Total Maximum Daily Load

Evaluation

for the

Coosa River

in the

Coosa River Basin

for

Dissolved Oxygen

Submitted to:
The U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

Submitted by:
The Georgia Department of Natural Resources
Environmental Protection Division
Atlanta, Georgia

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EXECUTIVE SUMMARY

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 one of three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. 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 (GA EPD, 2000-2001).

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 in-stream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and to restore and maintain water quality.

The State of Georgia has identified one stream segment, Coosa River, located in the Coosa River Basin, as water quality limited due to dissolved oxygen (DO). This waterbody was included in the State's 2002 303(d) list. This report presents the dissolved oxygen TMDL for this segment.

Part of the TMDL analysis is the identification of potential source categories. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Nonpoint sources are diffuse, and generally, but not always, involve accumulation of oxygen demanding substances on land surfaces that wash off as a result of storm events.

The process of developing the dissolved oxygen TMDL for Coosa River included developing a computer model for the listed segment. EPD RIV-1, a hydrodynamic water quality model developed by Georgia Environmental Protection Division (GA EPD), was used. This model was run for the calendar year 2001, when water quality data was collected in the Coosa River Basin.

Management practices may be used to help reduce and/or maintain the Ultimate Oxygen Demand (UOD) loads. These include:

- Compliance with the requirements of the NPDES permit program,
- Application of Best Management Practices (BMPs) appropriate to nonpoint sources.

The amount of oxygen demanding substances delivered to a stream is difficult to determine. However, by requiring and monitoring the implementation of these practices, their effects will improve stream water quality, and represent a beneficial measure of TMDL implementation.

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 one of three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. 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 (GA EPD, 2000-2001).

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The State of Georgia has identified one stream segment, Coosa River, located in the Coosa River Basin as water quality limited due to dissolved oxygen. This waterbody was included in the State's 2002 303(d) list. This report presents the dissolved oxygen TMDL for the listed segment in the Coosa River basin identified in Table 1.

Table 1. Waterbody Listed For Dissolved Oxygen in the Coosa River Basin

Stream Segment	Location	Segment Length (miles)	Designated Use	Status
Coosa River	Hwy 100 to State Line (Floyd Co.)	15	Fishing	Not Support

1.2 Watershed Description

The Coosa River originates in Tennessee as the Conasauga River, and in the north Georgia mountains as the Etowah, and Coosawattee Rivers (see Figure 1). The Conasauga River flows south from Tennessee where it converges with the Coosawattee River near Resaca, Georgia, to form the Oostanaula River. The Coosawattee River originates in Ellijay, Georgia, by the merging of the Ellijay and Cartecay Rivers. The Coosawattee flows west from Ellijay, joins with Mountain Creek and then flows into Carter's Lake. From Carter's Lake, the Coosawattee River flows west toward Resaca where it meets the Conasauga to form the Oostanaula River The Etowah River flows southwest from Lumpkin County to Lake Allatoona. From there, it flows west toward Rome, Georgia, where it merges with the Oostanaula River to form the Coosa River. The Coosa River then flows west into Alabama into Lake Weiss. The

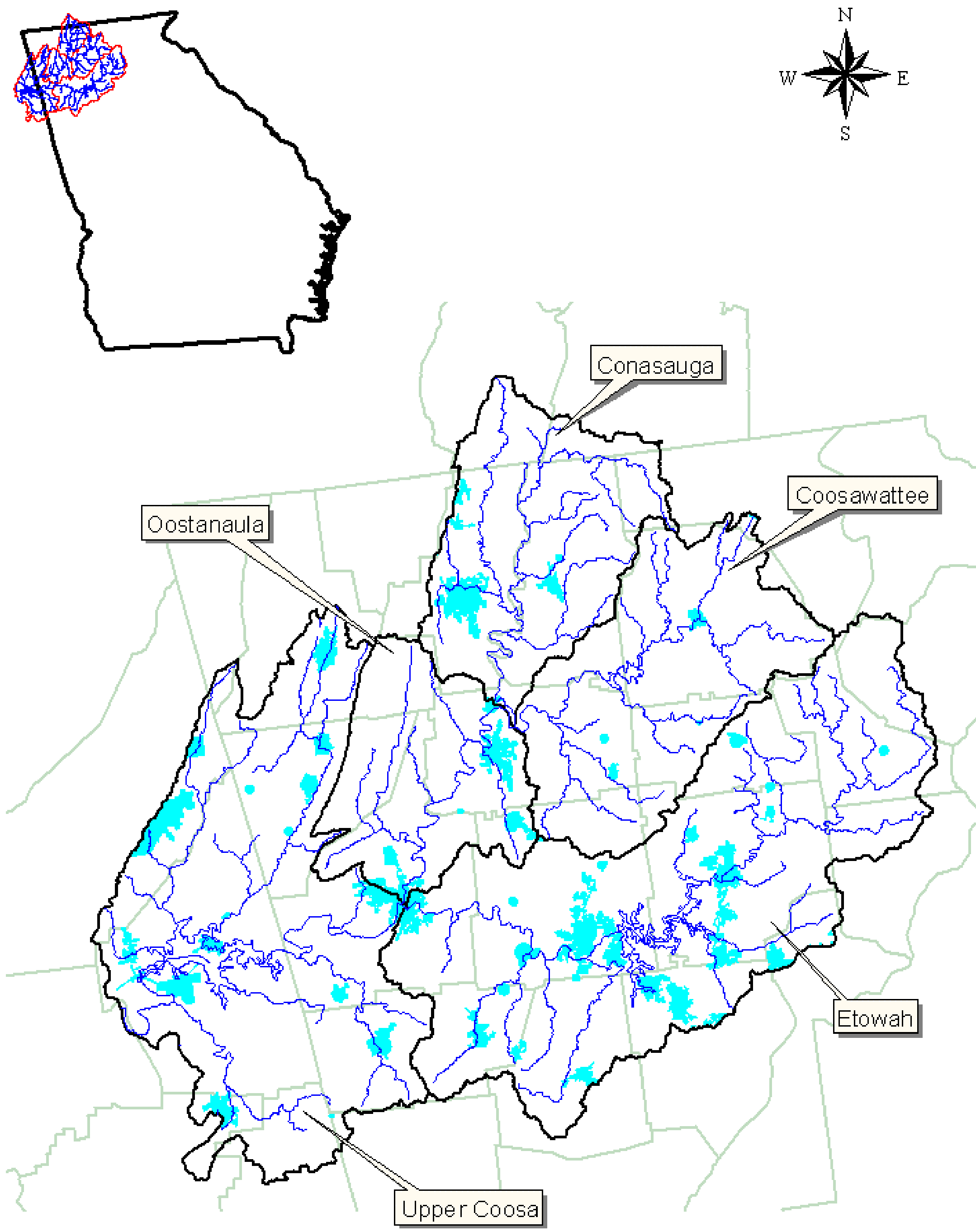

Figure 1. Location of the Coosa River Basin

Coosa River flows from Lake Weiss through several other lakes and eventually flows into the Alabama River, which ultimately discharges to the Gulf of Mexico.

The USGS has divided the Coosa River Basin into five sub-basins, or Hydrologic Unit Codes (HUCs). Figure 1 shows the location of these sub-basins and the associated counties within each sub-basin. The Coosa River is located in the Upper Coosa (HUC 03150105). Figure 2 shows the location of the listed dissolved oxygen segment within the Coosa River Basin. The Coosa River Basin contains parts of the Blue Ridge, Piedmont, and Ridge and Valley physiographic provinces that extend throughout the southeastern United States.

The land use characteristics of the Coosa River Basin watersheds were determined using data from Georgia's National Land Cover Dataset (NLCD). This coverage is based on Landsat Thematic Mapper digital images developed in 1995. The classification is based on a modified Anderson level one and two system. Table 2 lists the land cover distribution and associated percent land cover.

Table 2. Land Cover Distribution Associated with the Listed Segment of the Coosa River

Sub-Basin	Land Cover in Acres (Percentage)								
	Open Water	Urban	Barren or Mining	Cropland	Pasture land	Forest	Grass	Wetlands	Total
Conasauga	1,533 (0.3)	23,447 (5.0)	518 (0.1)	20,116 (4.3)	63,255 (13.6)	353,613 (75.8)	3,093 (0.7)	661 (0.1)	466,236 (100.0)
Coosawattee	4,828 (0.9)	14,434 (2.6)	253 (0.0)	10,051 (1.8)	48,340 (8.9)	466,213 (85.6)	386 (0.1)	220 (0.0)	544,725 (100.0)
Etowah	15,101 (1.3)	57,061 (4.8)	1,169 (0.1)	35,535 (3.0)	110,528 (9.3)	956,994 (80.7)	5,972 (0.5)	3,180 (0.3)	1,185,540 (100.0)
Oostanaula	2,646 (0.7)	17,220 (4.8)	1,118 (0.3)	18,254 (5.1)	50,590 (14.1)	265,171 (74.0)	2,183 (0.6)	1,398 (0.4)	358,580 (100.0)
Upper Coosa	1,998 (0.9)	8,251 (3.8)	485 (0.2)	12,490 (5.7)	28,112 (12.8)	165,802 (75.4)	1,361 (0.6)	1,491 (0.7)	219,990 (100.0)

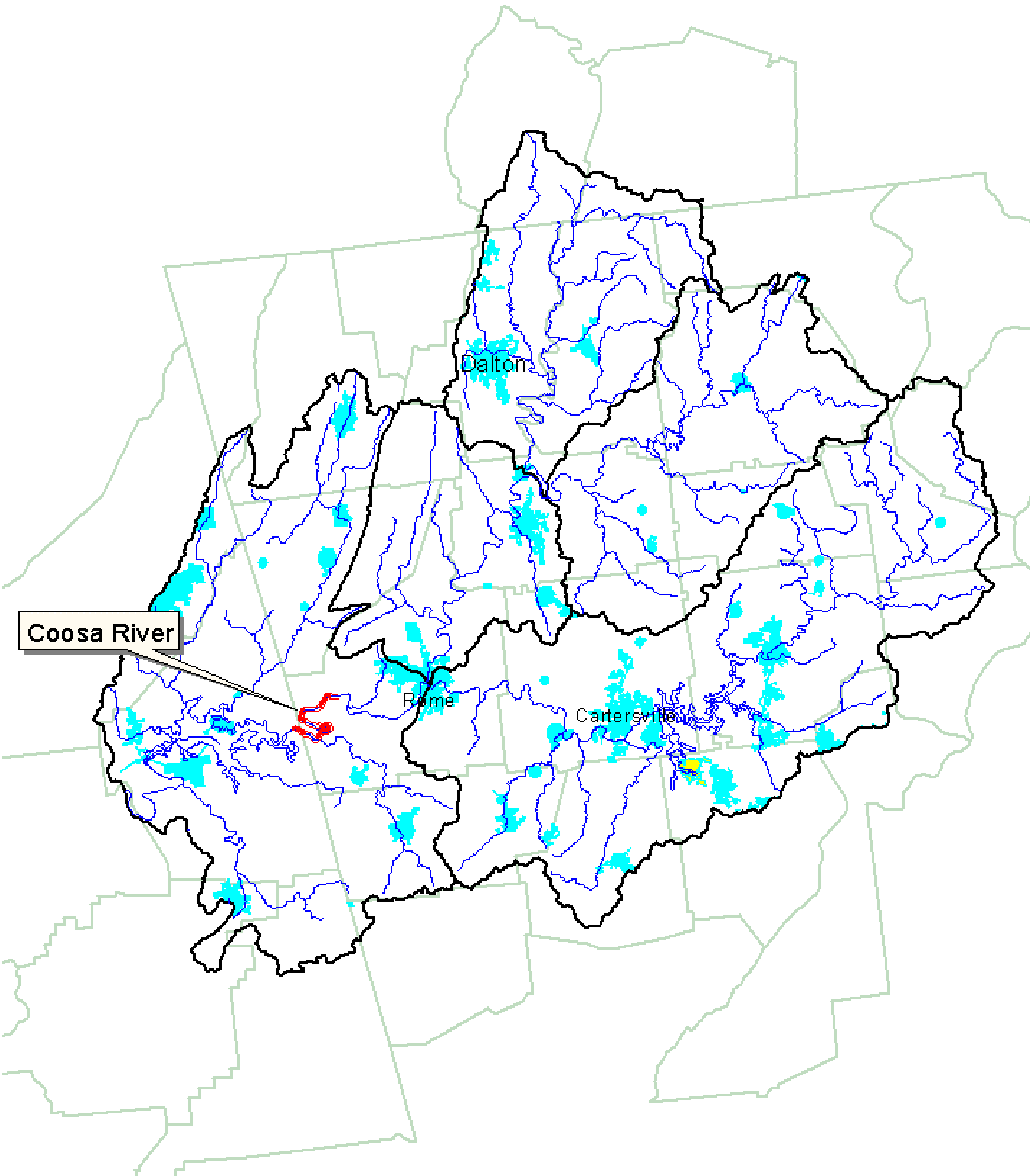

Figure 2. 303(d) Listed Segment for Dissolved Oxygen in the Coosa River Basin

1.3 Water Quality Standard

The water use classification for the listed watersheds in the Coosa River Basin is Fishing. The Coosa River is not classified as a trout stream. The criterion violated is listed as dissolved oxygen. The potential cause listed includes industry and nonpoint source runoff. The use classification water quality standards for dissolved oxygen, as stated in *Georgia's Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03 (c) (i), are:

> 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 Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

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. This is addressed in *Georgia's Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03 (c) (i):

> *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.

EPA dissolved oxygen criteria are 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.

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

2.0 WATER QUALITY ASSESSMENT

During 2001, the United States Geological Survey (USGS) collected water quality data at USGS Station 02397530 (GA EPD Station 14450001) – Coosa River near Coosa, Georgia. A total of twenty-one discrete dissolved oxygen measurements were taken at this station in 2001, and Figure 3 is a plot of the dissolved oxygen measured. These data show no violation of the dissolved oxygen standard.

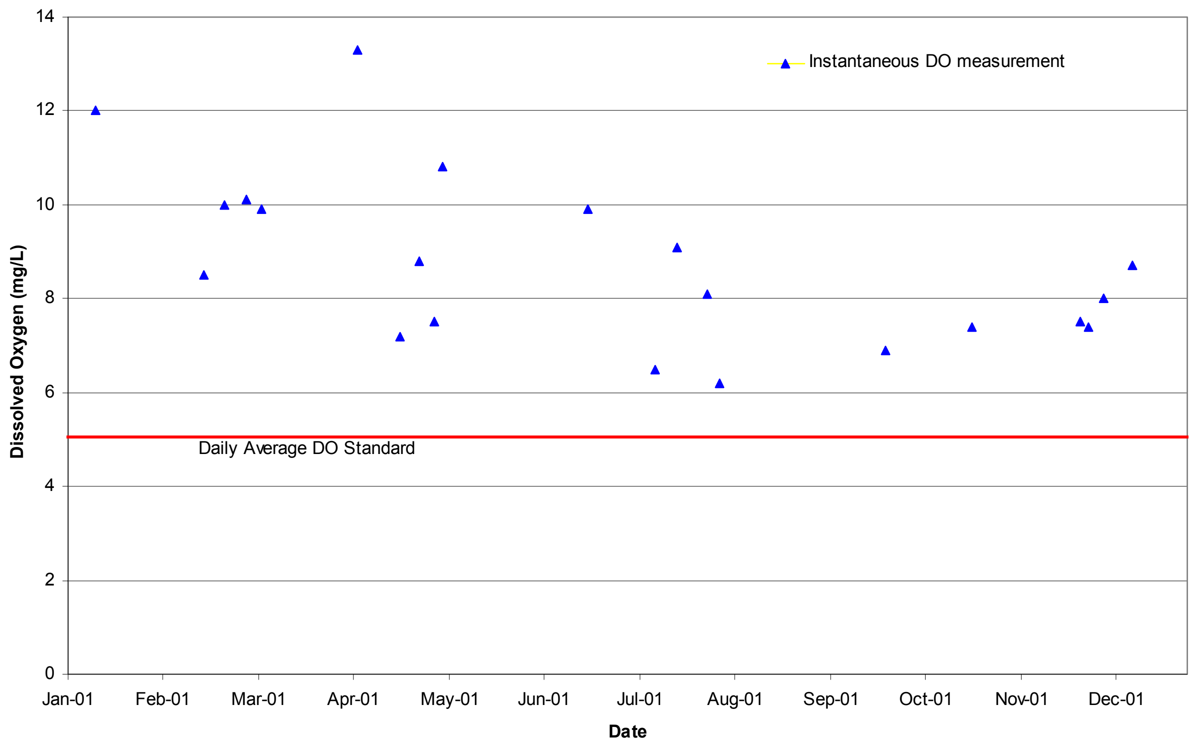

Figure 3. Discrete Dissolved Oxygen Measured at USGS Station 02397530- Coosa River near Coosa, Georgia, 2001

In addition to these discrete measurements, the USGS has operated a continuous monitoring station at this same location since August 1976. The monitor is located on the right edge of water at a fixed elevation (Gage datum 555.00 feet above sea level NGVD29) at a depth of approximately three feet. Figure 4 is a plot of the hourly dissolved oxygen concentrations measured by the continuous monitor along with the published minimum and maximum daily values. There are gaps in the data. These are due to problems with the DO monitor during those periods. The minimum daily dissolved oxygen concentrations were below 5.0 mg/L for three days in early September (9/1/01-9/3/01), but never dropped below 4.0 mg/L.

Figure 5 is a plot of the published minimum and maximum daily dissolved oxygen values and the corresponding flow measured at USGS Station 02397000 - Coosa River near Rome, Georgia, for the period 1997 through 2001. These data show that low dissolved oxygen values usually occurred during the summer months during periods of low flow.

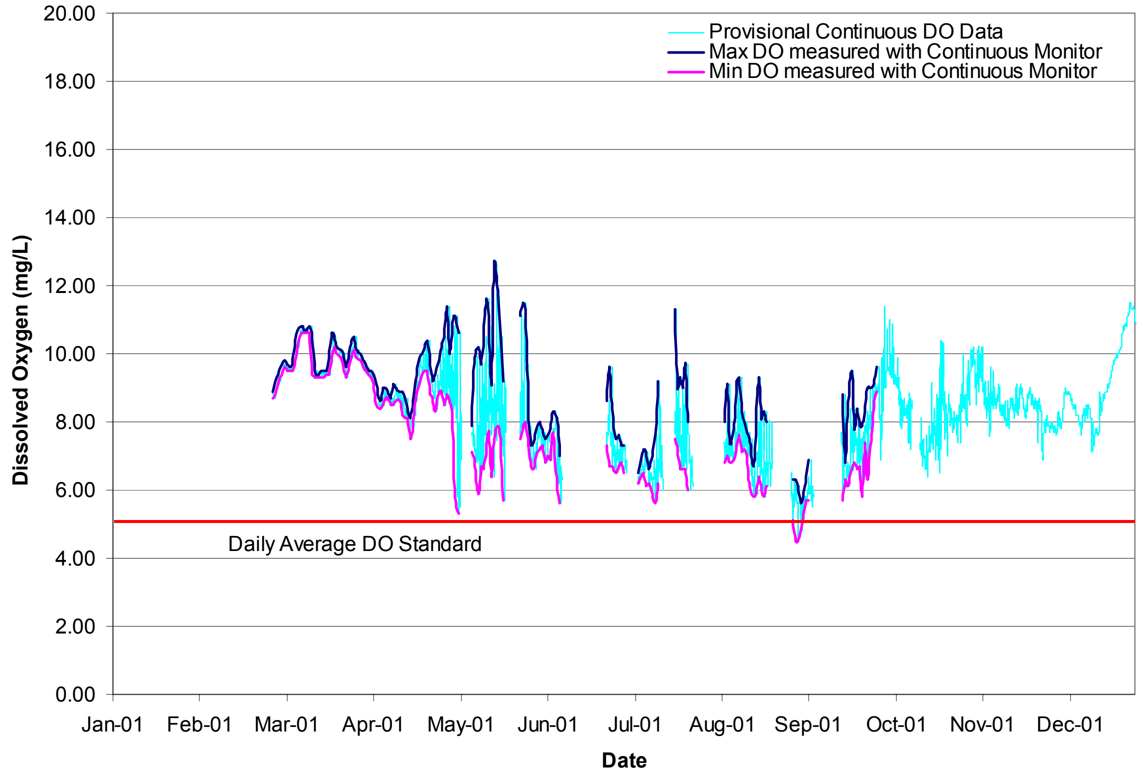

Figure 4. Continuous Dissolved Oxygen Measured at USGS Station 02397530 - Coosa River near Coosa, Georgia, 2001

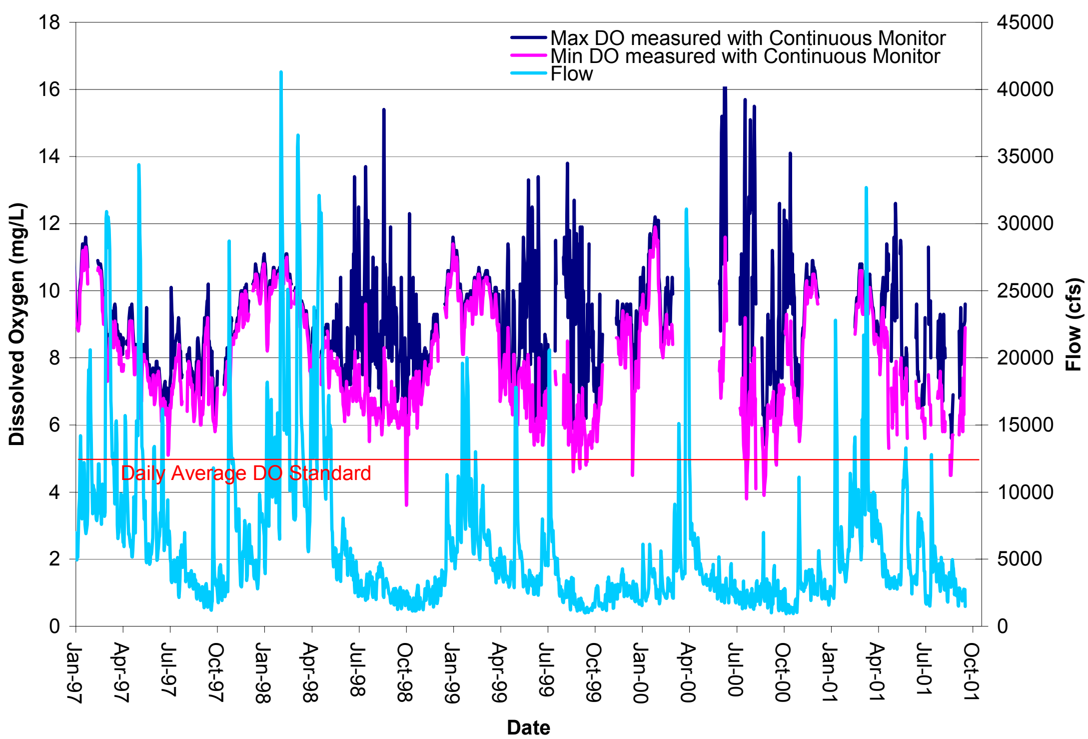

Figure 5. Dissolved Oxygen and Flow in the Coosa River, 1997-2001

All field data relevant to the Coosa River Basin were compiled by GA EPD and included in electronic database files. The data are managed in the Water Resources Data Base (WRDB), a software database that was developed by GA EPD. Project data files contain the following information:

1. Historic trend monitoring data through 2001,
2. 2001 GA EPD/USGS water quality data, and
3. Historic USGS daily average flow data through December 31, 2001.

3.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of potential source categories. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Nonpoint sources are diffuse, and generally, but not always, involve accumulation of oxygen demanding substances on land surfaces that wash off as a result of storm events.

3.1 Point Source Assessment

Title IV of the Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES) permit program. Basically, there are two categories of NPDES permits: 1) municipal and industrial wastewater treatment facilities, and 2) regulated storm water discharges.

3.1.1 Wastewater Treatment Facilities

In general, industrial and municipal wastewater treatment facilities have NPDES permits with effluent limits. These permit limits are either based on federal and state effluent guidelines (technology-based limits) or water quality standards (water quality-based limits).

EPA has developed technology-based guidelines, which establish a minimum standard of pollution control for municipal and industrial discharges without regard for the quality of the receiving waters. These are based on Best Practical Control Technology Currently Available (BPT), Best Conventional Control Technology (BCT), and Best Available Technology Economically Achievable (BAT). The level of control required by each facility depends on the type of discharge and the pollutant.

EPA and the states have also developed numeric and narrative water quality standards. Typically, these standards are based on the results of aquatic toxicity tests and/or human health criteria and include a margin of safety. Water quality-based effluent limits are set to protect the receiving stream. These limits are based on water quality standards that have been established for a stream based on its intended use and the prescribed biological and chemical conditions that must be met to sustain that use.

Municipal and industrial wastewater treatment facilities' discharges may contribute oxygen-demanding substances to the receiving waters. There are 40 NPDES permitted discharges with effluent limits for oxygen consuming substances identified in the Coosa River Basin watershed upstream from the listed segment. Ten of these discharges are classified as major, with discharges of 1.0 million gallons per day (MGD) or more. Five of these major discharges are located on the mainstem of the Coosa River. In addition, Georgia Power operates two power plants, Plant Bowen and Plant Hammond, on the Etowah and Coosa Rivers, respectively. In addition to outfall 001, the pulp waste, Inland Paperboard also has three other permitted outfalls (002, 004 and 005) that discharge ash pond supernate, and cooling water into the Coosa River. Figure 6 provides the locations of the major mainstem point source discharges and the two power plants. The locations of the major tributary point sources are shown in Figure 7. Table 3 provides the permitted flows, as well as the 5-day Biochemical Oxygen Demand (BOD_5), ammonia (NH_3), and dissolved oxygen (DO) concentrations for the municipal and industrial treatment facilities.

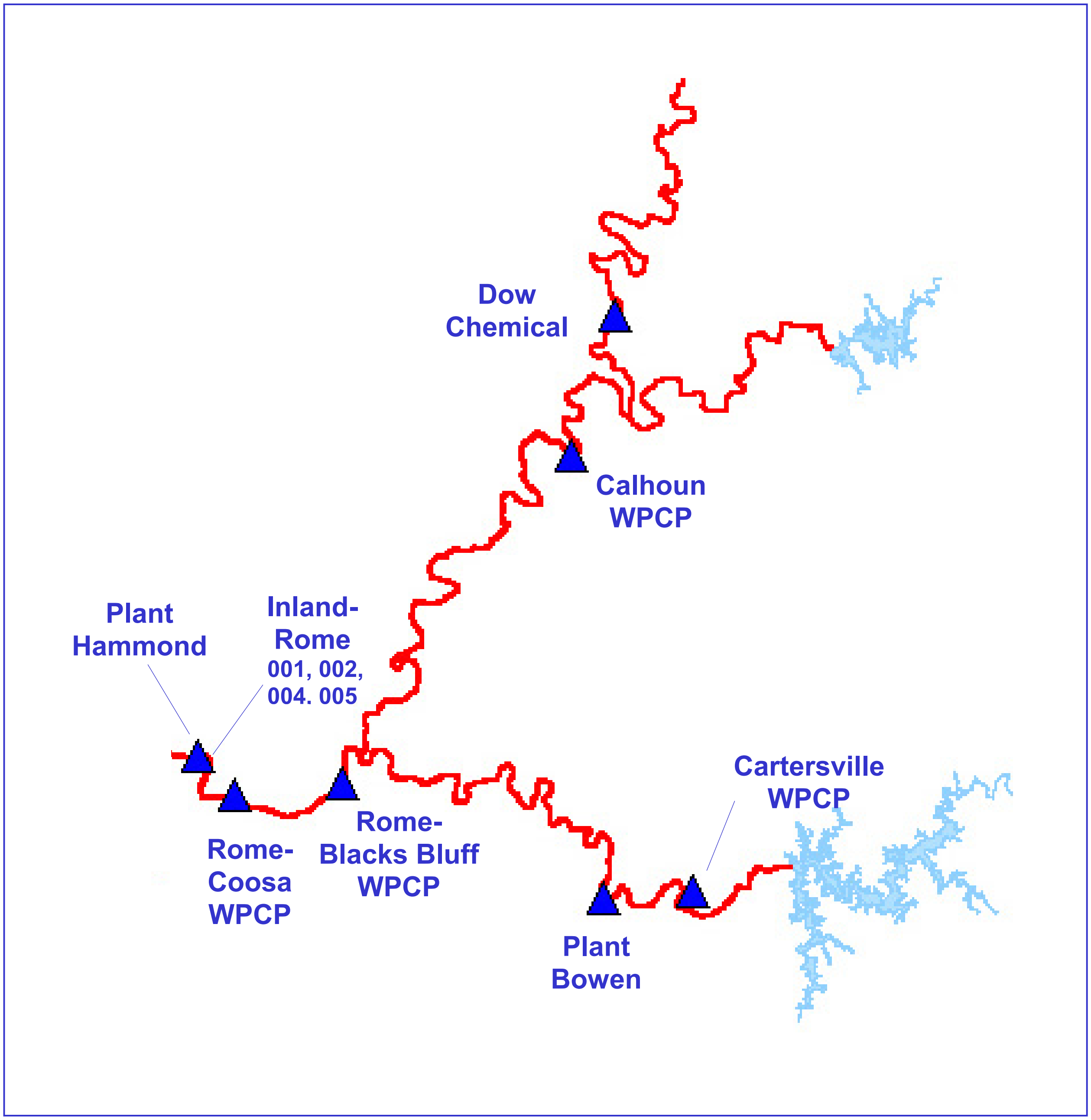

Figure 6. Location of Major Mainstem Discharges

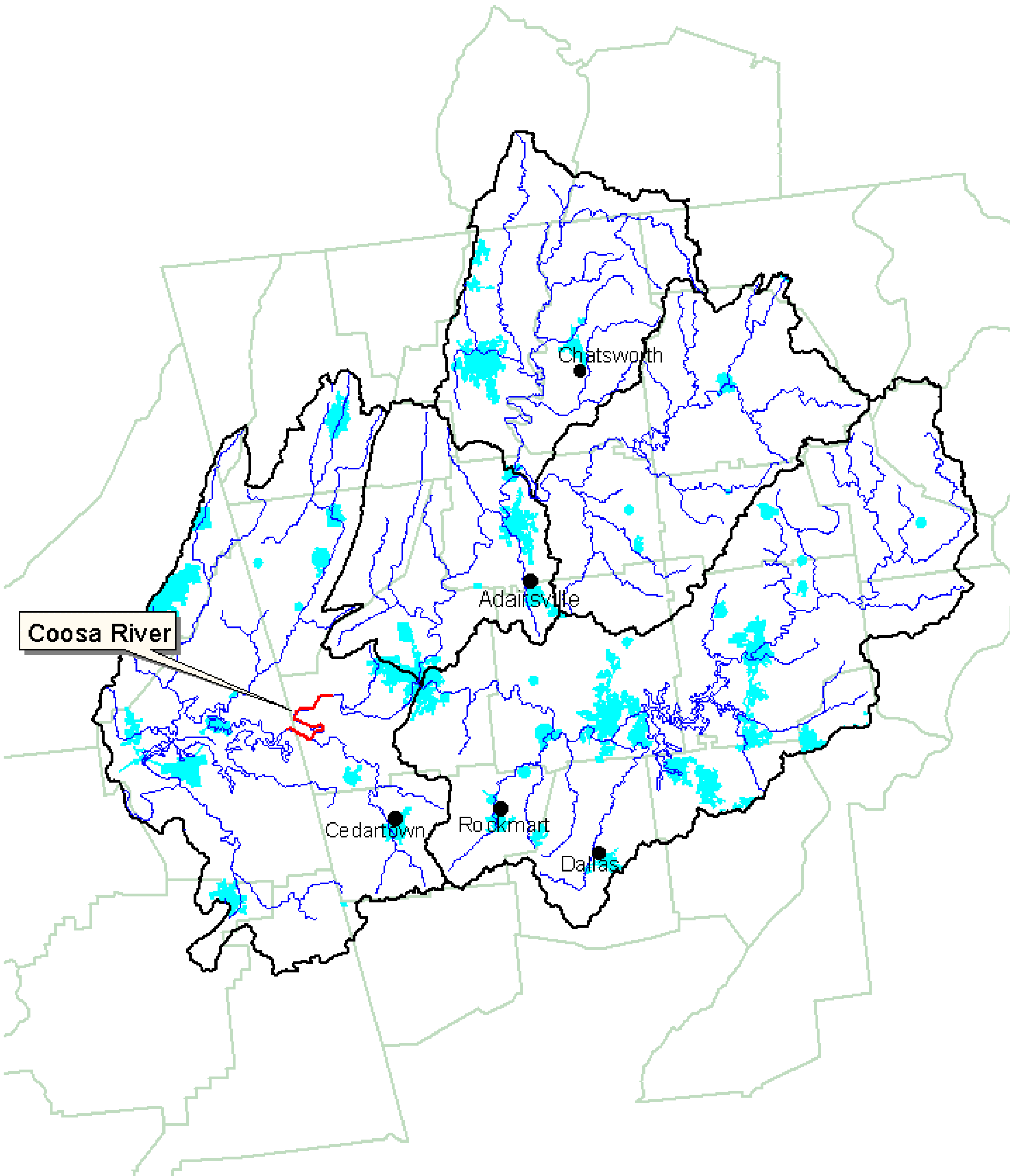

Figure 7. Location of Major Tributary Discharges

Table 3. NPDES Facilities in the Coosa River Basin

Facility Name	NPDES Permit No.	Receiving Stream	NPDES Permit Limits: Average Monthly Flow (MGD)	Average Monthly BOD_5 (mg/L)	Average Monthly NH_3 (mg/L)	Minimum DO (mg/L)
Conasauga Sub-Basin						
Dow Chemical Company	GA0000426	Coosa River – RM 343.7	0.125	15.4	82.5	---
Mountain View Acres	GA0047848	Stone Branch	0.0840	30	---	5
Whispering Pines Mobile Home Park (MHP)	GA0023426	Ketchum Branch	0.0380	30	---	---
Varnell Elementary	GA0034029	Kenyon Creek	0.0100	30	---	---
City of Chatsworth WPCP	GA0032492	Holly Creek	3.0	10	2	6
DNR Fort Mountain	GA0049191	Holly Creek	0.0070	30	---	---
East Brook Middle School	GA0034037	Davis Creek	0.0165	30	---	---
Dug Gap Elementary	GA0034011	Drowning Bear Creek	0.0100	30	---	---
Antioch Elementary School	GA0048488	Davis Creek	0.005	30	---	---
Super 8 Motel	GA0048887	Unnamed Trib.	0.0250	30	---	---
Dawnville Elementary School	GA0034002	Moody Branch	0.0120	30	---	---
Coosawattee Sub-Basin						
City of Fairmount WPCP	GA0046388	Salacoa Creek	0.2000	30	17.4	2
Oostanaula Sub-Basin						
City of Calhoun WPCP	GA0030333	Coosa River – RM 323.4	16	20	5	5
Cumberland Academy	GA0035947	Coosa River – RM 312.6	0.016	30	---	---
City of Adairsville - North WPCP	GA0046035	Oothkalooga Creek	1.0	30	3	5
City of Adairsville - South WPCP	GA0032832	Oothkalooga Creek	0.5000	30	10	5
OMNOVA Solutions, Inc.	GA0000329	Oothkalooga Creek	0.1500	36.4	16.4	---
W. L. Swain Elementary School	GA0032221	Robbins Creek	0.0100	30	---	---
Etowah Sub-Basin						
Bartow County Southeast	GA0037664	Coosa River – RM 329.1	0.100	10	2	6
City of Cartersville WPCP	GA0024091	Coosa River – RM 324.7	15	30	10	2
Georgia Power Plant Bowen	GA0001449	Coosa River – RM 318.0	85	---	---	---
City of Dallas - West	GA0026026	Weaver Creek	1.0	20	5	6
City of Dallas - North	GA0026034	Lawrence Creek	0.5000	20	3	6

Facility Name	NPDES Permit No.	Receiving Stream	NPDES Permit Limits			
			Average Monthly Flow (MGD)	Average Monthly BOD_5 (mg/L)	Average Monthly NH_3 (mg/L)	Minimum DO (mg/L)
Etowah Sub-Basin (continued)						
City of Emerson Pond	GA0026115	Pumpkinvine Creek	0.1720	30	---	---
Fairway Villas MHP	GA0026611	Trib. Pumpkinvine Creek	0.0570	20	---	---
Three Cedars MHP	GA0032042	Picketts Mill Creek	0.0140	30	---	---
W. C. Abney Elementary School	GA0029921	Possum Creek	0.0100	30	---	---
Goodyear Tire & Rubber Company	GA0000515	Pettit Creek	0.0780	5.2	---	---
City of White-Whispering Pine WPCP	GA0046671	Wolfpen Branch	0.0250	30	---	---
White Elementary School	GA0029904	Pettit Creek	0.0130	30	---	---
Best Western Crown Inn	GA0023540	Pettit Creek	0.0060	30	---	---
City of Rockmart WPCP	GA0026042	Euharlee Creek	3.0	30	4.7	5
Polk County-Aragon	GA0026182	Euharlee Creek	0.3400	30	---	2
Engineered Fabrics Company	GA0000523	Euharlee Creek	0.0200	36	---	---
Bartow County Two Run Creek WPCP	GA0020702	Two Run Creek	0.1000	30	---	2
Upper Coosa Sub-Basin						
City of Rome - Blacks Bluff WPCP	GA0024112	Coosa River – RM 283.0	18	30	17.4	2
City of Rome - Coosa WPCP	GA0024341	Coosa River – RM 275.1	2	20	17.4	2
Inland Paperboard - Outfall 001, 002, 005 (Dec-Apr) (Nov, May) (June-Oct)	GA0001104	Coosa River – RM 270.3 RM 271.4 RM 271.0		13396 * 10528* 5076*	---	2
Inland Paperboard - Outfall 004 cooling water	GA0001104	Coosa River – RM 270.8	---	---	---	---
Georgia Power Plant Hammond	GA0001457	Coosa River – RM 270.3	655	---	---	---
City of Cedartown WPCP	GA0024074	Cedar Creek	3.5	10	2	6
Geo Specialty Chemicals	GA0001708	Cedar Creek	0.3600	44	10	6
City of Cave Springs	GA0025721	Little Cedar Creek	0.2200	30	---	2

Note: * Daily Average Permit Limits in lbs/day

Combined sewer systems convey a mixture of raw sewage and storm water in the same conveyance structure to the wastewater treatment plant. These are considered a component of municipal wastewater treatment facilities. When the combined sewage exceeds the capacity of the wastewater treatment plant, the excess is diverted to a combined sewage overflow (CSO) discharge point. There are no permitted CSO outfalls in the Coosa River Basin.

3.1.2 Regulated Storm Water Discharges

Some storm water runoff is covered under the NPDES Permit Program. It is considered a diffuse source of pollution. Unlike other NPDES permits that establish end-of-pipe limits, storm water NPDES permits establish controls "to the maximum extent practicable" (MEP). Currently, regulated storm water discharges that may contain oxygen demanding substances consist of those associated with industrial activities including construction sites five acres or greater, and large and medium municipal separate storm sewer systems (MS4s) that serve populations of 100,000 or more.

Storm water discharges associated with industrial activities are currently covered under a General Storm Water NPDES permit. This permit requires visual monitoring of storm water discharges, site inspections, implementation of BMPs, and record keeping.

Storm water discharges from MS4s are very diverse in pollutant loadings and frequency of discharge. At present, all cities and counties within the state of Georgia that had a population of greater than 100,000 at the time of the 1990 Census are permitted for their storm water discharge under Phase I. This includes 60 permittees, 45 of which are located in the greater Atlanta metro area (see Table 4).

Table 4. Phase I Permitted MS4s in the Coosa River Basin

Name	Permit No.	Watershed
Acworth	GAS000101	Coosa
Cobb County	GAS000108	Coosa, Chattahoochee
Fulton County	GAS000117	Coosa, Chattahoochee, Ocmulgee, Flint
Forsyth County	GAS000300	Coosa, Chattahoochee
Kennesaw	GAS000121	Coosa

Source: Nonpoint Source Permitting Program, GA EPD, 2001

Phase I MS4 permits require the prohibition on non-storm water discharges (i.e., illicit discharges) into the storm sewer systems, and controls to reduce the discharge of pollutants to the maximum extent practicable, including the use of management practices, control techniques and systems, and design and engineering methods (Federal Register, 1990). A site-specific Storm Water Management Plan (SWMP) outlining appropriate controls is required by and referenced in the permit.

In 2003, small MS4s serving urbanized areas were required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. It is estimated that 56 communities will be permitted under the Phase II regulations in Georgia. Table 4 lists those counties and communities located in the Coosa River Basin that will be covered by the Phase II General Storm Water Permit, GAG610000.

Table 5. Phase II Permitted MS4s in the Coosa River Basin

Name	Watershed
Bartow County	Coosa
Canton	Coosa
Cherokee County	Coosa
Dallas	Coosa
Dalton	Coosa
Emerson	Coosa
Floyd County	Coosa
Holly Springs	Coosa
Mountain Park	Coosa
Paulding County	Coosa, Tallapoosa, Chattahoochee
Rome	Coosa
Varnell	Coosa
Walker County	Coosa, Tennessee
Whitfield County	Coosa, Tennessee
Woodstock	Coosa

Source: Nonpoint Source Permitting Program, GA DNR, 2003

3.2 Nonpoint Source Assessment

In general, nonpoint sources cannot be identified as entering a waterbody through a discrete conveyance at a single location. Typical nonpoint sources of oxygen demanding substances come from materials being washed into the rivers and streams during storm events. In 2001, many streams in the Coosa River Basin were dry, or had ponded areas and stagnant pools as a result of a four-year drought in Georgia. Due to the lack of rainfall during the summer of 2001, storm water did not contribute to significant wash off of materials into the streams. Constituents that may have washed off of land surfaces in previous months or years had either: 1) flushed out of the system along with the water column flow; or, 2) settled out and became part of the stream channel bottom.

In this manner, historic wash off of settleable material accumulate and exert sediment oxygen demand. Constituents of concern from surface washoff include the fractions of ammonia and BOD_5 that become an integral part of channel bottom sediments, thus becoming a potential source of sediment oxygen demand. Table 2 provides the land cover distributions for the Coosa River sub-basins. These data show that the watersheds are predominately forested, with approximately 63.4 percent (ranging from 56.9 to 70.8 percent) of forest landuse. Agriculture is the next predominate land use, with approximately 18.0 percent pasture land (ranging from 12.6 to 22.2 percent). Approximately 10.8 percent (ranging from 8.3 to 14.3 percent) of the landuse in these watersheds is urban.

4.0 TECHNICAL APPROACH

The technical approach for this TMDL was to first select a model that could be used to effectively analyze the Coosa River DO resources. After the model was selected, data were gathered to develop and calibrate the model. The calibrated model was then used to establish the TMDL during critical conditions. The modeling approach is described in the following sections.

4.1 Model Selection and Structure

The analysis of the Coosa River 303(d) listed segment required a model to simulate reaches of the Coosa River watershed (see Figure 8) that could possibly contribute to the low dissolved oxygen concentration observed in the listed segment. Based on the geographic, demographic, and hydrologic features in the watershed, it was determined that approximately 200 miles of the Coosa River would need to be modeled. This 200-mile river system consists of five (5) river segments in Georgia (Conasauga, Coosawattee, Oostanaula, Etowah, and Coosa) and thirty-six (36) tributary segments. A summary of each river segment is provided below:

- 43.4-mile segment Conasauga River segment from USGS Eton Gauge to the Coosawattee River confluence;
- 25.2 miles of the Coosawattee River from Carter's Lake to the confluence with the Conasauga River;
- 48.8 miles of the Oostanaula River from the Conasauga and Coosawattee Rivers confluence to the confluence with the Etowah River;
- 48.7 miles of the Etowah River from Lake Allatoona to the confluence with the Oostanaula River; and
- 30.5 miles of the Coosa River from the Oostanaula and Etowah Rivers confluence to the Alabama state line.

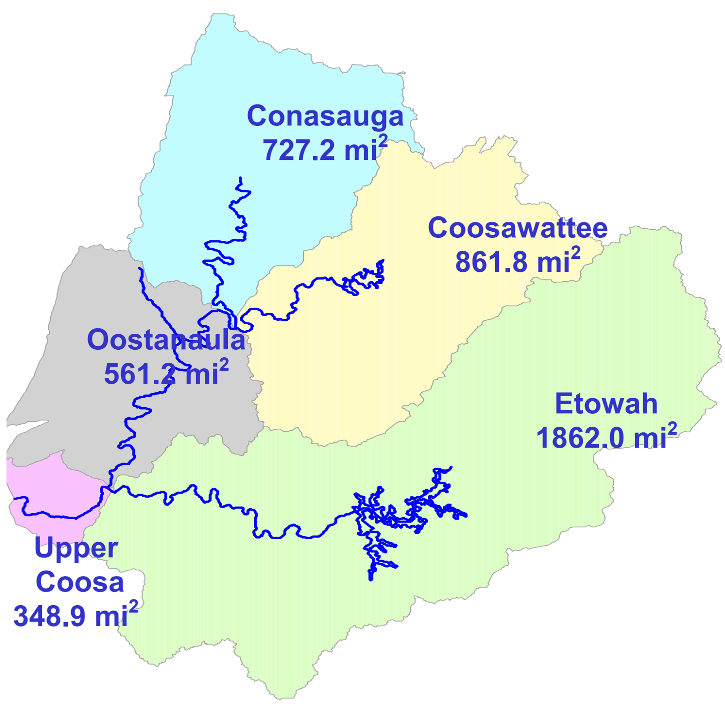

Figure 8. Coosa River Sub-Basin Model Structure

The model used for the analysis would be required to simulate the following:

- Rapidly varied flow from Allatoona Dam, Carter's Dam, and 36 tributary watersheds;
- Thermal discharge from two (2) power plants;
- 11 mainstem wastewater treatment discharges; and
- 11 municipal and private water withdrawals.

The Coosa River DO TMDL was prepared using a computer model developed by GA EPD. The objective of this project was to develop a hydrodynamic and water quality modeling system to analyze the complex issues within the Coosa River Basin watershed. The foundation of the model used for the Coosa River TMDL is the Corps of Engineer's RIV1 model. Modifications were made to the model to more accurately simulate the impact of various pollutant loads often found in Georgia, such as point sources, water withdrawals, power plants and tributaries.

EPD RIV-1 is a one-dimensional (cross-sectionally averaged) hydrodynamic and water quality model. It consists of two parts, a hydrodynamic code (EPD RIV-1H) and a water quality code (EPD RIV-1Q). EPD RIV-1H predicts flows, depths, velocities, water surface elevations, and other hydraulic characteristics. The hydrodynamic model solves St. Venant equations, as the governing flow equations, using the widely accepted four-point implicit finite difference numerical scheme.

For this study, EPD RIV-1Q predicts variations in each of ten state variables, including:

- Temperature,
- Carbonaceous Biochemical Oxygen Demand (CBOD),
- Organic nitrogen,
- Ammonia,
- Nitrate,
- Dissolved Oxygen,
- Organic phosphorus,
- Ortho phosphate,
- Algae, and
- Fecal coliform bacteria.

Numerical accuracy for the advection of sharp concentration gradients is preserved in the water quality simulation through the use of the first order Upwind solution schemes.

4.2 Data Input

The hydraulic model consists of a "mainstem" with two branches. The "mainstem" includes the Coosa River, Oostanaula River, and Coosawattee River upstream to Carter's Lake. The branches include the Etowah River upstream to Lake Allatoona and the Conasauga River upstream to USGS Eton Gauge. Figure 9 shows the model branches and boundaries. Table 6 outlines the tributaries included in the model and includes tributary ID, watershed, river mile, drainage area, and sub-basin areal percent.

The data needed to construct the hydrodynamic models included cross sectional information for the river segments, flow hydrographs for the three upstream boundary conditions (Coosawattee, Conasauga and Etowah Rivers), downstream boundary conditions, tributary/point source flows, water withdrawal quantities, and the observed intermediate flows used for calibration.

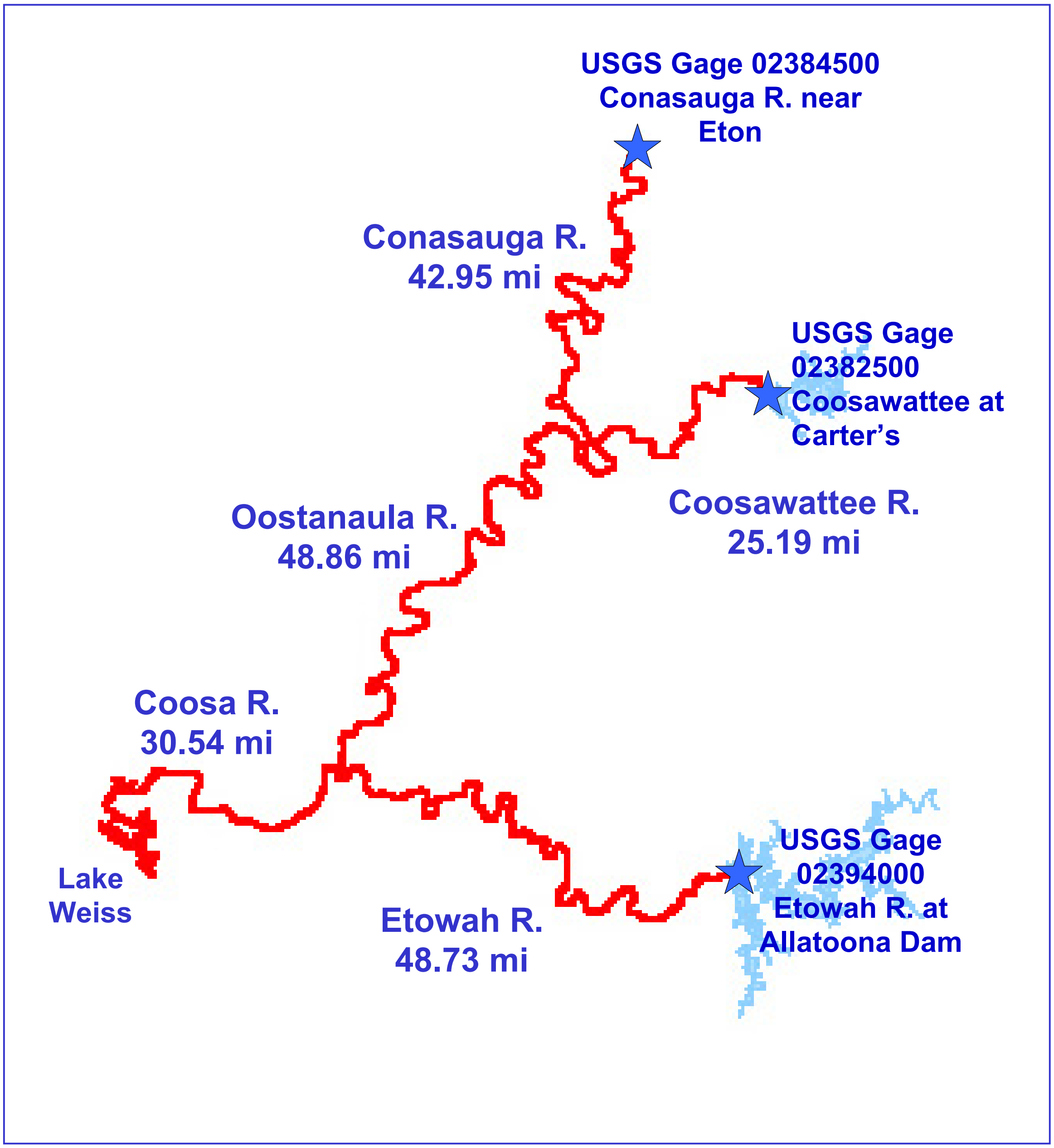

Figure 9. Model Branches and Boundaries

Table 6. Model Structure – Watershed Designation and IDs

Model ID	Watershed	River Mile	Drainage Area (mi2)	Percent
01-Conasauga River Sub-Basin			**727.1**	**100**
	Headwaters	378.0	251.9	34.6
Tr1-010	Mill Creek	374.5	41.1	5.7
Tr1-020	Town Branch	366.7	10.9	1.5
Tr1-030	Coahulla Creek	364.8	176.9	24.3
Tr1-040	Holly Creek	359.8	116.4	16.0
Tr1-050	Drowning Bear Creek	358.3	20.6	2.8
Tr1-060	Swamp Creek	347.4	24.2	3.3
Tr1-070	Polecat Creek	336.4	22.5	3.1
	Local		62.6	8.6
02-Coosawattee River Sub-Basin			**861.8**	**100**
	Headwaters	359.9	519.2	60.2
Tr2-080	Sugar Creek	355.8	16.3	1.9
Tr2-090	Dry Creek	346.3	14.6	1.7
Tr2-100	Salacoa Creek	344.9	242.5	28.1
Tr2-110	Vanns Creek	342.2	10.7	1.2
Tr2-120	Crane Eater Creek	355.8	7.6	0.9
	Local		50.9	5.9
03-Oostanaula River Sub-Basin			**561.2**	**100**
	Headwaters	344.7	0	0.0
Tr3-130	Camp Creek	330.1	15.4	2.7
Tr3-140	Oothkalooga Creek	323.0	65.2	11.6
Tr3-150	Snake/Graham Creeks	321.0	24.4	4.3
Tr3-160	Johns Creek	307.2	44.8	8.0
Tr3-170	Lovejoy Creek	306.5	17	3.0
Tr3-180	Armuchee Creek	297.3	225.4	40.2
Tr3-190	Woodward Creek	293.8	27	4.8
Tr3-200	Dozier Creek	292.6	10.9	1.9
Tr3-210	Big Dry Creek	288.7	30.5	5.4
	Local		100.6	17.9
04-Etowah River Sub-Basin			**1862.1**	**100**
	Headwaters	344.4	1119.6	60.1
Tr4-220	Pumpkinvine Creek	328.4	141.0	7.6
Tr4-230	Pettit Creek	325.1	56.7	3.0
Tr4-240	Raccoon Creek	320.9	55.0	3.0
Tr4-250	Euharlee Creek	317.3	177.1	9.5
Tr4-260	Two Run Creek	306.6	50.8	2.7
Tr4-270	Connesena Creek	306.2	15.7	0.8
Tr4-280	Toms Creek	300.6	16.1	0.9
Tr4-290	Spring Creek	295.6	38.4	2.1
Tr4-300	Dykes Creek	293.5	17.5	0.9
Tr4-310	Silver Creek	286.2	40.1	2.2
	Local		134.1	7.2
05-Coosa River Sub-Basin			**348.9**	**100**
	Headwaters	285.8	0	0.0
Tr5-320	Horseleg Creek	284.8	7.3	2.1
Tr5-330	Beech Creek	272.5	25.8	7.4
Tr5-340	Smith-Cabin Creek	270.8	16.3	4.7
Tr5-350	Kings Creek	265.3	12.4	3.6
Tr5-360	Big Cedar Creek	258.0	211.3	60.6
	Local		75.8	21.7

The water quality model data needs include the loadings at the upstream boundary and tributary/point sources, meteorological data, and the thermal loading from power plants.

The vast majority of stream bathymetry (cross shape and elevations) used to develop the model was provided by Alabama Power Company. Alabama Power provided over 200 field-surveyed cross sections that characterized the Conasauga, Coosawattee, Oostanaula, Etowah, and Coosa Rivers. Cross sections for the approximately 30-mile upstream reach of the Conasauga River were obtained using USGS quadrangles and available USGS field data.

The upstream boundary conditions were obtained from the USGS Gage Station data (hourly flow and monthly water quality data) located at or near the upstream boundaries of the model. The data for the downstream boundary, located at the State Line, was obtained from daily water levels collected by the USGS at Weiss Dam.

Data for the eight wastewater treatment facilities that discharge in the mainstem of the model were obtained from each facility's operating monitoring reports (OMRs). Data for the eleven water intakes on the model mainstem were also obtained from monitoring reports that are regularly submitted to GA EPD or from data provided directly by the facility. Table 7 provides information on each, including facility name, intake location (by river mile), permit number, and permitted monthly average and daily maximum water withdrawal. Figure 10 shows the location of the mainstem withdrawals.

Table 7. Water Intakes

Facility Name	River Mile	Permit Number	Flow Limit (MGD)	
			Monthly Average	Daily Maximum
Conasauga Sub-Basin				
City of Dalton	371.6	155-1404-01	40.3	49.4
Coosawattee Sub-Basin				
City of Calhoun	33.7	004-1493-01	16.0	18.0
Oostanaula Sub-Basin				
City of Calhoun	324.4	064-1492-02	9.0	13.2
City of Rome	287.1	057-1492-01	15.0	16.5
Etowah Sub-Basin				
New Riverside Ochre Co.	332.0	008-1421-01	5.0	5.0
New Riverside Ochre Co.	330.9	008-1421-02	6.0	6.0
Cimbar (Baroid Drilling Fluids)	330.4	008-1423-02	2.5	3.4
Georgia Power Plant Bowen	318.1	008-1491-01	85.0	520.0
City of Rome	287.7	057-1492-01	15.0	16.5
Upper Coosa Sub-Basin				
Inland Paperboard -- Rome, Ga.	271.4	057-1490-01	32.0	34.00
Georgia Power Plant Hammond	270.5	057-1490-02	655.0	655.0

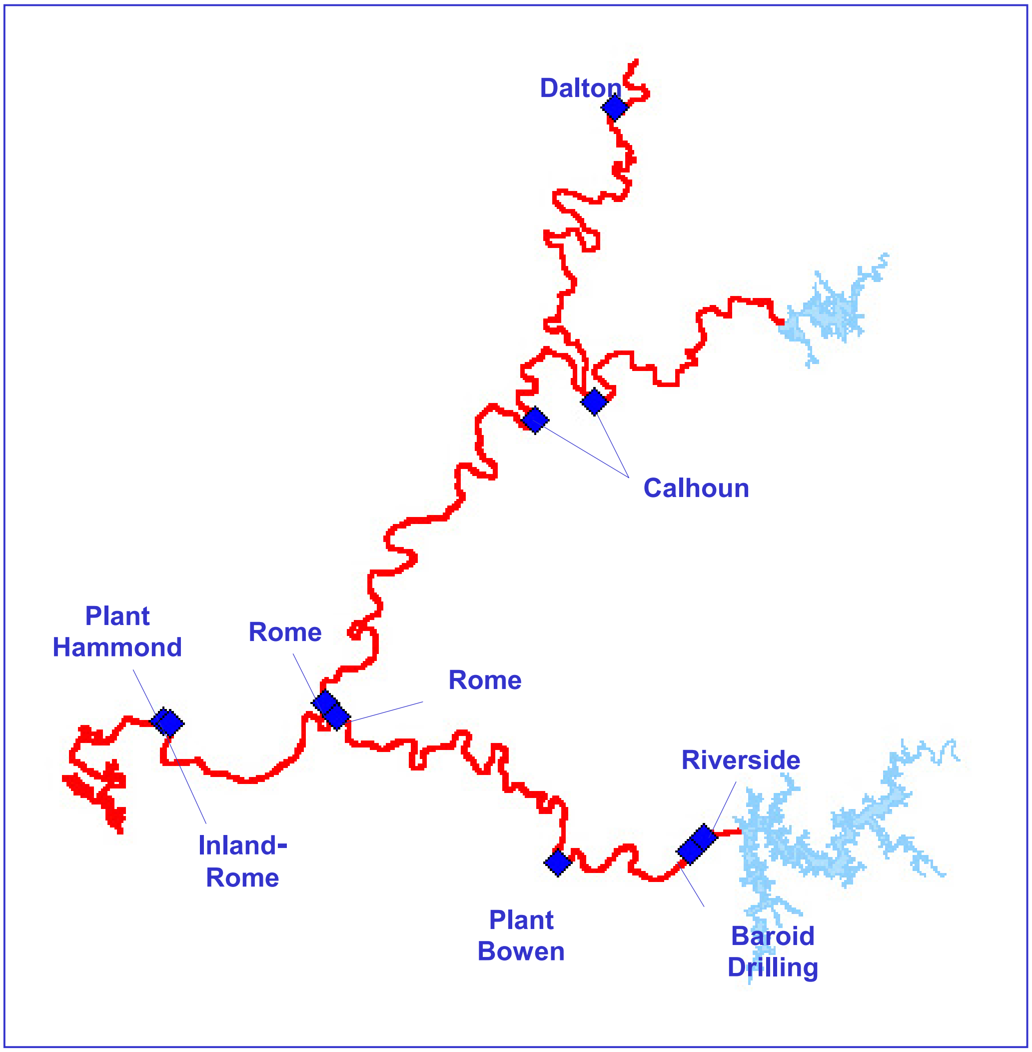

Figure 10. Mainstem Water Withdrawals

In addition, the model includes the thirty-two tributary point sources, which are incorporated into the tributary loads. Table 8 provides a list of the tributary discharges and the tributary watersheds in which they are included.

EPD RIV-1 requires site-specific meteorological parameters to perform the water quality simulations. The time-series data required for the simulation includes: cloud cover, wind speed, barometric pressure, wet bulb temperature, and dry bulb temperature. Meteorological data for the project were obtained from a meteorological station maintained by the University of Georgia (UGA) Department of Agriculture in Griffin, Georgia. The UGA Rome Station is located in Floyd County.

Table 8. Tributary Point Sources

Facility Name	NPDES Permit No.	Receiving Stream	ID - Watershed
Conasauga Sub-Basin			
Mountain View Acres	GA0047848	Stone Branch	Tr1-030 Coahulla
Whispering Pines Mobile Home Park	GA0023426	Ketchum Branch	Tr1-030 Coahulla
Varnell Elementary	GA0034029	Kenyon Creek	Tr1-030 Coahulla
City of Chatsworth WPCP	GA0032492	Holly Creek	Tr1-040 Holly Creek
DNR Fort Mountain	GA0049191	Holly Creek	Tr1-040 Holly Creek
East Brook Middle School	GA0034037	Davis Creek	Tr1-05 Drowning Bear
Dug Gap Elementary	GA0034011	Drowning Bear Creek	Tr1-05 Drowning Bear
Antioch Elementary School	GA0048488	Davis Creek	Tr1-05 Drowning Bear
Super 8 Motel	GA0048887	Unnamed Trib.	Tr1-060 Swamp
Dawnville Elementary School	GA0034002	Moody Branch	Tr1- Local 01
Coosawattee Sub-Basin			
City of Fairmount WPCP	GA0046388	Salacoa Creek	Tr2-100 Salacoa
Oostanaula Sub-Basin			
City of Adairsville - North WPCP	GA0046035	Oothkalooga Creek	Tr3-14 0 0othkalooga
City of Adairsville - South WPCP	GA0032832	Oothkalooga Creek	Tr3-14 0 0othkalooga
OMNOVA Solutions, Inc.	GA0000329	Oothkalooga Creek	Tr3-14 0 0othkalooga
W. L. Swain Elementary School	GA0032221	Robbins Creek	Tr3-Local 05
Etowah Sub-Basin			
City of Dallas--West	GA0026026	Weaver Creek	Tr4-220 Pumpkinvine
City of Dallas -North	GA0026034	Lawrence Creek	Tr4-220 Pumpkinvine
City of Emerson Pond	GA0026115	Pumpkinvine Creek	Tr4-220 Pumpkinvine
Fairway Villas MHP	GA0026611	Trib. Pumpkinvine	Tr4-220 Pumpkinvine
Three Cedars MHP	GA0032042	Picketts Mill Creek	Tr4-220 Pumpkinvine
W. C. Abney Elementary School	GA0029921	Possum Creek	Tr4-220 Pumpkinvine
Goodyear Tire & Rubber Company	GA0000515	Pettit Creek	Tr4-230 Pettit
City of White-Whispering Pine WPCP	GA0046671	Wolfpen Branch	Tr4-230 Pettit
White Elementary School	GA0029904	Pettit Creek	Tr4-230 Pettit
Best Western Crown Inn	GA0023540	Pettit Creek	Tr4-250 Euharlee
City of Rockmart WPCP	GA0026042	Euharlee Creek	Tr4-250 Euharlee
Polk County-Aargon	GA0026182	Euharlee Creek	Tr4-250 Euharlee
Engineered Fabrics Company	GA0000523	Euharlee Creek	Tr4-250 Euharlee
Bartow County Two Run Creek WPCP	GA0020702	Two Run Creek	Tr4-250 Euharlee
Upper Coosa Sub-Basin			
City of Cedartown WPCP	GA0024074	Cedar Creek	Tr5-360 Cedar
Geo Specialty Chemicals	GA0001708	Cedar Creek	Tr5-360 Cedar
City of Cave Springs	GA0025721	Little Cedar Creek	Tr5-360 Cedar

4.3 Model Calibration

The model calibration period was determined from an examination of the USGS 2001 water quality data for the listed segment. The data examined included streamflow, dissolved oxygen, water temperature, BOD_5, and ammonia. The combination of the lowest flow, lowest dissolved oxygen, and highest water temperature defined the critical modeling period. For the listed segment, July through September was found to be the critical period. The calibration model was run using input data for this period, including boundary conditions and meteorological data.

Daily discharge flows, BOD_5, NH_3, and DO concentrations for the major mainstem discharges were obtained from 2001 Operating Monitoring Reports (OMRs). These data were input into the calibration model. Table 9 is a summary of the actual discharges from these facilities for calendar year 2001. The minor mainstem discharges were input at permit limits.

Table 9. Summary of Major Mainstem NPDES Discharges during 2001

Facility	NPDES Permit No.	Actual Discharge for Calendar Year 2001				
		Average Monthly Flow (MGD)	BOD_5		NH_3	
			mg/L	lb/day	mg/L	lb/day
City of Calhoun WPCP	GA0030333	8.1	13.9	937	0.75	50
City of Cartersville WPCP	GA0024091	8.2	5.5	375	0.23	16
City of Rome Blacks Bluff WPCP	GA0024112	11.9	6.3	626	0.32	32
City of Rome-Coosa WPCP	GA0024341	1.0	1.5	12	0.47	1
Inland-Paperboard	GA0001104					
(Dec-Apr)				2322		
(Nov, May)				2287		
(Jun-Oct)				2178		

The point sources located on tributaries were included in the tributary inputs. During 2001, the USGS conducted discrete water quality sampling in 19 tributaries of the Coosa River Basin (see Table 10). The data were used as the tributary inputs in the calibration model. For tributaries that were not sampled, inputs were established using data from reference tributaries that had similar characteristics.

There are only four USGS flow gages on the tributaries that have sufficient data to calculate daily flows in 2001. However, each branch of the Coosa River Basin has both an upstream and downstream USGS flow gage (see Figure 11). The tributary flows were estimated using these mainstem flows as follows. Accounting for a shift in the hydrograph based on time of travel, the difference in the upstream and downstream mainstem flows was determined on a daily basis. These differences represent the daily flows coming from the tributaries. By dividing these flows by the difference in the upstream and downstream drainage areas, a daily productivity factor for each sub-basin could be determined. These productivity factors were then used to calculate estimated daily tributary flows to be used as input into the calibration model.

Table 10. Coosa River Tributaries Discretely Sampled by USGS During 2001

Tributary	Location	USGS Station ID
Conasauga Sub-Basin		
Coahulla Creek	at US 76 near Dalton	02385250
Holly Creek	at State Road 22	02386100
Coosawattee Sub-Basin		
Salacoa Creek	at Lovebridge Road NE near Redbud	02383180
Oostanaula Sub-Basin		
Oothkalooga Creek	at SR 156 near Calhoun	02387605
Johns Creek	at SR 156 near Curryville	02387690
Armuchee Creek	at Old Dalton Road near Rome	02388350
Woodward Creek	at Bells Ferry Road NE near Rome	02388370
Etowah Sub-Basin		
Pumpkinvine Creek	at CR 636 near Emerson	02394520
Raccoon Creek	at SR 113 near Stilesboro	02394750
Euharlee Creek	at CR 32 near Stilesboro	02394958
Two Run Creek	at Reynolds Bridge Road near Kingston	02395150
Spring Creek	at SR 20 near Rome	02395540
Silver Creek	at Crescent Avenue near Rome	02396525
Webb Creek	at Blacks Bluff Road SW near Rome	02397010
Upper Coosa Sub-Basin		
Beech Creek	at Mays Bridge Road SW near Rome	02397075
Cabin Creek	at SR 20 near Rome	02397095
Cedar Creek	at Cave Springs Road near Cedartown	02397500

Downstream of Rome, in the vicinity of the listed segment, where effects of nonpoint source loads needed to be better defined, watershed models were developed for the tributaries using the Hydrological Simulation Program – FORTRAN (HSPF). The watershed models were calibrated to the USGS tributary water quality data. These models simulate the effects of surface runoff on both water quality and flow. The results of the watershed models were used as tributary inputs into the calibration model.

Figure 11. Mainstem USGS Flow Gages

Table 11 provides the major kinetic rates and parameters developed during model calibration. These parameters include Manning's n used to calculate flow, O'Connor Dobbins reaeration coefficient used to determine stream reaeration, carbonaceous BOD (CBOD) decay rate, ammonia decay rate, and sediment oxygen demand (SOD) rate. Parameters are given by sub-basin and river reach.

Table 11. Modeling Parameters

River Stretch	Manning's n	Reaeration Coeff.	CBOD Decay Rate	Ammonia Decay Rate	SOD (m/m2/day)
Conasauga Sub-Basin					
	0.035	12.5	0.060	0.2	1.5
Coosawattee Sub-Basin					
	0.035	12.5	0.045	0.2	1.0
Etowah Sub-Basin					
Allatoona to Old Cartersville Dam	0.030	12.5	0.045	0.1	0.5
Old Dam to Rome	0.030	12.5	0.045	0.1	2.0
Oostanaula Sub-Basin					
	0.035	12.5	0.050	0.2	2.0
Upper Coosa Sub-Basin					
Rome to Mayo's Bar	0.025	19.5	0.050	0.2	2.0
Mayo's Bar to State Road 100	0.025	19.5	0.040	0.2	1.5

The EPD RIV-1 Coosa River model was calibrated at nine locations where the USGS collected continuous data and fifteen locations where the USGS, City of Rome, or Inland Paperboard collected discrete water quality samples during 2001. Table 12 provides a summary of the types of calibration data used. Appendix A provides the plotted data from the monitoring sites in each sub-basin and the calibrated model predictions for flow, stage, temperature, dissolved oxygen, ultimate carbonaceous oxygen demand, ammonia, nitrate, and total phosphorus.

Table 12. Summary of Available Calibration Data

Model Cross-section No.	Monitoring Site	Data Source	Hourly Monitoring				Discrete Monitoring						
			Flow (cfs)	Stage (ft MSL)	DO (mg/L)	Temp (deg C)	Flow (cfs)	Temp (deg C)	DO (mg/L)	BOD_5 (mg/L)	NH_3 (mg/L)	NO_3 (mg/L)	P total (mg/L)
	Conasauga Sub-Basin												
130	Conasauga at US 76 near Dalton	USGS	---	---	---	---	X	X	X	X	X	X	X
154	Conasauga at Tilton Br.	USGS	X	X	X	X	---	---	---	X	X	X	X
161	Conasauga SR 136 near Resaca	USGS	---	---	---	---	X	X	X	X	X	X	X
	Coosawattee Sub-Basin												
1	Coosawattee at US 411	USGS	---	---	---	---	---	X	X	X	X	X	X
17	Coosawattee nr Pine Chapel	USGS	X	X	---	---	---	---	---	---	---	---	---
27	Coosawattee at SR 225	USGS	---	---	---	---	X	X	X	X	X	X	X
	Oostanaula Sub-Basin												
32	Oostanaula near US 41 Resaca	USGS	X	X	---	---	---	X	X	X	X	X	X
47	Oostanaula SR 156 nr Calhoun	USGS	---	---	---	---	X	X	X	X	X	X	X
74	Oostanaula US from Rome	USGS	X	X	---	---	---	---	---	---	---	---	---
78	Oostanaula at Rome Intake	City of Rome	---	---	---	---	X	X	X	X	X	X	X
	Etowah Sub-Basin												
169	Etowah US 41 near Cartersville	USGS	---	---	---	---	X	X	X	X	X	X	X
178	Etowah SR 61 near Cartersville	USGS	---	X	---	---	X	X	X	X	X	X	X
187	Etowah at Hardin Bridge	USGS	---	---	---	---	X	X	X	X	X	X	X
193	Etowah at US 411 nr Kingston	USGS	---	X	---	---	---	---	---	---	---	---	---
210	Etowah at GA Loop 1 nr Rome	USGS	X	X	---	---	---	---	---	---	---	---	---
213	Etowah at Rome Intake	City of Rome	---	---	---	---	---	X	X	---	X	---	X
	Upper Coosa Sub-Basin												
90	Coosa at Mayo's Bar	USGS	X	X	---	X	---	---	---	---	---	---	---
91	Coosa DS Mayo's Bar	City of Rome	---	---	---	---	---	X	X	X	X	---	X
92	Coosa at Blacks Bluff Rd	USGS	---	---	---	---	X	X	X	X	X	X	X
100	At Inland Paperboard (SR 100)	Inland Paper	---	---	---	---	---	X	X	---	---	---	---
122	Coosa at State Line	USGS	---	---	X	X	---	---	---	X	X	X	X

Measured dissolved oxygen and temperature values for the period July through September 2001 were used as instream targets to calibrate the model. Figures 12 and 13 show the temperature and dissolved oxygen calibration curves for the Coosa River at Inland Paperboard (SR 100), the upstream boundary of the listed segment. Figure 14 shows the temperature calibration curve at the State Line. The field data are discrete instantaneous daily temperature and DO measurements. The model results are hourly.

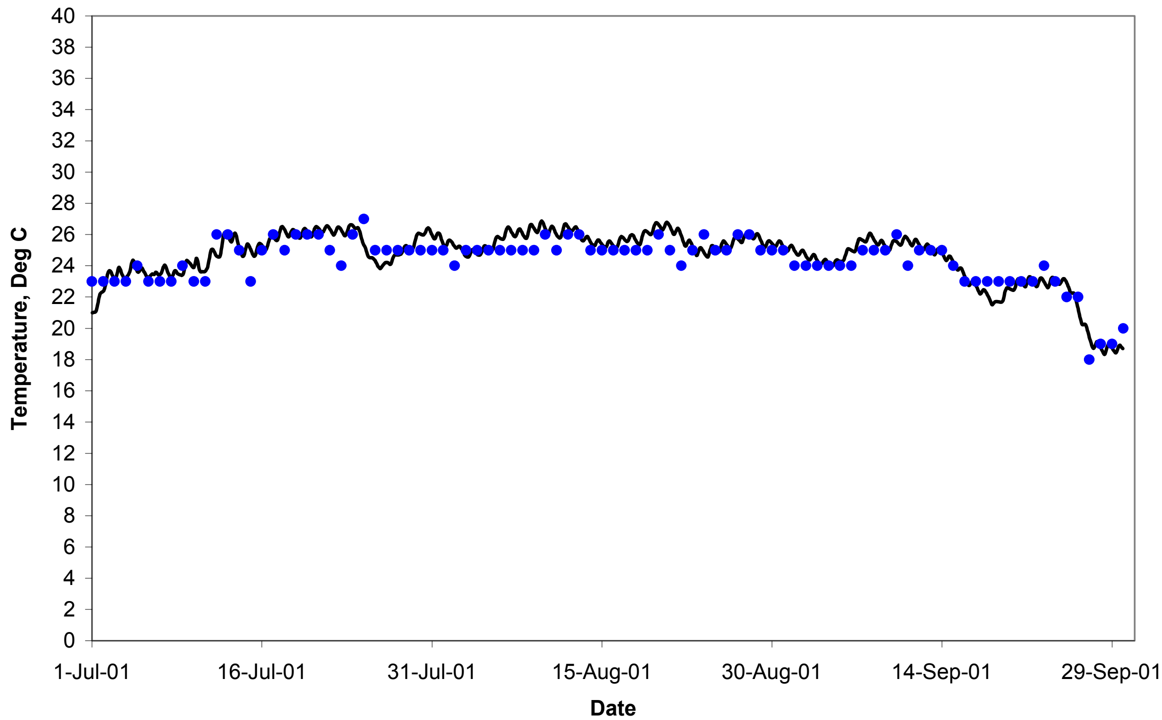

Figure 12. Temperature Calibration for the Coosa River at Inland Paperboard (SR 100)

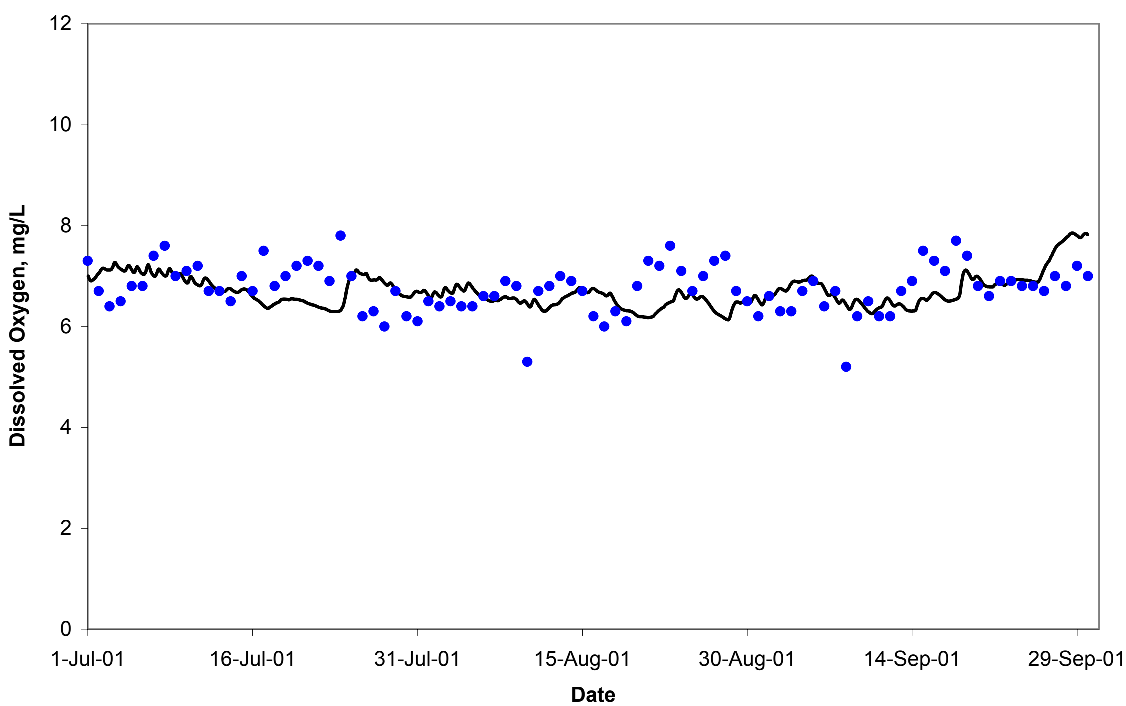

Figure 13. Dissolved Oxygen Calibration for the Coosa River at Inland Paperboard (SR 100)

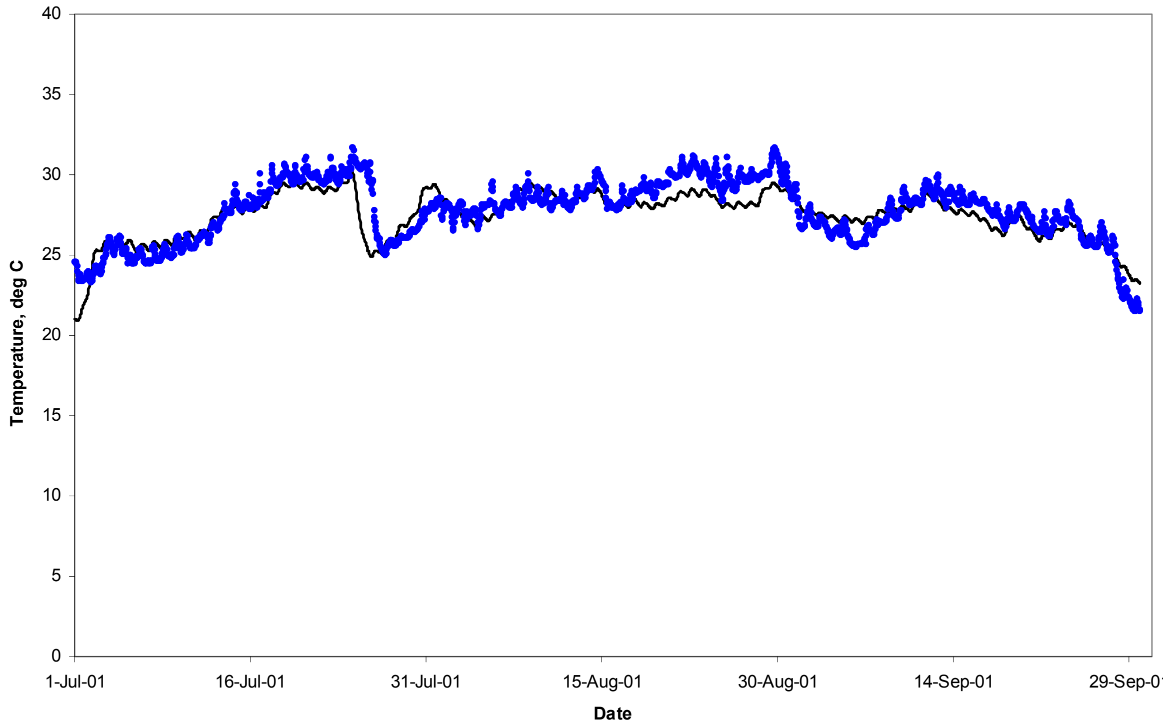

Figure 14. Temperature Calibration for the Coosa River at the State Line

4.4 Critical Conditions Model

The critical conditions model is used to assess dissolved oxygen standards and to determine if a problem exists requiring regulatory intervention. Model critical conditions were developed in accordance with GA EPD standard practices (GA EPD, 1978).

Low flow analyses of the Coosa River were performed, based on data from the USGS Stations, to determine monthly 7-day, 10 year minimum flows (7Q10). Productivity factors, in cubic feet per second (cfs) per square mile, were computed by dividing the monthly 7Q10s by the watershed areas at the gages. These monthly 7Q10 productivity factors were then used to determine critical tributary flows.

Monthly 7Q10s were determined at USGS Station 02397000 - Coosa River near Rome, Georgia, otherwise known as Mayo's Bar. Data used were from 1977 (when Carter's Lake Dam was completed and operational) to present.

On May 1, 2003, the *ACT Allocation Formula Agreement* for the Alabama, Coosa, and Tallapoosa Basins reached between the State of Alabama and the State of Georgia was issued. In Section 2.1, "State Line Flow Requirements and COE Operations," it states:

> B. The COE shall operate Allatoona Reservoir and Dam and Carter's Reservoir and Reregulation Dam in the manner necessary to provide a Flow at USGS gage # 02397000, Coosa River near Rome, Georgia (Mayo's Bar), that equals or exceeds 1,500 cfs on a Weekly Average basis and 1,000 cfs on a Daily Average basis.

Based on the minimum weekly flow required by the ACT Allocation Formula and the monthly 7Q10s, the critical flows used in the Coosa River EPD RIV-1 model at Mayo's Bar were developed. Table 13 provides the low flow analysis and critical flows developed at Mayo's Bar. Figure 15 is a plot of these data.

Table 13. Monthly Low-Flow of the Coosa River near Rome Georgia (Mayo's Bar)

Month	7Q10 (cfs)	Productivity Factor (cfs/ sq mile)	Critical 7Q10 (cfs)
Jan	2217	0.55	2217
Feb	2701	0.67	2701
Mar	2874	0.71	2874
Apr	2623	0.65	2623
May	2212	0.55	2212
Jun	1924	0.48	1924
Jul	1578	0.39	1500
Aug	1479	0.37	1500
Sep	1353	0.33	1500
Oct	1238	0.31	1500
Nov	1464	0.36	1500
Dec	2075	0.51	2075
Annual	1200	0.30	1500

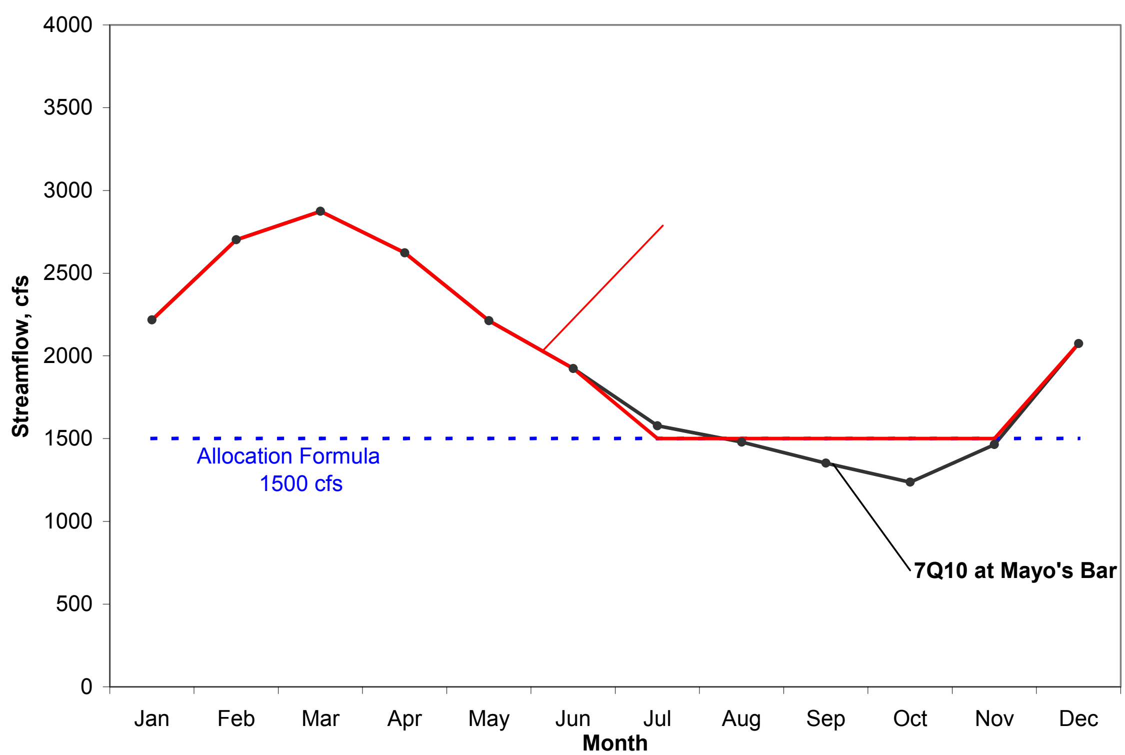

Figure 15. Monthly 7Q10 of the Coosa River near Rome, Georgia (Mayo's Bar)

Monthly 7Q10's developed from USGS gage data at Eton were used as model input for the Conasauga River branch. Monthly critical flows from Carter's Lake and Lake Allatoona were determined by performing a flow balance so that critical monthly flows are met at Mayo's Bar. The 2001 meteorological data, boundary conditions, SOD rates, reaeration coefficients, and all other modeling rates and constants were the same as those used in the calibrated model.

Natural conditions are determined from the critical conditions model, where all point source loads were removed and critical flows were maintained at Mayo's Bar. This model is used to determine the natural dissolved oxygen concentrations during critical conditions. The model predicted natural dissolved oxygen concentrations at State Road 100, during the summer months, to be greater than 5.0 mg/L.

In the critical conditions model all point sources were incorporated at their current NPDES permit limits and monitored temperatures. The tributary point source loads were adjusted to account for decay that occurs during the travel time in the tributary. The hourly DO concentrations resulting from this model run and the DO Standard at State Road 100 are shown in Figure 16.

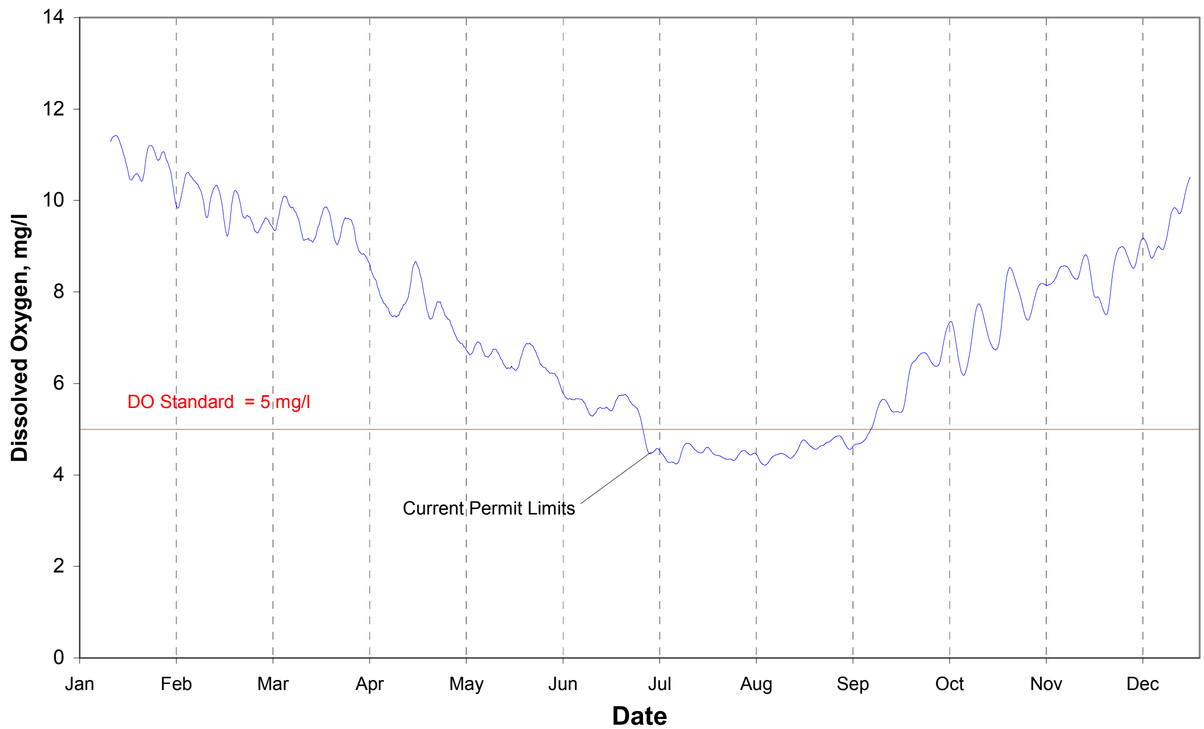

Figure 16. DO Concentrations for the Coosa River at State Road 100 under Critical Conditions at Current Permit Limits

Figure 16 shows that under current permit limits, the modeled DO is below the water quality standard during the summer months. The next step is to run the model to determine the loads needed to achieve the standard, which will be used to develop the TMDL.

5.0 TOTAL MAXIMUM DAILY LOADS

A TMDL is the amount of a pollutant that can be assimilated by the receiving waterbody without exceeding the applicable water quality standard. A TMDL is the sum of the individual waste load allocations (WLAs) from point sources and load allocations (LAs) from nonpoint sources, as well as the natural background (40 CFR 130.2) for a given waterbody. The TMDL must also include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the water quality response of the receiving water body. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measures. For oxygen demanding substances, this TMDL is expressed as Millions of British Thermal Units per day, M-Btu/day, (for power plant heat loads) and lbs/day (for wastewater facilities).

A TMDL can be expressed as follows:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

This TMDL determines the allowable oxygen demanding loads to the Coosa River. The following sections describe the various oxygen demanding substances TMDL components.

5.1 Waste Load and Load Allocations

The WLA is the portion of the receiving water's loading capacity that is allocated to existing or future point sources. There are 42 NPDES permitted facilities in the Coosa River watershed that effect instream dissolved oxygen. Waste load allocations are provided to the point sources from municipal and industrial wastewater treatment systems. The EPD RIV-1 critical conditions model was used to determine the WLAs required by the discharges upstream from State Road 100 to meet the DO standard at this location. Figure 17 is a plot of the DO concentrations resulting from the TMDL loads required to meet the DO standard at State Road 100 versus the DO Standard.

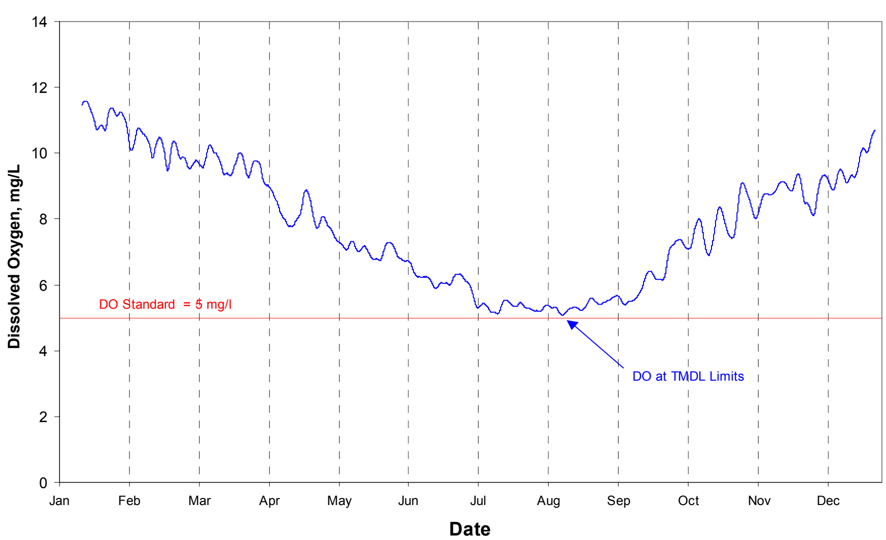

Figure 17. DO Concentrations for the Coosa River at State Road 100 under Critical Conditions at TMDL Loads

The WLAs required for discharges downstream from State Road 100 are based on existing hourly dissolved oxygen concentrations measured by the USGS continuous monitor at the State Line. These data had no documented water quality violations in 2001. This TMDL determines the amount of oxygen demanding material that can be assimilated by the Coosa River without exceeding the dissolved oxygen standard. However, the amount of oxygen available in a water body decreases as the water temperature increases. In summer months, river temperatures tend to be higher and dissolved oxygen concentrations tend to be lower than during the cooler seasons of the year. The greatest stress with respect to protection of aquatic life can occur during summer months.

In order to attain the dissolved oxygen water quality standard in the Coosa River, a thermal reduction is required at Plant Hammond. Table 14 provides the modeled 2001 monthly heat load allocation for Plant Hammond, which would have assured that the temperature water quality standard would have been met during the critical summer period. Inland Rome, which discharges downstream from State Road 100, will be held at its 2001 demonstrated performance level shown in Table 9. Table 15 is a list of the UOD WLAs required to meet the dissolved oxygen TMDL. The load reductions, set out in Tables 14 and 15, both thermal and UOD, are expected to result in both Georgia's and Alabama's DO standards being met at the State Line.

Table 14. Modeled Heat Load Allocation for Plant Hammond for 2001

	Maximum Allowable Heat Load (M-Btu/day)
Jun	450,126
Jul	474,709
Aug	469,792
Sep	396,046

Allowable heat load based on Plant Hammond permit flow = 655 MGD

If necessary, GA EPD may modify the WLAs during the NPDES permitting process. In addition, the TMDL will be used to assess the permit renewals. The partitioning of allocations between point (WLA) and nonpoint (LA) sources shown in Table 16 is based on modeling results and professional judgment.

State and Federal Rules define storm water discharges covered by NPDES permits as point sources. However, storm water discharges are from diffuse sources and there are multiple storm water outfalls. Storm water sources (point and nonpoint) are different than traditional NPDES permitted sources in four respects: 1) they do not produce a continuous (pollutant loading) discharge; 2) their pollutant loading depends on the intensity, duration, and frequency of rainfall events, over which the permittee has no control; 3) the activities contributing to the pollutant loading may include various allowable activities of others, and control of these activities is not solely within the discretion of the permittee; and (4) they do not have wastewater treatment plants that control specific pollutants to meet numerical limits.

Table 15. Coosa River Basin WLAs

Facility Name	NPDES Permit No.	NPDES Permit Limits				
		Average Monthly Flow (MGD)	Average Monthly BOD_5 (mg/L)	Average Monthly NH_3 (mg/L)	Minimum DO (mg/L)	Total Daily UOD Load (lbs/day)
Conasauga Sub-Basin						
Dow Chemical Company	GA0000426	0.125	15.4	82.5	---	457
Mountain View Acres	GA0047848	0.0840	30	---	5	84
Whispering Pines Mobile Home Park	GA0023426	0.0380	30	---	---	38
Varnell Elementary	GA0034029	0.0100	30	---	---	10
City of Chatsworth WPCP	GA0032492	3.0	10	2	6	1,229
DNR Fort Mountain	GA0049191	0.0070	30	---	---	7
East Brook Middle School	GA0034037	0.0165	30	---	---	17
Dug Gap Elementary	GA0034011	0.0100	30	---	---	10
Antioch Elementary School	GA0048488	0.005	30	---	---	5
Super 8 Motel	GA0048887	0.0250	30	---	---	25
Dawnville Elementary School	GA0034002	0.0120	30	---	---	12
Coosawattee Sub-Basin						
City of Fairmount WPCP	GA0046388	0.2000	30	17.4	2	333
Oostanaula Sub-Basin						
City of Calhoun WPCP	GA0030333					
(June – Sept)		16	10	2	6	6,557
(Oct – May)		16	20	5	5	13,724
Cumberland Academy	GA0035947	0.016	30	---	---	16
City of Adairsville - North WPCP	GA0046035	1.0	30	3	5	1,115
City of Adairsville -South WPCP	GA0032832	0.5000	30	10	5	691
OMNOVA Solutions, Inc.	GA0000329	0.1500	36.4	16.4	---	276
W. L. Swain Elementary School	GA0032221	0.0100	30	---	---	10

Facility Name	NPDES Permit No.	NPDES Permit Limits				
		Average Monthly Flow (MGD)	BOD_5 (mg/L)	NH_3 (mg/L)	DO (mg/L)	Total Daily UOD Load (lbs/day)
Etowah Sub-Basin						
Bartow County Southeast	GA0037664	0.100	10	2	6	41
City of Cartersville WPCP	GA0024091					
(June – Sept)		15	10	2	6	6,147
(Oct – May)		15	20	5	5	11,151
City of Dallas--West	GA0026026	1.0	20	5	6	858
City of Dallas -North	GA0026034	0.5000	20	3	6	391
City of Emerson Pond	GA0026115	0.1720	30	---	---	172
Fairway Villas MHP	GA0026611	0.0570	20	---	---	38
Three Cedars MHP	GA0032042	0.0140	30	---	---	17
W. C. Abney Elementary School	GA0029921	0.0100	30	---	---	10
Goodyear Tire & Rubber Company	GA0000515	0.0780	5.2	---	---	14
City of White-Whispering Pine WPCP	GA0046671	0.0250	30	---	---	25
White Elementary School	GA0029904	0.0130	30	---	---	13
Best Western Crown Inn	GA0023540	0.0060	30	---	---	6
City of Rockmart WPCP	GA0026042	3.0	30	4.7	5	3,540
Polk County-Aragon	GA0026182	0.3400	30	---	2	340
Engineered Fabrics Company	GA0000523	0.0200	36	---	---	24
Bartow County Two Run Creek WPCP	GA0020702	0.1000	30	---	2	100

Facility Name	NPDES Permit No.	NPDES Permit Limits				
		Average Monthly Flow (MGD)	BOD_5 (mg/L)	NH_3 (mg/L)	DO (mg/L)	Total Daily UOD Load (lbs/day)
Upper Coosa Sub-Basin						
City of Rome - Blacks Bluff WPCP	GA0024112					
(June – Sept)		18	10	2	6	7,377
(Oct – May)		18	20	5	5	15,440
City of Rome - Coosa WPCP	GA0024341					
(June – Sept)		2	10	2	6	820
(Oct – May)		2	20	5	5	1,716
Inland Paperboard - Outfall 001, 002, 005	GA0001104	---		---	2	
(Dec-Apr)			13,396 *			120,564
(Nov, May)			10,528 *			94,752
(June- Sept)			2,200 *			19,800
(Oct)			5,076 *			45,684
City of Cedartown WPCP	GA0024074	3.5	10	2	6	1,434
Geo Specialty Chemicals	GA0001708	0.3600	44	10	6	666
City of Cave Springs	GA0025721	0.2200	30	---	2	220

Note = * Daily average Permit Limit in lbs/day

The intent of storm water NPDES permits is not to treat the water after collection, but to reduce the exposure of storm water to pollutants by implementing various controls. It would be infeasible and prohibitively expensive to try to control pollutant discharges from each storm water outfall. Therefore, storm water NPDES permits require the establishment of controls or BMPs to reduce pollutants entering the environment.

The EPD RIV-1 Coosa River model was run under critical conditions, assuming 7Q10 flows and dry weather conditions. Because the critical conditions occur when there are no storm events, no numeric allocation is given to the waste load allocations from storm water discharges associated with MS4s (WLAsw).

The background concentrations and 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 under critical conditions.

Table 16. TMDL Loads for Coosa River Basin under Critical Conditions

Sub-Basin	WLA (lbs/day)	WLAsw (lbs/day)	LA (lbs/day)	TMDL * (lbs/day)
Conasauga	1,894	NA	2,225	4,119
Coosawattee	333	NA	12,970	13,303
Etowah	11,736	NA	13,129	24,865
Oostanaula	8,665	NA	1,420	10,085
Upper Coosa	22,120	NA	1,662	23,783

Note:* TMDL expressed as average monthly Ultimate Oxygen Demand (UOD), which includes the Carbonaceous Biochemical Oxygen Demand (CBOD) and the Nitrogenous Biochemical Oxygen Demand (NBOD).
NA = no storm water discharges associated with MS4s contributing to the listed segment. during critical conditions

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.

5.3 Margin of Safety

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.

For this TMDL, the MOS was implicitly incorporated in the use of the following conservative modeling assumptions:

- Critical flows that took into account monthly 7Q10s and the minimum flow required by the ACT allocation formula;
- Hot summer temperatures, based on 2001 meteorological data collected during part of a four-year drought;
- Conservative reaction rates; and
- The assumption that all point sources discharge continuously at their NPDES permitted limits for the same critical period.

6.0 RECOMMENDATIONS

During the TMDL development phase and the public comment period, it became clear that the Coosa River Basin, including Lake Weiss in Alabama, is a very complex system. The management of the dissolved oxygen resources in this watershed has a significant impact on many stakeholders. It was determined that an integrated management approach, using a system of linked models, would be beneficial to both the State of Georgia and the State of Alabama. This approach will be useful to refine current and future allocations of both oxygen demanding substances and nutrients, for both point and nonpoint sources.

Many stakeholders, including NPDES permit holders, as well as environmental groups, provided comments regarding the use of a lake model for the lower portion of the Coosa River system in Georgia. In order for new modeling efforts to be successful, additional data must be collected and evaluated. Based on new modeling results, allocations leading to permit limits can be developed with added confidence. Reasonable assurance procedures will be used as appropriate. The TMDL implementation will also include plans for the control of nonpoint sources throughout the watersheds. This process will be costly and will include stakeholder participation, as well as cooperation between EPD, Alabama Department of Environmental Management (ADEM), and EPA.

6.1 Additional Modeling

EPD received comments suggesting that this section of the Coosa River is a river-reservoir transition zone, representing an upstream backwater of Weiss Reservoir, where vertical DO gradients may be present during the algal growing season. The EPD RIV-1 model is suitable for free-flowing and well-mixed riverine systems and was successfully used to model the approximately 200 miles of the Coosa River from the headwaters at Allatoona Lake, Carter's Lake, and Conasauga River near Eton to State Road 100. However, other modeling approaches are expected to provide additional, useful information on the section of the river from State Road 100 to the Georgia/Alabama State Line due to potential hydrodynamic impacts of Lake Weiss.

EPD agrees that EPD RIV-1 is a one-dimensional model that does not precisely model the effects of algae on dissolved oxygen concentrations in the lower section of the Coosa River where water depths can reach 50 feet. EPA has developed a draft Lake Weiss nutrient TMDL using CE-QUAL-W2. This TMDL examined nutrient loads and their effects on lake chlorophyll *a* levels, but did not look at the effect the nutrients load reductions would have on DO concentrations. The Lake Weiss model was run from the Georgia/Alabama State Line to Weiss Dam. The modeling report, *CE-QUAL-W2 Model Recalibration and Simulations in Support of TMDL Activities for Weiss Lake*, *Alabama* (EPA Region IV, August 29, 2002), identifies the need for additional data to characterize the lake boundary inputs and recommends that the Lake Weiss model be integrated, with upstream river and watershed models. The use of an integrated basin management approach, with linkages between the Coosa River model and the Lake Weiss model, would be preferred. However, there is a 15-mile gap between the downstream DO boundary of the Coosa River EPD RIV-1 model (State Road 100) and the upstream boundary of the Lake Weiss model (the State Line).

Plans are currently being developed to model the lower section of the Coosa River from Mayo's Bar to the Georgia/Alabama State Line, including Lake Weiss, using the hydrodynamic model EFDC and the Water Quality Analysis Simulation Program (WASP). This model can then be linked with the upstream Coosa River EPD RIV-1 model. In fact, there will be an overlap in the two models for the section of the Coosa River from Mayo's Bar to the State Line. If deemed necessary, watershed models may be developed for some of the larger Coosa River tributaries using the Hydrological Simulation Program – FORTRAN (HSPF). These watershed models would be used to predict nonpoint source loads. The output from the HSPF models would be used as tributary inputs into the Coosa River EPD RIV-1 model. In addition, this new Lake Weiss model can also be linked with the downstream WASP lake models that have been developed by ADEM.

These integrated models will be used to verify, and if necessary, revise both the Coosa River DO TMDL and the Lake Weiss nutrient TMDL. The models will be used to examine load reductions in oxygen demanding substances and nutrients from both point and non-point sources; temperature effects with respect to heat; and operations of Carters Lake and Allatoona Dams with respect to future interstate water allocation proposals. The revised TMDL will assign revised wasteload allocations to point sources and revised load allocations to nonpoint sources.

6.2 Monitoring

In order to link the Coosa River EPD RIV-1 and the WASP Lake Weiss models, data will be simultaneously collected in both the Coosa River Basin and Lake Weiss. A detailed monitoring plan will be developed to look at the effects of oxygen demanding substances and nutrients. The goal of the monitoring plan will be to provide sufficient field data to calibrate and verify the Coosa River EPD RIV-1 model, HSPF watershed models, and the new Lake Weiss WASP model. The monitoring plan will collect data needed for the water quality models. These data may include:

- Hydraulic boundary conditions
- Watershed flow and water quality
- Stream data, including instantaneous chemical data and continuous water quality monitoring
- DO and temperature depth profiles
- Chlorophyll *a* and algal data
- Basin-wide phosphorus data
- Long-Term BOD analysis
- Sediment oxygen demand measurements
- Reaeration measurements
- Time of travel studies
- Meteorological data
- Wastewater facility sampling

GA EPD 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 (GA EPD, 1996). The Coosa, Tallapoosa, and Tennessee River Basins were the basins of focused monitoring in 2001 and will again receive focused monitoring in 2006. These data will add to the field study proposed specifically for model development.

6.3 Reasonable Assurance

GA EPD is responsible for administering and enforcing laws to protect the waters of the State. Permitted discharges will be regulated through the NPDES permitting process described in this report. 40 CFR 122.44(d) requires new and reissued NPDES effluent limitations and requirements be consistent with conditions and allocations in a TMDL. The target oxygen demanding substance WLA reduction projected to be needed may not be implemented until additional data and modeling have been conducted to verify the Coosa River EPD RIV-1 and WASP Lake Weiss models. If it is determined that the target WLA reductions need to be re-evaluated based on the new data and modeling of critical conditions, the TMDL will be revised.

GA 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 landuse activities that 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 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. These efforts will be continued during the study period and if it is determined that the target LA reductions need to be re-evaluated based on the new data and modeling, the TMDL will be revised.

6.4 TMDL Implementation

Once a TMDL has been developed, it must be implemented. TMDL Implementation Plans are developed after wasteload allocations and load allocations have been finalized. In general, these include more appropriate effluent limitations and requirements for point sources and implementation of BMPs for nonpoint sources. The TMDL Implementation Plan will outline an appropriate water quality sampling program for this segment of the Coosa River. The monitoring program will be developed to help identify the various oxygen demanding sources and to provide data for model calibration.

The listed segment of the Coosa River is an interstate water flowing from Georgia into Alabama. EPA has agreed to work with EPD and ADEM to study the Coosa River downstream to Lake Weiss Dam. The anticipated schedule is that a Coosa River/ Lake Weiss study plan will be developed during 2004. Field work will be conducted during the summers (critical period) of 2005 and 2006. The modeling will occur during 2006 and be finalized in early 2007. If necessary, this TMDL will be revised in 2007 and finalized in early 2008.

6.5 Public Participation

A sixty-day public notice was provided for this TMDL. During this time, the availability of the TMDL was public noticed, a copy of the TMDL was provided as requested, and the public was invited to provide comments on the TMDL. This TMDL has been modified to address the comments received. As mentioned above, the stakeholders will be involved with the development of the Coosa River/Lake Weiss study plan and may participate in the field work.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

GA EPD has coordinated with EPA to prepare this Initial TMDL Implementation Plan for this TMDL. GA EPD has also established a plan and schedule for development of a more comprehensive implementation plan after this TMDL is established. GA 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 GA EPD and/or Regional Development Centers (RDCs), or other GA EPD contractors (hereinafter, “GA EPD Contractors”), will develop expanded plans (hereinafter, “Revised TMDL Implementation Plans”).

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

1. NPDES permit discharges are a primary source of excessive pollutant loading, where they are a factor. Any wasteload allocations in this TMDL will be implemented in accordance with the Recommendations Section above. Nonpoint sources are the secondary cause of excessive pollutant loading in most cases. 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.

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

3. As part of the Initial TMDL Implementation Plan the GA EPD brochure entitled “Watershed Wisdom -- Georgia’s TMDL Program” will be distributed by GA EPD to the GA 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 GA EPD Contractor for its use in making presentations to appropriate stakeholders on TMDL Implementation Plan development.

4. If for any reason the GA EPD Contractor does not complete one or more elements of a Revised TMDL Implementation Plan, GA 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 December 2005.

6. The GA EPD Contractor helping to develop the Revised TMDL Implementation Plan, in coordination with GA 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 GA 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 GA EPD approves the Revised TMDL Implementation Plan.

Management Measure Selector Table

Land Use	Management Measures		*Dissolved Oxygen*	*pH*	*Oxygen demanding substances*	*Temperature*	*Toxicity*	*Mercury*	*Metals (copper, lead, zinc, cadmium)*	*PCBs, toxaphene*
Agriculture	1. Oxygen demanding substances & 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	_	_	_		_		_		

Land Use	Management Measures		*Dissolved Oxygen*	*pH*	*Oxygen demanding substances*	*Temperature*	*Toxicity*	*Mercury*	*Metals (copper, lead, zinc, cadmium)*	*PCBs, toxaphene*
Urban	1. New Development	–	–		–	–			–	
	2. Watershed Protection & Site Development	–	–		–	–		–	–	
	3. Construction Site Erosion and Oxygen demanding substances 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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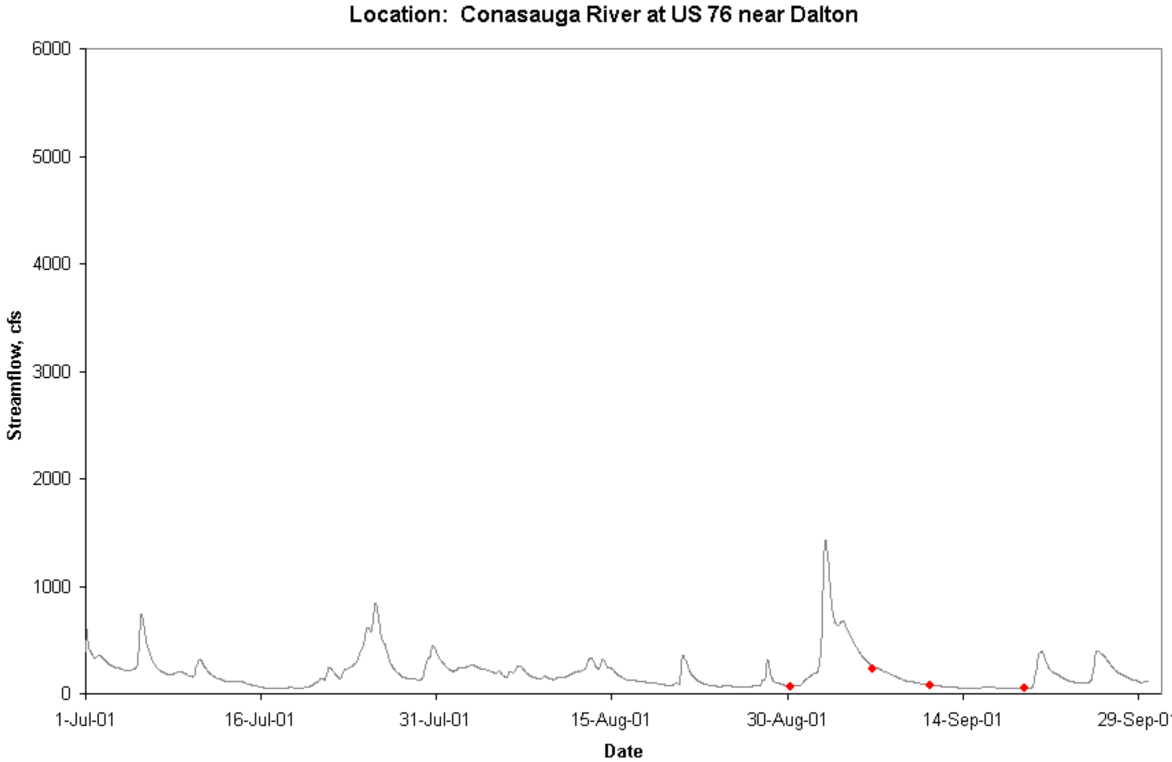
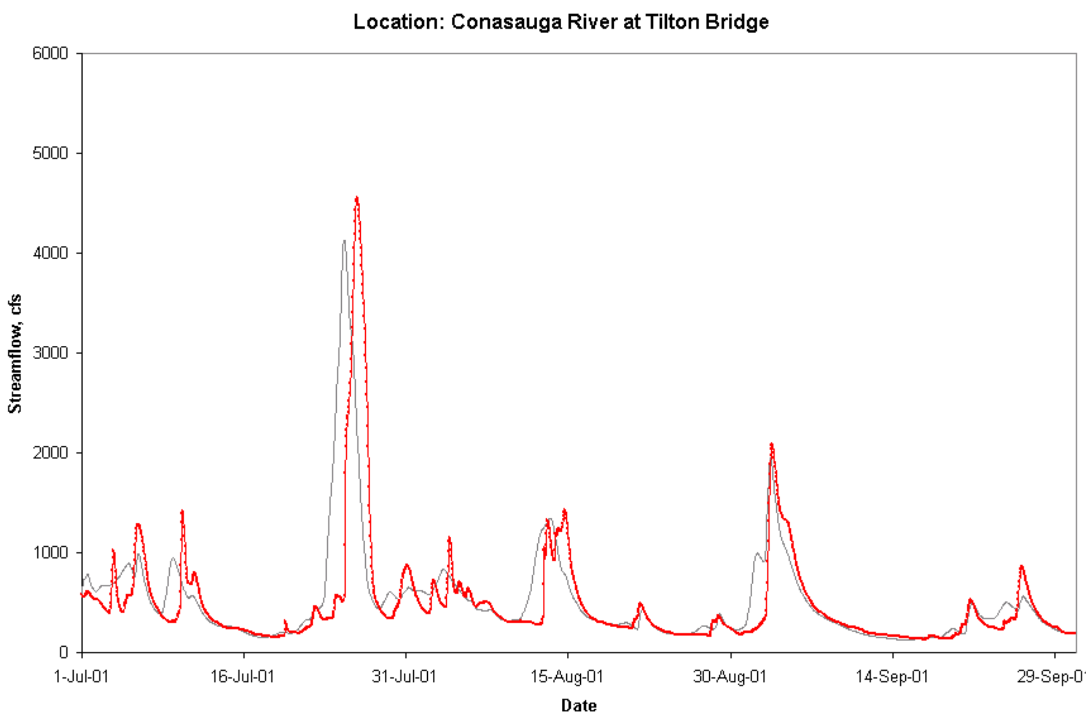
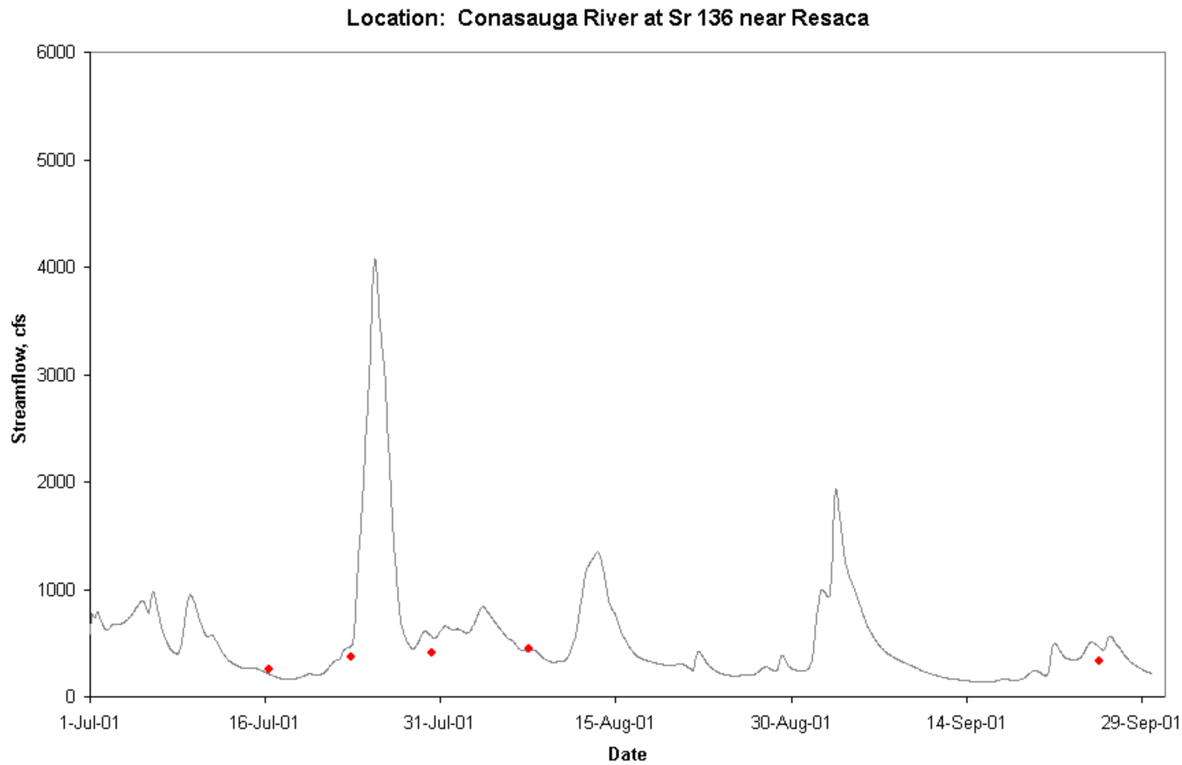
APPENDIX A

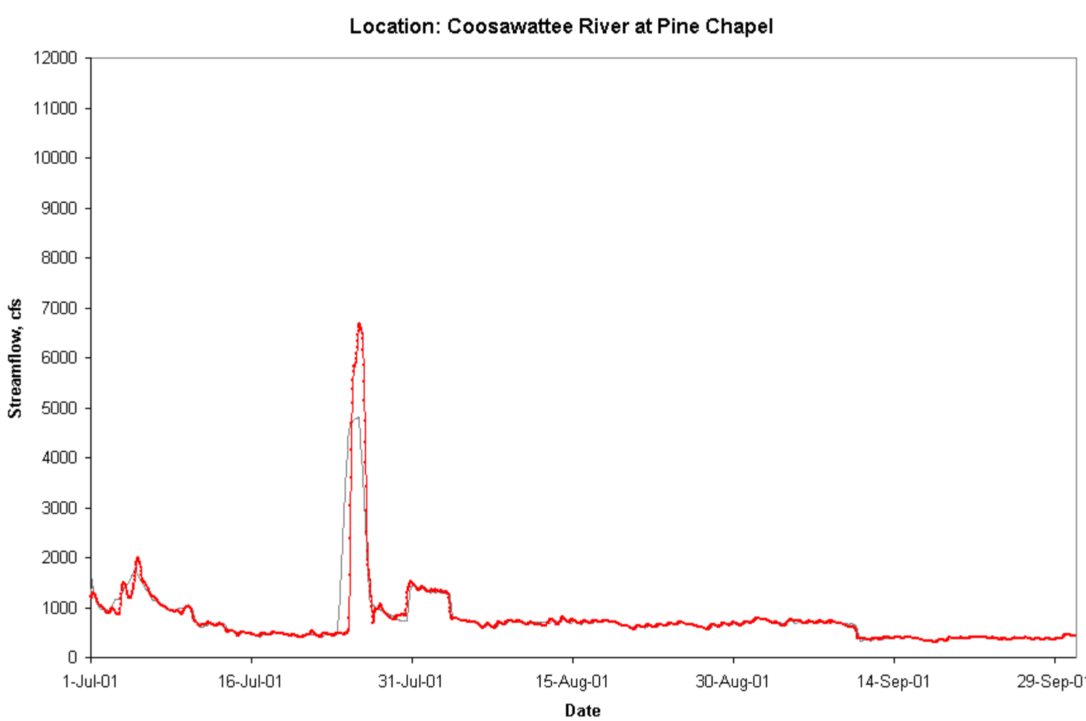
Model Calibration Plots

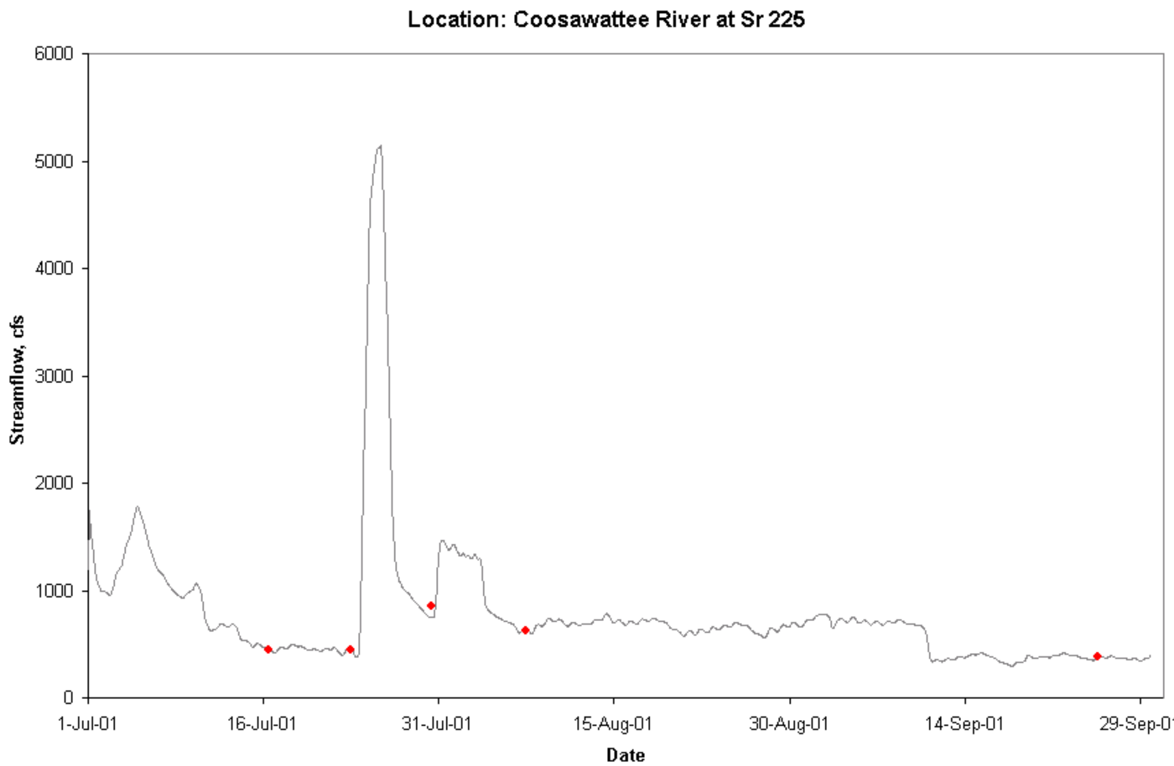
Flow Calibration – July through September 2001

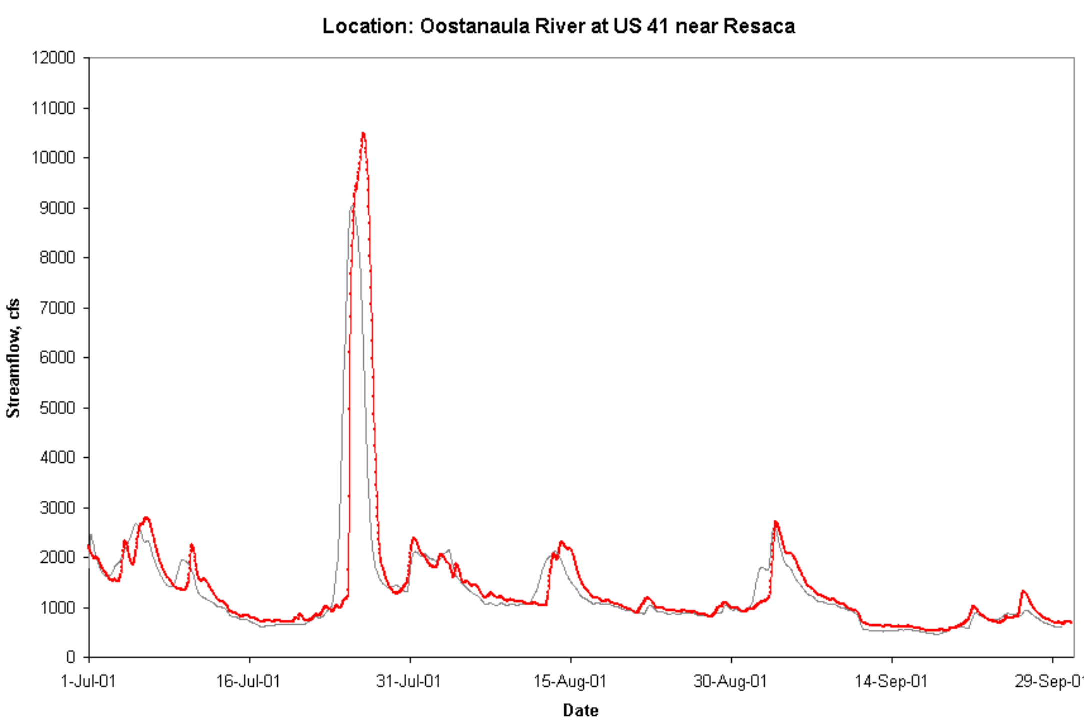


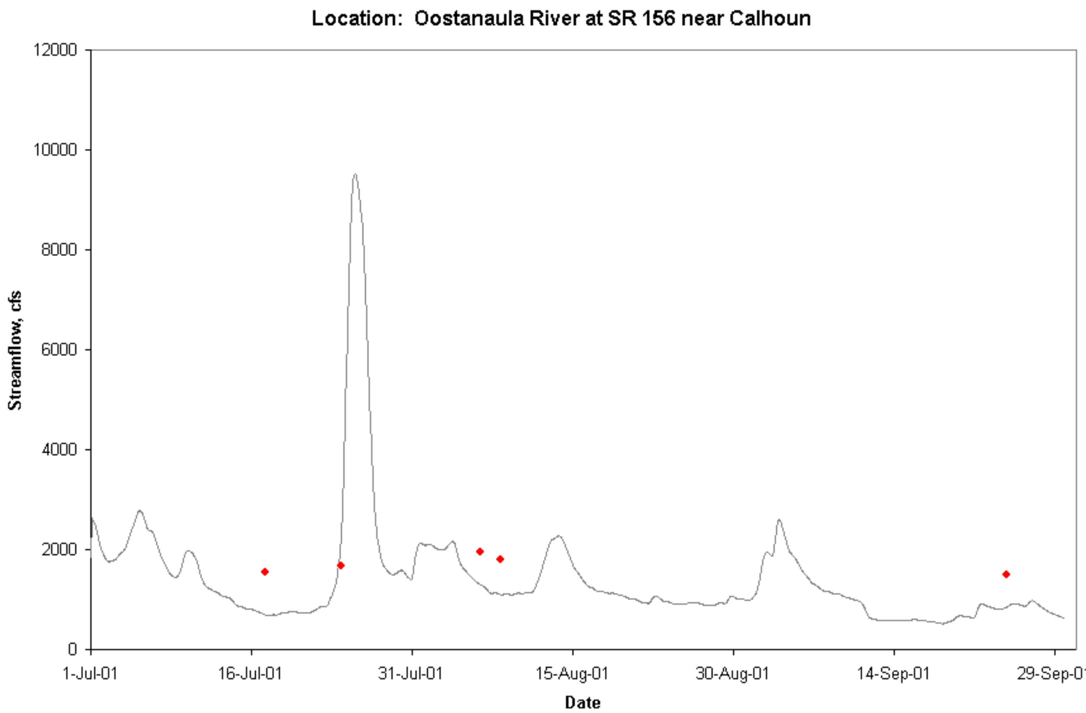


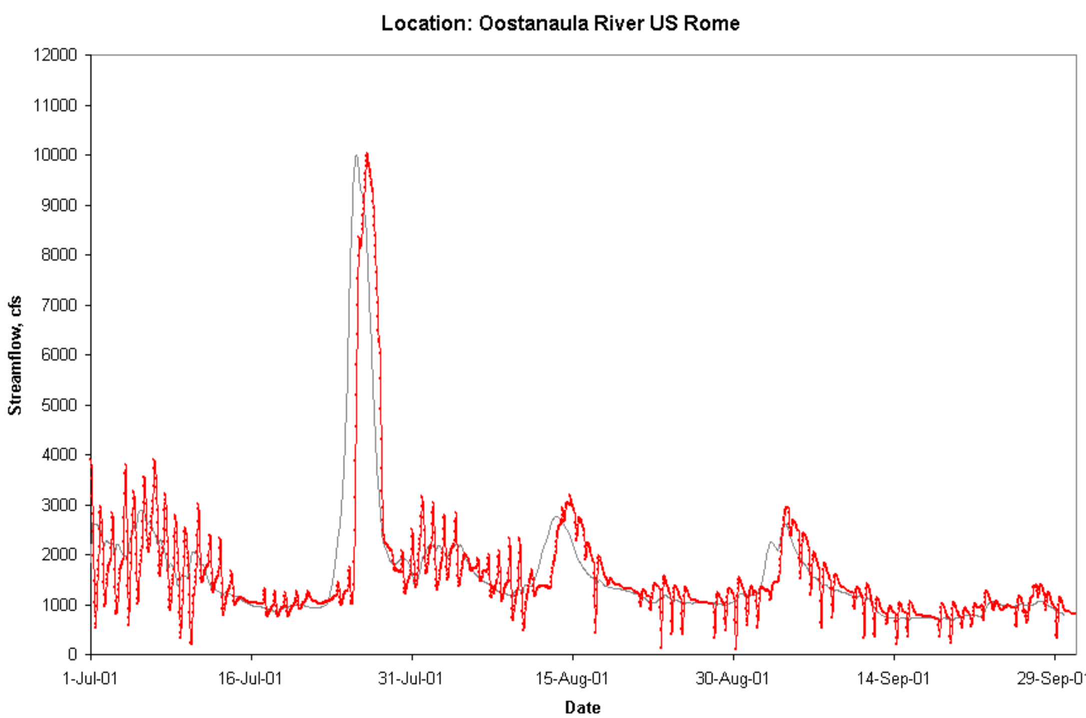

Location: Conasauga River at Sr 136 near Resaca
Streamflow, cfs
6000
5000
4000
3000
2000
1000
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

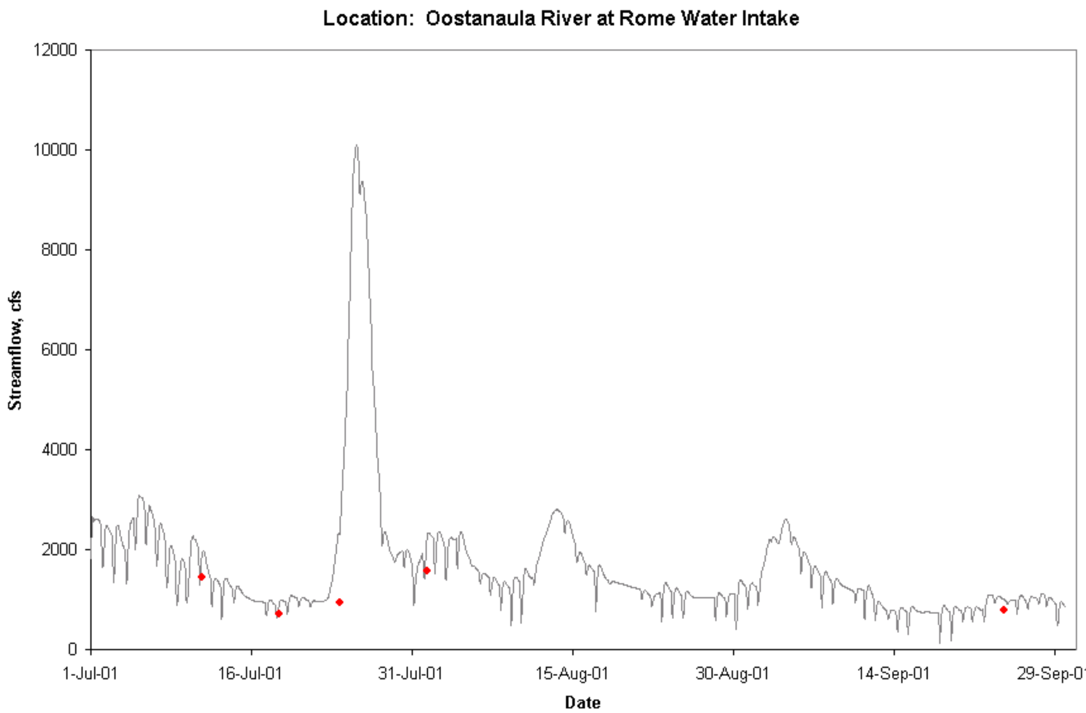

Location: Coosawattee River at Pine Chapel
Streamflow, cfs
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

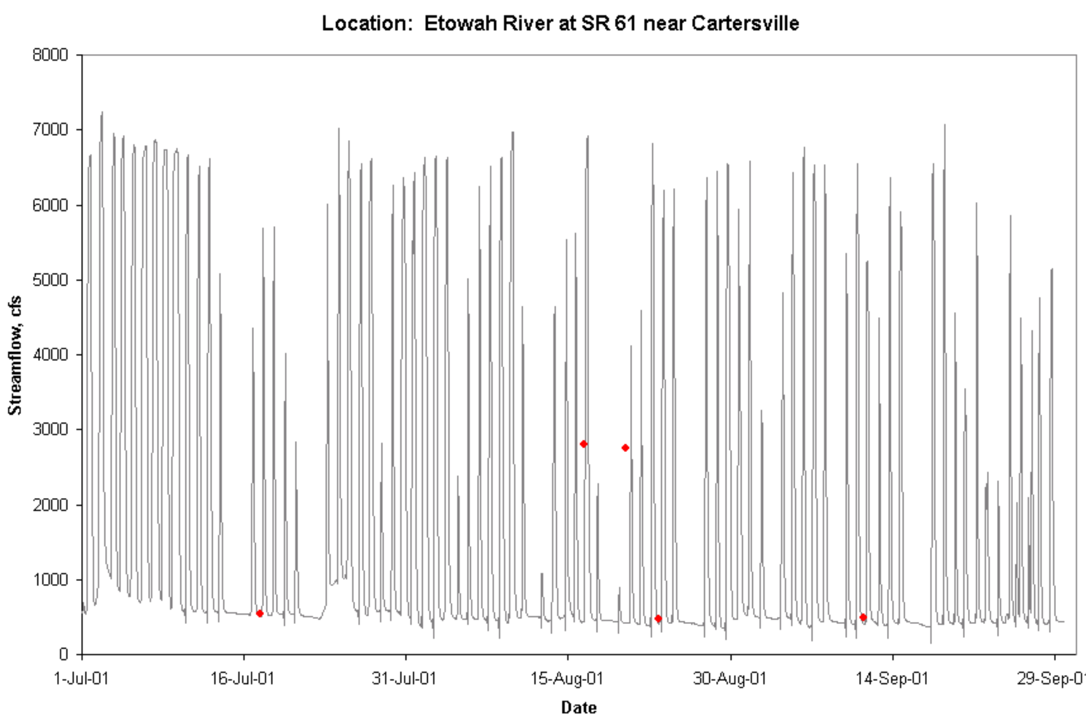

Location: Coosawattee River at Sr 225
Streamflow, cfs
6000
5000
4000
3000
2000
1000
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

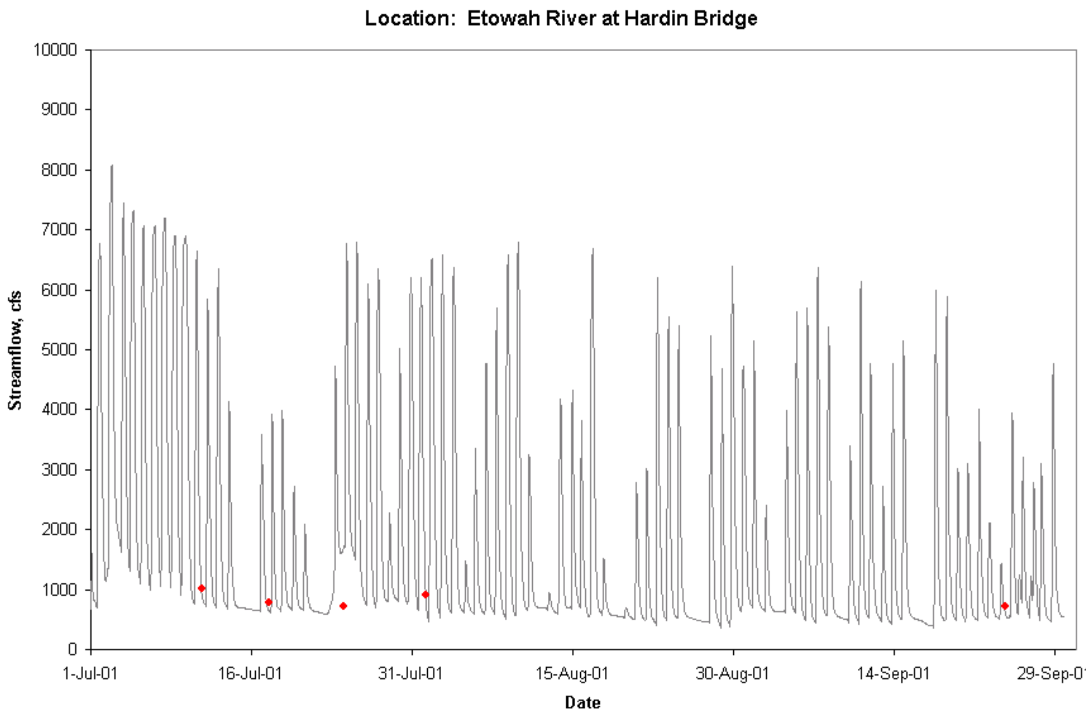

Location: Oostanaula River at US 41 near Resaca
Streamflow, cfs
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

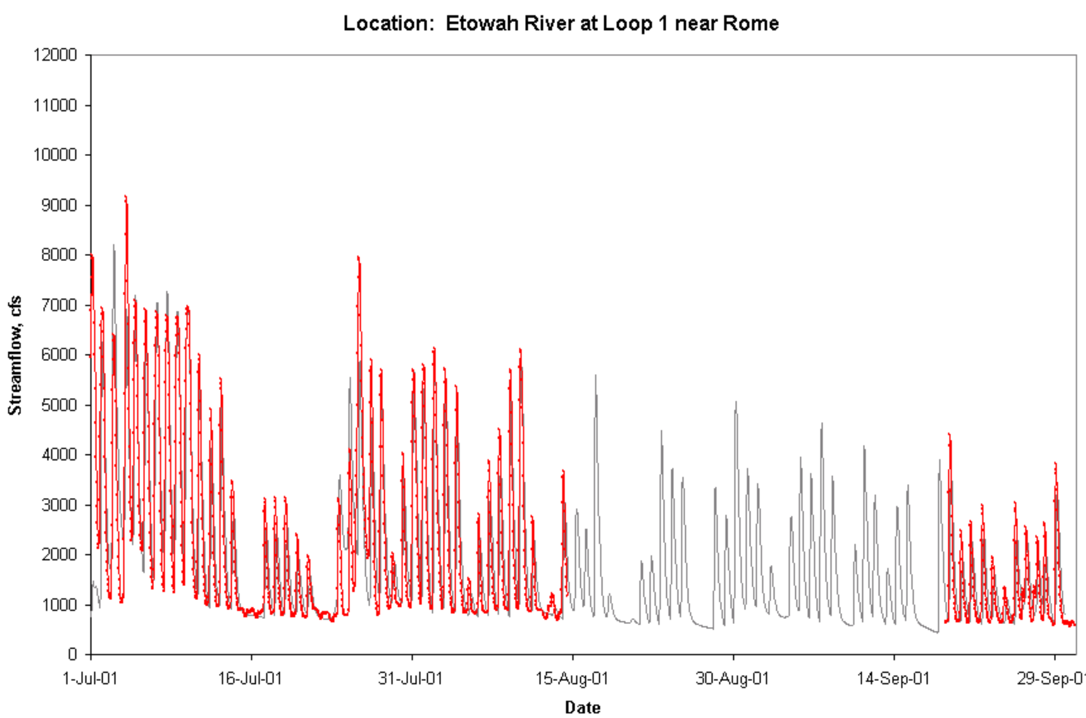

Location: Oostanaula River at SR 156 near Calhoun
Streamflow, cfs
12000
10000
8000
6000
4000
2000
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

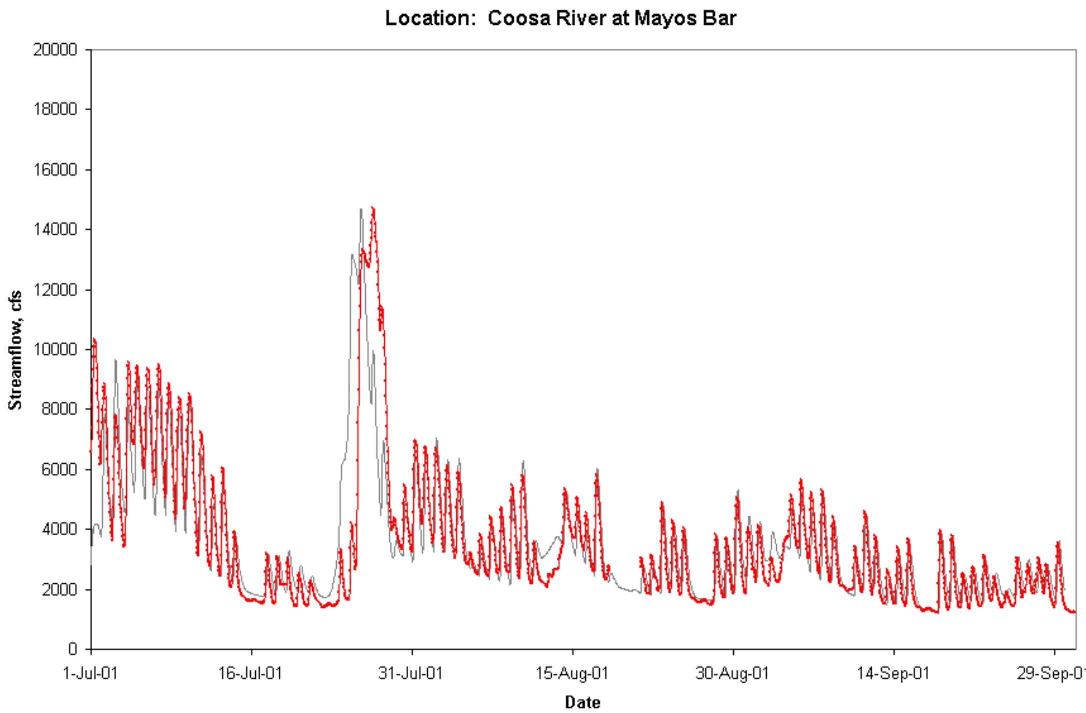

Location: Oostanaula River US Rome
Streamflow, cfs
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

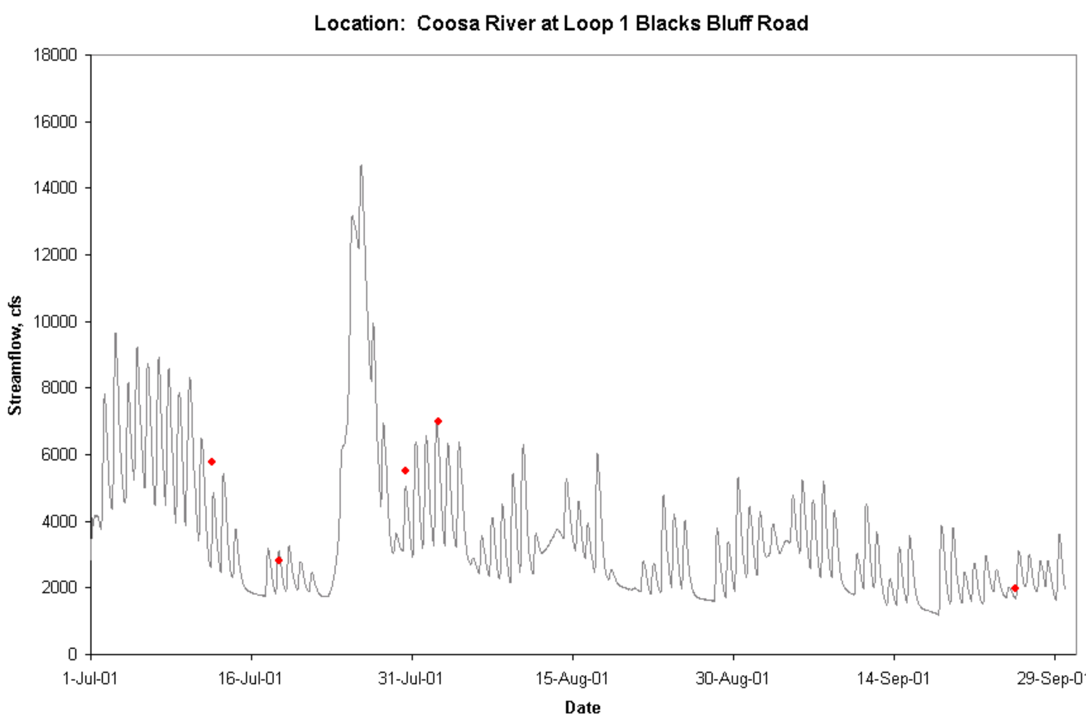

Location: Oostanaula River at Rome Water Intake
Streamflow, cfs
12000
10000
8000
6000
4000
2000
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Etowah River at SR 61 near Cartersville
Streamflow, cfs
8000
7000
6000
5000
4000
3000
2000
1000
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

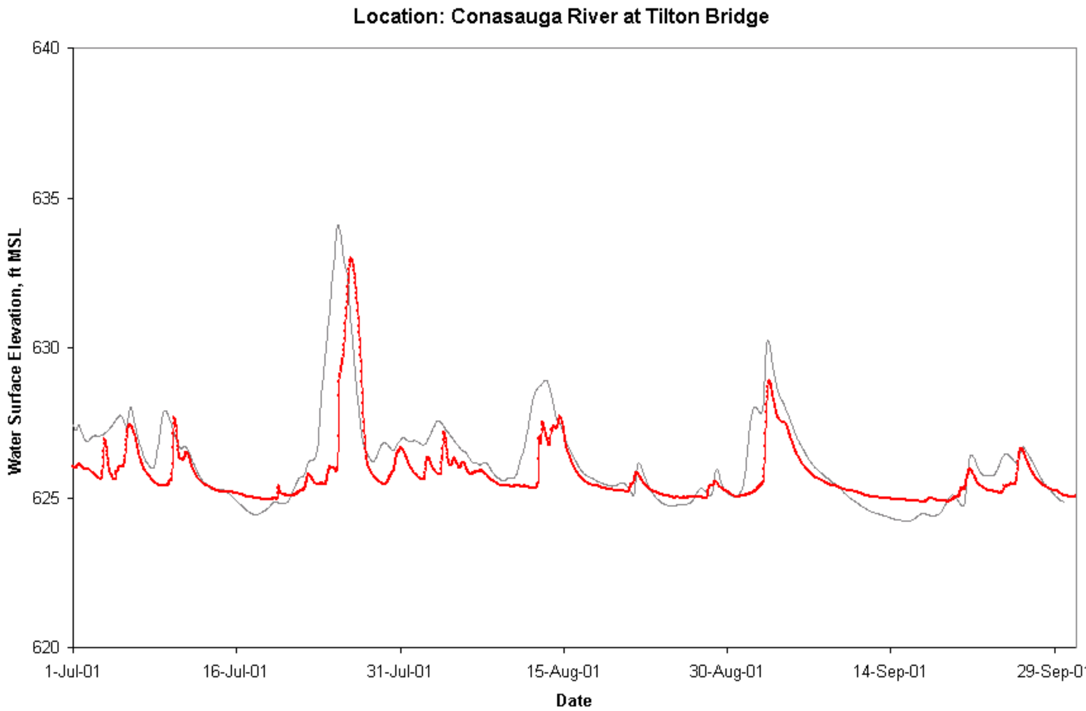

Location: Etowah River at Hardin Bridge
Streamflow, cfs
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

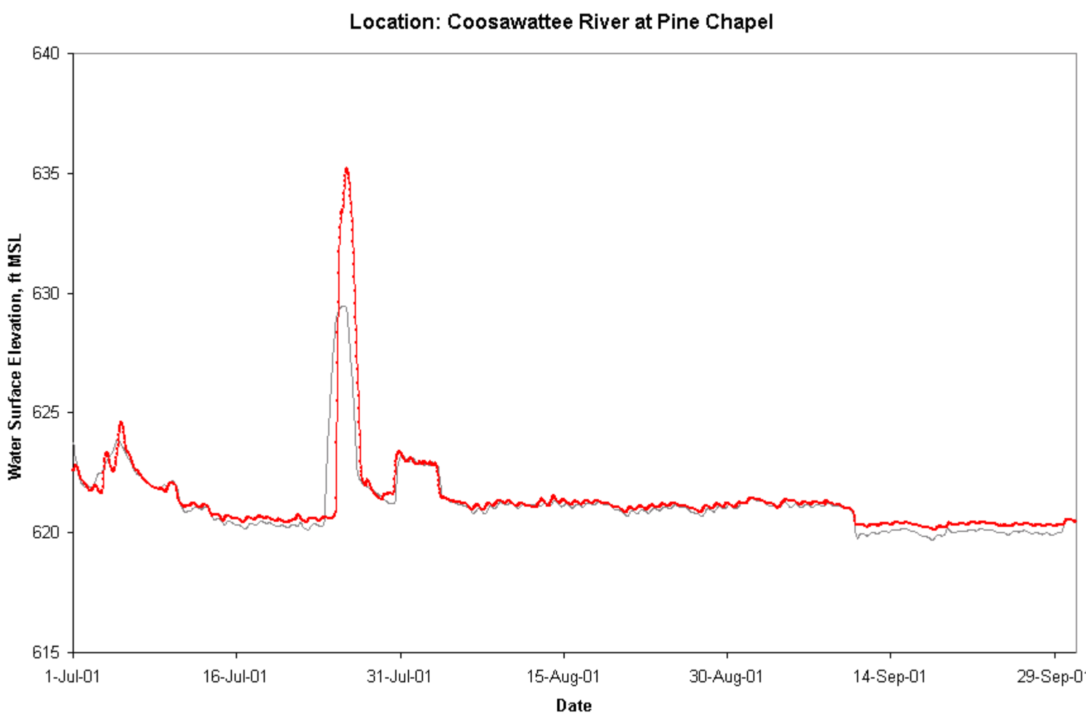

Location: Etowah River at Loop 1 near Rome
Streamflow, cfs
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

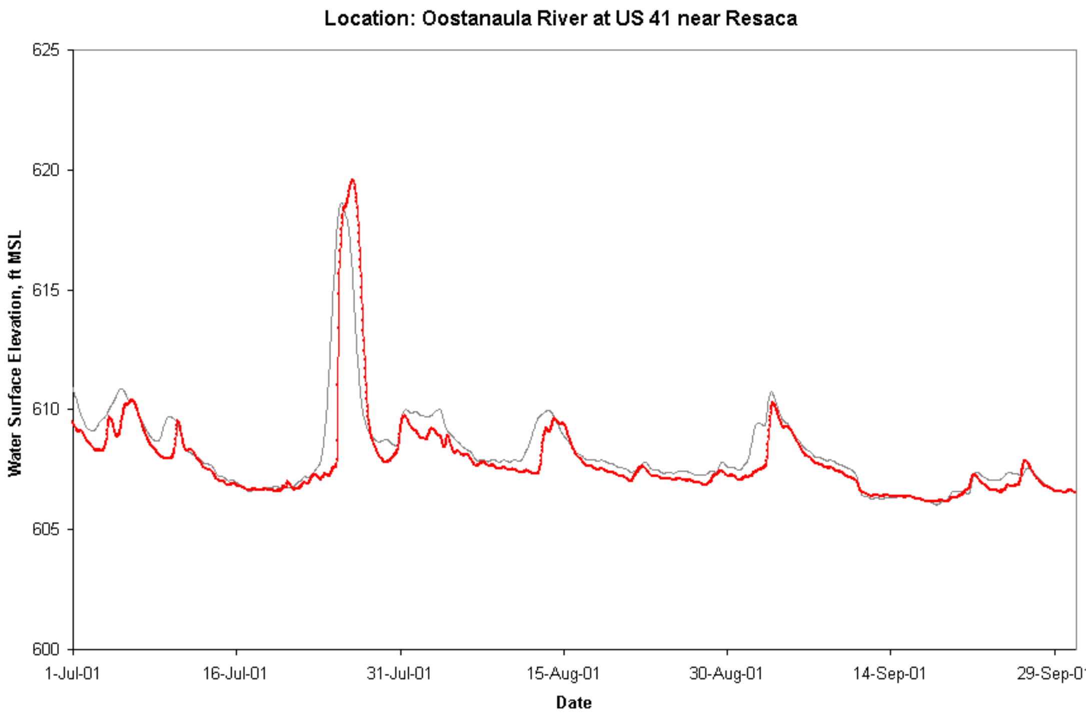

Location: Coosa River at Mayos Bar
Streamflow, cfs
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

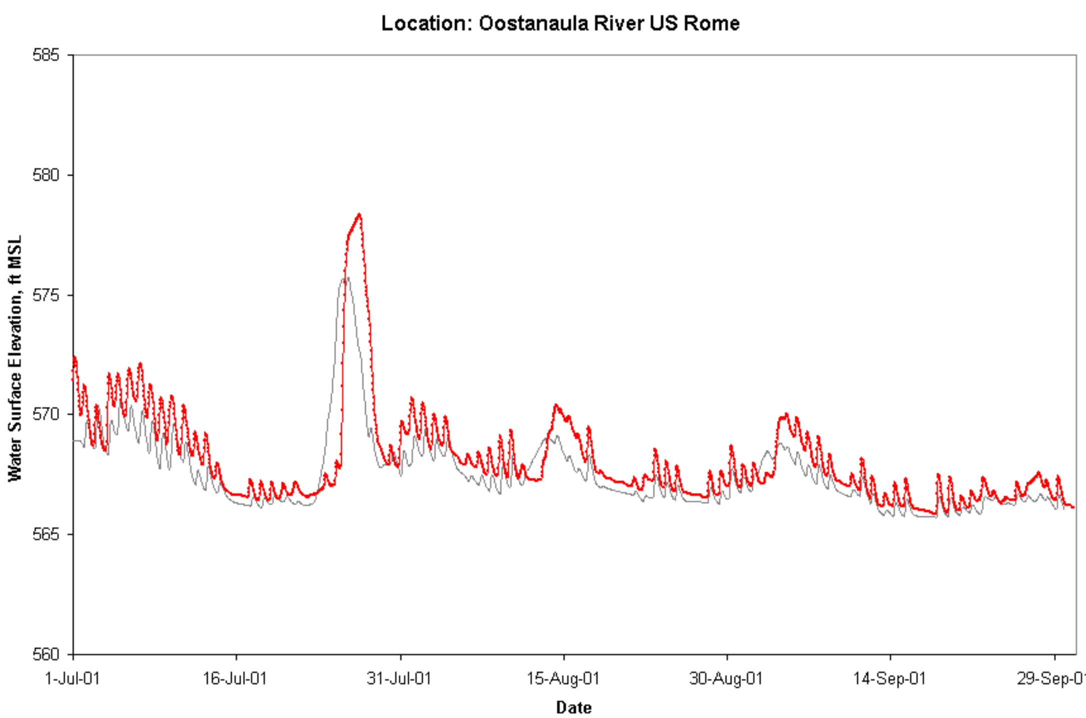

Location: Coosa River at Loop 1 Blacks Bluff Road
Streamflow, cfs
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

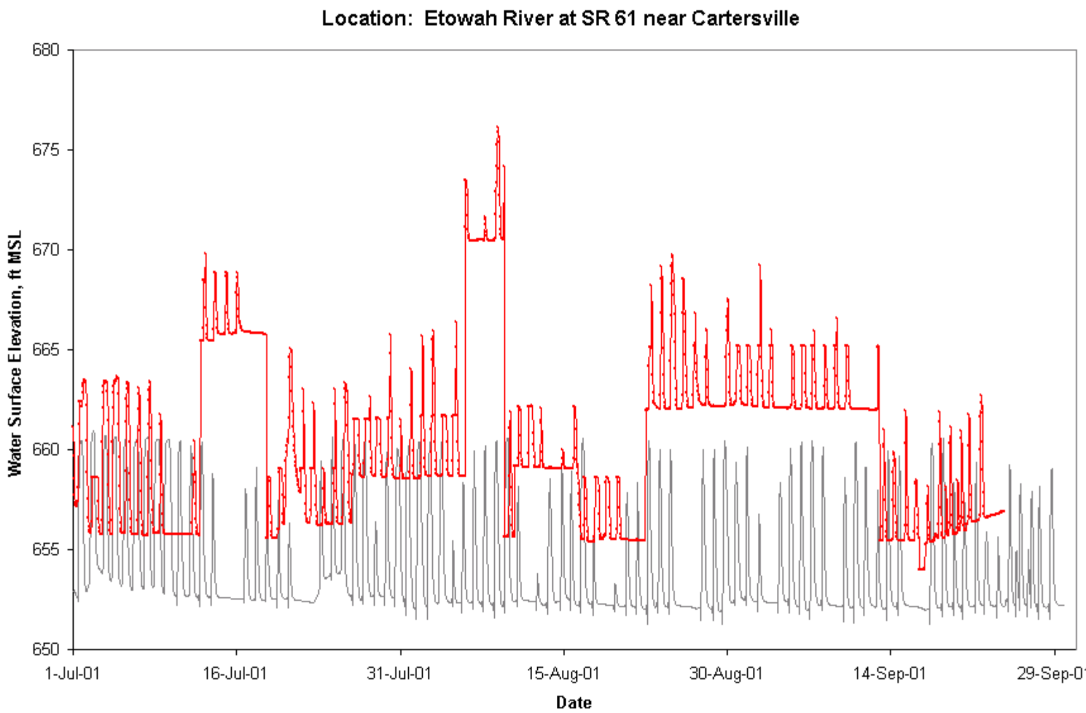
Stage Calibration – July through September 2001

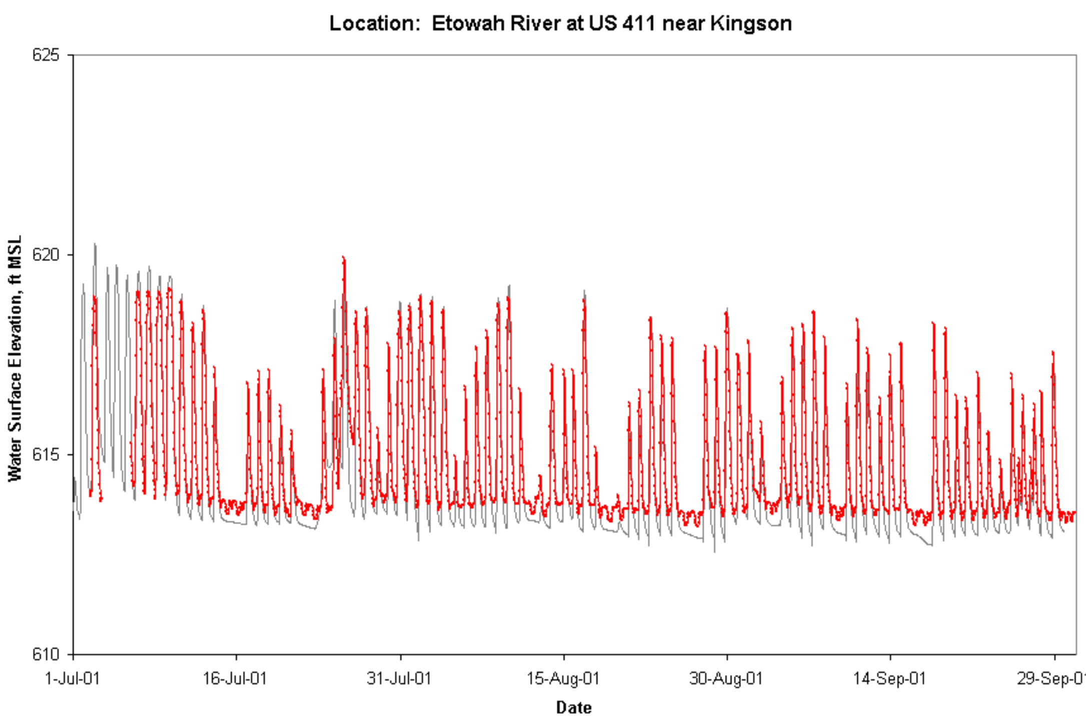


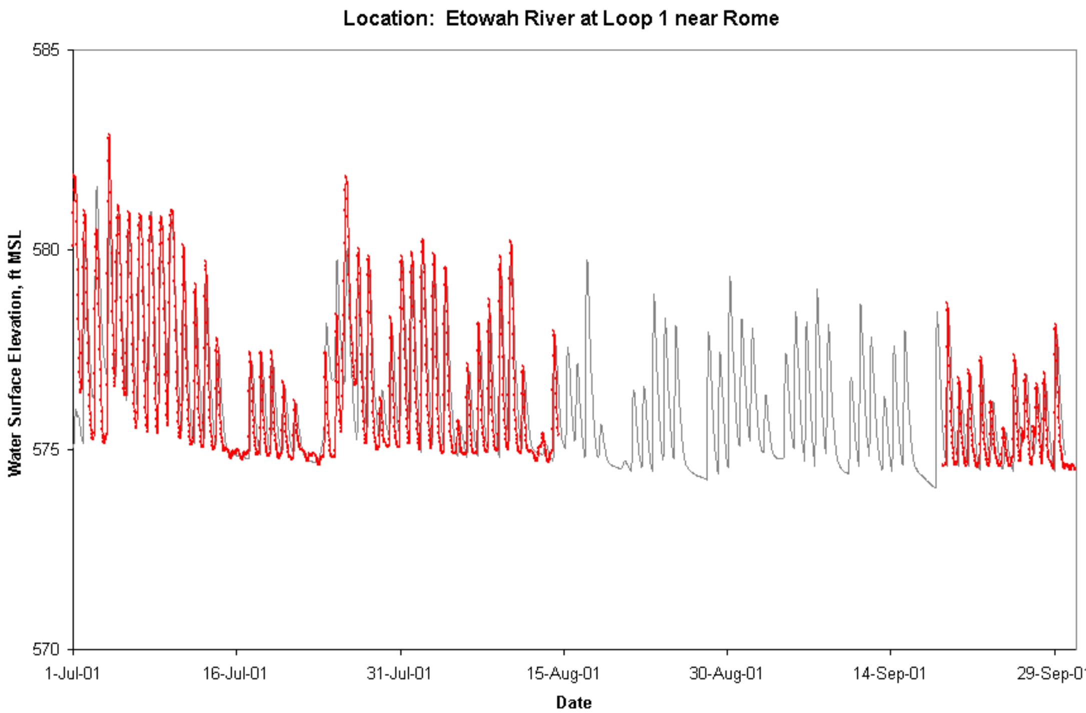


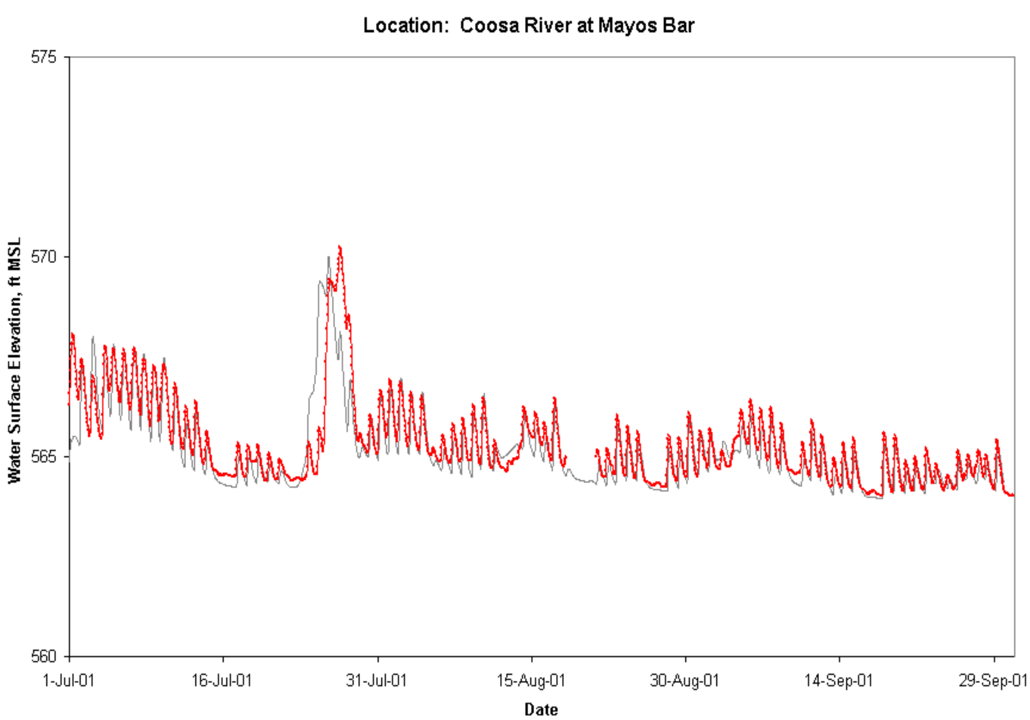

Location: Oostanaula River at US 41 near Resaca
Water Surface Elevation, ft MSL
625
620
615
610
605
600
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Oostanaula River US Rome
Water Surface Elevation, ft MSL
585
580
575
570
565
560
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

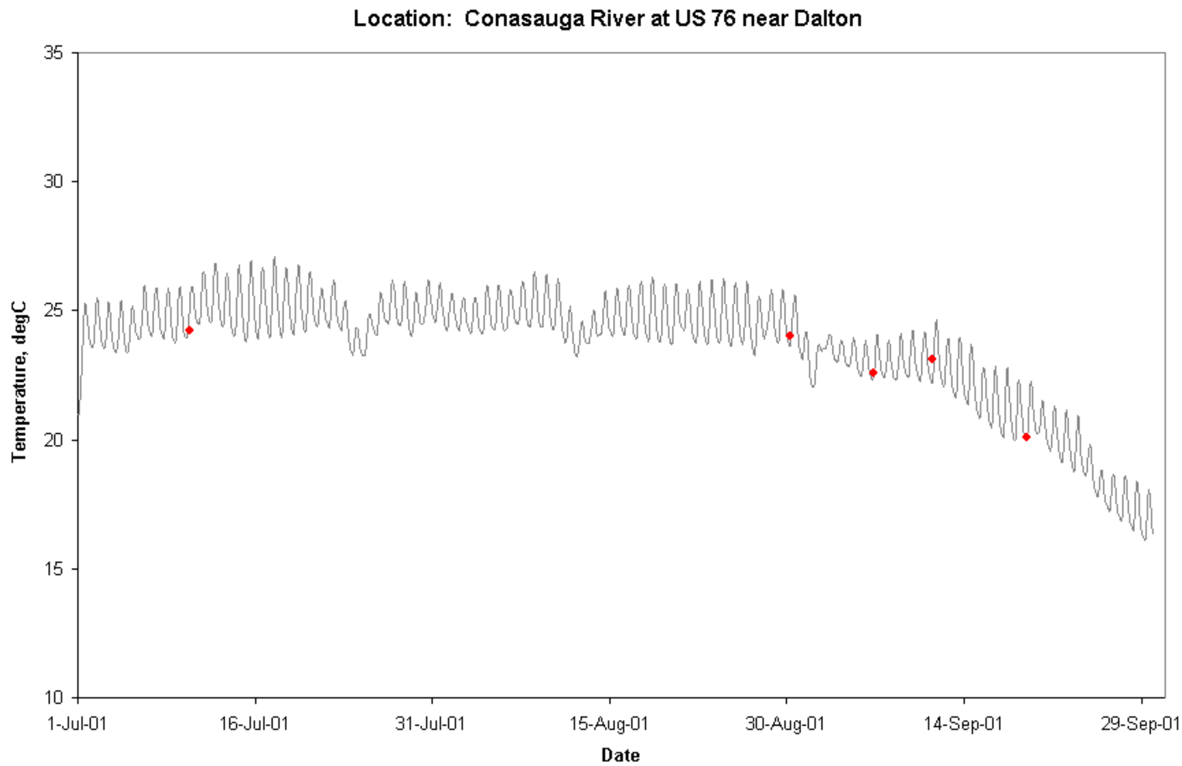

Location: Etowah River at SR 61 near Cartersville
680
675
670
665
660
655
650
Water Surface Elevation, ft MSL
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

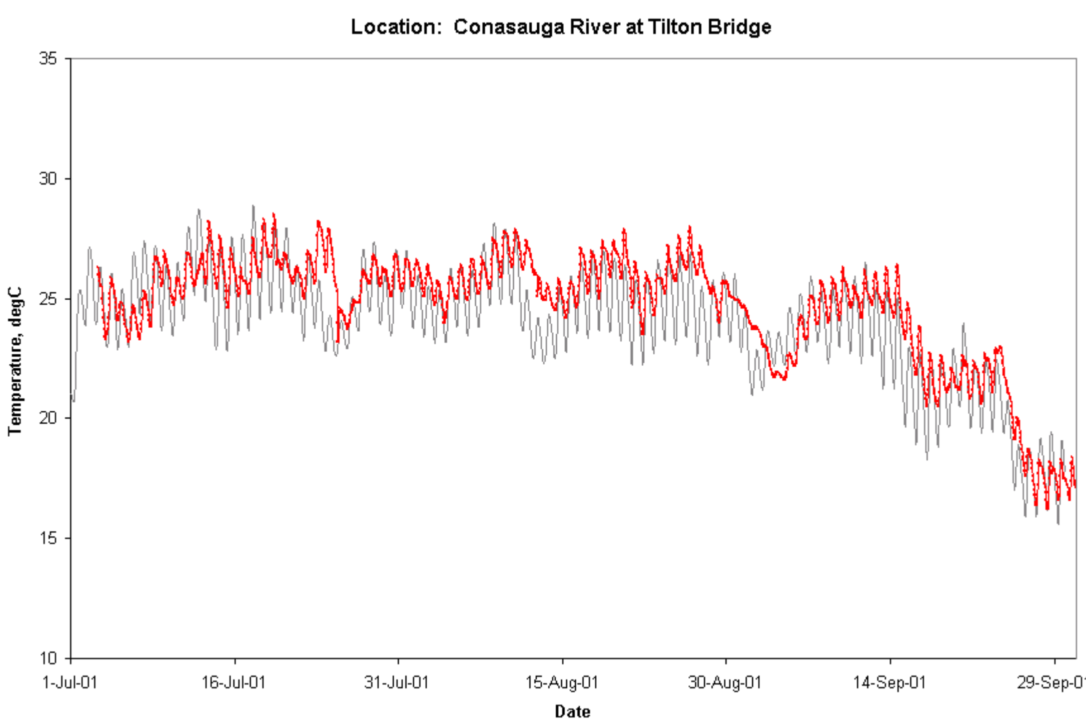

Location: Etowah River at US 411 near Kingson
625
620
615
610
Water Surface Elevation, ft MSL
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

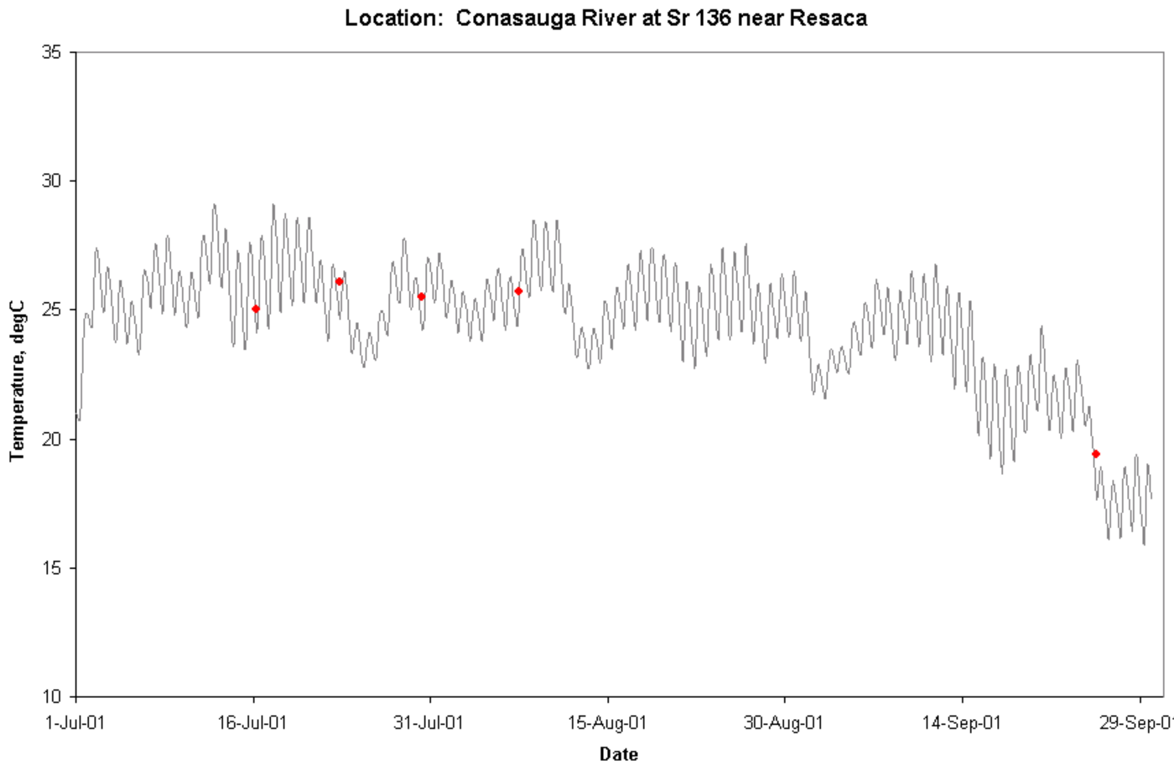

Location: Etowah River at Loop 1 near Rome
585
580
575
570
Water Surface Elevation, ft MSL
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

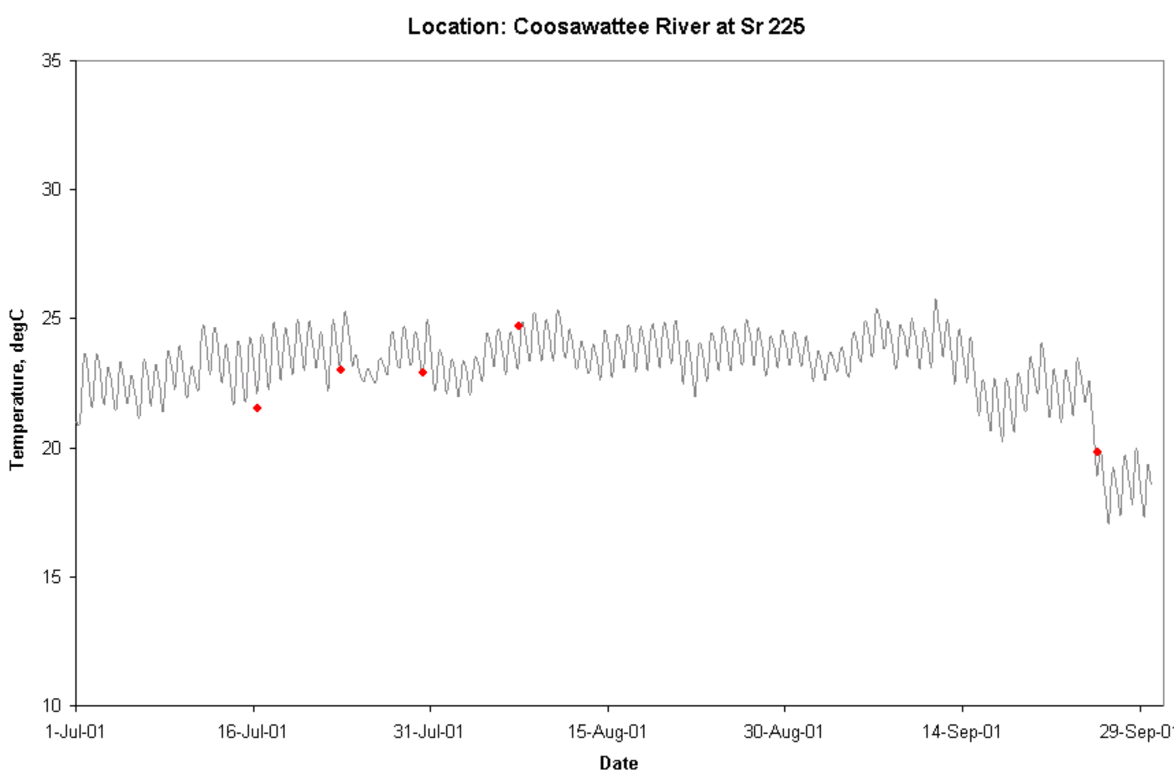

Location: Coosa River at Mayos Bar
575
570
565
560
Water Surface Elevation, ft MSL
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

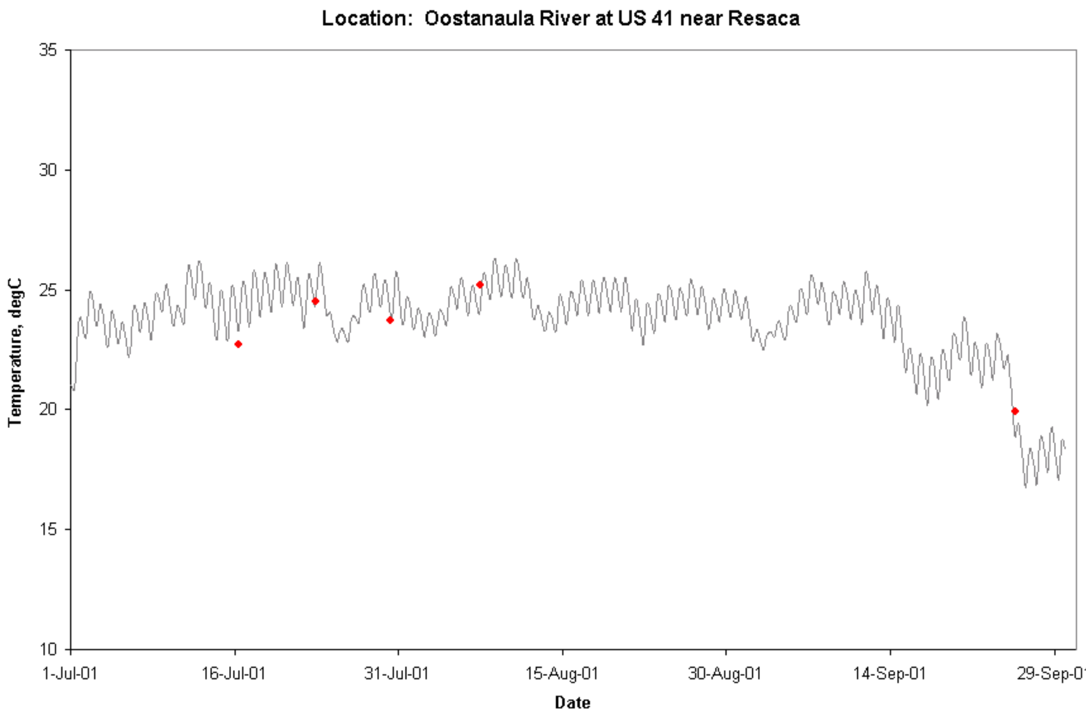
Temperature Calibration – July through September 2001

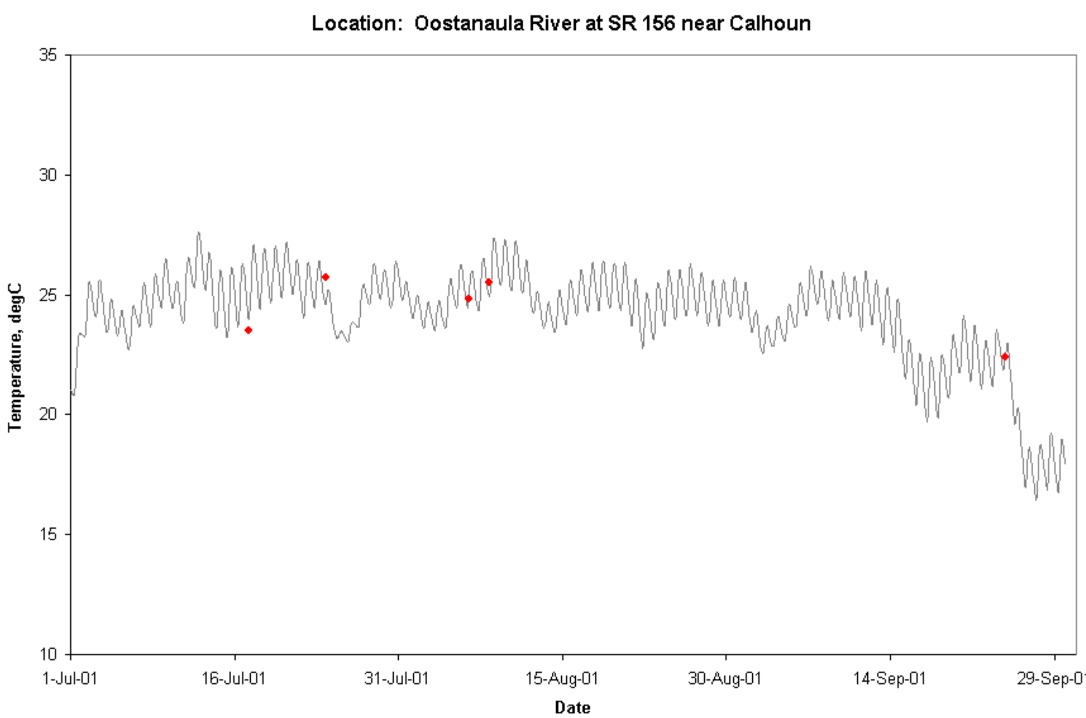


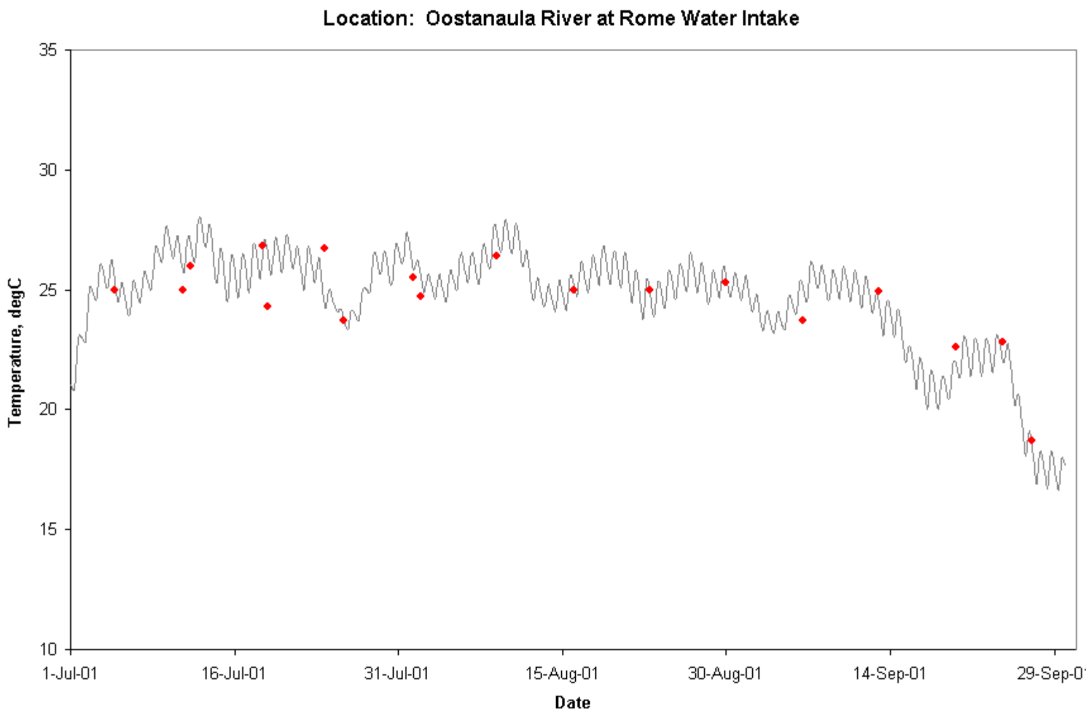


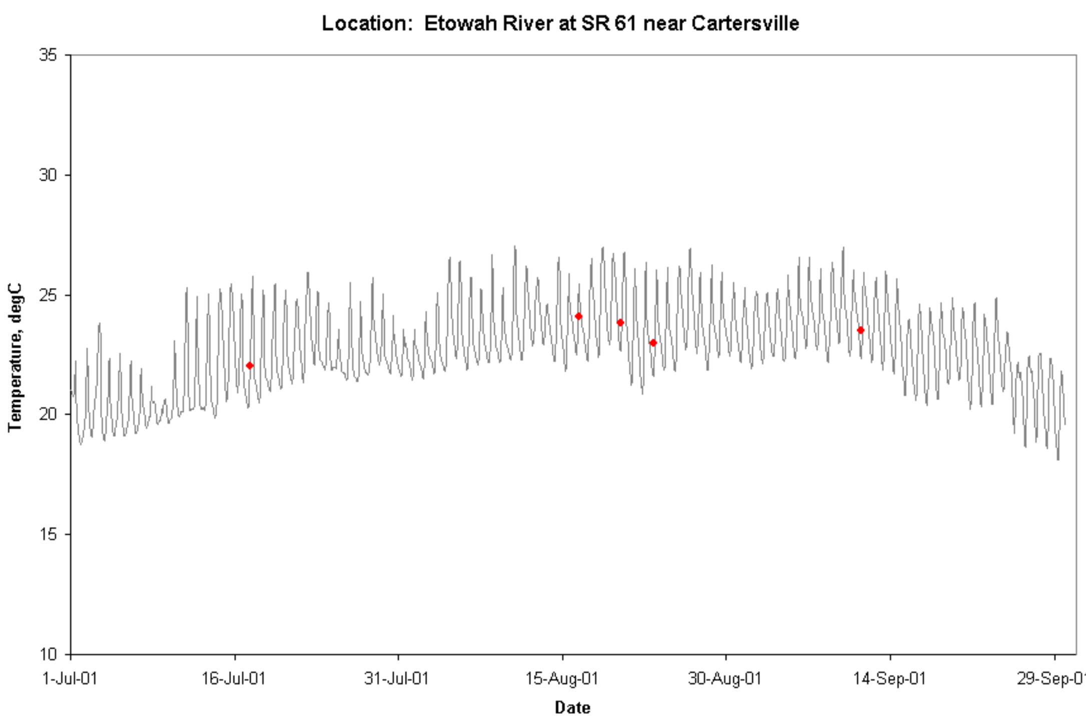

Location: Conasauga River at Sr 136 near Resaca
35
30
25
20
15
10
Temperature, degC
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

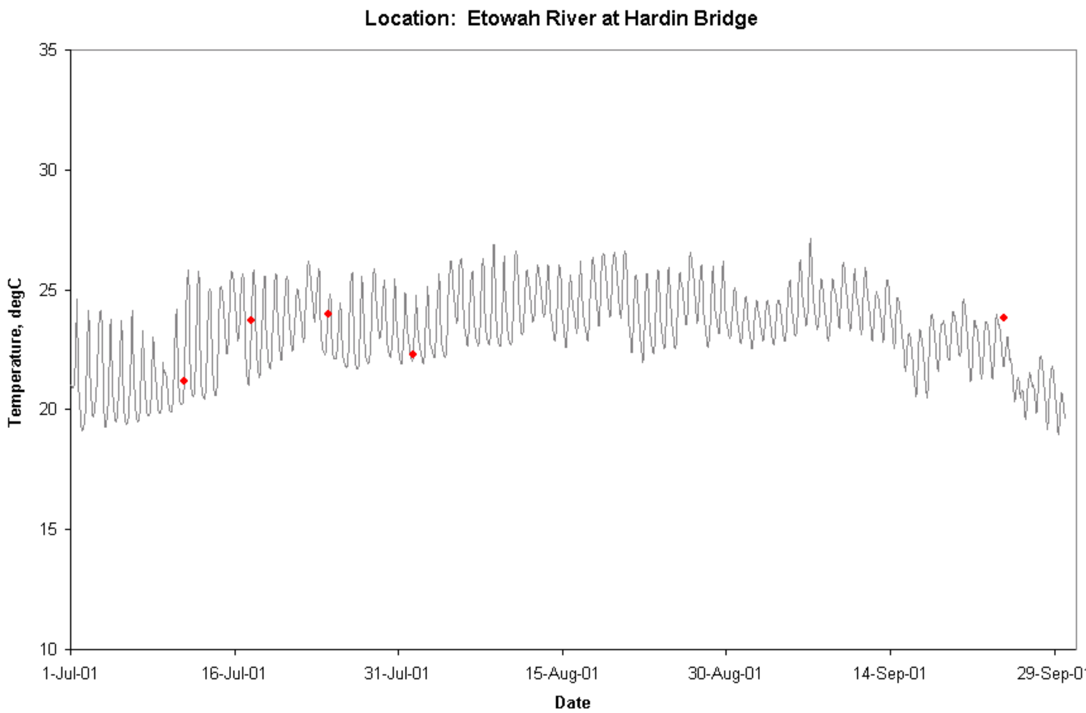

Location: Coosawattee River at Sr 225
35
30
25
20
15
10
Temperature, degC
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

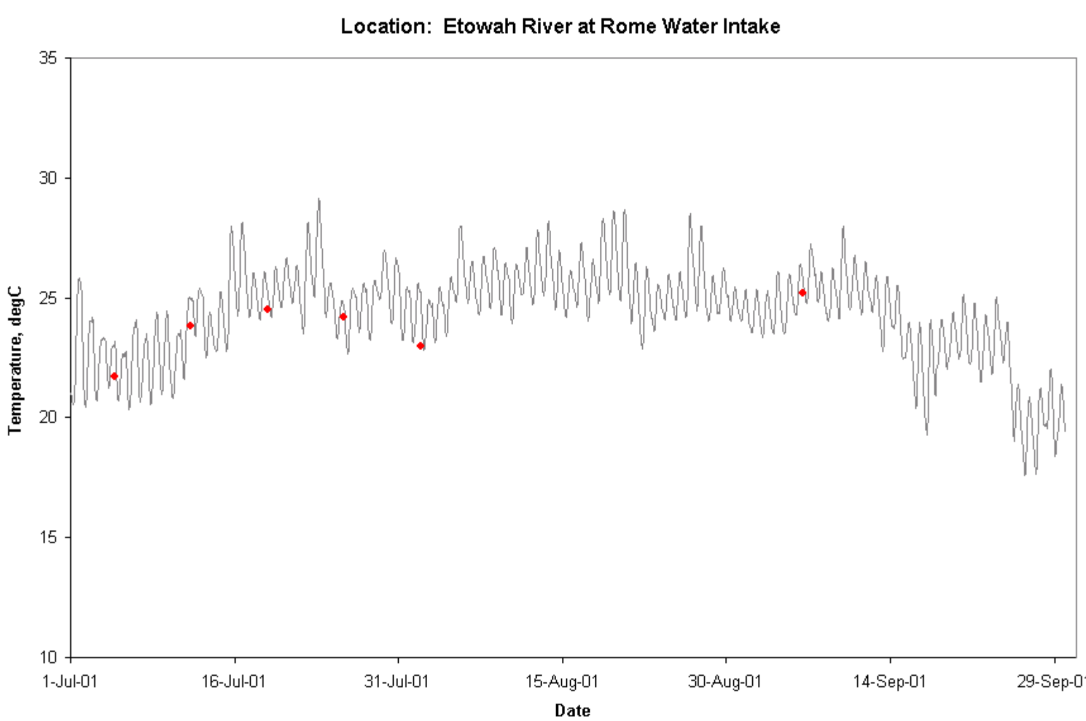

Location: Oostanaula River at US 41 near Resaca
35
30
25
20
15
10
Temperature, degC
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

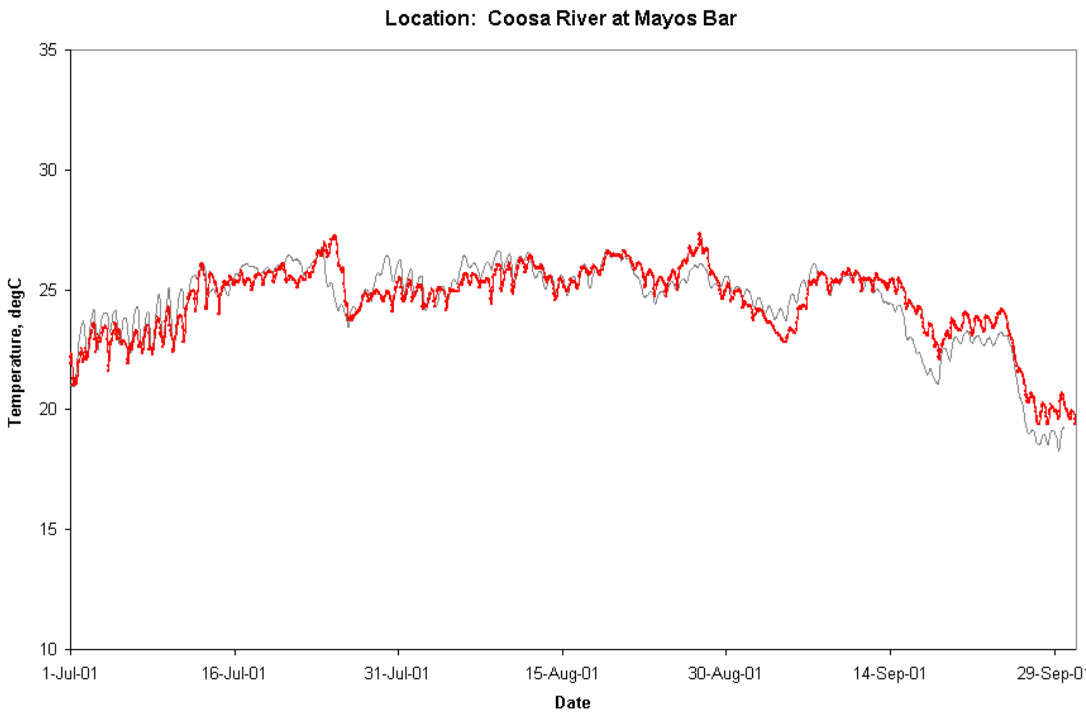

Location: Oostanaula River at SR 156 near Calhoun
35
30
25
20
15
10
Temperature, degC
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

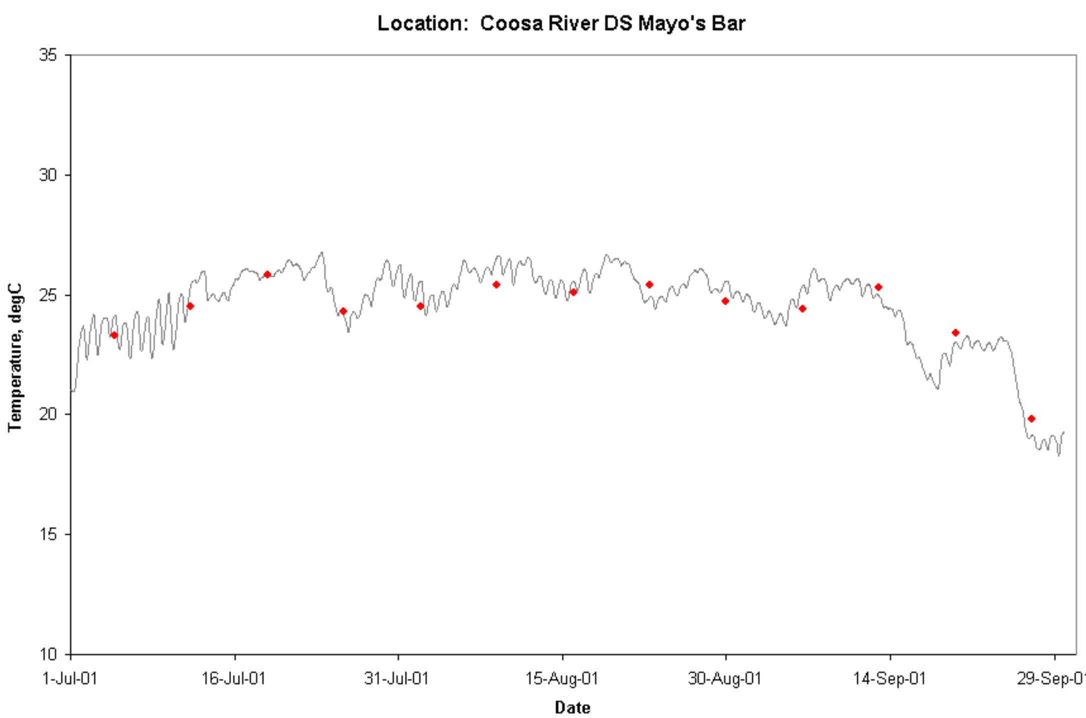

Location: Oostanaula River at Rome Water Intake
Temperature, degC
35
30
25
20
15
10
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

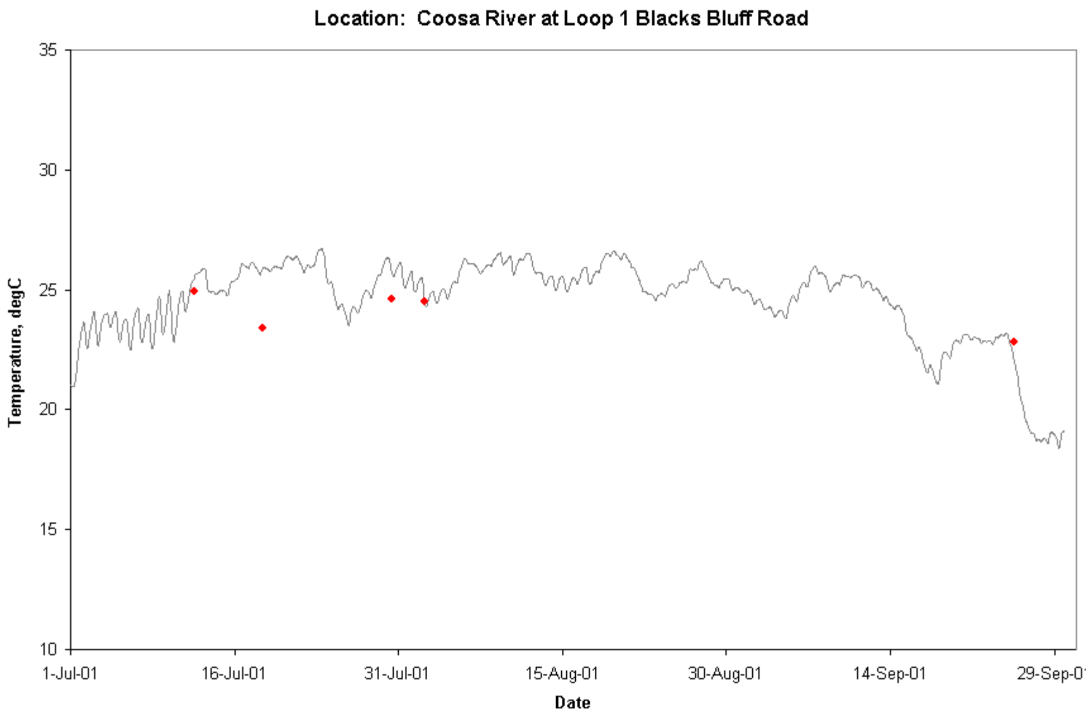

Location: Etowah River at SR 61 near Cartersville
Temperature, degC
35
30
25
20
15
10
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

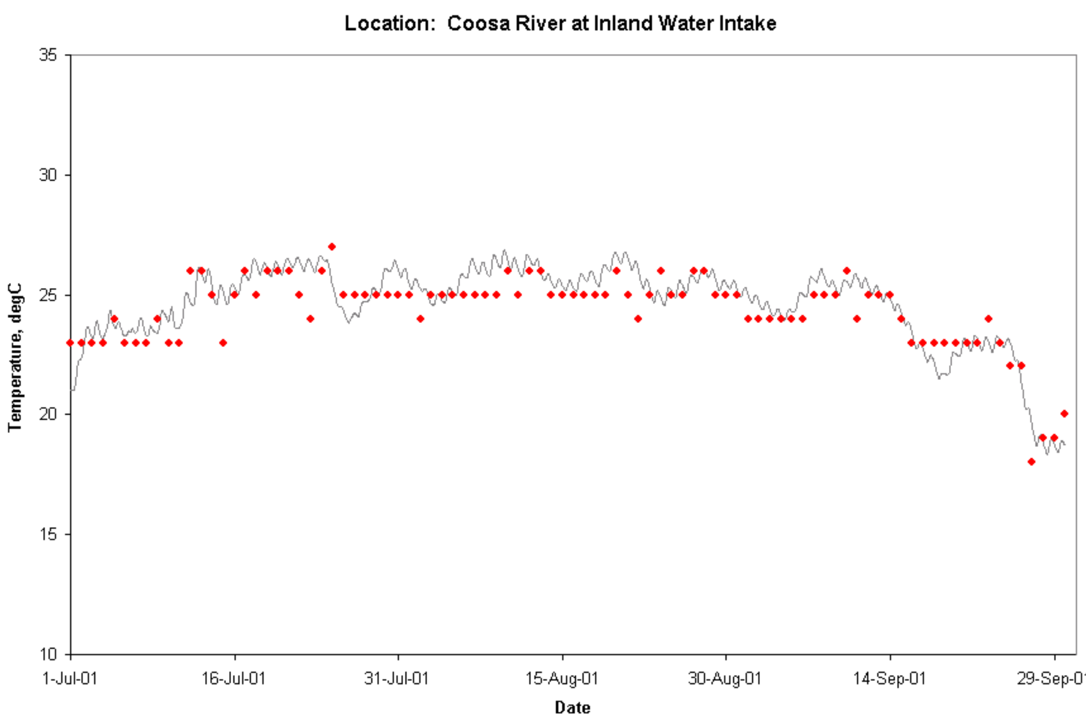

Location: Etowah River at Hardin Bridge
35
30
25
20
15
10
Temperature, degC
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

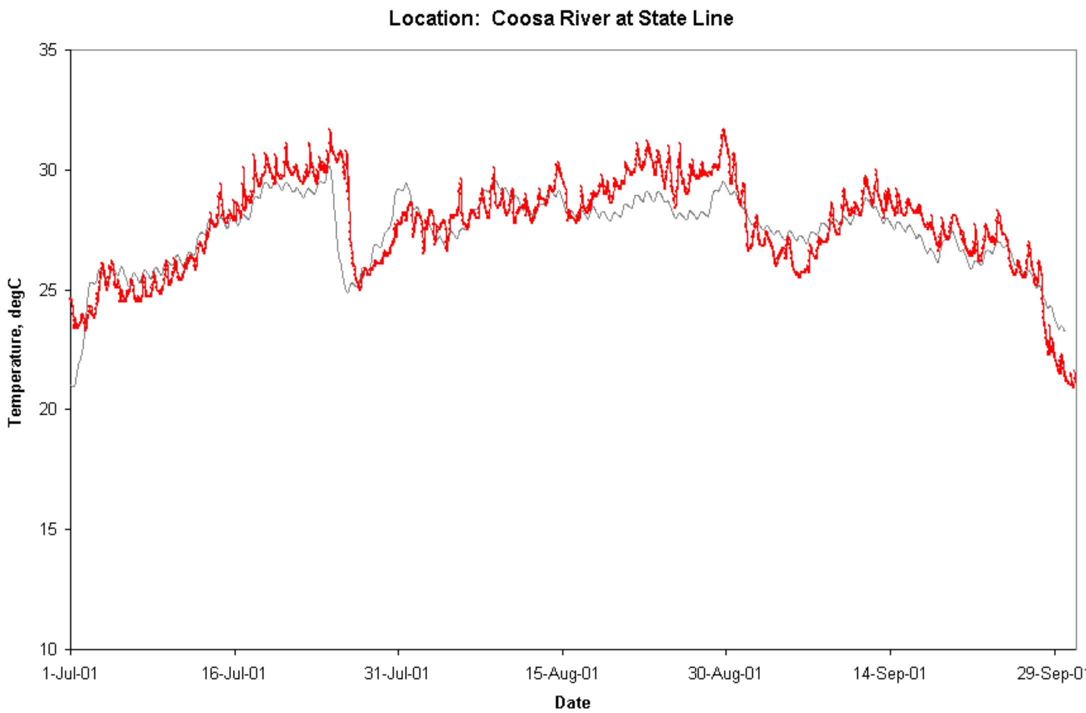

Location: Etowah River at Rome Water Intake
35
30
25
20
15
10
Temperature, degC
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Coosa River at Mayos Bar
Temperature, degC
35
30
25
20
15
10
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

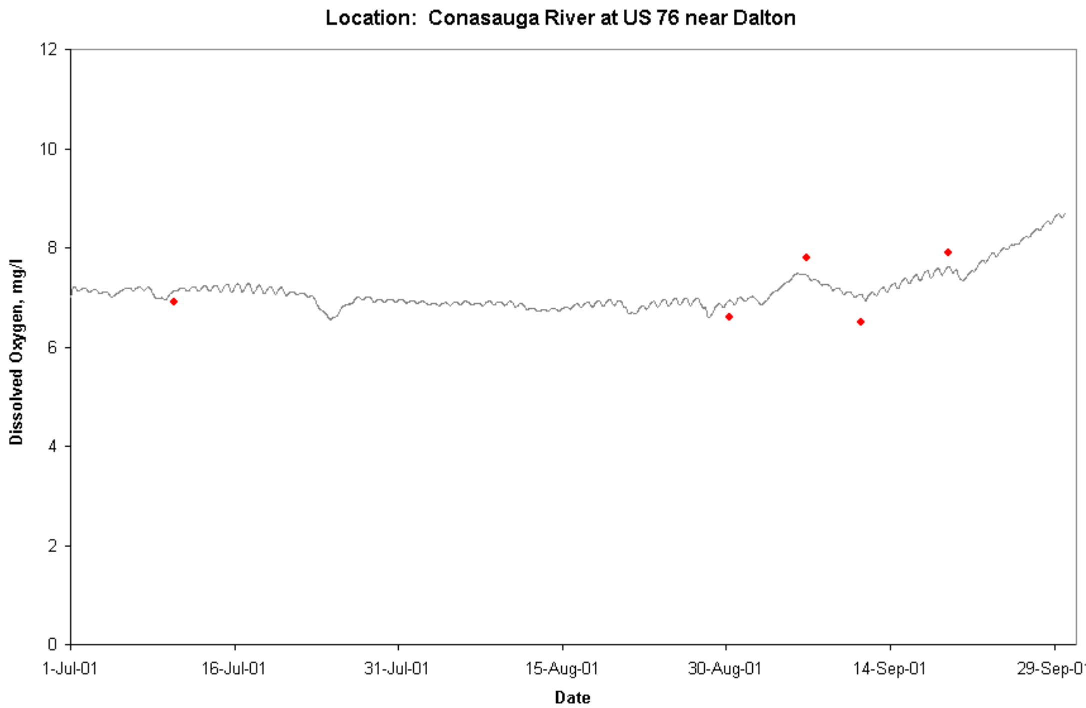

Location: Coosa River DS Mayo's Bar
Temperature, degC
35
30
25
20
15
10
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

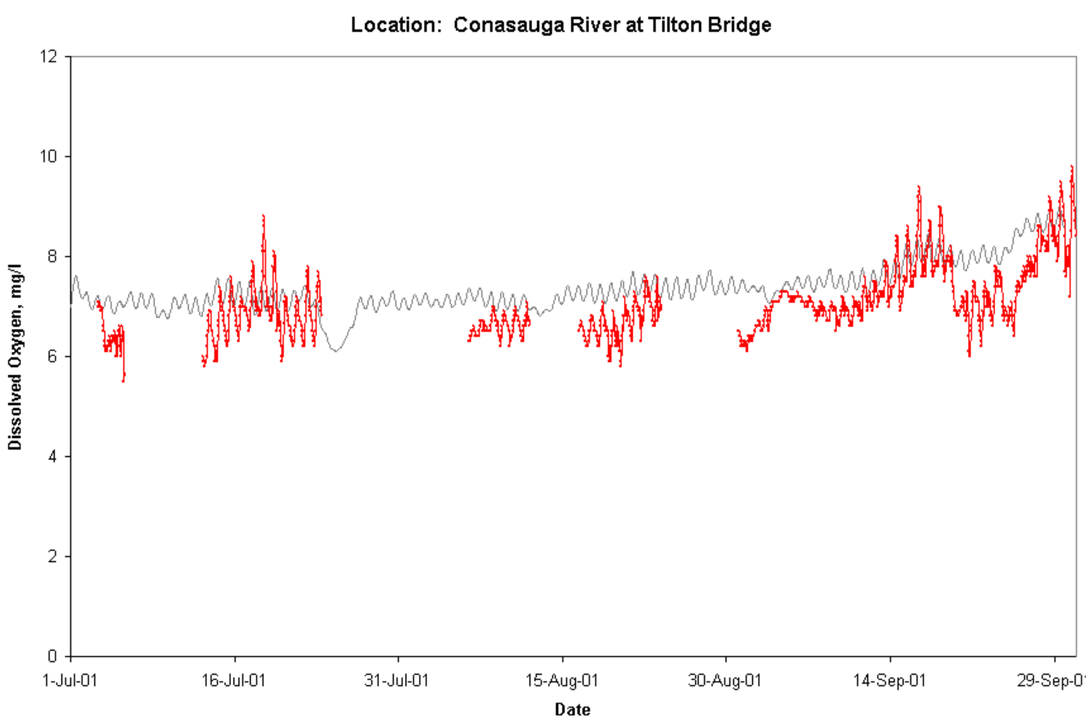

Location: Coosa River at Loop 1 Blacks Bluff Road
Temperature, degC
35
30
25
20
15
10
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

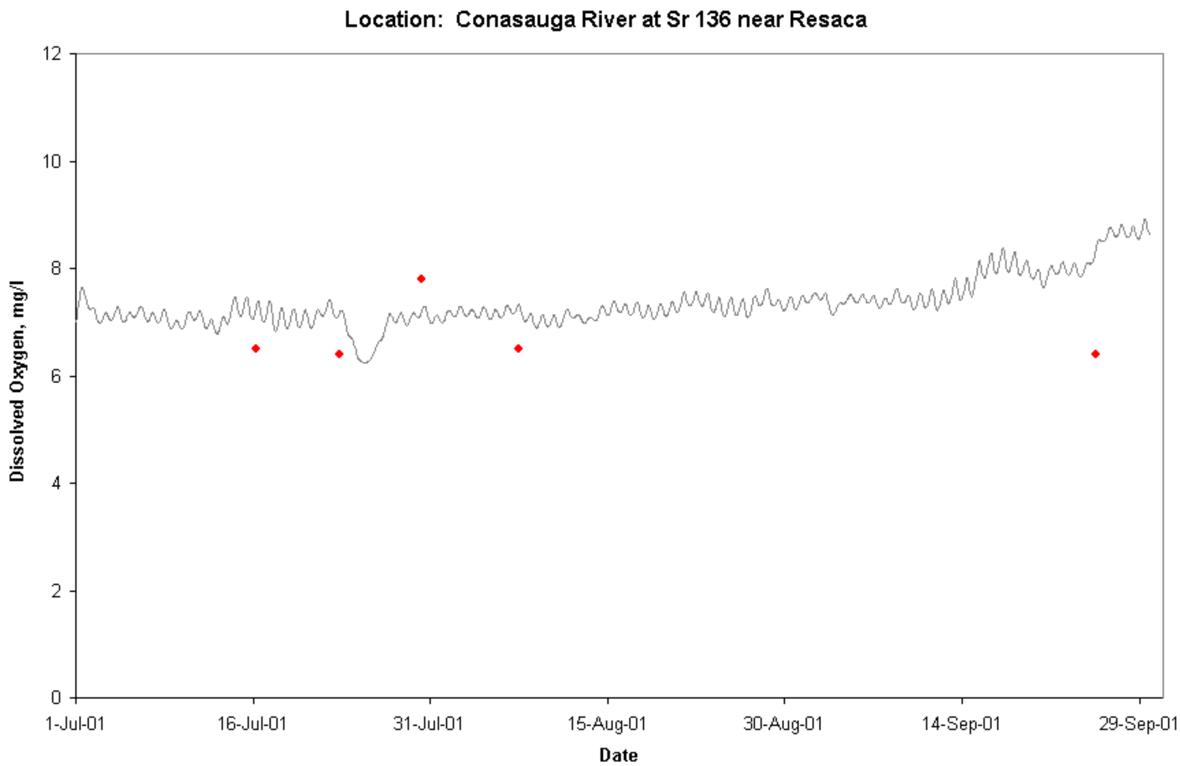

Location: Coosa River at Inland Water Intake
Temperature, degC
35
30
25
20
15
10
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

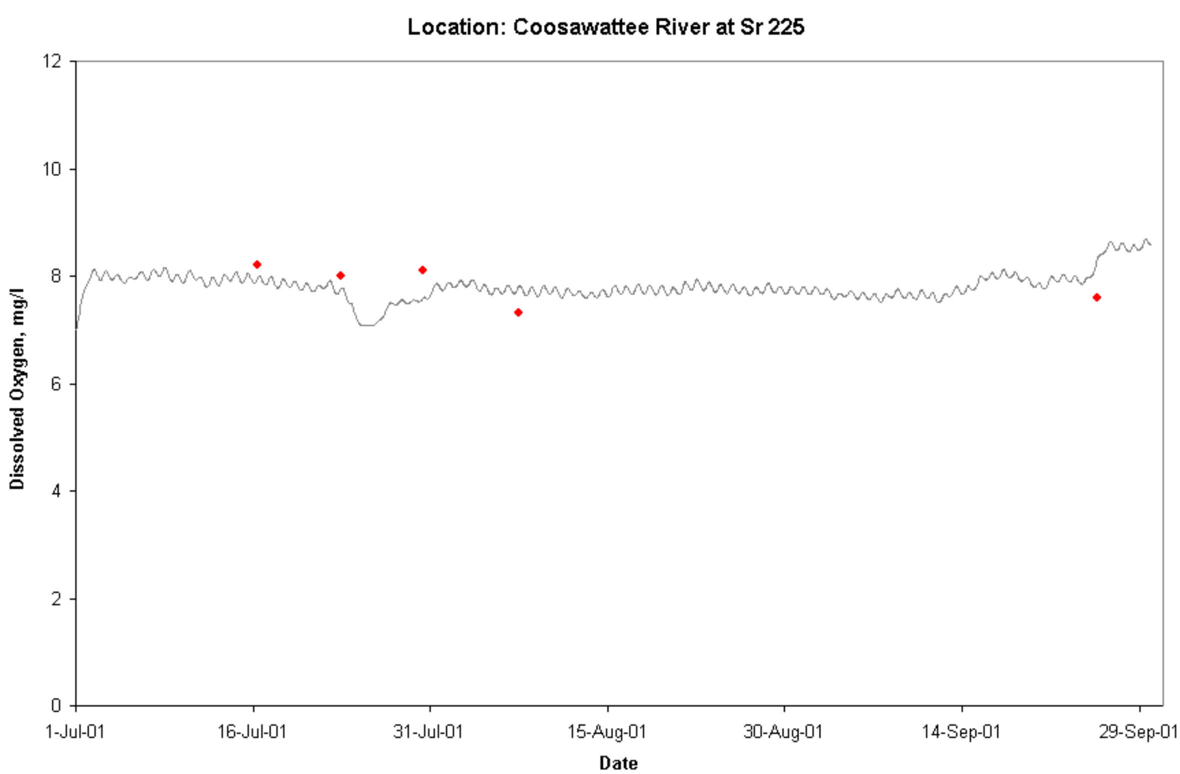

Location: Coosa River at State Line
35
30
25
20
15
10
Temperature, degC
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

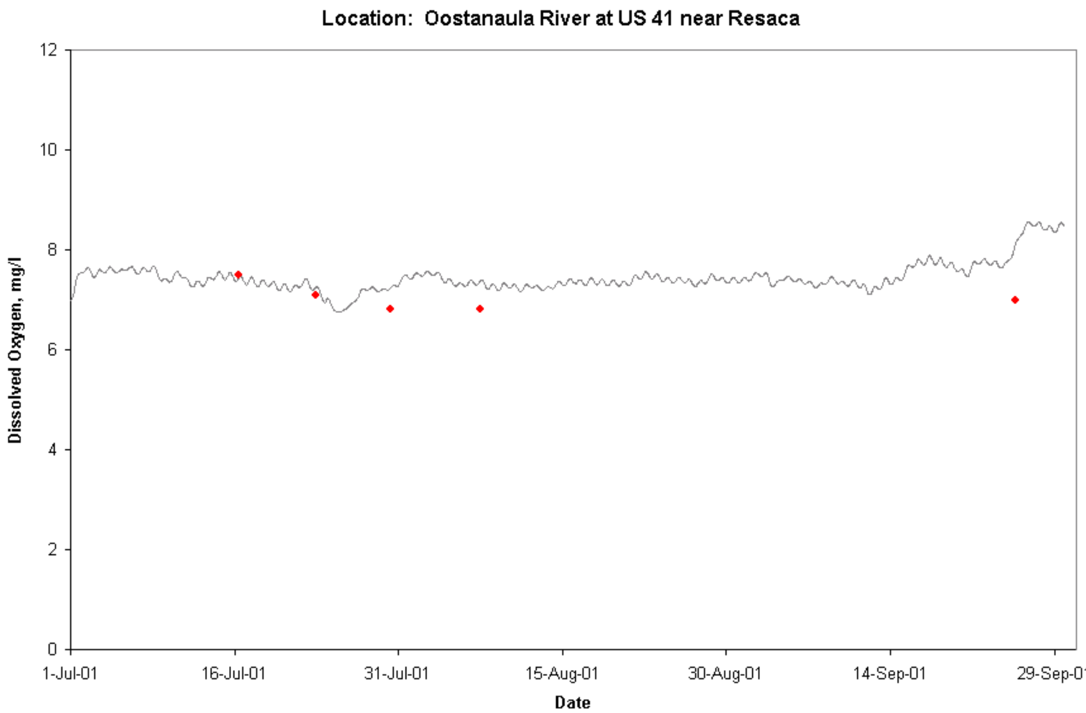
Dissolved Oxygen Calibration – July through September 2001

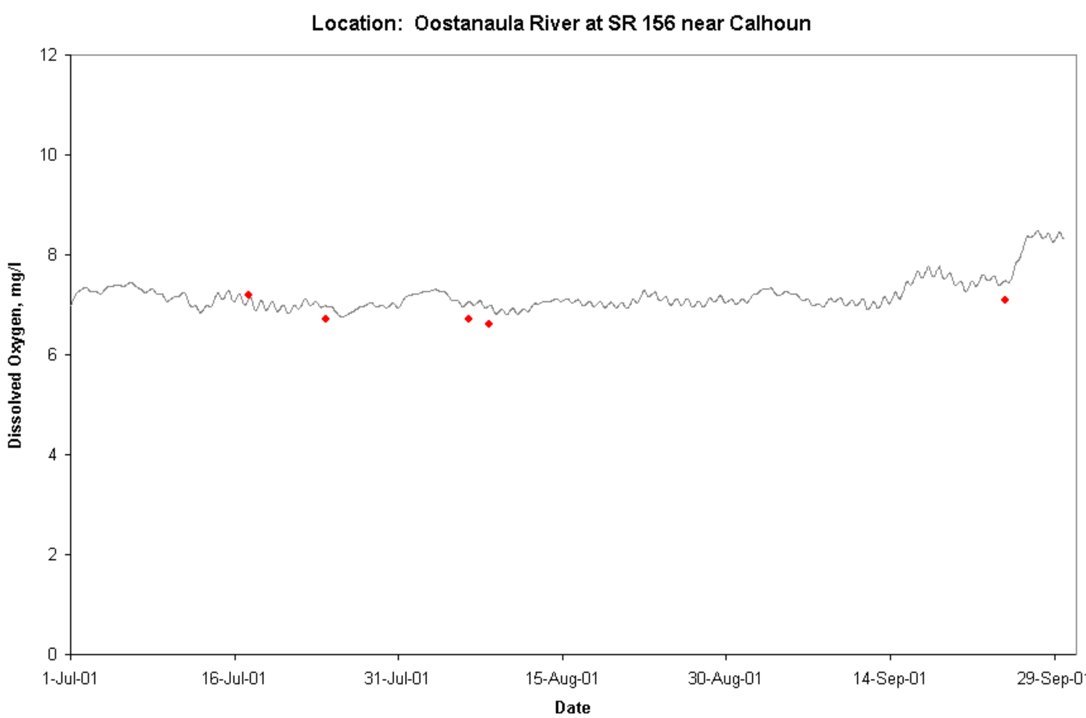


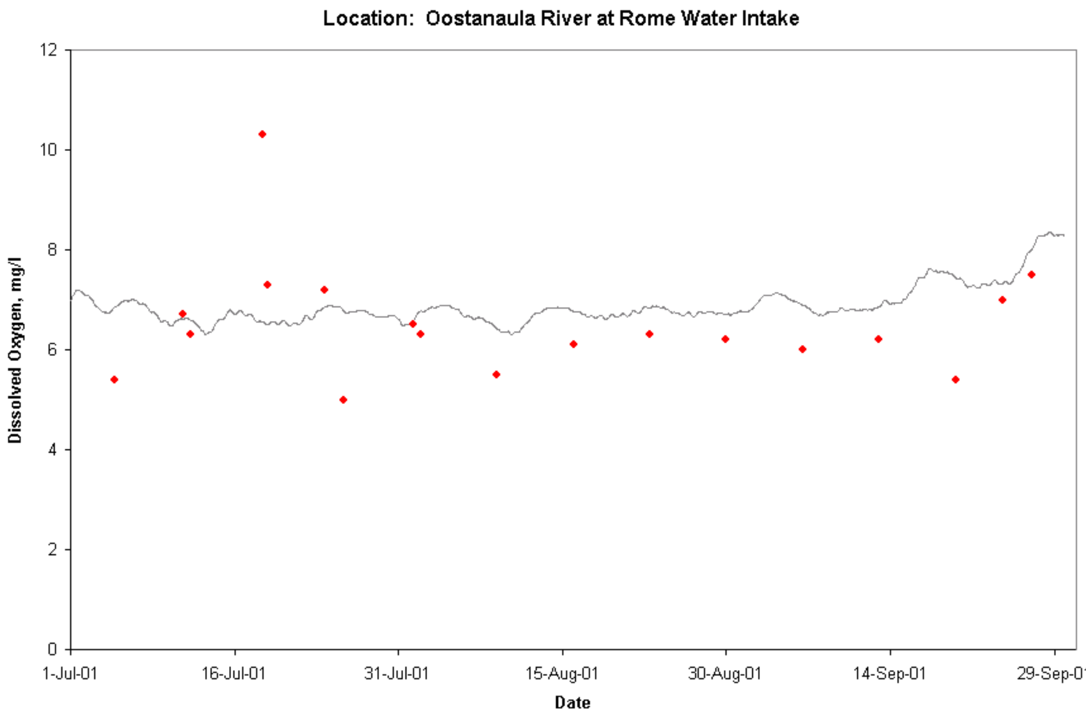


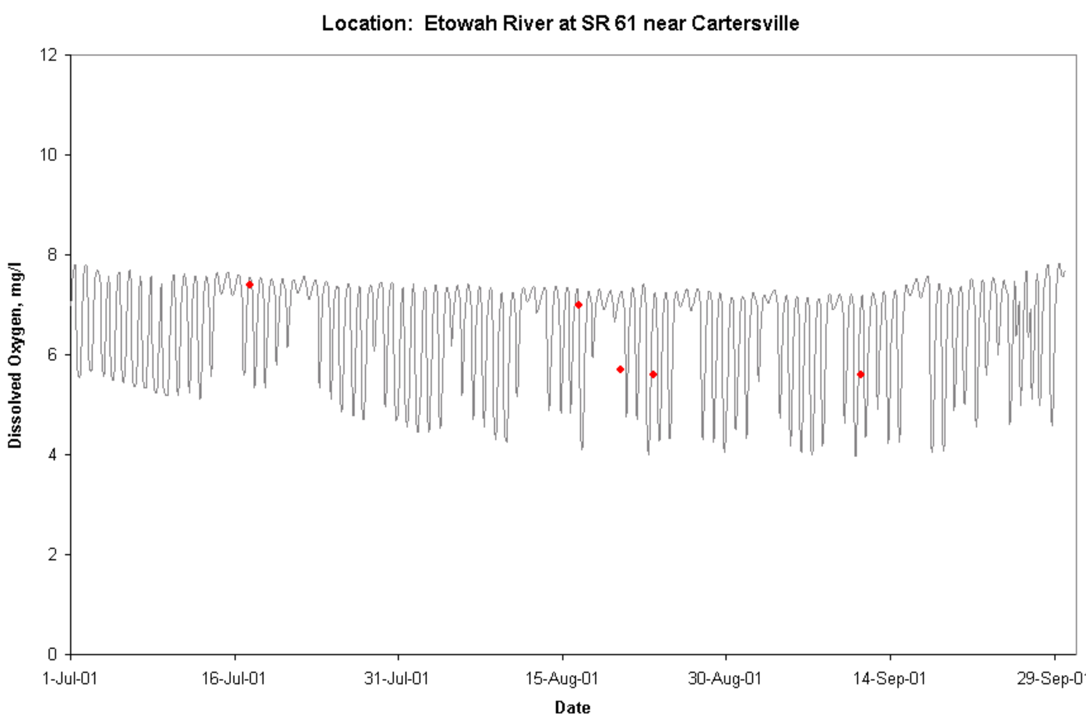

Location: Conasauga River at Sr 136 near Resaca
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

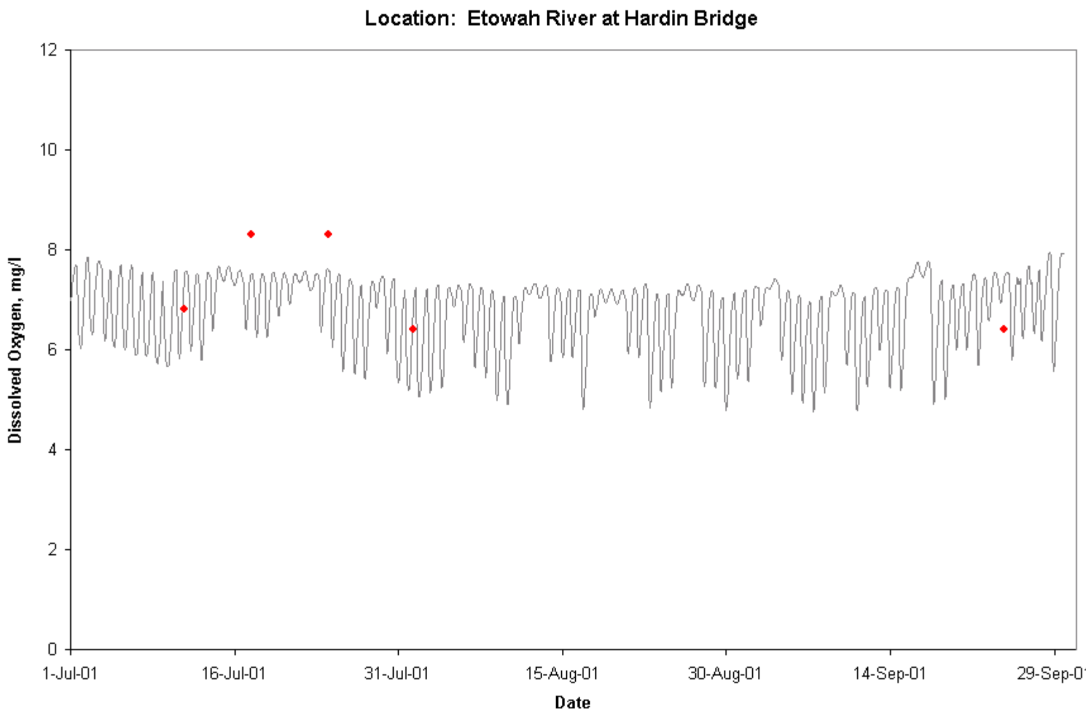

Location: Coosawattee River at Sr 225
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

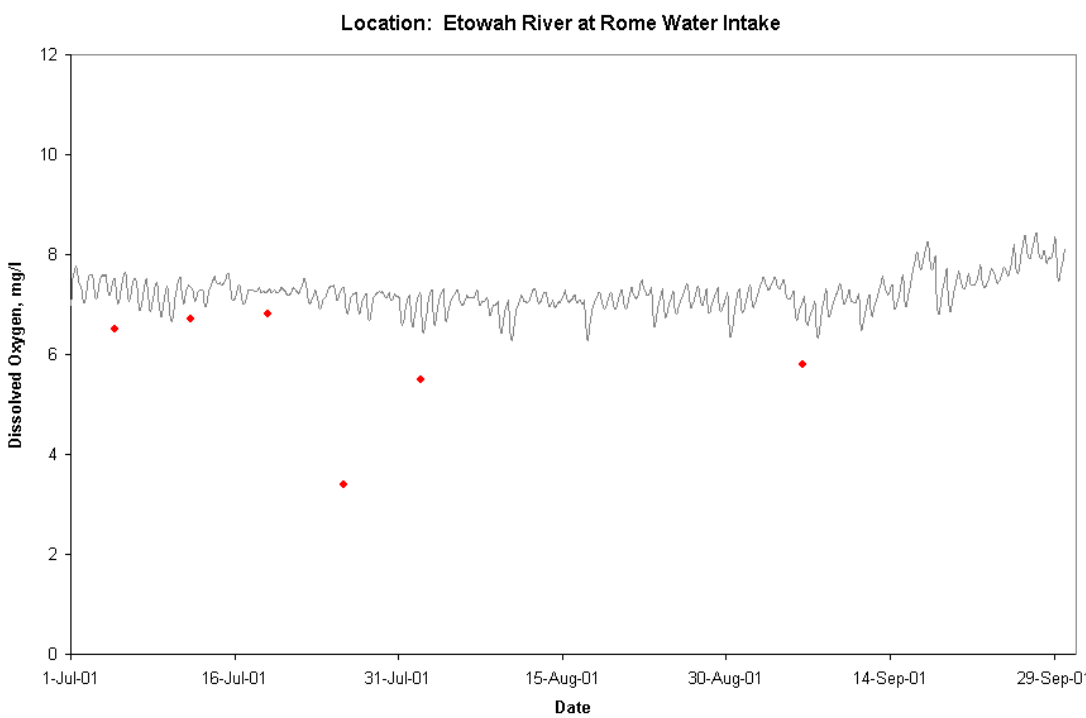

Location: Oostanaula River at US 41 near Resaca
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

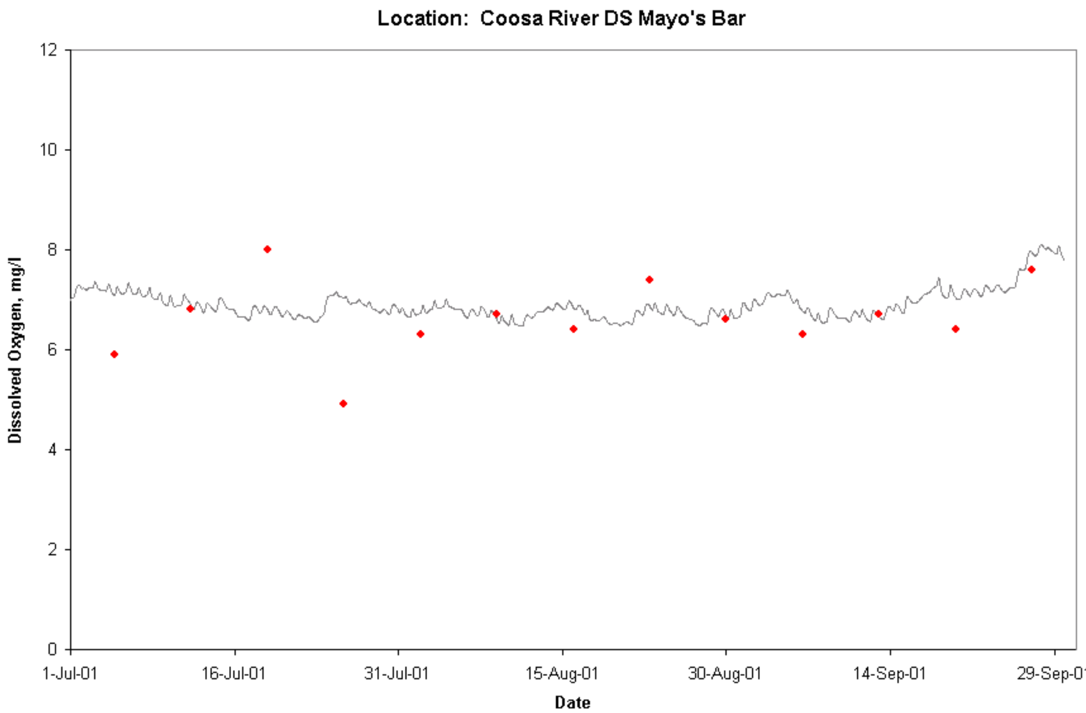

Location: Oostanaula River at SR 156 near Calhoun
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

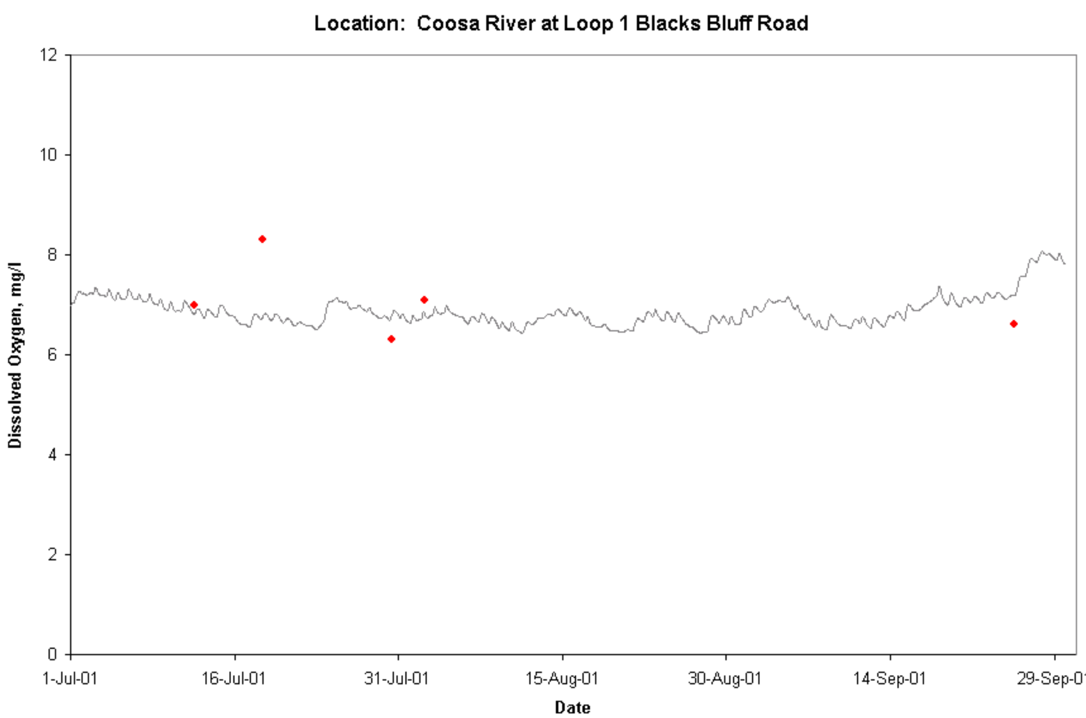

Location: Oostanaula River at Rome Water Intake
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

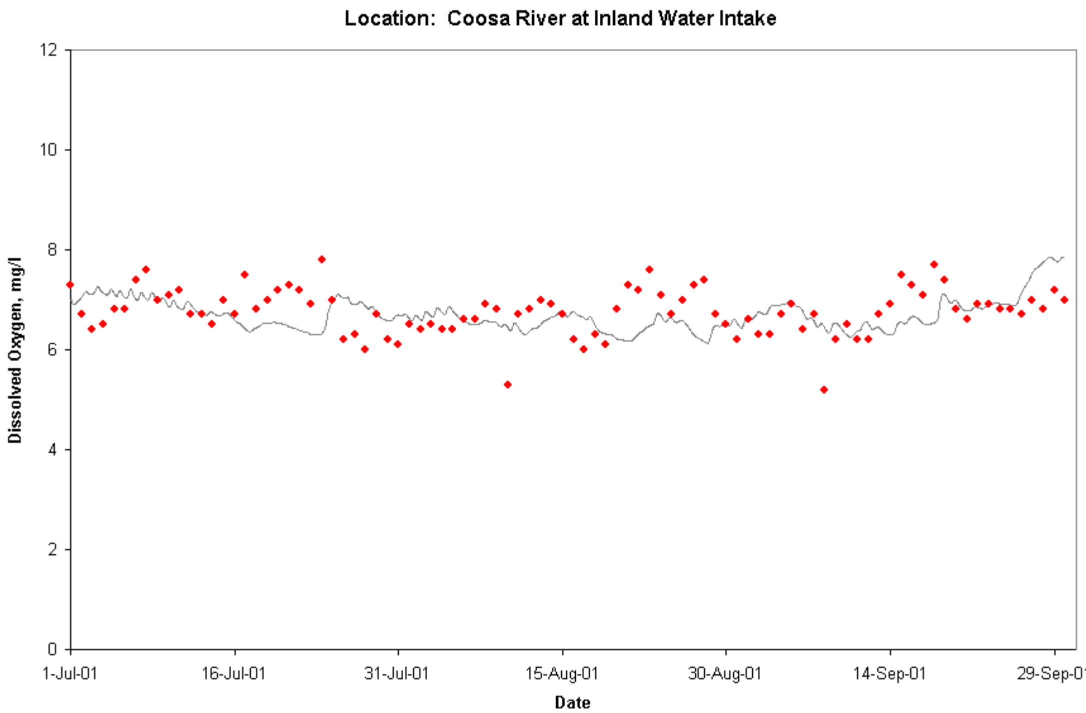

Location: Etowah River at SR 61 near Cartersville
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

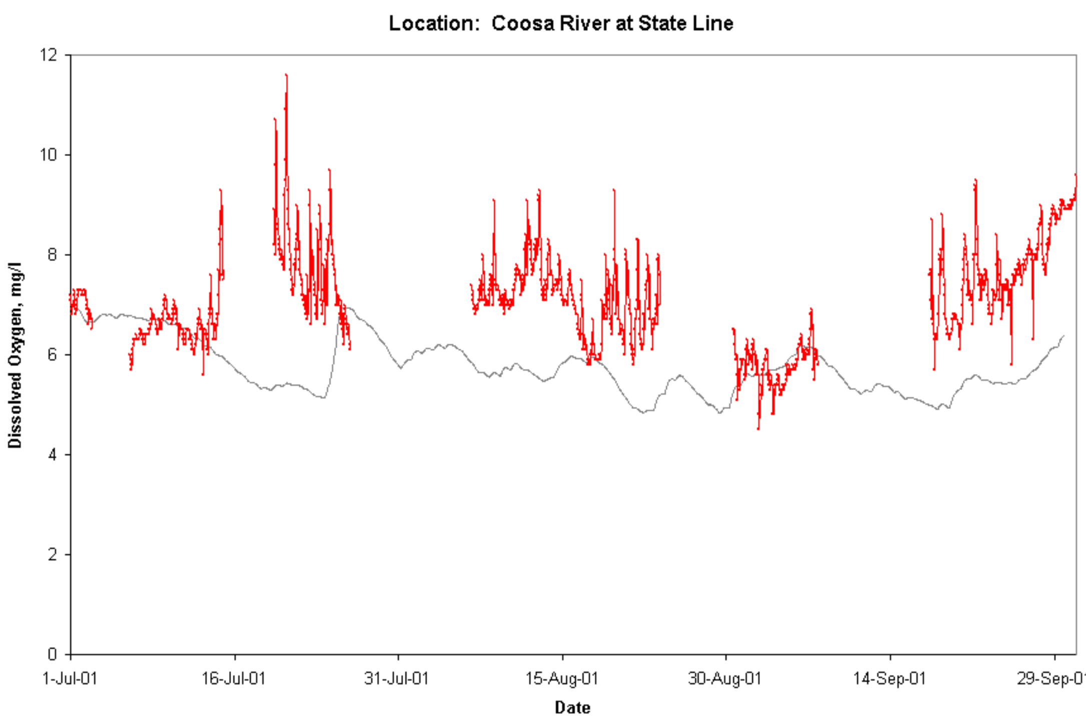

Location: Etowah River at Hardin Bridge
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Etowah River at Rome Water Intake
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

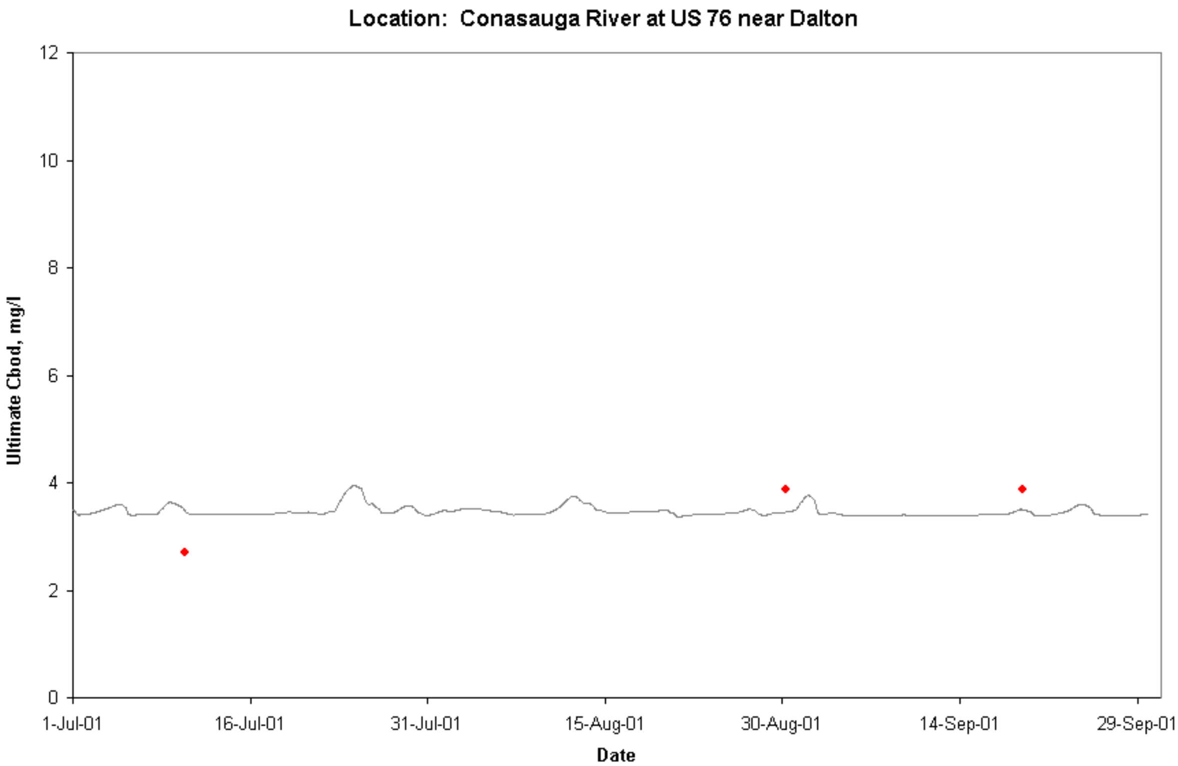

Location: Coosa River DS Mayo's Bar
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

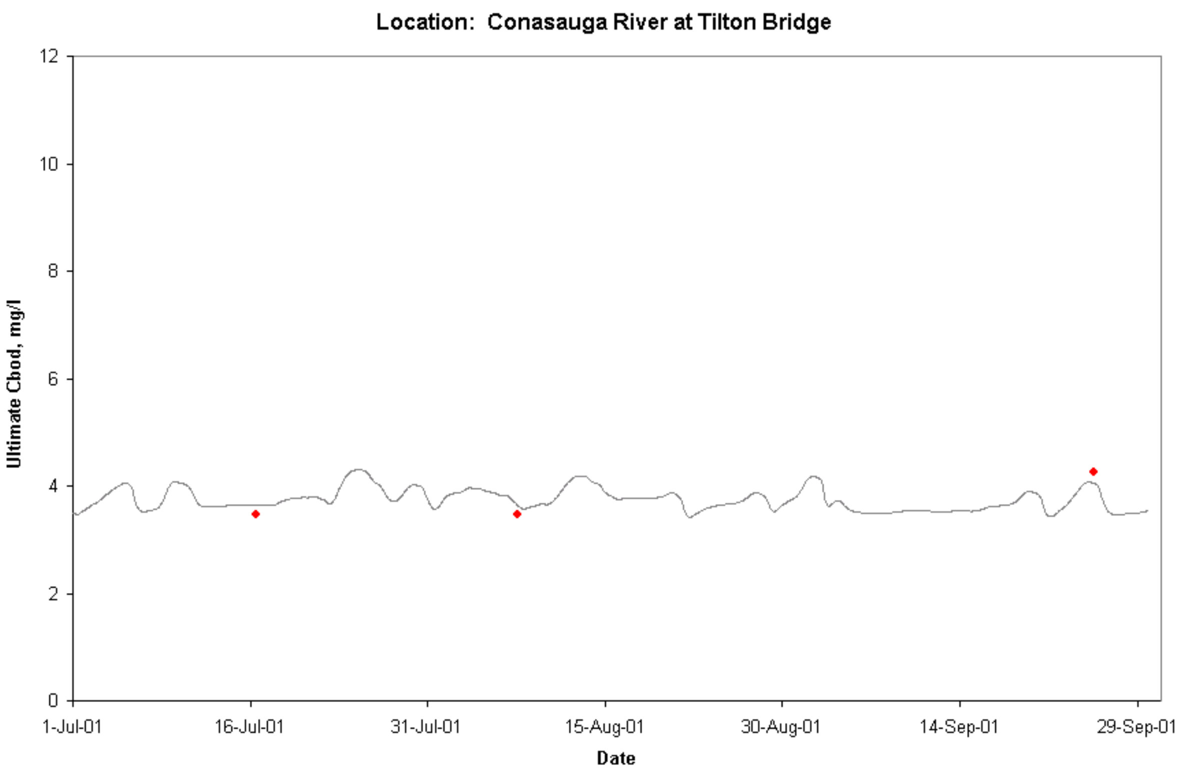

Location: Coosa River at Loop 1 Blacks Bluff Road
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

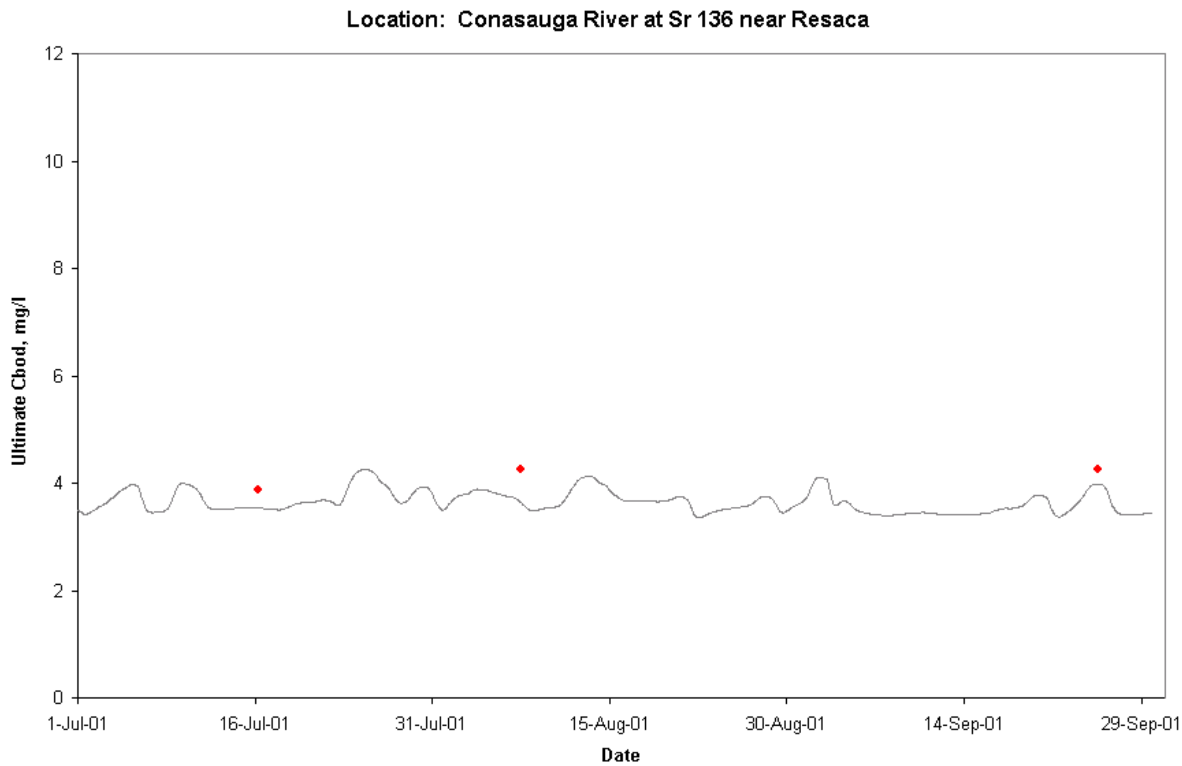

Location: Coosa River at Inland Water Intake
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

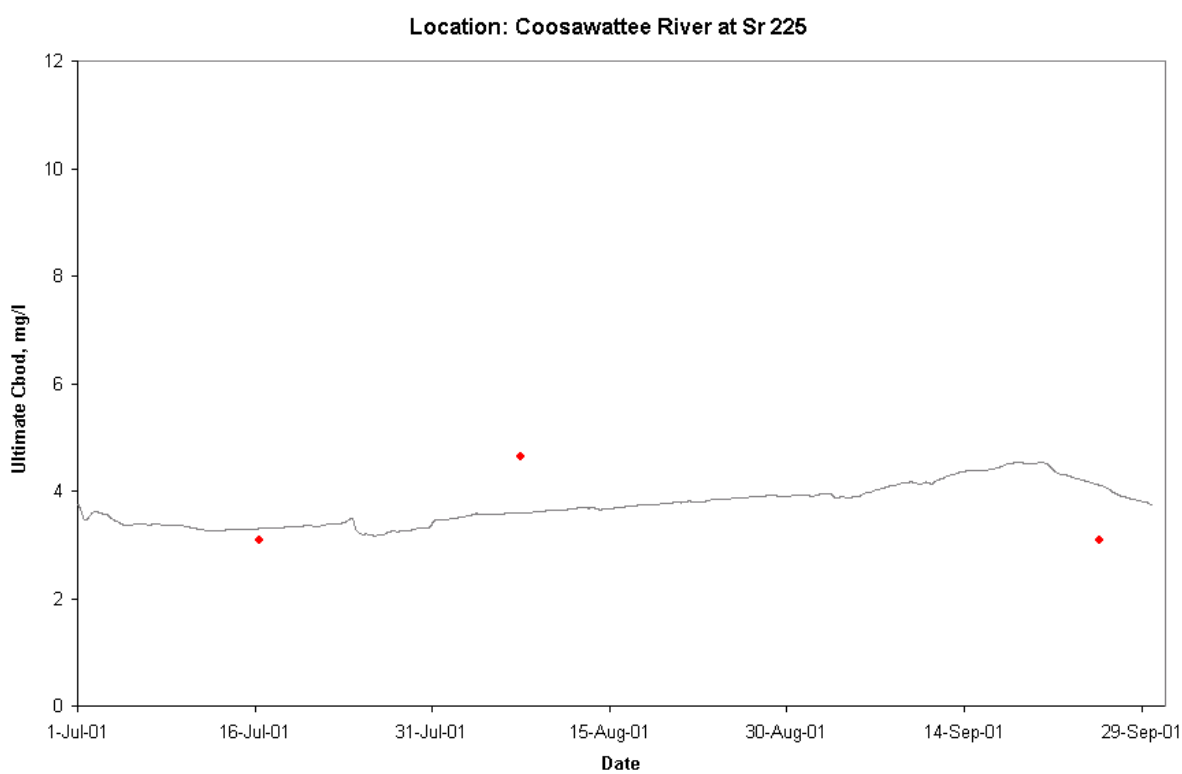

Location: Coosa River at State Line
Dissolved Oxygen, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

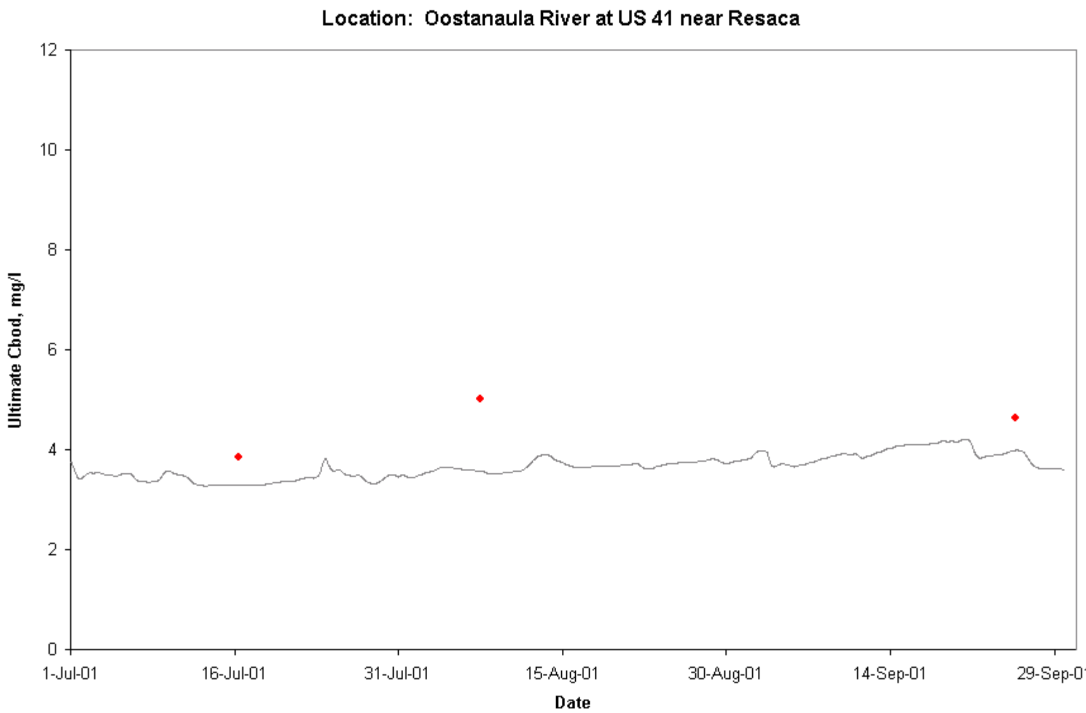
Ultimate CBOD Calibration – July through September 2001

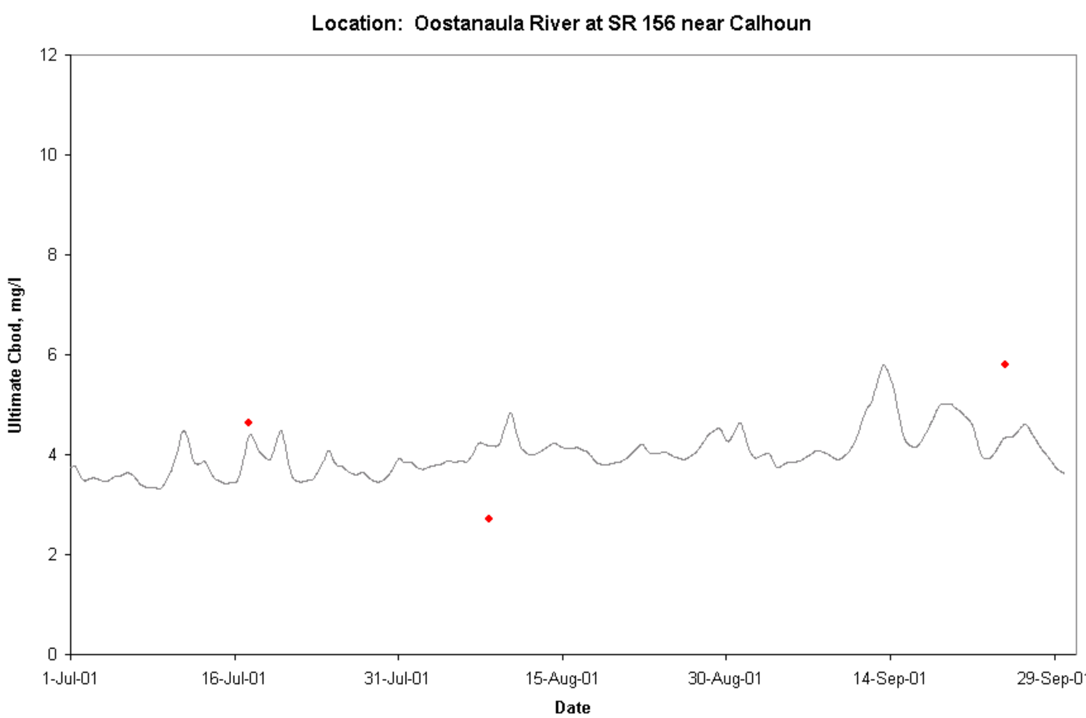


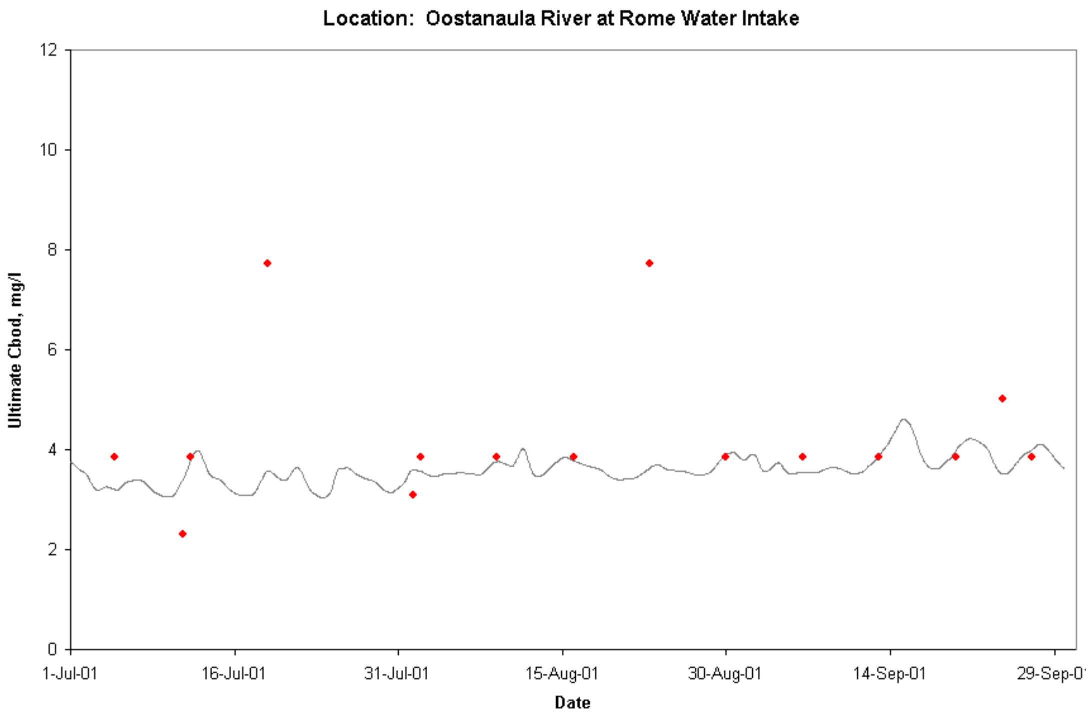


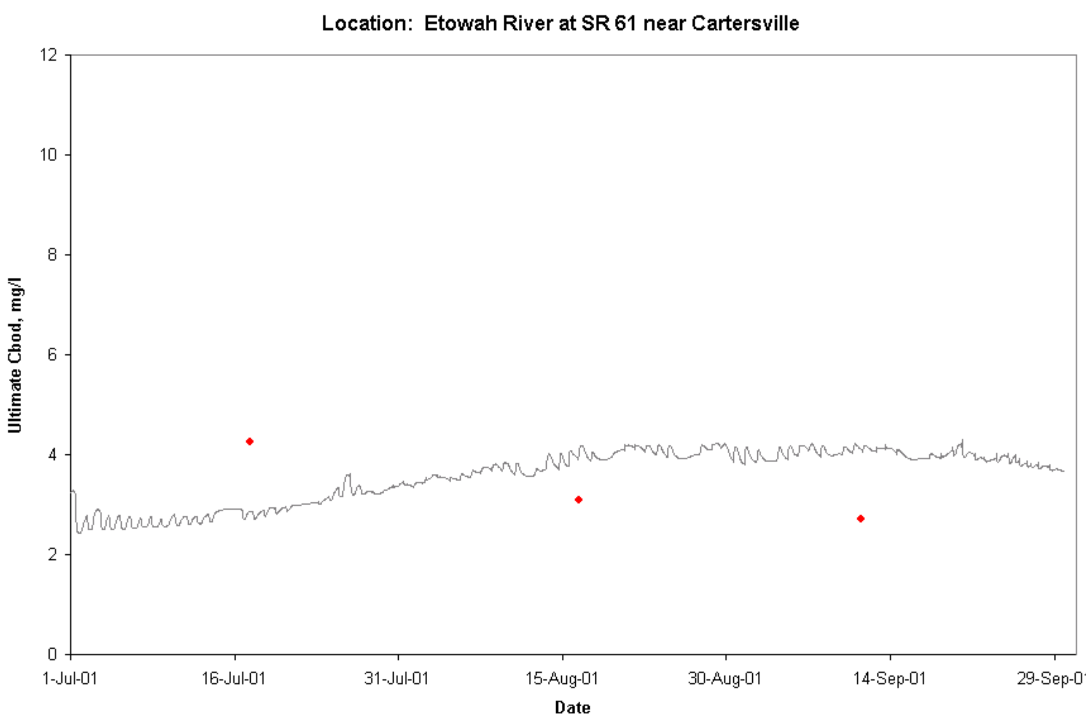

Location: Conasauga River at Sr 136 near Resaca
Ultimate Cbod, mg/l
Date
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01

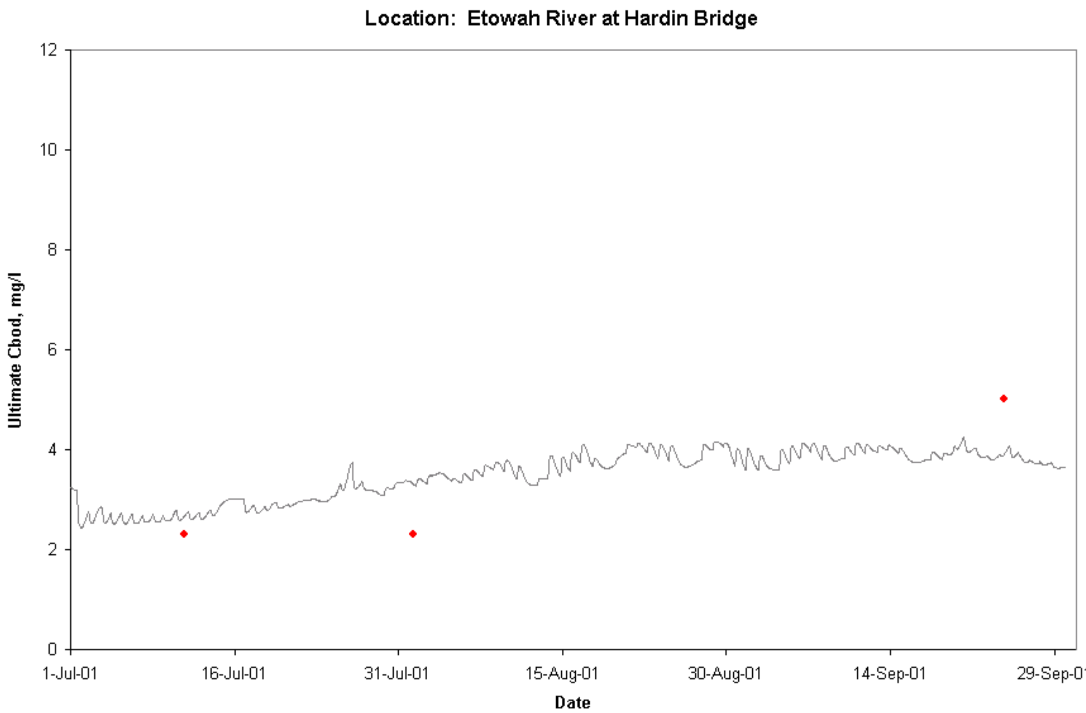

Location: Coosawattee River at Sr 225
Ultimate Cbod, mg/l
Date
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01

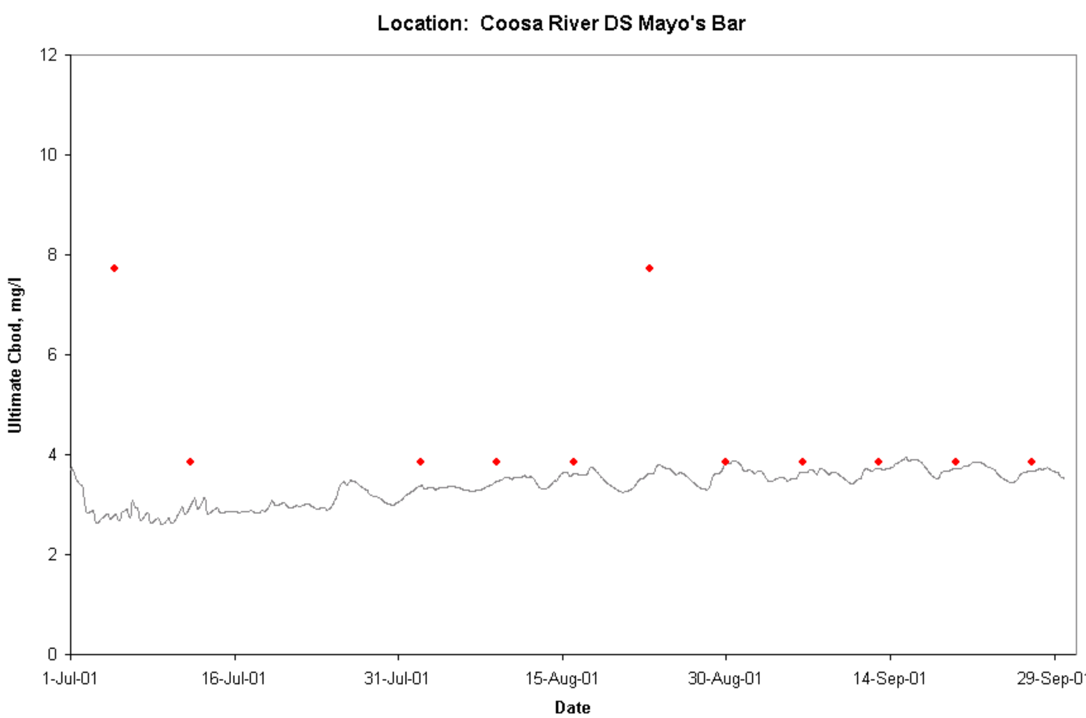

Location: Oostanaula River at US 41 near Resaca
Ultimate Cbod, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

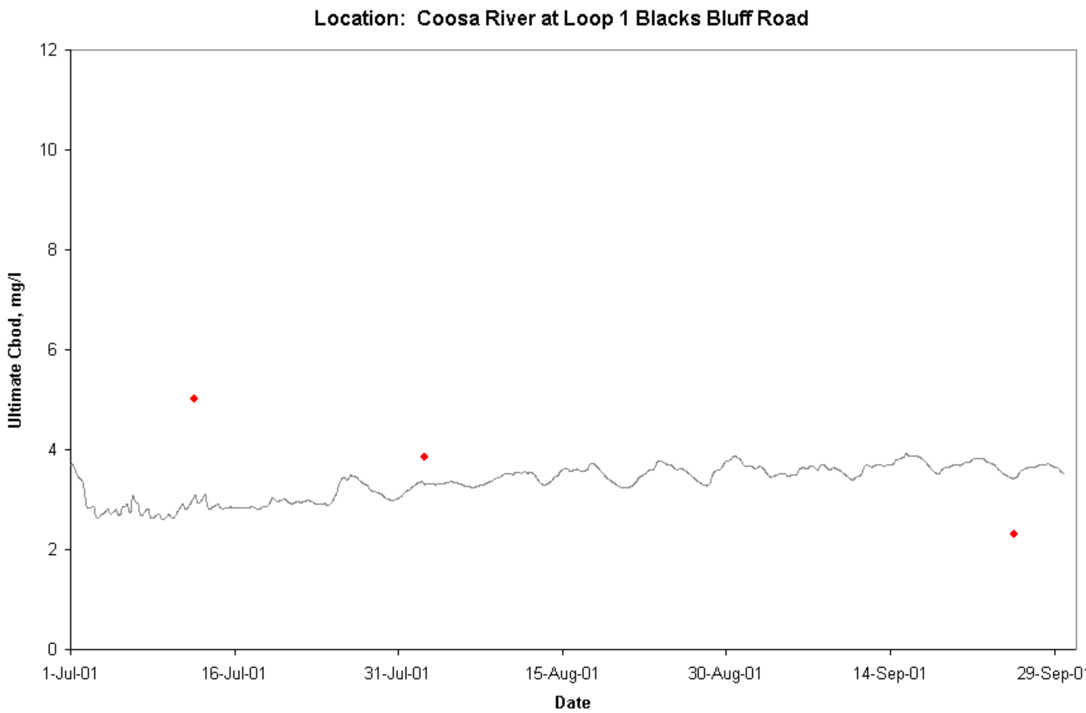

Location: Oostanaula River at SR 156 near Calhoun
Ultimate Cbod, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

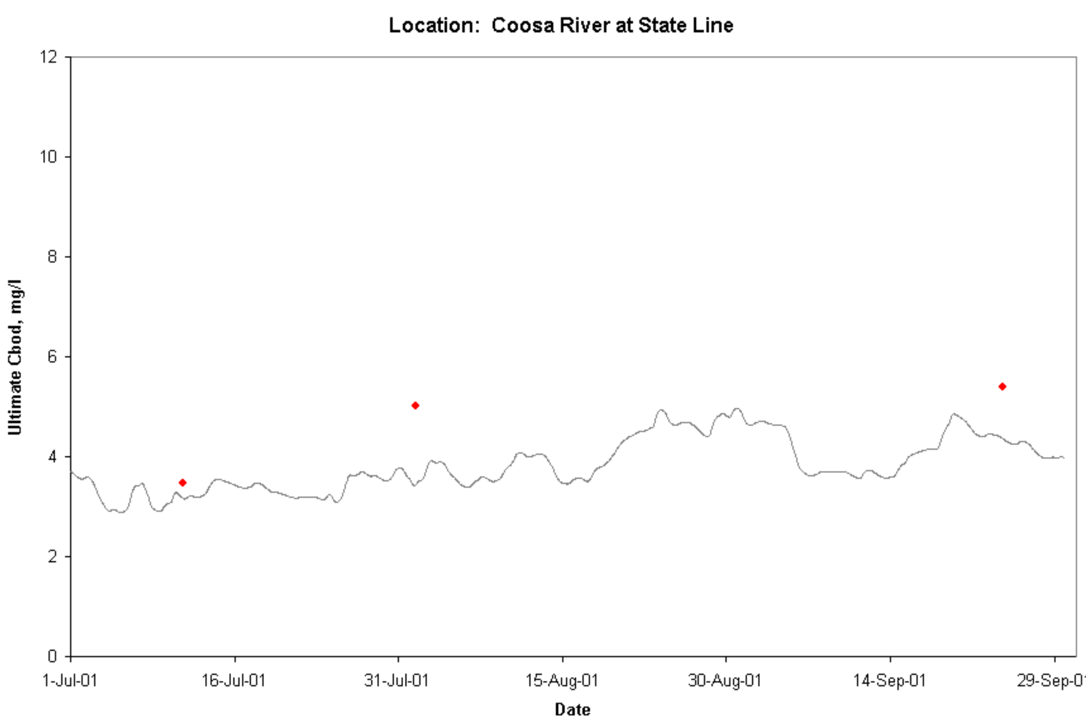

Location: Oostanaula River at Rome Water Intake
Ultimate Cbod, mg/l
12
10
8
6
4
2
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Etowah River at SR 61 near Cartersville
Ultimate Cbod, mg/l
12
10
8
6
4
2
0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

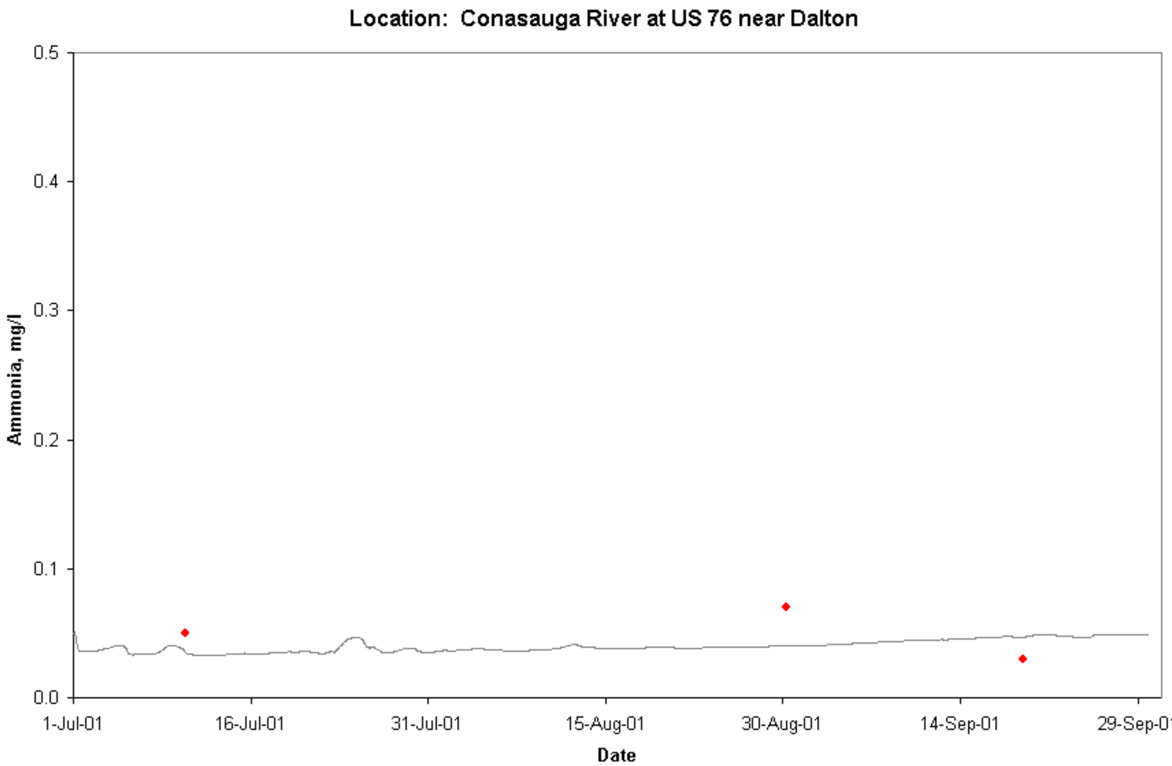

Location: Etowah River at Hardin Bridge
Ultimate Cbod, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

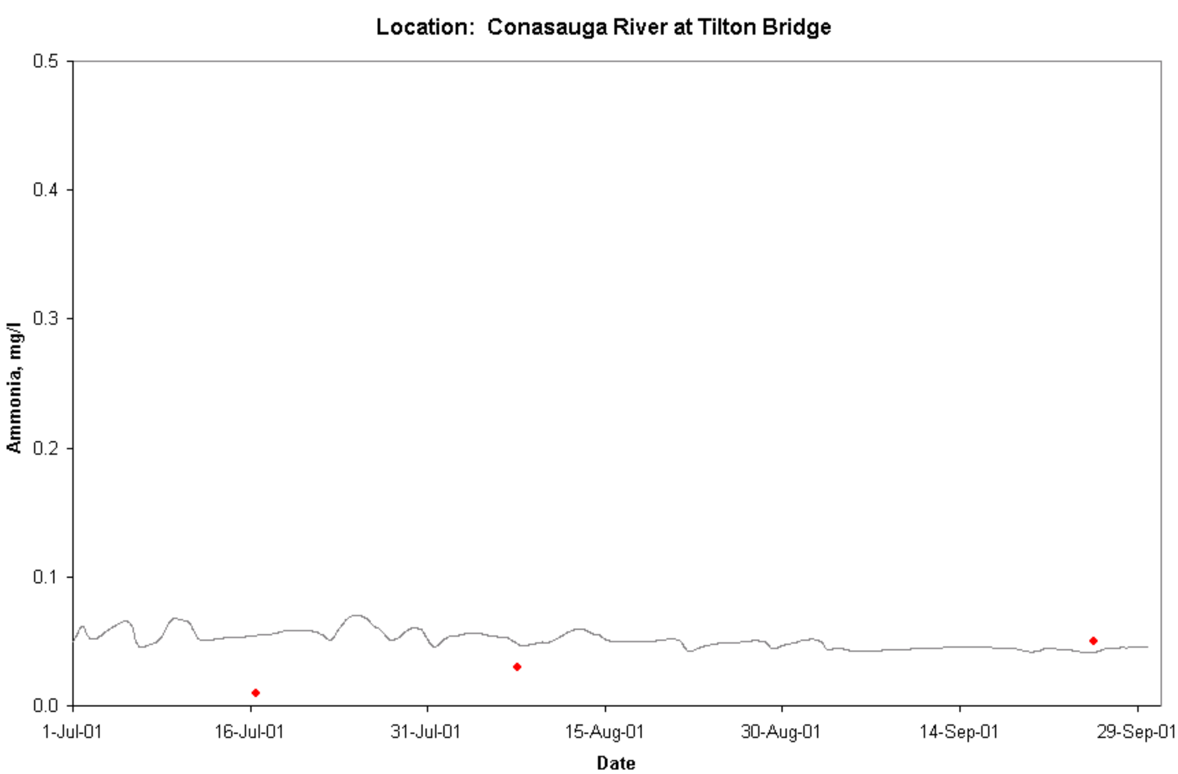

Location: Coosa River DS Mayo's Bar
Ultimate Cbod, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

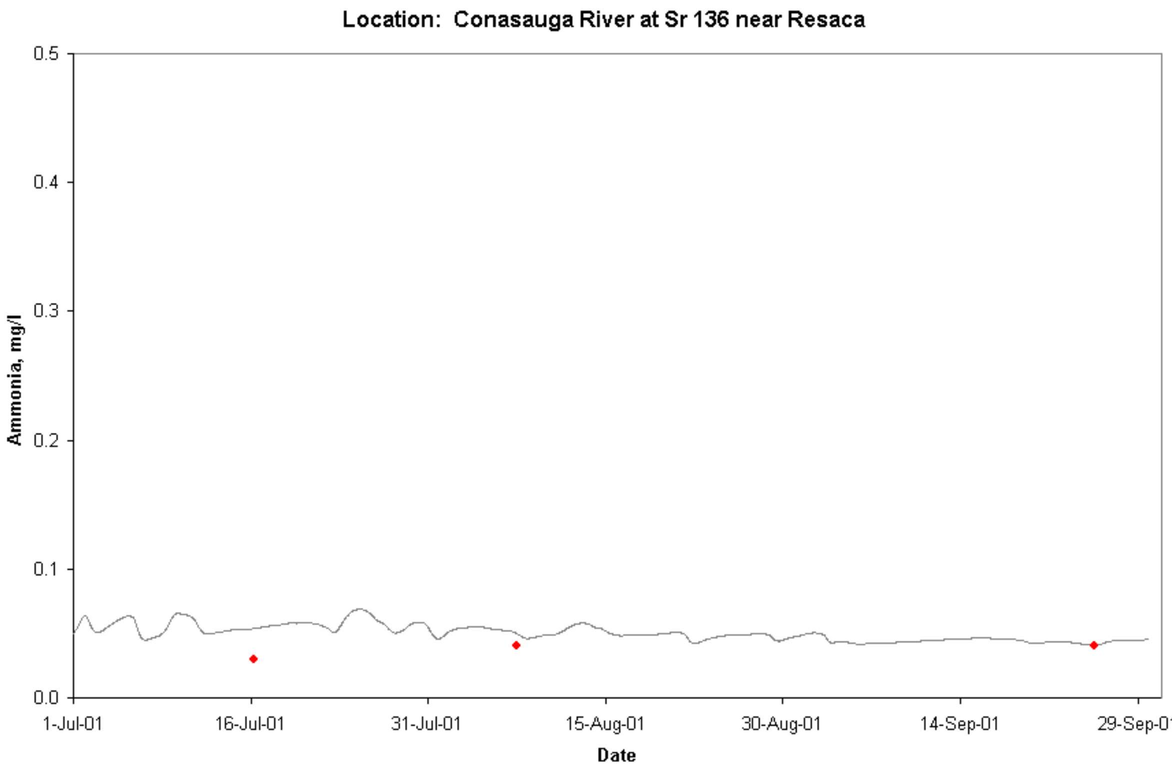

Location: Coosa River at Loop 1 Blacks Bluff Road
Ultimate Cbod, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

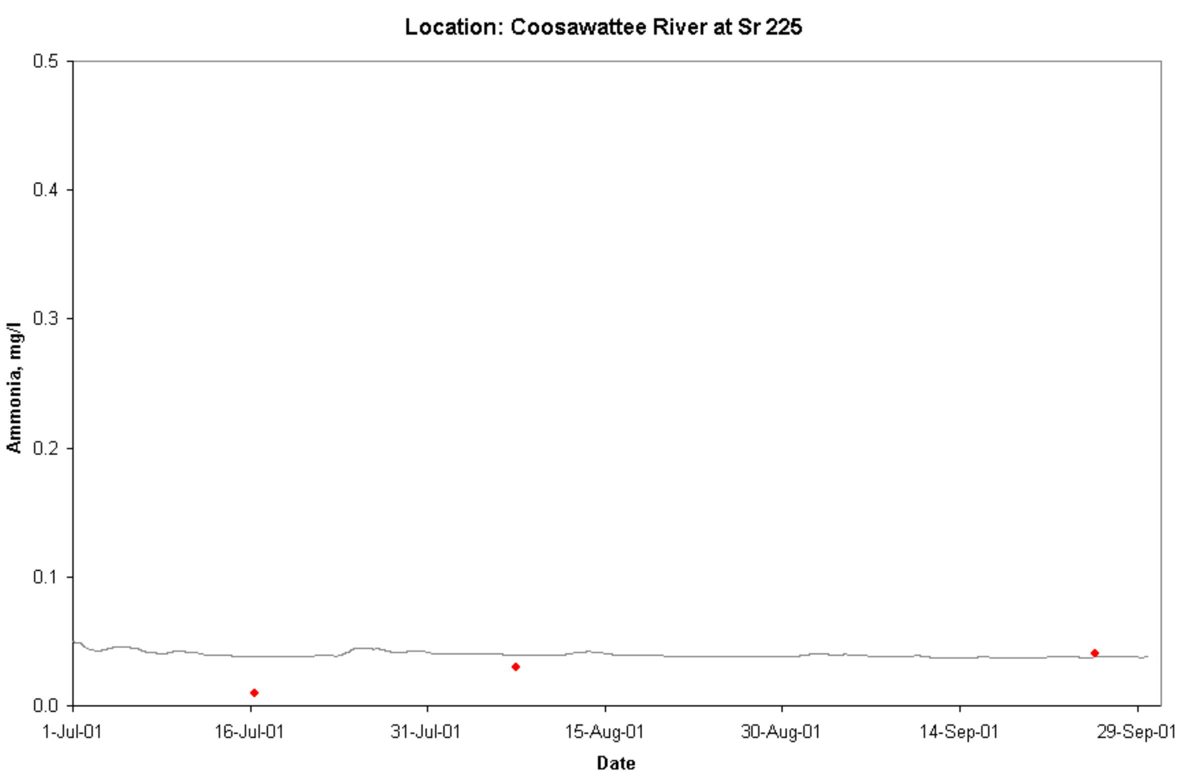

Location: Coosa River at State Line
Ultimate Cbod, mg/l
0
2
4
6
8
10
12
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

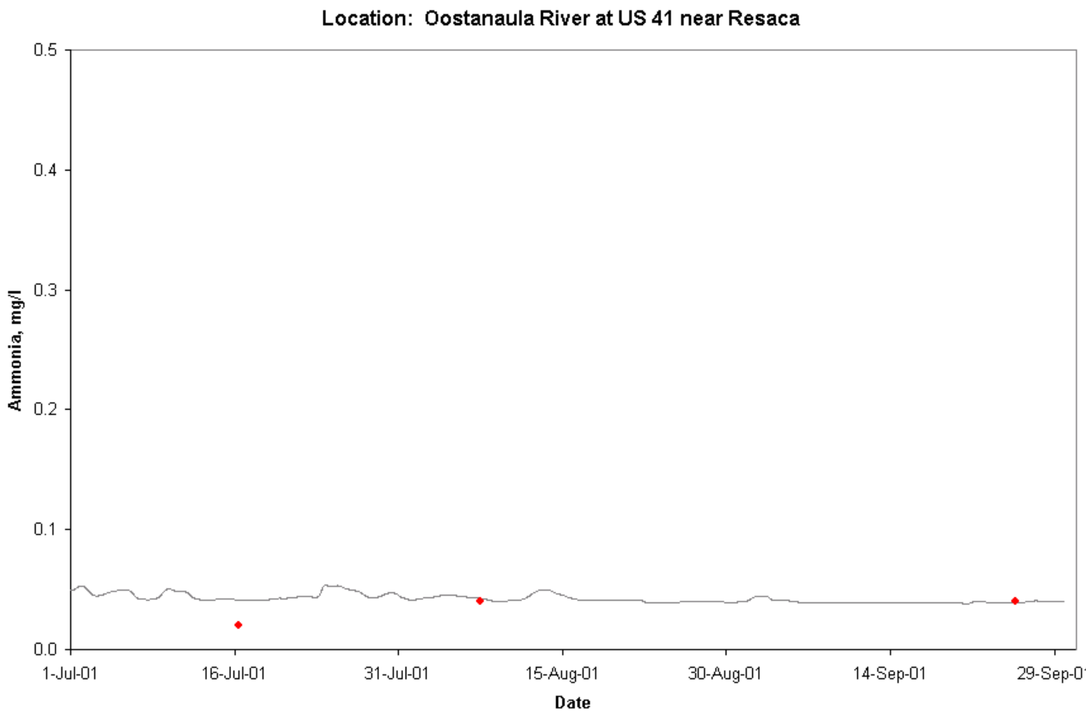
Ammonia Calibration – July through September 2001

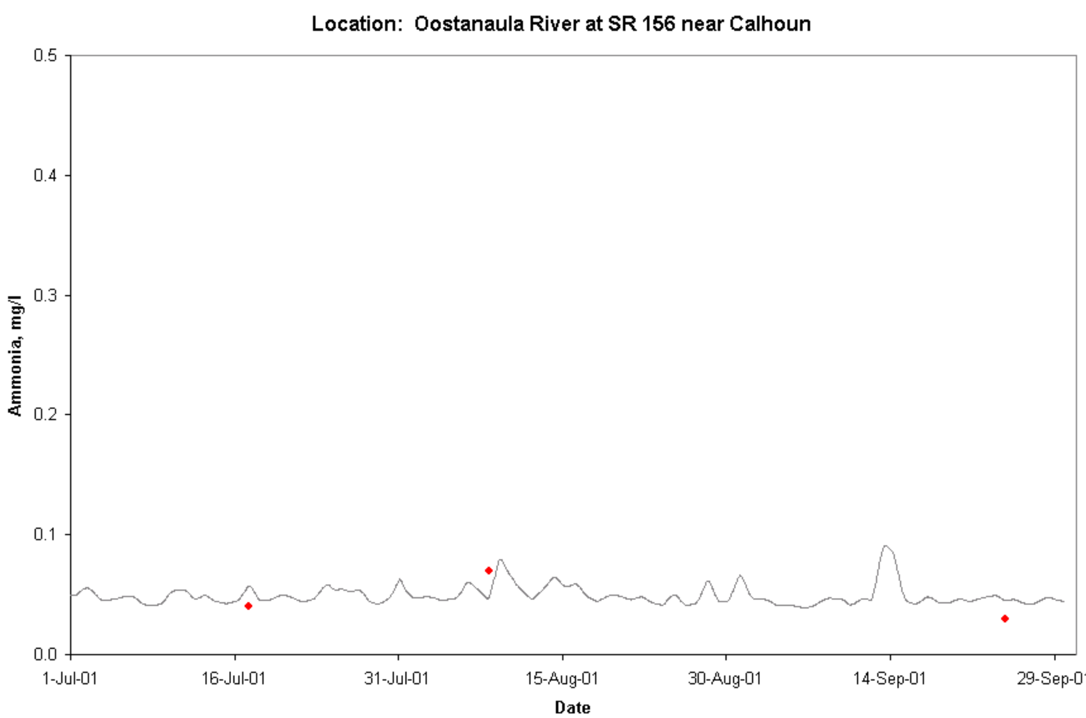


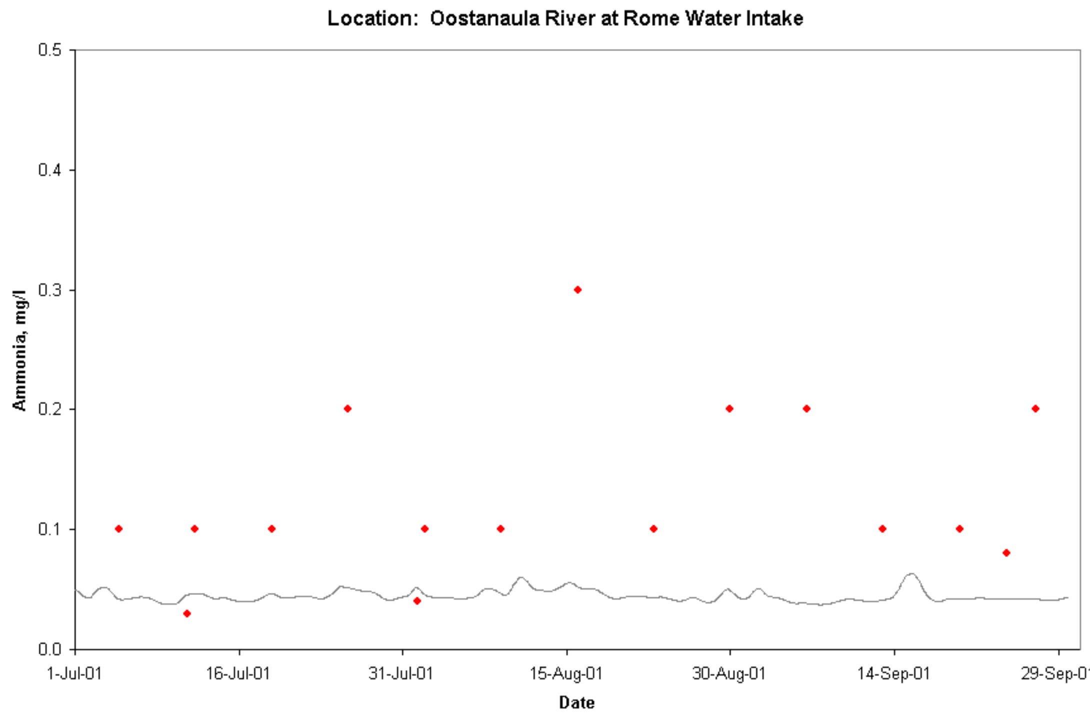


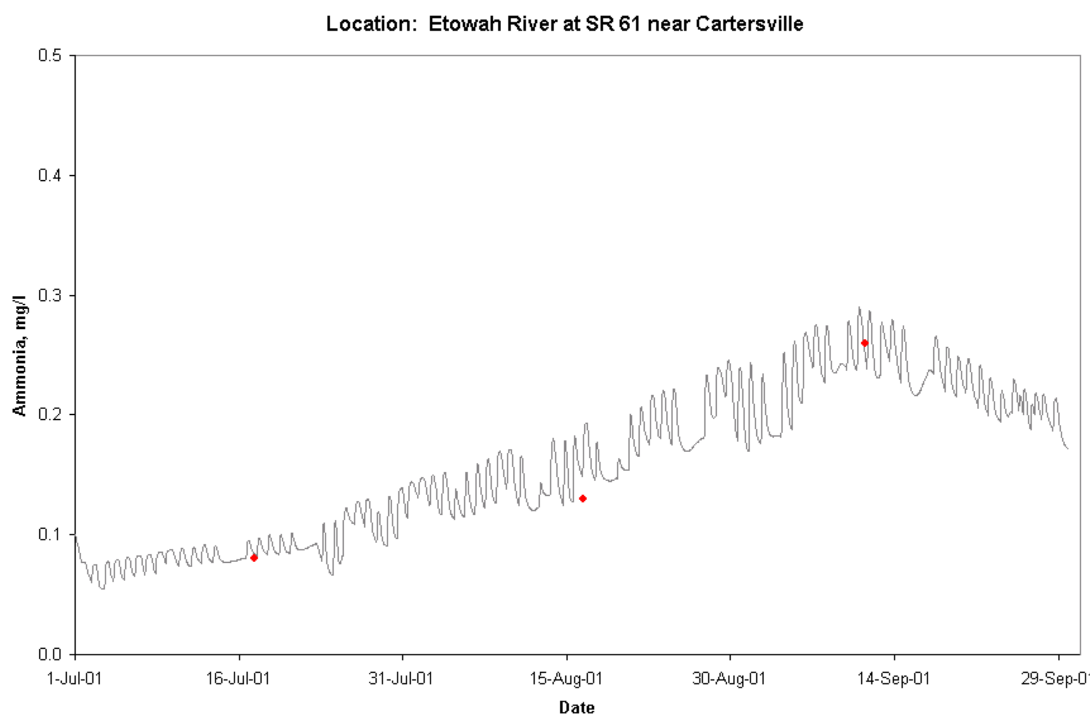

Location: Conasauga River at Sr 136 near Resaca
0.5
0.4
0.3
0.2
0.1
0.0
Ammonia, mg/l
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

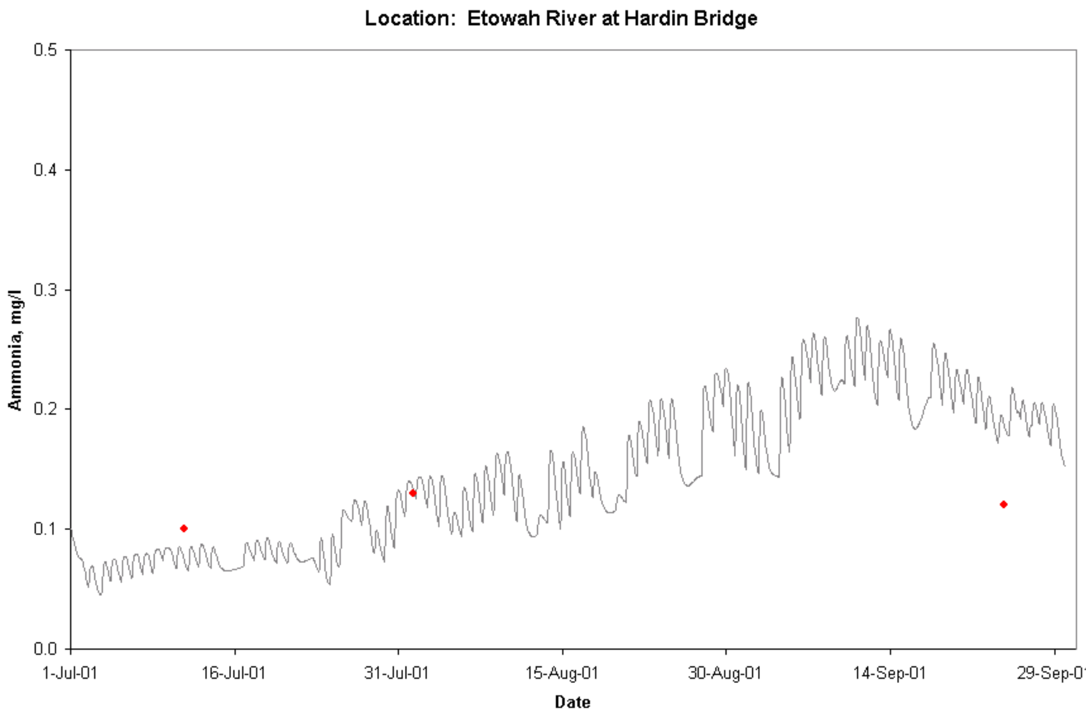

Location: Coosawattee River at Sr 225
0.5
0.4
0.3
0.2
0.1
0.0
Ammonia, mg/l
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

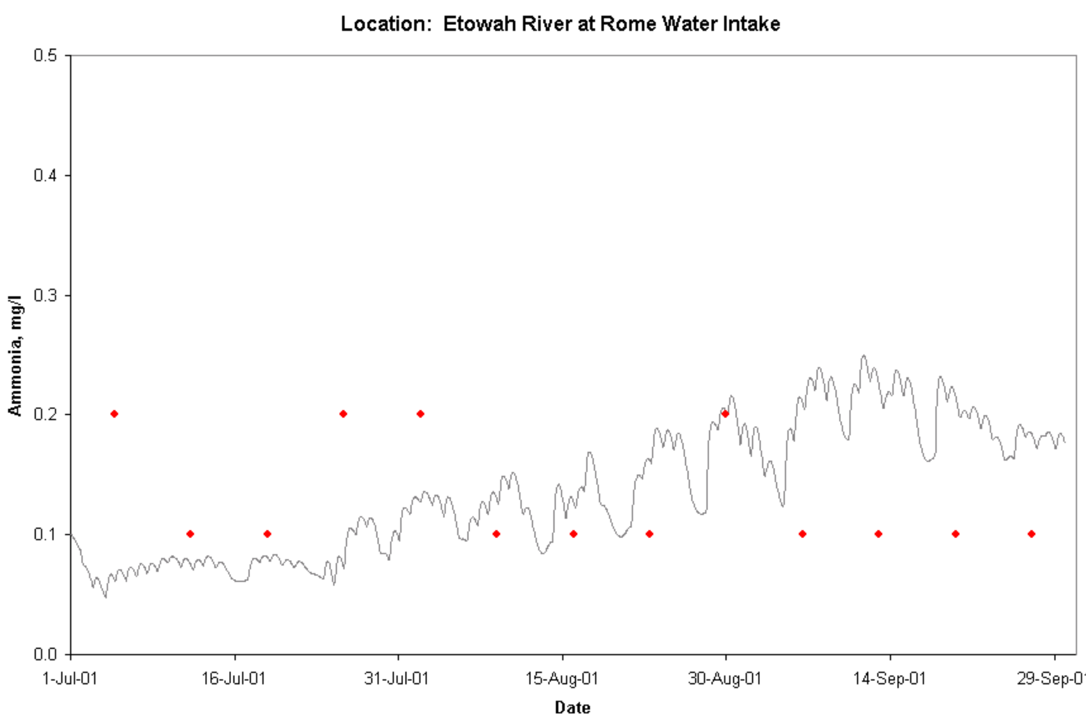

Location: Oostanaula River at US 41 near Resaca
Ammonia, mg/l
0.5
0.4
0.3
0.2
0.1
0.0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

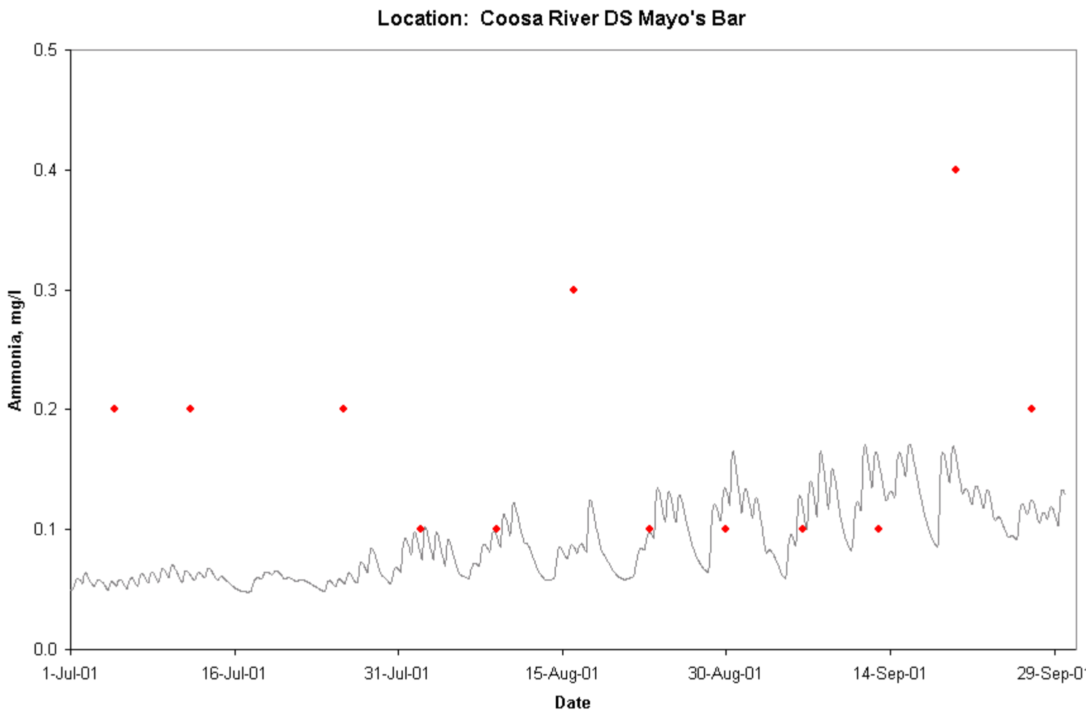

Location: Oostanaula River at SR 156 near Calhoun
Ammonia, mg/l
0.5
0.4
0.3
0.2
0.1
0.0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

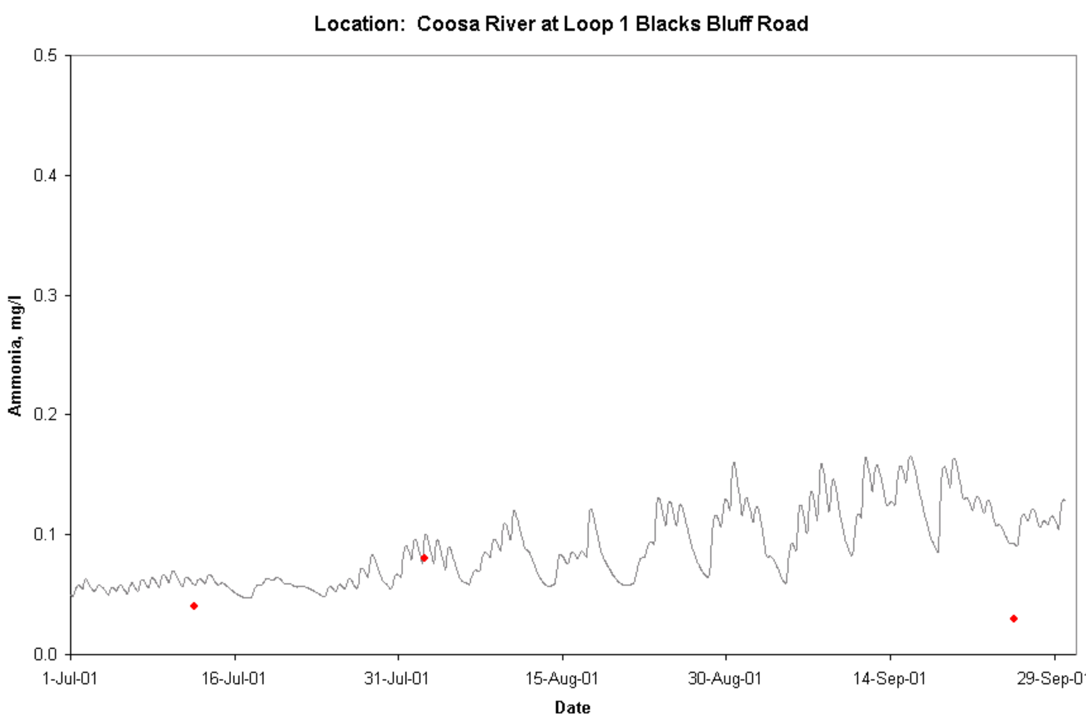

Location: Oostanaula River at Rome Water Intake
Ammonia, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

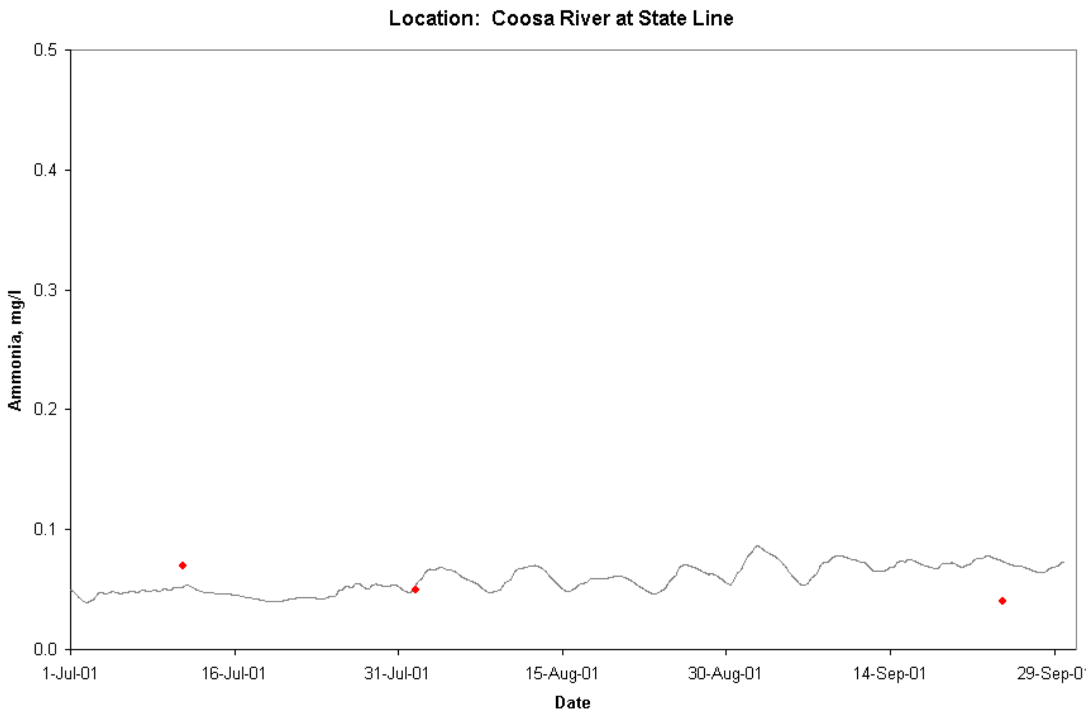

Location: Etowah River at SR 61 near Cartersville
Ammonia, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Etowah River at Hardin Bridge
Ammonia, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

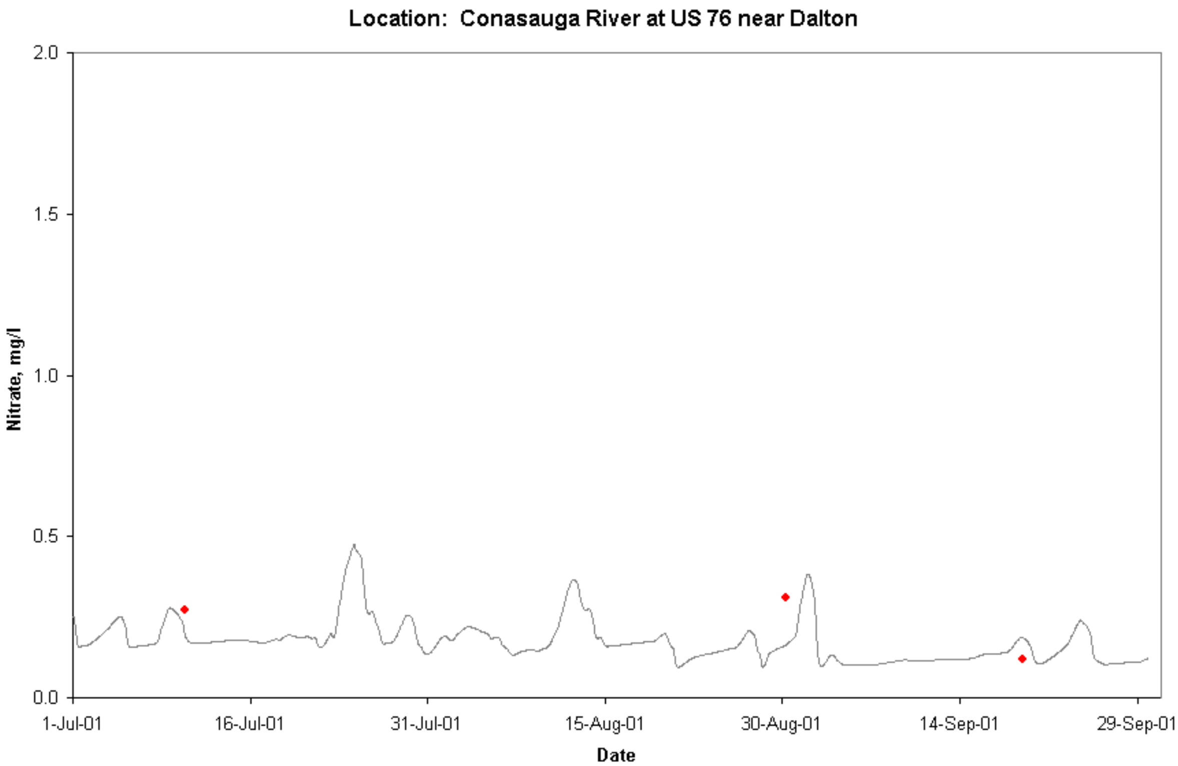

Location: Etowah River at Rome Water Intake
Ammonia, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

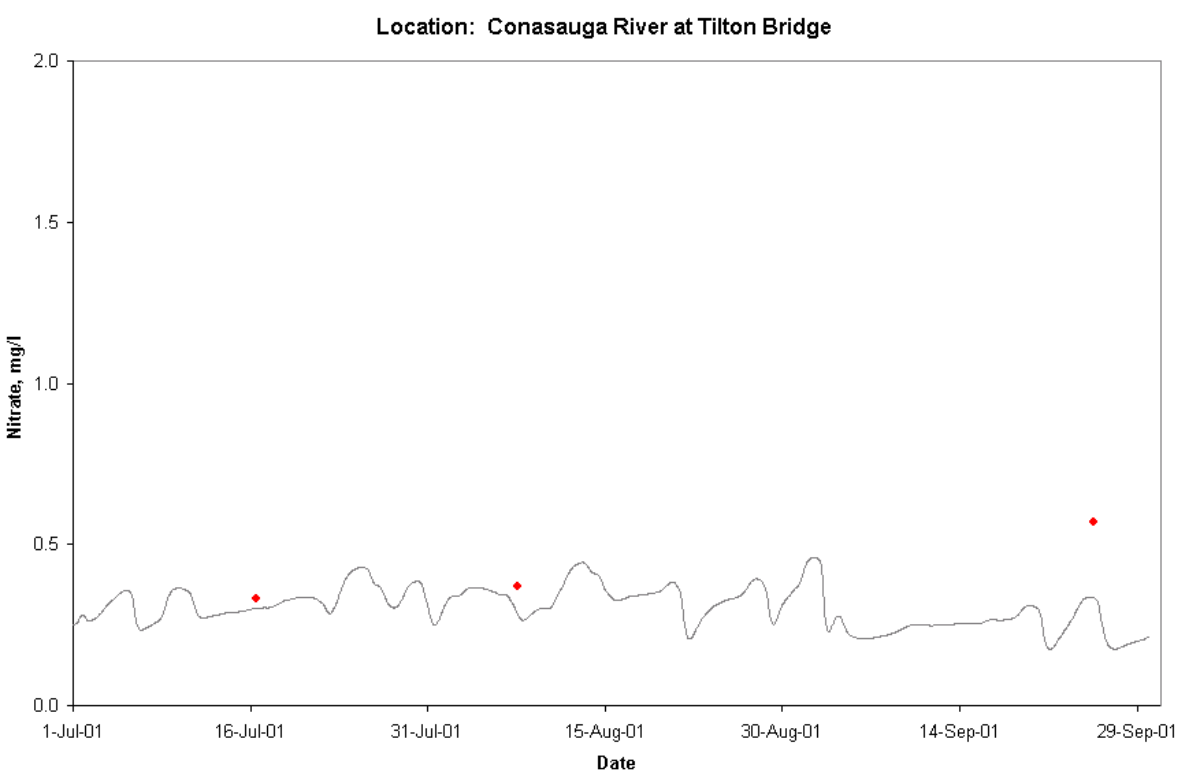

Location: Coosa River DS Mayo's Bar
Ammonia, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

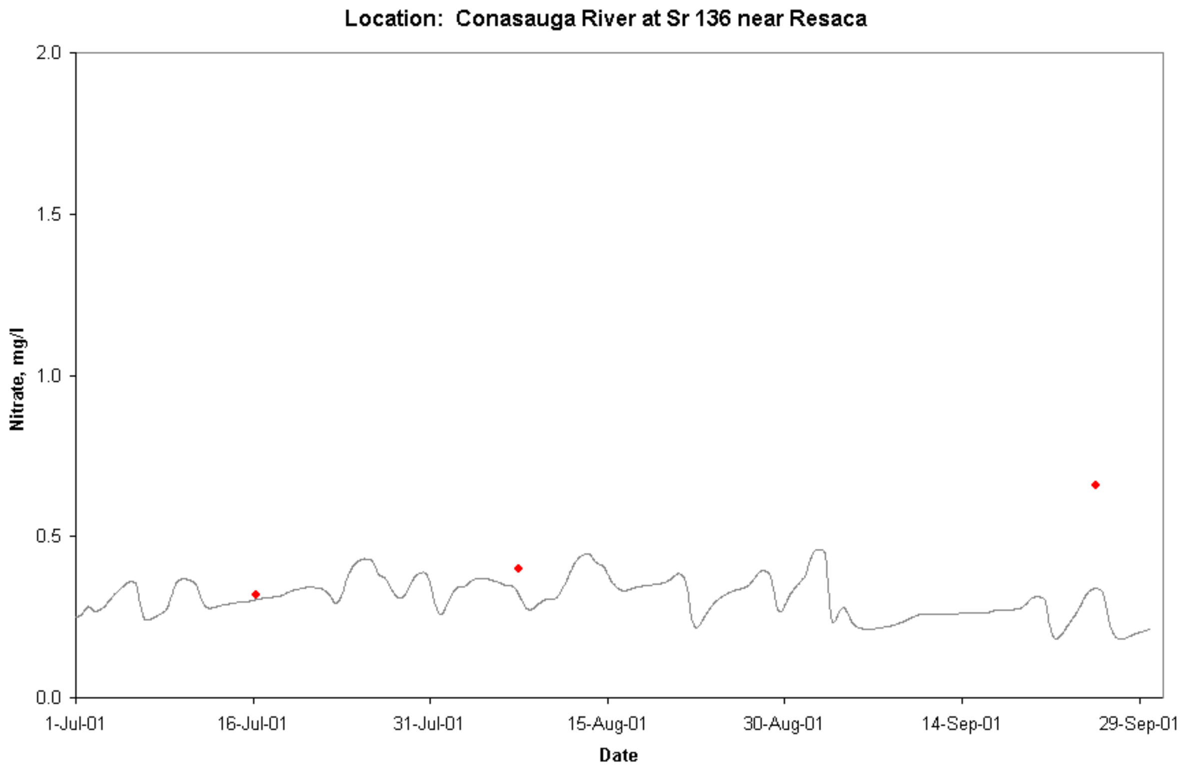

Location: Coosa River at Loop 1 Blacks Bluff Road
Ammonia, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

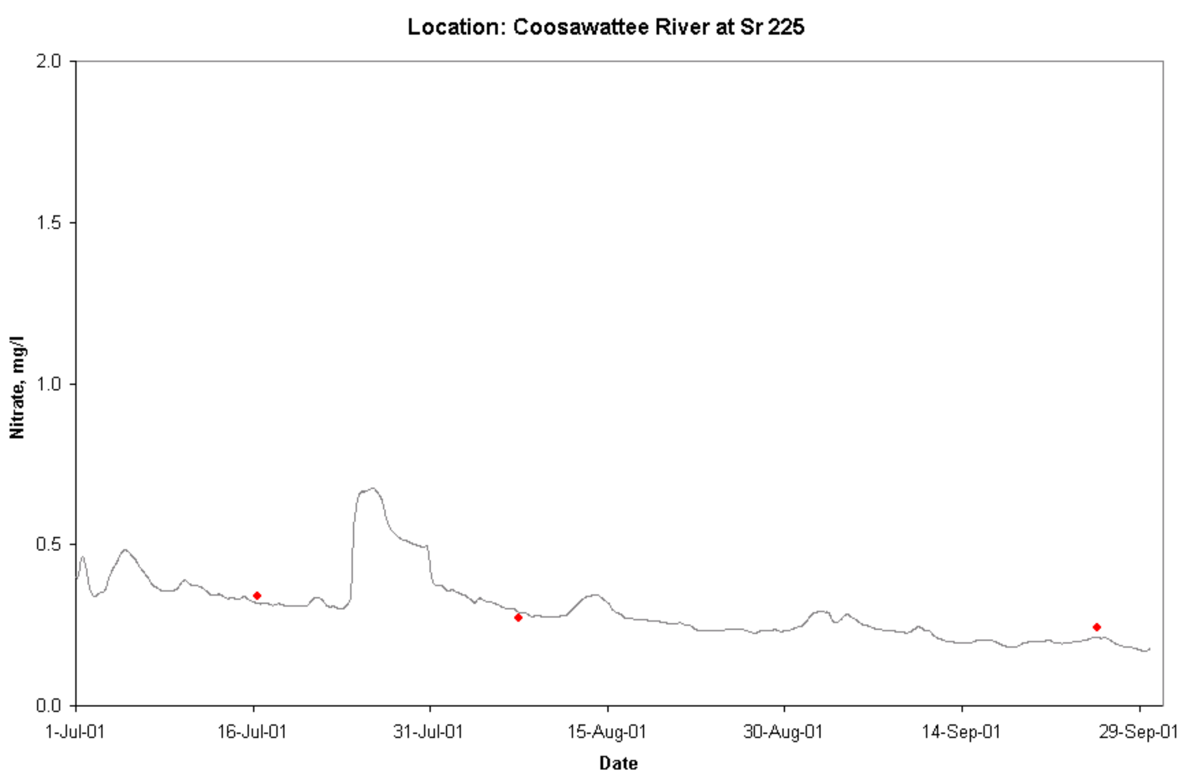

Location: Coosa River at State Line
0.5
0.4
0.3
0.2
0.1
0.0
Ammonia, mg/l
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

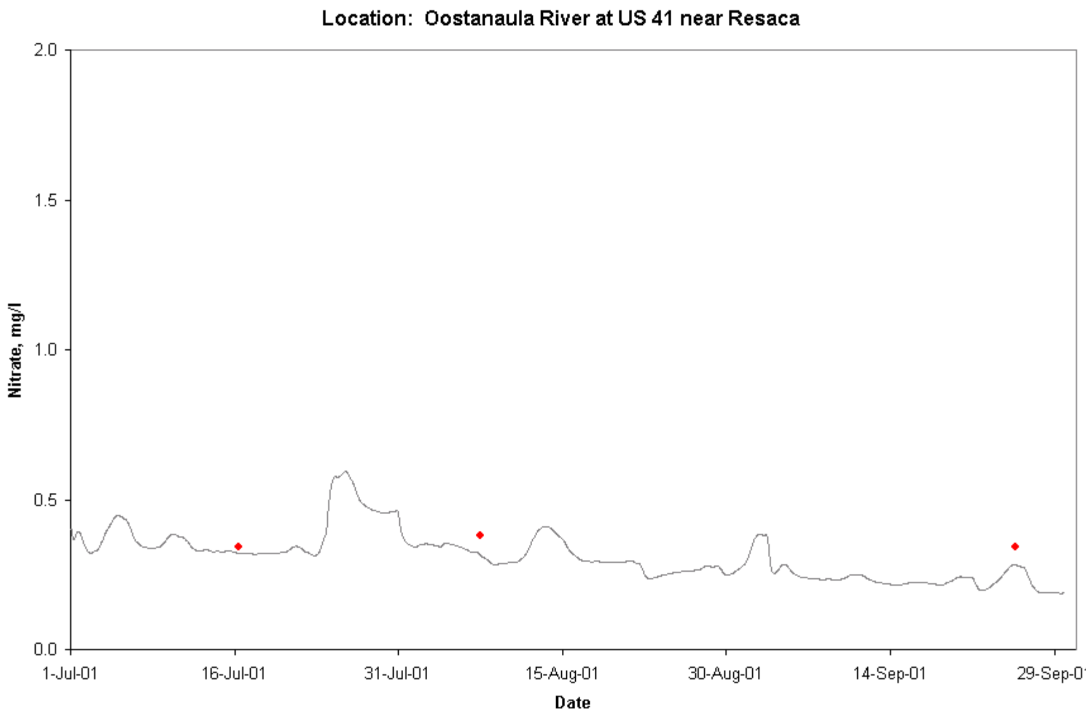
Nitrate Calibration – July through September 2001

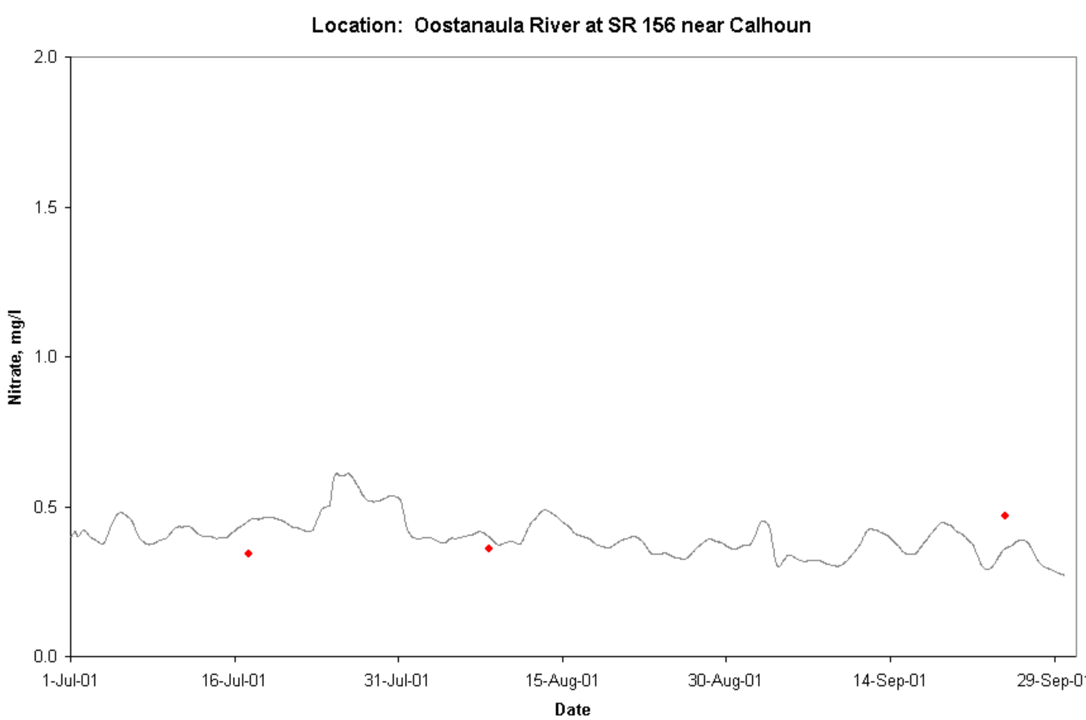


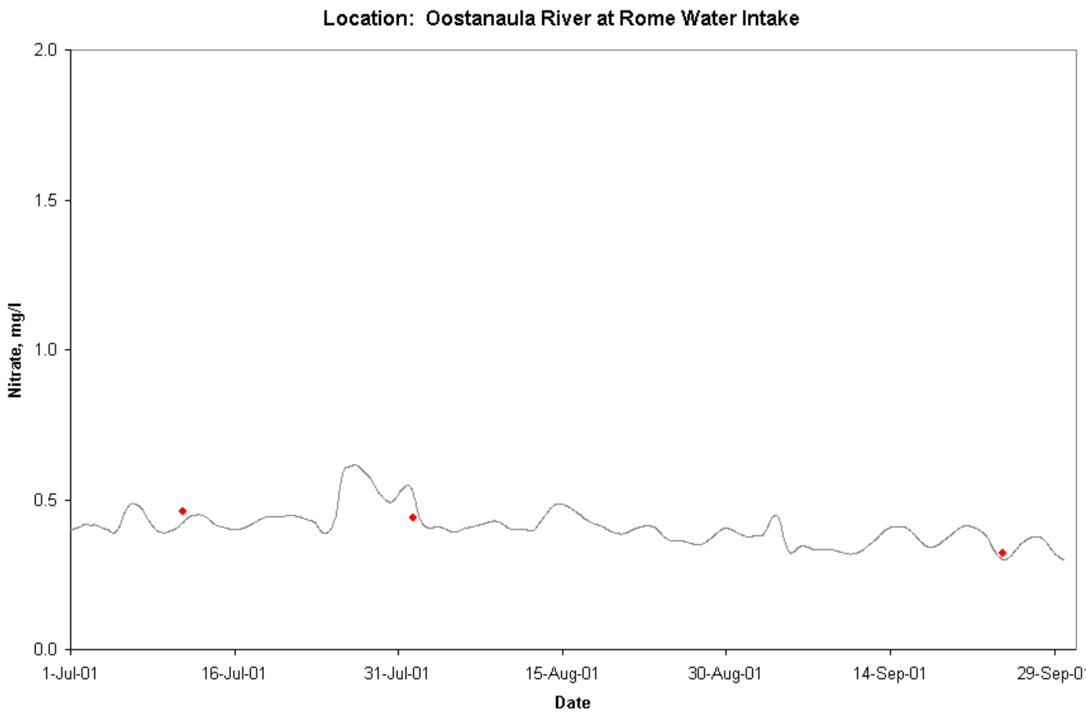


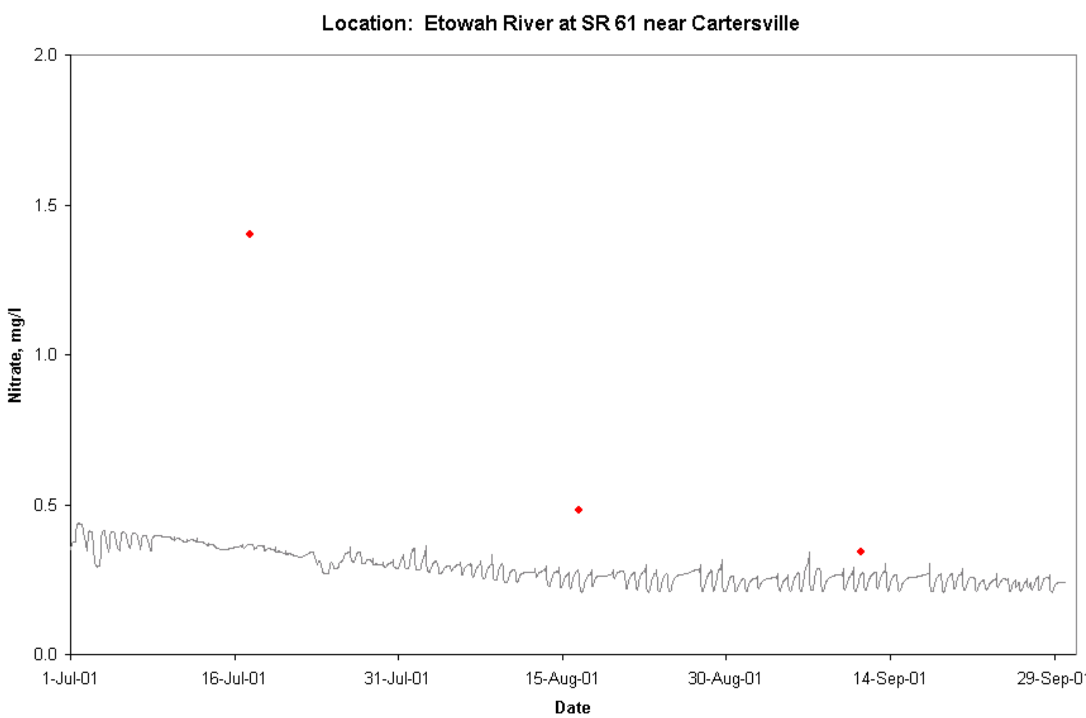

Location: Conasauga River at Sr 136 near Resaca
2.0
1.5
1.0
0.5
0.0
Nitrate, mg/l
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

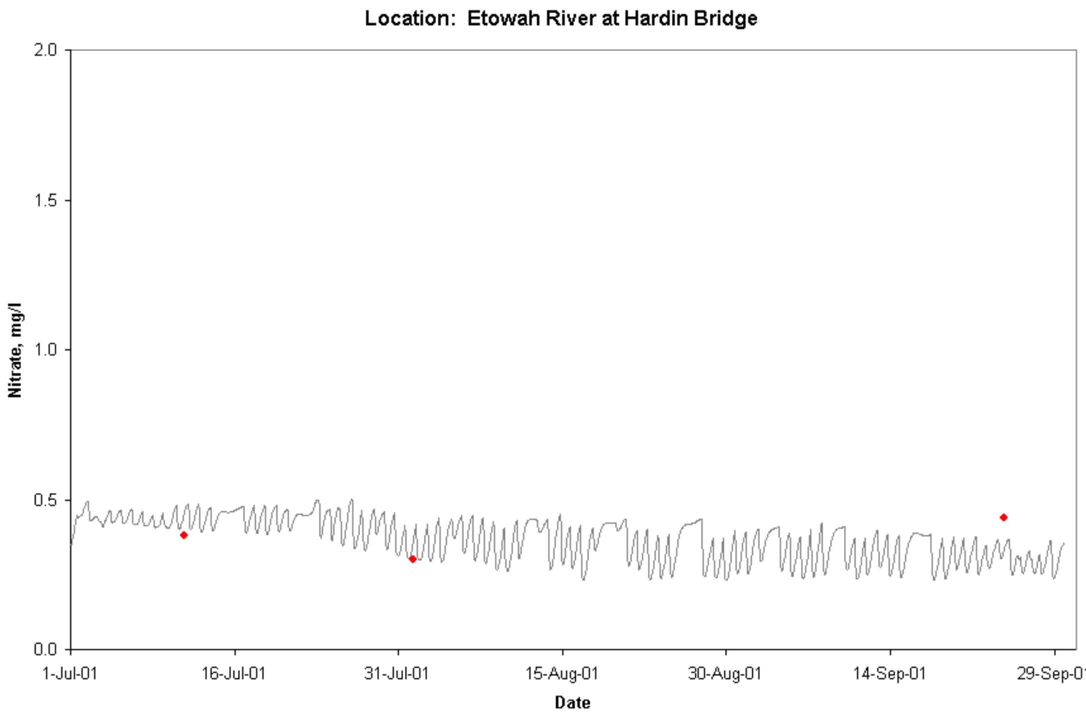

Location: Coosawattee River at Sr 225
2.0
1.5
1.0
0.5
0.0
Nitrate, mg/l
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

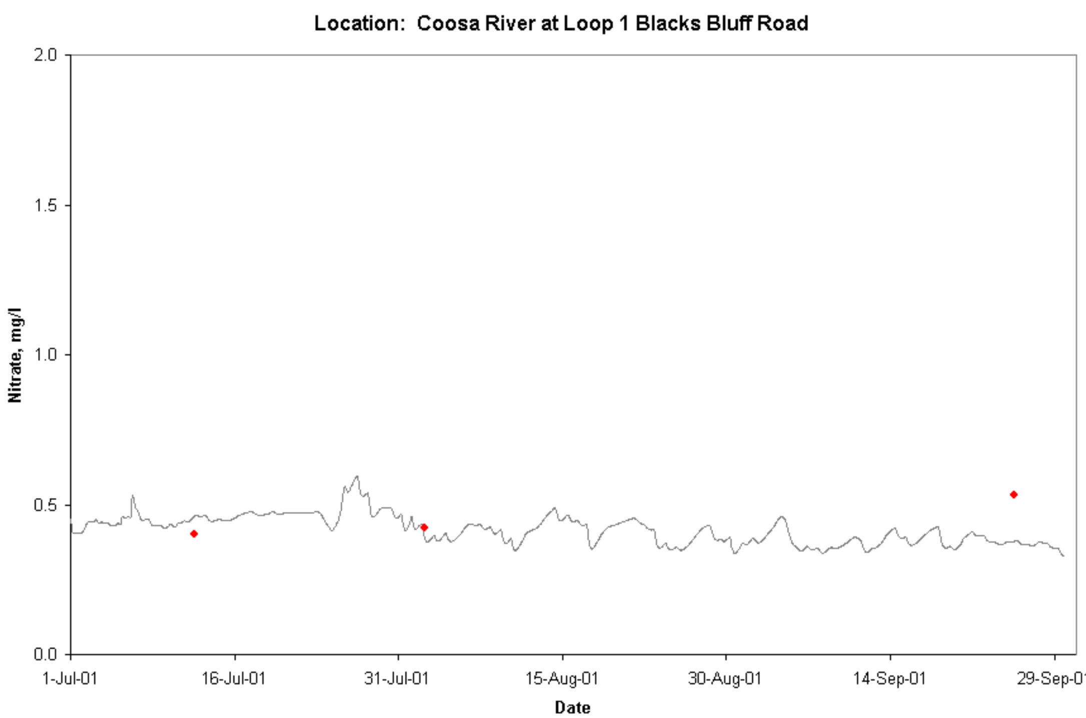

Location: Oostanaula River at US 41 near Resaca
Nitrate, mg/l
2.0
1.5
1.0
0.5
0.0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

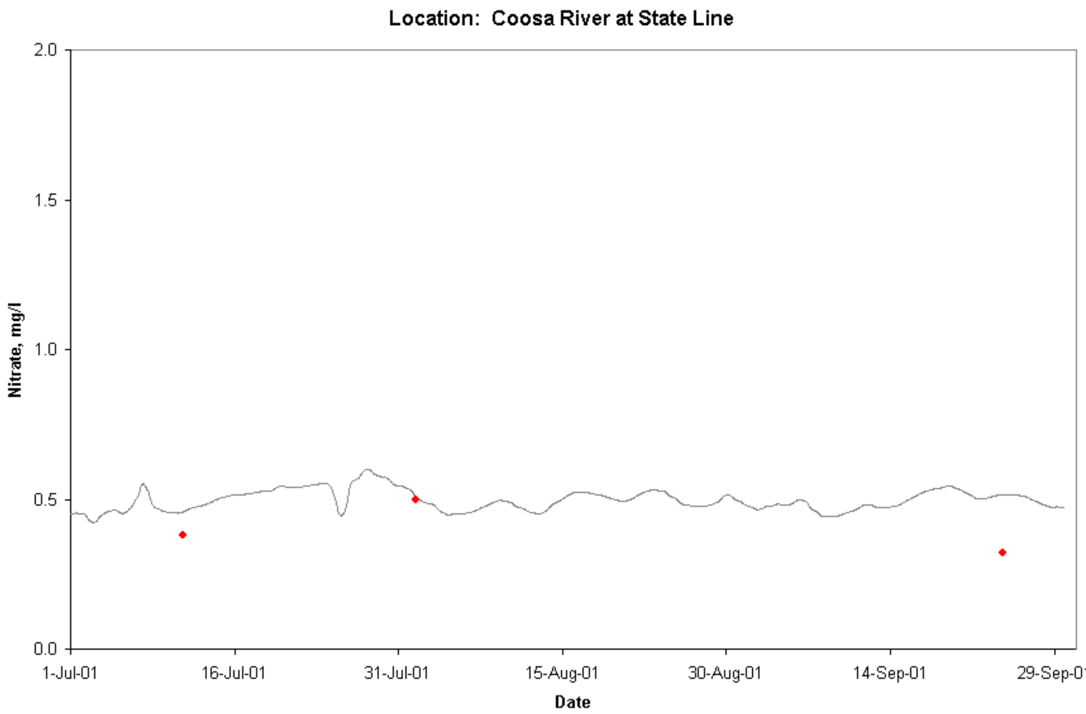

Location: Oostanaula River at SR 156 near Calhoun
Nitrate, mg/l
2.0
1.5
1.0
0.5
0.0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Oostanaula River at Rome Water Intake
2.0
1.5
1.0
0.5
0.0
Nitrate, mg/l
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

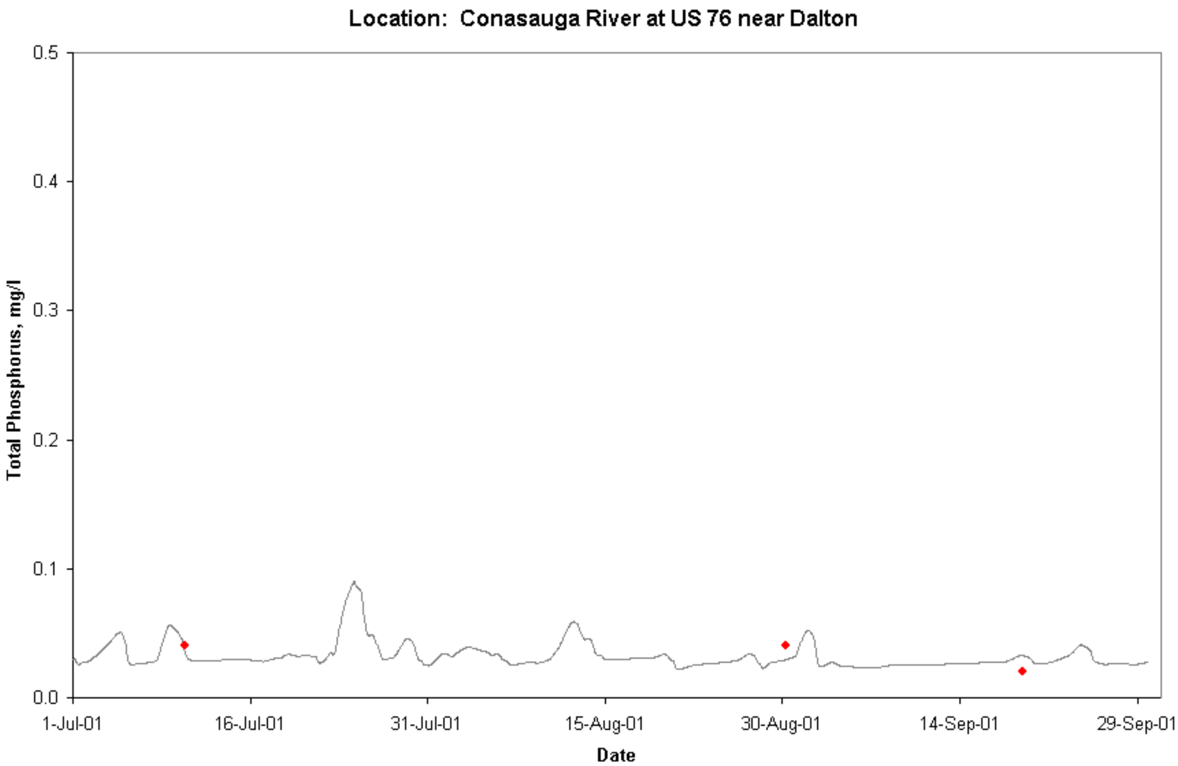

Location: Etowah River at SR 61 near Cartersville
2.0
1.5
1.0
0.5
0.0
Nitrate, mg/l
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

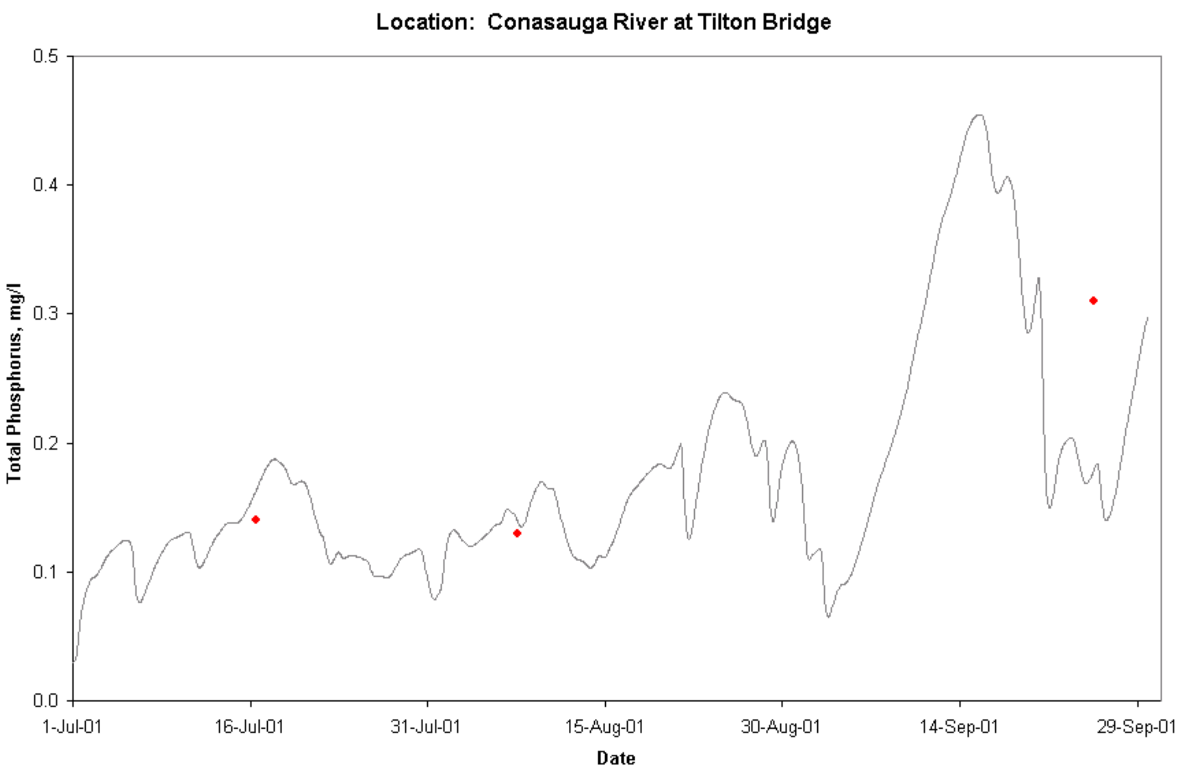

Location: Etowah River at Hardin Bridge
Nitrate, mg/l
2.0
1.5
1.0
0.5
0.0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

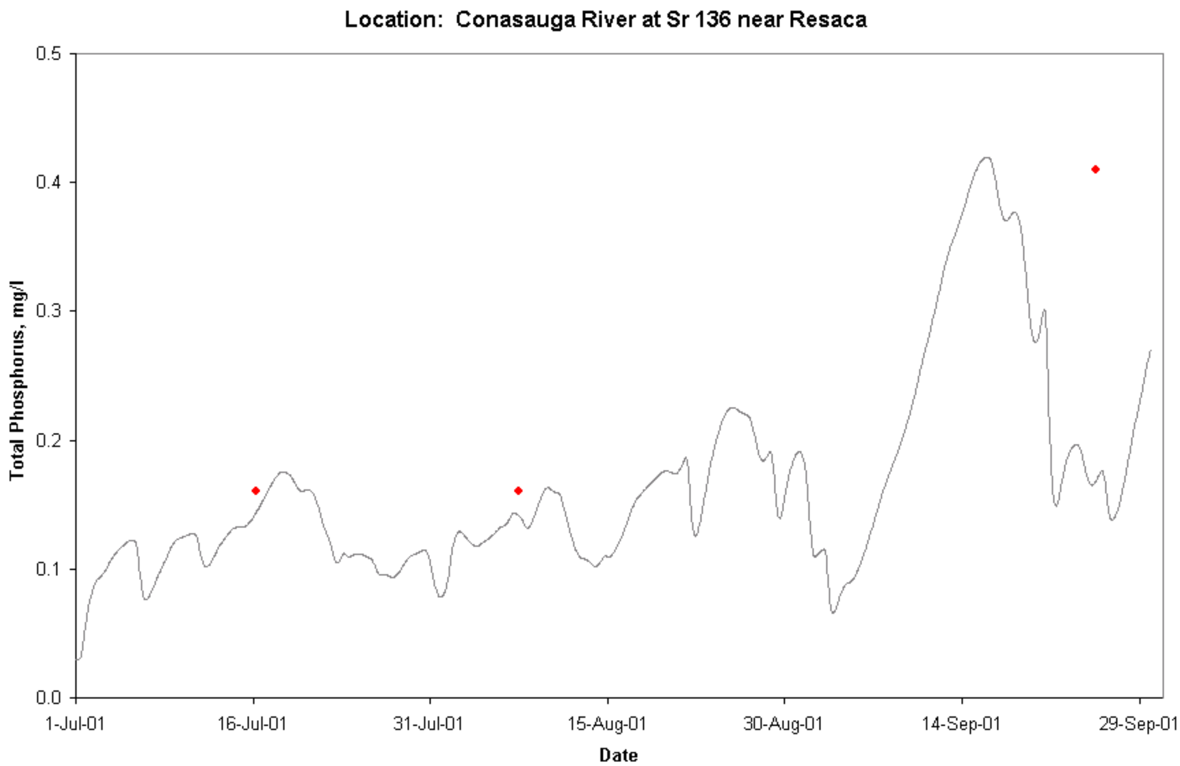

Location: Coosa River at Loop 1 Blacks Bluff Road
Nitrate, mg/l
2.0
1.5
1.0
0.5
0.0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

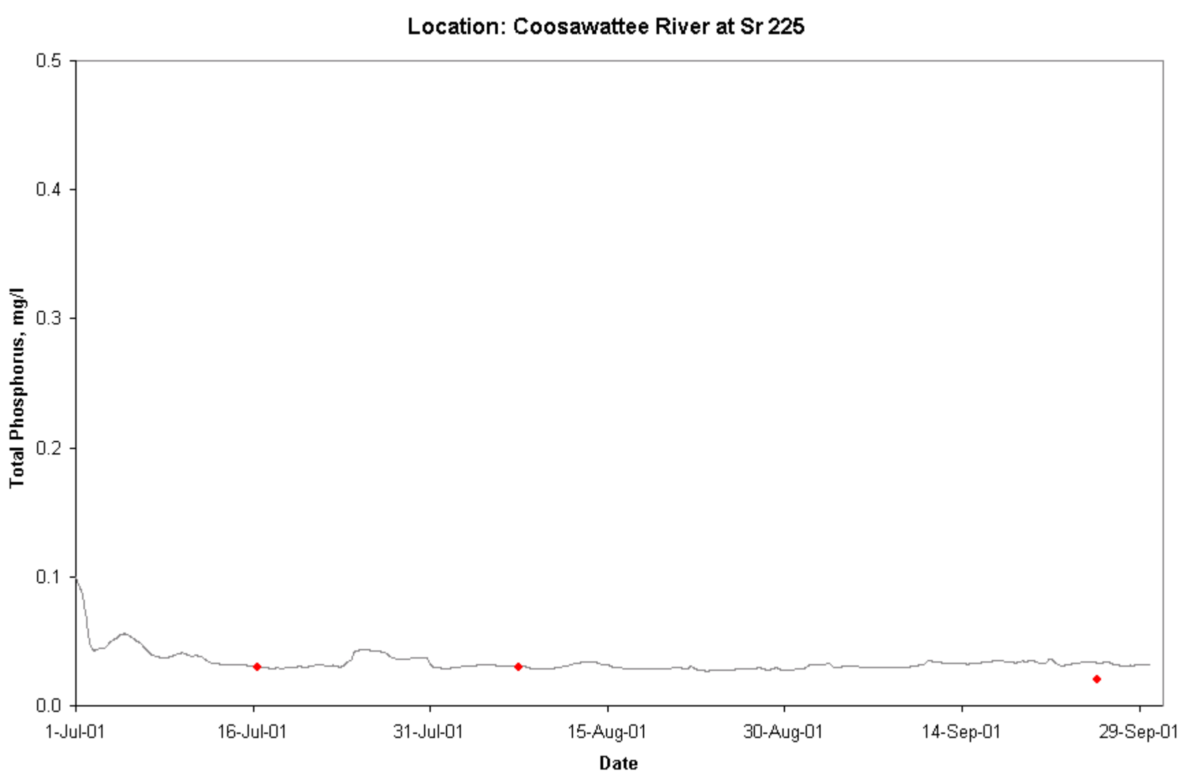

Location: Coosa River at State Line
2.0
1.5
1.0
0.5
0.0
Nitrate, mg/l
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

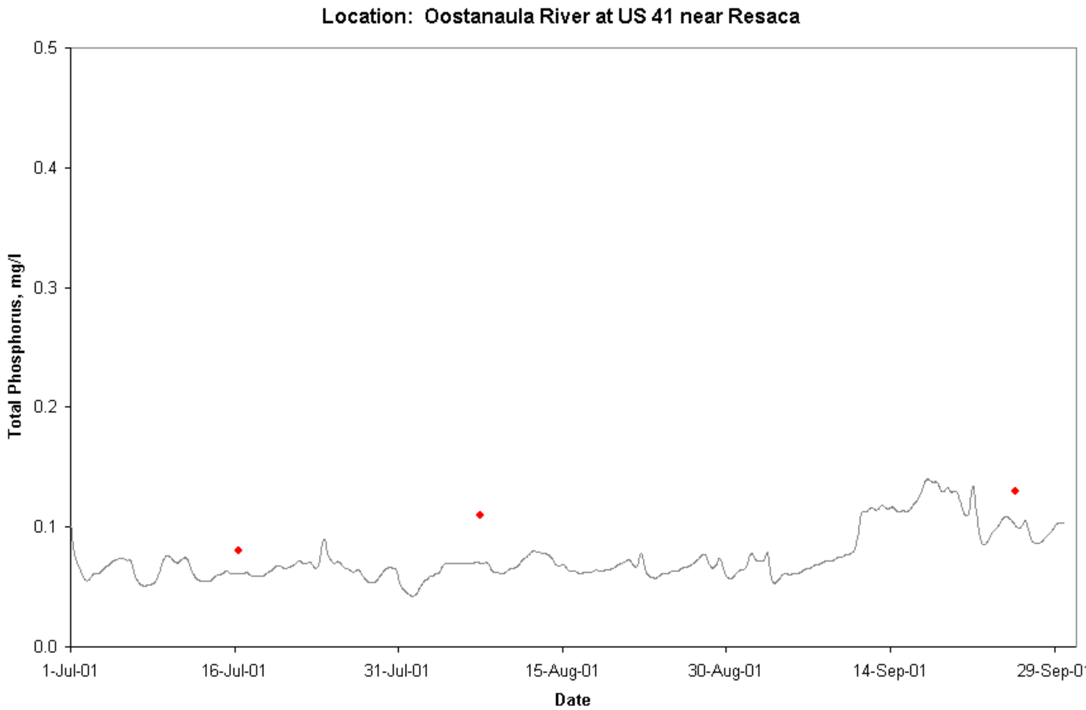
Total Phosphorus Calibration – July through September 2001

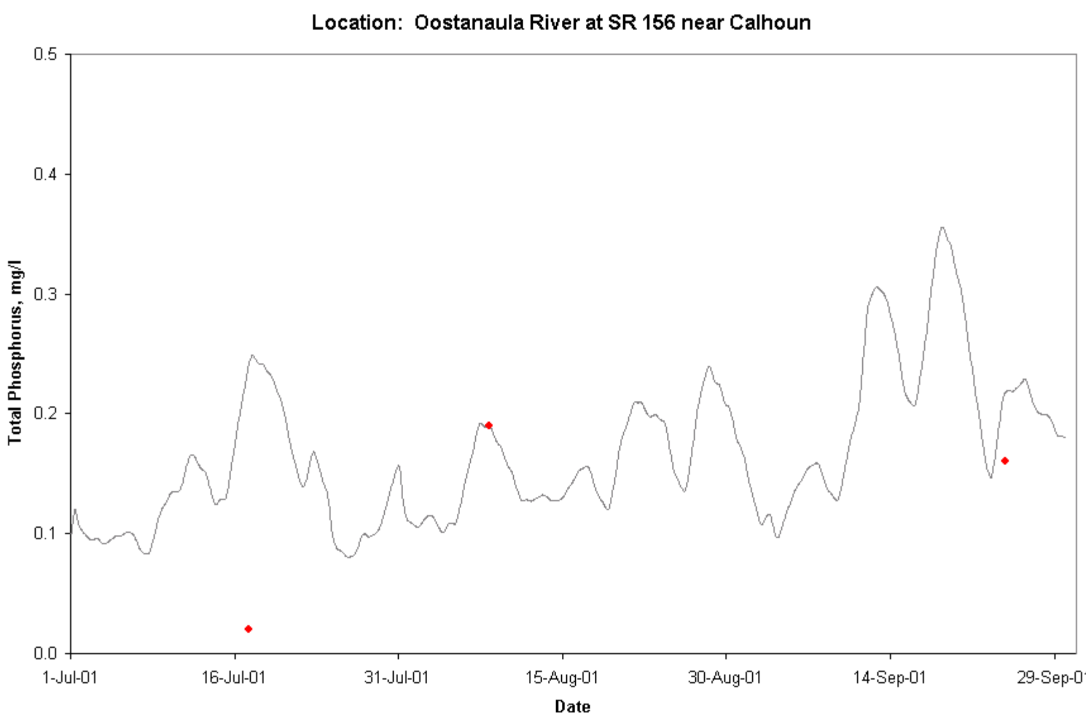


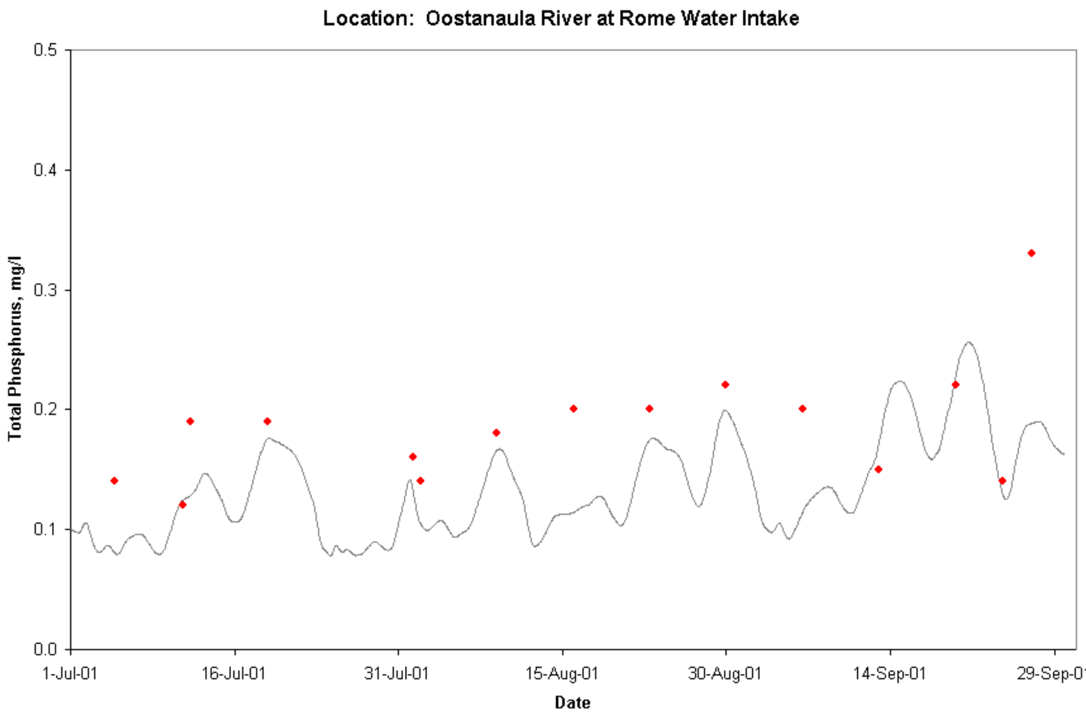


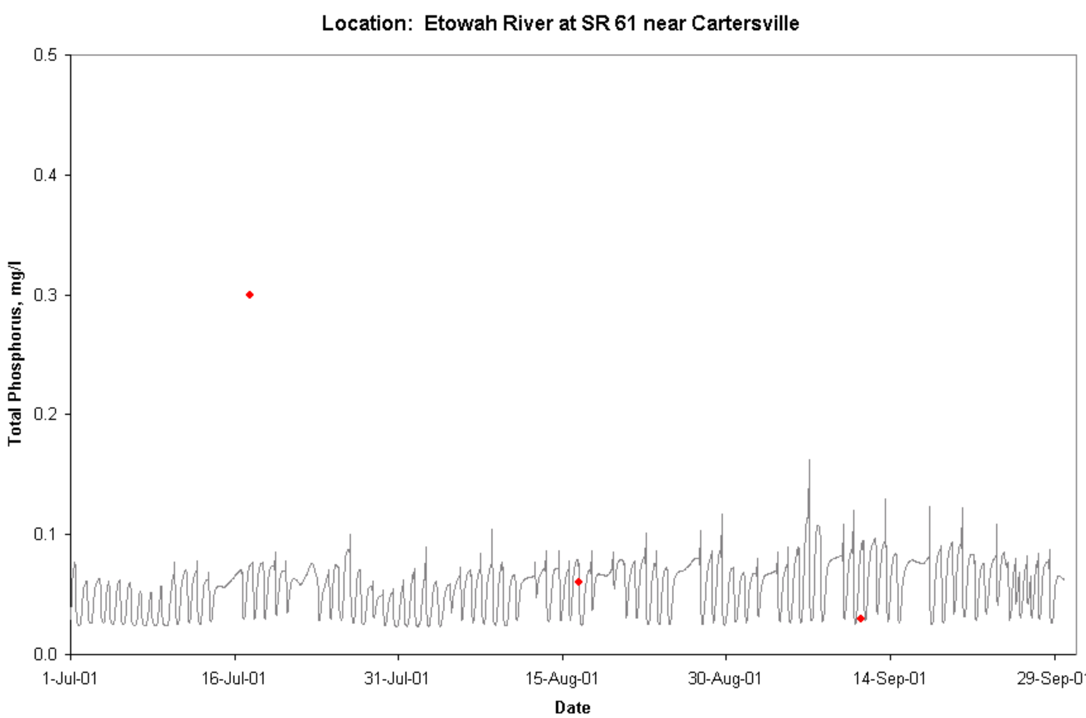

Location: Conasauga River at Sr 136 near Resaca
Total Phosphorus, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

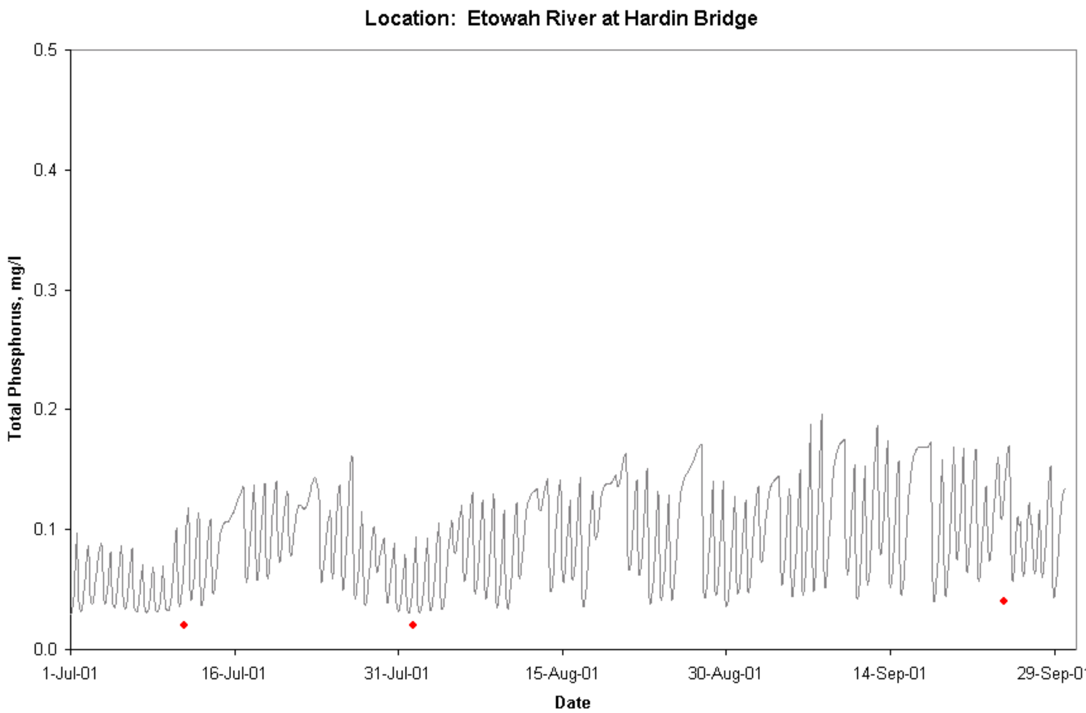

Location: Coosawattee River at Sr 225
Total Phosphorus, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

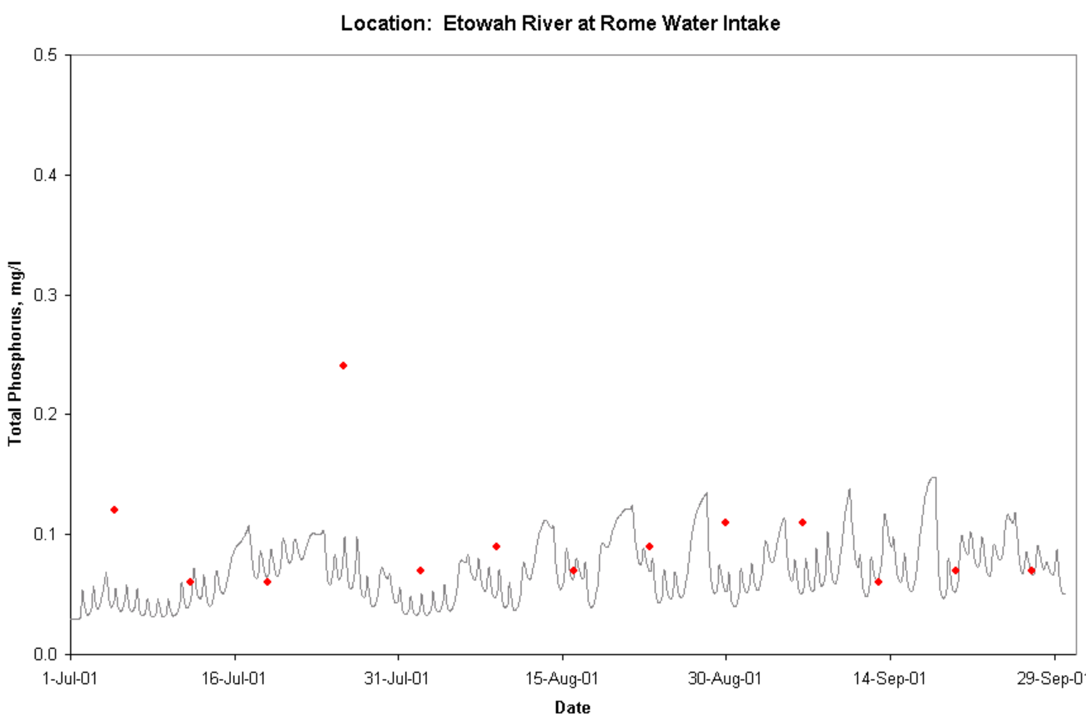

Location: Oostanaula River at US 41 near Resaca
Total Phosphorus, mg/l
0.5
0.4
0.3
0.2
0.1
0.0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

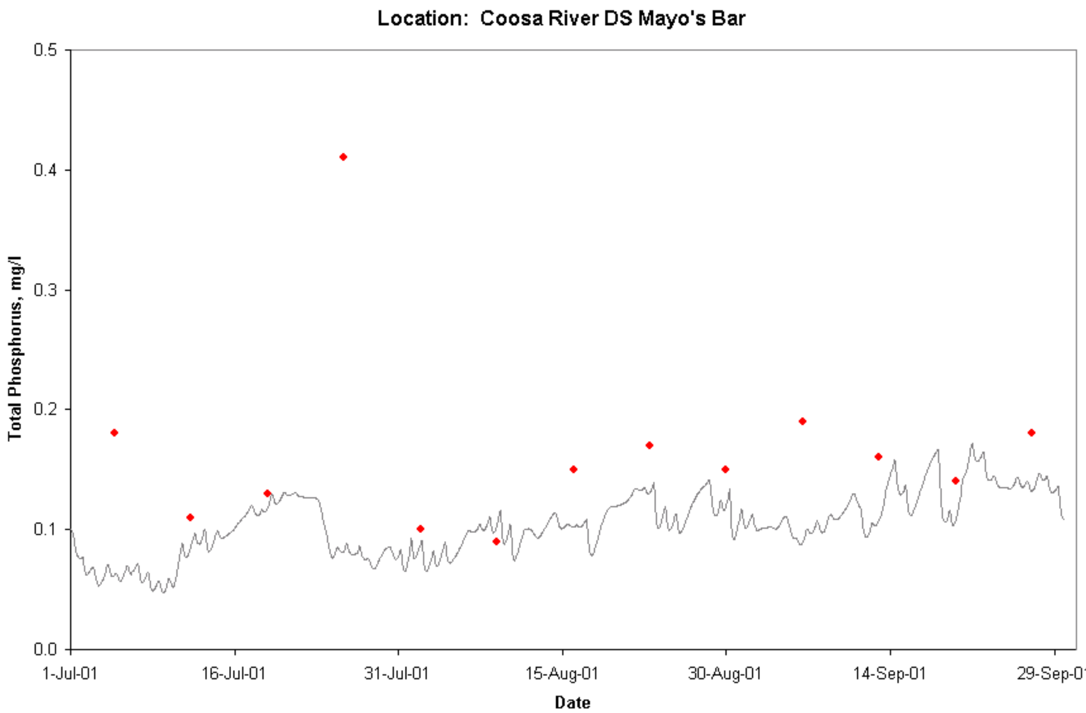

Location: Oostanaula River at SR 156 near Calhoun
Total Phosphorus, mg/l
0.5
0.4
0.3
0.2
0.1
0.0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

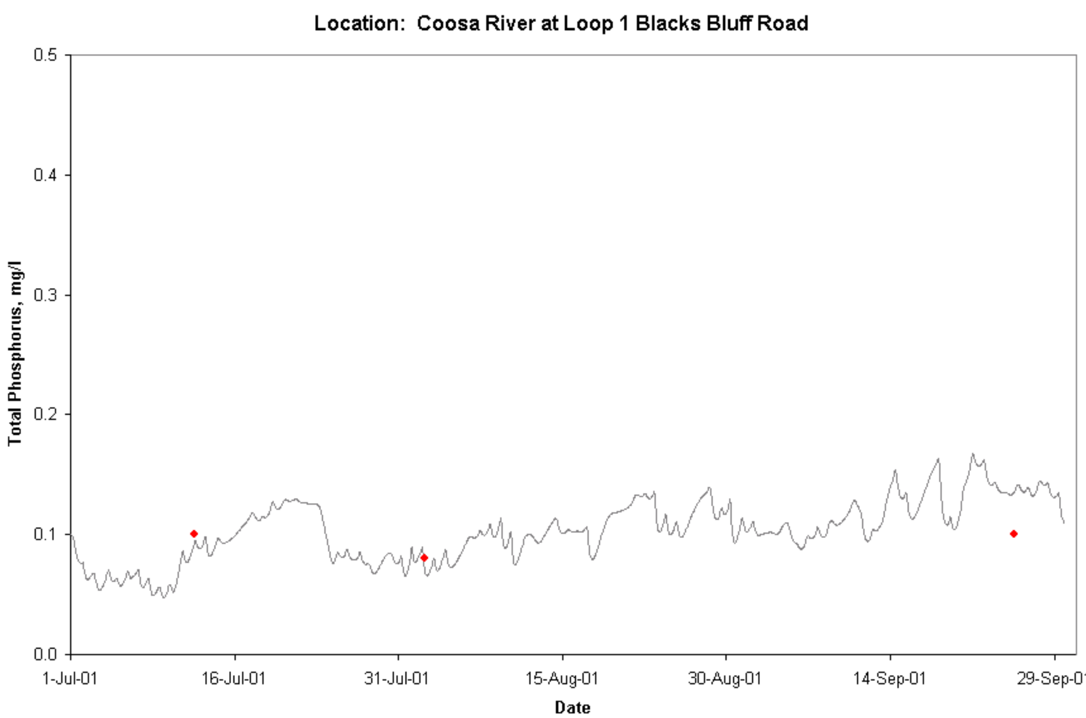

Location: Oostanaula River at Rome Water Intake
Total Phosphorus, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

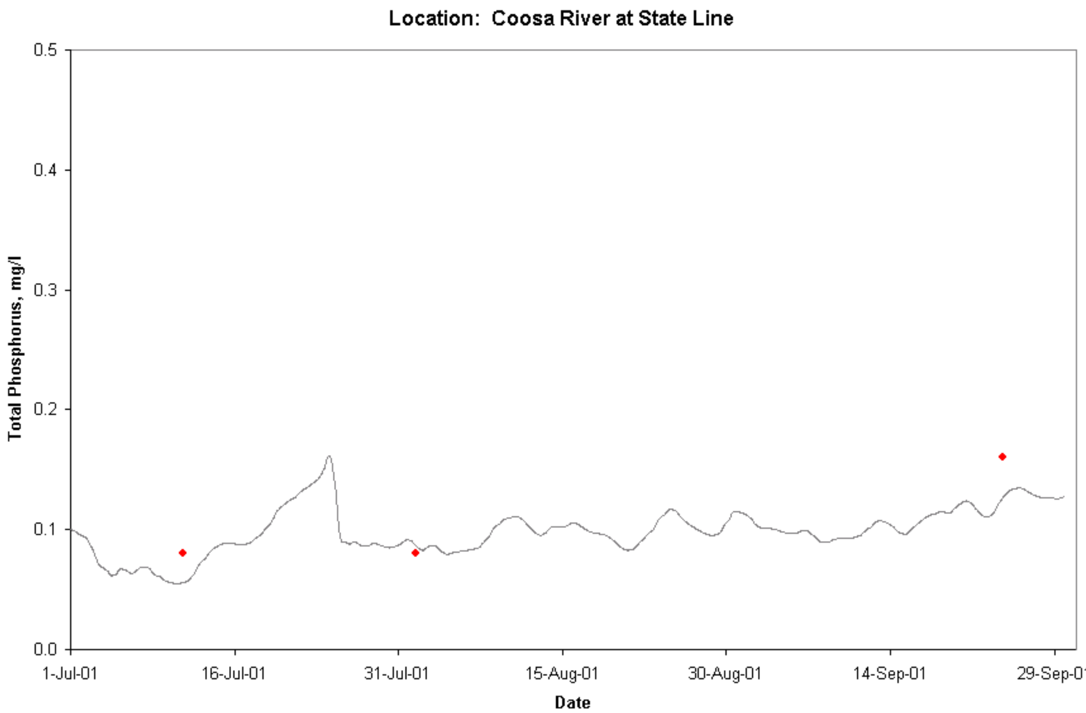

Location: Etowah River at SR 61 near Cartersville
Total Phosphorus, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Etowah River at Hardin Bridge
Total Phosphorus, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Etowah River at Rome Water Intake
Total Phosphorus, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Coosa River DS Mayo's Bar
Total Phosphorus, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Coosa River at Loop 1 Blacks Bluff Road
Total Phosphorus, mg/l
0.0
0.1
0.2
0.3
0.4
0.5
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date


Location: Coosa River at State Line
Total Phosphorus, mg/l
0.5
0.4
0.3
0.2
0.1
0.0
1-Jul-01
16-Jul-01
31-Jul-01
15-Aug-01
30-Aug-01
14-Sep-01
29-Sep-01
Date

APPENDIX B

Daily Oxygen Demanding Substances Load Summary Memorandum

SUMMARY MEMORANDUM
Annual Average Oxygen demanding substances Load
Coosa River

1. 303(d) Listed Waterbody Information

State: Georgia
County: Floyd

Major River Basin: Coosa
8-Digit Hydrologic Unit Code(s): 03150105

Waterbody Name: Coosa River
Location: Hwy 100 to State Line
Stream Length: 16 miles
Watershed Area: 4040 square miles
Ecoregion: Blue Ridge, Ridge and Valley, and Piedmont

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standard:

***Dissolved Oxygen*: 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 Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.**

***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.**

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.

***Temperature:* Not to exceed 90 degrees F (Fahrenheit). At no time is the temperature of the receiving waters to be increased more than 5 degrees F above intake temperature.**

2. TMDL Development

Analysis/Modeling:	**EPD RIV-1 – Hydrodynamic water quality model developed by Georgia Environmental Protection Division.**
Calibration Data:	**Coosa River – 2001 DO TMDL Study field data.**
Critical Conditions:	**1) 7Q10 flows based on the Low-Flow Analysis and ACT Allocation Formula of the Coosa River at Mayo's Bar. 2) Temperatures derived from 2001 Meteorological data. 3) All point source discharges at permit limits. 4) Velocities, kinetic rates, reaeration, and SOD as per the guidance provided in the Modeling Procedures Manual and developed during model calibration. 5) SOD, kinetic rates, reaeration, and boundary water quality conditions same as calibration conditions.**

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**44,748 lbs/day***
(WLAsw):	**NA under critical conditions**
Load Allocation (LA):	**31,406 lbs/day* under critical conditions**
Margin of Safety (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) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2001. 4) Water depths are shallow, generally less than one foot, which aggravates the effect of SOD**
Total Maximum Daily Load:	**76,155 lbs/day* under critical conditions**

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