Flint River Basin
Dissolved Oxygen TMDLs

<u>Beaver Creek</u>, Partially Supporting, Crawford County
<u>Big Slough</u>, Not Supporting, Mitchell County
<u>Dry Creek</u>, Partially Supporting, Early County
<u>Fish Pond Drain</u>, Not Supporting, Seminole County
<u>Flat Creek</u>, Partially Supporting, Fayette County
<u>Gulley Creek</u>, Not Supporting, Crisp County
<u>Spring Creek</u>, Partially Supporting, Early and Miller Counties
<u>White Oak Creek</u>, Partially Supporting, Coweta and Meriwether Counties

Submitted to:

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

Submitted by:

Georgia Department of Natural Resources
Environmental Protection Division
Atlanta, Georgia

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Table of Contents

List of Figures

List of Tables

EXECUTIVE SUMMARY

Basin Name: **Flint River**

Table ES-1 2002-303(d) Listed Segments for Dissolved Oxygen in the Flint River Basin

SEGMENT NUMBER	STREAM	SEGMENT LENGTH (Miles)	2000 MONITORING STATION	12 DIGIT HUC ID
1	Beaver Creek	11	Historical Listing	031300051305
2	Big Slough	4	11107501	031300080505, 031300080506B
3	Dry Creek	12	11430001	031300100201, 031300100202, 031300100203, 031300100204, 031300100205
4	Fish Pond Drain	7	11780501	031300100801, 031300100802, 031300100803A, 031300100803B, 031300100804
5	Flat Creek	4	Historical Listing	031300050203
6	Gulley Creek	4	Historical Listing	031300060611A
7	Spring Creek	22	11450001	031300100101, 031300100102, 031300100103, 031300100104, 031300100301, 031300100302, 031300100303, 031300100501, 031300100502, 031300100503, 031300100504, 031300100505
8	White Oak Creek	14	11027201	031300050301, 031300050302A, 031300050302B, 031300050302C, 031300050302D, 031300050303

Description of Analysis

USGS water quality data collected in 2000 identified low dissolved oxygen (DO) concentrations in Big Slough, Dry Creek, Fish Pond Drain, Spring Creek, and White Oak Creek in the Flint River Basin (see Table ES-1). The data indicated that these occurred during, and were limited to, summer months, low flow and high temperature conditions. Beaver Creek, Flat Creek, and Gulley Creek were listed due to historical DO data. Stream flows during the period of the low DOs for these segments, were at, or below, the minimum 7-day average flow that occurs once in 10 years on the average (7Q10). This is consistent with the 3-year drought experienced in Georgia from 1998 to 2000. Since the observed DO concentrations were driven by low flows and high temperatures, occurring over several summer months, a steady state modeling approach was adopted as appropriate for DO TMDL analysis.

Applicable Water Quality Standards

The applicable dissolved oxygen water quality standards for waters in the Flint River Basin 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, 2002)
>
> _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 listed segments, the EPA natural water quality policy 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 model result would define the natural 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:	Beaver Creek – biological monitoring during June-September, 1991. Big Slough - USGS field data from June 2000. Dry Creek - USGS field data from June 2000. Fish Pond Drain - USGS field data from June 2000. Flat Creek – Time of Travel study in 1991. Gulley Creek – Clean Lakes data 1992. Spring Creek - USGS field data from June 2000. White Oak Creek - USGS field data from June 2000.
Calibration Conditions:	(1) USGS flows measured in June 2000. (2) USGS temperatures measured in June 2000. (3) Point source DMR data for June 2000. (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 2000 USGS field data and/or GAEPD

standard modeling practices.

Critical Conditions:
(1) 7Q10 flows recomputed to include data through 2000.
(2) Temperatures derived from historic trend monitoring data.
(3) Point source discharges at current permit limits.
(4) Same SOD for 'mixed land uses' as calibration conditions.
(5) Same depths, velocities, kinetic rates, reaeration, and boundary conditions as calibration conditions.

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.

Margin Of Safety: 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 2000.
(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 the River Basin Planning 5-year cycle (Georgia EPD, 1996)

Approach: NPDES permits for point sources; Best Management Practices for nonpoint sources.

Date Submitted: Draft June 2002, Final January 2003.

Table ES-2 Summary of TMDLs for Dissolved Oxygen Listed Segments in the Flint River Basin

SEGMENT NUMBER	STREAM	TMDL* (lbs/day)
1	Beaver Creek	56
2	Big Slough	234
3	Dry Creek	1,121
4	Fish Pond Drain	593
5	Flat Creek	353
6	Gulley Creek	36
7	Spring Creek	1,936
8	White Oak Creek	582

NOTE: * TMDL expressed as Ultimate Oxygen Demand (UOD) which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and the Nitrogenous Biochemical Oxygen Demand (NBOD).

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into three categories: supporting, partially supporting, or not supporting their designated uses, depending on water quality assessment results. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process and are published in *Water Quality in Georgia* every two years.

Some of the 305(b) partially and not supporting water bodies are also assigned to Georgia's 303(d) list also named after that section of the CWA. Water bodies on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality standard. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and instream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and to restore and maintain water quality.

Water quality data collected by the United States Geological Survey (USGS) in 2000 and historical data indicate that eight waterbodies in the Flint River Basin did not achieve water quality standards for dissolved oxygen (DO). These waterbodies were included in the state's 2002-303(d) list. This report presents the dissolved oxygen TMDLs for the listed segments in the Flint River basin identified in Table 1-1.

Table 1-1 Waterbodies Listed For Dissolved Oxygen in the Flint River Basin

LISTED STREAM	LOCATION	SEGMENT LENGTH (Miles)	STATUS
Beaver Creek	Headwaters to Spring Creek (Crawford Co)	11	Partially Support
Big Slough	Near Pelham (Mitchell Co.)	4	Not Support
Dry Creek	Headwaters, downstream of Bakley to Spring Creek (Early Co.)	12	Partially Support
Fish Pond Drain	U.S. Hwy 84, Donalsonville to Wash Pond (Seminole Co.)	7	Not Support
Flat Creek	Lake Peachtree to Line Creek, Peachtree City (Fayette Co.)	4	Partially Support
Gulley Creek	Upstream Lake Balckshear (Crisp Co.)	4	Not Support
Spring Creek	SR62 near Arlington to Aycocks Creek (Early/Miller Co.)	22	Partially Support
White Oak Creek	Chandlers Creek to Bear Creek (Coweta/Meriwether Co.)	14	Partially Support

1.2 Watershed Description

The Flint River originates on the south side of Fulton County, in metropolitan Atlanta, near Hartsfield International Airport. The river flows south to Lake Blackshear to Lake Seminole. At this point, the Flint converges with the Chattahoochee River in Lake Seminole at the Georgia-Florida border. The outflow from Lake Seminole forms the Apalachicola River in Florida, which ultimately discharges to the Gulf of Mexico. The Flint River Basin contains parts of the Piedmont and Coastal Plain physiographic provinces that extend throughout the southeastern United States.

Table 1-2 shows that there are six 8-digit Hydrologic Unit Codes (HUCs) within the Flint River Basin. Figure 1-1 shows the location of these HUCs. Figure 1-2 shows the listed segments for dissolved oxygen in the Flint River Basin.

Table 1-2 Summary of Chattahoochee and Flint River Dissolved Oxygen TMDLs

River Basin	Drainage Area (square miles)	Listed Segments	2000 WQ Stations	8-Digit Hydrologic Unit Codes
Chattahoochee	8,742	3	60	• Upper Chattahoochee (HUC 03130001) • Middle Chattahoochee – Lake Harding (HUC 03130002) • Middle Chattahoochee – WF George Reservoir (HUC 03130003) • Lower Chattahoochee (HUC 03130004)
Flint	8,447	8	62	• Upper Flint (HUC 03130005) • Middle Flint (HUC 03130006) • Kinchafoonee-Muckalee (HUC 03130007) • Lower Flint (HUC 03130008) • Ichawaynochaway (HUC 03130009) • Spring (HUC 03130010)

The land use characteristics of the Flint River Basin watersheds were determined using data from Georgia's Multiple Resolution Land Coverage (MRLC). This coverage was produced from Landsat Thematic Mapper digital images developed in 1995. For the thirteen metro Atlanta counties, the Atlanta Regional Commission (ARC) Landuse Coverage was used. The ARC landuse was derived from digital images developed in 2000. Landuse classification is based on a modified Anderson level one and two system. Table 1-3 lists the land use distribution of the eight watersheds on the 303(d) list. Detailed information on each of the watersheds is provided in Appendix A.

Table 1-3 Land Uses Associated with Listed Segments in the Flint River Basin

Seg. #	Stream	Total Contributing Area (acres)	Cropland (%)	Pasture (%)	Forest (%)	Wetland (%)	Built-Up Impervious (%)	Built-Up Pervious (%)
1	Beaver Creek	7,577	4.2%	1.4%	75.4%	1.1%	0.0%	17.7%
2	Big Slough	16,004	48.7%	14.8%	24.5%	6.2%	1.5%	4.3%
3	Dry Creek	66,861	33.2%	13.5%	29.0%	18.6%	1.3%	4.4%
4	Fish Pond Drain	81,469	40.3%	18.1%	25.8%	10.3%	1.3%	4.2%
5	Flat Creek	15,729	4.3%	7.1%	60.2%	6.5%	19.8%	2.1%
6	Gulley Creek	7,297	44.3%	25.3%	17.6%	6.4%	1.7%	4.6%
7	Spring Creek	234,388	38.3%	12.4%	29.6%	15.2%	0.6%	3.9%
8	White Oak Creek	54,491	4.8%	10.3%	70.9%	7.8%	3.0%	3.2%

1.3 Water Quality Standards

The eight listed segments in the Flint 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 Flint 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 percent 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.

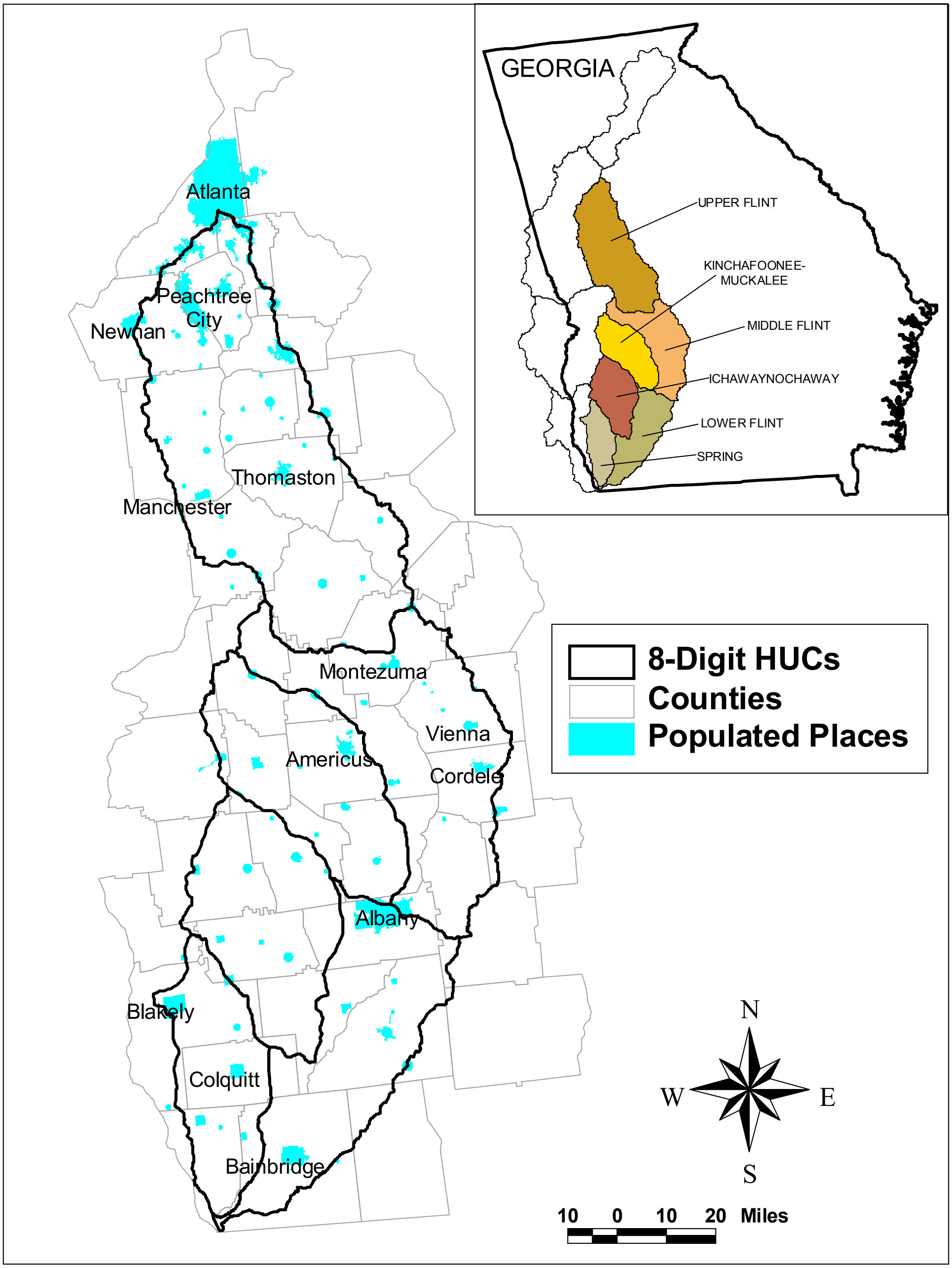

Figure 1-1 Location of the Flint River Basin

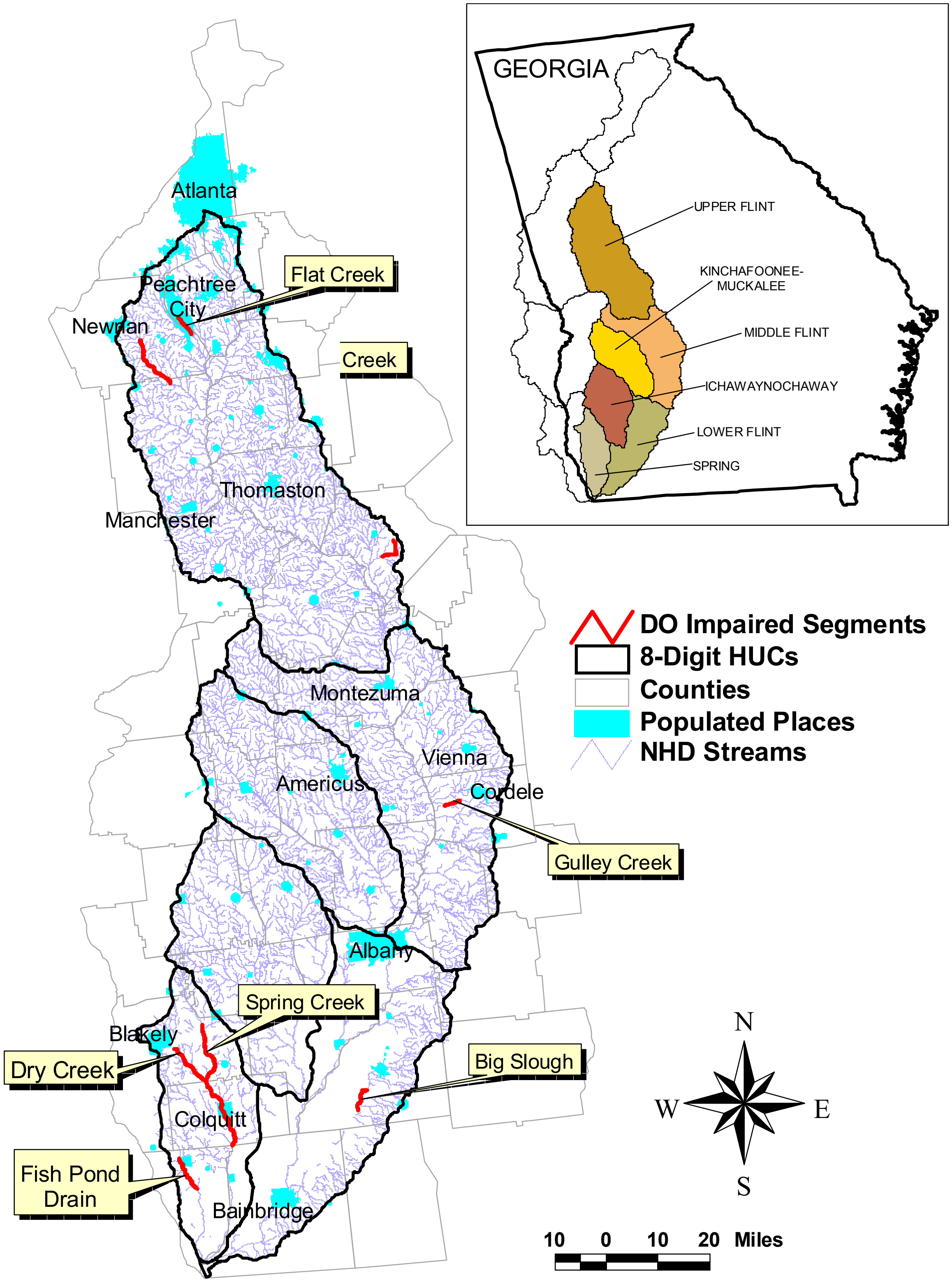

Figure 1-2 303(d) Listed Segments for Dissolved Oxygen in the Flint River Basin

2.0 WATER QUALITY ASSESSMENT

USGS collected water quality data in Georgia during 2000. There were a total of 122 stations in the Chattahoochee and Flint River Basins. There were 62 water quality stations in the Flint River Basin for 2000. Figure 2-1 shows the USGS/GAEPD water quality and USGS flow stations that were sampled during 2000. Data collected for the eight DO listed segments are provided in Appendix B.

These data show that low dissolved oxygen values usually occurred during the summer months. Furthermore, these were limited to headwater streams where the drainage areas are relatively small and dry weather flows are low, intermittent, or zero. In larger watersheds where the flows are higher, the dissolved oxygen concentrations always met the minimum standard of 4.0 mg/L and the daily average of 5.0 mg/L. Figure 2-2 is a graph of the dissolved oxygen versus flow in Dry Creek during 2000. The plot shows that dissolved oxygen values below 5.0 mg/L typically occur at flows less than 10 cfs. The computed 7Q10 for Dry Creek is 2.55 cfs.

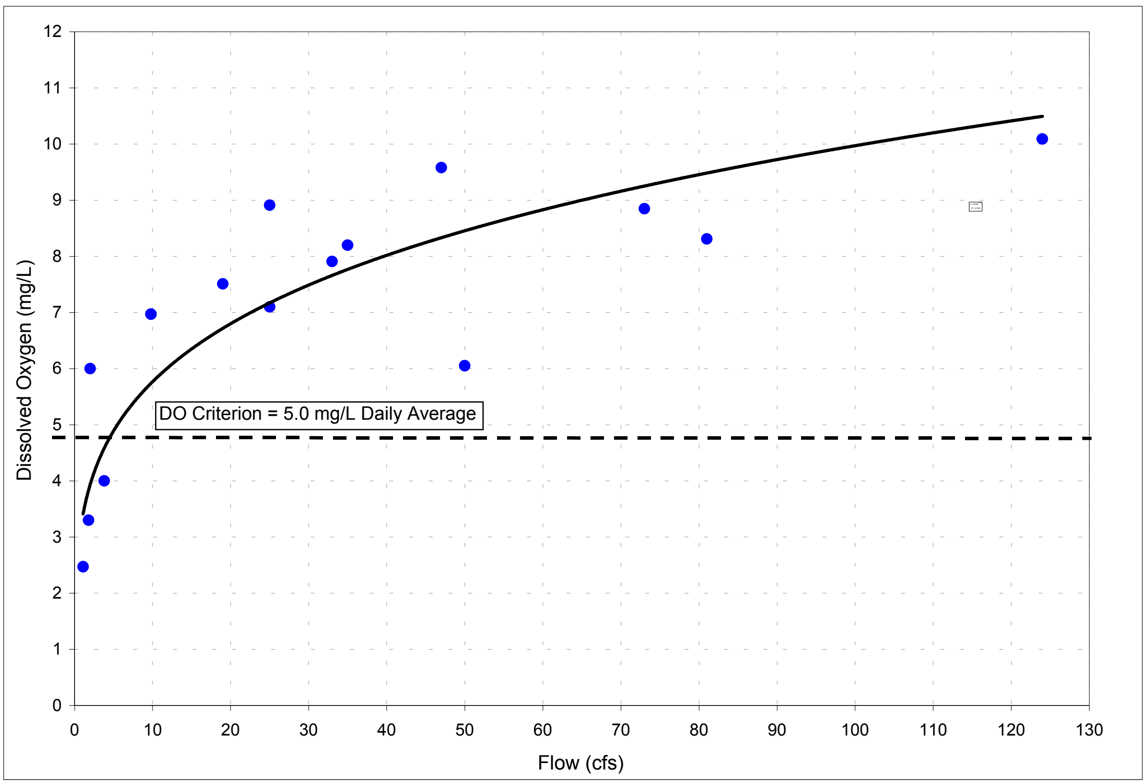

Figure 2-2 Dissolved Oxygen and Discharge at #11430001 – Dry Creek at CR279 near Hentown, GA

All field data relevant to the Chattahoochee and Flint River Basins were compiled by GAEPD and included in electronic database files. The data are managed in the Water Resources Data Base (WRDB), a software database that was developed by GAEPD. Project data file(s) contain the following information comprising over a half million records:

1. Historic trend monitoring data through 1999,
2. 2000 GAEPD/USGS water quality data, and
3. Historic USGS daily average flow data through December 31, 2000.

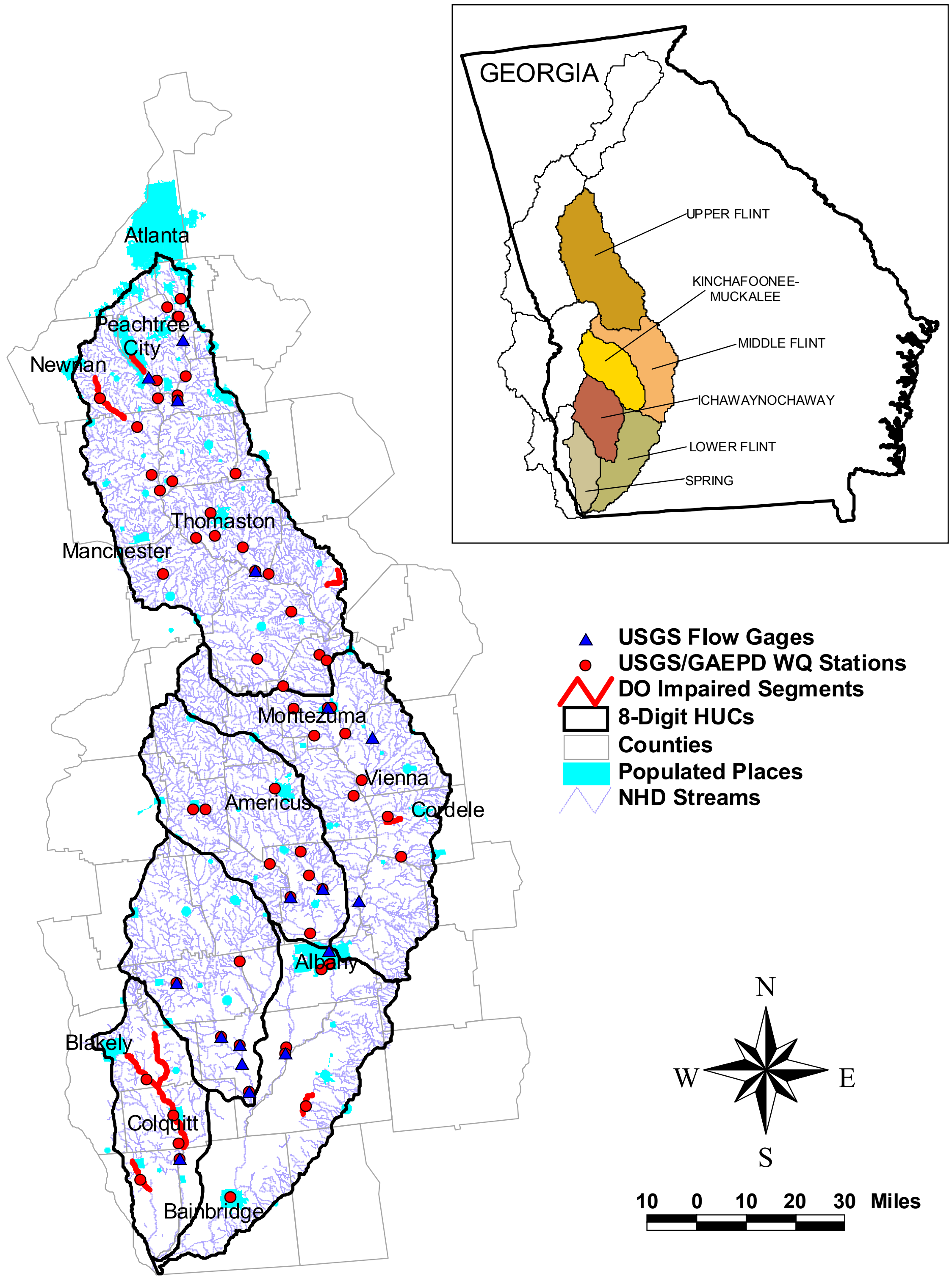

Figure 2-1 2000 USGS Water Quality and Flow Stations in the Flint River Basin

3.0 SOURCE ASSESSMENT

3.1 Point Sources

GAEPD maintains a database of current NPDES permits and GIS files that locate each permitted outfall. Monthly Discharge Monitoring Reports (DMRs) for 2000 were downloaded from the Permit Compliance System (PCS). Table 3-1 shows the point sources in the Flint River Basin that discharge into or upstream of the DO listed segments. This table contains the June 2000 permit limits that were used for model development. The locations of these facilities relative to the listed stream are shown in Appendix A.

3.2 Nonpoint Sources – Surface Washoff and Leaf Litter Decay

In 2000, 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 2000, 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 BOD_5 that become an integral part of channel bottom sediments and thus become a potential source of sediment oxygen demand.

Table 1-3 describes the land use distributions for each DO listed stream. Note the relatively high percentages of forested and wetland land uses and the low percentages of built up areas.

In addition to nonpoint sources of sediment oxygen demand associated with man's land disturbing activities, most of the streams in the Chattahoochee Basin receive significant natural contributions of oxygen demanding organic materials from local wetlands and forested stream corridors. 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 sediment oxygen demand (SOD) associated with vegetation decaying on stream channel bottoms.

Table 3-1 Contributing Point Sources to the Dissolved Oxygen Listed Segments in the Flint River Basin

NPDES Permit	Facility Name	Receiving Water	8-Digit HUC	County	June 2000 Monthly Average Permit Limits			
					Flow (mgd)	DO (mg/L)	BOD_5 (mg/L)	NH_3 (mg/L)
GA0020362 *	Camilla WPCP *	Big Slough	Lower Flint (HUC 03130008)	Mitchell	None	None	None	None
GA0025585	Blakely WPCP	Baptist Branch Tributary to Dry Creek	Spring (HUC 03130010)	Early	1.315	5.0 (min)	20	2
GA0031968	Blakely Pond A	Blue Creek Tributary to Dry Creek	Spring (HUC 03130010)	Early	0.12	NP	30	NP
GA0031976	Blakely Pond B	Breastworks Branch to Dry Creek	Spring (HUC 03130010)	Early	0.12	NP	30	NP
GA0026204	Arlington Pond #1	Perry Creek Tributary to Spring Creek	Spring (HUC 03130010)	Early	0.10	NP	30	NP
GA0047252	Colquitt WPCP	Spring Creek	Spring (HUC 03130010)	Miller	0.40	5.0 (min)	30	15
GA0026123	Donalsonville WPCP	Fish Pond Drain	Spring (HUC 03130010)	Seminole	0.40	NP	30	NP
GA0020371	Flat Creek WPCP	Flat Creek	Upper Flint (HUC 03130005)	Fayette	0.90	5.0 (min)	20	20
GA0034614	Shenandoah WPCP	White Oak Creek	Upper Flint (HUC 03130005)	Coweta	0.90	5.0 (min)	12	2

NOTE: * Discharge was eliminated on July 1, 2000, converted to land application system.
NP = not currently permitted.

4.0 TECHNICAL APPROACH

The technical approach is described in the steps below:

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

Model Selection and Setup
Initially, an analysis was performed to correlate indicated low DO values to basic causes such as point and nonpoint contributions, flow conditions, stream and watershed characteristics, seasonal temperature effects, and others. From this analysis, low DOs were found to coincide 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 2000 occurred during sustained periods of low flows, a steady-state modeling approach was choosen. The steady-state Georgia DOSAG, developed by the Georgia Environmental Protection Division, was selected for the following reasons:

- It is simple, without unnecessary complexity.
- It conforms to GAEPD standard practices for developing wasteload allocations.
- It works well for low flow and high temperature conditions.
- It can be developed with a limited dataset.
- It is able to handle branching tributaries and both point and nonpoint source inputs.

Georgia DOSAG computes dissolved oxygen using an enhanced form of the Streeter-Phelps equation (Thomann and Mueller, 1987). The model applies the equation to each stream reach over small incremental distance intervals. The model also provides a complete spatial view of a system, upstream to downstream. This allows the modeler to understand the important differences in stream behavior at various locations throughout a basin.

A total of eight DOSAG models were developed to represent the eight listed segments in the Flint River Basin. USGS quadrangle maps along with Arcview and MapInfo spatial graphics files were used to develop drainage areas, stream lengths, bed slopes, and other physical input data for each model.

Low-Flow Analysis
For the eight listed segments in the Flint River basin, only one segment had 2000 water quality and flow data. Dry Creek had both flow and dissolved oxygen data for the year 2000 (see Table B-2). Since the flow data were limited at best, an analysis was performed to examine the adjacent longterm USGS gages to develop a representative flow during June 2000. Table 4-1 lists the USGS longterm gages that were selected to represent a low flow for modeling purposes for each of the listed segments.

Table 4-1 Low-Flow Analysis Summary for the Flint River Listed Segments

DO TMDL Segment	Drainage Area to bottom of listed segment (sq. miles)	Nearest USGS Gage	Drainage Area of Gage (sq. miles)	7Q10 of USGS Gage	Productivity Factor of 7Q10 (cfs/sq. mile)	Weighted 7Q10 for Modeling (cfs)
Beaver Creek	11.84	02349900	45	2.73	0.0607	0.718
Big Slough	25.01	02353400	188	34.12	0.1815	4.538
Dry Creek	104.47	02357000	485	11.84	0.0244	2.550
Fish Pond Drain	127.30	02357000	485	11.84	0.0244	3.108
Flat Creek	24.58	02344700	101	3.15	0.0312	0.767
Gulley Creek	11.40	02349900	45	2.73	0.0607	0.692
Spring Creek	366.23	02357000	485	11.84	0.0244	8.941
White Oak Creek	85.14	02344700	101	3.15	0.0312	2.655

A productivity factor was computed by dividing the 7Q10 by the watershed area of the USGS gage. The units of the productivity factor are cfs per square mile. A weighting 7Q10 was then computed by multiplying the listed segment watershed drainage area by the calculated productivity factor. The proximity of the USGS longterm gages are shown in Appendix A (Figures A-1, -2, -3, and –4).

Calibration Data

The model calibration period was determined from an examination of the USGS 2000 water quality data for each station located on the listed segments. The data examined included streamflow, dissolved oxygen, water temperature, BOD_5, and ammonia. The combination of the lowest, steady flow period with the lowest dissolved oxygen, and highest BOD concentrations, defined the critical modeling period. For all eight of the listed segments, June 2000 was found to be the critical period. The June 2000 average dissolved oxygen, BOD_5, and ammonia were also extracted from the dataset for each sampling station. BOD_5 was converted to Ultimate Carbonaceous Biochemical Oxygen Demand ($CBOD_U$) by multiplying by an f-ratio of 2.5 (standard GAEPD modeling practice) and ammonia was converted to Ultimate Nitrogenous Biochemical Oxygen Demand ($NBOD_U$) by multiplying by the stoichometric conversion factor of 4.57. These values were incorporated into the DOSAG model calibration files.

SOD Representation

SOD is an important part of the oxygen budget in these shallow streams. There are no field sediment oxygen demand measurements in the Flint River basin. However, there were several SOD measurements from the South 4 Basins. The values ranged from 0.9 to 1.9 $g/m^2/day$. It is necessary to be realistic in the development and application of SOD values in the Flint models, and to be consistent with the findings from the South 4 Basins. For this reason, an examination of South 4 SOD results was performed.

The 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 Flint models 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.

Calibration Conditions

Monthly average values of DO, Ultimate Carboneous Biochemical Oxygen Demand ($CBOD_U$), and Ultimate Nitrogenous Biochemical Oxygen Demand ($NBOD_U$) for June 2000 were used as instream targets to calibrate the models. June 2000 water temperatures were varied across the basin in accordance with the sampling data. Point source discharges were put into the model at their June 2000 DMR values for DO, BOD_5, NH_3, and flow. Headwater and tributary water quality boundaries were developed from instream 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 4-1 depicts a longitudinal dissolved oxygen calibration curve for the mainstem of the Flat Creek developed using this approach.

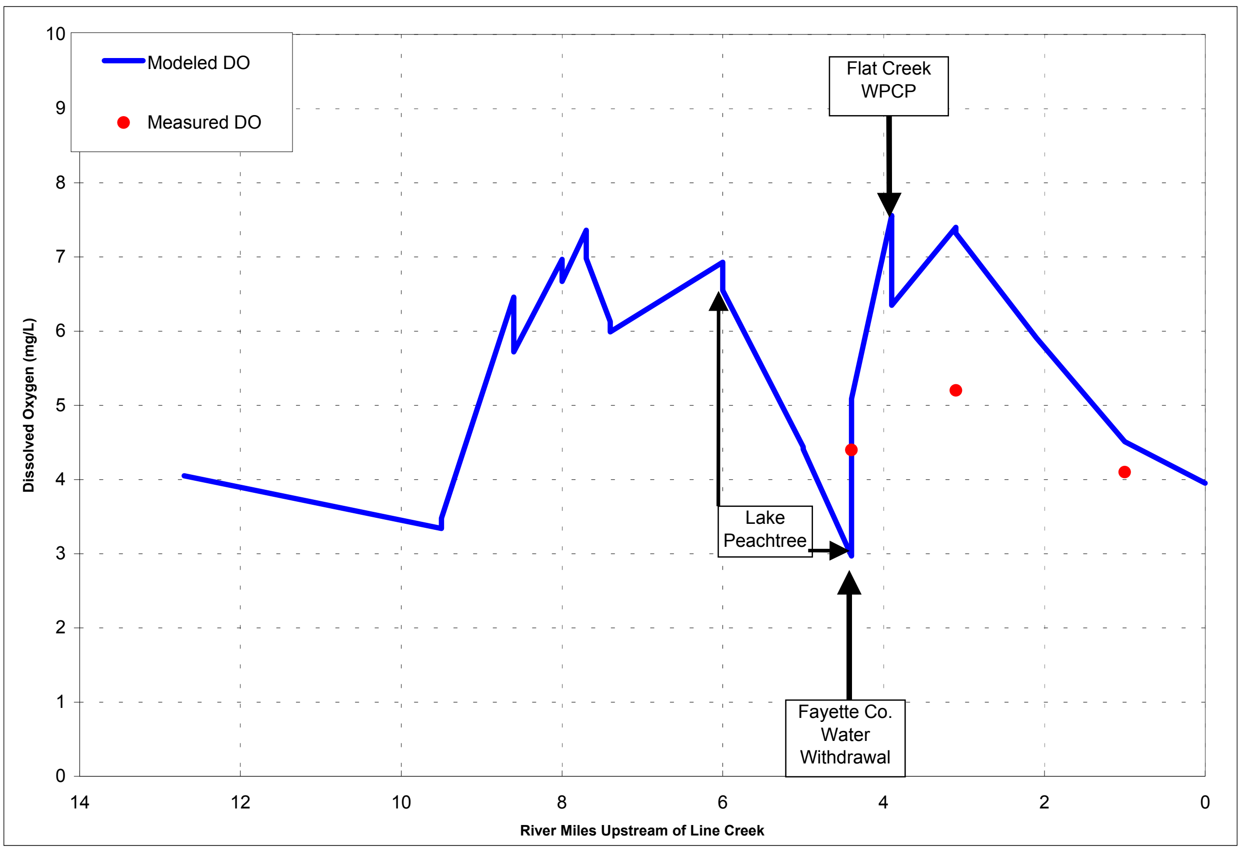

Figure 4-1 Dissolved Oxygen Calibration for Flat Creek

Critical Conditions

Model critical conditions were developed, in accordance with GAEPD standard practices. Critical conditions are used to assess dissolved oxygen standards, to determine if a problem exists requiring regulatory intervention, and to establish a level of protection if necessary. To do this, each calibrated model was modified in the following manner: 1) For flows, a 7Q10 was used. This is consistent with provisions in Georgia's Water Quality Regulations. Older published 7Q10 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 values were calculated and an average of the June through September 7Q10 was adopted. Productivity factors were then calculated from the revised 7Q10 values and applied uniformly throughout the basin. 2) For Temperature, 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. The June through August average temperature from the harmonic fit was used to represent each trend station. Critical temperatures in other locations in the basin were adjusted on the basis of June 2000 field data. Point sources were incorporated into the critical conditions models at their current NPDES permit limits. For NPDES permits that do not have an ammonia limit, a value of 17.4 mg/L was assumed. Water quality boundaries the SOD rate, and all other modeling rates and constants were the same as those in the calibrated models. To determine the effects of point sources alone, at critical conditions, additional model runs were made with point source flows set equal to zero.

Natural Conditions

For the natural condition runs, two 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. 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 4-2 along with the June 2000 and critical conditions results for comparison. It is important to note: (1) even though DO was found to be low in the summer of 2000 the results are even lower at standard critical conditions and (2) June 2000 conditions are very close to natural conditions and compare favorably with the 90 percent of natural DO standard.

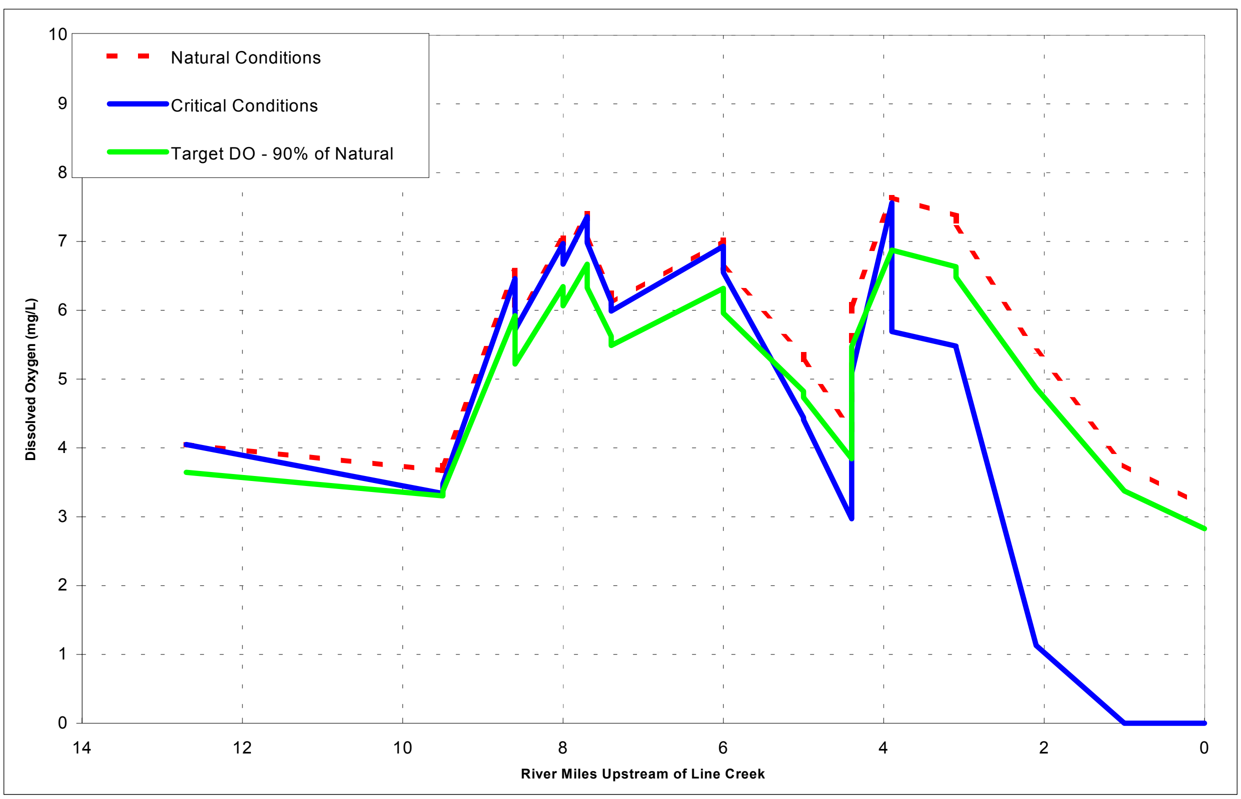

Figure 4-2 Critical, Natural, and Target Conditions for Flat Creek

<u>Allocations</u>

Allocations are based on EPA Dissolved Oxygen Criteria that states if the natural dissolved oxygen is less than the standard, then only a 10 percent reduction in the natural condition is allowed. The target limits are defined as 90 percent of the naturally occurring dissolved oxygen concentration at critical conditions. Figure 4-3 shows the natural condition model run with the target DO and TMDL allocation model runs. The low dissolved oxygen observed at River Mile 4.5 is the result of the sediment oxygen demand being exerted by the lake. The SOD rate used in the TMDL allocation model was based model predictions and may need to be verified.

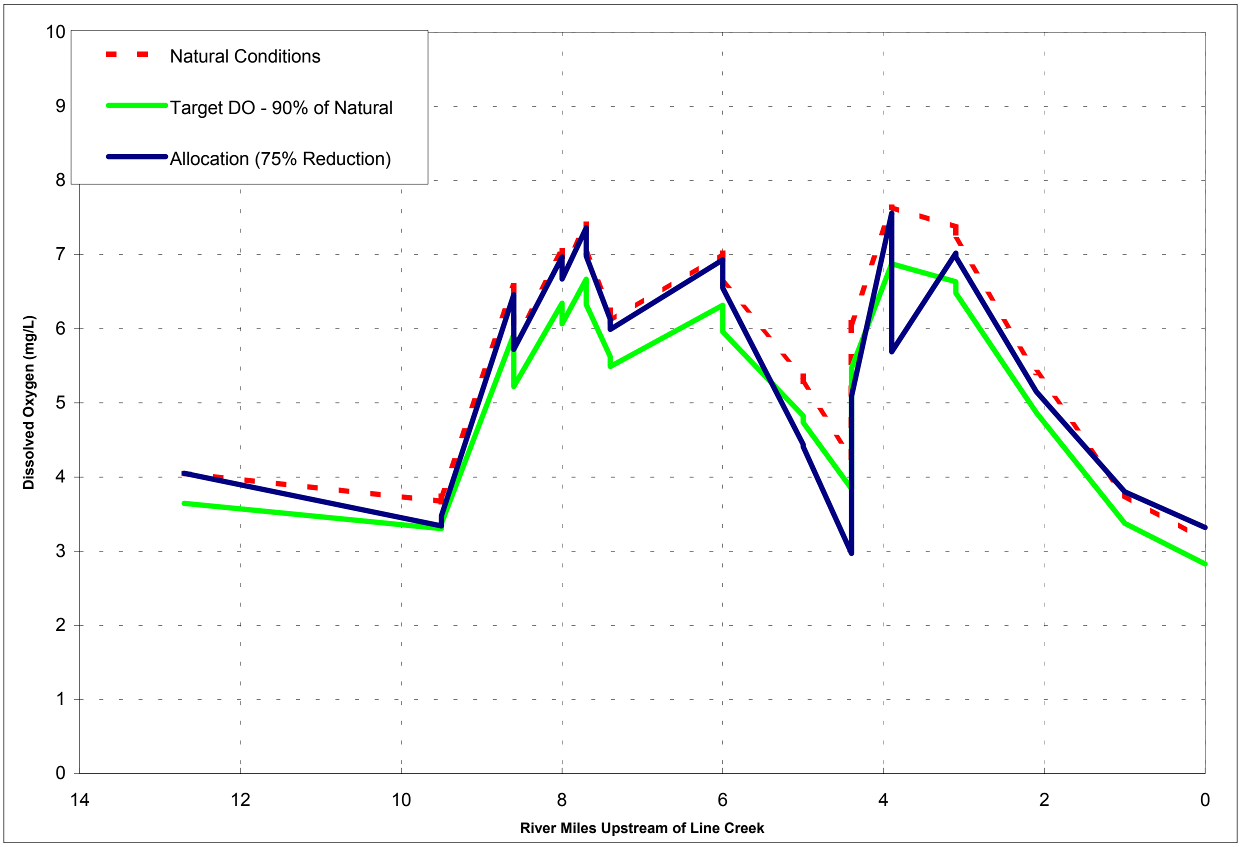

Figure 4-3 Natural, Target, and Allocation Conditions for Flat Creek

5.0 ALLOCATION

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

To determine naturally occurring dissolved oxygen concentrations, the steady-state DOSAG models were run with 1) critical conditions, 2) zero point source inputs and 3) 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 percent of the naturally occurring concentration.

After identifying the dissolved oxygen target limits, the models were run 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).

5.1 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 allocations to point source facilities contributing to listed waterbodies, while the LAs represent allocations to the nonpoint source contributions.

The partitioning of allocations between point (WLA) and nonpoint (LA) sources shown in Table 5-1 is based on modeling results and professional judgment. The existing WLA is separated into 'Direct' and 'Upstream' contributions. The 'Direct' loads are the point source loads discharging directly into the listed stream segment. The 'Upstream' load is one that discharges in an upstream segment and is transported downstream into the listed segment. The model was used to account for instream kinetic processes that would occur from the discharge point to the upstream boundary of the listed segment. The WLAs may be modified by GAEPD during the NPDES permitting process. The TMDLs will be used to assess the permit renewals. 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 5-1 Existing and TMDL Loads for Listed Segments in the Flint River Basin

Segment Number	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
1	Beaver Creek	None	None	56	56	56	NA	0%
2	Big Slough	None	None	351	351	234	NA	33%
3	Dry Creek	None	1,038	197	1,235	1,121	11%	0%
4	Fish Pond Drain	465	None	241	706	593	24%	0%
5	Flat Creek	1,136	None	59	1,196	353	74%	0%
6	Gulley Creek	None	None	107	107	36	NA	67%
7	Spring Creek	1,154	428	692	2,274	1,936	15%	0%
8	White Oak Creek	None	376	205	582	582	0%	0%

NOTE: * TMDL expressed as Ultimate Oxygen Demand (UOD) which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and the Nitrogenous Biochemical Oxygen Demand (NBOD).
None = no permitted point source contributing to listed segment.
NA = since there is not a permitted point source, a percent reduction is not applicable.

The point source reductions for Dry Creek, Fish Pond Drain, Flat Creek, and Spring Creek are as follows:

- Blakely Pond A (Dry Creek) – 41%
- Blakely Pond B (Dry Creek) – 41%
- Arlington Pond #1 (Spring Creek) – 41%
- Colquitt WPCP (Spring Creek) – 51%
- Donalsonville WPCP (Fish Pond Drain) – 24%
- Flat Creek WPCP (Flat Creek) – 74%

The Flat Creek WPCP currently has a design report and draft permit limits that will remove the oxygen demanding load (BOD_5 and NH_3) from their discharge while maintaining the permitted flow of 0.9 mgd. The 74% reduction that is presented above will be implemented through the current design report and draft permit limits.

The two ponds at Blakely and the Arlington Pond #1 have 41% reductions based on the assumption of a 17.4 mg/L for NH_3. The Donalsonville WPCP requires a 24% reduction and was also based on the assumption of a 17.4 mg/L for NH_3.

The Colquitt WPCP requires a 51% reduction. The TMDL modeling specified that a reduction of 10 mg/L (30 to 20) in the BOD_5 and 10 mg/L (15 to 5) in the NH_3 current permit limits would meet the instream water quality criteria.

5.2 Seasonal Variation

The low flow critical conditions incorporated in this TMDL are assumed to represent the most critical design conditions and to provide year-round protection of water quality. This TMDL is expressed as a total load during the critical low flow period.

5.3 Margin of Safety (MOS)

The MOS is a required component of TMDL development. As specified by section 303(d) of the CWA, the margin of safety must account for any lack of knowledge concerning the relationship between effluent limitations and water quality. There are two basic methods for incorporating the MOS: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations, or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations.

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 2000.
- 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.

6.0 RECOMMENDATIONS

6.1 Monitoring

Water quality monitoring is conducted at a number of locations across the State each year. GAEPD has adopted a basin approach to water quality management that divides Georgia's major river basins into five groups. This approach provides for additional sampling work to be focused on one of the five basin groups each year and offers a five-year planning and assessment cycle. The Chattahoochee and Flint River Basins were the subjects of focused monitoring in 2000 and will again receive focused monitoring in 2005.

The TMDL Implementation Plan will outline an appropriate water quality sampling program for the listed streams in the Flint River Basin. The monitoring program will be developed to help identify the various oxygen demanding sources. The sampling program will be used to verify the 303(d) stream segment listings. This will be especially valuable for those segments where no data or old data that resulted in the listing.

6.2 Reasonable Assurance

The Georgia EPD is responsible for administering and enforcing laws to protect the waters of the State. The TMDL implementation will be done using a phased approach due to the insufficient data available on the natural background dissolved oxygen concentrations. Permitted discharges will be regulated through the NPDES permitting process d1escribed in this report. The permittee may be required to perform dissolved oxygen monitoring upstream and downstream of the point source to verify the natural dissolved oxygen concentrations assumed in the model. The target WLA reduction will not be implemented until sufficient data has been collected to verify the model assumptions. If it is determined that the model assumptions need to be updated, the target WLA reductions will be re-evaluated based on the new data collected during critical conditions, and the TMDL will be reallocated.

EPD is the lead agency for implementing the State's Nonpoint Source Management Program. Regulatory responsibilities that have a bearing on nonpoint source pollution include establishing water quality standards and use classifications, assessing and reporting water quality conditions, and regulating land-use activities, which may affect water quality. Georgia is working with local governments, agricultural, and forestry agencies such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission to foster the implementation of Best Management Practices (BMPs) that address nonpoint source pollution. In addition, public education efforts are being targeted to individual stakeholders to provide information regarding the use of BMPs to protect water quality.

6.3 Public Participation

A 30-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.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

EPD has coordinated with EPA to prepare this Initial TMDL Implementation Plan for this TMDL. EPD has also established a plan and schedule for development of a more comprehensive implementation plan after this TMDL is established. EPD and EPA have executed a Memorandum of Understanding that documents the schedule for developing the more comprehensive plans. This Initial TMDL Implementation Plan includes a list of BMPs and provides for an initial implementation demonstration project to address one of the major sources of pollutants identified in this TMDL, while State and/or local agencies work with local stakeholders to develop a revised TMDL implementation plan. It also includes a process whereby EPD and/or Regional Development Centers (RDCs), or other EPD contractors (hereinafter, “EPD Contractors”), will develop expanded plans (hereinafter, “Revised TMDL Implementation Plans”).

This Initial TMDL Implementation Plan, written by EPD and for which EPD and/or the EPD Contractor are responsible, contains the following elements.

1. EPA 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.

2. EPD and the EPD Contractor will select and implement one or more 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 pollutant categories of concern for the respective River Basin as identified in the TMDLs. 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. Also, 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 the 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 2004.

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.

Table 7-1 Management Measure Selector Table

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	_	_		_	_		_	_	

Land Use	Management Measures	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	*Metals (copper, lead, zinc, cadmium)*	PCBs, toxaphene
	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	–	–			–			–	

#202082

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Appendix A – Source Assessments for Listed Streams

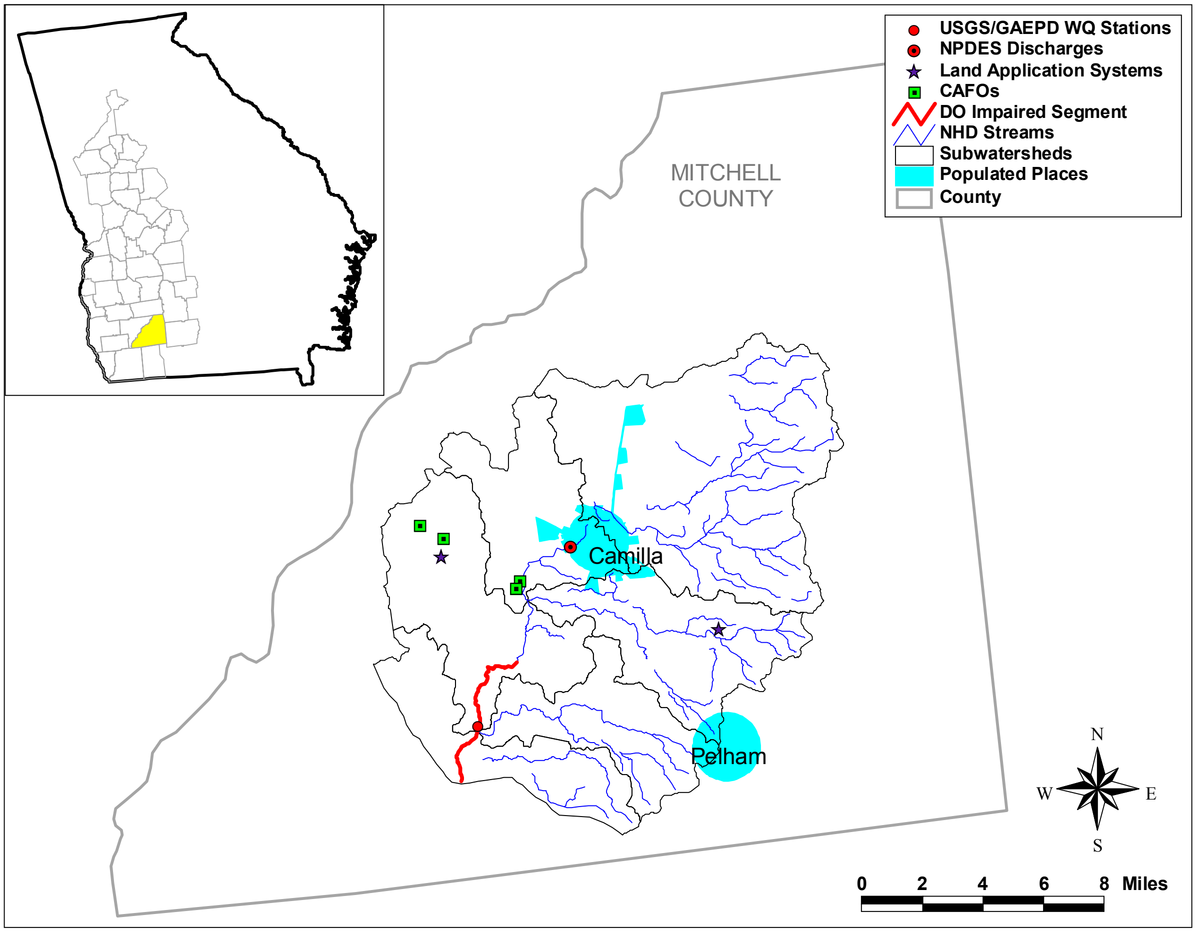

Figure A-1 Location of Point Sources and Data Stations in the Contributing Big Slough Watershed

Table A-1 Summary of Source Assessment for the Big Slough Watershed

Impaired Segment:	Big Slough
Miles of Impairment:	4 miles
8-Digit HUC:	03130008
12-Digit HUC:	031300080505, 031300080506B
County:	Mitchell
Cities:	near Pelham
Reason for Listing:	2000 WQ Data
USGS/GAEPD WQ Station ID	River Basin 95 and 11107501
DO Violations (Year of data):	1 of 5 (2000)
USGS Station ID:	near 02353400 (Pachitla Creek near Edison, GA), DA = 188 sq. miles
NPDES Facilities:	GA0020362 - Camilla WPCP
Landfills:	101-004D(SL) - Mitchell County SR 3A
	101-002D(SL) - Mitchell County S1643
CAFOs:	Holton Floor
	Pinecliff Farm
	Roger's Floor
	Peacot Swine - North
	Peacot Swine - South
Land Applications:	GAU020088 - Camilla LAS
	GAU030740 - Mitchell Co Board of Commissioners
Water Withdrawals:	none
Area of Watershed (sq. miles)	25
Area of Watershed (acres):	16,004

Land Use	sq. meters	acres	% of Total
Open Water	765,000	189.04	0.17%
Low Intensity Residential	3,724,200	920.27	0.85%
High Intensity Residential	1,041,300	257.31	0.24%
High Intensity Commercial/Industrial/Transportation	1,643,400	406.09	0.37%
Bare Rock/Sand/Clay	226,800	56.04	0.05%
Quarries/Strip Mines/Gravel Pits	6,300	1.56	0.00%
Transitional	17,604,900	4,350.27	4.01%
Deciduous Forest	17,309,700	4,277.32	3.95%
Evergreen Forest	70,706,700	17,472.01	16.12%
Mixed Forest	19,593,900	4,841.76	4.47%
Pasture/Hay	64,765,800	16,003.98	14.76%
Row Crops	213,620,400	52,786.75	48.70%
Other Grasses (Urban/recreational; e.g. parks, lawns)	1,103,400	272.66	0.25%
Woody Wetlands	22,825,800	5,640.38	5.20%
Emergent Herbaceous Wetlands	3,743,100	924.94	0.85%
Totals =	438,680,700	108,400.36	100%

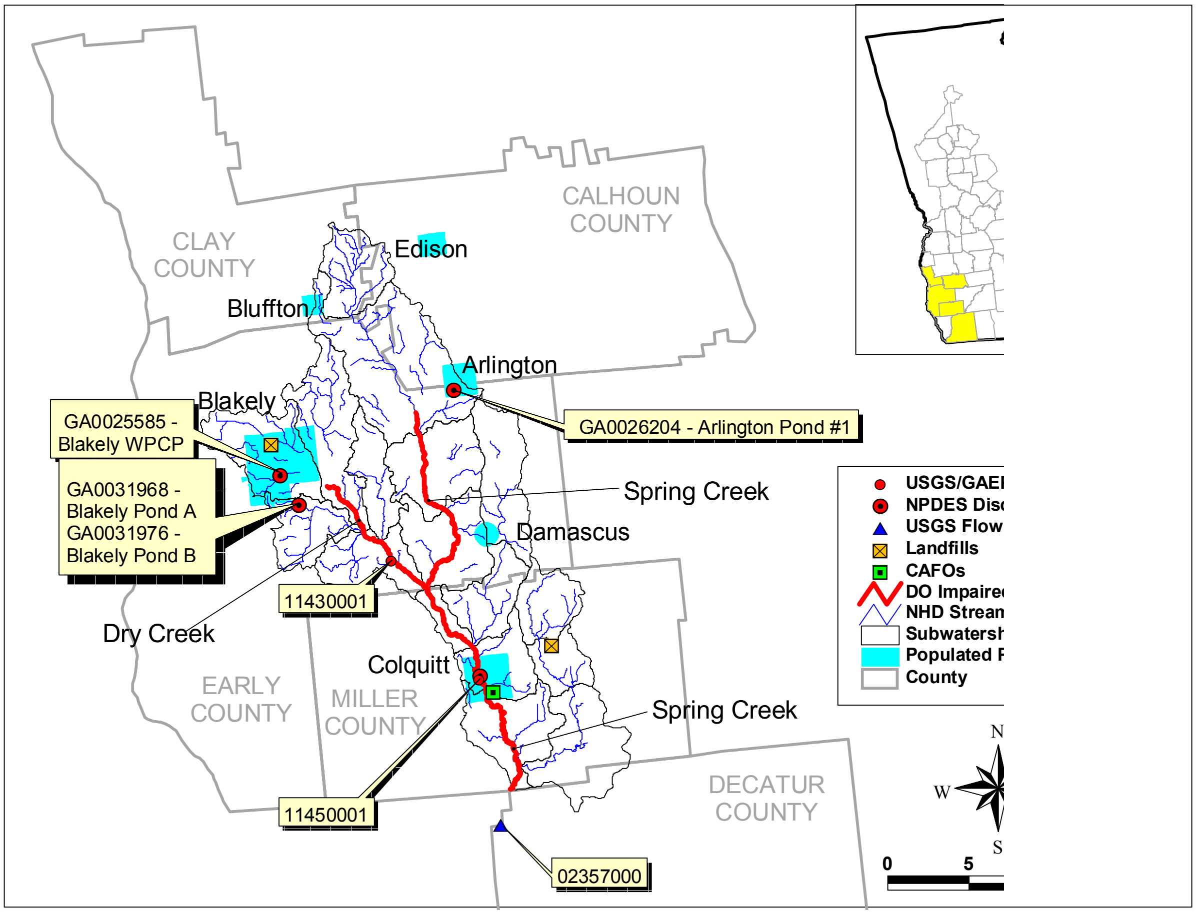

Figure A-2 Location of Point Sources and Data Stations in the Contributing Dry and Spring Creek Watersheds

Table A-2 Summary of Source Assessment for the Dry Creek Watershed

Impaired Segment:	Dry Creek
Miles of Impairment:	12
8-Digit HUC:	03130010
12-Digit HUC:	031300100201, 031300100202, 031300100203, 031300100204, 031300100205
County:	Early
Cities:	Blakely
Reason for Listing:	2000 WQ Data
USGS/GAEPD WQ Station ID:	11430001
DO Violations (Year of data):	2 of 16 (2000)
USGS Station ID:	upstream of 02357000 (Spring Creek near iron City, GA), DA = 485 sq. miles
NPDES Facilities:	GA0025585 - Blakely WPCP GA0031968 - Blakely Pond A GA0031976 - Blakely Pond B
Landfills:	049-002D(SL) Blakely - Howell Street - Pitt Road
CAFOs:	none
Land Applications:	none
Water Withdrawals:	none
Area of Watershed (sq. miles):	104.47
Area of Watershed (acres):	66,861

Land Use	sq. meters	acres	% of Total
Open Water	1,596,600	394.53	0.59%
Low Intensity Residential	2,077,200	513.29	0.77%
High Intensity Residential	530,100	130.99	0.20%
High Intensity Commercial/Industrial/Transportation	874,800	216.17	0.32%
Transitional	11,237,400	2,776.82	4.15%
Deciduous Forest	30,542,400	7,547.19	11.29%
Evergreen Forest	19,401,300	4,794.17	7.17%
Mixed Forest	28,418,400	7,022.34	10.50%
Pasture/Hay	36,399,600	8,994.54	13.45%
Row Crops	89,862,300	22,205.46	33.21%
Other Grasses (Urban/recreational; e.g. parks, lawns)	798,300	197.26	0.30%
Woody Wetlands	45,647,100	11,279.64	16.87%
Emergent Herbaceous Wetlands	3,189,600	788.17	1.18%
Totals =	270,575,100	66,861	100%

Table A-3 Summary of Source Assessment for the Spring Creek Watershed

Impaired Segment:	Spring Creek
Miles of Impairment:	22
8-Digit HUC:	03130010
12-Digit HUC:	031300100101, 031300100102, 031300100103, 031300100104, 031300100301, 031300100302 031300100303, 031300100501, 031300100502, 031300100503, 031300100504, 031300100505
County:	Clay, Calhoun, Early, Miller, Decatur
Cities:	Arlington, Colquitt, Damascus
Reason for Listing:	2000 WQ Data
USGS/GAEPD WQ Station ID:	11450001
DO Violations (Year of data):	3 of 22 (2000)
USGS Station ID:	02357000 (Spring Creek near iron City, GA), DA = 485 sq. miles
NPDES Facilities:	GA0026204 - Arlington Pond #1 GA0047252 - Colquitt WPCP GA0025585 - Blakely WPCP GA0031968 - Blakely Pond A GA0031976 - Blakely Pond B
Landfills:	100-004D(SL) CR37 - Sheffield 049-002D(SL) Blakely - Howell Street - Pitt Road
CAFOs:	Atkinson Swine
Land Applications:	none
Water Withdrawals:	none
Area of Watershed (sq. miles):	366.23
Area of Watershed (acres):	234,388

Land Use	sq. meters	acres	% of Total
Open Water	6,843,600	1,691.09	0.72%
Low Intensity Residential	3,116,700	770.15	0.33%
High Intensity Residential	710,100	175.47	0.07%
High Intensity Commercial/Industrial/Transportation	1,527,300	377.40	0.16%
Bare Rock/Sand/Clay	7,200	1.78	0.00%
Transitional	35,390,700	8,745.23	3.73%
Deciduous Forest	115,045,200	28,428.29	12.13%
Evergreen Forest	66,942,000	16,541.73	7.06%
Mixed Forest	98,902,800	24,439.41	10.43%
Pasture/Hay	117,336,600	28,994.51	12.37%
Row Crops	363,675,600	89,866.20	38.34%
Other Grasses (Urban/recreational; e.g. parks, lawns)	1,438,200	355.39	0.15%
Woody Wetlands	130,756,500	32,310.63	13.79%
Emergent Herbaceous Wetlands	6,840,900	1,690.42	0.72%
Totals =	948,533,401	234,388	100%

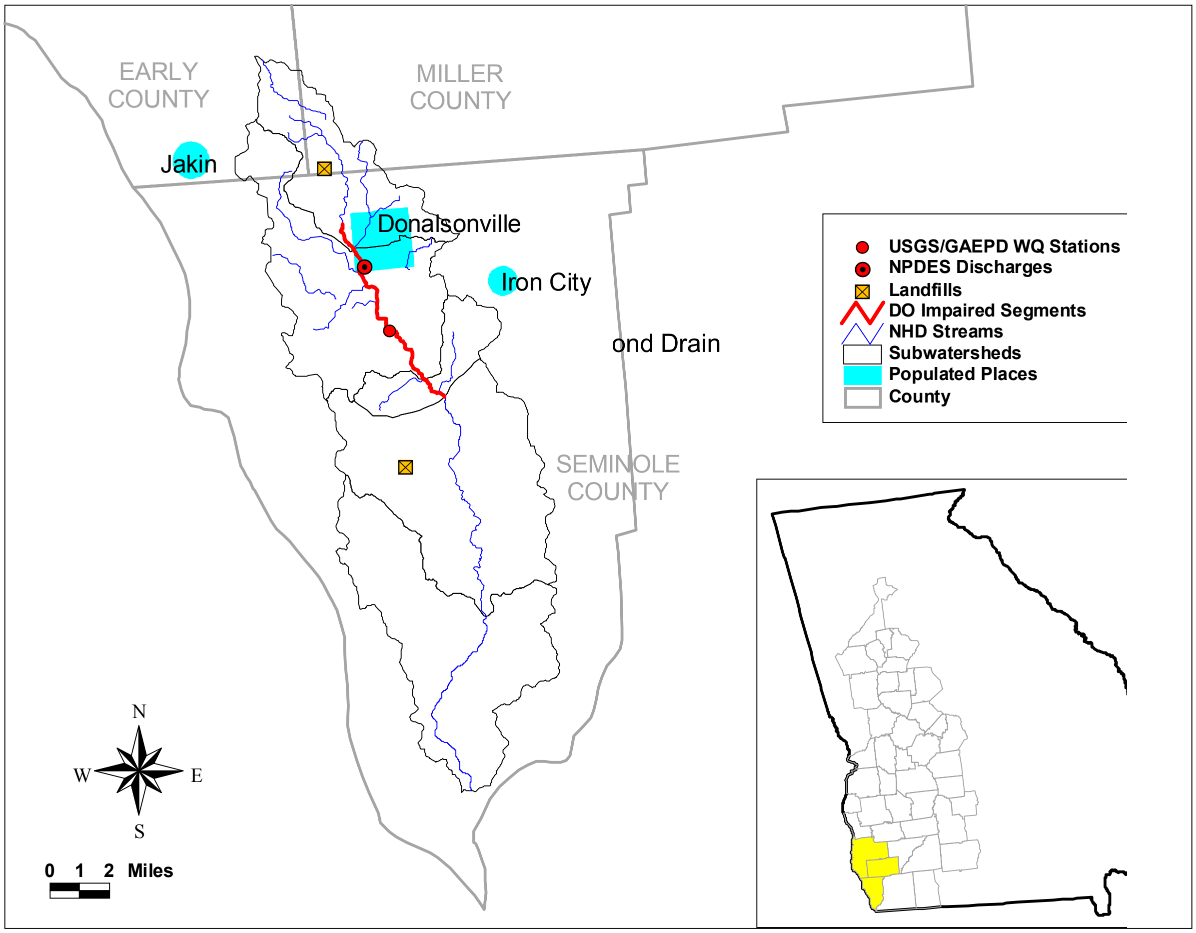

Figure A-3 Location of Point Sources and Data Stations in the Contributing Fish Pond Drain Watershed

Table A-4 Summary of Source Assessment for the Fish Pond Drain Watershed

Impaired Segment:	Fish Pond Drain
Miles of Impairment:	7
8-Digit HUC:	03130010
12-Digit HUC:	031300100801, 031300100802, 031300100803A, 031300100803B, 031300100804
County:	Early, Miller, and Seminole
Cities:	Jakin, Donalsonville, Iron City
Reason for Listing:	2000 WQ Data
USGS/GAEPD WQ Station ID:	11780501
DO Violations (Year of data):	6 of 20 (2000)
USGS Station ID:	02357000 (Spring Creek near iron City, GA), DA = 485 sq. miles
NPDES Facilities:	GA0026123 - Donalsonville WPCP
Landfills:	100-005D(L) - Donalsonville - SR 39N 125-003D(SL) Donalsonville SR 39
CAFOs:	none
Land Applications:	none
Water Withdrawals:	none
Area of Watershed (sq. miles):	127.30
Area of Watershed (acres):	81,469

Land Use	sq. meters	acres	% of Total
Open Water	14,076,900	3,478.48	4.27%
Low Intensity Residential	2,022,300	499.72	0.61%
High Intensity Residential	292,500	72.28	0.09%
High Intensity Commercial/Industrial/Transportation	1,862,100	460.13	0.56%
Bare Rock/Sand/Clay	17,100	4.23	0.01%
Transitional	13,121,100	3,242.29	3.98%
Deciduous Forest	33,993,000	8,399.85	10.31%
Evergreen Forest	24,791,400	6,126.09	7.52%
Mixed Forest	26,336,700	6,507.94	7.99%
Pasture/Hay	59,742,000	14,762.57	18.12%
Row Crops	133,022,700	32,870.63	40.35%
Other Grasses (Urban/recreational; e.g. parks, lawns)	693,000	171.24	0.21%
Woody Wetlands	16,415,100	4,056.26	4.98%
Emergent Herbaceous Wetlands	3,307,500	817.30	1.00%
Totals =	329,693,400	81,469	100%

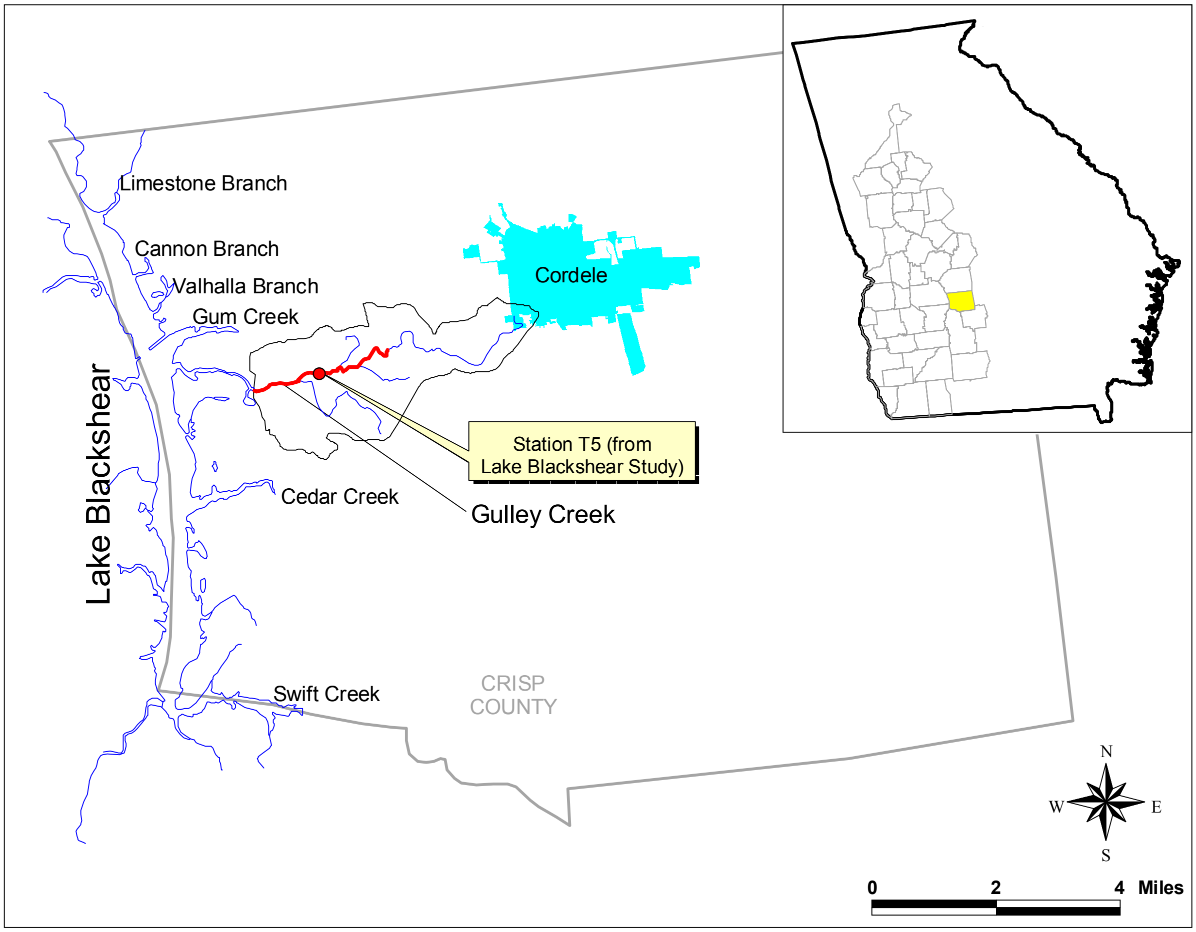

Figure A-4 Location of Point Sources and Data Stations in the Contributing Gulley Creek Watershed

Table A-5 Summary of Source Assessment for the Gulley Creek Watershed

Impaired Segment:	Gulley Creek
Miles of Impairment:	4
8-Digit HUC:	03130006
12-Digit HUC:	031300060611A
County:	Crisp
Cities:	Cordele
Reason for Listing:	Clean Lakes 92,93 (Lake Blackshear Phase I Diagnostic Study - April 1992 through March 1993)
USGS/GAEPD WQ Station ID:	none
DO Violations (Year of data):	3 of 18 (1992-1993)
USGS Station ID:	near 02349900 (Turkey Creek near Byromville, GA), DA = 45 sq. miles
NPDES Facilities:	none
Landfills:	none
CAFOs:	none
Land Applications:	none
Water Withdrawals:	none
Area of Watershed (sq. miles):	11.40
Area of Watershed (acres):	7,297

Land Use	sq. meters	acres	% of Total
Open Water	22,500	5.56	0.08%
Low Intensity Residential	144,900	35.81	0.49%
High Intensity Residential	282,600	69.83	0.96%
High Intensity Commercial/Industrial/Transportation	81,000	20.02	0.27%
Bare Rock/Sand/Clay	12,600	3.11	0.04%
Transitional	1,254,600	310.02	4.25%
Deciduous Forest	2,221,200	548.87	7.52%
Evergreen Forest	1,802,700	445.46	6.10%
Mixed Forest	1,187,100	293.34	4.02%
Pasture/Hay	7,468,200	1,845.43	25.29%
Row Crops	13,094,100	3,235.62	44.34%
Other Grasses (Urban/recreational; e.g. parks, lawns)	98,100	24.24	0.33%
Woody Wetlands	1,795,500	443.68	6.08%
Emergent Herbaceous Wetlands	64,800	16.01	0.22%
Totals =	29,529,900	7,297	100%

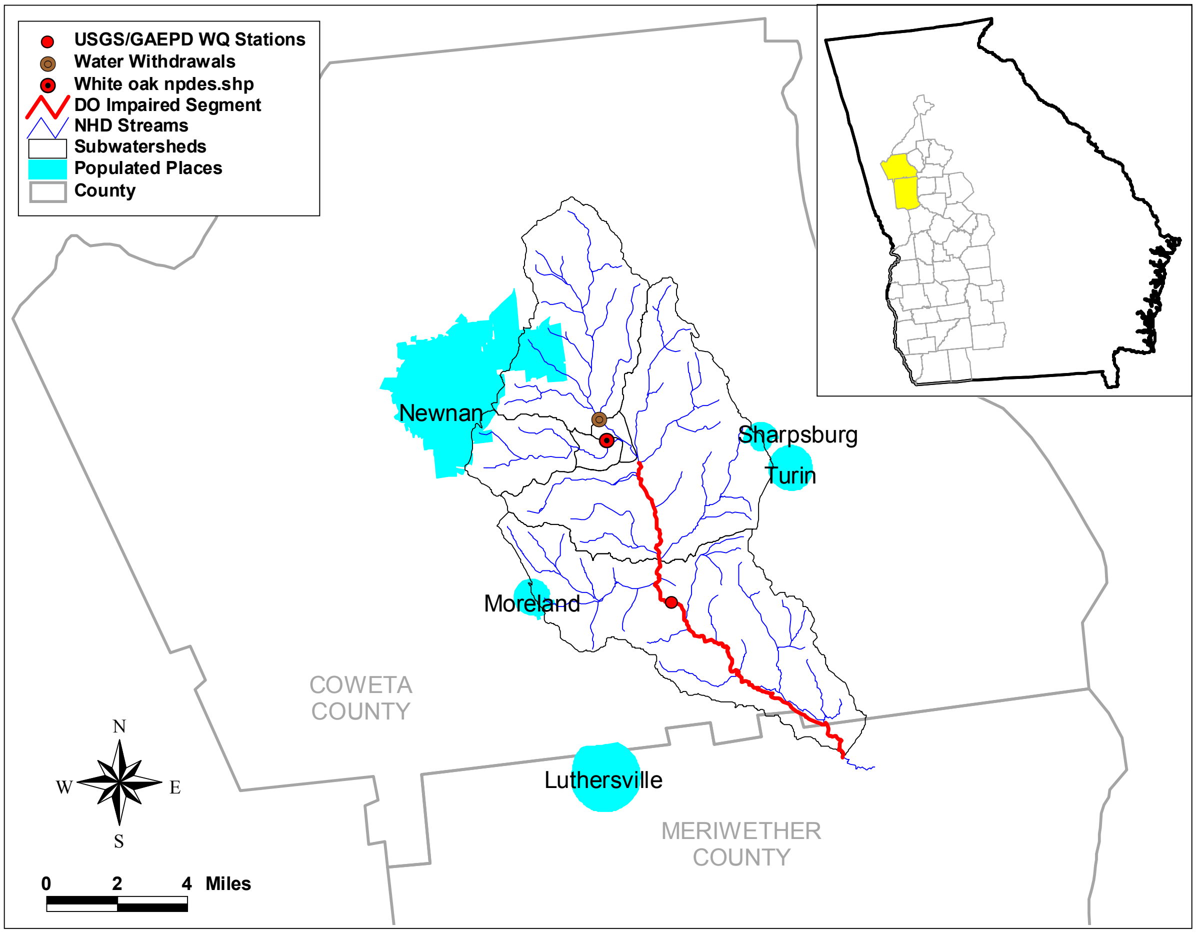

Figure A-5 Location of Point Sources and Data Stations in the Contributing White Oak Creek Watershed

Table A-6 Summary of Source Assessment for the White Oak Creek Watershed

Impaired Segment:	White Oak Creek
Miles of Impairment:	14
8-Digit HUC:	03130005
12-Digit HUC:	031300050301, 013100050302A, 031300050302B 031300050302C, 031300050302D, 031300050303
County:	Coweta and Meriwether
Cities:	Newnan, Sharpsburg, Turin, Moreland
Reason for Listing:	2000 WQ Data
USGS/GAEPD WQ Station ID:	11027201
DO Violations (Year of data):	4 of 23 (2000)
USGS Station ID:	02344700 (Line Creek near Senoia, GA), DA = 101 sq. miles
NPDES Facilities:	GA0034614 - Shenandoah WPCP
Landfills:	100-005D(L) - Donalsonville - SR 39N 125-003D(SL) Donalsonville SR 39
CAFOs:	none
Land Applications:	none
Water Withdrawals:	none
Area of Watershed (sq. miles):	85.14
Area of Watershed (acres):	54,491

Land Use	sq. meters	acres	% of Total
Open Water	2,716,200	671.19	1.23%
Low Intensity Residential	2,758,500	681.64	1.25%
High Intensity Residential	232,200	57.38	0.11%
High Intensity Commercial/Industrial/Transportation	3,731,400	922.05	1.69%
Transitional	3,978,000	982.99	1.80%
Deciduous Forest	57,980,700	14,327.34	26.29%
Evergreen Forest	46,274,400	11,434.65	20.98%
Mixed Forest	52,071,300	12,867.10	23.61%
Pasture/Hay	22,761,000	5,624.37	10.32%
Row Crops	10,581,300	2,614.70	4.80%
Other Grasses (Urban/recreational; e.g. parks, lawns)	3,043,800	752.14	1.38%
Woody Wetlands	14,152,500	3,497.16	6.42%
Emergent Herbaceous Wetlands	236,700	58.49	0.11%
Totals =	220,518,000	54,491	100%

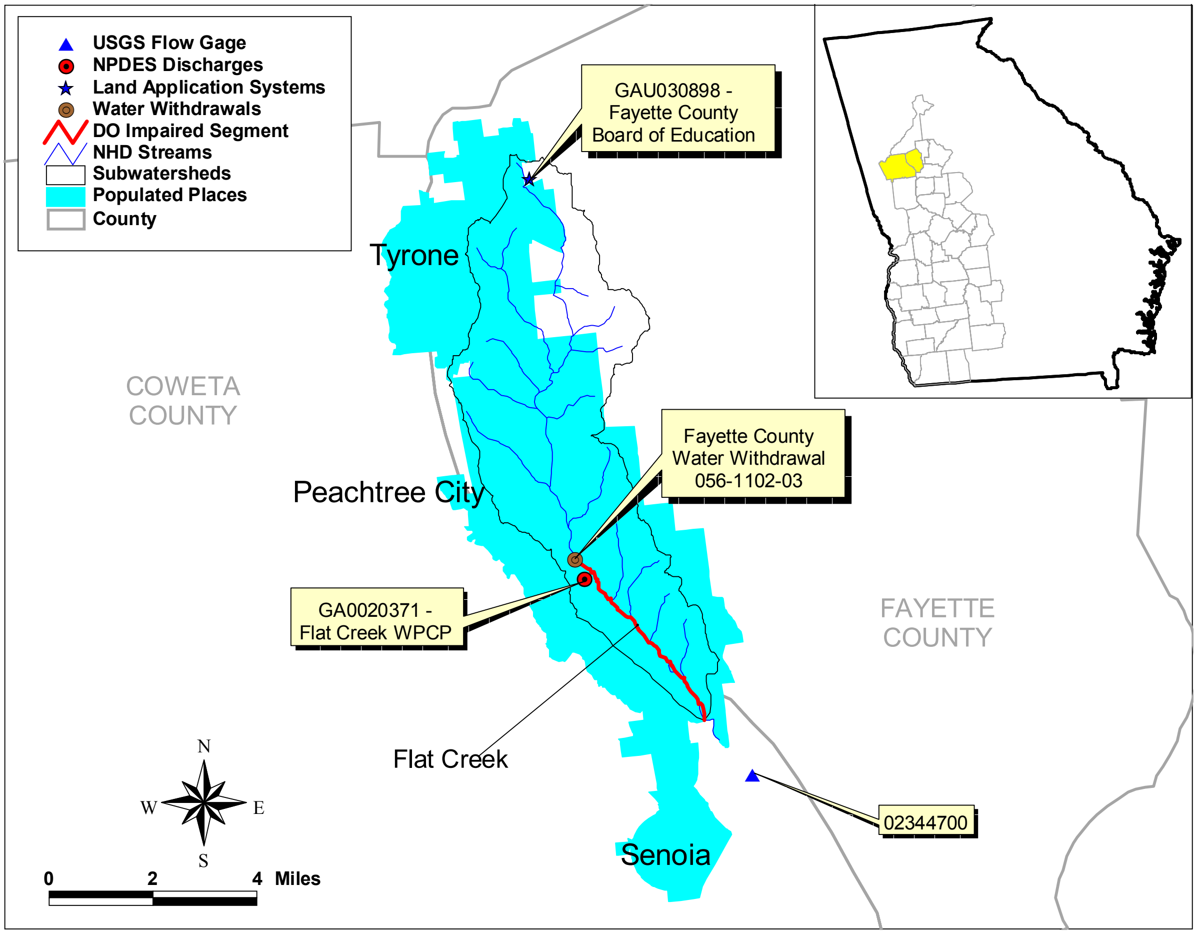

Figure A-6 Location of Point Sources and Data Stations in the Contributing Flat Creek Watershed

Table A-7 Summary of Source Assessment for the Flat Creek Watershed

Impaired Segment:	Flat Creek
Miles of Impairment:	4
8-Digit HUC:	03130005
12-Digit HUC:	031300050203
County:	Coweta and Fayette
Cities:	Peachtree City, Tyrone, Senoia
Reason for Listing:	Intensive Survey, TOT Study 92
USGS/GAEPD WQ Station ID:	none
DO Violations (Year of data):	none
USGS Station ID:	02344700 (Line Creek near Senoia, GA), DA = 101 sq. miles
NPDES Facilities:	GA0020371 - Flat Creek WPCP
Landfills:	none
CAFOs:	none
Land Applications:	GAU030898 - Fayette County Board of Education
Water Withdrawals:	056-1102-03 - Fayette County Water Withdrawal
Area of Watershed (sq. miles):	24.58
Area of Watershed (acres):	15,729

	MRLC Land Use			ARC Land Use		
Land Use	sq. meters	Acres	% of Total	sq. meters	Acres	% of Total
Open Water	2,250,052	556	3.53%	1,950,585	482	3.06%
Low Intensity Residential	31,043,436	7671	48.77%	0	0	0.00%
High Intensity Residential	1,222,151	302	1.92%	11,080,293	2738	17.41%
High Intensity Commercial/Industrial/Transportatio	6,280,721	1552	9.87%	1,549,946	383	2.43%
Bare Rock/Sand/Clay	0	0	0.00%	0	0	0.00%
Quarries/Strip Mines/Gravel Pits	0	0	0.00%	0	0	0.00%
Transitional	1,137,167	281	1.79%	222,577	55	0.35%
Forest	10,436,843	2579	16.40%	38,331,824	9472	60.22%
Row Crops	6,891,796	1703	10.83%	2,719,488	672	4.27%
Pasture/Hay	0	0	0.00%	4,487,964	1109	7.05%
Other Grasses (Urban/Recreational;e.g.parks/lawns)	2,298,614	568	3.61%	1,145,260	283	1.80%
Woody Wetlands	2,092,225	517	3.29%	2,140,787	529	3.36%
Emergent Herbaceous Wetlands	0	0	0.00%	24,281	6	0.04%
Totals =	63,653,005	15,729	100%	63,653,005	15,729	100%

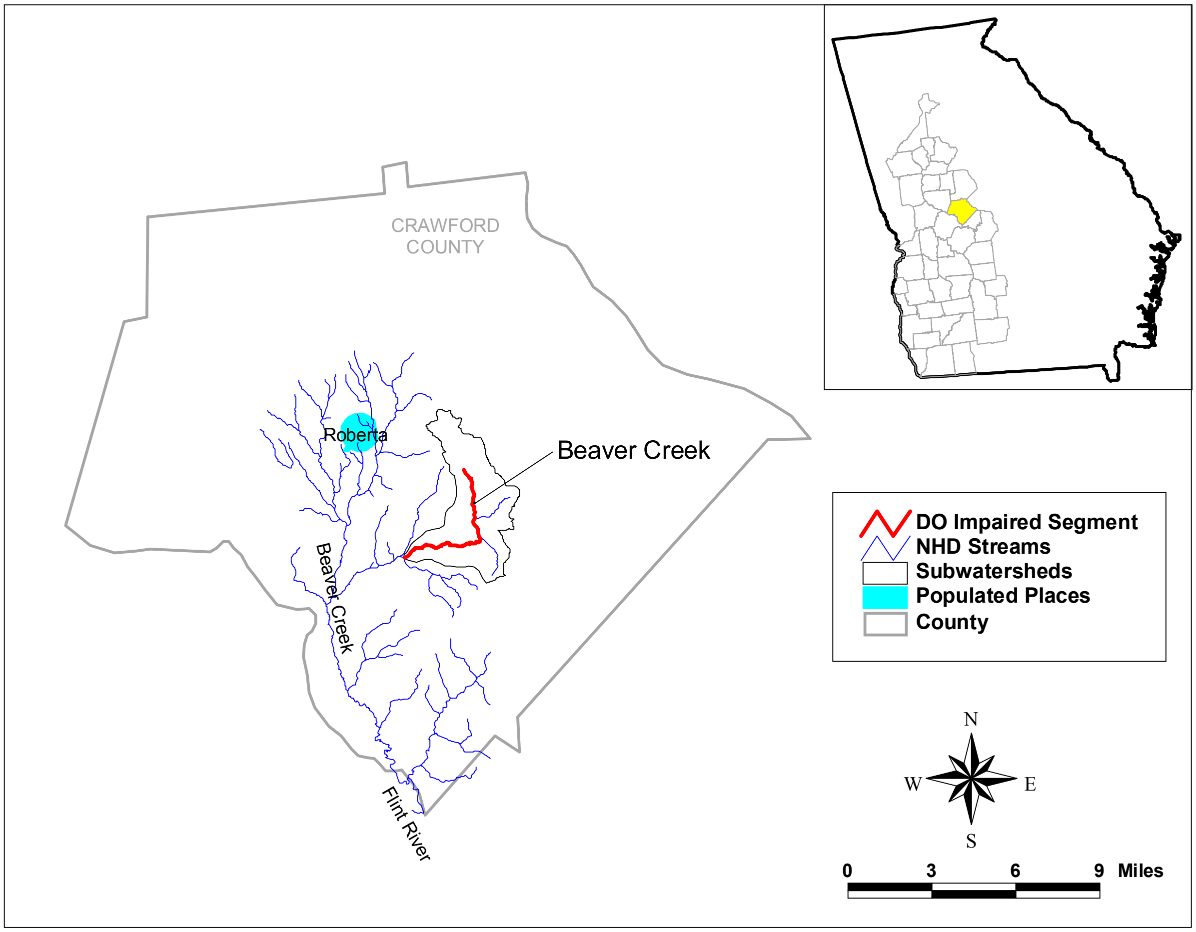

Figure A-7 Location of Point Sources and Data Stations in the Contributing Beaver Creek Watershed

Table A-8 Summary of Source Assessment for the Beaver Creek Watershed

Impaired Segment: Beaver Creek
Miles of Impairment: 11 miles
8-Digit HUC: 03130005
12-Digit HUC: 031300051305
County: Crawford
Cities: near Roberta
Reason for Listing: Fish IBI (WRD#389)
USGS/GAEPD WQ Station ID: none
DO Violations (Year of data): 2.7 mg/L (1991)
USGS Station ID: near 02349900 (Turkey Creek at Byromville, GA), DA = 45 sq. miles
NPDES Facilities: none
Landfills: none
CAFOs: none
Land Applications: none
Water Withdrawals: none
Area of Watershed (sq. miles): 11.84
Area of Watershed (acres): 7,577.44

Land Use	sq. meters	acres	% of Total
Open Water	66,600	16.46	0.22%
High Intensity Commercial/Industrial/Transportation	14,400	3.56	0.05%
Transitional	5,442,300	1,344.82	17.75%
Deciduous Forest	12,556,800	3,102.85	40.95%
Evergreen Forest	6,991,200	1,727.56	22.80%
Mixed Forest	3,587,400	886.47	11.70%
Pasture/Hay	441,900	109.20	1.44%
Row Crops	1,295,100	320.03	4.22%
Woody Wetlands	268,200	66.27	0.87%
Emergent Herbaceous Wetlands	900	0.22	0.00%
Totals =	30,664,800	7,577.44	100%

Appendix B – Water Quality Data

Table B-1 2000 Water Quality Data Collected in Big Slough

Date	Time	BOD_5 (mg/L)	DO (mg/L)	% Saturation	Gage Height (feet)	NH_3 (mg/L)	NO_2-NO_3 (mg/L)	pH	TP (mg/L)	Water Temp (deg C)	TOC (mg/L)	Turbidity (NTU)
02/17/00	9:05	2.2	4.3	42	3.59	0.08	0.37	6.5	0.39	15.4	13	59
03/30/00	8:25	2	4.24	46	1.01	0.05	<0.02	6.93	0.39	19.1	17	9.9
07/27/00	7:45		1.76	21	0.98			6.35		24.9		
08/03/00	8:00		4.5	53	0.47			6.15		23.9		
12/07/00	9:15	3.2	6.7	53	0.15	0.03	<0.02	6.58	0.09	6	6.7	8.2

Table B-2 2000 Water Quality Data Collected in Dry Creek

Date	Time	BOD_5 (mg/L)	Discharge (cfs)	DO (mg/L)	% Saturation	Gage Height (feet)	NH_3 (mg/L)	NO_2-NO_3 (mg/L)	pH	TP (mg/L)	Water Temp (deg C)	TOC (mg/L)	Turbidity (NTU)
1/25/2000	12:50	1.7	124	10.09	81	9.28	0.05	0.08	7.43	0.05	5.9	7.4	21
2/22/2000	10:55	0.6	47	9.58	83	8.48	0.04	0.21	7.87	<0.02	9.6	3.4	4.2
3/7/2000	09:55		33	7.91	75	8.25			7.58		13.4		
3/14/2000	09:50		73	8.85	78	8.81			7.5		10.6		
3/21/2000	11:20	0.8	81	8.31	80	8.9	0.07	0.11	7.85	0.03	14	6.6	8.4
4/4/2000	09:00		50	6.05	63	8.52			7.69		17.9		
4/11/2000	10:40		25	8.91	84	8.1			7.8		13.1		
4/19/2000	10:00	1	19	7.51	76	7.96	0.09	0.46	7.83	<0.02	16	3.1	6.6
5/2/2000	09:45	1.1	9.8	6.97	73	7.66	0.09	0.49	7.83	0.02	18	2.8	9.2
9/19/2000	10:30	1.1	1.1	2.47	28	6.87	0.1	0.06	7.25	0.04	21.8	5.8	3.8
9/26/2000	09:30		3.8	4	47	7.31					23.4		
10/4/2000	09:20		1.8	3.3	36	7.04			6.95		19.6		
10/17/2000	10:45	0.7	2	6	59	7.07	0.07	0.05	7.15	<0.02	14.9	3.7	4.8
11/28/2000	10:35	2.4	35	8.2	71	8.28	0.03	0.03	6.85	0.03	9.6	9.1	6.4
12/12/2000	11:10	0.8	25	7.1	67	8.09	0.03	0.05	6.97	<0.02	13.3	8.9	2.1

Table B-3 2000 Water Quality Data Collected in Fish Pond Drain

Date	Time	BOD_5 (mg/L)	DO (mg/L)	% Saturation	Gage Height (feet)	NH_3 (mg/L)	NO_2-NO_3 (mg/L)	pH	TP (mg/L)	Water Temp (deg C)	TOC (mg/L)	Turbidity (NTU)
02/02/2000	10:45		13.7	111	8.7			7.88		7		
02/09/2000	09:05		11.37	93	8.41			8.45		7.2		
02/16/2000	10:50	2.4	5.36	51	8.7	1.7	1.2	7.09	0.81	13.5	9.1	82
03/29/2000	08:10	1.7	5.88	59	8.4	0.06	6.6	7.87	0.62	16.3	3.9	3.5
04/26/2000	08:05	2.8	2.65	27	8.52	1.5	2.8	7.1	1.3	16.2	5.5	23
05/10/2000	08:15	1.2	5.12	58	8.42	0.1	8.5	7.8	1.9	21.6	4.1	2.5
05/17/2000	08:15		6.33	72	8.4			8.08		22.1		
05/24/2000	08:05		4.1	49	8.37			7.87		24.3		
06/07/2000	07:45	1	3.4	40	8.39	0.13	6.8	7.92	1.9	23.2	3.3	6.2
07/19/2000	07:00	0.9	3.54	45	8.39	0.21	9.5	7.75	1.3	27.3	3.1	2.3
07/26/2000	07:55		3.55	42	8.51			7.55		24.7		
08/02/2000	08:05		4.58	55	8.69			7.48		24.5		
08/16/2000	08:10	1	4.79	57	8.43	0.08	6.8	7.67	1.1	24.7	2.9	1.2
09/13/2000	08:30	0.5	3.5	42	8.47	0.12	7.2	7.58	0.56	24.1	3	2.6
10/25/2000	07:50	2.3	4.5	45	8.47	0.1	12	7.4	1.4	15.9	6.6	3.3
11/07/2000	08:25	1.8	4.1	45	8.47	0.08	10	7.3	1.8	20.3	5.1	2.3
11/14/2000	09:25		5.2	54	8.81			6.87		17.3		
11/20/2000	10:00				8.67			6.86				
12/06/2000	10:40	0.8	8.9	71	7.5	0.51	7.4	7.6	1.3	6.2	3.6	3.5

Table B-4 2000 Water Quality Data Collected in Spring Creek

Date	Time	BOD_5 (mg/L)	DO (mg/L)	% Saturation	Gage Height (feet)	NH_3 (mg/L)	NO_2-NO_3 (mg/L)	pH	TP (mg/L)	Water Temp (deg C)	TOC (mg/L)	Turbidity (NTU)
01/20/2000	11:55	0.9	7.04	69	3.2	0.02	0.31	7.88	<0.02	14.3	3.4	3.9
02/02/2000	10:00		11.6	94	4.37			7.21		7		
02/09/2000	11:40		10.36	88	3.7			7.5		9		
02/16/2000	14:45	1.1	8.26	81	4.81	0.04	0.11	7.48	0.03	15.1	6.9	8.4
03/29/2000	11:30	1.2	7.31	75	4.69	0.04	0.23	7.8	0.04	16.8	5.5	5.7
04/26/2000	12:20	0.8	8.57	87	3.12	0.08	0.56	7.87	0.03	16.1	3.3	8
05/10/2000	10:20	1	7.13	81	1.14	0.08	0.62	7.63	0.04	21.7	2.3	3.7
05/17/2000	09:45		6.94	79	0.72			7.85		22.2		
05/24/2000	10:05		6	72	-0.61			7.75		24.6		
06/07/2000	12:10	3.2	4.72	56	0.12	0.69	1.3	8.05	1.2	24.5	5.2	3.1
07/19/2000	09:30	4.6	2.2	28	0.11	1.2	0.43	7.75	1.4	27.5	5.9	4.7
07/26/2000	09:45		1.87	23	0.16			7.4		25.2		
08/02/2000	09:35		7.45	89	0.48			7.65		24.5		
08/16/2000	11:00	4.9	3.71	46	0.1	0.56	0.32	7.67	1	26.6	3.9	3.1
09/13/2000	10:45	1.1	5.69	68	0.31	0.12	0.52	7.82	0.22	24.4	2.7	1.6
10/25/2000	10:25	2.2	7.6	79	1.21	0.14	0.83	7.53	0.09	17.7	2.6	2.1
11/07/2000	10:55	2.5	6.7	75	1.36	0.06	0.71	7.53	0.12	20.8	1.7	5.1
11/14/2000	10:55		7.8	79	1.51			7.4		16.3		
11/20/2000	10:40		8.1	74	1.72			7.37		12.2		
12/06/2000	12:10	0.8	9.6	82	1.86	0.03	0.42	7.26	<0.02	8.9	7.6	2.7

Table B-5 2000 Water Quality Data Collected in White Oak Creek

Date	Time	BOD_5 (mg/L)	DO (mg/L)	% Saturation	Gage Height (feet)	NH_3 (mg/L)	NO_2-NO_3 (mg/L)	pH	TP (mg/L)	Water Temp (deg C)	TOC (mg/L)	Turbidity (NTU)
01/27/2000	08:30		12.16	89	1.92	1.8	0.4	6.35	0.05	1.8	3.2	30
02/28/2000	11:05	<0.1	8.38	79	1.99	0.05	0.28	6.93	0.06	12.2	3.4	13
03/01/2000	08:45		10.55	94	1.53			6.8		9.5		
03/13/2000	09:50		8.68	78	1.42			7.2		10.2		
03/16/2000	09:30		7.91	78	1.49			6.87		14		
03/21/2000	08:30	1.8	7.88	74	4.81	0.07	0.2	5.92	0.07	12.1	5.5	65
04/11/2000	09:30	2.3	7.61	74	1.62	0.06	0.41	6.8	0.05	13.5	2.8	14
05/30/2000	09:20	0.7	5.14	58	0.57	0.13	0.46	6.82	0.05	20.6	2.9	14
06/12/2000	09:05		5.18	60	0.38			6.86		21.9		
06/19/2000	07:25	0.6	2.41	29	0.29	0.14	0.25	7.35	0.03	24.7	2.4	6
06/26/2000	08:50		2.4	29	0.24			6.79		23.6		
07/06/2000	08:05	1.2	4.19	52	0.13	0.11	0.14	7.3	0.04	25	2.7	7.3
07/10/2000	07:20		3.5	44	0.07			6.98		25.6		
07/20/2000	08:10		3.31	41	0.06			7.04		25.2		
08/03/2000	09:10	1.1	4.88	57	0.65	0.12	0.16	6.75	0.03	22.8	3.2	18
09/07/2000	08:30		6.08	67	0.81			6.99		19.5		
09/11/2000	09:20	0.5	5.24	60	0.52	0.08	0.57	7.05	0.08	21.4	3.8	10
09/13/2000	08:40		5.03	58	0.43			7		21.6		
10/02/2000	08:40	0.6	6.09	64	0.39	0.07	0.25	7.28	0.08	17.3	3.4	13
11/20/2000	10:10	2	9.38	78	3.26	0.07	0.43	6.99	0.09	7.1	3.6	41
12/06/2000	10:35	0.6	10.37	80	1.05	0.05	0.89	7.04	0.03	4.2	2.7	7.1

Appendix C – Low Flow Analysis

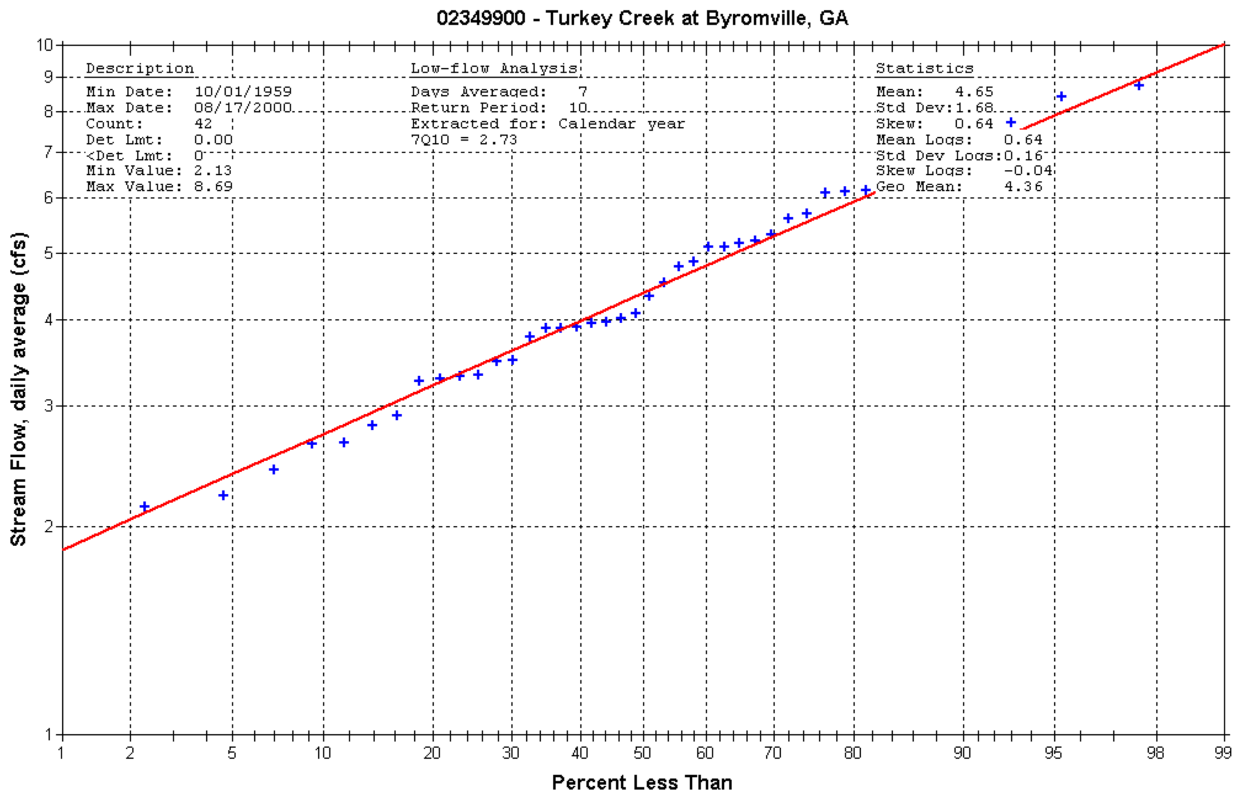

Figure C-1 Low-Flow Analysis at USGS 02349900 (Turkey Creek at Byromville, GA), Drainage Area Equals 45 square miles

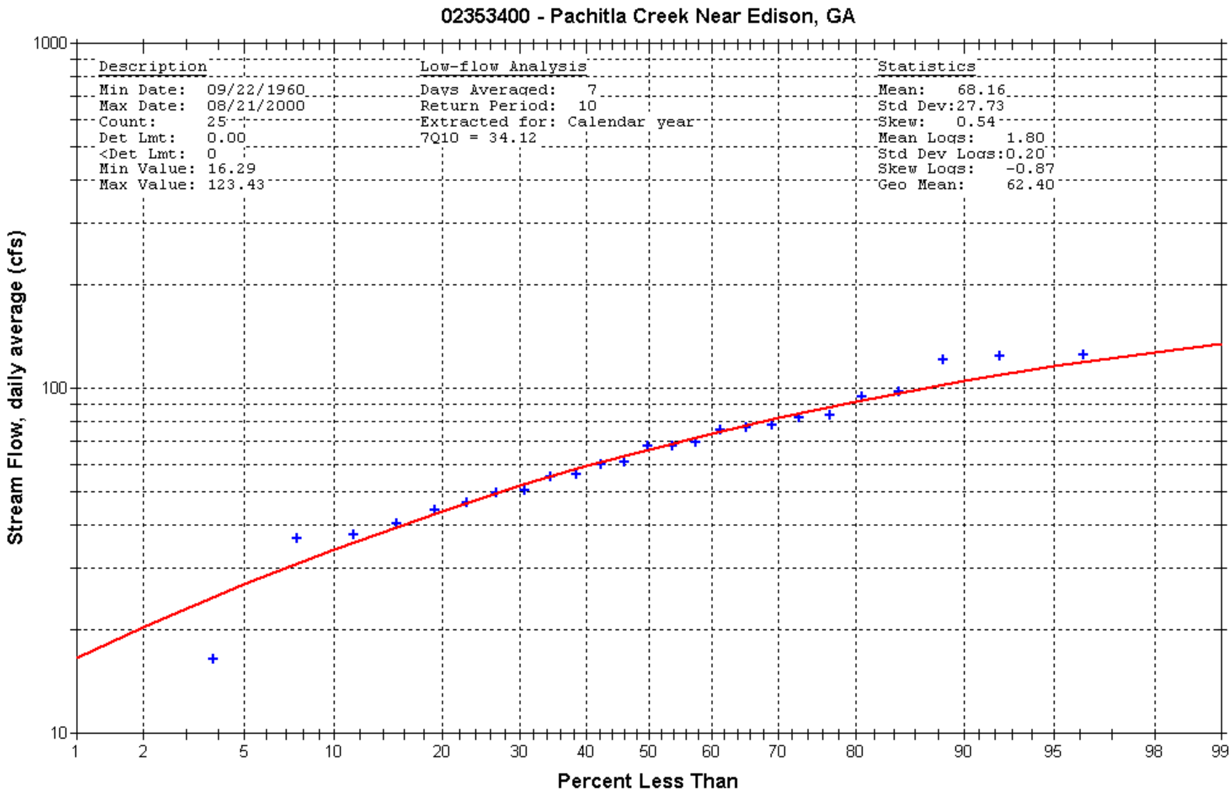

Figure C-2 Low-Flow Analysis at USGS 02353400 (Pachitla Creek near Edison, GA), Drainage Area Equals 188 square miles

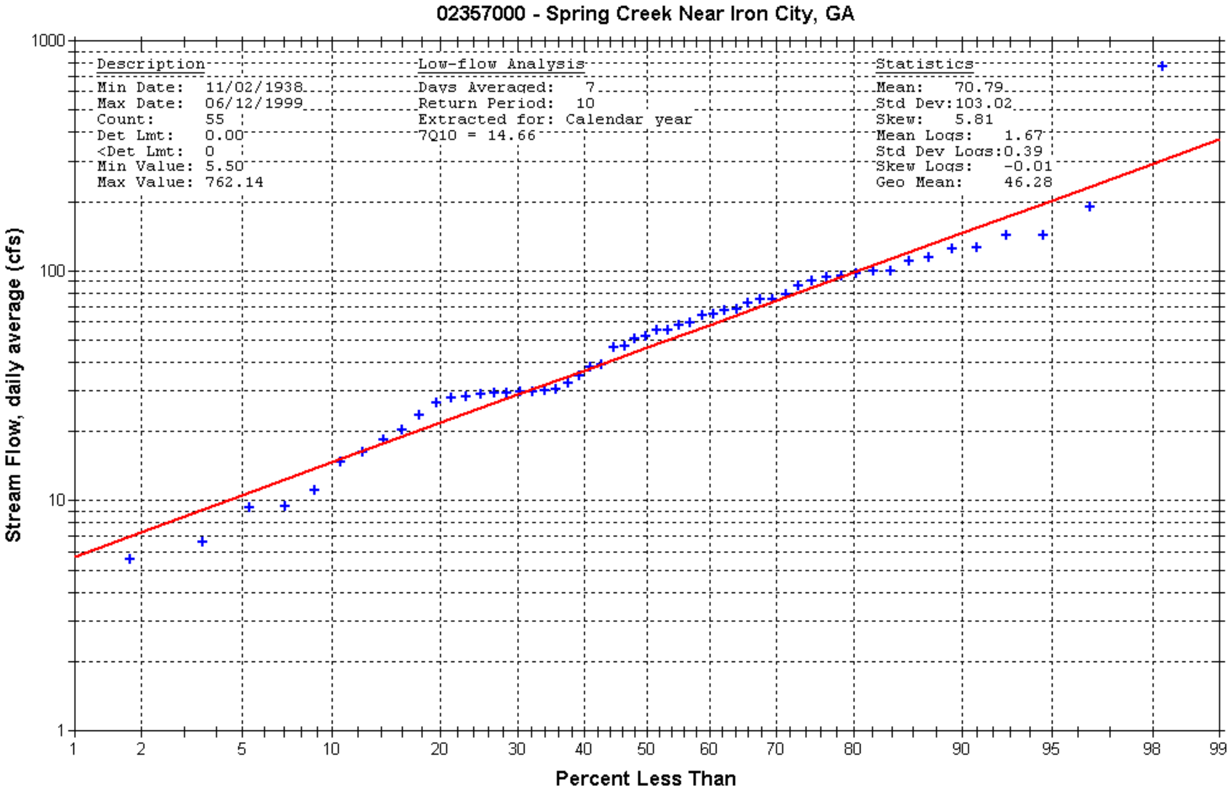

Figure C-3 Low-Flow Analysis at USGS 02357000 (Spring Creek near Iron City, GA), Drainage Area Equals 485 square miles

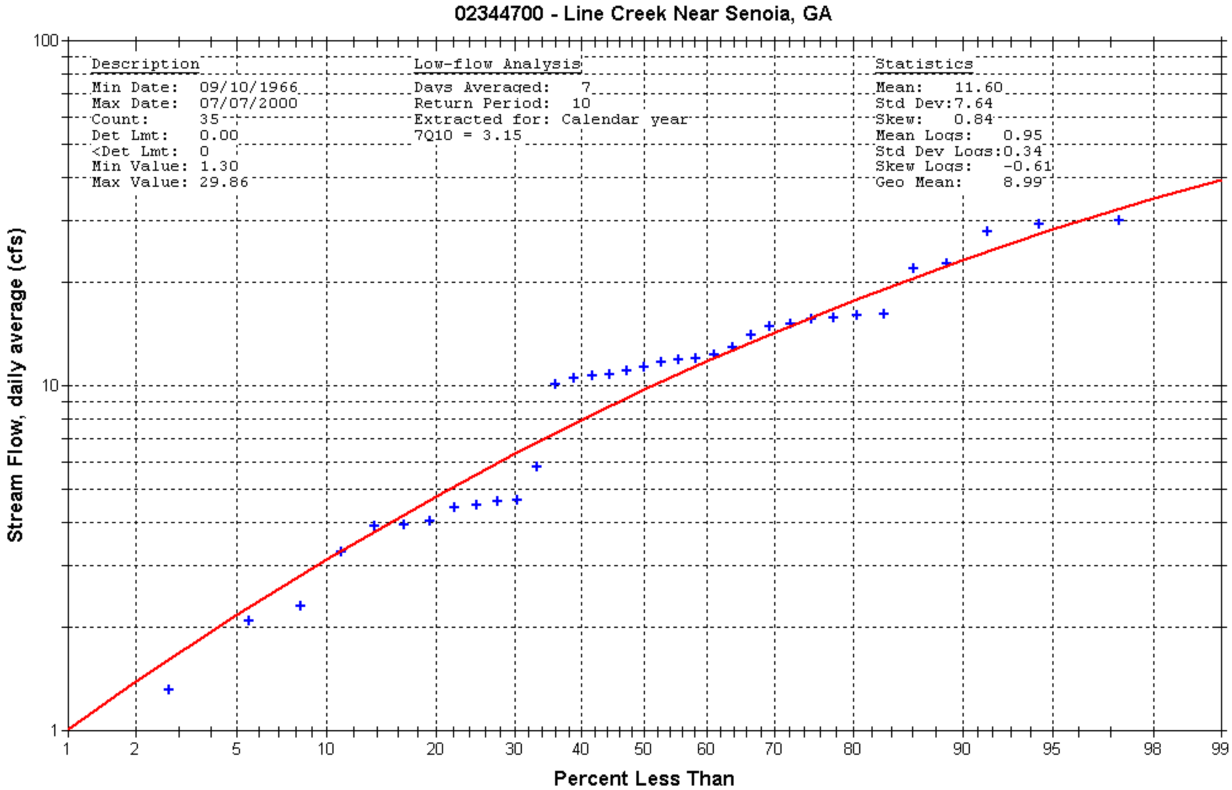

Figure C-4 Low-Flow Analysis at USGS 02344700 (Line Creek near Senoia, GA), Drainage Area Equals 101 Square Miles