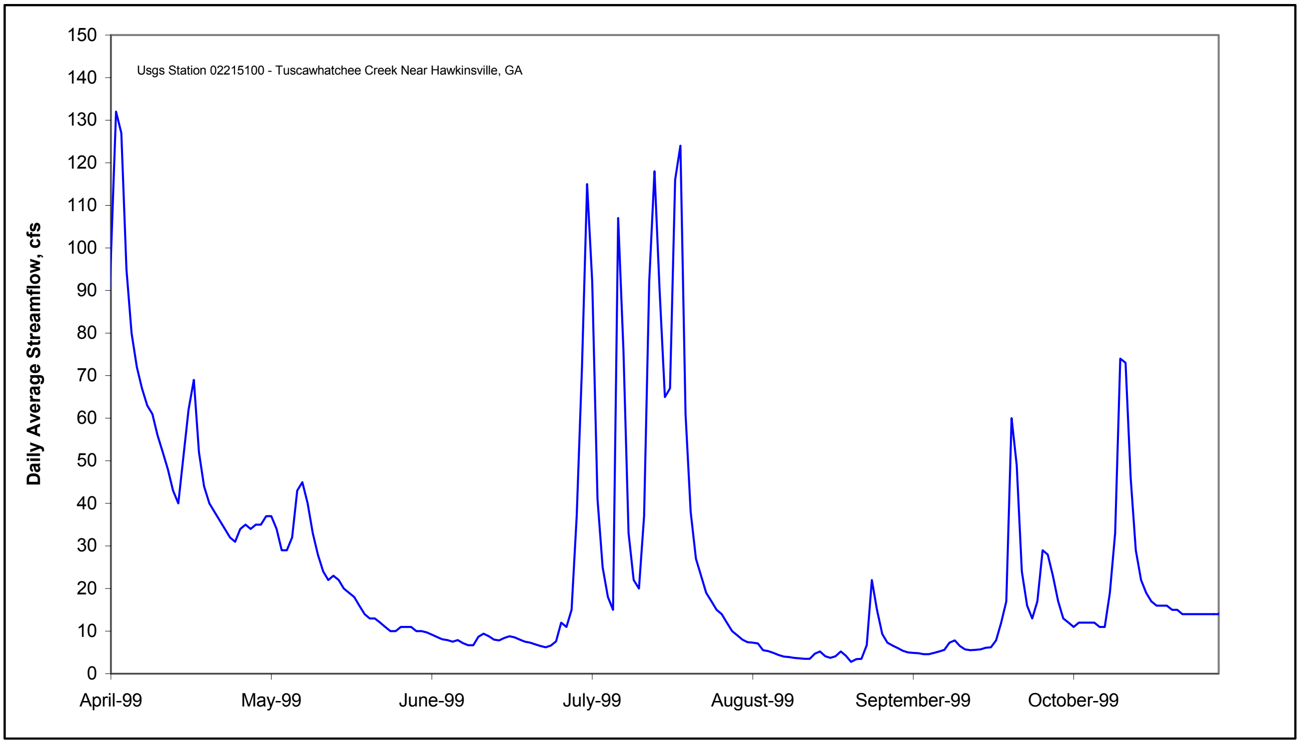

Figure 3-3. 1999 USGS Flow Data (Daily Average) at USGS02215100.

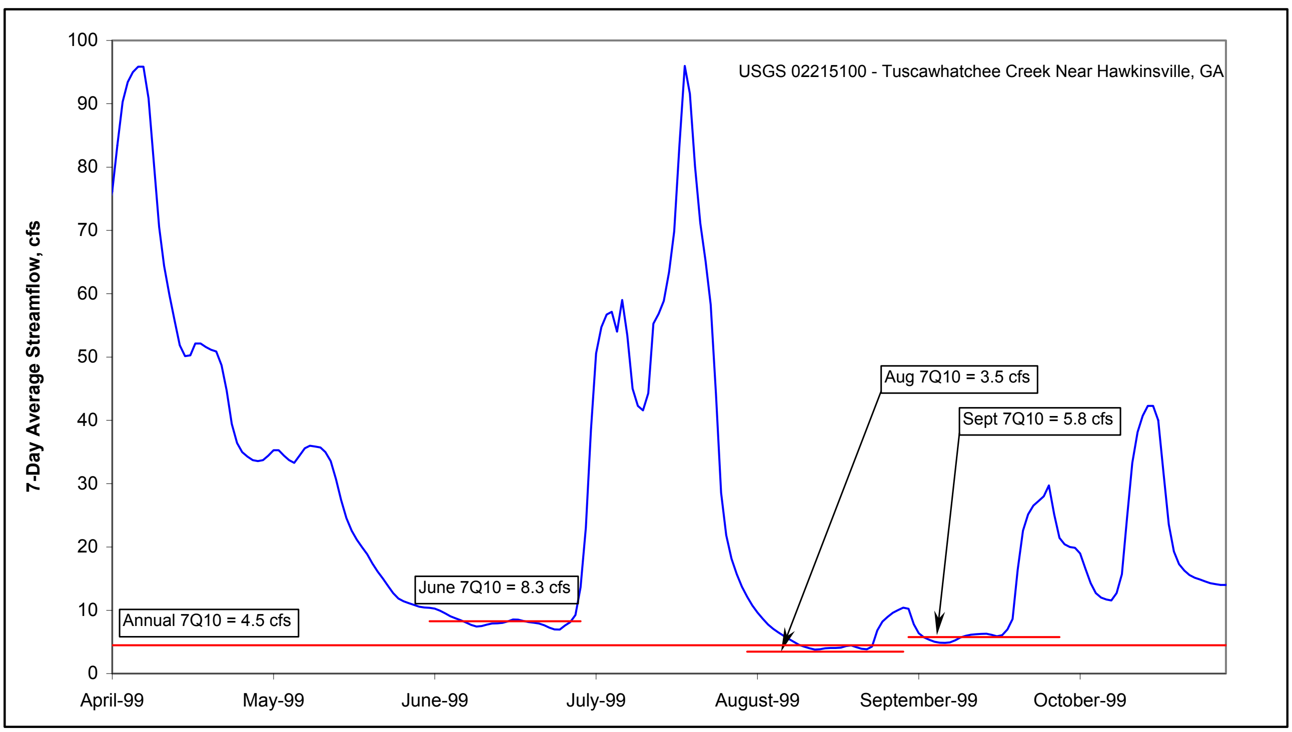

Figure 3-4. 1999 USGS Flow Data (7-Day Average) at USGS02215100.

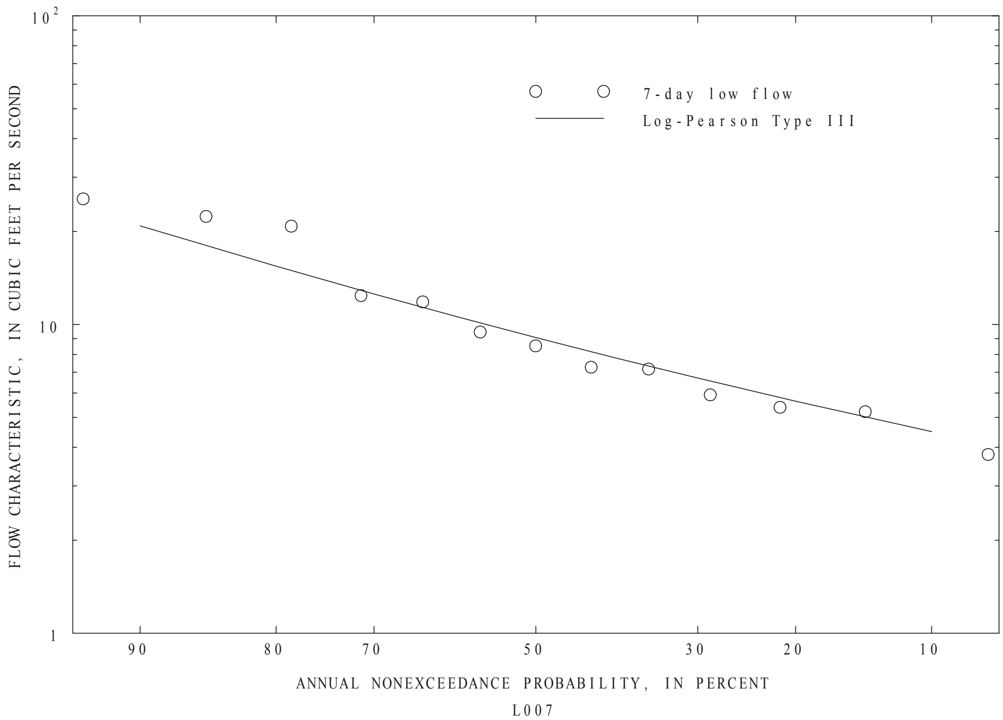

Figure 3-5. Log Pearson Type III Fit to Flow Data at USGS02215100.

Figure 3-5 presents the results of the frequency analysis in SWTAT to calculate the 7Q10. The non-exceedance probability is plotted versus the flow generated from the statistical analysis. The inverse of the non-exceedance probability is equal to the recurrence interval. Therefore, a 10-year recurrence interval is equal to a 0.1 non-exceedance probability and is expressed as 10% in Figure 3-5. From Figure 3-5, one can see the 7Q10 value of 4.5 at the 10% non-exceedance probability.

4.0 Water Quality Standards

All DO impaired waterbodies in the Big Creek Watershed in the Lower Ocmulgee River Basin have been assigned a water use classification of fishing. Georgia's water quality standards specify the following DO criteria for this use classification:

Numeric. 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*. A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resource Division. (*There are no designated trout streams in the Lower Ocmulgee River Basin).

Georgia EPD, 2000

Certain waters of the state may have conditions where dissolved oxygen is naturally lower than the numeric criteria specified above and therefore cannot meet these standards unless naturally occurring loads are reduced or streams are artificially or mechanically aerated.

Natural Water Quality. "It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and best management practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation." 391-3-6-.03(7)

Georgia EPD, 2000

EPA Dissolved Oxygen Criteria were used to address these situations. Alternative EPA limits are defined as 90% of the naturally occurring dissolved oxygen concentration at critical conditions.

"Where natural conditions alone create dissolved oxygen concentrations less than 110 percent of the applicable criteria means or minima or both, the minimum acceptable concentration is 90 percent of the natural concentration." Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Freshwater), EPA440/5-86-003, April 1986.

US EPA, 1986

Accordingly, if the naturally occurring dissolved oxygen exceeds GAEPD numeric limits at critical conditions then the GAEPD numeric limits apply. If naturally occurring DO is lower than the GAEPD numeric limits then 90% of the natural DO will become the minimum allowable.

5.0 Source Assessment

Point Sources

Table 5-1 shows the 2 point sources in the Big Creek Watershed that discharge into or upstream of the impaired segment. Table 5-2 contains the current permit limits that were available for model development. The locations of both of these facilities are shown in Figure 3-1. The data and locations were gathered from a combination of the Watershed Characterization System (WCS) and the Permit Compliance System (PCS). The locations were verified with an ArcView coverage of active point sources from GAEPD.

Table 5-1. Contributing Point Sources in the Big Creek Watershed.

NPDES Permit	Facility Name	Receiving Water	8-Digit HUC	County
GA0022594	Singleton Shell Service Station	Burnham Branch	Lower Ocmulgee	Houston
GA0023612	Dot Safety Rest Area # 14	South Prong Creek	Lower Ocmulgee	Dooly

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

		June 1999 Monthly Average Permit Limits			
NPDES Permit	Facility Name	Flow (mgd)	DO (mg/L)	BOD5 (mg/L)	NH3 (mg/L)
GA0022594	Singleton Shell Service Station	0.0075	NA	30	NA
GA0023612	Dot Safety Rest Area # 14	0.025	NA	30	NA

Notes: NA = Not Available on Permit Compliance System.

Nonpoint Sources – Surface Washoff and Leaf Litter Decay

In 1999, many streams in the basin were dry or had ponded areas and stagnant pools as a result of a 3-year drought in Georgia. Due to the absence of rainfall during the summer months of 1999, the critical time period, stormwater did not contribute any washoff of materials into the streams. Any constituents that may have washed off of disturbed land surfaces in previous months or years have either: (1) already flushed out of the system along with the water column flow; or, (2) a portion may have settled out to become a part of the stream channel bottom. In this manner, the historic washoff of settleable material could accumulate and exert an additional sediment oxygen demand attributable to man's land disturbing activities. The constituents of concern from surface washoff include the fraction of ammonia and BOD5 that become an integral part of channel bottom sediments and thus become a potential source of sediment oxygen demand. Table 5-3 describes the land use distributions associated with the Big Creek Watershed.

As part of the habitat assessment requirements, EPA sampled Big Creek at State Highway 27/257 during March 11-14, 2001. The nitrogen parameters that were measured ranged from 0.03 to 0.06 mg/L for NH3, 0.15 to 0.34 mg/L for NO2-NO3, and 0.21 to 0.54 mg/L for Total Kjeldahl Nitrogen (TKN). The flows for that same time period ranged from 77 to 1,203 cfs. BOD5 and DO were not measured.

Table 5-3. Land Use Distribution in the Big Creek Watershed.

Land Use Category (from MRLC)	Total (acres)	Total (sq mi)	% Of Total
Row Crops	66,054	103.2	44.2
Pasture/Hay	23,566	36.8	15.8
Woody Wetlands	19,246	30.1	12.9
Deciduous Forest	17,970	28.1	12.0
Evergreen Forest	8,765	13.7	5.9
Transitional	5,993	9.4	4.0
Mixed Forest	5,517	8.6	3.7
High Intensity Commercial/Industrial/Trans	543	0.8	0.4
Low Intensity Residential	506	0.8	0.3
Open Water	422	0.7	0.3
Emergent Herbaceous Wetlands	238	0.4	0.2
Other Grasses	354	0.6	0.2
High Intensity Residential	80	0.1	0.1
Bare Rock/Sand/Clay	72	0.1	0.0
Quarries/Strip Mines/Gravel Pits	9	0.0	0.0
TOTAL	149,335	233.3	100.0

Most of the streams in central and southern Georgia receive significant natural contributions of oxygen demanding organic materials from local wetlands and forested stream corridors, in addition to the aforementioned nonpoint sources of sediment oxygen demand associated with man's land disturbing activities. The following sources of naturally occurring organic materials have been identified:

- Adjacent wetlands and swamps with organically rich bottom sediments; and,
- Direct leaf litterfall onto water surfaces and adjacent floodplains from overhanging trees and vegetation.

Leaf litterfall is a major contributor to the amount of dissolved organic matter in the stream water column and the amount of sediment oxygen demand being exerted. Many streams in southern Georgia are also referred to as "blackwater" streams because of highly colored humic substances leached from surrounding marshes and swamps. In addition, low dissolved oxygen in blackwater streams is very common in the summer months when the temperatures are high and the flows are low (Meyer, 1992). The oxygen demanding effects of leaf litterfall were reflected here in two ways: (1) by lowering the DO saturation of water entering the channel from adjacent swampy areas caused by decaying vegetation; and, (2) by increasing SOD associated with vegetation decaying on stream channel bottoms.

6.0 Technical Approach

The technical approach is described by the steps below:

- Model Selection and Setup,
- Calibration Data,
- SOD Representation,
- Calibration Conditions,
- Critical Conditions,
- Natural Conditions, and
- Allocations

Model Selection and Setup

Initially, an analysis was performed to correlate indicated impairments to basic causes such as point and nonpoint contributions, flow conditions, stream and watershed characteristics, seasonal temperature effects, and others. From this analysis, it was obvious that impairments coincided with low or zero flows, slow stream velocities, shallow water depths, and high temperatures. Inflows of very low dissolved oxygen waters from adjacent marshes and forested swamps compounded the situation. Since all of the impairments noted in 1999 occurred during sustained periods of consistently low flows, a steady-state modeling approach was adopted as appropriate to represent the relevant conditions in the impaired streams. The steady-state Georgia DoSag, developed by the Georgia Environmental Protection Division, was selected for the following reasons:

- It's simplified without unnecessary complexity.
- Conforms to GAEPD standard practices for developing wasteload allocations.
- Works well for low flow and high temperature conditions.
- Can be developed with a limited dataset, which existed in 1999.
- Able to handle branching tributaries and both point and nonpoint source inputs.

Georgia DoSag also provides a complete spatial view of a system, upstream to downstream, indispensible for understanding important differences in stream behavior at various locations throughout a basin. The model computes dissolved oxygen using an enhanced form of the Streeter-Phelps equation (Thomann and Mueller, 1987). It is applied to each stream reach over small incremental distance intervals.

Georgia DoSag was developed for 233 square miles in the Big Creek Watershed. There were 78 reaches with 1 main-stem segment and 5 branches. The main-stem branch was Big Creek. The 5 branches were Elko Creek, Burnham Branch, Camp Creek, South Prong Creek, and Cedar Creek. There were 2 discharges included in the modeling as discussed in the source assessment section. A total of approximately 83 river miles were modeled including the main-stem and 5 major tributaries.

Calibration Data

The model calibration period was determined from an examination of the USGS 1999 water quality data, for each station located on an impaired segment. The data were plotted and evaluated for streamflow, dissolved oxygen, water temperature, BOD5, and ammonia to determine a worst case for dissolved oxygen. The combination of the lowest, steady flow period with the lowest dissolved oxygen, and highest BOD concentrations, defined the critical modeling period. Due to the 2 low dissolved oxygen measurements and the persistent low flows, August 1999 was adopted as the critical period for model calibration. Accordingly, the 7-day average streamflow of 3.5 cfs for August 1999 at USGS 02215100 (Tuscawhatchee Creek Near Hawkinsville, GA) was used to compute a productivity factor. The productivity factor was 0.021

cfs/mi^2 (using a flow of 3.5 cfs and a drainage area of 164 square miles). This productivity factor was applied consistently to the basin. The August 1999 average of dissolved oxygen, BOD5, and ammonia were also extracted from the dataset for each sampling station. BOD5 was converted to CBODU by multiplying by an f-ratio of 2.5 (standard GAEPD modeling practice) and ammonia was converted to NBODU by multiplying by the stoichometric conversion factor of 4.57. These values, thusly determined, were incorporated into the DoSag model calibration files.

<u>SOD Representation</u>
There were no field sediment oxygen demand (SOD) measurements in the Middle Three Basins. For the 2000 TMDLS in the South 4 Basins, there were several SOD measurements that ranged from 0.9 to 1.9 g/m^2/day. SOD is an important part of the oxygen budget in these shallow streams. Accordingly, it is necessary to be realistic in the development and application of SOD values in the Big Creek model and to be consistent with 2001 findings from the Middle 3 Basins and the 2000 findings from the South 4 Basins. For this reason, an examination of SOD results from the year-2000 TMDLs in the South 4 Basins was performed. Results from all calibrated models of existing conditions in June 1998 were compiled and summarized. An average value of existing SOD was determined to be 1.35 g/m^2/day. This represented 12 models that had mixed land uses and varying degrees of point source activity. When the same 12 models were re-run under natural conditions (assuming zero point source discharges and completely forested watersheds), SOD averaged 1.25 g/m^2/day. These two values were adopted for the Middle Three Basins to represent SOD for: (1) mixed land uses, including agriculture; and, (2) natural or totally forested watersheds, respectively. From this, the anthropogenic nonpoint source contributions, those caused by man's land disturbing activities, are accounted for in the 0.1 g/m^2/day difference between the two adopted SOD values.

<u>Calibration Conditions</u>
Monthly average values of DO, CBODU, and NBODU for August 1999 were used as in-stream targets to calibrate the models as discussed previously. Calibration flows throughout the basin were set equal to 0.021 cfs/mi^2 derived from daily flow records at USGS 02215100. Water temperature was equal to 26 degrees Celsius for August 1999. Point source discharges were put into the model at their permit limits for BOD5 and flow. DO was assumed to be 6.0 mg/L for both point sources for modeling purposes. Headwater and tributary water quality boundaries were developed from in-stream field data, expected low DO saturation values (Meyer, 1992), and GAEPD standard modeling practices. SOD was set to 1.35 g/m^2/day to reflect mixed land uses. Figure 6-1 depicts a longitudinal dissolved oxygen calibration curve for the mainstem of the Big Creek developed using this approach. Considering that there was only 1 water quality station on Big Creek to calibrate, the model results were consistent with the Middle 3 and South 4 modeling results.

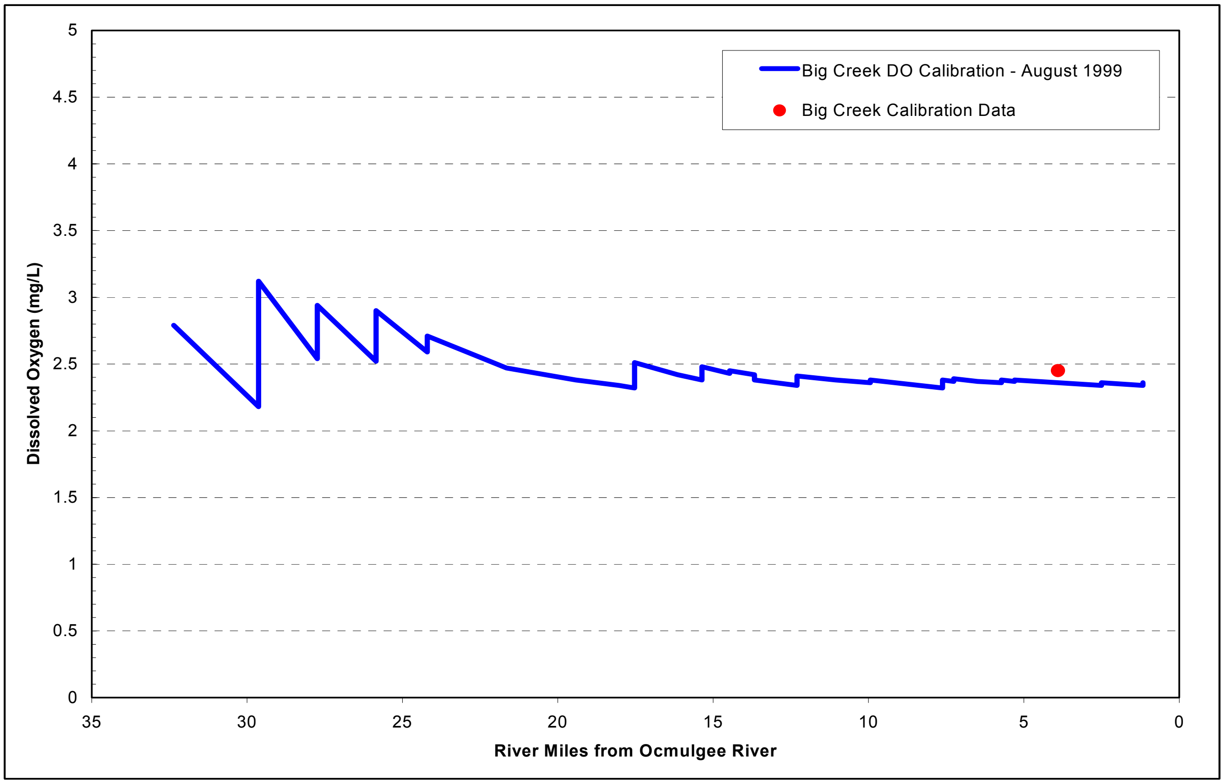

Figure 6-1. Dissolved Oxygen Calibration for the Big Creek.

<u>Critical Conditions</u>

Model critical conditions were developed, in accordance with GAEPD standard practices, to assess dissolved oxygen standards, to determine if a problem exists requiring regulatory intervention, and to establish a level of protection if necessary. For flows, a 7Q10 flow (the minimum 7-day average flow that occurs once in 10 years on the average) was adopted consistent with provisions in Georgia's Water Quality Regulations. Older published 7Q10 flow values in the USGS report (Carter and Fanning, 1982) only considered data through 1979. To account for the droughts in the late 1980s and 1990s, new monthly 7Q10 flow values were calculated; and, the August 7Q10 was adopted. Productivity factors were then calculated from the revised 7Q10 flow values and applied uniformly throughout the basin. The adopted productivity factor equaled 0.021 cfs/mi^2, which is the same as the calibration. Typically, critical water temperatures were developed by examining the long-term trend monitoring data and fitting a harmonic sine function to all of the historical data at a given station. There were not historical data available in the Big Creek Watershed. Therefore, the calibration temperature of 26 degrees Celsius was adopted. Point sources were incorporated into the critical conditions models at their current NPDES Permit limits. Water quality boundaries and all other modeling rates and constants were the same as those in the calibrated models, including SOD = 1.35 g/m^2/day representing mixed land uses. To determine the effects of point sources alone, at critical conditions, a parallel set of model runs were made with point source flows set equal to zero. The results are shown in Figure 6-2.

<u>Natural Conditions</u>

For the natural conditions runs, two relevant changes were made to the critical conditions models. First, SOD was changed from 1.35 g/m^2/ day to 1.25 g/m^2/day to reflect the change from mixed land uses to natural or completely forested land uses. And second, all point source discharges were completely removed. All other model parameters remained the same. The results of the natural conditions runs are plotted in Figure 6-3 along with the August 1999 and critical conditions results for comparison.

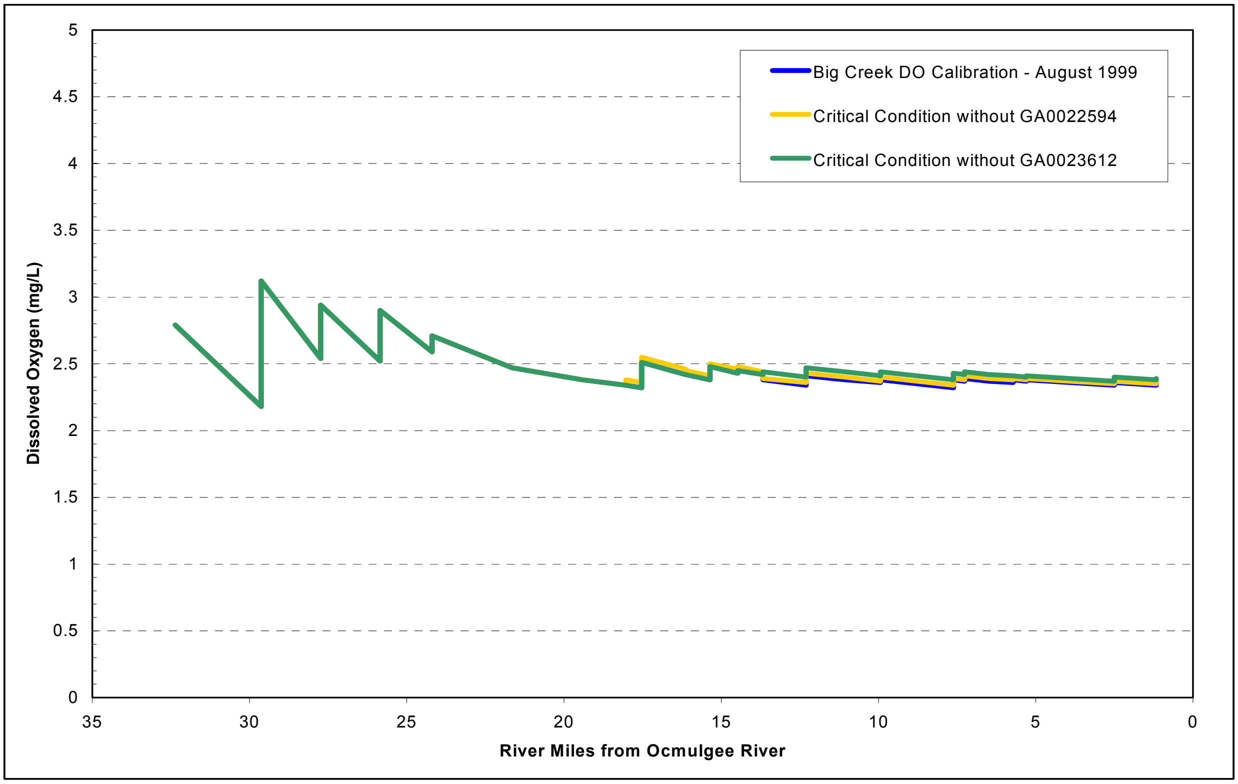

Figure 6-2. Sensitivity of Point Sources and Impacts on DO in Big Creek.

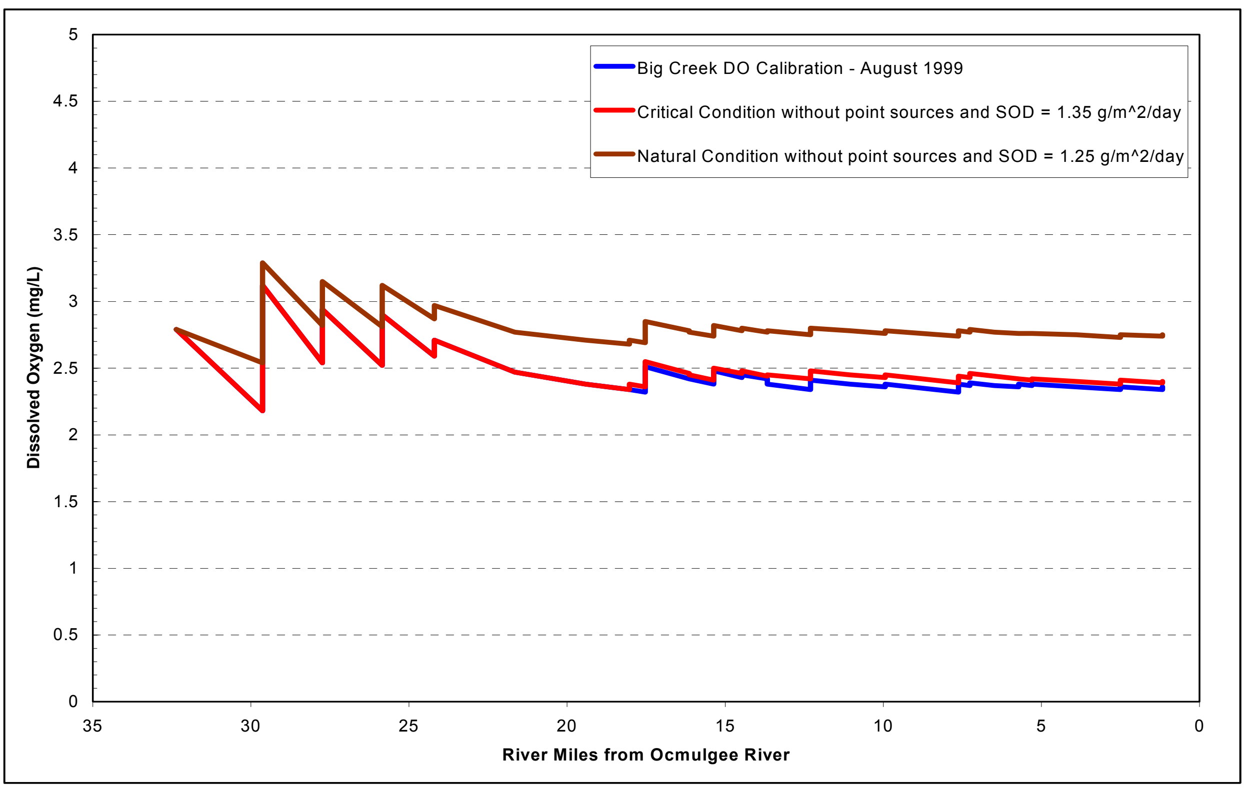

Figure 6-3. Critical Without Point Sources and Natural Conditions in Big Creek.

Allocations
Allocations were based on EPA Dissolved Oxygen Criteria that states if the natural dissolved oxygen is less than the standard, then only a 10% reduction in the natural condition is allowed. Or, the target limits are defined as 90% of the naturally occurring dissolved oxygen concentration at critical conditions.

Figure 6-2 shows the sensitivity of the model to the 2-point sources. They are both minor facilities and do not expect to be a major contributor to the dissolved oxygen impairment. If they were a factor, the influence on the dissolved oxygen concentrations would be evident during other periods of the year. Figure 6-2 reinforces the assumptions in the model and shows that the point sources have negligible impact on dissolved oxygen, even at permits during this critical time period.

Figure 6-3 shows the difference between the natural condition run and the critical condition run without point sources. The only difference between these 2 runs is that SOD is 1.25 g/m^2/day in the natural scenario and 1.35 g/m^2/day in the critical scenario. The August 1999 calibration is shown as a reference.

Figure 6-4 represents the results of the TMDL. This figure shows the August 1999 calibration run, the natural conditions run, and the target for the TMDL. Since the natural run is below the dissolved oxygen standard of 5.0-mg/L daily average, a target is computed. The target is 90% of the natural condition run. The figure shows that at approximately river mile 23, the critical condition run (same as the model calibration run) falls below the target. At the most downstream point on the Big Creek, the critical condition run is 0.1 mg/L below the target. This difference does not make it necessary for point and nonpoint source allocations, but simply within the accuracy of the model. Therefore, no allocations are needed for the Big Creek. The low dissolved oxygen in Big Creek can directly be related to low flow conditions.

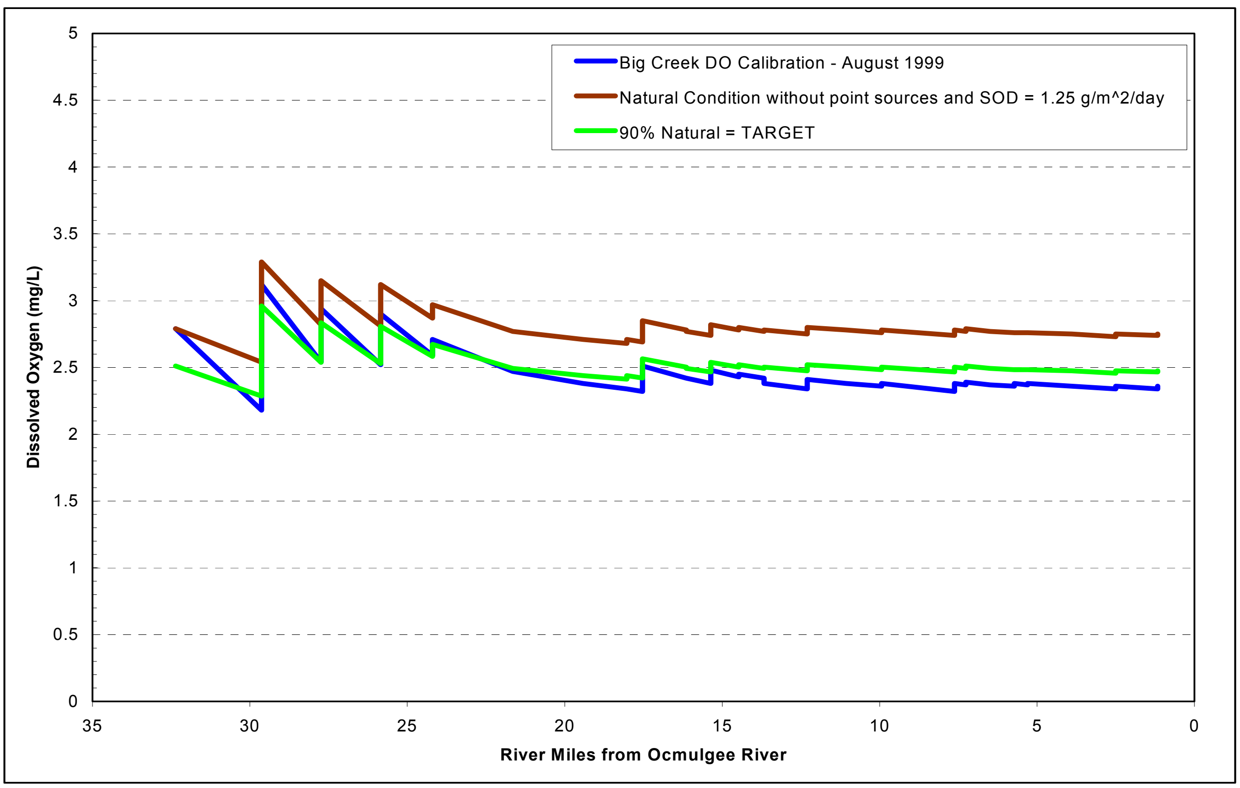

Figure 6-4. Critical Conditions and 90% of Natural Conditions for Big Creek.

7.0 Loading Capacity

The first step in the process was to determine naturally occurring dissolved oxygen concentrations for the impaired waterbodies. By doing so, the applicable water quality standard used for TMDL development can be identified.

To determine naturally occurring dissolved oxygen concentrations, the steady-state DOSAG models were run, at critical conditions, with zero point source inputs and nonpoint source inputs representing forested or wetland conditions free from man's influences. According to EPA Dissolved Oxygen Criteria, the target limits were identified as 90% of the naturally occurring concentration.

After identifying the dissolved oxygen target limits, the models were run at critical conditions to determine the loading capacity of the waterbody. This was accomplished through a series of simulations aimed at meeting the dissolved oxygen target limit by varying source contributions. The final acceptable scenario represented the TMDL (and loading capacity of the waterbody).

8.0 Waste Load and Load Allocations

Two critical components of the TMDL are the Waste Load Allocations (WLAs) and the Load Allocations (LAs). The WLAs represent the load allocations to point source facilities contributing to impaired waterbodies, while the LAs represent load allocations to the nonpoint source contributions. WLAs and LAs sum to represent the entire TMDL, because MOS is implicitly considered through model assumptions.

The partitioning of allocations between point (WLA) and nonpoint (LA) sources shown in Table 8-1 was based on modeling results and professional judgment to meet the TMDL. The existing WLA is separated into 'Direct' and 'Upstream' contributions. The 'Direct' loads are the point source loads discharging directly into the impaired stream segment. The 'Upstream' load is one that discharges in an upstream segment and is transported downstream into the impaired segment. The model was used to account for in-stream, kinetic processes that would occur from the discharge point to the upstream boundary of the impaired segment. The WLAs may be modified by GAEPD during the NPDES permitting process. The TMDLs will be used to assess the permit renewals in the impaired segments. The nonpoint source loads for the Existing LA and TMDL were computed from the model boundary conditions, which include the stream, tributary, and headwater model boundaries.

Table 8-1. Existing and TMDL Loads for Impaired Segments in Big Creek.

Stream	Existing Direct WLA (lbs/day)	Existing Upstream WLA (lbs/day)*	Existing LA (lbs/day)*	Total Existing Load (lbs/day)*	TMDL (lbs/day)*	% Reduction WLA	% Reduction LA
Big Creek	NA	16	153	169	169	None	None

* lbs/day of Oxygen Demanding Material

9.0 Margin of Safety

The margin of safety (MOS) is required in the TMDL development process. There are two basic methods for incorporating the MOS into the TMDL (USEPA 1991):

- Implicitly incorporate the MOS using conservative model assumptions.
- Explicitly specify a portion of the total TMDL as the MOS.

MOS was incorporated implicitly in this dissolved oxygen TMDL development based on the following conservative assumptions:

- Drought streamflows that persist through the critical summer months at monthly 7Q10 flow values.
- Hot summer temperatures, based on the historical record, that persist for the same critical period.
- All point sources discharge continuously at their NPDES Permit limits for the same critical period.
- DO saturation, for all flows entering the system, equal to those measured during the low DO period in the summer of 1999.
- Shallow water depths, generally less than one foot, which aggravates the effect of SOD.
- Slow water velocities, generally 0.5 fps or less, which intensifies the effect of BOD decay.

10.0 Seasonal Variation

The Statute and regulations require that a TMDL be established with consideration of seasonal variations. Since impairments occurred only during critical summer months, and not during other times of year, a seasonal variation in the TMDL was neither necessary nor appropriate.

11.0 Monitoring Plan

The GAEPD has adopted a basin approach to water quality management; an approach that divides Georgia’s major river basins into five groups. Each year, the GAEPD water quality monitoring 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 the next monitoring cycle for the Lower Ocmulgee in 2004 and will help further characterize water quality conditions resulting from the implementation of best management practices in the watershed.

12.0 Point and Nonpoint Source Approaches

Permitted discharges will be regulated through the NPDES permitting process described in this report. GAEPD is working with local governments, agricultural, and forestry agencies such as the Natural Resources Conservation Service, The Regional Development Councils, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission to foster the implementation of best management practices to address nonpoint sources. In addition, public education efforts will be targeted to individual stakeholders to provide information regarding the use of best management practices to protect water quality.

13.0 Public Participation

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

14.0 Implementation

EPA recognizes that a TMDL improves water quality when there is a plan for implementing the TMDL. However, CWA section 303(d) does not establish any new implementation authorities beyond those that exist elsewhere in State, local, Tribal or Federal law. Thus, the wasteload allocations within TMDLs are implemented through enforceable water quality-based effluent limitations in NPDES permits authorized under section 402 of the CWA. Load allocations within TMDLs are implemented through a wide variety of State, local, Tribal and Federal nonpoint source programs (which may be regulatory, non-regulatory, or incentive-based, depending on the program), as well as voluntary action by committed citizens. See New Policies for Establishing and Implementing Total Maximum Daily Loads (TMDLs), dated August 8, 1997.

EPA believes it is useful during TMDL development, if time is available, to gather information that would facilitate TMDL implementation. For example, the TMDL may identify management strategies that categories of sources can employ to obtain necessary load reductions. EPA believes, however, that TMDL implementation – and implementation planning – is the responsibility of the State of Georgia, through its administration of the National Pollutant Discharge Elimination System (NPDES) point source permit program and through its administration of any regulatory or non-regulatory nonpoint source control programs.

A consent decree in the case of Sierra Club v. EPA, 1:94-cv-2501-MHS (N.D. Ga.), requires EPA to develop TMDLs for all waterbodies on the State of Georgia's current 303(d) list that are not developed by the State that year, according to a schedule contained in the decree. That is, EPA and the State work cooperatively to develop all TMDLs for a given set of river basins each year, with all river basins in the State covered over a 5-year period. On July 24, 2001, the U.S. District Court entered an order finding that the decree also requires EPA to develop TMDL implementation plans. EPA disagrees with the court's conclusion that implementation plans are required by the decree and has appealed the July 24, 2001, order.

In the absence of that order, EPA would not propose an implementation plan for this TMDL. The Agency is moving forward, however, to comply with the obligations contained in the order. EPA has coordinated with the Georgia Environmental Protection Division (EPD) to prepare an initial implementation plan for this TMDL and has also entered into a Memorandum of Understanding (MOU) with EPD, which sets out a schedule for EPD to develop more comprehensive implementation plans after this TMDL is established. The initial plan provides for an implementation demonstration project to address one of the major sources of pollution identified in this TMDL while State and/or local agencies work with local stakeholders to develop a revised implementation plan.

EPA understands, pursuant to the July 24, 2001, order, that it continues to have responsibilities for implementation planning if for any reason EPA cannot complete an implementation plan for this TMDL as set out in the MOU. If the July 24, 2001, order is vacated, EPA would expect to support efforts by the State of Georgia to develop an implementation plan for this TMDL.

This Initial TMDL Implementation Plan, written by EPD and for which EPD and/or the EPD Contractor are responsible, contains the following elements. PA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some best management practices. The "Management Measure Selector Table shown below identifies these management strategies by source category and pollutant. Nonpoint sources are the primary cause of excessive pollutant loading in most cases. Any wasteload allocations in this TMDL will be implemented in the form of water-quality based effluent limitations in NPDES permits issued under CWA Section 402. See 40 C.F.R. § 122.44(d)(1)(vii)(B). NPDES permit discharges are a secondary source of excessive pollutant loading, where they are a factor, in most cases.

1. EPD and the EPD Contractor will select and implement one or more best management practice (BMP) demonstration projects for each River Basin. The purpose of the demonstration projects will be to evaluate by River Basin and pollutant parameter the site-specific effectiveness of one or more of the BMPs chosen. EPD intends that the BMP demonstration project be completed before the Revised TMDL Implementation Plan is issued. The BMP demonstration project will address the major category of contribution of the pollutant(s) of concern for the respective River Basin as identified in the TMDLs of the watersheds in the River Basin. The demonstration project need not be of a large scale, and may consist of one or more measures from the Table or equivalent BMP measures proposed by the EPD Contractor and approved by EPD. Other such measures may include those found in EPA's "Best Management Practices Handbook", the "NRCS National Handbook of Conservation Practices, or any similar reference, or measures that the volunteers, etc., devise that EPD approves. If for any reason the EPD Contractor does not complete the BMP demonstration project, EPD will take responsibility for doing so.

2. EPD and the EPD Contractor will select and implement one or more best management practice (BMP) demonstration projects for each River Basin. The purpose of the demonstration projects will be to evaluate by River Basin and pollutant parameter the site-specific effectiveness of one or more of the BMPs chosen. EPD intends that the BMP demonstration project be completed before the Revised TMDL Implementation Plan is issued. The BMP demonstration project will address the major category of contribution of the pollutant(s) of concern for the respective River Basin as identified in the TMDLs of the watersheds in the River Basin. The demonstration project need not be of a large scale, and may consist of one or more measures from the Table or equivalent BMP measures proposed by the EPD Contractor and approved by EPD. Other such measures may include those found in EPA's "Best Management Practices Handbook", the "NRCS National Handbook of Conservation Practices, or any similar reference, or measures that the volunteers, etc., devise that EPD

approves. If for any reason the EPD Contractor does not complete the BMP demonstration project, EPD will take responsibility for doing so.

3. As part of the Initial TMDL Implementation Plan the EPD brochure entitled "Watershed Wisdom -- Georgia's TMDL Program" will be distributed by EPD to the EPD Contractor for use with appropriate stakeholders for this TMDL, and a copy of the video of that same title will be provided to the EPD Contractor for its use in making presentations to appropriate stakeholders, on TMDL Implementation plan development.

4. If for any reason an EPD Contractor does not complete one or more elements of a Revised TMDL Implementation Plan, EPD will be responsible for getting that (those) element(s) completed, either directly or through another contractor.

5. The deadline for development of a Revised TMDL Implementation Plan, is the end of August, 2003.

6. The EPD Contractor helping to develop the Revised TMDL Implementation Plan, in coordination with EPD, will work on the following tasks involved in converting the Initial TMDL Implementation Plan to a Revised TMDL Implementation Plan:

   A. Generally characterize the watershed;
   B. Identify stakeholders;
   C. Verify the present problem to the extent feasible and appropriate, (e.g., local monitoring);
   D. Identify probable sources of pollutant(s);
   E. For the purpose of assisting in the implementation of the load allocations of this TMDL, identify potential regulatory or voluntary actions to control pollutant(s) from the relevant nonpoint sources;
   F. Determine measurable milestones of progress;
   G. Develop monitoring plan, taking into account available resources, to measure effectiveness; and
   H. Complete and submit to EPD the Revised TMDL Implementation Plan.

7. The public will be provided an opportunity to participate in the development of the Revised TMDL Implementation Plan and to comment on it before it is finalized.

8. The Revised TMDL Implementation Plan will supersede this Initial TMDL Implementation Plan when the Revised TMDL Implementation Plan is approved by EPD.

Land Use	Management Measures	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	*Metals (copper, lead, zinc, cadmium)*	PCBs, toxaphene
Agriculture	*1. Sediment & Erosion Control*	_	_		_	_				
	2. Confined Animal Facilities	_	_							
	3. Nutrient Management	_	_							
	4. Pesticide Management		_							
	5. Livestock Grazing	_	_		_	_				
	6. Irrigation		_		_	_				
Forestry	*1. Preharvest Planning*				_	_				
	2. Streamside Management Areas	_	_		_	_				
	3. Road Construction &Reconstruction		_		_	_				
	4. Road Management		_		_	_				
	5. Timber Harvesting		_		_	_				
	6. Site Preparation & Forest Regeneration		_		_	_				
	7. Fire Management	_	_	_	_	_				
	8. Revegetation of Disturbed Areas	_	_	_	_	_				
	9. Forest Chemical Management		_			_				
	10. Wetlands Forest Management	_	_	_		_		_		
Urban	*1. New Development*	_	_		_	_			_	
	2. Watershed Protection & Site Development	_	_		_	_		_	_	
	3. Construction Site Erosion and Sediment Control		_		_	_				
	4. Construction Site Chemical Control		_							
	5. Existing Developments	_	_		_	_			_	
	6. Residential and Commercial Pollution Prevention	_	_							
Onsite Wastewater	*1. New Onsite Wastewater Disposal Systems*	_	_							
	2. Operating Existing Onsite	_	_							

	Wastewater Disposal Systems									
Roads, Highways and Bridges	*1. Siting New Roads, Highways & Bridges*	–	–		–	–			–	
	2. Construction Projects for Roads, Highways and Bridges		–		–	–				
	3. Construction Site Chemical Control for Roads, Highways and Bridges		–							
	4. Operation and Maintenance- Roads, Highways and Bridges	–	–			–			–	

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