Total Maximum Daily Load

Evaluation

for

Seventy-Nine Stream Segments

in the

Chattahoochee River Basin

For

Fecal coliform

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 three categories, supporting, partially supporting, or not supporting their designated uses, depending on water quality assessment results. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* every two years.

Some of the 305(b) partially and not supporting water bodies are also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality standard. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and 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 seventy-nine (79) stream segments located in the Chattahoochee River Basin as water quality limited due to fecal coliform. A stream is placed on the partial support list if more than 10% of the samples exceed the fecal coliform criteria and on the not support list if more than 25% of the samples exceed the standard. Water quality samples collected within a 30-day period that have a geometric mean in excess of 200 counts per 100 milliliters during the period May through October, or in excess of 1000 counts per 100 milliliters during the period November through April are in violation of the bacteria water quality standard. In addition, a single sample in excess of 4000 counts per 100 milliliters during the period November through April can also provide a basis for adding a stream segment to the 303(d) listing. The water use classifications of all of the impacted streams are Fishing, Recreation, and Drinking Water.

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 fecal coliform bacteria on land surfaces that washoff as a result of storm events.

The process of developing fecal coliform TMDLs for the Chattahoochee River Basin listed segments includes the determination of the following:

- The "current" critical fecal coliform load to the stream under "current" conditions;
- The TMDL for similar conditions under which the "current" load was determined; and
- The percent reduction in the "current" critical fecal coliform load necessary to achieve the TMDL.

The calculation of the fecal coliform load at any point in a stream requires the fecal coliform concentration and stream flow. The availability of water quality and flow data varies considerably among the listed segments. Two different approaches were used depending on data availability: Loading Curve Approach and Equivalent Site Approach. The fecal coliform loads and required reductions for each of the listed segments are summarized in the table below.

Fecal Loads and Required Fecal Load Reductions

Stream Segment	Current Load (cnts/30 days)	TMDL Components					Percent Reduction
		WLA (cnts/30 days)	WLA_{SW} (cnts/30 days)	LA (cnts/30 days)	MOS (cnts/30 days)	TMDL (cnts/30 days)	
Anneewakee Creek	3.95E+12	6.69E+11		2.38E+12	3.39E+11	3.39E+12	14%
Arrow Creek	6.87E+12		4.48E+11	1.99E+11	7.19E+10	7.19E+11	90%
Ball Mill Creek	2.49E+12		2.08E+11	1.01E+11	1.23E+11	1.23E+12	51%
Balus Creek	5.17E+12			1.70E+12	1.89E+11	1.89E+12	64%
Big Creek - Headwaters to Cheatham Creek	7.73E+12	2.12E+11		5.34E+12	1.39E+11	1.39E+12	82%
Big Creek - Hwy 400 to Chattahoochee River	1.01E+13		2.43E+11	1.00E+12	6.17E+11	6.17E+12	39%
Bishop Creek	2.04E+11		6.64E+10	2.97E+10	1.07E+10	1.07E+11	48%
Blue John Creek	2.34E+12			1.14E+12	1.27E+11	1.27E+12	46%
Bubbling Creek	2.87E+12		1.23E+11	5.49E+10	1.97E+10	1.97E+11	93%
Bull Creek	2.86E+12		1.65E+11	4.43E+11	6.75E+10	6.75E+11	76%
Burnt Fork Creek	1.02E+13		9.27E+11	4.56E+11	1.54E+11	1.54E+12	85%
Buttermilk Creek	5.67E+11		1.43E+11	1.07E+11	2.78E+10	2.78E+11	51%
Camp Creek	9.86E+14		4.41E+13	1.04E+14	1.64E+13	1.64E+14	83%
Chattahoochee River - Ga Hwy 17, Helen	2.97E+14			4.08E+13	4.54E+12	4.54E+13	85%
Chattahoochee River - Morgan Falls Dam to Peachtree Creek	3.16E+14	5.15E+12	5.68E+13	8.57E+13	1.64E+13	1.64E+14	48%
Chattahoochee River - Peachtree Creek to Utoy Creek	4.54E+14	2.73E+13	5.78E+13	7.07E+13	1.78E+13	1.78E+14	61%
Chattahoochee River - Utoy Creek to Pea Creek	2.02E+15	8.50E+12	1.07E+14	1.81E+14	3.29E+13	3.29E+14	84%
Chattahoochee River - Pea Creek to Wahoo Creek	2.28E+15	8.65E+10	9.33E+13	2.21E+14	3.50E+13	3.50E+14	85%
Chattahoochee River - Wahoo Creek to Franklin	1.26E+16	2.39E+18		3.59E+17	3.99E+16	3.99E+17	83%
Chattahoochee River - North Highland Dam to Upatoi Creek	5.11E+15	5.73E+12	1.60E+12	3.40E+14	3.86E+13	3.86E+14	92%
Chattahoochee River - Upatoi Creek to Railroad	1.26E+15	3.41E+11		4.40E+14	4.90E+13	4.90E+14	61%
Chattahoochee River - Downstream W.F. George Dam	3.14E+14	9.10E+09		2.70E+14	3.00E+13	3.00E+14	5%
Clear Creek	3.38E+13	Q*200[a]	2.25E+11	1.05E+11	3.66E+10	3.66E+11	99%
Cracker Creek	1.11E+12			3.41E+11	3.79E+10	3.79E+11	66%
Crawfish Creek	6.40E+12			3.78E+12	4.20E+11	4.20E+12	34%
Crooked Creek	3.62E+12		4.68E+11	2.85E+11	8.36E+10	8.36E+11	77%
Flat Creek	1.49E+13	1.57E+12		6.75E+11	2.49E+11	2.49E+12	83%
Foe Killer Creek	7.72E+11		3.93E+11	2.69E+11	7.35E+10	7.35E+11	5%
Foxwood Branch	9.75E+10		4.08E+10	1.75E+10	6.48E+09	6.48E+10	34%
Hilly Mill Creek	5.60E+12			2.46E+12	2.74E+11	2.74E+12	51%
Hog Waller Creek	2.69E+11		1.38E+11	7.45E+10	2.36E+10	2.36E+11	12%

Stream Segment	Current Load (cnts/30 days)	TMDL Components					Percent Reduction
		WLA (cnts/30 days)	WLA_{SW} (cnts/30 days)	LA (cnts/30 days)	MOS (cnts/30 days)	TMDL (cnts/30 days)	
Johns Creek	3.26E+12		5.86E+11	5.46E+11	1.26E+11	1.26E+12	61%
Kelly Mill Branch	4.23+11			3.47E+11	4.12E+10	4.12E+11	3%
Level Creek	2.72E+13		1.36E+12	2.15E+12	3.90E+11	3.90E+12	86%
Long Cane Creek	6.40E+12			3.16E+12	4.84E+11	4.84E+12	24%
Long Island Creek	5.69E+11		1.67E+11	8.02E+10	2.75E+10	2.75E+11	52%
Lullwater Creek	3.45E+12		4.76E+11	2.58E+11	8.16E+10	8.16E+11	76%
Marsh Creek	9.64E+11		2.22E+11	1.24E+11	3.85E+10	3.85E+11	60%
Mobley Creek	4.38E+12			1.85E+12	2.05E+11	2.05E+12	53%
Mountain Oak Creek	1.76E+12			1.52E+12	1.68E+11	1.68E+12	5%
Mud Creek	8.47E+11			6.43E+11	7.14E+10	7.14E+11	16%
Mud Creek	3.23E+12		6.23E+11	8.85E+11	1.68E+11	1.68E+12	48%
Mulberry Creek	1.69E+12			1.37E+12	1.53E+11	1.53E+12	10%
Nancy Creek	2.70E+13		2.57E+12	1.26E+12	4.25E+11	4.25E+12	84%
New River	1.59E+12			4.26E+11	4.73E+10	4.73E+11	70%
Nickajack Creek	3.59E+12		3.41E+11	2.86E+11	6.97E+10	6.97E+11	81%
North Fork Balus Creek	9.55E+11			4.23E+11	4.70E+10	4.70E+11	51%
North Fork Peachtree Creek	1.68E+14		9.32E+12	4.54E+12	1.54E+12	1.54E+13	91%
North Utoy Creek	1.60E+12		1.23E+11	8.15E+10	2.28E+10	2.28E+11	86%
Olley Creek	1.20E+12		3.28E+11	2.27E+11	6.17E+10	6.17E+11	49%
Orr Creek	5.02E+12	2.56E+11		1.41E+11	4.42E+10	4.42E+11	91%
Pataula Creek	1.58E+13			1.35E+13	1.50E+12	1.50E+13	5%
Pea Creek	2.20E+12		1.26E+11	1.32E+12	1.60E+11	1.60E+12	27%
Peachtree Creek	3.22E+14		2.79E+12	1.43E+12	4.69E+11	4.69E+12	99%
Peavine Creek	8.52E+12		1.09E+12	5.32E+11	1.80E+11	1.80E+12	79%
Proctor Creek	2.55E+13	Q*200[a]	4.55E+11	2.84E+11	8.22E+10	8.22E+11	97%
Richland Creek	3.32E+13	3.54E+10	1.42E+12	3.08E+12	5.04E+11	5.04E+12	85%
Rocky Branch	1.44E+11		1.01E+10	1.02E+10	2.26E+09	2.26E+10	84%
Rottenwood Creek	3.02E+12	4.10E+11	2.98E+11	1.74E+11	9.79E+10	9.79E+11	68%
Sandy Creek	4.21E+11		1.59E+10	1.09E+10	2.97E+09	2.97E+10	93%
Sewell Mill Creek	1.08E+12		4.50E+11	2.29E+11	7.55E+10	7.55E+11	30%
Sope Creek	3.87E+14		3.73E+13	2.09E+13	6.46E+12	6.46E+13	83%
Soquee River	1.46E+13	4.60E+10		8.60E+12	9.61E+11	9.61E+12	34%
South Fork Peachtree Creek	1.02E+14		8.86E+11	4.72E+11	1.51E+11	1.51E+12	99%

Stream Segment	Current Load (cnts/30 days)	TMDL Components					Percent Reduction
		WLA (cnts/30 days)	WLA_{SW} (cnts/30 days)	LA (cnts/30 days)	MOS (cnts/30 days)	TMDL (cnts/30 days)	
South Utoy Creek	2.21E+12		1.47E+11	9.62E+10	2.70E+10	2.70E+11	88%
Suwanee Creek	5.80E+13	1.76E+11	2.53E+12	5.05E+12	8.62E+11	8.62E+12	85%
Sweetwater Creek- Paulding/Cobb	1.09E+13		3.67E+12	8.35E+12	6.53E+11	6.53E+12	40%
Sweetwater Creek - Cobb/Douglas	1.59E+13		2.49E+11	5.63E+12	1.33E+12	1.33E+13	16%
Tanyard Branch	3.11E+13	Q*200[a]	1.49E+11	6.37E+10	2.36E+10	2.36E+11	99%
Tanyard Creek	6.32E+11			1.02E+11	1.14E+10	1.14E+11	82%
Testnatee Creek - Cleveland	5.78E+12	6.83E+10		3.23E+12	3.67E+11	3.67E+12	37%
Testnatee Creek - Town Creek to Chestatee River	5.78E+12			3.30E+12	3.67E+11	3.67E+12	37%
Tributary to Mud Creek	2.36E+11		7.58E+10	1.39E+11	2.39E+10	2.39E+11	0%
Utoy Creek	5.53E+12		3.61E+11	3.19E+11	7.56E+10	7.56E+11	86%
Ward Creek	5.79E+11		2.11E+11	1.17E+11	3.65E+10	3.65E+11	37%
Weracoba Creek	5.64E+11		3.98E+10	3.76E+10	8.60E+09	8.60E+10	85%
White Oak Creek	2.50E+12		8.43E+10	1.61E+12	1.89E+11	1.89E+12	25%
Willeo Creek	1.51E+12		6.98E+11	3.68E+11	1.18E+11	1.18E+12	22%
Woodall Creek	2.15E+13		8.12E+10	4.64E+10	1.42E+10	1.42E+11	99%

Note: The TMDL was developed for the “current” critical conditions. The average stream flow for the critical period was used to determine the TMDL and the corresponding monthly average discharge from each wastewater treatment facility was used to determine the WLA.

Management practices that may be used to help reduce and/or maintain the average annual sediment loads include:

- Compliance with NPDES permit limits and requirements
- Adoption of NRCS Conservation Practices
- Application of Best Management Practices (BMPs) appropriate to agricultural or urban land uses, whichever applies

The amount of fecal coliform delivered to a stream is difficult to determine. However, by requiring and monitoring the implementation of these management 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 three categories, supporting, partially supporting, or not supporting their designated uses depending on water quality assessment results. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that addresses the assessment process, and are published in *Water Quality in Georgia* every two years.

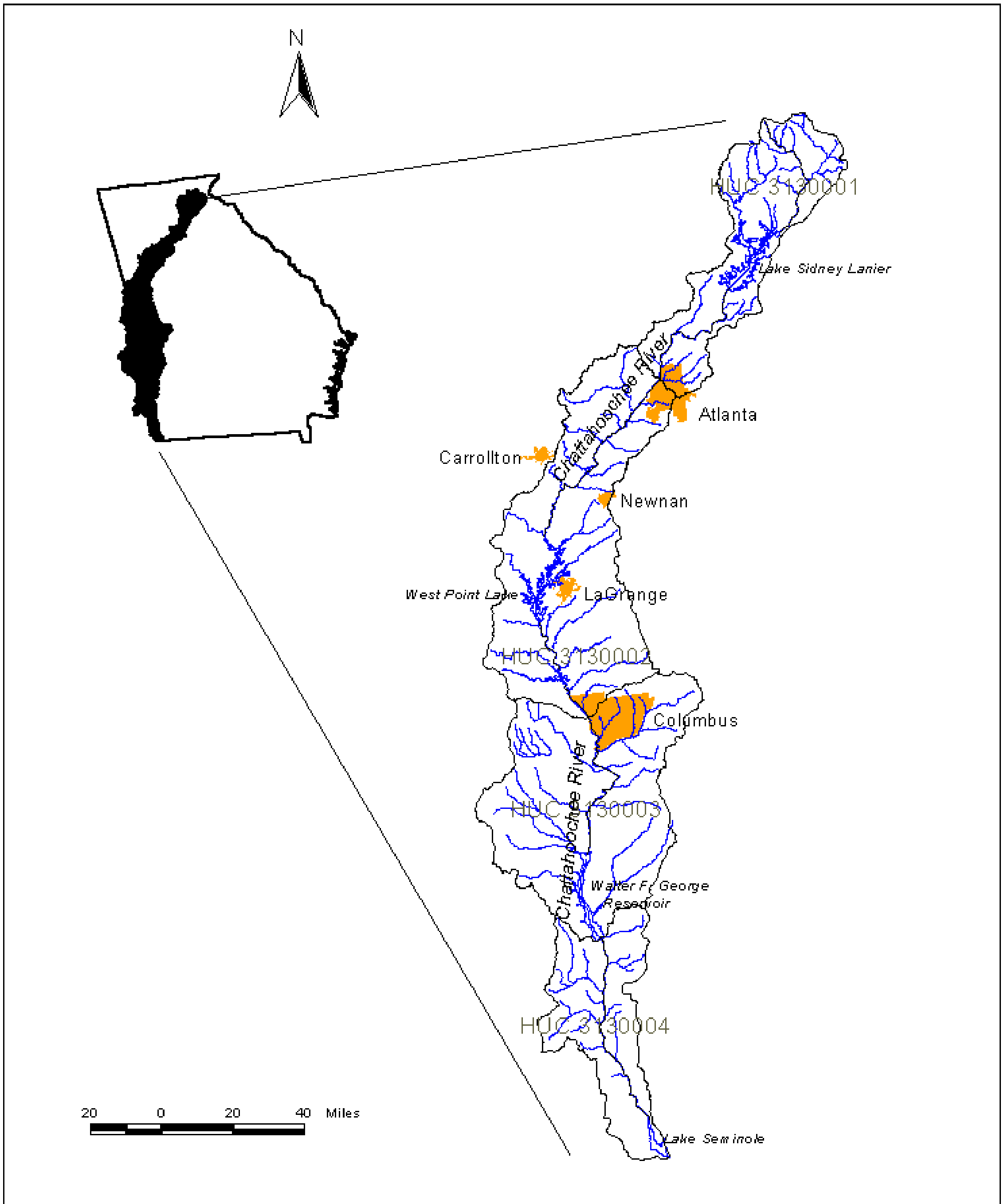
Some of the 305(b) partially and not supporting water bodies are also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality standard. The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution 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.

EPA Region 4 approved Georgia's final 2002 303(d) list on April 30, 2002. The list identifies the waterbodies as either not supporting or partially supporting designated use classifications, due to exceedances of water quality standards for fecal coliform bacteria. Fecal coliform bacteria are used as an indicator of the potential presence of pathogens in a stream. Table 1 presents the streams of the Chattahoochee River Basin included on the 303(d) list for exceedances of the fecal coliform standard criteria. A total of 35 stream segments were listed as partially supporting the designated use, and 44 stream segments were listed as not supporting their designated use.

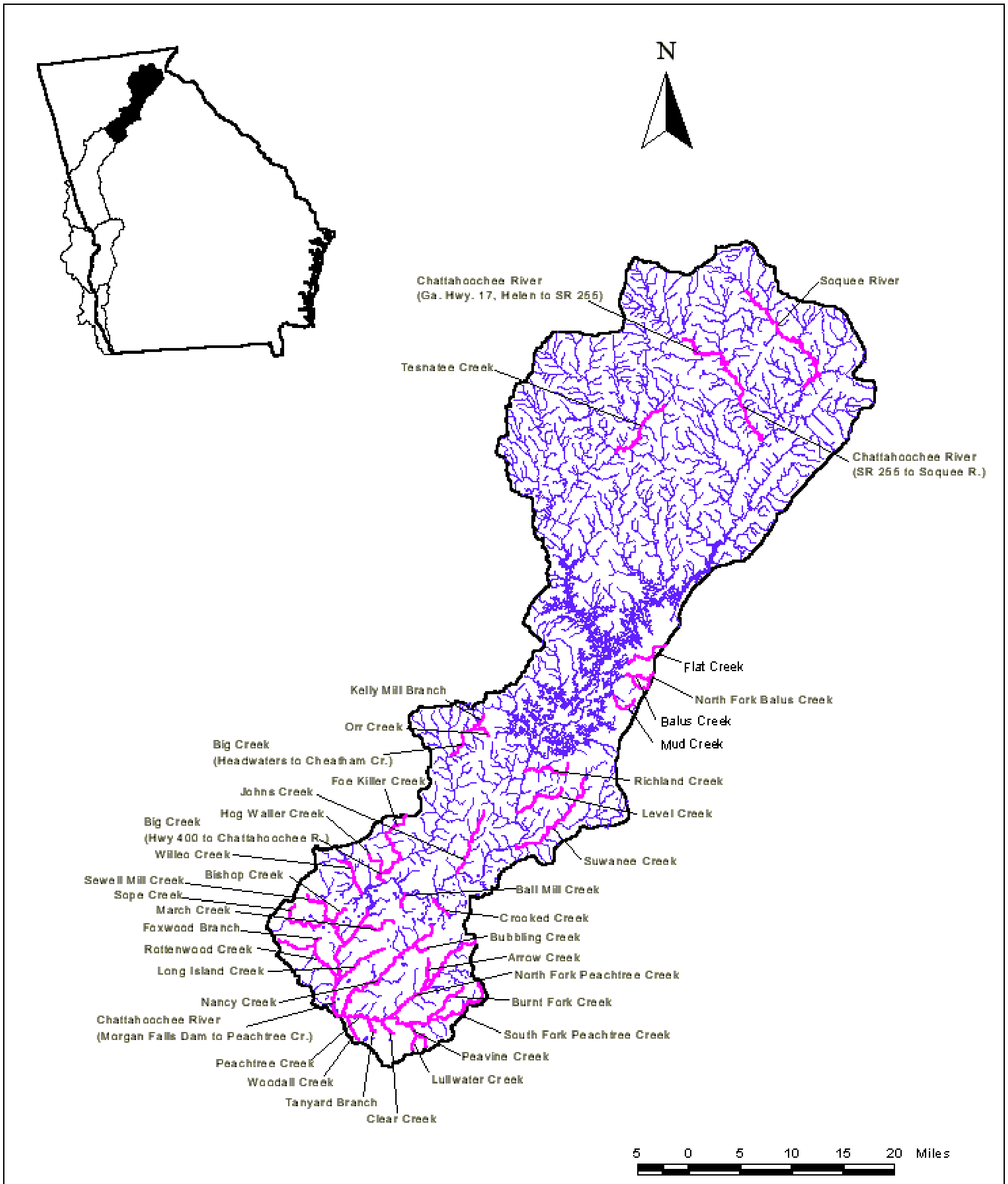
1.2 Watershed Description

The Chattahoochee River originates in the southeast corner of Union County, in north Georgia, within the Blue Ridge Mountains (Figure 1). The river flows southwest to Lake Sidney Lanier (Lake Lanier), then through the Atlanta metropolitan area to West Point Lake on the Alabama border. At this point, the Chattahoochee forms the border between Georgia and Alabama. It continues flowing south through Walter F. George Reservoir and converges with the Flint River in Lake Seminole, at the Georgia-Florida border. The outflow from Lake Seminole forms the Apalachicola River in Florida, which ultimately discharges to the Gulf of Mexico. The Chattahoochee River Basin contains parts of the Blue Ridge, Piedmont, and Coastal Plain physiographic provinces that extend throughout the southeastern United States (EPD, 1997).

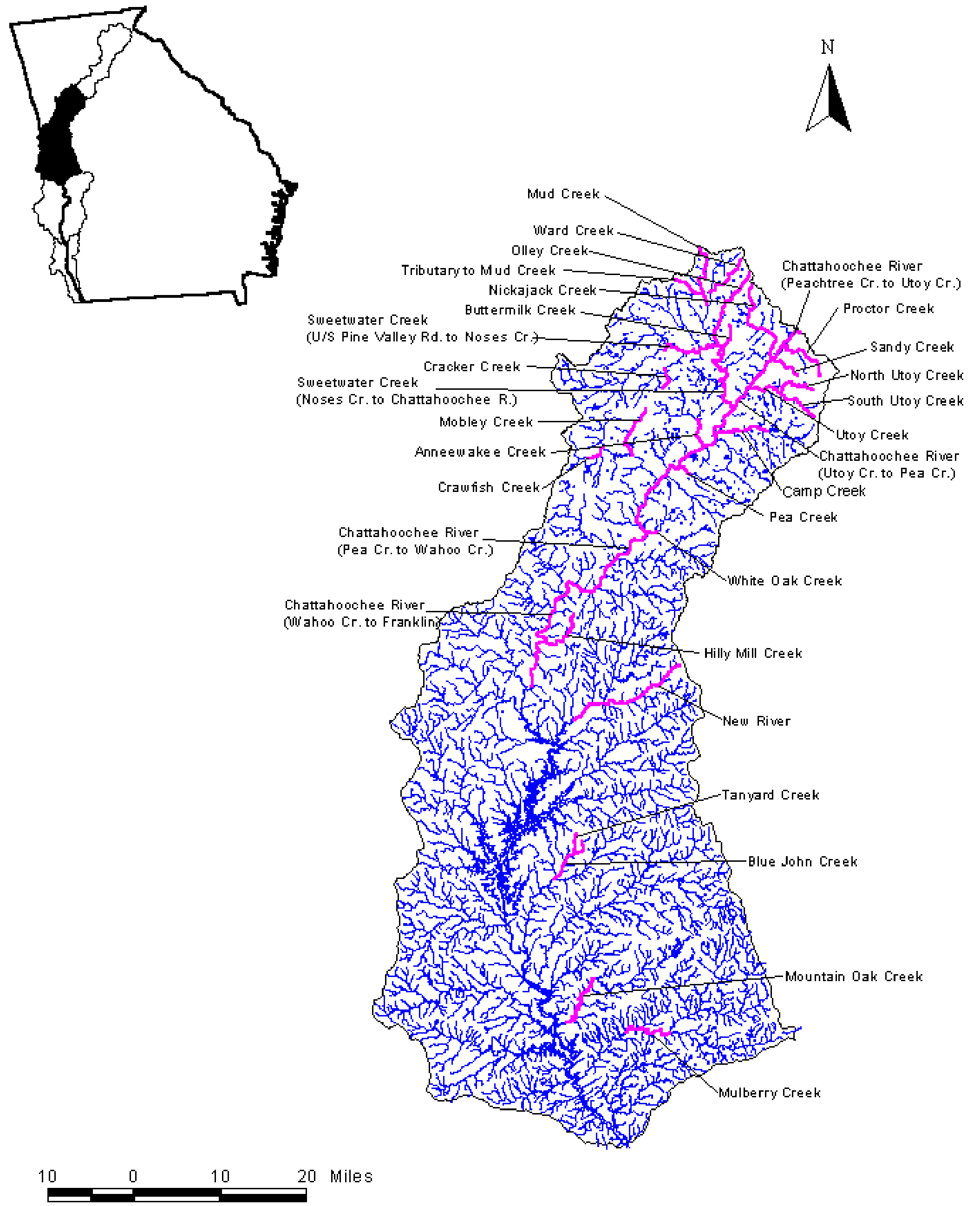
The USGS has divided the Chattahoochee basin into four sub-basins, or Hydrologic Unit Codes (HUCs). Figures 2 through 4 show the location of these sub-basins and the associated counties within each sub-basin.



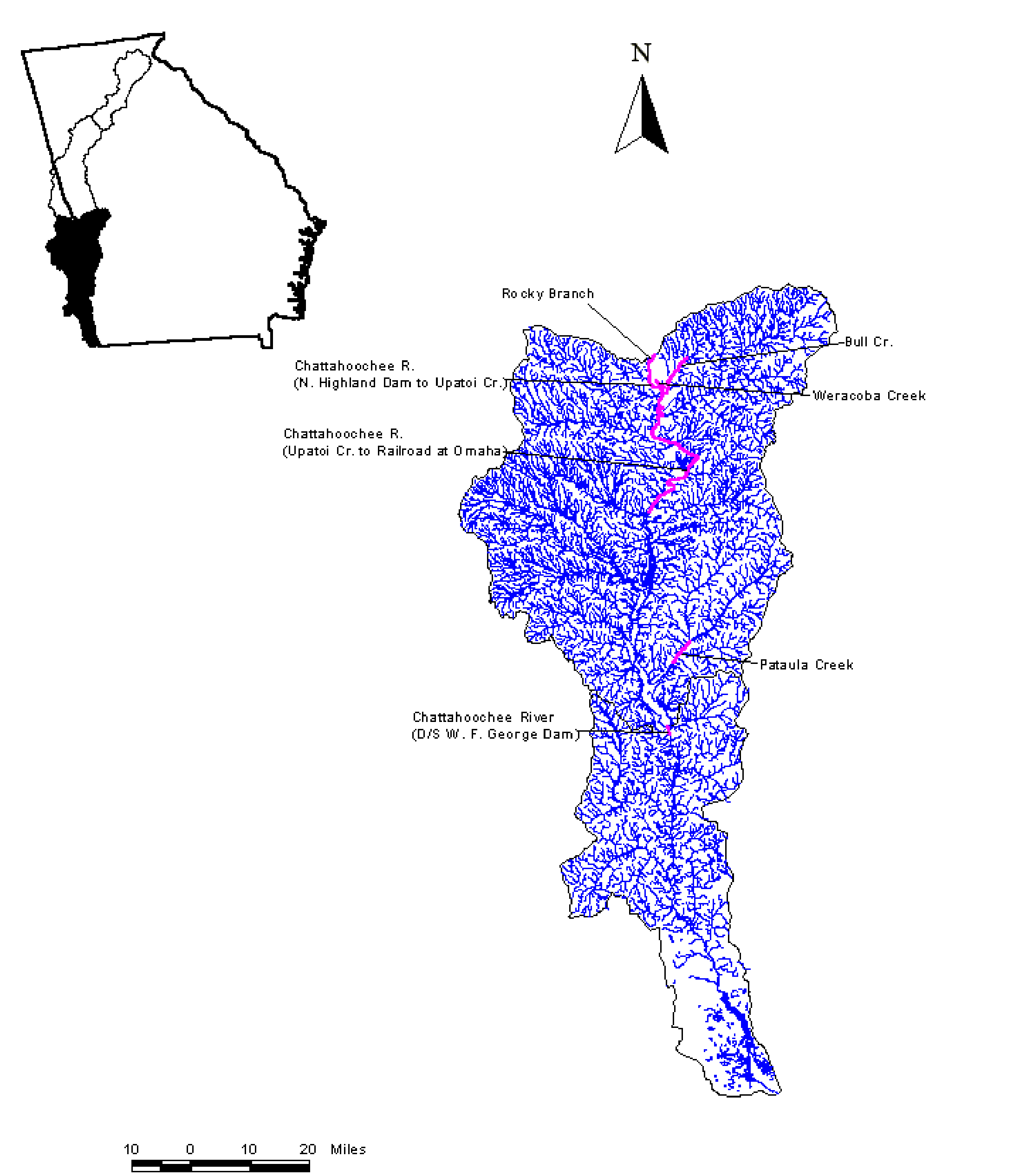
TMDL Evaluation - Fecal Coliform Chattahoochee River Basin	Figure 1. Location of Chattahoochee River Basin



TMDL Evaluation - Fecal Coliform Chattahoochee River Basin	Figure 2. HUC 03130001 303(d) Listed Streams



TMDL Evaluation - Fecal Coliform Chattahoochee River Basin	Figure 3. HUC 03130002 303(d) Listed Streams



TMDL Evaluation - Fecal Coliform
Chattahoochee River Basin

Figure 4. HUC 03130003 and 03130004
303(d) Listed Streams

Table 1. Waterbodies Listed for Fecal Coliform Bacteria in the Chattahoochee River Basin

Stream Segment	Location	Segment Length (miles)	Designated Use	Listing
Anneewakee Creek	House Creek to Lake Monroe, Douglas Co.	3	Fishing	PS
Arrow Creek	Atlanta, DeKalb Co.	3	Fishing	NS
Ball Mill Creek	Fulton/DeKalb Counties	3	Fishing	NS
Balus Creek	Gainesville, Hall Co.	3	Fishing	PS
Big Creek	Headwaters to Cheatham Creek, Forsyth Co.	3	Fishing	PS
Big Creek	Hwy 400 to Chattahoochee River, Fulton Co.	5	Fishing/ Drinking Water	NS
Bishop Creek	Cobb County	2	Fishing	NS
Blue John Creek	LaGrange, Troup Co.	8	Fishing	PS
Bubbling Creek	DeKalb County	2	Fishing	NS
Bull Creek	Columbus, Muscogee Co.	11	Fishing	NS
Burnt Fork Creek	DeKalb County	6	Fishing	NS
Buttermilk Creek	Cobb County	4	Fishing	NS
Camp Creek	Fulton County	4	Fishing	PS
Chattahoochee River	Ga. Hwy. 17, Helen to SR255. White/Habersham Co.	8	Recreation	PS
Chattahoochee River	Morgan Falls Dam to Peachtree Creek, Fulton/Cobb Co.	12	Recreation, Drinking Water	PS
Chattahoochee River	Peachtree Creek to Utoy Creek, Fulton/Cobb Co.	9	Fishing	NS
Chattahoochee River	Utoy Creek to Pea Creek, Fulton/Douglas Co.	14	Fishing	NS
Chattahoochee River	Pea Creek to Wahoo Creek Fulton/Douglas/Coweta/Carroll	21	Fishing	NS
Chattahoochee River	Wahoo Creek to Franklin Coweta/Carroll/Heard Co.	21	Fishing	PS
Chattahoochee River	N. Highland Dam to Upatoi Creek, Muscogee Co.	12	Fishing	PS
Chattahoochee River	Upatoi Creek to Railroad at Omaha, Chattahoochee/Stewart	31	Fishing	NS
Chattahoochee River	Downstream W. F. George Dam, Clay Co.	2	Fishing	PS
Clear Creek	Atlanta, Fulton Co.	3	Fishing	PS
Cracker Creek	Douglas County	3	Fishing	PS
Crawfish Creek	Douglas County	3	Fishing	PS
Crooked Creek	Tributary to Chattahoochee River, Gwinnett Co.	2	Fishing	NS
Flat Creek	Headwaters, Gainesville to Lake Lanier, Hall Co.	6	Fishing	NS
Foe Killer Creek	Fulton County	7	Fishing	NS
Foxwood Branch	Tributary to Rottenwood Creek, Cobb Co.	1	Fishing	PS
Hilly Mill Creek	Heard/Coweta Counties	6	Fishing	PS
Hog Waller Creek	Roswell, Fulton Co.	4	Fishing	PS
Johns Creek	Headwaters to Chattahoochee River, Fulton Co.	4	Fishing	NS
Kelly Mill Branch	Headwaters to Orr Creek, Forsyth Co.	2	Fishing	PS
Level Creek	Headwaters to Chattahoochee River, Gwinnett Co.	5	Fishing	NS
Long Cane Creek	Panther, Blue John & Long Cane Creeks, d/s LaGrange to Chattahoochee River, Troup Co.	14	Fishing	NS
Long Island Creek	Headwaters to Chattahoochee River, Fulton Co.	5	Fishing	NS
Lullwater Creek	DeKalb County	2	Fishing	NS
Marsh Creek	Fulton County	4	Fishing	NS
Mobley Creek	Douglas County	7	Fishing	NS
Mountain Oak Creek	Hamilton, Harris Co.	5	Fishing	PS

Stream Segment	Location	Segment Length (miles)	Designated Use	Listing
Mud Creek	Hall County	2	Fishing	PS
Mud Creek	Ga. Hwy. 120 to Noses Creek, Cobb Co.	5	Fishing	NS
Mulberry Creek	Ossahatchie Creek to Five Points Branch West near Mulberry Grove, Harris Co.	8	Fishing	PS
Nancy Creek	Headwaters to Peachtree Creek, Atlanta, DeKalb/Fulton Co.	16	Fishing	NS
New River	Heard/Coweta Counties	24	Fishing	PS
Nickajack Creek	Headwaters to Chattahoochee River, Cobb Co.	11	Fishing	NS
North Fork Balus Creek	Gainesville, Hall Co.	2	Fishing	PS
North Fork Peachtree Cr	Headwaters to Peachtree Creek, Gwinnett/DeKalb/Fulton	14	Fishing	NS
North Utoy Creek	Atlanta, Fulton Co.	6	Fishing	PS
Olley Creek	Cobb County	11	Fishing	NS
Orr Creek	U/S Castleberry Rd., Tyson Foods, to Big Creek, Forsyth	3	Fishing	NS
Pataula Creek	Hodchodkee Creek to W. F. George Lake, Quitman/Clay Co	6	Fishing	PS
Pea Creek	Fulton County	3	Fishing	PS
Peachtree Creek	I-85 to Chattahoochee River, Atlanta, Fulton Co.	7	Fishing	NS
Peavine Creek	DeKalb County	3	Fishing	NS
Proctor Creek	Headwaters to Chattahoochee River, Atlanta, Fulton Co.	9	Fishing	NS
Richland Creek	Headwaters to Chattahoochee River, Gwinnett Co.	5	Fishing	PS
Rocky Branch	Columbus, Muscogee Co.	2	Fishing	PS
Rottenwood Creek	Headwaters to Chattahoochee River, Cobb Co.	9	Fishing	NS
Sandy Creek	I-285 to Chattahoochee River, Fulton Co.	2	Fishing	NS
Sewell Mill Creek	Cobb County	4	Fishing	NS
Sope Creek	Headwaters to Chattahoochee River, Cobb Co.	11	Fishing	NS
Soquee River	Goshen Creek to SR 17, Clarkesville, Habersham Co.	29	Fishing	NS
South Fork Peachtree Cr	Headwaters to Peachtree Ck, DeKalb Co./Atlanta, Fulton Co.	15	Fishing	NS
South Utoy Creek	Headwaters to Fairburn Rd., Atlanta, Fulton Co.	5	Fishing	NS
Suwanee Creek	Mill Creek to Chattahoochee River, Gwinnett Co.	4	Fishing	NS
Sweetwater Creek	Noses to Chattahoochee River, Cobb/Douglas Co.	14	Fishing	PS
Sweetwater Creek	U/S Pine Valley Rd. To Noses Creek, Paulding/CobbCo.	10	Fishing	NS
Tanyard Branch	Atlanta, Fulton Co.	2	Fishing	PS
Tanyard Creek	LaGrange, Troup Co.	2	Fishing	PS
Tesnatee Creek	Cleveland, White Co.	5	Fishing	PS
Tesnatee Creek	Town Creek to Chestatee River, White/Lumpkin Co.	5	Fishing	NS
Tributary to Mud Cr	Cobb County	3	Fishing	PS
Utoy Creek	Atlanta, Fulton Co.	5	Fishing	NS
Ward Creek	Cobb County	6	Fishing	PS
Weracoba Creek	Columbus, Muscogee Co.	6	Fishing	NS
White Oak Creek	Fulton County	2	Fishing	NS
Willeo Creek	Cobb/Fulton Counties	5	Fishing	PS
Woodall Creek	Atlanta, Fulton Co.	3	Fishing	PS

Notes:
PS = Partially Supporting designated uses
NS = Not Supporting designated uses

The land use characteristics of the Chattahoochee River Basin watersheds were determined using data from Georgia's Multiple Resolution Land Coverage (MRLC). This coverage was produced from Landsat Thematic Mapper digital images developed in 1995. For the thirteen metro Atlanta counties, the Atlanta Regional Commission (ARC) Landuse Coverage was used, which was derived from digital images developed in 2000. Landuse classification is based on a modified Anderson level one and two system. Table 2 lists the land use distribution of the 79 watersheds on the 303(d) list. Regulated dams (Buford Dam, West Point Lake Dam, and W.F. George Dam) were considered as the upstream boundaries for the Chattahoochee River watersheds.

1.3 Water Quality Standard

The water use classification for the listed watersheds in the Chattahoochee River Basin is Drinking Water, Recreation, and Fishing. The criterion violated is listed as fecal coliform. The potential cause(s) listed include urban runoff, nonpoint sources, unknown sources, and combine sewer overflows. The use classification water quality standards for fecal coliform bacteria as stated in Georgia's Rules and Regulations for Water Quality Control Chapter 391-3-6-.03(6)(a), 391-3-6-.03(6)(b), and 391-3-6-.03(6)(c) is:

(a) Drinking Water Supplies: Those waters approved as a source for public drinking water systems permitted or to be permitted by the Environmental Protection Division. Waters classified for drinking water supplies will also support the fishing use and any other use requiring water of a lower quality.

(i) Bacteria: For the months of May through October, when water contact recreation activities are expected to occur, fecal coliform not to exceed a geometric mean of 200 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours. Should water quality and sanitary studies show fecal coliform levels from non-human sources exceed 200/100 ml (geometric mean) occasionally, then the allowable geometric mean fecal coliform shall not exceed 300 per 100 ml in lakes and reservoirs and 500 per 100 ml in free flowing freshwater streams. For the months of November through April, fecal coliform not to exceed a geometric mean of 1,000 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours and not to exceed a maximum of 4,000 per 100 ml for any sample. The State does not encourage swimming in surface waters since a number of factors which are beyond the control of any State regulatory agency contribute to elevated levels of fecal coliform.

(b) Recreation: General recreational activities such as water skiing, boating, and swimming, or for any other use requiring water of a lower quality, such as recreational fishing. These criteria are not to be interpreted as encouraging water contact sports in proximity to sewage or industrial waste discharges regardless of treatment requirements:

(i) Bacteria: Fecal coliform not to exceed the following geometric means based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours:

(1) Coastal waters 100 per 100 ml

(2) All other recreational waters 200 per 100 ml

(3) Should water quality and sanitary studies show natural fecal coliform levels exceed 200/100 ml (geometric mean) occasionally in high quality recreational waters, then the allowable geometric mean fecal coliform level shall not exceed 300 per 100 ml in lakes and reservoirs and 500 per 100 ml in free flowing fresh water streams.

(c) Fishing: Propagation of Fish, Shellfish, Game and Other Aquatic Life; secondary contact recreation in and on the water; or for any other use requiring water of a lower quality:

(iii) Bacteria: For the months of May through October, when water contact recreation activities are expected to occur, fecal coliform not to exceed a geometric mean of 200 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours. Should water quality and sanitary studies show fecal coliform levels from non-human sources exceed 200/100 ml (geometric mean) occasionally, then the allowable geometric mean fecal coliform shall not exceed 300 per 100 ml in lakes and reservoirs and 500 per 100 ml in free flowing freshwater streams. For the months of November through April, fecal coliform not to exceed a geometric mean of 1,000 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours and not to exceed a maximum of 4,000 per 100 ml for any sample. The State does not encourage swimming in surface waters since a number of factors which are beyond the control of any State regulatory agency contribute to elevated levels of fecal coliform. For waters designated as approved shellfish harvesting waters by the appropriate State agencies, the requirements will be consistent with those established by the State and Federal agencies responsible for the National Shellfish Sanitation Program. The requirements are found in the National Shellfish Sanitation Program Manual of Operation, Revised 1988, Interstate Shellfish Sanitation Conference, U. S. Department of Health and Human Services (PHS/FDA), and the Center for Food Safety and Applied Nutrition. Streams designated as generally supporting shellfish are listed in Paragraph 391-3-6-.03(14).

Table 2. Chattahoochee River Basin Landuse

Stream/Segment	Landuse Categories - Acres (Percent)														
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total	Landuse Source
Anneewakee Creek	109 (0.6)	8479 (44.3)	329 (1.7)	1984 (10.4)	0 (0.0)	0 (0.0)	487 (2.5)	6140 (32.1)	889 (4.6)	0 (0.0)	513 (2.7)	209 (1.1)	0 (0.0)	19139	ARC
Arrow Creek	0 (0.0)	579.3 (29.6)	254.3 (13.0)	1030.6 (52.7)	0 (0.0)	0 (0.0)	49 (2.5)	21 (1.1)	0 (0.0)	0 (0.0)	21.6 (1.1)	0 (0.0)	0 (0.0)	1956	ARC
Ball Mill Creek	0 (0.0)	2157 (85.0)	39 (1.5)	135 (5.3)	0 (0.0)	0 (0.0)	0 (0.0)	103 (4.0)	0 (0.0)	0 (0.0)	105 (4.1)	0 (0.0)	0 (0.0)	2538	ARC
Balus Creek	0 (0.0)	0 (0.0)	437 (9.4)	319 (6.9)	0 (0.0)	0 (0.0)	0 (0.0)	2636 (56.9)	242 (5.2)	647 (14.0)	350 (7.6)	0 (0.0)	0 (0.0)	4631	MRLC
Big Creek - Headwaters	33 (0.4)	2722 (30.8)	15 (0.2)	1134 (12.8)	0 (0.0)	7 (0.1)	342 (3.9)	2793 (31.6)	1684 (19.1)	11 (0.1)	48 (0.5)	47 (0.5)	0 (0.0)	8836	ARC
Big Creek – Hwy 400	343 (0.5)	24785 (37.3)	1453 (2.2)	9579 (14.4)	0 (0.0)	7 (0.0)	2611 (3.9)	14299 (21.5)	10632 (16.0)	136 (0.2)	1189 (1.8)	1357 (2.0)	0 (0.0)	66391	ARC
Bishop Creek	0 (0.0)	957 (73.9)	0 (0.0)	234 (18.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	16 (1.3)	0 (0.0)	88 (6.8)	0 (0.0)	0 (0.0)	1295	ARC
Blue John Creek	50 (0.4)	1667 (11.9)	282 (2.0)	943 (6.7)	0 (0.0)	13 (0.1)	65 (0.5)	8346 (59.5)	645 (4.6)	726 (5.2)	914 (6.5)	369 (2.6)	0 (0.0)	14021	MRLC
Bubbling Creek	0 (0.0)	319 (28.6)	0.3 (0.0)	759 (68.2)	0 (0.0)	0 (0.0)	14 (1.3)	15 (1.3)	0 (0.0)	0 (0.0)	6 (0.5)	0 (0.0)	0 (0.0)	1113	ARC
Bull Creek	460 (0.9)	0 (0.0)	13518 (27.2)	3773 (7.6)	0 (0.0)	153 (0.3)	213 (0.4)	28093 (56.5)	800 (1.6)	1460 (2.9)	1156 (2.3)	75 (0.2)	5 (0.0)	49706	MRLC
Burnt Fork Creek	0 (0.0)	1803 (55.5)	225 (6.9)	965 (29.7)	0 (0.0)	0 (0.0)	13 (0.4)	138 (4.2)	0 (0.0)	0 (0.0)	107.6 (3.3)	0 (0.0)	0 (0.0)	3251	ARC

Stream/Segment	Landuse Categories - Acres (Percent)														
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total	Landuse Source
Buttermilk Creek	9 (0.2)	2420 (59.4)	28 (0.7)	786 (19.3)	0 (0.0)	0 (0.0)	82 (2.0)	536 (13.2)	173 (4.3)	0 (0.0)	0 (0.0)	40 (1.0)	0 (0.0)	4074	ARC
Camp Creek	253 (0.9)	7983 (27.5)	672 (2.3)	2408 (8.3)	0 (0.0)	70.1 (0.2)	718 (2.5)	14878 (51.3)	815 (2.8)	0 (0.0)	329.7 (1.1)	859 (3.0)	0 (0.0)	28987	ARC
Chattahoochee River Ga Hwy 17, Helen to SR 255	93 (0.1)	0 (0.0)	49 (0.1)	64 (0.1)	0 (0.0)	0 (0.0)	283 (0.4)	72431 (96.2)	377 (0.5)	1988 (2.6)	42 (0.1)	0 (0.0)	0 (0.0)	75327	MRLC
Chattahoochee River Morgan Falls Dam to Peachtree Creek	2923 (1.0)	133891 (46.0)	11936 (4.1)	43612 (15.0)	38 (0.0)	802 (0.3)	8439 (2.9)	61249 (21.0)	19262 (6.6)	255 (0.1)	6232 (2.1)	2625 (0.9)	0 (0.0)	291264	ARC
Chattahoochee River Peachtree Creek to Utoy Creek	3446 (0.9)	181531 (44.9)	23652 (5.9)	76781 (19.0)	38 (0.0)	931 (0.2)	9798 (2.4)	76676 (19.0)	19565 (4.8)	292 (0.1)	7737 (1.9)	3651 (0.9)	0 (0.0)	404098	ARC
Chattahoochee River Utoy Creek to Pea Creek	5713 (0.8)	279794 (40.9)	29287 (4.3)	96460 (14.1)	51 (0.0)	1241 (0.2)	14887 (2.2)	185056 (27.0)	47496 (6.9)	328 (0.0)	12105 (1.8)	11778 (1.7)	0 (0.0)	684196	ARC
Chattahoochee River Pea Creek to Wahoo Creek	7860 (0.9)	302808 (36.6)	29303 (3.5)	98909 (11.9)	51 (0.0)	1463 (0.2)	15484 (1.9)	275367 (33.2)	68932 (8.3)	371 (0.0)	12779 (1.5)	14961 (1.8)	0 (0.0)	828288	ARC
Chattahoochee River Wahoo Creek to Franklin	9163 (1.0)	315578 (34.9)	29492 (3.3)	101315 (11.2)	51 (0.0)	1478 (0.2)	15798 (1.7)	320664 (35.5)	79913 (8.8)	371 (0.0)	13348 (1.5)	17193 (1.9)	0 (0.0)	904364	ARC
Chattahoochee River N. Highland Dam to Upatoi Creek	13944 (1.7)	9 (0.0)	28345 (3.5)	12228 (1.5)	5 (0.0)	1115 (0.1)	19037 (2.4)	613805 (75.9)	29260 (3.6)	56371 (7.0)	5921 (0.7)	27772 (3.4)	930 (0.1)	808742	MRLC
Chattahoochee River Upatoi Creek to Railroad	20850 (1.3)	9 (0.0)	33614 (2.1)	17813 (1.1)	35 (0.0)	1898 (0.1)	62173 (3.9)	1215748 (77.2)	77312 (4.9)	71715 (4.6)	8973 (0.6)	62685 (4.0)	2390 (0.2)	1575215	MRLC
Chattahoochee River Downstream W. F. George Dam	103 (15.3)	35 (5.2)	1 (0.2)	11 (1.6)	0.9 (0.1)	0 (0.0)	40.5 (6.0)	480 (71.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	671	MRLC
Clear Creek	0 (0.0)	836 (18.0)	1332 (28.7)	2029 (43.6)	0 (0.0)	0 (0.0)	45 (1.0)	114 (2.5)	0 (0.0)	0 (0.0)	292.5 (6.3)	0 (0.0)	0 (0.0)	4648	ARC

Stream/Segment	Landuse Categories - Acres (Percent)														
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total	Landuse Source
Cracker Creek	0 (0.0)	774 (37.3)	0 (0.0)	444 (21.4)	0 (0.0)	0 (0.0)	23 (1.1)	815 (39.3)	0 (0.0)	0 (0.0)	0 (0.0)	18 (0.9)	0 (0.0)	2074	ARC
Crawfish Creek	276 (1.9)	79 (0.5)	5 (0.0)	181 (1.3)	1 (0.0)	74 (0.5)	33 (0.2)	11022 (76.8)	797 (5.6)	1555 (10.8)	154 (1.1)	162 (1.1)	7 (0.0)	14344	MRLC
Crooked Creek	17 (0.3)	1471 (25.4)	873 (15.1)	2631 (45.5)	0 (0.0)	0 (0.0)	139 (2.4)	647 (11.2)	0 (0.0)	0 (0.0)	5 (0.1)	0 (0.0)	0 (0.0)	5783	ARC
Flat Creek	0 (0.0)	390 (10.4)	114 (3.0)	715 (19.1)	6 (0.2)	0 (0.0)	0 (0.0)	1860 (49.6)	127 (3.4)	166 (4.4)	371 (9.9)	2 (0.0)	0 (0.0)	3751	MRLC
Foe Killer Creek	19 (0.2)	4299 (54.4)	248 (3.1)	1747 (22.1)	0 (0.0)	0 (0.0)	186 (2.3)	730 (9.2)	434 (5.5)	0 (0.0)	205 (2.6)	36 (0.5)	0 (0.0)	7904	ARC
Foxwood Branch	0 (0.0)	787 (93.7)	0 (0.0)	39 (4.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	13 (1.6)	0 (0.0)	0 (0.0)	840	ARC
Hilly Mill Creek	25 (0.3)	1 (0.0)	0 (0.0)	6 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	6978 (85.6)	475 (5.8)	601 (7.4)	0 (0.0)	62 (0.8)	0 (0.0)	8148	MRLC
Hog Waller Creek	0 (0.0)	1538 (60.6)	104 (4.1)	543 (21.4)	0 (0.0)	0 (0.0)	53 (2.1)	182 (7.2)	2 (0.1)	0 (0.0)	116 (4.6)	0 (0.0)	0 (0.0)	2538	ARC
Johns Creek	50 (0.6)	5451 (65.0)	86 (1.0)	753 (9.0)	0 (0.0)	0 (0.0)	265 (3.2)	969 (11.6)	359 (4.3)	0 (0.0)	333 (4.0)	117 (1.4)	0 (0.0)	8383	ARC
Kelly Mill Branch	15 (0.6)	1204 (48.9)	0 (0.0)	330 (13.4)	0 (0.0)	0 (0.0)	0 (0.0)	702 (28.5)	195 (7.9)	0 (0.0)	14 (0.6)	0 (0.0)	0 (0.0)	2460	ARC
Level Creek	21 (0.4)	2736 (48.4)	42 (0.7)	222 (3.9)	0 (0.0)	0 (0.0)	70 (1.2)	2146 (38.0)	346 (6.1)	29 (0.5)	37 (0.7)	0 (0.0)	0 (0.0)	5649	ARC

Stream/Segment	Landuse Categories - Acres (Percent)														
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total	Landuse Source
Long Cane Creek	368	1949	319	1398	0	154	378	37579	2527	4835	1090	2870	174	53642	MRLC
	(0.7)	(3.6)	(0.6)	(2.6)	(0.0)	(0.3)	(0.7)	(70.1)	(4.7)	(9.0)	(2.0)	(5.4)	(0.3)		
Long Island Creek	11	3987	302	627	0	0	8	176	0	0	22	0	0	5131	ARC
	(0.2)	(77.7)	(5.9)	(12.2)	(0.0)	(0.0)	(0.2)	(3.4)	(0.0)	(0.0)	(0.4)	(0.0)	(0.0)		
Lullwater Creek	0	575	564	188	0	0	0	126	0	0	273	0	0	1727	ARC
	(0.0)	(33.3)	(32.7)	(10.9)	(0.0)	(0.0)	(0.0)	(7.3)	(0.0)	(0.0)	(15.8)	(0.0)	(0.0)		
Marsh Creek	0	2273	466	609	0	0	51	312	0	0	17	0	0	3728	ARC
	(0.0)	(61.0)	(12.5)	(16.3)	(0.0)	(0.0)	(1.4)	(8.4)	(0.0)	(0.0)	(0.4)	(0.0)	(0.0)		
Mobley Creek	11	2522	0	415	0	207	48	4843	2285	0	76	77	0	10483	ARC
	(0.1)	(24.1)	(0.0)	(4.0)	(0.0)	(2.0)	(0.5)	(46.2)	(21.8)	(0.0)	(0.7)	(0.7)	(0.0)		
Mountain Oak Creek	527	0	5	143	1	0	1958	37403	678	1513	424	763	14	43429	MRLC
	(1.2)	(0.0)	(0.0)	(0.3)	(0.0)	(0.0)	(4.5)	(86.1)	(1.6)	(3.5)	(1.0)	(1.8)	(0.0)		
Mud Creek – Hall Co	3	0	17	105	0	0	0	1711	103	504	71	0	0	2514	MRLC
	(0.1)	(0.0)	(0.7)	(4.2)	(0.0)	(0.0)	(0.0)	(68.1)	(4.1)	(20.0)	(2.8)	(0.0)	(0.0)		
Mud Creek	74	5657	0	165	0	0	107	1867	2170	0	188	257	0	10486	ARC
	(0.7)	(53.9)	(0.0)	(1.6)	(0.0)	(0.0)	(1.0)	(17.8)	(20.7)	(0.0)	(1.8)	(2.5)	(0.0)		
Mulberry Creek	678	0	300	217	1	0	4682	103765	3794	8015	235	2804	27	124518	MRLC
	(0.5)	(0.0)	(0.2)	(0.2)	(0.0)	(0.0)	(3.8)	(83.3)	(3.0)	(6.4)	(0.2)	(2.3)	(0.0)		
Nancy Creek	68	13909	1868	6423	0	0	128	850	106	0	666	12	0	24030	ARC
	(0.3)	(57.9)	(7.8)	(26.7)	(0.0)	(0.0)	(0.5)	(3.5)	(0.4)	(0.0)	(2.8)	(0.0)	(0.0)		
New River	1066	8286	64	1375	0	36	126	52322	13589	0	59	3863	0	80786	ARC
	(1.3)	(10.3)	(0.1)	(1.7)	(0.0)	(0.0)	(0.2)	(64.8)	(16.8)	(0.0)	(0.1)	(4.8)	(0.0)		
Nickajack Creek	102	13425	892	2682	0	0	440	4505	262	0	178	334	0	22820	ARC
	(0.4)	(58.8)	(3.9)	(11.8)	(0.0)	(0.0)	(1.9)	(19.7)	(1.1)	(0.0)	(0.8)	(1.5)	(0.0)		
North Fork Balus Creek	0	40	5	32	0	0	0	499	21	45	64	0	0	706	MRLC
	(0.0)	(5.7)	(0.7)	(4.5)	(0.0)	(0.0)	(0.0)	(70.6)	(3.0)	(6.4)	(9.1)	(0.0)	(0.0)		

Stream/Segment	Landuse Categories - Acres (Percent)														
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total	Landuse Source
North Fork Peachtree Creek	55 (0.2)	13164 (52.6)	2863 (11.4)	7624 (30.5)	0 (0.0)	0 (0.0)	202 (0.8)	823 (3.3)	0 (0.0)	0 (0.0)	124 (0.5)	171 (0.7)	0 (0.0)	25026	ARC
North Utoy Creek	0 (0.0)	2341 (34.8)	1698 (25.2)	1070 (15.9)	0 (0.0)	6 (0.1)	18 (0.3)	940 (14.0)	0 (0.0)	0 (0.0)	656 (9.8)	0 (0.0)	0 (0.0)	6729	ARC
Olley Creek	9 (0.1)	4259 (47.0)	895 (9.9)	2002 (22.1)	0 (0.0)	0 (0.0)	157 (1.7)	961 (10.6)	356 (3.9)	0 (0.0)	324 (3.6)	90 (1.0)	0 (0.0)	9053	ARC
Orr Creek	29 (0.4)	2283 (33.9)	15 (0.2)	1090 (16.2)	0 (0.0)	7 (0.1)	191 (2.8)	1943 (28.8)	1153 (17.1)	10 (0.1)	14 (0.2)	0 (0.0)	0 (0.0)	6735	ARC
Pataula Creek	531 (0.2)	0 (0.0)	250 (0.1)	168 (0.1)	0 (0.0)	0 (0.0)	20876 (8.7)	179474 (74.8)	16147 (6.7)	5222 (2.2)	60 (0.0)	16965 (7.1)	250 (0.1)	239943	MRLC
North Fork Peachtree Creek	1 (0.3)	165 (32.3)	14 (2.7)	52 (10.1)	0 (0.0)	0 (0.0)	0 (0.0)	180 (35.2)	11 (2.2)	4 (0.9)	84 (16.5)	0 (0.0)	0 (0.0)	511	MRLC
Pea Creek	97 (1.1)	1019 (11.2)	0 (0.0)	12 (0.1)	0 (0.0)	0 (0.0)	9 (0.1)	6614 (72.5)	1246 (13.7)	0 (0.0)	0 (0.0)	127 (1.4)	0 (0.0)	9125	ARC
Peachtree Creek	142 (0.2)	27502 (46.1)	8131 (13.6)	19139 (32.1)	0 (0.0)	4 (0.0)	338 (0.6)	3062 (5.1)	0 (0.0)	37 (0.1)	1014 (1.7)	239 (0.4)	0 (0.0)	59608	ARC
Peavine Creek	0 (0.0)	1827 (48.0)	699 (18.4)	838 (22.0)	0 (0.0)	0 (0.0)	4 (0.1)	156 (4.1)	0 (0.0)	0 (0.0)	282 (7.4)	0 (0.0)	0 (0.0)	3807	ARC
Proctor Creek	0 (0.0)	3291 (31.3)	1784 (17.0)	3738 (35.5)	0 (0.0)	110 (1.0)	61 (0.6)	1267 (12.0)	0 (0.0)	0 (0.0)	268 (2.5)	0 (0.0)	0 (0.0)	10519	ARC
Richland Creek	6 (0.1)	2052 (28.6)	58 (0.8)	446 (6.2)	22 (0.3)	246 (3.4)	233 (3.2)	3787 (52.7)	144 (2.0)	12 (0.2)	177 (2.5)	0 (0.0)	0 (0.0)	7183	ARC
Rocky Branch	8 (0.7)	401 (39.0)	156 (15.2)	130 (12.6)	0 (0.0)	0 (0.0)	4 (0.3)	260 (25.3)	23 (2.3)	11 (1.1)	36 (3.5)	0 (0.0)	0 (0.0)	1029	MRLC
Rottenwood Creek	4 (0.0)	2615 (20.6)	1783 (14.0)	6628 (52.2)	0 (0.0)	0 (0.0)	125 (1.0)	1234 (9.7)	0 (0.0)	0 (0.0)	312 (2.5)	0 (0.0)	0 (0.0)	12701	ARC

Stream/Segment	Landuse Categories - Acres (Percent)														
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total	Landuse Source
Sandy Creek	0	1517	147	806	0	0	0	387	0	0	70	70	0	2997	ARC
	(0.0)	(50.6)	(4.9)	(26.9)	(0.0)	(0.0)	(0.0)	(12.9)	(0.0)	(0.0)	(2.3)	(2.3)	(0.0)		
Sewell Mill Creek	33.1	8089.8	15	453.7	1.7	0	26.4	449.9	40	0	54.6	0	0	9164	ARC
	(0.4)	(88.3)	(0.2)	(5.0)	(0.0)	(0.0)	(0.3)	(4.9)	(0.4)	(0.0)	(0.6)	(0.0)	(0.0)		
Sope Creek	59	16097	588	3263	16	0	154	1612	233	0	493	0	0	22515	ARC
	(0.3)	(71.5)	(2.6)	(14.5)	(0.1)	(0.0)	(0.7)	(7.2)	(1.0)	(0.0)	(2.2)	(0.0)	(0.0)		
Soquee Creek	94	0	134	123	4	24	594	50548	1346	7176	155	16	4	60218	MRLC
	(0.2)	(0.0)	(0.2)	(0.2)	(0.0)	(0.0)	(1.0)	(83.9)	(2.2)	(11.9)	(0.3)	(0.0)	(0.0)		
South Fork Peachtree Creek	6.1	8991.8	2906.6	5262.9	0	0	53.5	1229.3	0	37.2	625.5	36.3	0	19149	ARC
	(0.0)	(47.0)	(15.2)	(27.5)	(0.0)	(0.0)	(0.3)	(6.4)	(0.0)	(0.2)	(3.3)	(0.2)	(0.0)		
South Utoy Creek	0.1	4140	640.6	1736.6	0	0	83.4	1096.5	0	0	278	0	0	7975	ARC
	(0.0)	(51.9)	(8.0)	(21.8)	(0.0)	(0.0)	(1.0)	(13.7)	(0.0)	(0.0)	(3.5)	(0.0)	(0.0)		
Suwanee Creek	91	8770	256	3811	0	0	1929	13305	2546	10	181	640	0	31539	ARC
	(0.3)	(27.8)	(0.8)	(12.1)	(0.0)	(0.0)	(6.1)	(42.2)	(8.1)	(0.0)	(0.6)	(2.0)	(0.0)		
Sweetwater Creek	1104	62144	2073	10321	13	232	2998	54517	21224	36	2061	6295	0	163018	ARC
	(0.7)	(38.1)	(1.3)	(6.3)	(0.0)	(0.1)	(1.8)	(33.4)	(13.0)	(0.0)	(1.3)	(3.9)	(0.0)		
Sweetwater Creek	603	30111	200	3534	13	0	2209	36837	16282	28	978	4645	0	95440	ARC
U/S Pine Valley Rd to Noses Ck	(0.6)	(31.5)	(0.2)	(3.7)	(0.0)	(0.0)	(2.3)	(38.6)	(17.1)	(0.0)	(1.0)	(4.9)	(0.0)		
Tanyard Branch	40	542	286	2011	0	0	19	0	0	0	94	0	0	2992	ARC
	(1.4)	(18.1)	(9.5)	(67.2)	(0.0)	(0.0)	(0.6)	(0.0)	(0.0)	(0.0)	(3.1)	(0.0)	(0.0)		
Tanyard Creek	2	459	108	200	0	0	0	306	41	44	100	0	0	1259	MRLC
	(0.1)	(36.5)	(8.6)	(15.8)	(0.0)	(0.0)	(0.0)	(24.3)	(3.3)	(3.5)	(7.9)	(0.0)	(0.0)		
Tesnatee Creek	107	0	166	224	0	0	197	15587	223	1313	71	0	0	17888	MRLC
Cleveland	(0.6)	(0.0)	(0.9)	(1.3)	(0.0)	(0.0)	(1.1)	(87.1)	(1.2)	(7.3)	(0.4)	(0.0)	(0.0)		
Tesnatee Creek	149	0	178	239	0	29	372	39977	666	4041	71	0	0	45722	MRLC
Town Creek to Chestatee River	(0.3)	(0.0)	(0.4)	(0.5)	(0.0)	(0.1)	(0.8)	(87.4)	(1.5)	(8.8)	(0.2)	(0.0)	(0.0)		

Stream/Segment	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total	Landuse Source
	Landuse Categories - Acres (Percent)														
Trib to Mud Creek	9 (0.2)	1523 (43.4)	0 (0.0)	35 (1.0)	0 (0.0)	0 (0.0)	42 (1.2)	541 (15.4)	1146 (32.6)	0 (0.0)	157 (4.5)	57 (1.6)	0 (0.0)	3510	ARC
Utoy Creek	86 (0.4)	9539 (42.7)	2519 (11.3)	3576 (16.0)	0 (0.0)	7 (0.0)	163 (0.7)	5357 (24.0)	0 (0.0)	0 (0.0)	1034 (4.6)	60 (0.3)	0 (0.0)	22341	ARC
Ward Creek	21 (0.4)	3164 (59.1)	232 (4.3)	336 (6.3)	0 (0.0)	0 (0.0)	64 (1.2)	228 (4.3)	36 (0.7)	0 (0.0)	1103 (20.6)	171 (3.2)	0 (0.0)	5356	ARC
Weracoba Creek	0 (0.0)	1582 (40.4)	407 (10.4)	703 (17.9)	0 (0.0)	0 (0.0)	1 (0.0)	990 (25.3)	20 (0.5)	23 (0.6)	187 (4.8)	5 (0.1)	0 (0.0)	3919	MRLC
White Oak Creek	69 (0.6)	693 (6.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	7106 (66.2)	2336 (21.8)	0 (0.0)	0 (0.0)	531 (5.0)	0 (0.0)	10735	ARC
Willeo Creek	142 (1.3)	9179 (86.1)	56 (0.5)	433 (4.1)	0 (0.0)	0 (0.0)	153 (1.4)	623 (5.8)	69 (0.6)	0 (0.0)	8 (0.1)	2 (0.0)	0 (0.0)	10664	ARC
Woodall Creek	13 (0.7)	117 (6.5)	102 (5.6)	1258 (69.9)	0 (0.0)	4 (0.2)	11 (0.6)	164 (9.1)	0 (0.0)	0 (0.0)	130 (7.2)	0 (0.0)	0 (0.0)	1798	ARC

2.0 WATER QUALITY ASSESSMENT

Stream segments are placed on the 303(d) list as partially supporting or not supporting their water use classification based on water quality sampling data. A stream is placed on the partial support list if more than 10% of the samples exceed the fecal coliform criteria and on the not support list if more than 25% of the samples exceed the standard. Water quality samples collected within a 30-day period that have a geometric mean in excess of 200 counts per 100 milliliters during the period May through October, or in excess of 1000 counts per 100 milliliters during the period November through April are in violation of the bacteria water quality standard. In addition, a single sample in excess of 4000 counts per 100 milliliters during the period November through April can also provide a basis for adding a stream segment to the 303(d) listing.

Fecal coliform data were collected during calendar years 2000 and 2001. Sources of these data including the following:

- USGS basin water quality data, 2000 and 2001.
- EPD Trend Monitoring data, 2000 and 2001
- EPD special studies sampling data, 2000.
- City of Atlanta water quality data, 2000 and 2001
- Douglas County water quality data, 2000 and 2001
- Gwinnett County water quality data, 2000 and 2001

These sources had enough information to calculate a 30-day geometric mean and the data used for these TMDLs are presented in Appendix A.

For a number of listed stream segments, available data were not sufficient to calculate a 30-day geometric mean. Many of these stream segments had been placed on the 303(d) list as a result of data collected prior to 2000. These data were assembled from a variety of sources, which included:

- Atlanta Region Commission storm water sampling data
- Chattahoochee River Management Project, 1993 – 1996
- Cobb County Spills data, 1993; water quality sampling data, 1990 - 2002
- DeKalb County spills data, 1992 - 1993; water quality data, 1994 – 1995
- Columbus, GA. spills data, 1992 - 1993; water quality data, 1993 – 1994
- City of Gainesville water quality data, (1999-2001)
- Lake Sidney Lanier Clean Lakes Study
- NAWQUA water quality data
- Sanitary Survey sampling data, 1993

Summaries of these data are presented in Appendix B.

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 fecal coliform bacteria on land surfaces that washoff 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 on water quality standards (water quality-based limits).

EPA has developed technology-based guidelines that 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 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 fecal coliform to receiving waters. There are 50 NPDES permitted discharges with effluent limits for fecal coliform bacteria identified in the Chattahoochee River Basin Watershed upstream from the listed segments. Table 3 provides the monthly average discharge flows and fecal coliform concentrations for the municipal and industrial treatment facilities, obtained from calendar year 2000 Discharge Monitoring Report (DMR) data. The permitted flow and fecal coliform concentrations for these facilities are also included in this table.

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. The CSOs are permitted to discharge only under high flow conditions with the WPCP facilities operating at full capacity.

Table 3. NPDES Facilities Discharging Fecal Coliform in the Chattahoochee River Basin

Facility Name	NPDES Permit No.	Receiving Stream	Actual 2000 Discharge: Average Flow (MGD)	Actual 2000 Discharge: Geo Mean (No./ 100 mL)	NPDES Permit Limits: Average Monthly Flow (MGD)	NPDES Permit Limits: Geo Mean (No./ 100 mL)	Number. of Violations July 1998-June 2001
Atlanta R M Clayton	GA0021482	Chattahoochee River	73.33	18.4	100.00	200	0
Atlanta Utoy Creek	GA0021458	Chattahoochee River	26.50	13.5	37.00	200	4
Baldwin WPCP	GA0033243	Little Mud Creek	0.13	36.7	0.30	200	0
Buford Southside	GA0023167	Suwanee Creek	0.87	30.9	2.00	200	2
Buford Westside WPCP	GA0023175	Richland Creek	0.15	51.5	0.25	200	1
Cagles Inc Harris	GA0001316	Fort Creek	0.32	4.6	NA	400 daily max	0
Callaway Gardens	GA0022527	Mountain Creek	0.15	34.2	0.50	200	0
City of Hamilton	GA0033618	Palmetto Creek	0.03	57.4	0.10	200	1
Clarkesville WPCP	GA0032514	Soquee River	0.23	89.1	0.75	200	3
Cleveland WPCP	GA0036820	Tesnatee Creek Trib	0.28	32.5	0.75	200	0
Cobb Co R L Sutton	GA0026140	Chattahoochee River	30.27	3.1	40.00	200	0
Cobb Co South	GA0026158	Chattahoochee River	20.44	34.8	42.0	200	2
Columbus South	GA0020516	Chattahoochee River	29.96	20.2	42.00	200	0
Columbus Water Works	GA0020532	Tiger Creek	Inactive - permit expired 7/1994		0.15	200	0
Cornelia WPCP	GA0021504	South Fork Little Mud Creek	2.4	59.8	3.00	200	0
Countryside MHP	GA0030201	Suwanee Creek	Countryside Village of Lake Lanier was connected to the city of Buford sewer system on March 6, 1998		0.13	200	0
Coweta Co Arnco WPCP	GA0000311	Wahoo Creek	0.07	3,740.0	0.10	200	0
Cumming WPCP	GA0046019	Big Creek	0.87	2.5	2.00	200	1
Dahlonega WPCP	GA0026077	Yahoola Creek Trib	0.87	5.0	1.44	200	0
Demorest WPCP	GA0032506	Hazel Creek Trib	0.19	42.0	0.40	200	0
Douglasville North	GA0030350	Gothards Creek to Sweetwater Ck	0.49	34.1	0.60	200	0
Douglasville Southside	GA0030341	Anneewakee Creek	2.32	36.8	3.25	200	0
Douglasville Sweetwater	GA0047201	Chattahoochee River	1.02	5.4	3.00	200	0
Flowery Branch WPCP	GA0031933	Lake Sidney Lanier	0.18	4.5	0.20	200	0
Fort Gaines	GA0026191	Chattahoochee River	0.08	27.7	0.30	200	0

Facility Name	NPDES Permit No.	Receiving Stream	Actual 2000 Discharge		NPDES Permit Limits		Number. of Violations July 1998-June 2001
			Average Flow (MGD)	Geo Mean (No./ 100 mL)	Average Monthly Flow (MGD)	Geo Mean (No./ 100 mL)	
Fulton Co Big Creek	GA0024333	Chattahoochee River	19.58	99.8	24.00	200	3
Fulton Co Camp Creek	GA0025381	Chattahoochee River	10.07	10.9	13.00	200	1
Fulton Co Johns Creek	GA0030686	Chattahoochee River	7.04	27.3	7.00	200	2
Fulton Co Little Bear	GA0047104	Little Bear Creek	0.03	1.8	0.10	200	0
Gainesville Flat Cr WPCP	GA0021156	Flat Creek	6.68	8.3	7.20	200	0
Gainesville Linwood	GA0020168	Lake Lanier	1.70	2.4	3.00	200	0
Gwinnett Co Crooked Cr/North	GA0026433	Chattahoochee River	14.13	6.3	36.00	25	1
Gwinnett Co North Advanced	GA0038130	Lake Lanier	Permit under appeal		40.00	200	0
Habersham BOE (Baldwin)	GA0033243	Licklog Creek	0.13	36.7	0.40	200	0
Habersham on Lanier	GA0030261	Lake Lanier	0.07	5.7	0.11	200	0
Heards County Water Authority	GA0021148	Chattahoochee River	0.09	5.3	0.16	200	0
LaGrange Long Cane	GA0036951	Chattahoochee River	5.49	7.6	12.50	200	0
Lake Lanier Islands	GA0049115	Lake Lanier	0.12	53.8	0.35	200	0
Lumpkin WPCP	GA0021032	Hodchodkee Creek Trib	0.15	No fecal limits	0.20	No fecal limits	0
Newnan Snake Creek	GA0021431	Snake Cr Trib to Wahoo	Diverted to Wahoo Ck in 10/1997		0.40	200	0
Newnan Wahoo WPCP	GA0031721	Unnamed Trib to Wahoo Creek	1.51	8.5	3.00	200	0
Palmetto WPCP	GA0025542	Little Bear Cr	0.44	30.7	0.60	200	4
Pine Mountain WPCP	GA0025691	Turkey Creek Trib	0.09	141.3	0.12	200	0
Tyson Foods Inc	GA0001074	Unnamed Trib/Orr's Cr	1.22	18.3	NA	400 daily max	0
Union City WPCP	GA0023094	Deep Creek Trib	Diverted to Fulton Cnty - Deep Creek WPCP in 1997		0.25	200	0
USA FT Benning Plant 1	GA0000973	Chattahoochee R	1.98	8.1	3.80	200	0
USA FT Benning Plant 2	GA0000973	Chattahoochee R	1.63	6.7	4.60	200	0
USAF Lockheed 006	GA0001198	Nickajack Creek	1.49	1.3	7.0	200	0
Villa Rica Sweetwater	GA0027171	Town Branch/Sweetwater Cr	0.15	1.6	0.52	200	0
West Point WPCP	GA0020052	Chattahoochee R	0.54	166.3	1.00	200	0

Source: EPA PCS Website, 2001

Four NPDES-permitted CSOs are located within the City of Atlanta and discharge to 303(d) listed stream segments. Two NPDES-permitted CSOs are located in Columbus, Georgia, and discharge directly into the Chattahoochee River. The permitted CSOs in the Chattahoochee River Basin are listed in Table 4.

The Atlanta CSOs are currently under a consent decree (EPA, 1999) to meet end-of-pipe limits for fecal coliform bacterial by 2007. These limits have yet to be established. The goal is for the CSOs to achieve instream water quality standards. Interim operational standards tied to stipulated penalties for the Atlanta CSOs, under the Consent Decree, are 2000 counts/100 mL between May through October and 4,000-counts/100 mL between November through April.

The wastewater of the Atlanta and Columbus CSOs are treated by chlorination. The Tanyard Creek CSO treatment facility is presently being upgraded to allow for enough contact time for adequate disinfection. The Columbus CSOs are only required to report fecal coliform concentrations for their discharges. Table 4 provides the percent of sampled events for 2000-2001 that exceeded the permit limits.

Table 4. Permitted Combined Sewer Overflows (CSOs) in the Chattahoochee River Basin

Municipality/County	Permit No.	Facility Name	Receiving Stream	Percent of Sampled Events that Exceeded Permitted Limit
Atlanta/Fulton Co.	GA0036871	Clear Creek	Clear Creek	14.3
Atlanta/Fulton Co.	GA0037125	Proctor Creek/Greens Ferry	Proctor Creek	14.3
Atlanta/Fulton Co.	GA0037117	Proctor Creek/North Ave	Proctor Creek	27.8
Atlanta/Fulton Co.	GA0037109	Tanyard Creek	Tanyard Branch	15.0
Columbus/Muscogee	GA0036838	Uptown Park – 19th Street	Chattahoochee River	No limit
Columbus/Muscogee	GA0036838	South Commons – State Docks	Chattahoochee River	No limit

Source: Permitting and Compliance Program, Environmental Protection Division, GA EPD, 2002

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. Currently, regulated storm water discharges that may include discharges with fecal coliform bacteria 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 Permit NPDES permit. This permit requires visual monitoring of storm water discharges, site inspections, implementation of Best Management Practices (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 Georgia that had a population of greater than 100,000 at the time of the 1990 Census, are permitted for storm water discharge. This includes 60 permittees, 45 of which are located in the greater Atlanta metro area (see Table 5).

Table 5. Permitted MS4s in the Chattahoochee River Basin

Name	Permit No.	Watershed
Alpharetta	GAS000102	Chattahoochee
Atlanta	GAS000100	Chattahoochee, Flint
Austell	GAS000103	Chattahoochee
Berkeley Lake	GAS000138	Chattahoochee
Burford	GAS000104	Chattahoochee
Chamblee	GAS000105	Chattahoochee
Clarkston	GAS000106	Chattahoochee
Cobb County	GAS000108	Chattahoochee, Coosa
College Park	GAS000109	Chattahoochee, Flint
Columbus Consolidated	GAS000202	Chattahoochee
Decatur	GAS000110	Chattahoochee, Ocmulgee
DeKalb County	GAS000111	Chattahoochee, Ocmulgee
Doraville	GAS000113	Chattahoochee
Duluth	GAS000112	Chattahoochee, Ocmulgee
East Point	GAS000114	Chattahoochee, Flint, Ocmulgee
Fairburn	GAS000115	Chattahoochee, Flint
Forest Park	GAS000116	Chattahoochee, Flint, Ocmulgee
Forsyth County	GAS000300	Chattahoochee, Coosa
Fulton County	GAS000117	Chattahoochee, Ocmulgee, Coosa, Flint
Gwinnett County	GAS000118	Chattahoochee, Ocmulgee, Oconee
Marietta	GAS000125	Chattahoochee
Norcross	GAS000127	Chattahoochee, Ocmulgee
Palmetto	GAS000128	Chattahoochee, Flint
Powder Springs	GAS000129	Chattahoochee
Roswell	GAS000131	Chattahoochee
Smyra	GAS000132	Chattahoochee
Sugar Hill	GAS000135	Chattahoochee
Suwanee	GAS000144	Chattahoochee
Union City	GAS000136	Chattahoochee, Flint

Source: Nonpoint Source Permitting Program, GA DNR, 2001

MS4 permits require the prohibition of non-storm water discharges (i.e., illicit discharges) into the storm sewer systems, as well as 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 March 2003, small MS4s serving urbanized areas will be 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 approximately 60 communities may be permitted under the Phase II regulations, which will also require site-specific SWMPs.

3.1.2 Confined Animal Feeding Operations

Confined livestock and confined animal feeding operations (CAFOs) are characterized by high animal densities. This results in large quantities of fecal material contained within a limited area. Processed agricultural manure from confined hog, dairy cattle and some poultry operations is generally collected in lagoons and applied to pastureland and cropland as a fertilizer during the growing season, at rates which often vary on a monthly basis.

In 1990, the State of Georgia began registering CAFOs. Many of the CAFOs have been issued land application permits for treatment of wastewaters generated from their operations. Table 6 presents the swine and non-swine (primarily dairies) CAFOs located in the Chattahoochee River Basin that are registered or have land application permits.

Table 6. Registered CAFOs in the Chattahoochee River Basin

Name	County	Type	Total No. of Animals
Bobby R. Gunter Dairy Farm	Lumpkin	Dairy	200
Elmer Truelove Dairy, Inc.	Hall	Dairy	150
Farmer's Dairy	Hall	Dairy	300
GilCrest Farms	Habersham	Swine	1900
McClure Hog Farm	Lumpkin	Swine	2000
R&R Farm #4	White	Swine	2200
Riverbottom Swine Unit	Stewart	Swine	1450

Source: Permitting and Compliance Program, Environmental Protection Division, GA EPD, 2002

3.2 Nonpoint Source Assessments

In general, nonpoint sources cannot be identified as entering a waterbody through a discrete conveyance at a single location. Typical nonpoint sources of fecal coliform bacteria include:

- Wildlife
- Agricultural Livestock
  - Animal grazing
  - Animal access to streams
  - Application of manure to crop and pasture land
- Urban Development
  - Leaking septic systems
  - Land Application Systems
  - Landfills

In urban areas, a large portion of storm water runoff may be collected to storm sewer systems and discharged through distinct outlet structures. For large urban areas, these storm sewer discharge points may be regulated as described in Section 3.1.2.

3.2.1 Wildlife

The importance of wildlife as a source of fecal coliform bacteria in streams varies considerably, depending on the animal species present in the subwatersheds. Based on information provided by the Wildlife Resources Division (WRD) of DNR, the animals that spend a large proportion of their time in or around aquatic habitats are considered to be the most important wildlife sources of fecal coliform. Waterfowl, most notably ducks and geese, are considered to potentially be the greatest contributors of fecal coliform. This is because they are typically found on the water surface, often in large numbers, and deposit their feces directly into the water. Other potentially important animals, regularly found around aquatic environments, include racoon, beaver, muskrat, and to a lesser extent, river otter and mink. Population estimates of these animal species in Georgia are currently not available.

White-tailed deer have a significant presence throughout the Chattahoochee River Basin. The 2000 deer census for counties in the Chattahoochee River Basin is presented in Table 7. Fecal coliform bacteria contributions from deer to water bodies are generally considered less significant than that of waterfowl, racoon, and beaver. This is because a greater portion of their time is spent in terrestrial habitats. However, feces deposited on the land surface can result in the introduction of fecal coliform to streams during runoff events. It should be noted that between storm events, considerable decomposition of the fecal matter might occur, resulting in a decrease in the associated fecal coliform numbers. This is especially true in warm, humid environments typical of the southeast. This also holds true for other terrestrial mammals such as squirrel and rabbit, and terrestrial birds (Personal communication, WRD, 2002).

3.2.2 Agricultural Livestock

Agricultural livestock are a potential source of fecal coliform to streams in the Chattahoochee River Basin. The animals grazing on pasture land deposit their feces onto land surfaces where it can be transported during storm events to nearby streams. Animal access to pasture land varies monthly, resulting in varying fecal coliform loading rates throughout the year. Beef cattle spend all of their time in pastures, while dairy cattle and hogs are confined periodically. Agricultural livestock also often have direct access to streams that pass through pastures, and as such can impact water quality in a more direct manner. (Personal communication, EPA, Georgia Agribusiness Council, NRCS, University of Georgia, et. al.).

Table 7. 2000 Deer Census Data by County in the Chattahoochee River Basin

County	Deer Density (number/sq mile)
Banks	40
Carroll	50
Chattahoochee	35
Cherokee	40
Clay	35
Cobb	35
Coweta	50
Dawson	40
DeKalb	35
Douglas	35
Early	35
Forsyth	40
Fulton	35
Gwinnett	35
Habersham	25
Hall	40
Harris	50
Heard	50
Henry	50
Lumpkin	25
Meriwether	50
Miller	35
Monroe	50
Muscogee	50
Paulding	40
Quitman	35
Rabun	25
Randolph	35
Seminole	35
Stewart	35
Taylor	50
Towns	25
Troup	50
Turner	35
Union	25
White	25

Source: Wildlife Resource Division, GA DNR, 2000

Table 8, provides the estimated number of beef cattle per USGS 12-digit HUC. The number of dairy cattle, swine, sheep, goats and horses reported by county are presented in Table 9. These data were provided by the Natural Resources Conservation Service (NRCS) and are based on 2000 data.

Table 8. Estimated Beef Cattle Population in the Chattahoochee River Basin

HUC	Beef Cattle
31300010101	8
31300010102	316
31300010103	78
31300010104	753
31300010105	491
31300010106	1,036
31300010201	424
31300010202	1,044
31300010203	2,189
31300010204	1,269
31300010205	2,345
31300010206	928
31300010301	1,795
31300010302	3,085
31300010303	2,485
31300010304	2,367
31300010305	485

Source: NRCS, 2000

3.2.3 Urban Development

Fecal coliform from urban areas are attributable to multiple sources including: domestic animals, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, leaking septic systems, runoff from improper disposal of waste materials, and leachate from operating and closed landfills.

Urban runoff can contain high concentrations of fecal coliform from domestic animals and urban wildlife. Fecal coliform enter streams by direct washoff from the land surface, or the runoff may be diverted to a storm water collection system and discharged through a discrete outlet structure. For larger urban areas (population greater than 100,000), the storm water outlets are regulated under MS4 permits (see Section 3.1.2). For smaller urban areas, the storm water discharge outlets currently remain unregulated.

Table 9. Estimated Agricultural Livestock Populations in the Chattahoochee River Basin

County	Livestock						
	Dairy Cattle	Swine	Sheep	Horse	Goats	Chickens Layers	Chickens-Broilers Sold
Banks		1610	200	1325	3800	1429562	43554651
Carroll	408	-	100	300	500	313306	37169013
Chattahoochee		-	0	20	0	0	0
Cherokee	205	-	0	520	300	0	20758494
Clay	233	1250	0	75	500	0	0
Cobb		-	0	0	0	0	0
Coweta	383	-	0	600	100	429	0
Dawson		300	30	1200	300	238710	14376227
DeKalb	600	-	0	72	0	0	0
Douglas	200	-	0	525	0	0	0
Early		600	0	30	700	0	0
Forsyth		-	0	1500	0	716580	23076510
Fulton		-	0	0	200	0	0
Gwinnett	200	-	0	600	500	0	1967683
Habersham	75	1600	0	0	400	0	46662654
Hall	1460	200	40	900	1450	1373149	44321204
Harris		-	115	575	280	91	0
Heard	-	-	10	150	125	0	10082963
Henry	200	-	40	145	200	0	0
Lumpkin	283	175	20	180	50	0	14722844
Meriwether	325	100	30	1000	1100	138	0
Miller		2300	0	0	300	0	1342400
Monroe	1383	-	0	125	200	0	7474929
Muscogee		-	0	450	0	0	0
Paulding	100	-	0	2200	400	0	5120864
Quitman		-	0	30	300	0	0
Rabun		-	100	100	200	125	5217122
Randolph	321	1400	0	150	250	0	0
Seminole	99	240	176	150	300	0	0
Stewart	-	1000	0	60	175	0	1009137
Taylor		-	0	15	600	407665	6293097
Towns		450	30	515	200	0	0
Troup	608	-	0	350	0	0	0
Turner		749	25	80	650	0	0
Union	375	100	40	1000	300	0	0
White	448	3000	20	550	50	303818	18135126

Source: NRCS, 2000

In addition to urban animal sources of fecal coliform, there may be illicit sanitary sewer connections to the storm sewer system. As part of the MS4 permitting program, municipalities are required to conduct dry-weather monitoring to identify and then eliminate these illicit discharges. Fecal coliform may also enter streams from leaky sewer pipes or during storm events when the combine sewer overflows discharge.

3.2.3.1 Leaking Septic Systems

Some fecal coliform in the Chattahoochee River Basin may be attributed to failure of septic systems and illicit discharges of raw sewage. Table 10 presents the number of septic systems in each county of the Chattahoochee River Basin existing in 1990 based on U.S. 1990 Census Data, and the number existing in 2000 based on Georgia Department of Human Resources, Division of Public Health data. In addition, an estimate of the number of septic systems repaired during the ten-year period form 1990 to 2000 is given.

These data show that a substantial increase in the number of septic systems has occurred in several counties. This is generally a reflection of population increases outpacing the expansion of sewage collection systems during the decade. Hence, a large number of septic systems are installed to contain and treat the sanitary waste. It is estimated that there are approximately 2.37 people per household on septic systems (EPA, personal communication).

3.2.4.2 Land Application Systems

Many smaller communities use land application systems (LAS) for treatment of their sanitary wastewaters. These facilities are required through LAS permits to treat all their wastewater by land application and have zero discharge. However, runoff during storm events may carry surface residual containing fecal coliform bacteria to nearby streams. Some of these facilities may also exceed the ground percolation rate when applying the wastewater, resulting in surface runoff from the field. If not properly bermed, this runoff, which likely contains fecal coliform bacteria, may discharge to nearby surface waters. There are nineteen permitted LAS systems located in the Chattahoochee River Basin and they are listed in Table 11.

3.2.4.3 Landfills

Leachate from landfills may contain fecal coliform bacteria and may at some point discharge into surface waters. Sanitary (or municipal) landfills are the most likely type of landfills to serve as a source of fecal coliform bacteria. These receive household wastes, animal manure, offal, hatchery and poultry processing plant wastes, dead animals, and other types of wastes. Older sanitary landfills were not lined and have been closed. Those that remain active and have not been lined operate as construction/demolition landfills. Currently active sanitary landfills are lined and have leachate collection systems. All landfills, except inert landfills, are now required to install environmental monitoring systems for groundwater sampling and methane. There are 117 known landfills in the Chattahoochee River Basin (Table 12). Of these, eight are active landfills, and 109 are landfills that are inactive or closed. As shown in the Table 12, many of the older, inactive landfills were never permitted.

Table 10. Number of Septic Systems by County in the Chattahoochee River Basin

County	Total Septic Systems in 2000	Total Septic Systems in 1990	No. of Septic Systems Repaired 1990 to 2000
Banks	Note Available	Note Available	Note Available
Carroll	25298	17067	1916
Chattahoochee	Note Available	Note Available	Note Available
Cherokee	Note Available	Note Available	Note Available
Clay	1227	827	20
Cobb	33209	25631	4247
Coweta	29232	12833	834
Dawson	8504	4056	337
DeKalb	24333	20432	1403
Douglas	22552	17258	2102
Early	3727	2454	242
Forsyth	39885	16083	953
Fulton	30312	21485	2647
Gwinnett	75333	56752	4486
Habersham	13508	7934	272
Hall	50661	25664	4596
Harris	9240	6360	100
Heard	4589	2878	106
Henry	32741	14903	0
Lumpkin	8477	4898	156
Meriwether	7052	4902	133
Miller	2204	1684	260
Monroe	7832	4280	170
Muscogee	2834	1604	30
Paulding	31547	13085	277
Quitman	1616	1191	20
Rabun	Note Available	Note Available	Note Available
Randolph	1928	1178	20
Seminole	6399	2999	528
Stewart	1315	690	20
Taylor	2726	1626	25
Towns	Note Available	Note Available	Note Available
Troup	15084	9103	1195
Turner	Note Available	Note Available	Note Available
Union	Note Available	Note Available	Note Available
White	10046	5031	216

Source: 1990 Census Data, Georgia Department of Human Resources, Division of Public Health, 2000

Table 11. Permitted Land Application Systems in the Chattahoochee River Basin

LAS Name	County	Permit No	Type
Alexander High School	Douglas	GAU030757	Municipal
Carroll County Water Authority	Carroll	GAU020071	Municipal
Chattahoochee County Municipal Waste Water Plant	Chattahoochee	GAU020224	Municipal
City of Whitesburg	Carroll	GAU020118	Municipal
Colonial Pipeline Co.	Cobb	GAU010543	Industrial
Days Inn Lagrange	Troup	GAU020276	Municipal
Dorsett Shoals Elementary School	Douglas	GAU030826	Municipal
Douglas Co. Water & Sewer Authority	Douglas	GAU020048	Municipal
Dutch Quality House	Hall	GAU010432	Industrial
Glidden Company	Hall	GAU010362	Industrial
Helen LAS	White	GAU020157	Municipal
Hogansville LAS	Troup	GAU020019	Municipal
International Processing	Douglas	GAU010489	Industrial
LJS Grease and Tallow	Carroll	GAU010591	Industrial
Paulding Co. Water System	Paulding	GAU020297	Municipal
Sugar Hill LAS	Gwinnett	GAU020003	Municipal
Unicoi State Park Lodge	White	GAU020066	Municipal
Windermere Urban Reuse	Forsyth	GAU020195	Private
Wrigley WM Jr. Company	Hall	GAU010595	Industrial

Source: Permitting and Compliance Program, Environmental Protection Division, GA EPD, 2000

Table 12. Landfills in the Chattahoochee River Basin

Name	County	Permit No.	Type	Status
McGukin - Cedar Heights Rd.	Carroll		Not Applicable	Inactive
Cusseta - Osteen St.	Chattahoochee		Not Applicable	Inactive
Ft. Benning - US 27/ 280, Old Cusseta Rd.	Chattahoochee	026-003D	Sanitary Landfill	Inactive
Ft. Benning - 1st Division Rd.	Chattahoochee	026-004D	Sanitary Landfill	Closed
Fort Gaines	Clay		Not Applicable	Inactive
SR 39 PH1	Clay	030-002D	Sanitary Landfill	Closed
SR 39 PH2	Clay	030-003D	Sanitary Landfill	Closed
Austell	Cobb		Not Applicable	Inactive
Austell Box Board	Cobb		Not Applicable	Inactive
Chambers - Oakdale Rd. I-285	Cobb	033-081D	Dry Trash Landfill	Closed
Chambers - Oakdale/ I-285	Cobb	033-093P	Recovered Materials Facility	Inactive
Cobb Co. Baler	Cobb	033-004P	Baler Facility	Inactive
Cobb Co. County Farm Rd.	Cobb	033-020D	Dry Trash Landfill	Inactive
Cobb Co. County Farm Rd.	Cobb	033-032D	Sanitary Landfill	Inactive
County Farm Rd. No. 2 PH 1-2-3	Cobb	033-037D	Dry Trash Landfill	Ceased Accepting Waste
County Farm Rd. PH2	Cobb	033-039D	Sanitary Landfill	Closed
Hoyt Samples Landfill	Cobb		Not Applicable	Inactive
Mid - South Supply - Bankhead Hwy	Cobb		Not Applicable	Inactive
North Cooper Lake Rd.	Cobb	033-030D	Dry Trash Landfill	Inactive
O.E. Matlock - Hwy 41	Cobb		Not Applicable	Inactive
Pacific Cabinet Co., Cousin St.	Cobb		Not Applicable	Inactive
Pebblebrook Baptist Church	Cobb		Not Applicable	Inactive
Sam Floyd - Powder Springs Rd.	Cobb		Not Applicable	Inactive
Six Flags - I-20	Cobb		Not Applicable	Inactive
Whitfield - Gordon Rd.	Cobb		Not Applicable	Inactive
Arnco - Sargent	Coweta		Not Applicable	Inactive
Coweta Co. Ishman Ballard Rd	Coweta	038-009D	Sanitary Landfill	Inactive
Coweta Co. Ishman Ballard Rd.	Coweta	038-015D	Construction and Demolition Waste Landfill	Active
Coweta Co. Ishman Ballard Rd. Ph 1A	Coweta	038-007D	Sanitary Landfill	Closed
Ga. Reclamation Center	Coweta	038-010P	Recovered Materials Facility	Inactive
Georgia Power, Plant Yates Gypsum	Coweta	038-014D	Industrial	Inactive
Grantville	Coweta		Not Applicable	Inactive
Palmetto	Coweta		Not Applicable	Inactive
Buford Highway	DeKalb	044-009D	Sanitary Landfill	Inactive
Chamblee-Keswick Dr.	DeKalb	044-031D	Dry Trash Landfill	Closed
Emory - Old Briarcliff Rd.	DeKalb	044-036D	Dry Trash Landfill	Inactive
Laurelwood	DeKalb		Not Applicable	Inactive
Blythe Ga. Hwy 92	Douglas		Not Applicable	Inactive
Cedar Mtn. - Worthan Rd. PH1	Douglas	048-009D	Sanitary Landfill	Active
Cedar Mtn. Rd.	Douglas	048-007D	Sanitary Landfill	Closed
Downs Rd.	Douglas		Not Applicable	Inactive
Giddens - Hwy. 92 Landfill	Douglas		Not Applicable	Inactive

Name	County	Permit No.	Type	Status
Lee H. Wallace - Basket Creek Rd.	Douglas		Not Applicable	Inactive
Cumming	Forsyth		Not Applicable	Inactive
Forsyth Co. - Kelly Mill Rd. Site # 2	Forsyth	058-001D	Sanitary Landfill	Inactive
Forsyth Co. - Kelly Mill Rd. Site # 2	Forsyth	058-003D	Sanitary Landfill	Inactive
Kelly Mill Rd. No. 2	Forsyth	058-004D	Sanitary Landfill	Closed
Miller/Trammel Trammel Rd.	Forsyth	058-007D	Dry Trash Landfill	Closed
Tomahawk Recycling	Forsyth	058-011P	Recovered Materials Facility	Inactive
Atlanta - Cascade Road SL	Fulton	060-046D	Sanitary Landfill	Closed
Atlanta - Gun Club Road	Fulton	060-026D	Sanitary Landfill	Closed
B.F.I. - Marietta Blvd.	Fulton		Not Applicable	Inactive
BFI - Watts Road	Fulton	060-051D	Sanitary Landfill	Closed
Chambers - Bolton Road	Fulton	060-083D	Municipal Solid Waste Landfill	Active
East Point Landfill	Fulton	060-017D	Not Applicable	Inactive
Field Road #1	Fulton		Not Applicable	Inactive
Fields Road No. 2 Atlanta Landfill	Fulton	060-033D	Dry Trash Landfill	Inactive
Fulton County - Merk Rd.	Fulton	060-011D	Sanitary Landfill	Closed
Fulton County - Morgan Falls	Fulton	060-007D	Sanitary Landfill	Closed
Grady Price - Hwy 29	Fulton		Not Applicable	Inactive
Grove Park	Fulton		Not Applicable	Inactive
James Ferell - Cascade Rd.	Fulton		Not Applicable	Inactive
Joe Jones	Fulton		Not Applicable	Inactive
MacDougald Construction Co.	Fulton	060-039D	Dry Trash Landfill	Inactive
Merk/Miles Road	Fulton	060-064D	Sanitary Landfill	Closed
Morris Road Dump	Fulton		Not Applicable	Inactive
Oxbo	Fulton		Not Applicable	Inactive
Price - Roosevelt Hwy	Fulton	060-075D	Dry Trash Landfill	Closed
Roy Pittman Prop. - Hwy 29	Fulton	060-028D	Dry Trash Landfill	Inactive
Safeguard Landfill Mgt C&D	Fulton	060-088D	Construction and Demolition Waste Landfill	Active
Skinner - Watts Rd.	Fulton		Not Applicable	Inactive
Southern States - Bolton Road	Fulton	060-010D	Sanitary Landfill	Closed
Strickland - Kimball Br. Rd.	Fulton		Not Applicable	Inactive
United Waste Westview PH2	Fulton	060-062D	Sanitary Landfill	Closed
Westview	Fulton	060-024D	Not Applicable	Inactive
Worley - Nesbitt Ferry Rd.	Fulton		Not Applicable	Inactive
B.J.	Gwinnett	067-014D	Not Applicable	Inactive
BFI - Richland Creek	Gwinnett	067-032D	Municipal Solid Waste Landfill	Active
Buford	Gwinnett	067-008D	Sanitary Landfill	Closed
Buford - Peachtree Ind. Blvd PH2	Gwinnett	067-030D	Sanitary Landfill	Closed
Buford - Tuggle Greer Rd.	Gwinnett	067-019D	Dry Trash Landfill	Closed
Norcross	Gwinnett		Not Applicable	Inactive
Sugar Hill - Appling Rd. PH1	Gwinnett	067-016D	Sanitary Landfill	Closed
Suwanee	Gwinnett		Not Applicable	Inactive
Walt McManus	Gwinnett		Not Applicable	Inactive

Name	County	Permit No.	Type	Status
Weathers - Nelson & Budd, Inc.	Gwinnett		Not Applicable	Inactive
WMI BJ Landfill Expansion	Gwinnett	067-025D	Sanitary Landfill	Closed
WMI BJ landfill PH3&4	Gwinnett	067-027D	Municipal Solid Waste Landfill	Closed
Clarkesville	Habersham		Not Applicable	Inactive
Cornelia	Habersham		Not Applicable	Inactive
Pea Ridge Road PH1	Habersham	068-016D	Sanitary Landfill	Closed
Pea Ridge Road PH2-3	Habersham	068-017D	Sanitary Landfill	Closed
City of West Point SR 103	Harris	072-003D	Sanitary Landfill	Closed
Hamilton Rd. E.	Harris	072-009D	Sanitary Landfill	Closed
Harris Co. - S2651	Harris	072-004D	Sanitary Landfill	Inactive
Franklin	Heard		Not Applicable	Inactive
Frolona Rd.	Heard	074-004D	Sanitary Landfill	Closed
Hwy. 100	Heard	074-001D	Sanitary Landfill	Inactive
CR 98 Durand SL	Meriwether	099-015D	Sanitary Landfill	Closed
Garden Services Inc.	Meriwether	099-010D	Dry Trash Landfill	Inactive
Phillips Rd.	Meriwether	099-004D	Sanitary Landfill	Inactive
Cols. Cons. Govt. Schatlulge Rd. East Side	Muscogee	106-008D	Not Applicable	Inactive
Columbus Sanitary Landfill	Muscogee	106-001D	Sanitary Landfill	Ceased Accepting Waste
Columbus Schatulga Rd W Fill PH2	Muscogee	106-011D	Sanitary Landfill	Ceased Accepting Waste
Columbus, Pine Grove	Muscogee	106-016D	Municipal Solid Waste Landfill	Active
Schatulga Road	Muscogee		Not Applicable	Inactive
Tyler Buena Vista Rd.	Muscogee	106-004D	Dry Trash Landfill	Ceased Accepting Waste
Coleman	Randolph		Not Applicable	Inactive
CR 145S PH2	Stewart	128-001D	Sanitary Landfill	Closed
Junction City	Talbot		Not Applicable	Inactive
Hogansville - Blue Creek Rd.	Troup	141-009D	Sanitary Landfill	Closed
LaGrange - Orchard Hill Rd.	Troup	141-005D	Sanitary Landfill	Closed
LaGrange I85/SR109	Troup	141-013D	Sanitary Landfill	Active
SR 109 Mountville PH1	Troup	141-008D	Sanitary Landfill	Closed
SR 109 Mountville PH2	Troup	141-023D	Construction and Demolition Waste Landfill	Active
Warner Rd. S.	Troup	141-012D	Sanitary Landfill	Closed
Duke's Creek	White	154-003D	Sanitary Landfill	Closed

Source: Land Protection Branch, GA DNR, 1999

4.0 ANALYTICAL APPROACH

The process of developing fecal coliform TMDLs for the Chattahoochee River Basin listed segments includes the determination of the following:

- The “current” critical fecal coliform load to the stream under “current” conditions;
- The TMDL for similar conditions under which the ”current” load was determined; and
- The percent reduction in the “current” critical fecal coliform load necessary to achieve the TMDL.

The calculation of the fecal coliform load at any point in a stream requires the fecal coliform concentration and stream flow. The availability of water quality and flow data varies considerably among the listed segments. A discussion of the available monitoring data was presented in Section 2.0. For the majority of listed segments, fecal coliform sampling data were sufficient to calculate at least one 30-day geometric mean to compare with the regulatory criteria (see Appendix A). Fecal coliform data for the remaining segments were limited (see Appendix B). Depending on the nature and availability of water quality data, different approaches were used to determine the “current” critical loads and TMDLs for the listed segments. These different approaches are outlined below.

4.1 Loading Curve Approach

For those segments in which sufficient water quality data were collected to calculate at least one 30-day geometric mean that was above the regulatory standard, the loading curve approach was used. The method involves comparing the “current” critical load to summer and winter seasonal TMDL curves.

As mentioned in Section 2.0, the USGS monitored many of the listed segments and collected stream flow information concurrently with water quality samples. Stream depths were measured and used to determine stream flows, based on rating curves developed by the USGS for each sampling location.

In cases where no stream flow measurements were available, flow on the day the fecal coliform samples were collected was estimated using data from a nearby gaged stream. The nearby stream had to have relatively similar watershed characteristics, including landuse, slope, and drainage area. The stream flows were estimated by multiplying the gaged flow by the ratio of the listed stream drainage area to the gaged stream drainage area. Table 13 listed those segments in which no flow data was available and the gaged station that was used to estimate the flow. If a gage stream was available within the same watershed, it was used.

The “current” critical loads were determined using fecal coliform data collected within a 30-day period to calculated the geometric means, and multiplying these values by the arithmetic mean of the flows measured at the time the water quality samples were collected. Georgia’s instream fecal coliform standards are based on a geometric mean of samples collected over a 30-day period, each sample is at least 24 hours apart. To reflect this in the load calculation, the fecal coliform loads are expressed as 30-day accumulation loads with units of counts per 30 days. This is described by the equation below:

$$L_{critical} = C_{geomean} * Q_{mean}$$

Table 13. Monitoring Stations with No Flow Data and USGS Gaging Stations used to Estimate the Flow

Stream Name	USGS Station Name	Station No.
Anneewakee Creek	Noses Creek at Powder Springs	02336968
Big Creek Headwaters	Big Creek near Alpharetta, GA	02335700
Big Creek Hwy 400	Big Creek near Alpharetta, GA	02335700
Chattahoochee River Morgan Falls Dam to Peachtree Ck	Chattahoochee at Atlanta, GA	02336000
Chattahoochee River Peachtree Ck to Utoy Ck	Chattahoochee at St Hwy 280	02336490
Chattahoochee River Utoy Ck to Pea Ck	Chattahoochee at Fairburn, GA	02337170
Chattahoochee River North Highland Dam to Upatoi	Chattahoochee at Columbus	02341500
Crawfish Creek	Snake Creek near Whitesburg, GA	02337500
Kelly Mill Branch	Big Creek near Alpharetta, GA	02335700
Mobley Creek	Snake Creek near Whitesburg, GA	02337500
Level Creek	Suwanee Creek near Suwanee, GA	02334885
North Fork Peachtree Creek	Peachtree Creek at Atlanta, GA	02336300
Orr Creek	Big Creek near Alpharetta, GA	02335700
Peachtree Creek	Peachtree Creek at Atlanta, GA	02336300
Richland Creek	Suwanee Creek near Suwanee, GA	02334885
Sope Creek	Sope Creek near Marietta, GA	02335870
Sweetwater Creek (Cobb/Douglas Co.)	Sweetwater Creek near Austell, GA	02337000

Where:
$L_{critical}$ = "current" critical fecal coliform load
$C_{geomean}$ = fecal coliform concentration as a 30-day geometric mean
Q_{mean} = stream flow as arithmetic mean

The "current" critical load is dependent on the fecal coliform concentrations and stream flows measured during the sampling events. The number of events sampled is usually 16 events per year. Thus, it does not represent the full range of flow conditions or loading rates that can occur. Therefore, it must be kept in mind that the "current" critical loads used are only representative of the time periods sampled.

The maximum fecal load at which the instream fecal coliform criteria will be met can be determined using a variation of the equation above. By setting C equal to the seasonal instream fecal coliform standards, the load will equal the TMDL. However, the TMDL is dependent on stream flow. Figures in Appendix A graphically illustrates that the TMDL is a continuum for the range of flows (Q) that can occur in the stream over time. There are two TMDL lines. One line represents the summer TMDL for the period from May through October when the 30-day geometric mean standard is 200 counts/ 100 mL. The second line represents the winter TMDL for the period from November through April when the 30-day geometric mean standard is 1000 counts/ 100 mL. The equations for these two TMDL lines are given below.

$$TMDL_{summer} = 200 \text{ counts (as a 30-day geometric mean)/100 mL} * Q * \text{Conversion Factor}$$

$$TMDL_{winter} = 1000 \text{ counts (as a 30-day geometric mean)/100 mL} * Q * \text{Conversion Factor}$$

The graph shows the relationship between the "current" critical load ($L_{critical}$) and the TMDL. The TMDL for a given stream segment is the load for the mean flow corresponding to the "current" critical load. This is the point where the "current" load most exceeds the TMDL curve. This critical TMDL can be represented by the following equation:

$$TMDL_{critical} = C_{standard} * Q_{mean} * \text{Conversion Factor}$$

Where:
$TMDL_{critical}$ = critical fecal coliform TMDL load
$C_{standard}$ = seasonal fecal coliform standard as 30-day geometric mean
summer - 200 counts/100 mL
winter - 1000 counts/ 100 mL
Q_{mean} = stream flow as arithmetic mean (same as used for $L_{critical}$)

A 30-day geometric mean load that plots above the respective seasonal TMDL curve, represents an exceedance of the instream fecal coliform standard. The difference between the "current" critical load and the TMDL curve represents the load reduction required for the stream segment to meet the appropriate instream fecal coliform standard. The load reduction can thus be expressed as follows:

$$\text{Load Reduction} = \frac{L_{critical} - TMDL_{critical}}{L_{critical}} * 100$$

4.2 Equivalent Site Approach

TMDLs must be developed for a number of listed segments for which sufficient data are not available to calculate the 30-day geometric mean fecal coliform concentrations. Although there may be sampling data for many of these streams, there are not enough data within a 30-day period to directly calculate geometric means. Therefore, an equivalent site approach is used to estimate the "current" and TMDL loads. This approach involves calculating loads for the stream segments that lack sufficient data based on a relationship to other, similar, equivalent site(s) that have data. This method provides estimates that can be refined in the future as additional data are collected.

Development of loads using the equivalent site approach addresses three key issues:

1. Site-specific monitoring data should be used, even if it is insufficient for direct estimation of geometric means. The site-specific and equivalent site monitoring data should be combined in a weighted approach that reflects the relative accuracy of information provided by each data source.

2. Equivalent site selection has a potential impact on the resulting load estimates. In the case where a TMDL has already been prepared for a downstream segment within the same watershed, the equivalent site selection is obvious. For other segments, multiple sites within the same general region may be available for use.

3. Different landuses result in different fecal coliform concentrations. An equivalent site with a perfect landuse match is unlikely to be available. Differences in landuses among watersheds should be addressed through use of a regionalization model that identifies the extent to which variability in fecal coliform concentrations can be explained by changes in landuse.

In translating data from an equivalent site to a listed segment, it is important to account for changes in fecal coliform runoff concentrations associated with different landuses, and for changes in flow associated with different drainage areas. The critical load at site *i* can be estimated in relations to the calculated critical loads at other sites using the following equation:

$$\text{Load}_{\text{critical}} = \frac{1}{n}\sum_{j=1}^{n}\left[A_{ij}\cdot C_j\cdot Q_{crit,j}\cdot\frac{DA_i}{DA_j}\right]$$

Where:

$L_{critical}$ = estimated critical fecal coliform load at site *i*
n = number of equivalent sites
A_{ij} = translation factor
C_j = fecal coliform concentration as 30-day geometric mean at site(s) *j*
$Q_{crit,j}$ = stream flow as arithmetic mean at site(s) *j*
DA_i = drainage area above site *i*
DA_j = drainage area above site *j*

The A_{ij} factor relates the geometric mean fecal coliform concentration at site *i* to that at site(s) *j.* It is expressed in log space, since a geometric mean is used. It is expected that this factor will vary with landuse, but may exhibit strong site-specific characteristics. For example, a given site might exhibit higher fecal coliform concentrations relative to an equivalent site than are expected from land use differences alone.

A method is needed that provides an appropriate weighing between limited site-specific data and a landuse based regression of equivalent sites. An empirical Bayes analysis is the mathematical technique ideally suited for this circumstance. This analysis combines two important concepts: maximum likelihood techniques for combining data sources, and hierarchical regionalization techniques. The data combination step assumes that both equivalent site data and site-specific data provide information the true local geometric mean. The two data sources are weighted in accordance with their degree of precision or accuracy. The regionalization step assumes that the true mean at any site is a result of random variability and a regional regression model on land use. Empirical Bayes techniques provide statistically optimal methods for computing both the data combination and regionalization steps from observed data.

In the empirical Bayes analysis, it is assumed that the long-term geometric mean fecal coliform concentration at a given site is a function of watershed landuse and site-specific factors that are represented by random noise. A sample realization of the geometric mean at site *i*, X_i, is assumed to be normally distributed about a true mean Θ_i, with standard error of the estimate given by σ_ι. In statistical notation:

$$X_i \sim N(\Theta_i, \sigma_\iota^2)$$

The desired translation factor is then: $A_c = \Theta_I / \Theta_j$. Full technical details on the implementation of the empirical Bayes approach are provided in Appendix C. Table 14 list the equivalent sites used for the listed segments that did not have sufficient data to calculate a 30-day geometric mean.

The estimated TMDL for the stream segments with insufficient data can be calculated using the following equation:

$$TMDL = \frac{1}{n} \sum_{j=1}^{n} \left[C_{standard} \bullet Q_j \bullet \frac{DA_i}{DA_j} \right]$$

Where:

TMDL = fecal coliform TMDL load at site *i*
n = number of equivalent sites
$C_{standard}$ = seasonal fecal coliform standard as 30-day geometric mean
summer - 200 counts/100 mL
winter - 1000 counts/ 100 mL
$Q_{crit,j}$ = stream flow as arithmetic mean at site(s) *j* (cfs)
DA_i = drainage area above site *i* (acres)
DA_j = drainage area above site *j* (acres)

Table 14. List of Equivalent Sites

Site	Equivalent Sites
Arrow Creek	Crooked Creek Long Island Creek Peachtree Creek North Fork Peachtree Creek
Ball Mill Creek	Crooked Creek Willeo Creek
Balus Creek	Flat Creek
Bishop Creek	Willeo Creek Long Island Creek
Blue John Creek	Long Cane Creek
Bubbling Creek	Nancy Creek
Burnt Fork Creek	North Fork Peachtree Creek Crooked Creek Peachtree Creek
Buttermilk Creek	Willeo Creek Rottenwood Creek Long Island Creek Nickajack Creek
Chattahoochee River	Pataula Creek
Clear Creek	Peachtree Creek
Cracker Creek	Sweetwater Creek Mobley Creek Anneewakee Creek Crawfish Creek
Foe Killer Creek	Big Creek
Foxwood Branch	Rottenwood Creek
Hilly Mill Creek	Flat Creek New River
Hog Wallow Creek	Big Creek
Lullwater Creek	North Fork Peachtree Creek Crooked Creek Peachtree Creek
Marsh Creek	Crooked Creek Long Island Creek Willeo Creek
Mud Creek	Willeo Creek Rottenwood Creek Long Island Creek Nickajack Creek
Mud Creek (South Hall)	Flat Creek
North Fork Balus Creek	Flat Creek

Site	Equivalent Sites
North Utoy Creek	Utoy Creek
Olley Creek	Willeo Creek Rottenwood Creek Long Island Creek Nickajack Creek
Pea Creek	Camp Creek Crawfish Creek Mobley Creek Anneewakee Creek
Peavine Creek	North Fork Peachtree Creek Crooked Creek Peachtree Creek
Rocky Branch	Bull Creek Mulberry Creek Mountain Oak Creek
South Fork Peachtree Creek	Peachtree Creek
South Utoy Creek	Utoy Creek
Sewell Mill Creek	Willeo Creek Long Island Creek
Tanyard Branch	Peachtree Creek
Tanyard Creek	Long Cane Creek
Tributary to Mud Creek	Willeo Creek Rottenwood Creek Long Island Creek Nickajack Creek
Ward Creek	Willeo Creek Rottenwood Creek Long Island Creek Nickajack Creek
Weracoba Creek	Bull Creek Mulberry Creek Mountain Oak Creek
White Oak Creek	Camp Creek Crawfish Creek Mobley Creek Anneewakee Creek
Woodall Creek	Peachtree Creek

The DA_i / DA_j ratio, as mentioned in the previous section, adjusts the flow from site *j* to site *i*. In the case where flow data are available, the actual arithmetic mean flow associated with the estimated 30-day geometric mean fecal coliform concentration can be used.

As in the loading curve approach, the estimated percent load reduction needed at site *i* can be expressed as follows:

$$\text{Load Reduction} = \frac{L_{critical} - TMDL}{L_{critical}} * 100$$

5.0 TOTAL MAXIMUM DAILY LOADS

A Total Maximum Daily Load (TMDL) is the amount of a pollutant that can be assimilated by the receiving waterbody without exceeding the applicable water quality standard; in this case the seasonal fecal coliform standards. A TMDL is the sum of the individual waste load allocations (WLAs) and load allocations (LAs) for nonpoint sources and 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 fecal coliform bacteria, the TMDLs are expressed as counts per 30 days as a geometric mean.

A TMDL is expressed as follows:

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

The TMDL calculates the WLAs and LAs with margins of safety to meet the stream's water quality standards. The allocations are based on estimates that use the best available data and provide the basis to establish or modify existing controls so that water quality standards can be achieved. In developing a TMDL, it is important to consider if adequate data is available to identify the sources, fate, and transport of the pollutant to be controlled.

TMDLs may be developed using a phased approach. Under a phased approach, the TMDL includes: 1) WLAs that confirm existing limits and controls or lead to new limits, and 2) LAs that confirm existing controls or include implementing new controls (EPA TMDL Guidelines). A phased TMDL requires additional data be collected to determine if load reductions required by the TMDL lead to the attainment of water quality standards.

The TMDL Implementation Plan will establish a schedule or timetable for the installation and evaluation of point and nonpoint source control measures, data collection, assessment of water quality standard attainment, and if needed, additional modeling. Future monitoring of the listed segment water quality will then be used to evaluate this phase of the TMDL, and if necessary, reallocate the loads.

The fecal coliform loads calculated for each listed stream segment include the sum of the total loads from all point and nonpoint sources for the segment. The load contributions to the listed segment from unlisted upstream segments are represented in the background loads, unless the unlisted segment contained point sources that had permit violations for fecal coliform. In these cases, the upstream point sources are included in the wasteload allocations for the listed segment. In cases where two or more adjacent segments are listed, the fecal coliform loads to each segment are individually evaluated on a localized watershed basis. Point source loads originating in upstream segments are included in the background loads of the downstream segment. The following sections describe the various fecal coliform TMDL components.

5.1 Waste Load Allocations

The waste load allocation (WLA) is the portion of the receiving water's loading capacity that is allocated to existing or future point sources. Waste load allocations are provided to the point sources from municipal and industrial wastewater treatment systems and CSOs that have NPDES effluent limits.

There are 29 active NPDES permitted outfalls with fecal coliform permit limits in the Chattahoochee River Basin watershed that discharge into listed segments. The maximum allocated fecal coliform loads for these municipal and industrial wastewater treatment facilities are given in Table 15. The WLA loads were calculated based on the permitted or design flows and average monthly permitted fecal coliform concentrations or a fecal coliform concentration of 200 counts/ 100 mL as a 30-day geometric mean. If a facility expands its capacity and the permitted flow increases, the wasteload allocation for the facility will increase in proportion to the flow. These were expressed as 30-day geometric mean, presented as units of counts per 30 days. Tyson Foods Inc. requires a 50% reduction in its waste load allocation.

Table 15. WLA for Chattahoochee River Basin

Facility Name	Permit No.	Receiving Stream	Listed Watershed	WLA
Atlanta R M Clayton	GA0021482	Chattahoochee River	Chattahoochee River - Peachtree	2.28E+13
Atlanta Utoy Creek	GA0021458	Chattahoochee River	Chattahoochee River - Utoy	8.42E+12
Buford Southside	GA0023167	Suwanee Creek	Suwanee Creek	4.55E+11
Buford Westside WPCP	GA0023175	Richland Creek	Richland Creek	5.69E+10
Clarkesville WPCP	GA0032514	Soquee River	Soquee River	1.71E+11
Cleveland WPCP	GA0036820	Tesnatee Creek Trib	Tesnatee Creek	1.71E+11
Cobb County R L Sutton	GA0026140	Chattahoochee River	Chattahoochee River - Peachtree	9.10E+12
Cobb County South	GA0026158	Chattahoochee River	Chattahoochee River - Peachtree	9.10E+12
Columbus South	GA0020516	Chattahoochee River	Chattahoochee River - N. Highland Dam	9.56E+12
Columbus Water Works	GA0020532	Tiger Creek	Chattahoochee River - N. Highland Dam	Inactive
Countryside MHP	GA0030201	Suwanee Creek	Suwanee Creek	2.84E+10
Coweta Co Arnco WPCP	GA0000311	Wahoo Creek	Chattahoochee R – Wahoo to Franklin	2.28E+10
Cumming WPCP	GA0046019	Big Creek	Big Creek - Headwaters	4.55E+11
Douglasville Southside	GA0030341	Anneewakee Creek	Anneewakee Creek	7.39E+11
Douglasville Sweetwater	GA0047201	Chattahoochee River	Chattahoochee River - Utoy	6.83E+11
Fort Gaines	GA0026191	Chattahoochee River	Chattahoochee River - WF George	6.83E+10
Fulton County Big Creek	GA0024333	Chattahoochee River	Chattahoochee - Morgan Fall	5.46E+12
Fulton County Camp Creek	GA0025381	Chattahoochee River	Chattahoochee River - Utoy	2.96E+12
Gainesville Flat Cr WPCP	GA0021156	Flat Creek	Flat Creek	1.64E+12
Gwinnett Co Crooked Cr/North	GA0026433	Chattahoochee River	Chattahoochee - Morgan Fall	2.05+12
Palmetto WPCP	GA0025542	Little Bear Creek	Chattahoochee - Pea	1.37E+11
Tyson Foods Inc	GA0001074	Unnamed Trib/Orr's Ck	Orr Creek	3.41E+11
USA Ft Benning	GA0000973	Chattahoochee River	Chattahoochee River - Upatoi	1.05E+12
USAF Lockheed	GA0001194	Rottenwood /Nickajack	Rottenwood Creek, Nickajack Creek	1.59E+12
Atlanta Clear Creek CSO	GA0036871	Clear Creek	Clear Creek	Q*200
Atlanta Proctor Ck Greens Ferry CSO	GA0037125	Proctor Creek	Proctor Creek	Q*200
Atlanta Proctor Creek North Ave CSO	GA0037117	Proctor Creek	Proctor Creek	Q*200
Atlanta Tanyard Creek CSO	GA0037109	Tanyard Branch	Tanyard Branch	Q*200
Columbus Uptown Park CSO	GA0036838	Chattahoochee River	Chattahoochee River - N. Highland Dam	Q*200
Columbus South Commons	GA0036838	Chattahoochee River	Chattahoochee River - N. Highland Dam	Q*200

Of these NPDES facilities, four are CSOs in the City of Atlanta and two are CSOs in Columbus. They treat the overflow with chlorination prior to discharge. A specific load cannot be assigned to the CSOs, since flow volumes were dependent on the nature of individual storm events. However, the WLA for the CSOs can be calculated using the following equation:

$$WLA_{CSOs} = \Sigma\ (200 \text{ counts (as 30-day geometric mean)}/100 \text{ mL} * Q_{CSOs}) * \text{Conversion Factor}$$

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.

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 waste load allocations from storm water discharges associated with MS4s (WLAsw) are estimated based on the percentage of urban landuse in each watershed covered by the MS4 storm water permit. At this time, the portion of each watershed that goes directly to the permitted storm sewer and that goes through non-permitted point sources or is sheet flow or agricultural runoff has not been clearly defined. Thus, it is assumed that approximately 70 percent of the storm water runoff from the regulated urban area is collected by the municipal separate storm sewer systems.

There are seven permitted CAFOs in the Chattahoochee River Basin. These facilities have no discharge. Therefore, they are not provided a WLA.

This TMDL will use an iterative approach. Future phases of the TMDL development will attempt to further define the sources of pollutants and the portion that enters the permitted storm sewer systems. As more information is collected and these TMDLs are implemented, it will become clearer, which BMPs are needed, and how the water quality standards can be achieved.

5.2 Load Allocations

The load allocation (LA) is the portion of the receiving water's loading capacity that is attributed to existing or future nonpoint sources or to natural background sources. Nonpoint sources are identified in 40 CFR 130.6 as follows:

- Residual waste
- Land disposal
- Agricultural and silvicultural
- Mines
- Construction
- Saltwater intrusion
- Urban storm water (non-permitted)

The LA is calculated as the remaining portion of the TMDL load available after allocating the WLA and the MOS and was determined by the following equation:

$$\Sigma\ LA = TMDL - (\Sigma\ WLA + \Sigma\ WLAsw + \Sigma MOS)$$

As described above, there are two types of load allocations: loads to the stream independent of precipitation including sources such as failing septic systems, leachate from landfills, animals in the stream, and leaking sewer system collection lines or background loads; and loads associated with fecal coliform accumulation on land surfaces that is washed off during storm events including runoff from saturated LAS fields. At this time, it is not possible to partition the various sources of load allocations. Table 16 presents the total load allocation expressed as counts per 30 days for the 303(d) listed streams located in the Chattahoochee River Basin for the “current” critical condition. In the future, with additional data, it may be possible to partition the load allocation by source.

Evaluation of the relationship between in-stream water quality and the potential sources of pollutant loading is an important component of TMDL development, and is the basis for later implementation of corrective measures and BMPs. For the ”current” TMDLs, the association between fecal coliform loads and the potential sources occurring within the subwatersheds of each segment was examined on a qualitative basis. The most probable sources were identified in Section 3.0.

5.3 Seasonal Variation

The Georgia fecal coliform criteria are seasonal. One set applies to the summer season, while a different set applies to the winter season. To account for seasonal variations, the critical loads for each listed segment were determined from sampling data obtained during both summer and winter seasons, when possible. However, in some cases, the available data was limited to a single season for the calculation of the critical load. The TMDL and percent reduction given in Table 16 for each listed segment was based on the season in which the critical load occurred. The TMDLs for each season, for any given flow, are presented as equations in Section 5.5.

Analyses of the available fecal coliform data and corresponding flows were performed to determine if the fecal coliform violations occurred during wet weather (high flow) or dry weather (low flow) conditions. The flow data from each sampling site were normalized by dividing the measured flow by the product of the average annual runoff (cfs/ sq mile), published in Open-File Report 82-577, and the appropriate drainage area (Carter, 1982). Plots of the normalized flows (Q/Qo) versus fecal coliform are shown in Appendix D. The plots do not show a consistent relationship between fecal coliform concentrations and flow. The summer and winter plots show that the fecal coliform violations occur during both high (wet weather) and low (dry weather) flow conditions.

5.4 Margin of Safety

The MOS is a required component of TMDL development. There are two basic methods for incorporating the MOS: 1) Implicitly incorporate the MOS using conservative assumptions to develop allocations; or 2) Explicitly specify a portion of the TMDL as the MOS and using the remainder for allocations. For this TMDL, an explicit MOS of 10 percent of the TMDL was used. The MOS values are presented in Table 16.

5.5 Total Fecal Coliform Loads

The fecal coliform TMDL for the listed stream segment is dependent on the time of year and the stream flow. The maximum seasonal fecal loads are given below.

$TMDL_{summer}$ = 200 counts (as a 30-day geometric mean)/100 mL * Q * Conversion Factor

$TMDL_{winter}$ = 1000 counts (as a 30-day geometric mean)/100 mL * Q * Conversion Factor

For purposes of determining necessary load reductions required to meet the instream water quality criteria, the "current" critical TMDL was determined. This load is the product of the applicable seasonal fecal coliform standard and the mean flow used to calculate the "current" critical load. It represents the sum of the allocated loads from point and nonpoint sources located within the immediate drainage area of the listed segment, the NPDES-permitted point discharges with recorded fecal coliform violations from the nearest upstream subwatersheds, and a margin of safety (MOS). The "current" critical loads and corresponding TMDLs, WLAs, LAs, MOSs, and percent load reductions for the Chattahoochee River Basin 303(d) listed streams are presented in Table 16.

The relationships of the "current" critical loads to the "current" critical TMDLs are shown graphically in Appendix A. The vertical distance between the two values represents the load reductions necessary to achieve the TMDLs. As a consequence of the localized nature of the load evaluations, the calculated fecal load reductions pertain to point and nonpoint sources occurring within the immediate drainage area of the listed segment. These "current" critical values represent a worst-case scenario for the limited set of data. Thus, the load reductions required are conservative estimates, and should be sufficient to prevent exceedances of the instream fecal coliform standard for a wide range of conditions.

Table 16. Fecal Loads and Required Fecal Load Reductions

Stream Segment	Current Load (cnts/30 days)	TMDL Components: WLA (cnts/30 days)	WLA$_{SW}$ (cnts/30 days)	LA (cnts/30 days)	MOS (cnts/30 days)	TMDL (cnts/30 days)	Percent Reduction
Anneewakee Creek	3.95E+12	6.69E+11		2.38E+12	3.39E+11	3.39E+12	14%
Arrow Creek	6.87E+12		4.48E+11	1.99E+11	7.19E+10	7.19E+11	90%
Ball Mill Creek	2.49E+12		2.08E+11	1.01E+11	1.23E+11	1.23E+12	51%
Balus Creek	5.17E+12			1.70E+12	1.89E+11	1.89E+12	64%
Big Creek - Headwaters to Cheatham Creek	7.73E+12	2.12E+11		5.34E+12	1.39E+11	1.39E+12	82%
Big Creek - Hwy 400 to Chattahoochee River	1.01E+13		2.43E+11	1.00E+12	6.17E+11	6.17E+12	39%
Bishop Creek	2.04E+11		6.64E+10	2.97E+10	1.07E+10	1.07E+11	48%
Blue John Creek	2.34E+12			1.14E+12	1.27E+11	1.27E+12	46%
Bubbling Creek	2.87E+12		1.23E+11	5.49E+10	1.97E+10	1.97E+11	93%
Bull Creek	2.86E+12		1.65E+11	4.43E+11	6.75E+10	6.75E+11	76%
Burnt Fork Creek	1.02E+13		9.27E+11	4.56E+11	1.54E+11	1.54E+12	85%
Buttermilk Creek	5.67E+11		1.43E+11	1.07E+11	2.78E+10	2.78E+11	51%
Camp Creek	9.86E+14		4.41E+13	1.04E+14	1.64E+13	1.64E+14	83%
Chattahoochee River - Ga Hwy 17, Helen	2.97E+14			4.08E+13	4.54E+12	4.54E+13	85%
Chattahoochee River - Morgan Falls Dam to Peachtree Creek	3.16E+14	5.15E+12	5.68E+13	8.57E+13	1.64E+13	1.64E+14	48%
Chattahoochee River - Peachtree Creek to Utoy Creek	4.54E+14	2.73E+13	5.78E+13	7.07E+13	1.78E+13	1.78E+14	61%
Chattahoochee River - Utoy Creek to Pea Creek	2.02E+15	8.50E+12	1.07E+14	1.81E+14	3.29E+13	3.29E+14	84%
Chattahoochee River - Pea Creek to Wahoo Creek	2.28E+15	8.65E+10	9.33E+13	2.21E+14	3.50E+13	3.50E+14	85%
Chattahoochee River - Wahoo Creek to Franklin	1.26E+16	2.39E+18		3.59E+17	3.99E+16	3.99E+17	83%
Chattahoochee River - North Highland Dam to Upatoi Creek	5.11E+15	5.73E+12	1.60E+12	3.40E+14	3.86E+13	3.86E+14	92%
Chattahoochee River - Upatoi Creek to Railroad	1.26E+15	3.41E+11		4.40E+14	4.90E+13	4.90E+14	61%
Chattahoochee River - Downstream W.F. George Dam	3.14E+14	9.10E+09		2.70E+14	3.00E+13	3.00E+14	5%
Clear Creek	3.38E+13	Q*200[a]	2.25E+11	1.05E+11	3.66E+10	3.66E+11	99%
Cracker Creek	1.11E+12			3.41E+11	3.79E+10	3.79E+11	66%
Crawfish Creek	6.40E+12			3.78E+12	4.20E+11	4.20E+12	34%
Crooked Creek	3.62E+12		4.68E+11	2.85E+11	8.36E+10	8.36E+11	77%
Flat Creek	1.49E+13	1.57E+12		6.75E+11	2.49E+11	2.49E+12	83%
Foe Killer Creek	7.72E+11		3.93E+11	2.69E+11	7.35E+10	7.35E+11	5%
Foxwood Branch	9.75E+10		4.08E+10	1.75E+10	6.48E+09	6.48E+10	34%
Hilly Mill Creek	5.60E+12			2.46E+12	2.74E+11	2.74E+12	51%
Hog Waller Creek	2.69E+11		1.38E+11	7.45E+10	2.36E+10	2.36E+11	12%

Stream Segment	Current Load (cnts/30 days)	TMDL Components					Percent Reduction
		WLA (cnts/30 days)	WLA_{SW} (cnts/30 days)	LA (cnts/30 days)	MOS (cnts/30 days)	TMDL (cnts/30 days)	
Johns Creek	3.26E+12		5.86E+11	5.46E+11	1.26E+11	1.26E+12	61%
Kelly Mill Branch	4.23+11			3.47E+11	4.12E+10	4.12E+11	3%
Level Creek	2.72E+13		1.36E+12	2.15E+12	3.90E+11	3.90E+12	86%
Long Cane Creek	6.40E+12			3.16E+12	4.84E+11	4.84E+12	24%
Long Island Creek	5.69E+11		1.67E+11	8.02E+10	2.75E+10	2.75E+11	52%
Lullwater Creek	3.45E+12		4.76E+11	2.58E+11	8.16E+10	8.16E+11	76%
Marsh Creek	9.64E+11		2.22E+11	1.24E+11	3.85E+10	3.85E+11	60%
Mobley Creek	4.38E+12			1.85E+12	2.05E+11	2.05E+12	53%
Mountain Oak Creek	1.76E+12			1.52E+12	1.68E+11	1.68E+12	5%
Mud Creek	8.47E+11			6.43E+11	7.14E+10	7.14E+11	16%
Mud Creek	3.23E+12		6.23E+11	8.85E+11	1.68E+11	1.68E+12	48%
Mulberry Creek	1.69E+12			1.37E+12	1.53E+11	1.53E+12	10%
Nancy Creek	2.70E+13		2.57E+12	1.26E+12	4.25E+11	4.25E+12	84%
New River	1.59E+12			4.26E+11	4.73E+10	4.73E+11	70%
Nickajack Creek	3.59E+12		3.41E+11	2.86E+11	6.97E+10	6.97E+11	81%
North Fork Balus Creek	9.55E+11			4.23E+11	4.70E+10	4.70E+11	51%
North Fork Peachtree Creek	1.68E+14		9.32E+12	4.54E+12	1.54E+12	1.54E+13	91%
North Utoy Creek	1.60E+12		1.23E+11	8.15E+10	2.28E+10	2.28E+11	86%
Olley Creek	1.20E+12		3.28E+11	2.27E+11	6.17E+10	6.17E+11	49%
Orr Creek	5.02E+12	2.56E+11		1.41E+11	4.42E+10	4.42E+11	91%
Pataula Creek	1.58E+13			1.35E+13	1.50E+12	1.50E+13	5%
Pea Creek	2.20E+12		1.26E+11	1.32E+12	1.60E+11	1.60E+12	27%
Peachtree Creek	3.22E+14		2.79E+12	1.43E+12	4.69E+11	4.69E+12	99%
Peavine Creek	8.52E+12		1.09E+12	5.32E+11	1.80E+11	1.80E+12	79%
Proctor Creek	2.55E+13	Q*200[a]	4.55E+11	2.84E+11	8.22E+10	8.22E+11	97%
Richland Creek	3.32E+13	3.54E+10	1.42E+12	3.08E+12	5.04E+11	5.04E+12	85%
Rocky Branch	1.44E+11		1.01E+10	1.02E+10	2.26E+09	2.26E+10	84%
Rottenwood Creek	3.02E+12	4.10E+11	2.98E+11	1.74E+11	9.79E+10	9.79E+11	68%
Sandy Creek	4.21E+11		1.59E+10	1.09E+10	2.97E+09	2.97E+10	93%
Sewell Mill Creek	1.08E+12		4.50E+11	2.29E+11	7.55E+10	7.55E+11	30%
Sope Creek	3.87E+14		3.73E+13	2.09E+13	6.46E+12	6.46E+13	83%
Soquee River	1.46E+13	4.60E+10		8.60E+12	9.61E+11	9.61E+12	34%
South Fork Peachtree Creek	1.02E+14		8.86E+11	4.72E+11	1.51E+11	1.51E+12	99%
South Utoy Creek	2.21E+12		1.47E+11	9.62E+10	2.70E+10	2.70E+11	88%

Stream Segment	Current Load (cnts/30 days)	TMDL Components WLA (cnts/30 days)	WLA$_{SW}$ (cnts/30 days)	LA (cnts/30 days)	MOS (cnts/30 days)	TMDL (cnts/30 days)	Percent Reduction
Suwanee Creek	5.80E+13	1.76E+11	2.53E+12	5.05E+12	8.62E+11	8.62E+12	85%
Sweetwater Creek- Paulding/Cobb	1.09E+13		3.67E+12	8.35E+12	6.53E+11	6.53E+12	40%
Sweetwater Creek - Cobb/Douglas	1.59E+13		2.49E+11	5.63E+12	1.33E+12	1.33E+13	16%
Tanyard Branch	3.11E+13	Q*200[a]	1.49E+11	6.37E+10	2.36E+10	2.36E+11	99%
Tanyard Creek	6.32E+11			1.02E+11	1.14E+10	1.14E+11	82%
Testnatee Creek - Cleveland	5.78E+12	6.83E+10		3.23E+12	3.67E+11	3.67E+12	37%
Testnatee Creek - Town Creek to Chestatee River	5.78E+12			3.30E+12	3.67E+11	3.67E+12	37%
Tributary to Mud Creek	2.36E+11		7.58E+10	1.39E+11	2.39E+10	2.39E+11	0%
Utoy Creek	5.53E+12		3.61E+11	3.19E+11	7.56E+10	7.56E+11	86%
Ward Creek	5.79E+11		2.11E+11	1.17E+11	3.65E+10	3.65E+11	37%
Weracoba Creek	5.64E+11		3.98E+10	3.76E+10	8.60E+09	8.60E+10	85%
White Oak Creek	2.50E+12		8.43E+10	1.61E+12	1.89E+11	1.89E+12	25%
Willeo Creek	1.51E+12		6.98E+11	3.68E+11	1.18E+11	1.18E+12	22%
Woodall Creek	2.15E+13		8.12E+10	4.64E+10	1.42E+10	1.42E+11	99%

Note: The TMDL was developed for the “current” critical conditions. The average stream flow for the critical period was used to determine the TMDL and the corresponding monthly average discharge from each wastewater treatment facility was used to determine the WLA.

6.0 RECOMMENDATIONS

The TMDL process consists of an evaluation of the 303(d) listed stream segments subwatersheds to identify, as best as possible, the sources of the fecal coliform loads causing the stream to exceed instream standard criteria. The TMDL analysis was performed using the best available data to specify WLAs and LAs that will meet fecal coliform water quality criteria so as to support the use classification specified for each listed segment.

This TMDL represents the first phase of a long-term process to reduce fecal coliform loading to meet water quality standards in the Chattahoochee River Basin. Implementation strategies will be reviewed and the TMDLs will be refined as necessary in the next phase (next five-year cycle). The phased approach will support progress toward water quality standards attainment in the future. In accordance with USEPA TMDL guidance, these TMDLs may be revised based on results of future monitoring and source characterization data efforts. The following recommendations target further source identification and involve the collection of data to support the "current" allocations and subsequent source reductions.

6.1 Monitoring

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

The TMDL Implementation Plan will outline an appropriate water quality sampling program for the listed streams in the Chattahoochee River Basin. The monitoring program will be developed to help identify the various fecal coliform sources. The sampling program will be used to verify the 303(d) stream segment listings. This will be especially valuable for those segments where no data, old data, or spill data resulted in the listing. In addition, scheduled quarterly geometric mean sampling will be performed to evaluate 303(d) listed waters and determine if there has been improvement in the water quality of the listed stream segments.

6.2 Fecal Coliform Management Practices

Based on the findings of the source assessment, NPDES point fecal coliform loads from wastewater treatment facilities do not significantly contribute to the impairment of the listed stream segments. This is because discharges from these facilities are required to treat to levels corresponding to instream water quality criteria. However, the 2000 - 2001 CSO DMR reports for the City of Atlanta revealed that, on several occasions, discharges these NPDES permitted facilities exceeded their fecal coliform permit limit. Fecal coliform loads from NPDES permitted MS4 areas may also be significant. But these sources cannot be easily segregated from other storm water runoff. Other sources of fecal coliform in urban areas include wastes that are attributable to domestic animals, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, leaking septic systems, runoff from improper disposal of waste materials, and leachate from operating and closed landfills. In agricultural areas, potential sources of fecal coliform may include CAFOs, animals grazing in pastures, dry manure storage facilities and lagoons, chicken litter storage areas, and direct access of livestock to streams. Wildlife and waterfowl can be an important source of fecal coliform bacteria.

Management practices are recommended to reduce fecal coliform source loads to the listed 303(d) stream segments, with the result of achieving the instream fecal coliform standard criteria. These recommended management practices include:

- Compliance with NPDES permit limits and requirements
- Adoption of NRCS Conservation Practices
- Application of Best Management Practices (BMPs) appropriate to agricultural or urban land uses, whichever applies.

6.2.1 Point Source Approaches

Point sources are defined as discharges of treated wastewater or storm water into rivers and streams at discrete locations. The NPDES permit program provides a basis for municipal, industrial and storm water permits, monitoring and compliance with limitations, and appropriate enforcement actions for violations.

In accordance with GAEPD rules and regulations, all discharges from point source facilities are required to be in compliance with the conditions of their NPDES permit at all times. In the future, all municipal and industrial wastewater treatment facilities with the potential for the occurrence of fecal coliform in their discharge will be given end-of-pipe limits equivalent to the water quality standard of 200 counts/100 ml or less.

The frequent exceedances of fecal coliform standards by the Atlanta CSOs should continue to be addressed. Operation of the CSO treatment facilities should be modified to reduce the frequency of noncompliant discharges. Compliance with the consent decree between the City of Atlanta and EPA should result in a significant reduction in the fecal coliform loads to the CSO receiving streams.

6.2.2 Nonpoint Source Approaches

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

6.2.2.1 Agricultural Sources

The Georgia Environmental Protection Division (EPD) should coordinate with other agencies that are responsible for agricultural activities in the state to address issues concerning fecal coliform loading from agricultural lands. It is recommended that information (e.g., livestock populations by subwatershed, animal access to streams, manure storage and application practices, etc.) be periodically reviewed so that watershed evaluations can be updated to reflect ”current” conditions. It is also recommended that BMPs be utilized to reduce the amount of fecal coliform bacteria transported to surface waters from agricultural sources to the maximum extent practicable.

The following three organizations have primary responsibility for working with farmers to promote soil and water conservation, and to protect water quality:

- The University of Georgia - Cooperative Extension Service
- Georgia Soil and Water Conservation Commission
- Natural Resources Conservation Service

The University of Georgia (UGA) has faculty, County Cooperative Extension Agents, and technical specialists who provide services in several key areas relating to agricultural impacts on water quality.

The Georgia EPD designated the GSWCC as the lead agency for agricultural Nonpoint Source Management in the State. The GSWCC develops nonpoint source management programs and conducts educational activities to promote conservation and protection of land and water devoted to agricultural uses.

The Natural Resources Conservation Service (NRCS) works with Federal, State, and local governments to provide financial and technical assistance to farmers. NRCS develops standards and specifications for BMPs that are to be used to improve, protect, or maintain our State's natural resources. In addition, every five years, the NRCS conducts the National Resources Inventory (NRI). The NRI is a statistically based sample of land use and natural resource conditions and trends that covers non-federal land in the United States.

NRCS is also providing technical assistance to the GSWCC and the Georgia Environmental Protection Division with the Georgia River Basin Planning Program. Planning activities associated with this program will describe conditions of the agricultural natural resource base once every five years. It is recommended that the GSWCC and the NRCS continue to encourage BMP implementation, education efforts, and river basin surveys with regard to River Basin Planning.

6.2.2.2 Urban Sources

Both point and nonpoint sources of fecal coliform bacteria can be significant in the Chattahoochee River Basin urban areas. Urban sources of fecal coliform can best be addressed using a strategy that involves public participation and intergovernmental coordination to reduce the discharge of pollutants to the maximum extent practicable. Management practices, control techniques, public education, and other appropriate methods and provisions may be employed. In addition to water quality monitoring programs, discussed in Section 6.1, the following activities and programs conducted by cities, counties, and state agencies are recommended:

- Uphold requirements that all new and replacement sanitary sewage systems be designed to minimize discharges from the system into storm sewer systems;

- Further develop and streamline mechanisms for reporting and correcting illicit connections, breaks, surcharges, and general sanitary sewer system problems;

- Sustained compliance with storm water NPDES permit requirements.

- Continue efforts to increase public awareness and education towards the impact of mans activities in urban settings on water quality, ranging from the consequences of industrial and municipal discharges down to activities of the individual in residential neighborhoods.

6.3 Reasonable Assurance

Permitted discharges will be regulated through the NPDES permitting process described in this report. Georgia is working federal and state agencies such as the NRCS and the GSWCC, and with local governments to foster the implementation of best management practices to address nonpoint sources. In addition, public education efforts will be targeted to individual stakeholders to provide information regarding the use of best management practices to protect water quality.

6.4 Public Participation

A thirty-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.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

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

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

1. EPA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some best management practices. The “Management Measure Selector Table” shown below identifies these management strategies by source category and pollutant. Nonpoint sources are the primary cause of excessive pollutant loading in most cases. Any wasteload allocations for wastewater treatment plant facilities will be implemented in the form of water-quality based effluent limitations in NPDES permits. Any wasteload allocations for regulated storm water will be implemented in the form of best management practices in the NPDES permits. NPDES permit discharges are a secondary source of excessive pollutant loading, where they are a factor, in most cases.

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

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

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

5. The deadline for development of a Revised TMDL Implementation Plan is the end of August 2004.

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

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

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

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

Management Measure Selector Table

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

Land Use	**Management Measures**	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	Metals (copper, lead, zinc, cadmium)	PCBs, toxaphene
	2. Watershed Protection & Site Development	–	–		–	–		–	–	
	3. Construction Site Erosion and Sediment Control		–		–	–				
	4. Construction Site Chemical Control		–							
	5. Existing Developments	–	–		–	–			–	
	6. Residential and Commercial Pollution Prevention	–	–							
Onsite Wastewater	1. New Onsite Wastewater Disposal Systems	–	–							
	2. Operating Existing Onsite Wastewater Disposal Systems	–	–							
Roads, Highways and Bridges	1. Siting New Roads, Highways & Bridges	–	–		–	–			–	
	2. Construction Projects for Roads, Highways and Bridges		–		–	–				
	3. Construction Site Chemical Control for Roads, Highways and Bridges		–							
	4. Operation and Maintenance-Roads, Highways and Bridges	–	–			–			–	

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Appendix A

30-day Geometric Mean Fecal coliform Monitoring Data

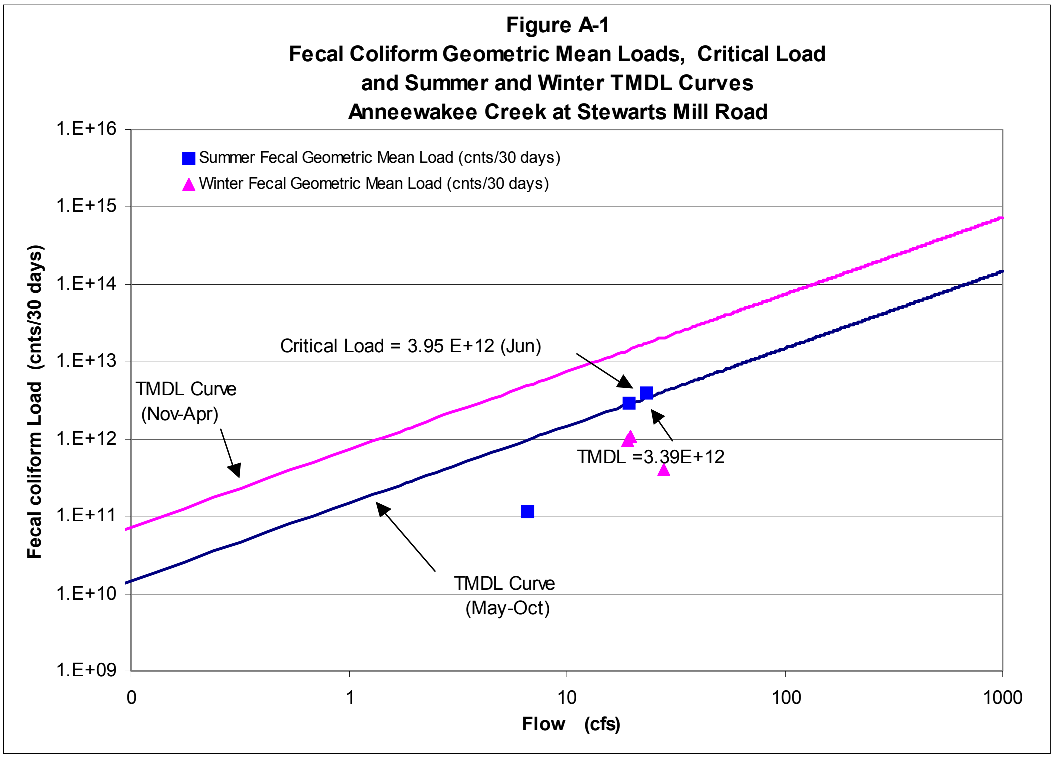
Figure A-1
Fecal Coliform Geometric Mean Loads, Critical Load
and Summer and Winter TMDL Curves
Anneewakee Creek at Stewarts Mill Road
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 3.95 E+12 (Jun)
TMDL Curve
(Nov-Apr)
TMDL =3.39E+12
TMDL Curve
(May-Oct)
Fecal coliform Load (cnts/30 days)
1.E+16
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
0
1
10
100
1000
Flow (cfs)

Table A-1. Data for Figure A-1, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
10/4/2000	20	8.71	5.40E+14			
10/12/2000	20	6.23	5.40E+14			
10/18/2000	20	6.03	5.40E+14			
10/25/2000	40	5.36	1.08E+15	23.78	6.58	1.15E+11
11/2/2000	30	5.02	8.11E+14			
11/7/2000	60	11.38	1.62E+15			
11/6/2000	50	5.02	1.35E+15			
11/20/2000	50	38.17	1.35E+15			
11/27/2000	575	38.17	1.55E+16	76.31	19.55	1.09E+12
12/7/2000	80	14.06	2.16E+15			
12/11/2000	40	12.72	1.08E+15			
12/20/2000	60	28.79	1.62E+15			
12/27/2000	120	20.09	3.25E+15	69.28	18.92	9.61E+11
4/10/2001	20	31.47	5.43E+14			
4/11/2001	20	29.46	5.43E+14			
4/17/2001	20	30.80	5.43E+14			
4/26/2001	20	19.42	5.43E+14	20.00	27.79	4.08E+11
5/1/2001	110	16.07	2.99E+15			
5/9/2001	70	13.39	1.90E+15			
5/14/2001	185	12.05	5.02E+15			
5/23/2001	510	15.40	1.39E+16			
5/30/2001	440	39.91	1.20E+16	199.96	19.37	2.84E+12
6/7/2001	550	48.21	1.49E+16			
6/14/2001	210	20.76	5.71E+15			
6/21/2001	110	11.38	2.99E+15			
6/26/2001	230	12.05	6.25E+15	233.34	23.10	3.95E+12

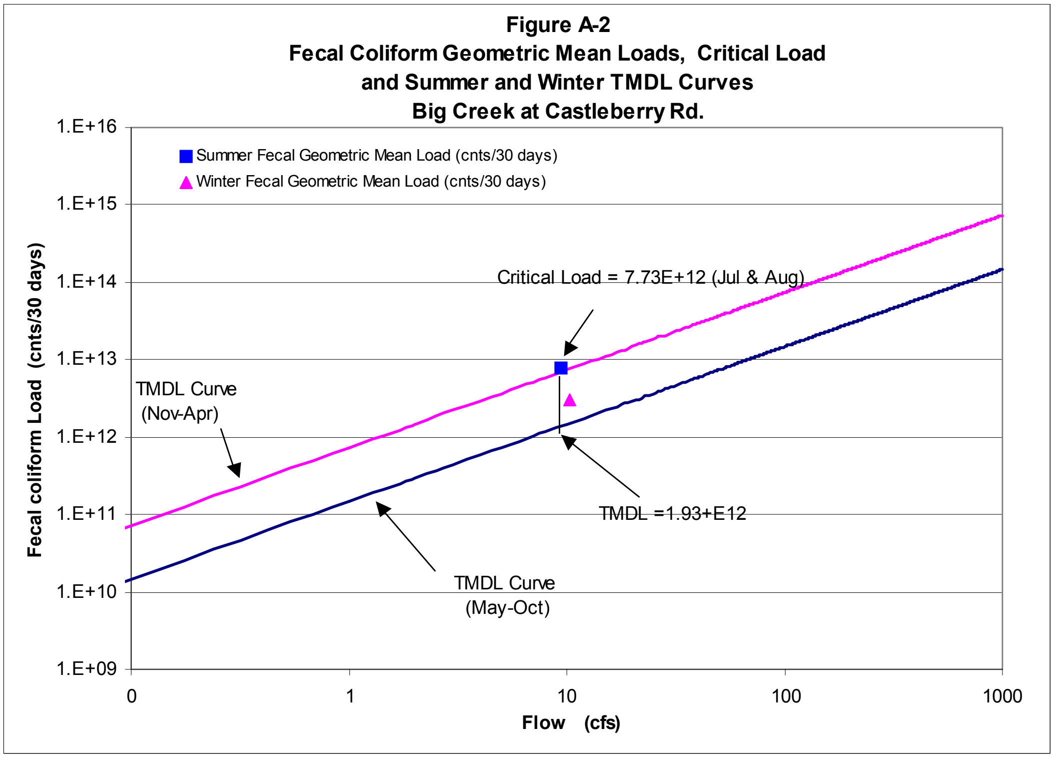

Table A-2. Data for Figure A-2, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
18-Jul-00	790	1.89	1.10E+12			
27-Jul-00	3300	1.89	4.58E+12			
31-Jul-00	330	28.92	7.00E+12			
7-Aug-00	1800	5.10	6.74E+12	1,116	9.45	7.73E+12
13-Nov-00	310	9.45	2.15E+12			
21-Nov-00	2300	12.10	2.04E+13			
28-Nov-00	460	11.53	3.89E+12			
5-Dec-00	80	8.32	4.88E+11	402	10.35	3.06E+12

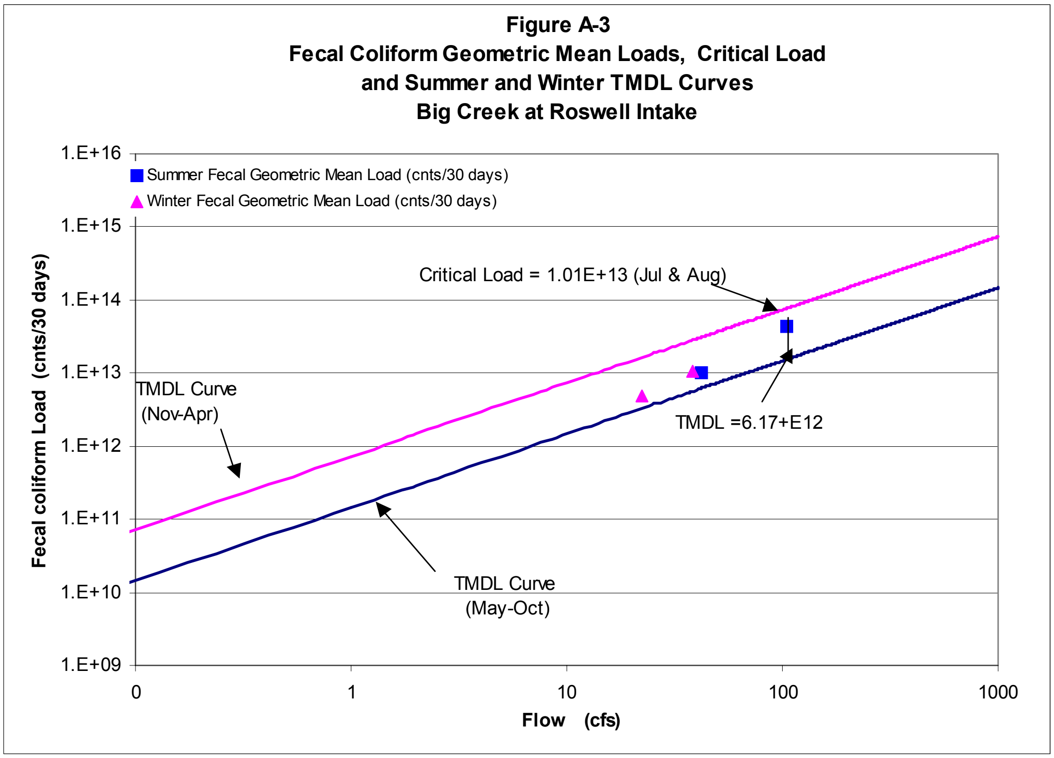

Table A-3. Data for Figure A-3, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
9-Mar-00	430	34.19	1.08E+13			
16-Mar-00	3300	234.96	5.69E+14			
23-Mar-00	330	92.05	2.23E+13			
30-Mar-00	230	59.62	1.01E+13	573	105.21	4.42E+13
11-May-00	490	25.42	9.14E+12			
18-May-00	220	19.29	3.11E+12			
25-May-00	140	28.05	2.88E+12			
1-Jun-00	490	16.66	5.99E+12	293	22.36	4.81E+12
27-Jul-00	130	8.77	8.36E+11			
3-Aug-00	460	129.75	4.38E+13			
10-Aug-00	330	17.53	4.24E+12			
17-Aug-00	580	12.27	5.22E+12	327	42.08	1.01E+13
8-Nov-00	1700	37.70	4.70E+13			
16-Nov-00	790	35.07	2.03E+13			
30-Nov-00	130	44.71	4.26E+12			
7-Dec-00	110	35.07	2.83E+12	372	38.14	1.04E+13

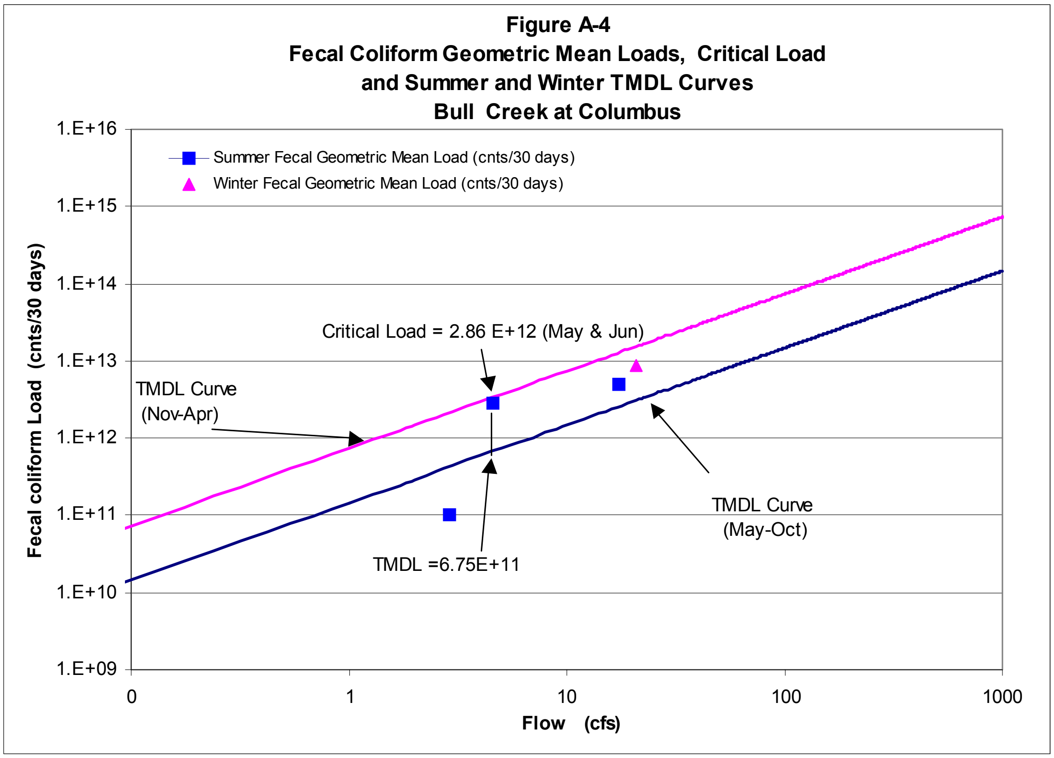

Table A-4. Data for Figure A-4, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
26-Jan-00	20	44.00	6.46E+11			
9-Feb-00	16000	14.00	1.64E+14			
16-Feb-00	700	13.00	6.68E+12			
23-Feb-00	490	13.00	4.67E+12	576	21.00	8.87E+12
31-May-00	310	2.80	6.37E+11			
7-Jun-00	140	2.80	2.88E+11			
20-Jun-00	1300	4.00	3.81E+12			
28-Jun-00	9200	8.80	5.94E+13	849	4.60	2.86E+12
30-Aug-00	2400	3.80	6.69E+12			
6-Sep-00	24000	57.00	1.00E+15			
20-Sep-00	20	3.00	4.40E+10			
27-Sep-00	20	6.00	8.80E+10	390	17.45	4.99E+12
27-Sep-00	20	6.00	8.80E+10			
4-Oct-00	20	2.20	3.23E+10			
18-Oct-00	260	2.00	3.81E+11			
25-Oct-00	50	1.30	4.77E+10	48	2.88	1.01E+11

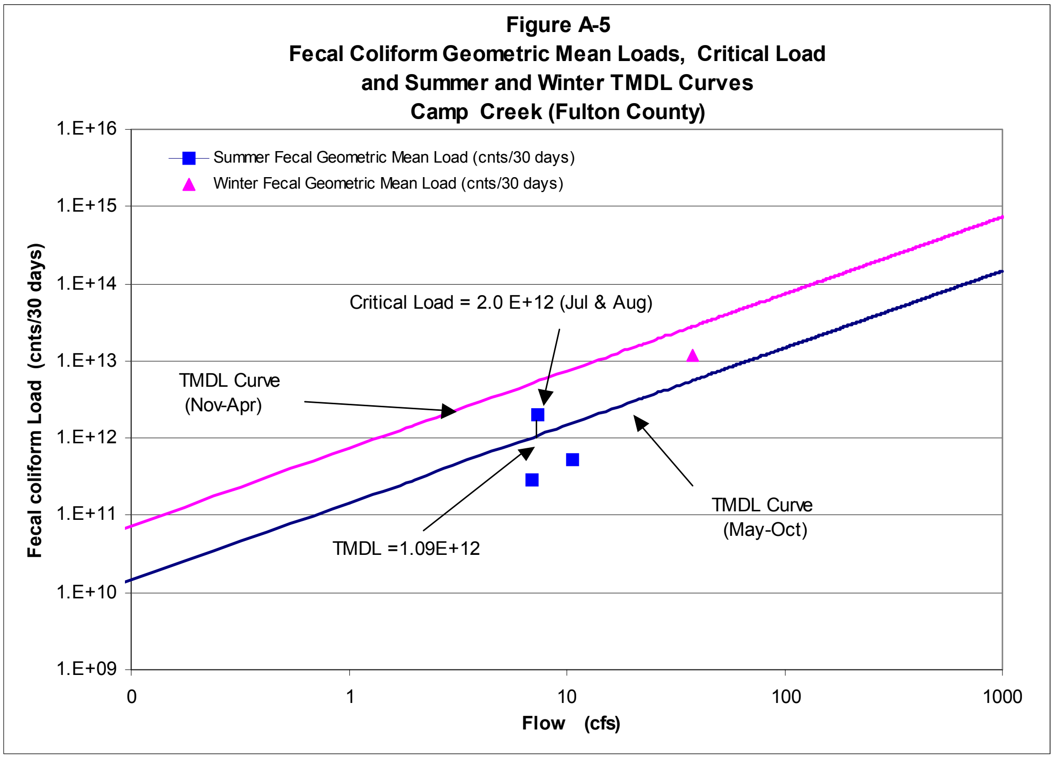

Table A-5. Data for Figure A-5, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
27-Jan-00	90	38.00	2.51E+12			
2-Feb-00	170	29.00	3.62E+12			
15-Feb-00	24000	56.00	9.86E+14			
24-Feb-00	90	29.00	1.91E+12	426	38.00	1.19E+13
4-May-00	220	17.00	2.74E+12			
10-May-00	40	10.00	2.93E+11			
15-May-00	50	8.10	2.97E+11			
1-Jun-00	50	7.60	2.79E+11	68	10.68	5.36E+11
12-Jul-00	1800	14.00	1.85E+13			
19-Jul-00	50	2.20	8.07E+10			
26-Jul-00	790	9.10	5.27E+12			
9-Aug-00	260	4.30	8.20E+11	369	7.40	2.00E+12
27-Sep-00	20	10.00	1.47E+11			
11-Oct-00	510	6.80	2.54E+12			
17-Oct-00	50	6.20	2.27E+11			
23-Oct-00	20	4.90	7.19E+10	57	6.98	2.89E+11

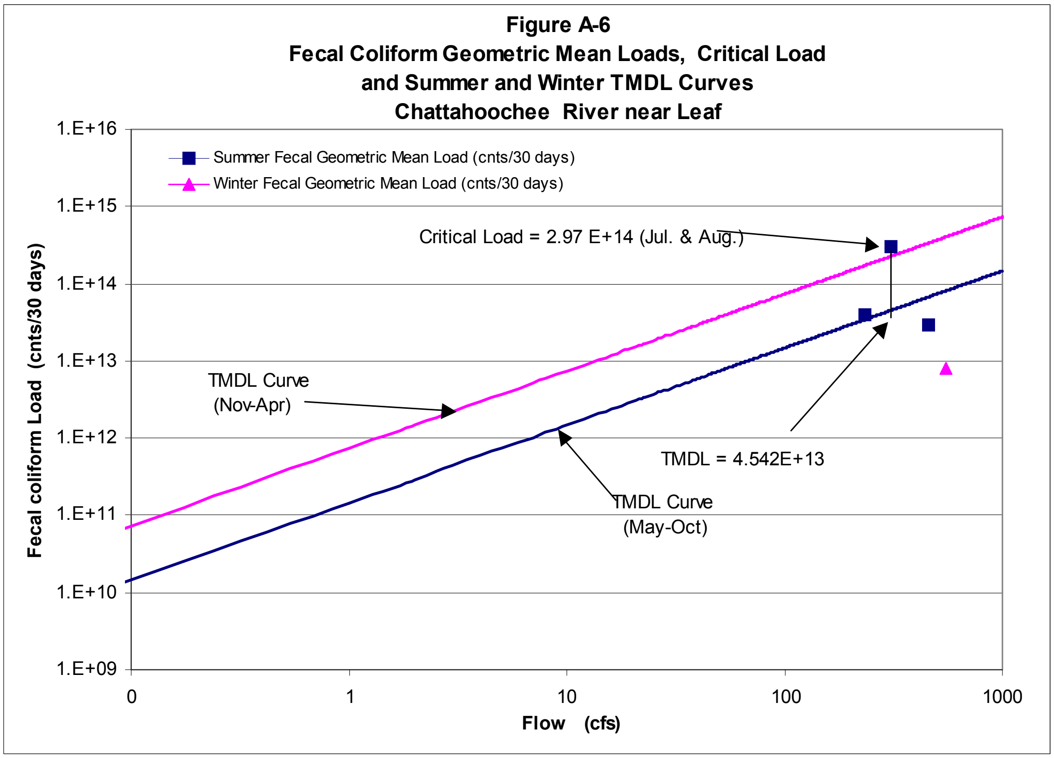

Table A-6. Data for Figure A-6, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
19-Jan-00	20	553.00	8.11E+12			
3-Feb-00	20	539.00	7.91E+12			
8-Feb-00	20	484.00	7.10E+12			
17-Feb-00	20	627.00	9.20E+12	20	550.75	8.08E+12
16-May-00	110	476.00	3.84E+13			
18-May-00	50	497.00	1.82E+13			
22-May-00	20	468.00	6.87E+12			
5-Jun-00	490	396.00	1.42E+14	86	459.25	2.89E+13
17-Jul-00	330	237.00	5.74E+13			
24-Jul-00	790	296.00	1.72E+14			
31-Jul-00	16000	429.00	5.03E+15			
8-Aug-00	700	275.00	1.41E+14	1,307	309.25	2.97E+14
11-Sep-00	330	210.00	5.08E+13			
18-Sep-00	50	166.00	6.09E+12			
25-Sep-00	490	371.00	1.33E+14			
4-Oct-00	330	195.00	4.72E+13	227	235.50	3.93E+13

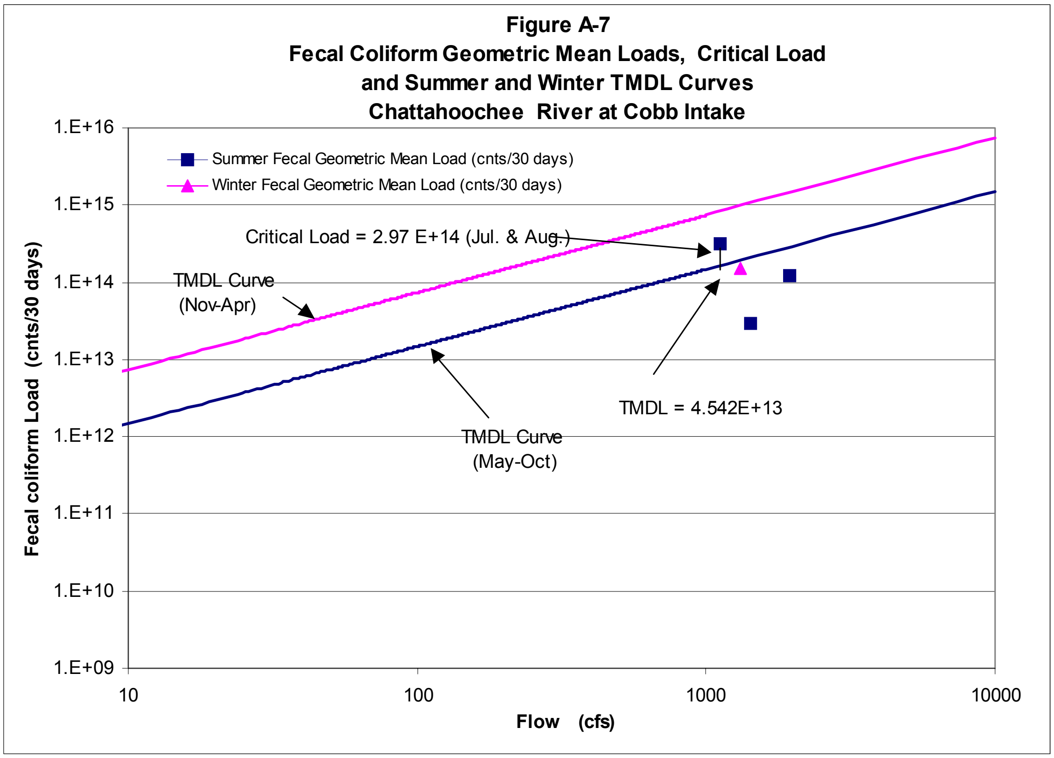

Table A-7. Data for Figure A-7, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
9-Mar-00	4900	1,070.00	3.85E+15			
16-Mar-00	20	1,940.00	2.85E+13			
23-Mar-00	330	1,200.00	2.90E+14			
30-Mar-00	20	1,020.00	1.50E+13	159	1,307.50	1.53E+14
11-May-00	790	881.00	5.11E+14			
18-May-00	1100	1,060.00	8.55E+14			
25-May-00	110	990.00	7.99E+13			
1-Jun-00	230	1,540.00	2.60E+14	385	1,117.75	3.16E+14
0-Jan-00	0	0.00	0.00E+00			
27-Jul-00	45	1,940.00	6.40E+13			
10-Aug-00	260	1,900.00	3.62E+14			
17-Aug-00	50	2,020.00	7.41E+13	84	1,953.33	1.20E+14
8-Nov-00	80	1,430.00	8.39E+13			
16-Nov-00	130	1,340.00	1.28E+14			
30-Nov-00	1	1,410.00	5.17E+11			
7-Dec-00	110	1,510.00	1.22E+14	28	1,422.50	2.87E+13

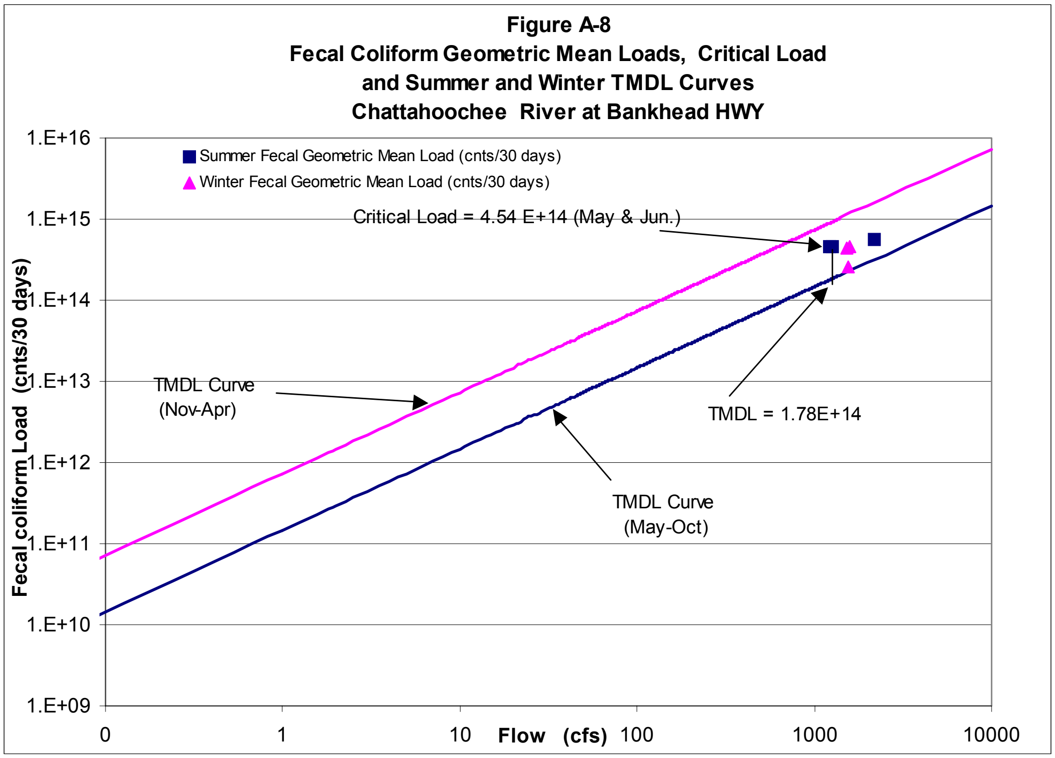
Figure A-8
Fecal Coliform Geometric Mean Loads, Critical Load
and Summer and Winter TMDL Curves
Chattahoochee River at Bankhead HWY
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 4.54 E+14 (May & Jun.)
TMDL Curve
(Nov-Apr)
TMDL = 1.78E+14
TMDL Curve
(May-Oct)
Fecal coliform Load (cnts/30 days)
1.E+16
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
0
1
10
100
1000
10000
Flow (cfs)

Table A-8. Data for Figure A-8, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
9-Mar-00	170	1,090.00	1.36E+14			
16-Mar-00	330	2,560.00	6.20E+14			
23-Mar-00	330	1,380.00	3.34E+14			
30-Mar-00	130	1,180.00	1.13E+14	221	1,552.50	2.52E+14
11-May-00	230	1,020.00	1.72E+14			
18-May-00	1300	1,140.00	1.09E+15			
25-May-00	460	1,090.00	3.68E+14			
1-Jun-00	490	1,610.00	5.79E+14	510	1,215.00	4.54E+14
27-Jul-00	4600	2,040.00	6.88E+15			
3-Aug-00	490	2,540.00	9.13E+14			
10-Aug-00	20	2,030.00	2.98E+13			
17-Aug-00	790	2,040.00	1.18E+15	356	2,162.50	5.65E+14
8-Nov-00	790	1,450.00	8.40E+14			
16-Nov-00	490	1,450.00	5.21E+14			
30-Nov-00	790	1,560.00	9.04E+14			
7-Dec-00	80	1,630.00	9.57E+13	395	1,522.50	4.42E+14
10-Jan-01	110	1,570.00	1.27E+14			
17-Jan-01	330	1,290.00	3.12E+14			
24-Jan-01	40	1,560.00	4.58E+13			
31-Jan-01	745	1,940.00	1.06E+15	181	1,590.00	2.12E+14
2-Apr-01	330	1,210.00	2.93E+14			
10-Apr-01	130	1,140.00	1.09E+14			
17-Apr-01	1700	1,170.00	1.46E+15			
24-Apr-01	90	1,260.00	8.32E+13	285	1,195.00	2.50E+14
	0	0.00	0.00E+00			
2-Jul-01	790	1,360.00	7.88E+14			
10-Jul-01	1100	1,190.00	9.60E+14			
17-Jul-01	130	1,250.00	1.19E+14	483	1,266.67	4.49E+14

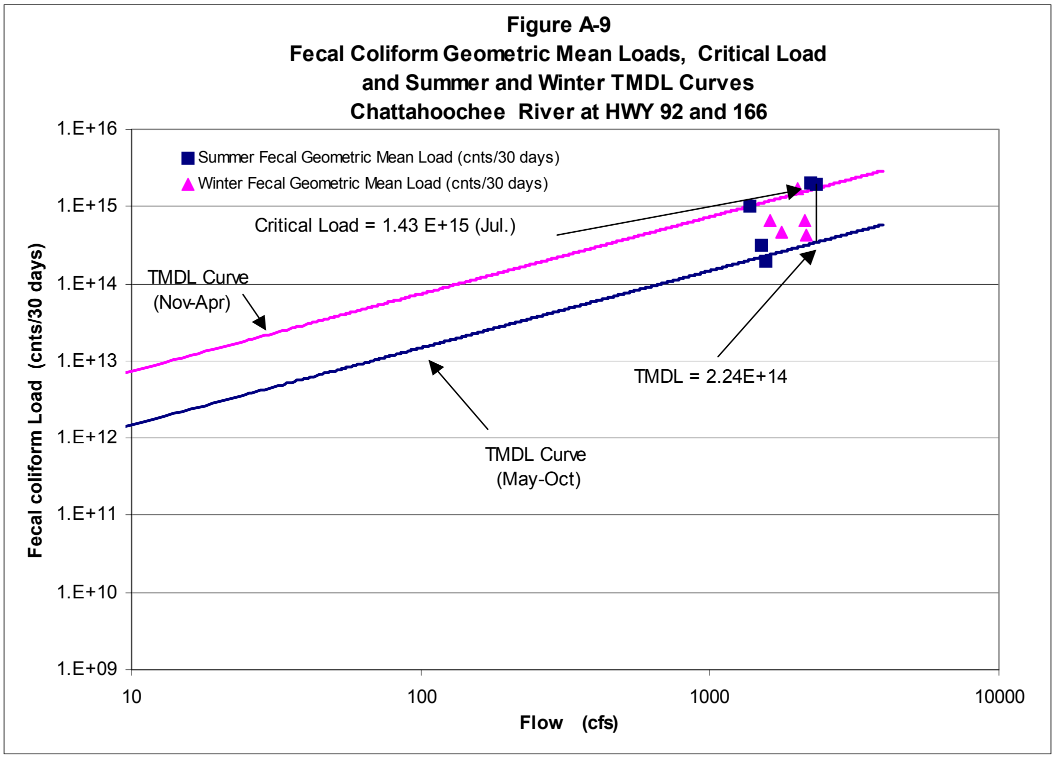
Figure A-9
Fecal Coliform Geometric Mean Loads, Critical Load
and Summer and Winter TMDL Curves
Chattahoochee River at HWY 92 and 166
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 1.43 E+15 (Jul.)
TMDL Curve
(Nov-Apr)
TMDL = 2.24E+14
TMDL Curve
(May-Oct)
Fecal coliform Load (cnts/30 days)
1.E+16
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
10
100
1000
10000
Flow (cfs)

Table A-9. Data for Figure A-9, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load from EDP Station 12140001.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
27-Jan-00	230	1,680.00	2.83E+14			
2-Feb-00	110	1,710.00	1.38E+14			
15-Feb-00	16000	1,590.00	1.87E+16			
24-Feb-00	230	1,520.00	2.56E+14	552	1,625.00	6.58E+14
4-May-00	5400	2,140.00	8.48E+15			
10-May-00	490	1,170.00	4.21E+14			
15-May-00	50	1,090.00	4.00E+13			
1-Jun-00	50	1,650.00	6.05E+13	285	1,512.50	3.16E+14
12-Jul-00	490	2,510.00	9.02E+14			
19-Jul-00	110	2,050.00	1.65E+14			
26-Jul-00	3500	2,720.00	6.98E+15			
9-Aug-00	9200	2,030.00	1.37E+16	1,148	2,327.50	1.96E+15
27-Sep-00	20	1,960.00	2.88E+13			
11-Oct-00	1100	1,630.00	1.32E+15			
17-Oct-00	80	1,440.00	8.45E+13			
23-Oct-00	490	1,250.00	4.49E+14	171	1,570.00	1.97E+14
9-Mar-00	790	1,510.00	8.75E+14			
16-Mar-00	1300	2,460.00	2.35E+15			
23-Mar-00	790	2,370.00	1.37E+15			
30-Mar-00	2300	1,670.00	2.82E+15	1,169	2,002.50	1.72E+15
11-May-00	24000	1,180.00	2.08E+16			
18-May-00	80	1,270.00	7.45E+13			
25-May-00	490	1,390.00	5.00E+14			
1-Jun-00	1100	1,650.00	1.33E+15	1,009	1,372.50	1.02E+15
27-Jul-00	2300	2,160.00	3.64E+15			
3-Aug-00	4100	2,800.00	8.42E+15			
10-Aug-00	490	2,070.00	7.44E+14			
17-Aug-00	490	1,950.00	7.01E+14	1,227	2,245.00	2.02E+15
8-Nov-00	940	1,680.00	1.16E+15			
16-Nov-00	110	1,650.00	1.33E+14			
30-Nov-00	330	1,890.00	4.58E+14			
7-Dec-00	460	1,870.00	6.31E+14	354	1,772.50	4.60E+14
10-Jan-01	170	1,970.00	2.46E+14			
17-Jan-01	330	1,570.00	3.80E+14			
24-Jan-01	790	2,060.00	1.19E+15			
31-Jan-01	700	2,910.00	1.49E+15	420	2,127.50	6.55E+14
2-Apr-01	105	2,170.00	1.67E+14			
10-Apr-01	130	1,790.00	1.71E+14			
17-Apr-01	2300	2,170.00	3.66E+15			
24-Apr-01	170	2,500.00	3.12E+14	270	2,157.50	4.28E+14
	0	0.00	0.00E+00			
2-Jul-01	1300	1,770.00	1.69E+15			
10-Jul-01	2300	1,430.00	2.41E+15			
17-Jul-01	700	1,380.00	7.09E+14	1,279	1,526.67	1.43E+15

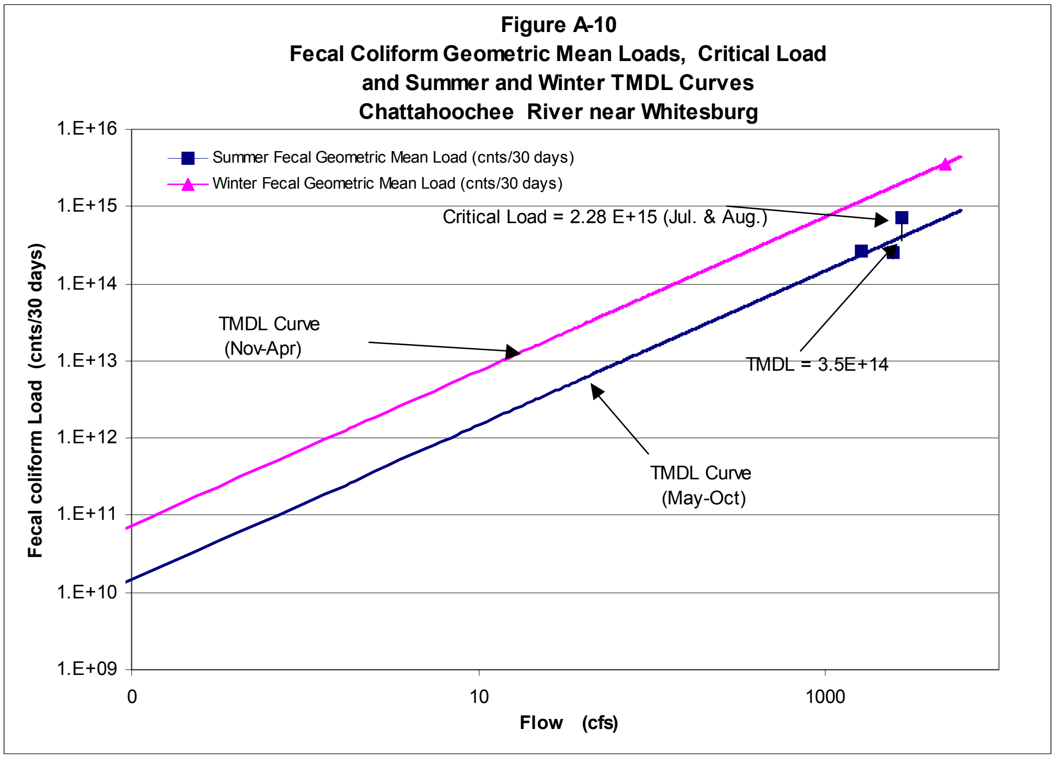
Figure A-10
Fecal Coliform Geometric Mean Loads, Critical Load
and Summer and Winter TMDL Curves
Chattahoochee River near Whitesburg
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 2.28 E+15 (Jul. & Aug.)
TMDL Curve
(Nov-Apr)
TMDL = 3.5E+14
TMDL Curve
(May-Oct)
Fecal coliform Load (cnts/30 days)
1.E+16
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
0
10
1000
Flow (cfs)

Table A-10. Data for Figure A-10, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
15-Mar-00	490	1,770.00	6.36E+14			
21-Mar-00	24000	8,610.00	1.52E+17			
29-Mar-00	70	2,010.00	1.03E+14			
5-Apr-00	1100	7,120.00	5.75E+15	975	4,877.50	3.49E+15
25-May-00	70	1,900.00	9.76E+13			
8-Jun-00	130	2,050.00	1.95E+14			
15-Jun-00	130	2,710.00	2.58E+14			
21-Jun-00	330	3,220.00	7.79E+14	141	2,470.00	2.55E+14
11-Jul-00	230	1,300.00	2.19E+14			
17-Jul-00	50	1,090.00	4.00E+13			
24-Jul-00	270	3,400.00	6.73E+14			
1-Aug-00	5400	5,150.00	2.04E+16	360	2,735.00	7.22E+14
28-Sep-00	790	1,770.00	1.03E+15			
5-Oct-00	50	1,480.00	5.43E+13			
11-Oct-00	260	1,300.00	2.48E+14			
18-Oct-00	230	1,880.00	3.17E+14	220	1,607.50	2.60E+14
15-Mar-00	50	1,800.00	6.60E+13			
21-Mar-00	7000	1,800.00	9.24E+15			
29-Mar-00	170	1,950.00	2.43E+14			
5-Apr-00	3500	6,900.00	1.77E+16	676	3,112.50	1.54E+15
25-May-00	80	1,650.00	9.68E+13			
8-Jun-00	80	1,790.00	1.05E+14			
15-Jun-00	130	2,500.00	2.38E+14			
21-Jun-00	490	1,300.00	4.67E+14	142	1,810.00	1.89E+14
11-Jul-00	1300	1,060.00	1.01E+15			
17-Jul-00	110	1,070.00	8.63E+13			
24-Jul-00	2200	2,600.00	4.20E+15			
1-Aug-00	9200	4,800.00	3.24E+16	1,304	2,382.50	2.28E+15
28-Sep-00	1300	1,740.00	1.66E+15			
5-Oct-00	230	1,740.00	2.94E+14			
11-Oct-00	790	1,540.00	8.92E+14			
18-Oct-00	230	1,590.00	2.68E+14	483	1,652.50	5.85E+14

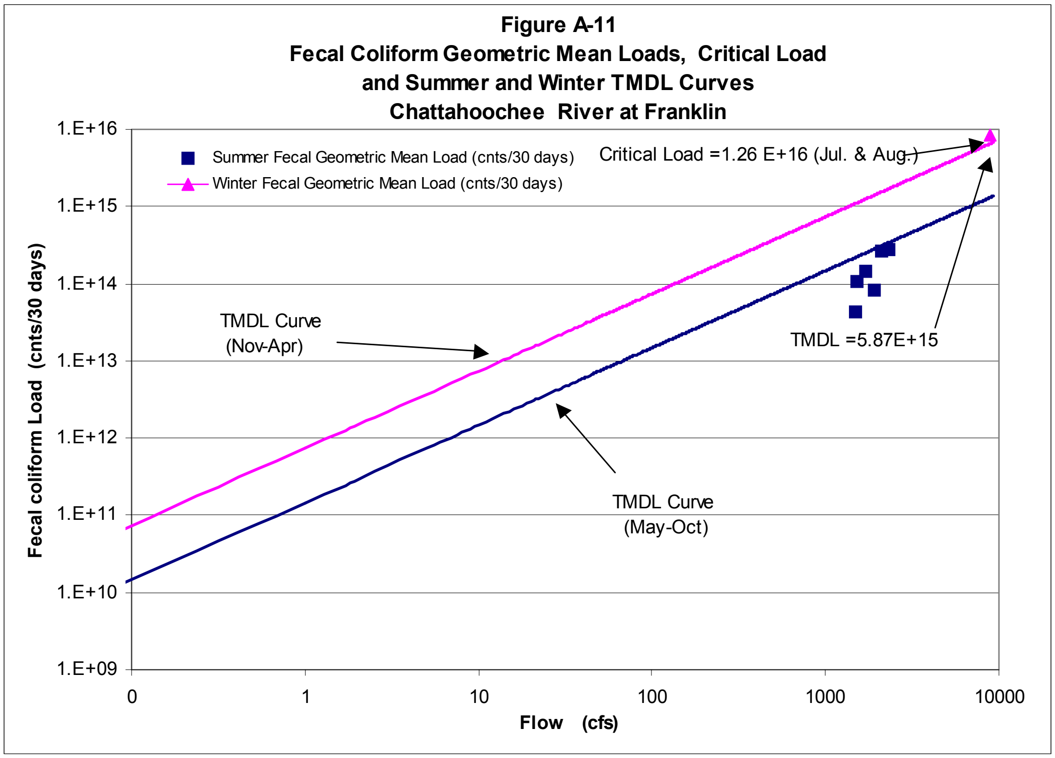
Figure A-11
Fecal Coliform Geometric Mean Loads, Critical Load
and Summer and Winter TMDL Curves
Chattahoochee River at Franklin
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load =1.26 E+16 (Jul. & Aug.)
TMDL Curve
(Nov-Apr)
TMDL =5.87E+15
TMDL Curve
(May-Oct)
Fecal coliform Load (cnts/30 days)
1.E+16
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
0
1
10
100
1000
10000
Flow (cfs)

Table A-11. Data for Figure A-11, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load (Sta.12170001).

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
20-Mar-00	4900	12,650.00	4.55E+16			
22-Mar-00	7900	5,760.00	3.34E+16			
27-Mar-00	20	2,080.00	3.05E+13			
3-Apr-00	3500	15,000.00	3.85E+16	1,283	8,872.50	8.35E+15
30-May-00	20	1,650.00	2.42E+13			
12-Jun-00	50	1,250.00	4.58E+13			
19-Jun-00	50	1,370.00	5.02E+13			
27-Jun-00	50	1,710.00	6.27E+13	40	1,495.00	4.36E+13
31-Jul-00	81	2,570.00	1.53E+14			
10-Aug-00	230	2,490.00	4.20E+14			
14-Aug-00	230	1,180.00	1.99E+14			
28-Aug-00	170	3,010.00	3.75E+14	164	2,312.50	2.79E+14
20-Sep-00	20	1,190.00	1.75E+13			
26-Sep-00	170	3,560.00	4.44E+14			
16-Oct-00	70	1,200.00	6.16E+13			
18-Oct-00	50	1,750.00	6.42E+13	59	1,925.00	8.29E+13

(Sta. 12169801).

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
20-Mar-00	7900	11,500.00	6.66E+16			
22-Mar-00	790	5,000.00	2.90E+15			
27-Mar-00	140	1,920.00	1.97E+14			
3-Apr-00	24000	13,600.00	2.39E+17	2,140	8,005	1.26E+16
30-May-00	80	1,500.00	8.80E+13			
12-Jun-00	80	1,180.00	6.92E+13			
19-Jun-00	80	1,300.00	7.63E+13			
27-Jun-00	170	2,100.00	2.62E+14	97	1,520	1.08E+14
31-Jul-00	270	2,340.00	4.63E+14			
10-Aug-00	230	2,210.00	3.73E+14			
14-Aug-00	170	1,070.00	1.33E+14			
28-Aug-00	80	2,740.00	1.61E+14	170	2,090	2.61E+14
20-Sep-00	20	1,080.00	1.58E+13			
26-Sep-00	460	3,090.00	1.04E+15			
16-Oct-00	80	1,110.00	6.51E+13			
18-Oct-00	230	1,590.00	2.68E+14	114	1,718	1.44E+14

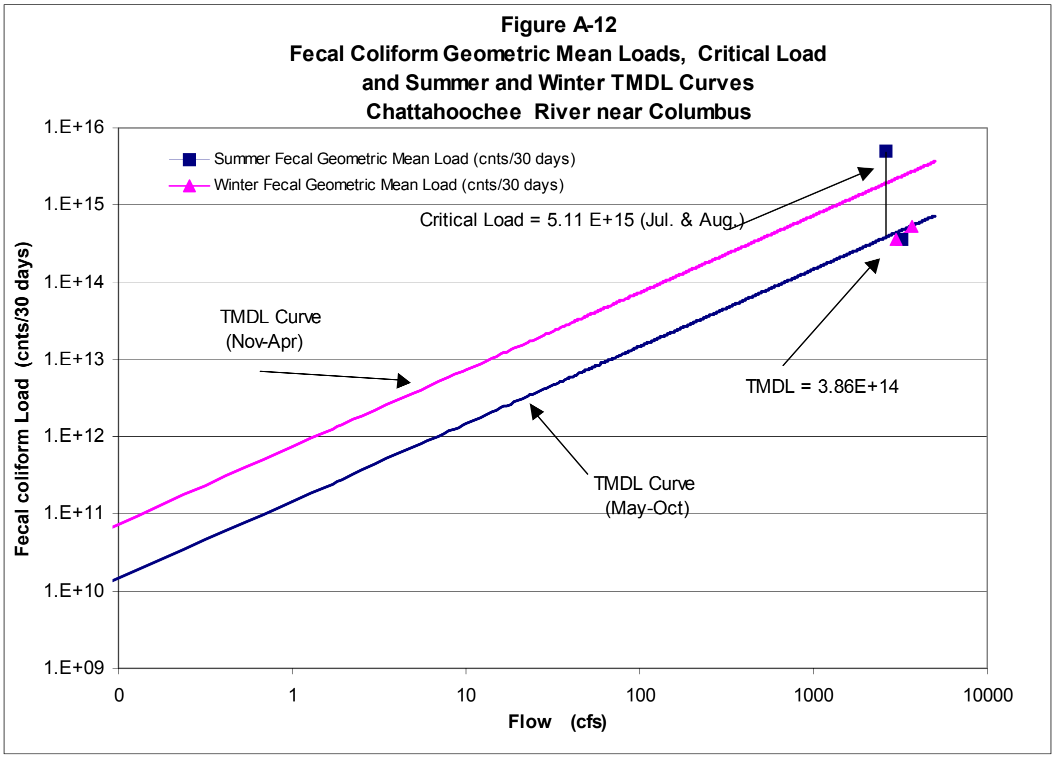

Table A-12. Data for Figure A-12, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
12-Jan-00	330	2,540.00	6.15E+14			
20-Jan-00	80	2,740.00	1.61E+14			
25-Jan-00	490	5,010.00	1.80E+15			
9-Feb-00	110	4,540.00	3.66E+14	194	3,707.50	5.28E+14
15-May-00	90	2,250.00	1.49E+14			
24-May-00	1100	2,560.00	2.07E+15			
30-May-00	50	4,430.00	1.62E+14			
14-Jun-00	110	3,570.00	2.88E+14	153	3,202.50	3.59E+14
17-Jul-00	80	2,140.00	1.26E+14			
25-Jul-00	700	2,040.00	1.05E+15			
2-Aug-00	54000	2,470.00	9.78E+16			
8-Aug-00	490	3,880.00	1.39E+15	2,646	2,632.50	5.11E+15
8-Nov-00	490	1,630.00	5.86E+14			
13-Nov-00	230	2,010.00	3.39E+14			
30-Nov-00	330	5,290.00	1.28E+15			
4-Dec-00	20	2,930.00	4.30E+13	165	2,965.00	3.59E+14

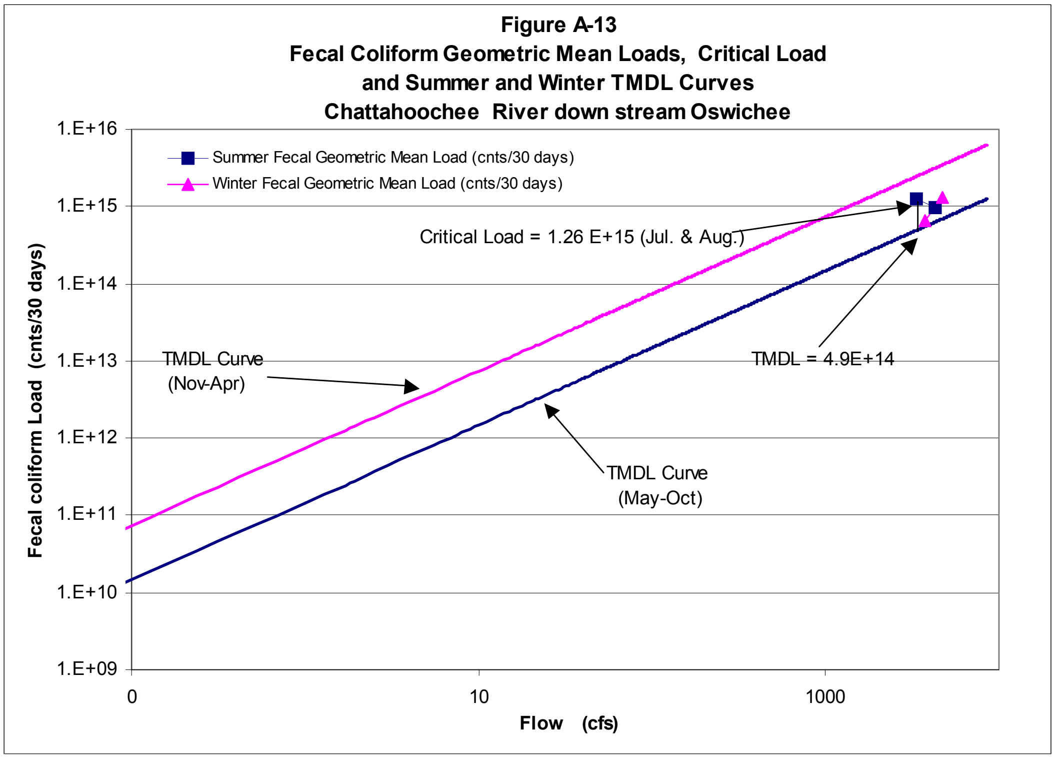

Table A-13. Data for Figure A-13, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
12-Jan-00	330	3,220.96	7.80E+14			
20-Jan-00	220	3,474.58	5.61E+14			
25-Jan-00	2300	6,353.15	1.07E+16			
9-Feb-00	130	5,757.15	5.49E+14	384	4,701.46	1.32E+15
0-Jan-00	0	0.00	0.00E+00			
15-May-00	330	2,853.21	6.91E+14			
30-May-00	490	5,617.66	2.02E+15			
14-Jun-00	170	4,527.10	5.65E+14	302	4,332.66	9.59E+14
17-Jul-00	170	2,713.72	3.38E+15			
25-Jul-00	1700	2,586.91	3.23E+15			
2-Aug-00	220	3,132.19	5.05E+14			
8-Aug-00	1100	4,920.21	3.97E+15	514	3,338.26	1.26E+15
0-Jan-00	0	0.00	0.00E+00			
8-Nov-00	790	2,066.99	5.00E+14			
13-Nov-00	330	2,548.87	9.35E+13			
30-Nov-00	50	6,708.22	2.46E+14	235	3,774.69	6.52E+14

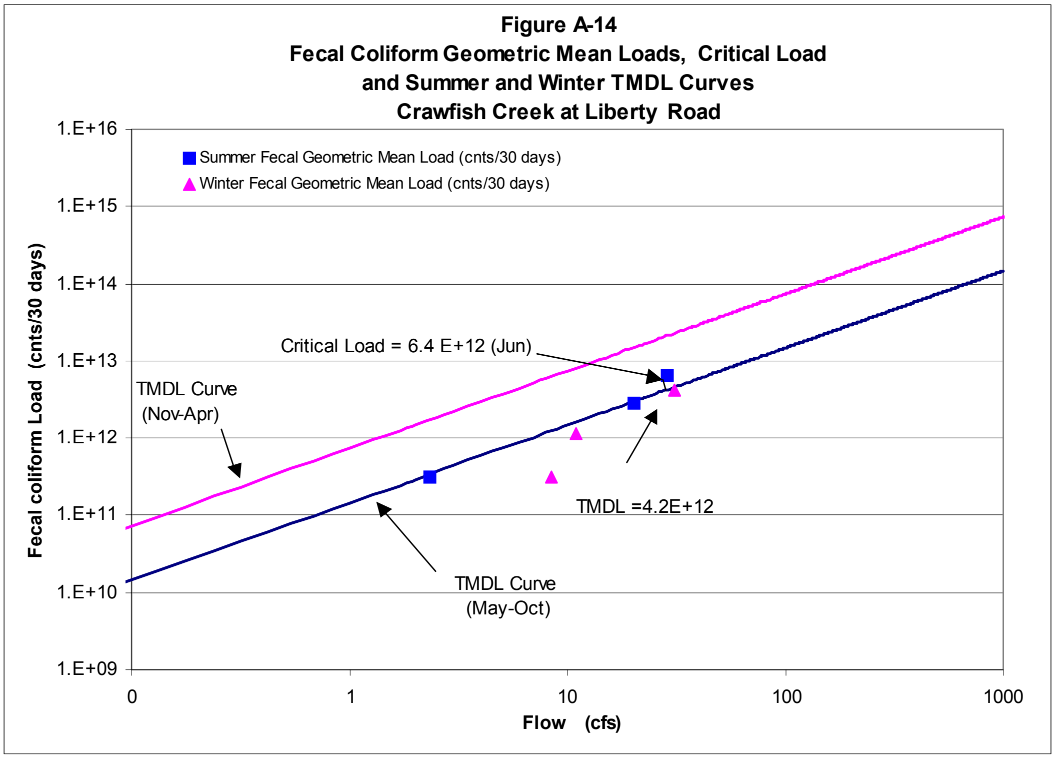
Figure A-14
Fecal Coliform Geometric Mean Loads, Critical Load
and Summer and Winter TMDL Curves
Crawfish Creek at Liberty Road
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 6.4 E+12 (Jun)
TMDL Curve
(Nov-Apr)
TMDL =4.2E+12
TMDL Curve
(May-Oct)
Fecal coliform Load (cnts/30 days)
1.E+16
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
0
1
10
100
1000
Flow (cfs)

Table A-14. Data for Figure A-14, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
4-Oct-00	1240	2.12	1.93E+12			
12-Oct-00	100	2.42	1.78E+11			
18-Oct-00	60	2.30	1.01E+11			
25-Oct-00	160	2.54	2.98E+11	186	2.35	3.20E+11
2-Nov-00	90	3.57	2.36E+11			
7-Nov-00	180	4.30	5.67E+11			
6-Nov-00	100	3.57	2.62E+11			
20-Nov-00	350	21.79	5.59E+12	141	11.00	1.14E+12
27-Nov-00	100	21.79	1.60E+12			
7-Dec-00	340	8.47	2.11E+12			
11-Dec-00	100	8.47	6.22E+11			
20-Dec-00	10	8.47	6.22E+10			
27-Dec-00	20	8.47	1.24E+11	51	8.47	3.17E+11
10-Apr-01	1900	33.89	4.72E+13			
11-Apr-01	80	32.08	1.88E+12			
17-Apr-01	80	33.89	1.99E+12			
26-Apr-01	90	24.82	1.64E+12	182	31.17	4.16E+12
1-May-01	140	21.79	2.24E+12			
9-May-01	190	18.76	2.62E+12			
14-May-01	160	16.34	1.92E+12			
23-May-01	330	26.03	6.30E+12			
30-May-01	190	17.55	2.45E+12	193	20.09	2.84E+12
7-Jun-01	200	31.47	4.62E+12			
14-Jun-01	240	36.32	6.39E+12			
21-Jun-01	160	19.97	2.34E+12			
26-Jun-01	1125	26.63	2.20E+13	305	28.60	6.40E+12

Figure A-15
Fecal Coliform Geometric Mean Loads, Critical Load and Summer and Winter TMDL Curves
Crooked Creek near Norcross

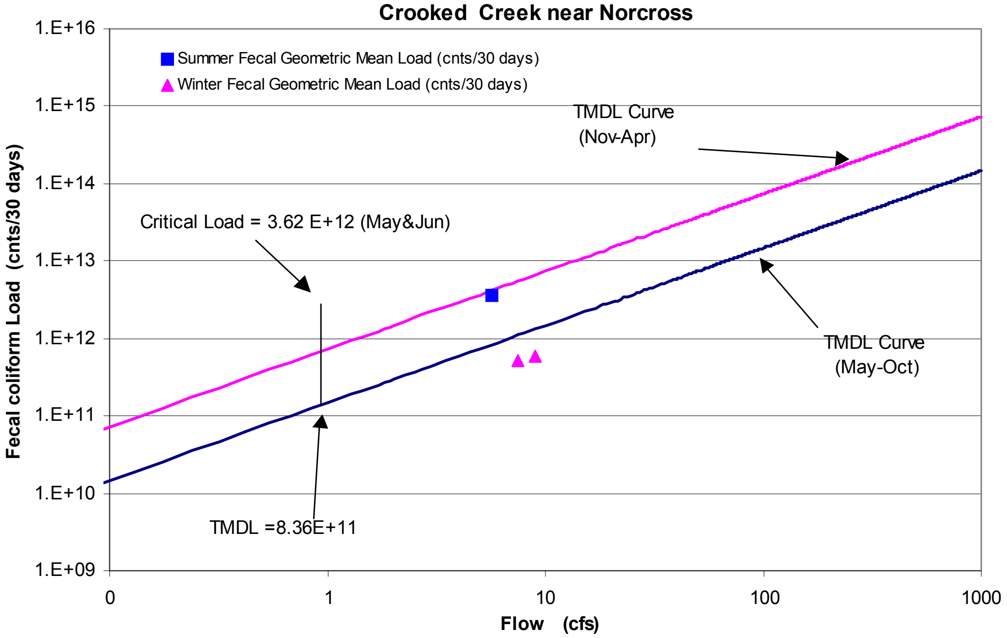

Table A-15. Data for Figure A-15, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
20-Jan-00	490	10.00	3.59E+12			
2-Feb-00	20	5.30	7.78E+10			
9-Feb-00	170	4.90	6.11E+11			
16-Feb-00	50	9.80	3.59E+11	96	7.50	5.26E+11
8-May-00	130	7.00	6.68E+11			
11-May-00	230	5.90	9.95E+11			
1-Jun-00	1100	4.70	3.79E+12			
6-Jun-00	17000	5.20	6.48E+13	865	5.70	3.62E+12
17-Jul-00	1100	3.00	2.42E+12			
24-Jul-00	1100	5.60	4.52E+12			
3-Aug-00	230	8.20	1.38E+12			
7-Aug-00	50	4.10	1.50E+11	343	5.23	1.32E+12
12-Sep-00	170	3.00	3.74E+11			
18-Sep-00	50	3.10	1.14E+11			
25-Sep-00	1700	17.00	2.12E+13			
3-Oct-00	220	3.10	5.00E+11	237	6.55	1.14E+12
5-Apr-01	860	18.00	1.14E+13			
12-Apr-01	300	7.00	1.54E+12			
19-Apr-01	1	6.00	4.40E+09			
26-Apr-01	232	5.00	8.51E+11	88	9.00	5.81E+11
5-Jul-01	88	29.00	1.87E+12			
12-Jul-01	920	4.00	2.70E+12			
19-Jul-01	1070	3.50	2.75E+12			
26-Jul-01	127	20.00	1.86E+12	324	14.13	3.36E+12
4-Oct-01	244	4.00	7.16E+11			
11-Oct-01	56	4.50	1.85E+11			
18-Oct-01	74	3.00	1.63E+11			
23-Oct-01	132	3.00	2.90E+11	107	3.63	2.86E+11

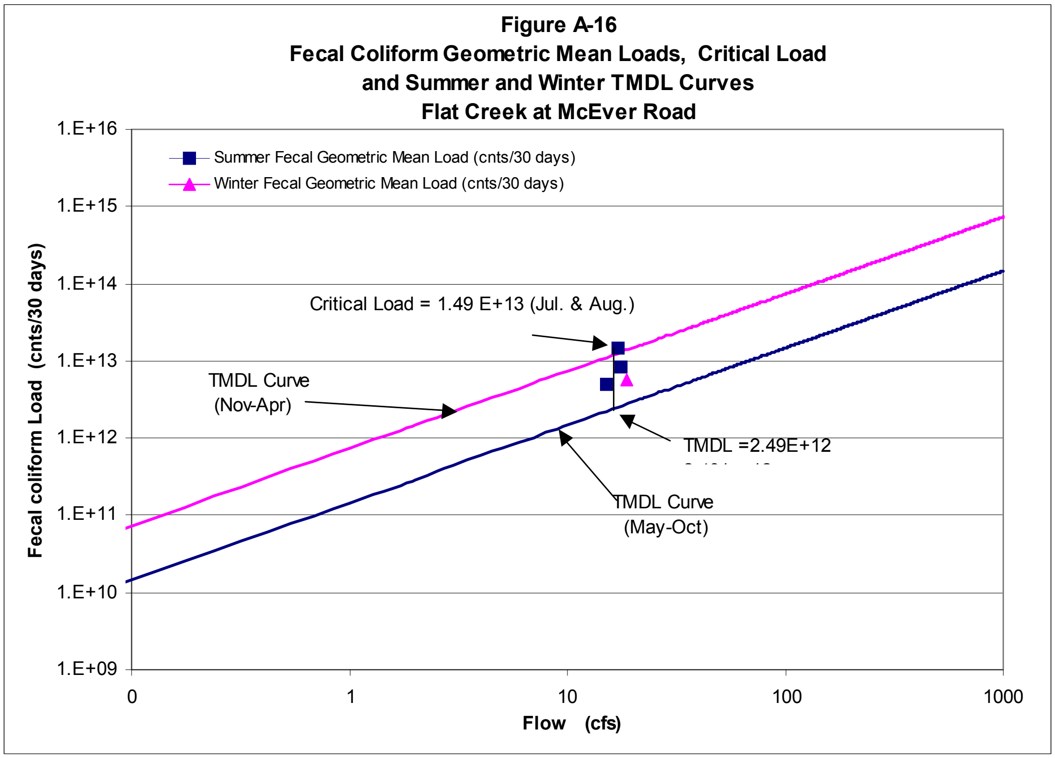

Table A-16. Data for Figure A-16, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
20-Jan-00	700	24.00	1.23E+13			
2-Feb-00	80	19.00	1.11E+12			
9-Feb-00	490	15.00	5.39E+12			
16-Feb-00	1100	17.00	1.37E+13	417	18.75	5.73E+12
8-May-00	50	15.00	5.50E+11			
11-May-00	3500	16.00	4.11E+13			
1-Jun-00	210	15.00	2.31E+12			
6-Jun-00	1100	14.00	1.13E+13	448	15.00	4.93E+12
17-Jul-00	790	13.00	7.53E+12			
24-Jul-00	330	15.00	3.63E+12			
3-Aug-00	24000	22.00	3.87E+14			
7-Aug-00	330	18.00	4.36E+12	1,199	17.00	1.49E+13
12-Sep-00	1100	14.00	1.13E+13			
18-Sep-00	130	7.00	6.68E+11			
25-Sep-00	3500	32.00	8.22E+13			
3-Oct-00	330	17.00	4.12E+12	637	17.50	8.18E+12

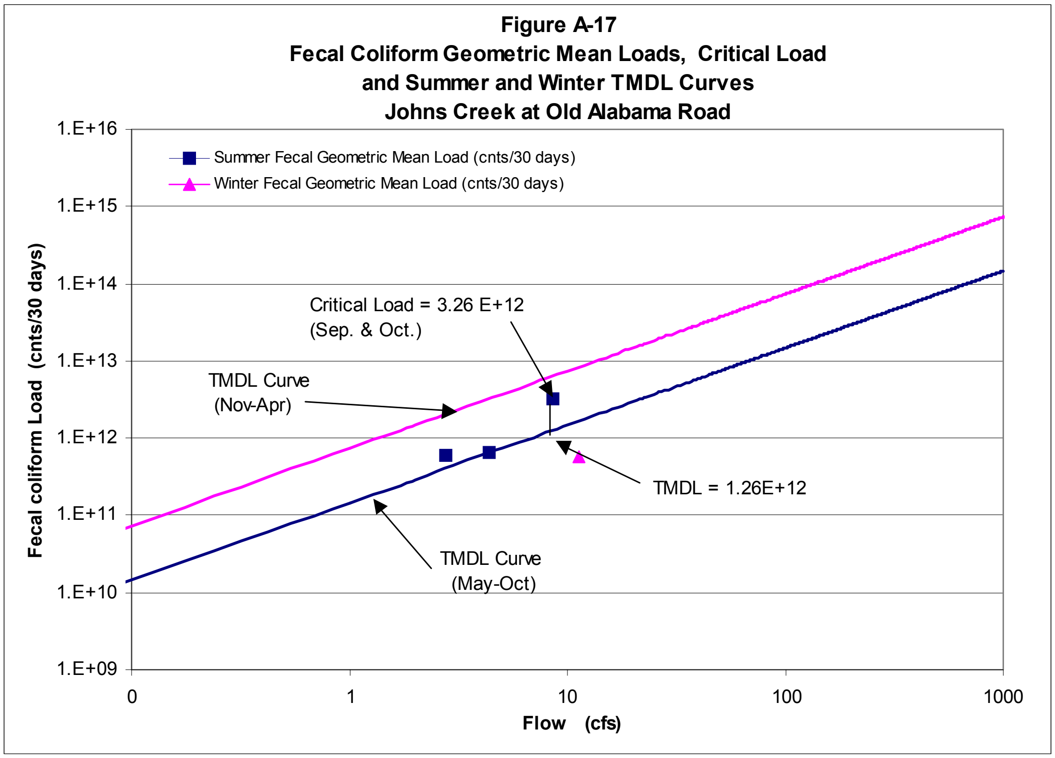

Table A-17. Data for Figure A-17, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
19-Jan-00	330	17.00	4.12E+12			
3-Feb-00	20	8.70	1.28E+11			
8-Feb-00	20	6.50	9.54E+10			
17-Feb-00	170	13.00	1.62E+12	69	11.30	5.70E+11
16-May-00	80	5.30	3.11E+11			
18-May-00	80	3.80	2.23E+11			
22-May-00	790	3.30	1.91E+12			
5-Jun-00	330	5.00	1.21E+12	202	4.35	6.45E+11
17-Jul-00	490	1.50	5.39E+11			
24-Jul-00	110	1.60	1.29E+11			
31-Jul-00	330	5.60	1.36E+12			
8-Aug-00	460	2.30	7.76E+11	301	2.75	6.07E+11
11-Sep-00	490	3.30	1.19E+12			
18-Sep-00	110	2.50	2.02E+11			
25-Sep-00	1700	24.00	2.99E+13			
4-Oct-00	790	4.50	2.61E+12	519	8.58	3.26E+12

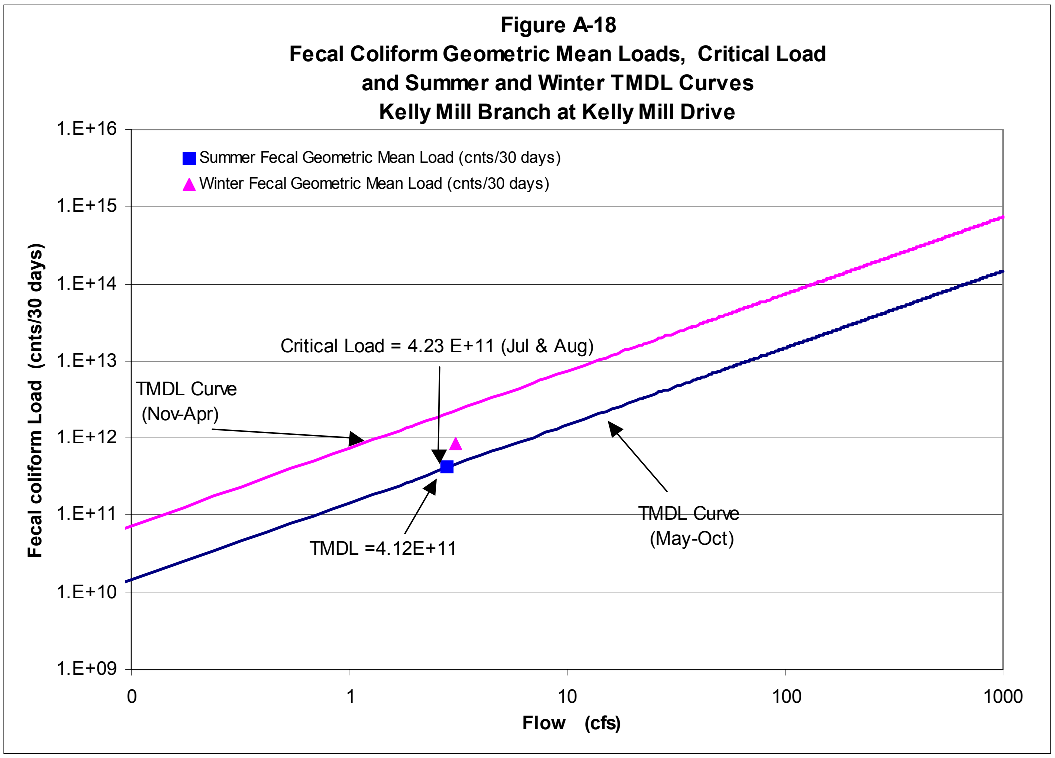

Table A-18. Data for Figure A-18, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
18-Jul-00	192	0.56	7.91E+10			
27-Jul-00	36	0.56	1.48E+10			
31-Jul-00	4600	8.59	2.90E+13			
7-Aug-00	56	1.52	6.23E+10	205	2.81	4.23E+11
13-Nov-00	528	2.81	1.09E+12			
21-Nov-00	188	3.59	4.96E+11			
28-Nov-00	460	3.43	1.16E+12			
5-Dec-00	448	2.47	8.12E+11	378	3.08	8.53E+11

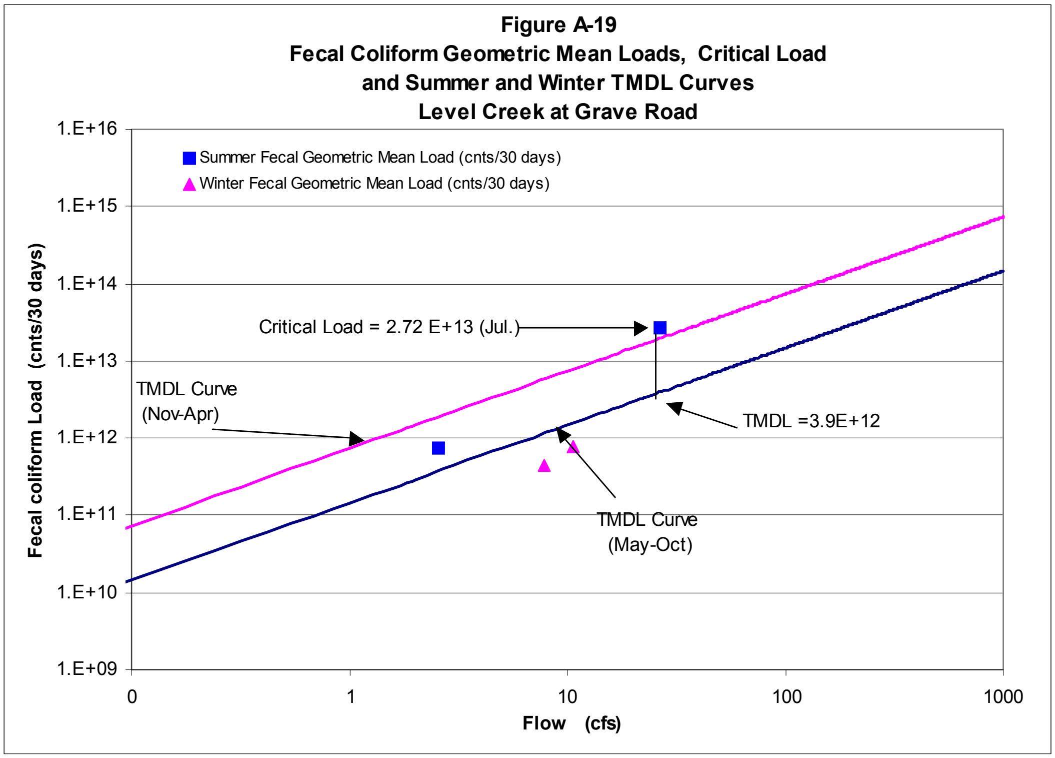

Table A-19. Data for Figure A-19, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
18-Jan-01	150	10.57	1.16E+12			
25-Jan-01	136	7.05	7.03E+11			
1-Feb-01	38	8.16	2.27E+11			
8-Feb-01	43	5.75	1.81E+11	76	7.88	4.39E+11
5-Apr-01	96	17.80	1.25E+12			
12-Apr-01	96	9.27	6.53E+11			
19-Apr-01	84	8.90	5.48E+11			
26-Apr-01	122	6.68	5.97E+11	99	10.66	7.71E+11
5-Jul-01	416	23.92	7.30E+12			
12-Jul-01	2440	4.26	7.63E+12			
19-Jul-01	610	2.97	1.33E+12			
26-Jul-01	6080	75.28	3.36E+14	1,393	26.61	2.72E+13
4-Oct-01	288	2.23	4.70E+11			
11-Oct-01	716	2.60	1.36E+12			
18-Oct-01	148	2.60	2.82E+11			
23-Oct-01	800	2.78	1.63E+12	395	2.55	7.39E+11

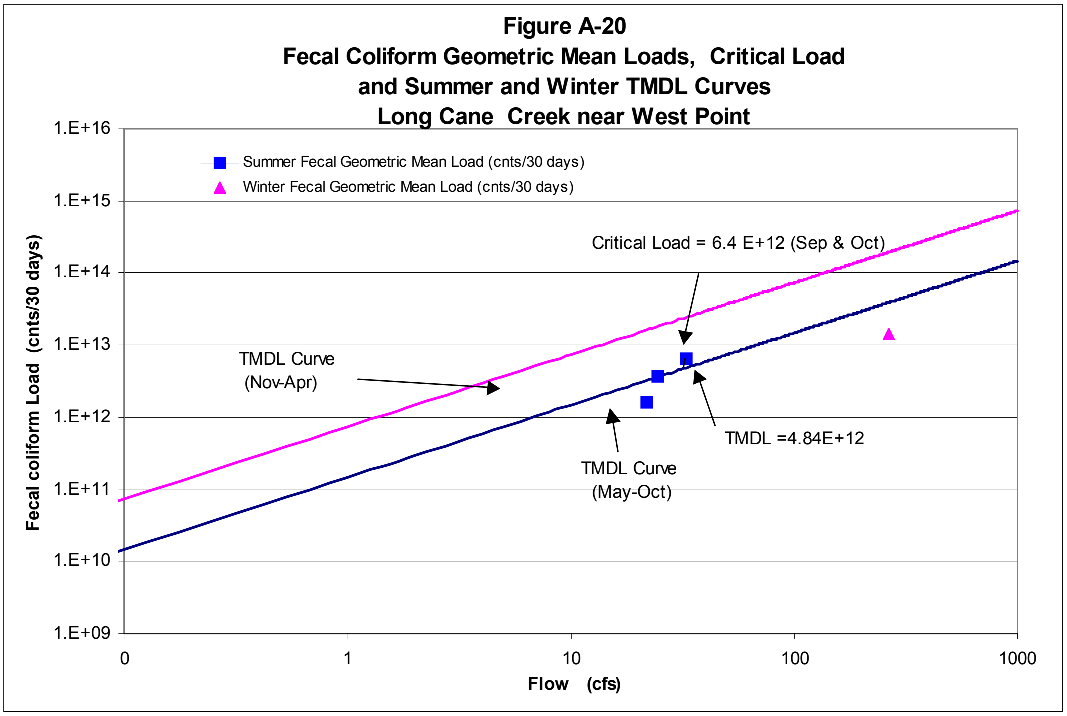

Table A-20. Data for Figure A-20, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
25-Jan-00	20	415.00	6.09E+12			
8-Feb-00	50	168.00	6.16E+12			
15-Feb-00	490	354.00	1.27E+14			
22-Feb-00	60	130.00	5.72E+12	74	266.75	1.44E+13
30-May-00	230	68.00	1.15E+13			
6-Jun-00	130	10.00	9.54E+11			
20-Jun-00	230	4.80	8.10E+11			
27-Jun-00	270	15.00	2.97E+12	208	24.45	3.72E+12
29-Aug-00	80	16.00	9.39E+11			
5-Sep-00	170	18.00	2.24E+12			
19-Sep-00	40	15.00	4.40E+11			
28-Sep-00	170	39.00	4.86E+12	98	22.00	1.58E+12
28-Sep-00	170	39.00	4.86E+12			
3-Oct-00	790	36.00	2.09E+13			
17-Oct-00	110	33.00	2.66E+12			
24-Oct-00	330	24.00	5.81E+12	264	33.00	6.40E+12

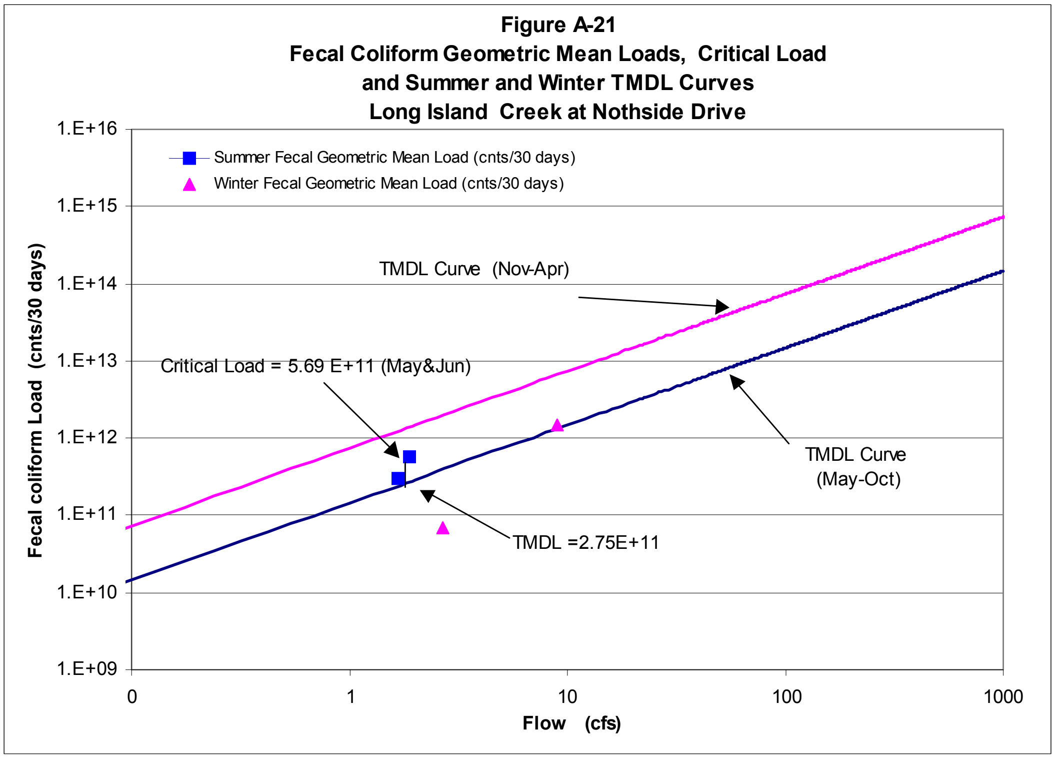

Table A-21. Data for Figure A-21, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
25-Jan-00	80	3.20	1.88E+11			
3-Feb-00	20	2.60	3.81E+10			
7-Feb-00	20	2.20	3.23E+10			
16-Feb-00	50	2.80	1.03E+11	36	2.70	7.04E+10
8-May-00	80	2.10	1.23E+11			
11-May-00	330	2.10	5.08E+11			
31-May-00	140	1.40	1.44E+11			
5-Jun-00	7900	1.90	1.10E+13	413	1.88	5.69E+11
5-Jul-00	700	0.36	1.85E+11			
12-Jul-00	81	1.70	1.01E+11			
19-Jul-00	130	1.70	1.62E+11			
2-Aug-00	460	2.90	9.79E+11	241	1.67	2.95E+11
6-Nov-00	700	2.60	1.34E+12			
16-Nov-00	790	4.40	2.55E+12			
30-Nov-00	280	1.70	3.49E+11			
4-Dec-00	2400	1.70	2.99E+12	781	2.60	1.49E+12

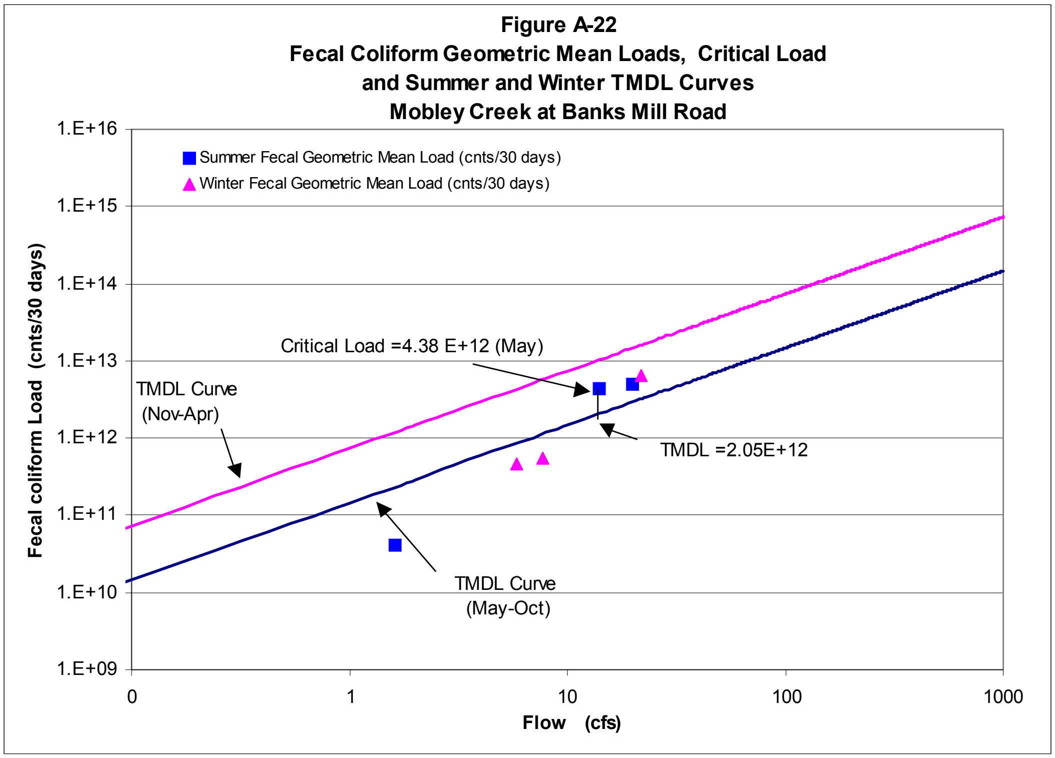
Figure A-22
Fecal Coliform Geometric Mean Loads, Critical Load
and Summer and Winter TMDL Curves
Mobley Creek at Banks Mill Road
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load =4.38 E+12 (May)
TMDL Curve
(Nov-Apr)
TMDL =2.05E+12
TMDL Curve
(May-Oct)
Fecal coliform Load (cnts/30 days)
1.E+16
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
0
1
10
100
1000
Flow (cfs)

Table A-22. Data for Figure A-22, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
4-Oct-00	20	1.47	2.16E+10			
12-Oct-00	80	1.68	9.88E+10			
18-Oct-00	20	1.60	2.35E+10			
25-Oct-00	40	1.77	5.19E+10	34	1.63	4.03E+10
2-Nov-00	30	2.48	5.47E+10			
7-Nov-00	210	2.99	4.61E+11			
6-Nov-00	200	2.48	3.64E+11			
20-Nov-00	100	15.16	1.11E+12			
27-Nov-00	75	15.16	8.34E+11	99	7.65	5.55E+11
7-Dec-00	80	5.89	3.46E+11			
11-Dec-00	130	5.89	5.62E+11			
20-Dec-00	170	5.89	7.35E+11			
27-Dec-00	70	5.89	3.03E+11	105	5.89	4.56E+11
10-Apr-01	640	23.58	1.11E+13			
11-Apr-01	280	22.32	4.58E+12			
17-Apr-01	340	23.58	5.88E+12			
26-Apr-01	420	17.26	5.32E+12	400	21.68	6.36E+12
1-May-01	730	15.16	8.12E+12			
9-May-01	350	13.05	3.35E+12			
14-May-01	420	11.37	3.50E+12			
23-May-01	330	18.11	4.38E+12			
30-May-01	400	12.21	3.58E+12	427	13.98	4.38E+12
7-Jun-01	340	21.89	5.46E+12			
14-Jun-01	330	25.26	6.12E+12			
21-Jun-01	340	13.89	3.47E+12			
26-Jun-01	340	18.53	4.62E+12	337	19.89	4.91E+12

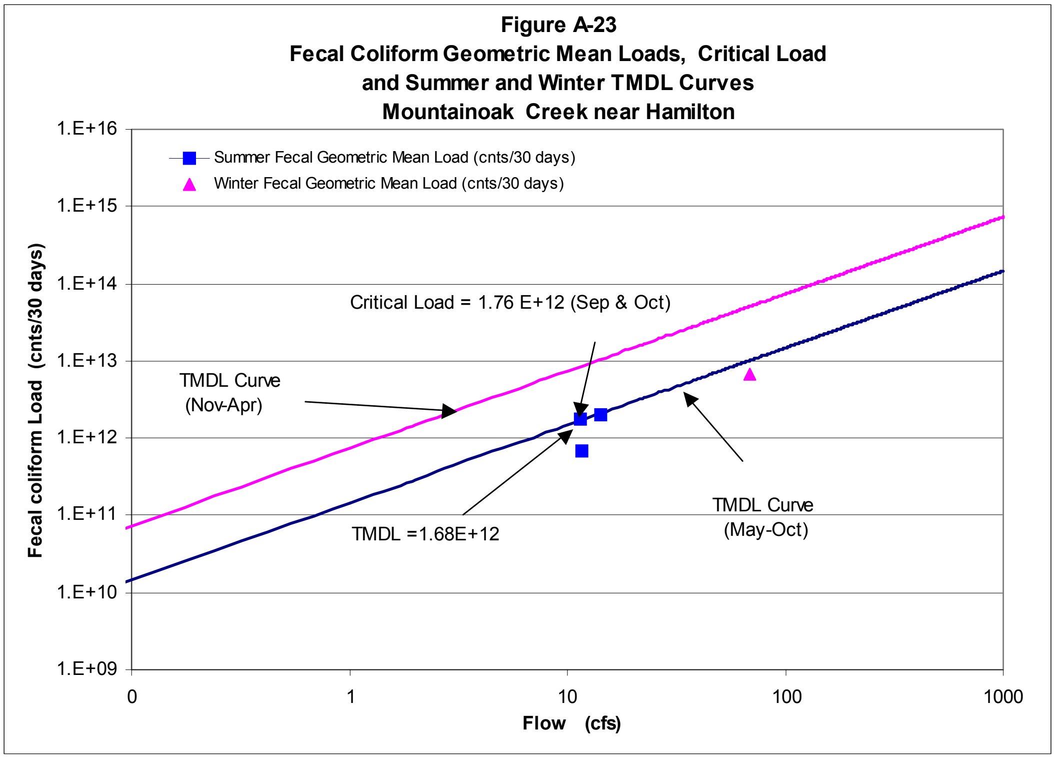

Table A-23. Data for Figure A-23, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
25-Jan-00	80	101.00	5.93E+12			
8-Feb-00	170	59.00	7.36E+12			
15-Feb-00	130	67.00	6.39E+12			
22-Feb-00	170	50.00	6.24E+12	132	69.25	6.69E+12
30-May-00	220	11.00	1.78E+12			
6-Jun-00	230	19.00	3.21E+12			
20-Jun-00	220	13.00	2.10E+12			
27-Jun-00	130	14.00	1.34E+12	195	14.25	2.04E+12
29-Aug-00	70	11.00	5.65E+11			
5-Sep-00	230	18.00	3.04E+12			
20-Sep-00	20	6.60	9.68E+10			
28-Sep-00	130	11.00	1.05E+12	80	11.65	6.87E+11
28-Sep-00	130	11.00	1.05E+12			
3-Oct-00	460	8.90	3.00E+12			
17-Oct-00	140	14.00	1.44E+12			
24-Oct-00	230	12.00	2.02E+12	209	11.48	1.76E+12

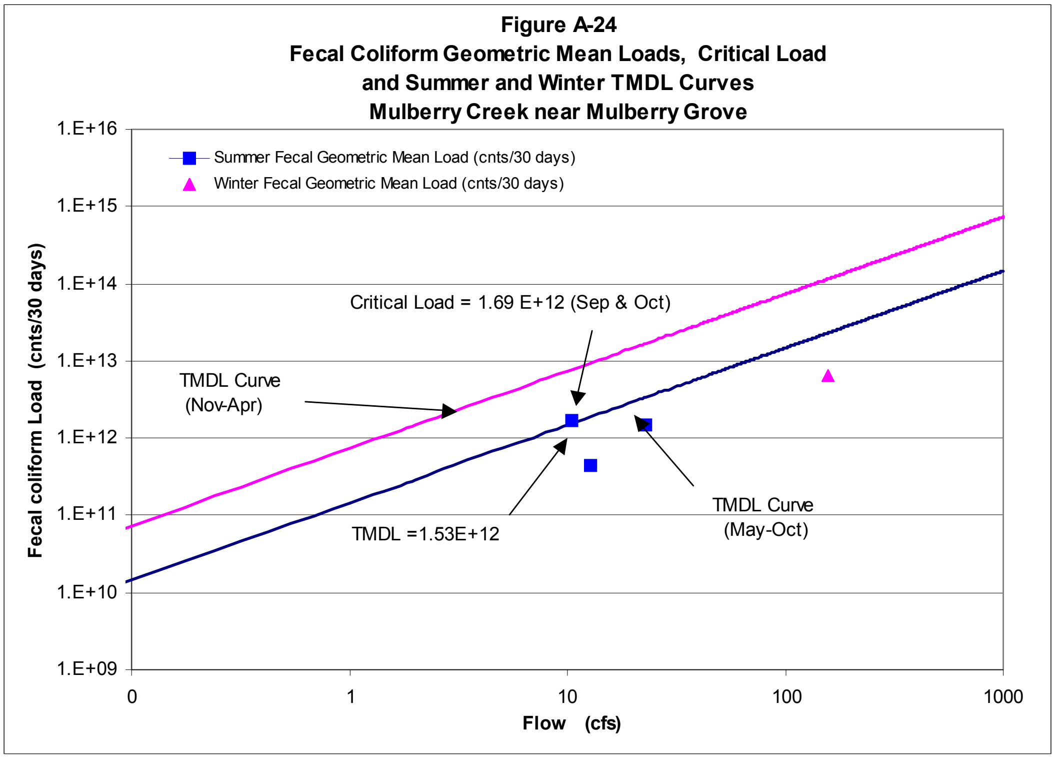

Table A-24. Data for Figure A-24, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
25-Jan-00	20	315.00	4.62E+12			
8-Feb-00	80	104.00	6.10E+12			
15-Feb-00	130	124.00	1.18E+13			
22-Feb-00	50	87.00	3.19E+12	57	157.50	6.56E+12
30-May-00	50	30.00	1.10E+12			
6-Jun-00	110	22.00	1.78E+12			
20-Jun-00	50	19.00	6.97E+11			
27-Jun-00	230	20.00	3.37E+12	89	22.75	1.49E+12
29-Aug-00	50	11.00	4.03E+11			
5-Sep-00	40	17.00	4.99E+11			
20-Sep-00	20	10.00	1.47E+11			
28-Sep-00	130	13.00	1.24E+12	48	12.75	4.47E+11
28-Sep-00	130	13.00	1.24E+12			
3-Oct-00	170	10.00	1.25E+12			
17-Oct-00	330	10.00	2.42E+12			
24-Oct-00	330	8.60	2.08E+12	221	10.40	1.69E+12

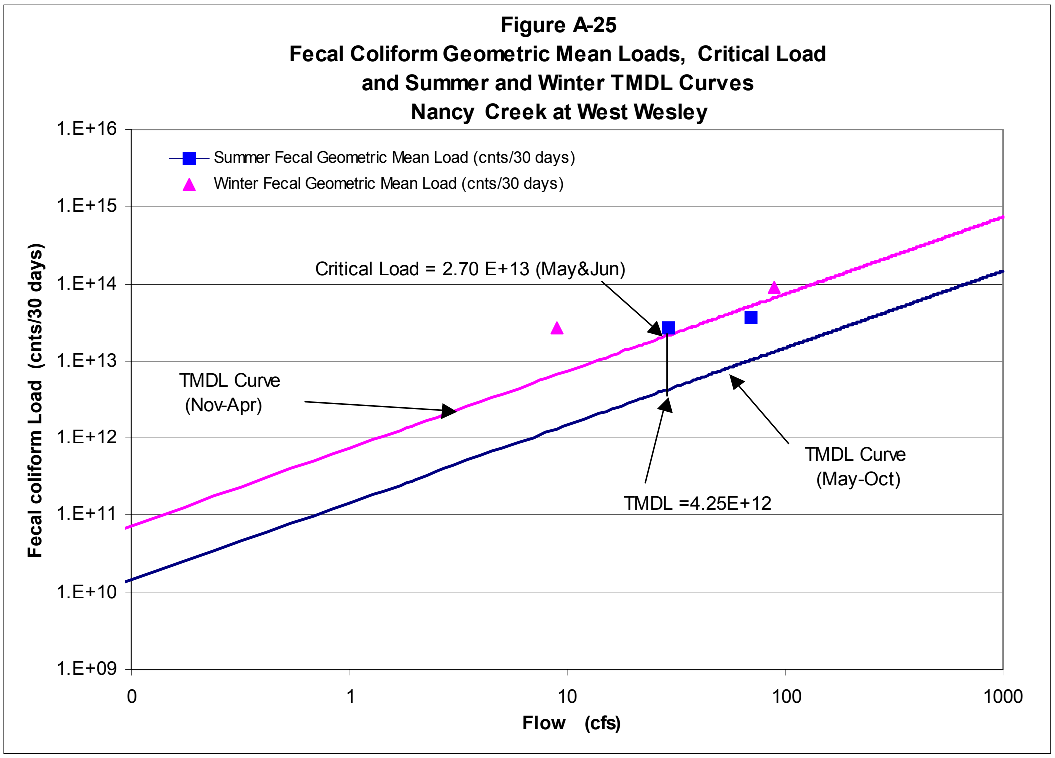

Table A-25. Data for Figure A-25, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
20-Mar-00	7900	252.00	1.46E+15			
22-Mar-00	790	44.00	2.55E+13			
30-Mar-00	790	39.00	2.26E+13			
12-Apr-00	700	22.00	1.13E+13	1,363	89.25	8.92E+13
9-May-00	1300	20.00	1.91E+13			
17-May-00	490	19.00	6.83E+12			
22-May-00	24000	58.00	1.02E+15			
1-Jun-00	170	19.00	2.37E+12	1,270	29.00	2.70E+13
6-Jul-00	20	24.00	3.52E+11			
18-Jul-00	90	13.00	8.58E+11			
25-Jul-00	24000	117.00	2.06E+15			
1-Aug-00	5400	126.00	4.99E+14	695	70.00	3.57E+13
19-Sep-00	230	14.00	2.36E+12			
21-Sep-00	20	805.00	1.18E+13			
26-Sep-00	700	43.00	2.21E+13			
16-Oct-00	260	16.00	3.05E+12	170	219.50	2.74E+13

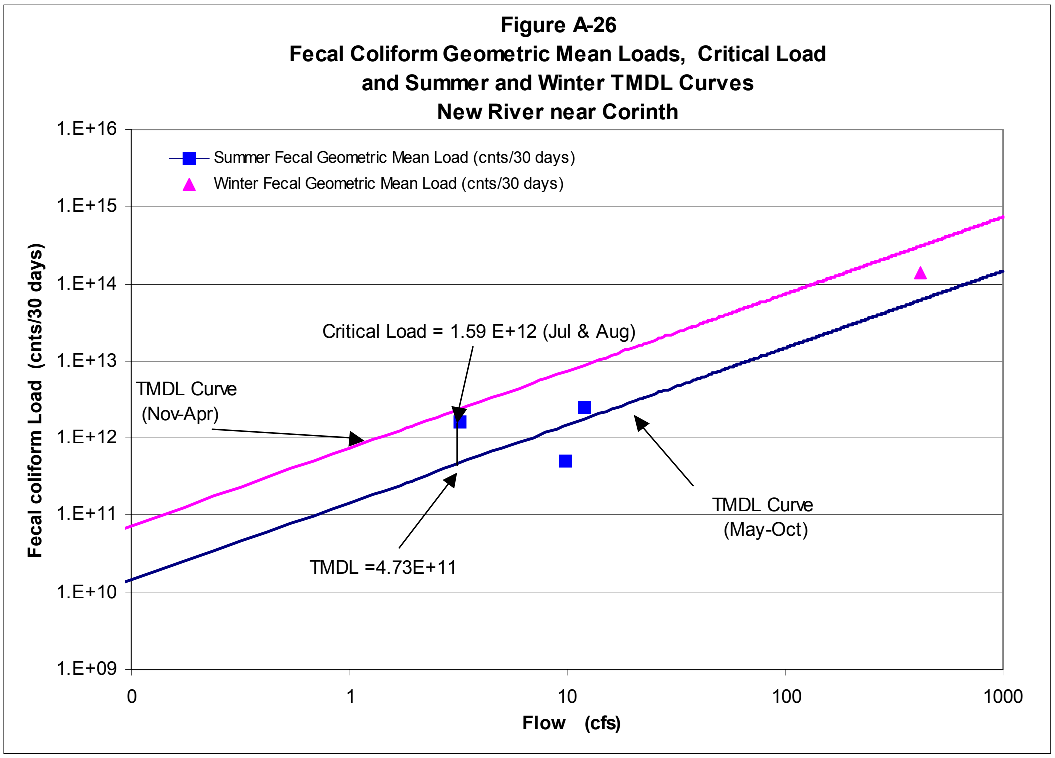

Table A-26. Data for Figure A-26, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
14-Mar-00	80	53.00	3.11E+12			
21-Mar-00	3300	807.00	1.95E+15			
28-Mar-00	220	120.00	1.94E+13			
4-Apr-00	790	689.00	3.99E+14	463	417.25	1.42E+14
30-May-00	50	19.00	6.97E+11			
12-Jun-00	330	9.20	2.23E+12			
19-Jun-00	170	10.00	1.25E+12			
26-Jun-00	2400	9.80	1.73E+13	286	12.00	2.52E+12
19-Jul-00	1300	1.20	1.14E+12			
2-Aug-00	5400	0.50	1.98E+12			
7-Aug-00	170	7.50	9.35E+11			
14-Aug-00	170	3.70	4.61E+11	671	3.23	1.59E+12
18-Sep-00	120	3.80	3.34E+11			
27-Sep-00	20	24.00	3.52E+11			
10-Oct-00	70	8.20	4.21E+11			
12-Oct-00	130	3.50	3.34E+11	68	9.88	4.95E+11

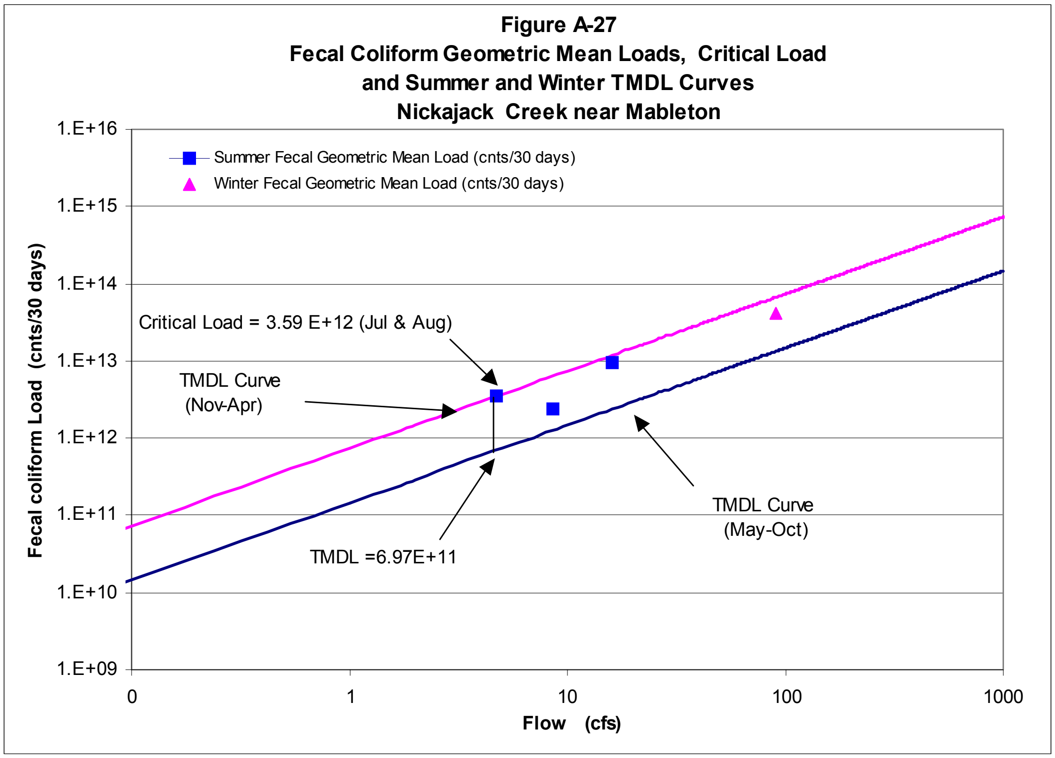

Table A-27. Data for Figure A-27, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
20-Mar-00	4900	276.00	9.92E+14			
22-Mar-00	1100	35.00	2.82E+13			
30-Mar-00	130	28.00	2.67E+12			
12-Apr-00	230	22.00	3.71E+12	634	90.25	4.19E+13
9-May-00	1100	4.70	3.79E+12			
17-May-00	310	2.30	5.23E+11			
22-May-00	9200	53.00	3.58E+14			
1-Jun-00	130	4.20	4.01E+11	799	16.05	9.41E+12
6-Jul-00	310	2.00	4.55E+11			
18-Jul-00	460	2.00	6.75E+11			
25-Jul-00	24000	13.00	2.29E+14			
1-Aug-00	330	2.00	4.84E+11	1,031	4.75	3.59E+12
19-Sep-00	490	4.70	1.69E+12			
21-Sep-00	330	2.70	6.54E+11			
26-Sep-00	940	22.00	1.52E+13			
16-Oct-00	130	4.70	4.48E+11	375	8.53	2.34E+12

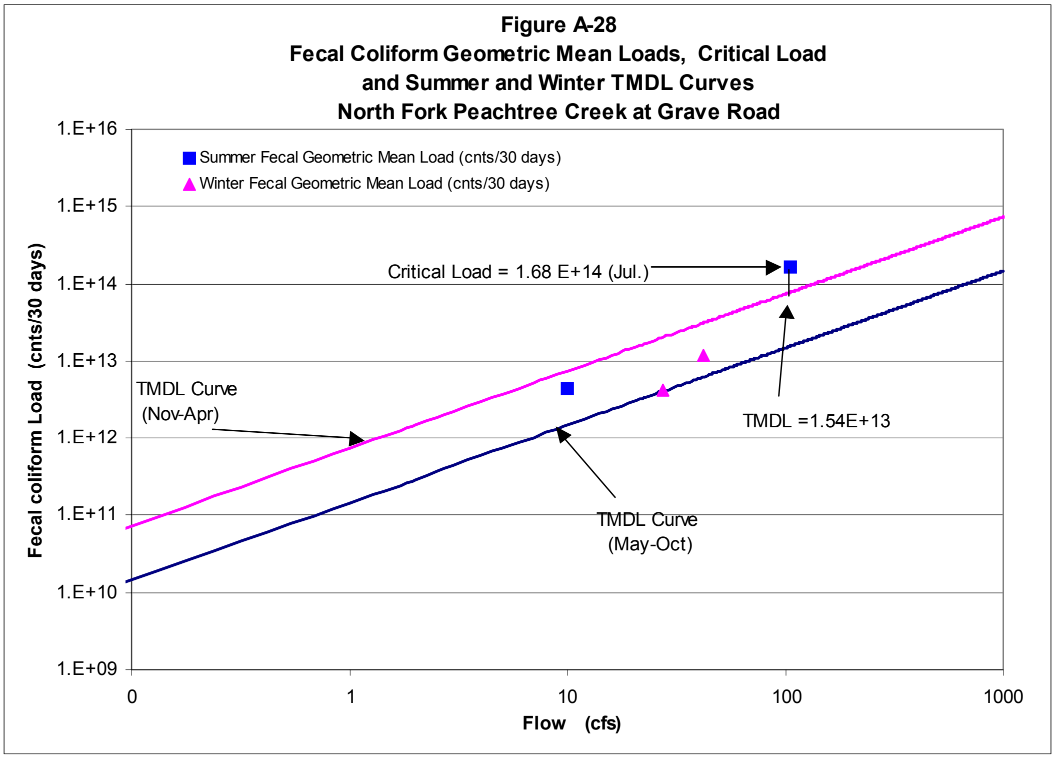

Table A-28. Data for Figure A-28, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
1-Jan-01	192	18.29	2.58E+12			
11-Jan-01	36	22.68	5.99E+11			
18-Jan-01	4600	41.69	1.41E+14			
25-Jan-01	56	27.80	1.14E+12	205	27.61	4.16E+12
5-Apr-01	528	70.22	2.72E+13			
12-Apr-01	188	36.57	5.04E+12			
19-Apr-01	460	35.11	1.18E+13			
26-Apr-01	448	26.33	8.65E+12	378	42.06	1.17E+13
5-Jul-01	432	94.36	2.99E+13			
12-Jul-01	3200	16.82	3.95E+13			
19-Jul-01	360	11.70	3.09E+12			
26-Jul-01	46000	296.98	1.00E+16	2,187	104.97	1.68E+14
4-Oct-01	840	8.78	5.41E+12			
11-Oct-01	968	10.24	7.27E+12			
18-Oct-01	272	10.24	2.04E+12			
23-Oct-01	560	10.97	4.51E+12	593	10.06	4.38E+12

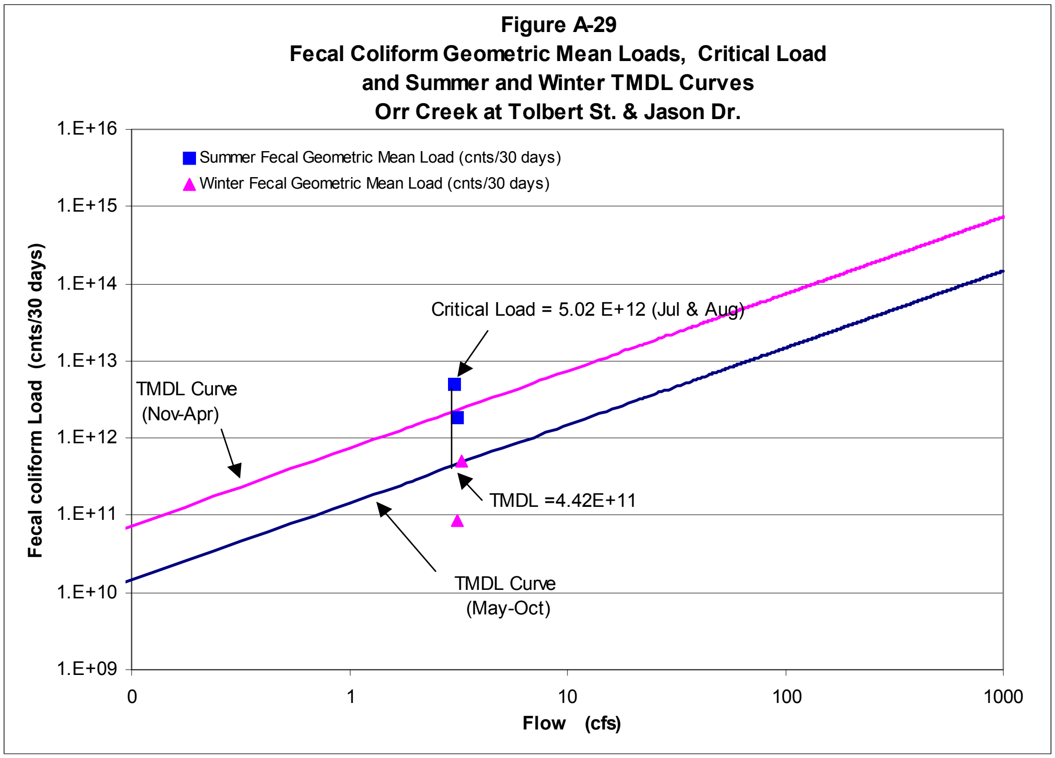

Table A-29. Data for Figure A-29, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
18-Jul-00	28000	1.96	4.03E+13			
27-Jul-00	1300	1.96	1.87E+12			
31-Jul-00	4300	5.71	1.80E+13			
7-Aug-00	170	2.41	3.00E+11	2,271	3.01	5.02E+12
13-Nov-00	50	3.01	1.10E+11			
21-Nov-00	20	3.38	4.95E+10			
28-Nov-00	90	3.30	2.18E+11			
5-Dec-00	20	2.85	4.19E+10	37	3.13	8.42E+10
18-Jul-00	1100	1.99	1.61E+12			
27-Jul-00	330	1.99	4.82E+11			
31-Jul-00	3300	6.10	1.48E+13			
7-Aug-00	330	2.48	6.00E+11	793	3.14	1.83E+12
13-Nov-00	2300	3.14	5.30E+12			
21-Nov-00	130	3.54	3.38E+11			
28-Nov-00	130	3.46	3.30E+11			
5-Dec-00	50	2.97	1.09E+11	210	3.28	5.05E+11

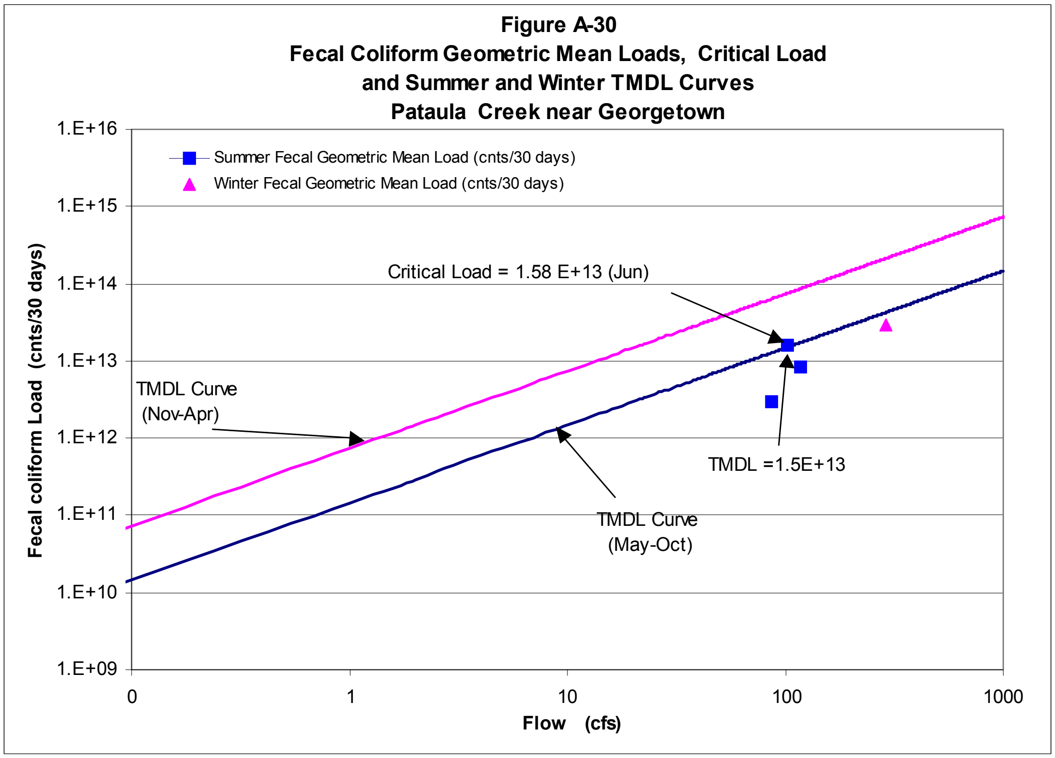

Table A-30. Data for Figure A-30, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
26-Jan-00	310	543.00	1.23E+14			
9-Dec-00	210	196.00	3.02E+13			
16-Feb-00	70	246.00	1.26E+13			
23-Feb-00	80	178.00	1.04E+13	138	290.75	2.95E+13
1-Jun-00	40	66.00	1.94E+12			
7-Jun-00	220	77.00	1.24E+13			
21-Jun-00	1300	115.00	1.10E+14			
28-Jun-00	170	152.00	1.90E+13	210	102.50	1.58E+13
30-Aug-00	130	70.00	6.68E+12			
6-Sep-00	1700	242.00	3.02E+14			
20-Sep-00	20	82.00	1.20E+12			
27-Sep-00	20	77.00	1.13E+12	97	117.75	8.38E+12
27-Sep-00	20	77.00	1.13E+12			
4-Oct-00	20	93.00	1.36E+12			
18-Oct-00	110	90.00	7.26E+12			
25-Oct-00	110	87.00	7.02E+12	47	86.75	2.98E+12

Figure A-31
Fecal Coliform Geometric Mean Loads, Critical Load and Summer and Winter TMDL Curves
Peachtree Creek at I-85

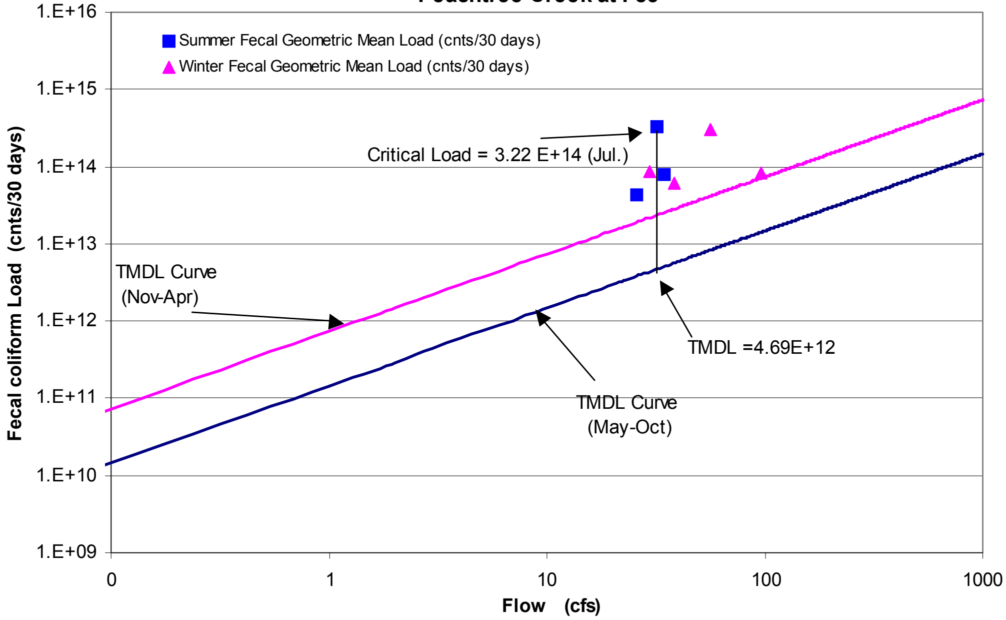

Table A-31. Data for Figure A-31, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
9-Mar-00	1700	34.00	4.24E+13			
16-Mar-00	1700	330.00	4.12E+14			
23-Mar-00	1100	63.00	5.08E+13			
30-Mar-00	7000	77.00	3.95E+14	2,172	38.25	6.09E+13
11-May-00	560	27.00	1.11E+13			
18-May-00	1300	22.00	2.10E+13			
25-May-00	3100	27.00	6.14E+13			
1-Jun-00	13000	18.00	1.72E+14	2,327	25.75	4.40E+13
27-Jul-00	7900	15.00	8.69E+13			
3-Aug-00	2300	58.00	9.79E+13			
10-Aug-00	2300	12.00	2.02E+13			
17-Aug-00	2300	8.40	1.42E+13	3,131	34.35	7.89E+13
8-Nov-00	1400	64.00	6.57E+13			
16-Nov-00	11000	34.00	2.74E+14			
30-Nov-00	4900	31.00	1.11E+14			
7-Dec-00	3300	24.00	5.81E+13	3,972	29.67	8.64E+13
10-Jan-01	4900	29.00	1.04E+14			
17-Jan-01	7900	27.00	1.56E+14			
24-Jan-01	54000	42.00	1.66E+15			
31-Jan-01	1300	127.00	1.21E+14	7,220	56.25	2.98E+14
2-Apr-01	940	56.00	3.86E+13			
10-Apr-01	790	55.00	3.19E+13			
17-Apr-01	4900	51.00	1.83E+14			
24-Apr-01	490	221.00	7.94E+13	1,156	95.75	8.12E+13
2-Jul-01	4900	30.00	1.08E+14			
10-Jul-01	2200	41.00	6.62E+13			
17-Jul-01	240000	25.00	4.40E+15	13,728	32.00	3.22E+14

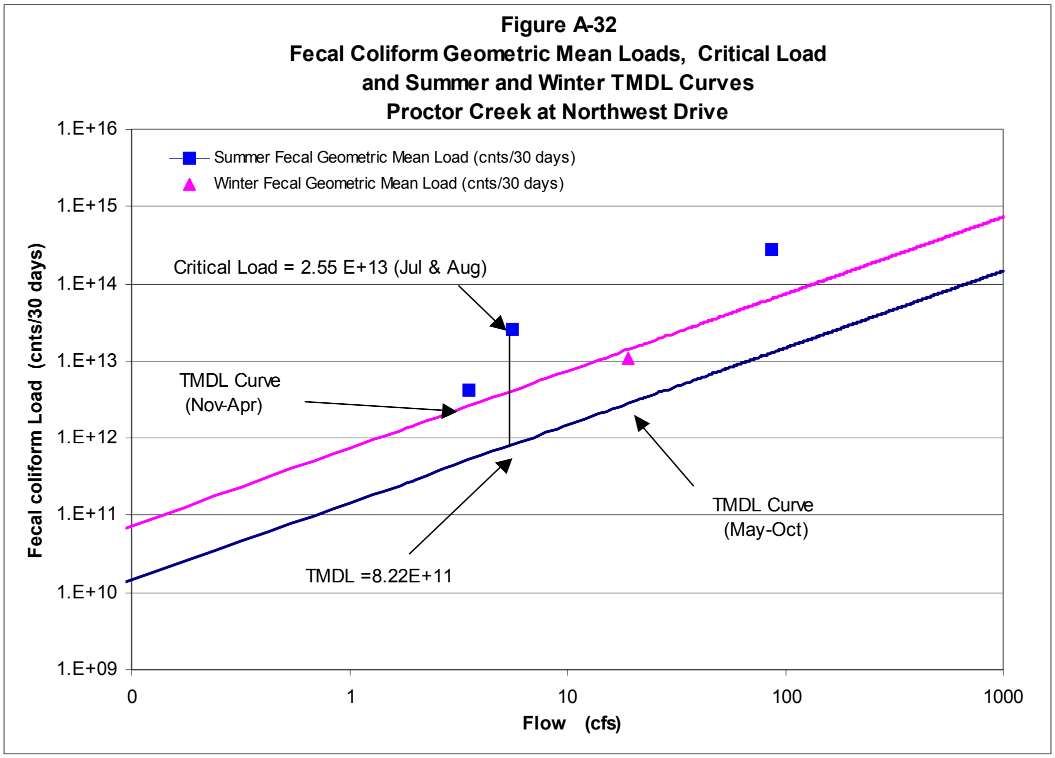

Table A-32. Data for Figure A-32, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
20-Mar-00	790	44.00	2.55E+13			
22-Mar-00	1300	7.10	6.77E+12			
30-Mar-00	490	19.00	6.83E+12			
12-Apr-00	790	5.80	3.36E+12	794	18.98	1.11E+13
9-May-00	790	3.30	1.91E+12			
17-May-00	1300	2.80	2.67E+12			
22-May-00	700	7.80	4.01E+12			
1-Jun-00	9200	0.19	1.28E+12	1,604	3.52	4.14E+12
6-Jul-00	1100	2.10	1.69E+12			
18-Jul-00	16000	1.20	1.41E+13			
25-Jul-00	24000	12.00	2.11E+14			
1-Aug-00	3500	7.10	1.82E+13	6,201	5.60	2.55E+13
19-Sep-00	790	9.90	5.74E+12			
21-Sep-00	160000	321.00	3.77E+16			
26-Sep-00	9200	11.00	7.42E+13			
16-Oct-00	330	5.50	1.33E+12	4,426	86.85	2.82E+14

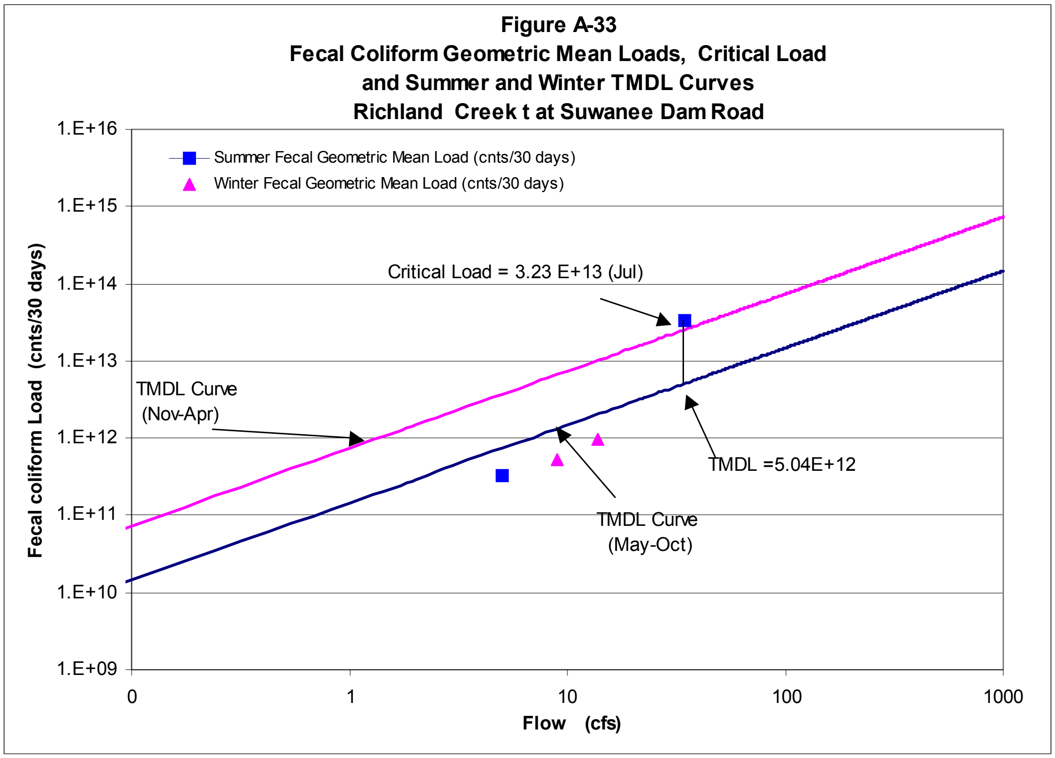

Table A-33. Data for Figure A-33, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
1-Jan-01	22	5.99	9.67E+10			
11-Jan-01	64	7.43	3.49E+11			
18-Jan-01	140	13.66	1.40E+12			
25-Jan-01	204	9.10	1.36E+12	80	9.04	5.28E+11
5-Apr-01	224	23.00	3.78E+12			
12-Apr-01	72	11.98	6.33E+11			
19-Apr-01	100	11.50	8.44E+11			
26-Apr-01	52	8.63	3.29E+11	96	13.78	9.67E+11
5-Jul-01	844	30.91	1.91E+13			
12-Jul-01	420	5.51	1.70E+12			
19-Jul-01	230	3.83	6.47E+11			
26-Jul-01	36800	97.27	2.63E+15	1,316	34.38	3.32E+13
4-Oct-01	256	2.88	5.40E+11			
11-Oct-01	156	3.35	3.84E+11			
18-Oct-01	80	3.35	1.97E+11			
23-Oct-01	100	3.59	2.64E+11	134	3.29	3.23E+11

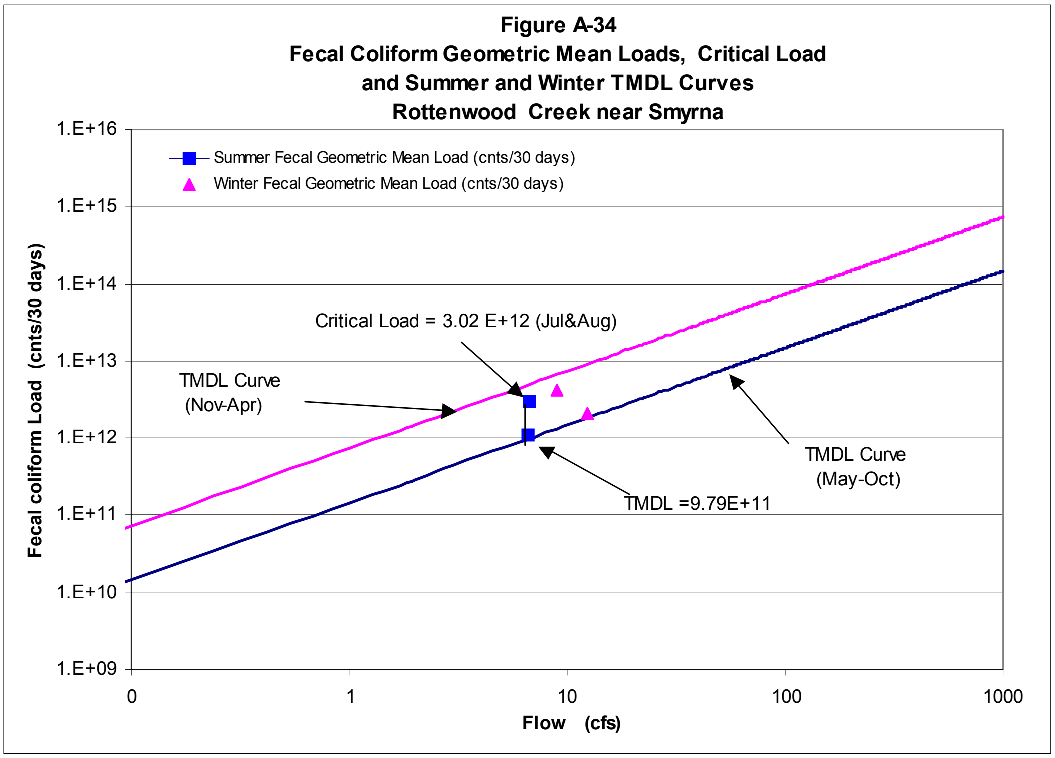

Table A-34. Data for Figure A-34, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
25-Jan-00	230	14.00	2.36E+12			
3-Feb-00	330	9.60	2.32E+12			
7-Feb-00	110	10.00	8.07E+11			
16-Feb-00	330	16.00	3.87E+12	229	12.40	2.08E+12
8-May-00	130	7.60	7.25E+11			
11-May-00	490	5.50	1.98E+12			
31-May-00	130	6.50	6.20E+11			
5-Jun-00	330	6.80	1.65E+12	229	6.60	1.11E+12
5-Jul-00	230	3.30	5.57E+11			
12-Jul-00	140	2.70	2.77E+11			
19-Jul-00	490	1.70	6.11E+11			
2-Aug-00	9200	19.00	1.28E+14	617	6.68	3.02E+12
6-Nov-00	3300	6.50	1.57E+13			
16-Nov-00	220	8.40	1.36E+12			
30-Nov-00	110	12.00	9.68E+11			
4-Dec-00	1700	11.00	1.37E+13	607	9.48	4.22E+12

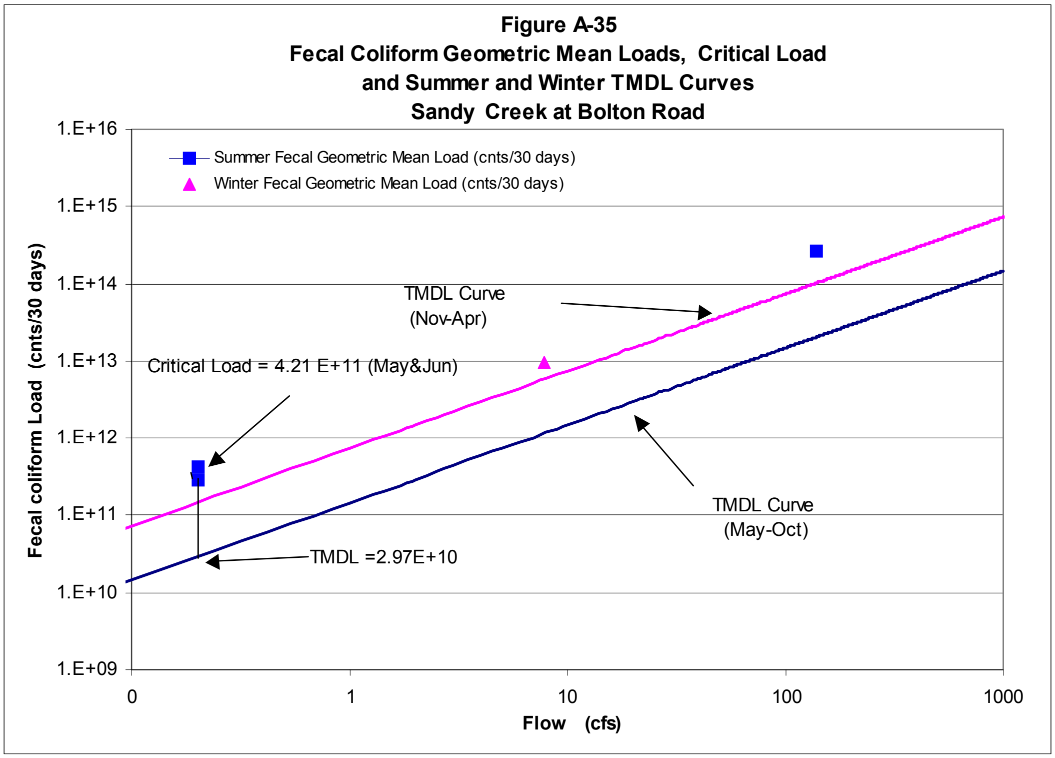

Table A-35. Data for Figure A-35, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
20-Mar-00	1300	10.30	9.82E+12			
22-Mar-00	24000	0.71	1.25E+13			
30-Mar-00	1400	20.00	2.05E+13			
12-Apr-00	170	0.38	4.74E+10	1,651	7.85	9.50E+12
9-May-00	2800	0.28	5.75E+11			
17-May-00	5400	0.19	7.53E+11			
22-May-00	5400	0.34	1.35E+12			
1-Jun-00	790	0.00	5.79E+08	2,834	0.20	4.21E+11
6-Jul-00	790	0.13	7.53E+10			
18-Jul-00	330	0.05	1.21E+10			
25-Jul-00	16000	0.17	2.00E+12			
1-Aug-00	3500	0.46	1.18E+12	1,955	0.20	2.90E+11
19-Sep-00	170	3.40	4.24E+11			
21-Sep-00	160000	542.00	6.36E+16			
26-Sep-00	3500	8.50	2.18E+13			
16-Oct-00	460	4.30	1.45E+12	2,572	139.55	2.63E+14

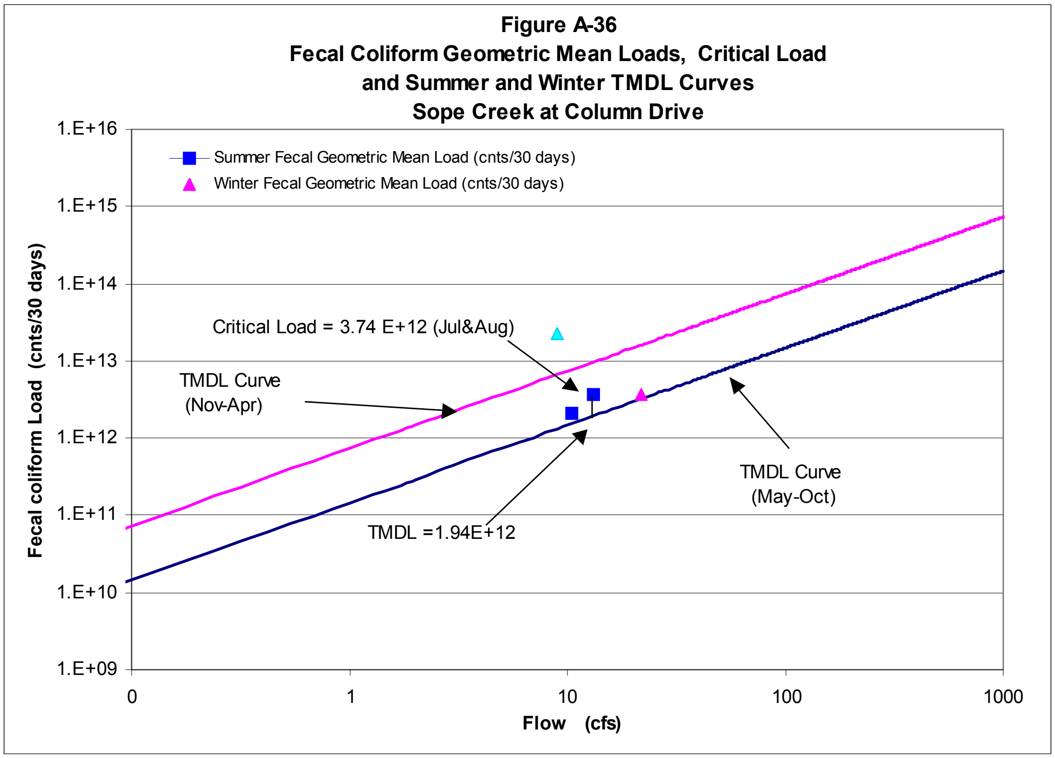

Table A-36. Data for Figure A-36, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
25-Jan-00	230	29.00	4.89E+12			
3-Feb-00	220	17.00	2.74E+12			
7-Feb-00	170	13.00	1.62E+12			
16-Feb-00	330	28.00	6.78E+12	231	21.75	3.68E+12
8-May-00	50	13.00	4.77E+11			
11-May-00	330	11.00	2.66E+12			
31-May-00	490	9.00	3.23E+12			
5-Jun-00	700	9.00	4.62E+12	274	10.50	2.11E+12
5-Jul-00	230	3.00	5.06E+11			
12-Jul-00	80	4.00	2.35E+11			
19-Jul-00	130	2.00	1.91E+11			
2-Aug-00	9200	44.00	2.97E+14	385	13.25	3.74E+12
6-Nov-00	3300	6.00	1.45E+13			
16-Nov-00	220	22.00	3.55E+12			
30-Nov-00	630	19.00	8.78E+12			
4-Dec-00	24000	22.00	3.87E+14	1,820	17.25	2.30E+13

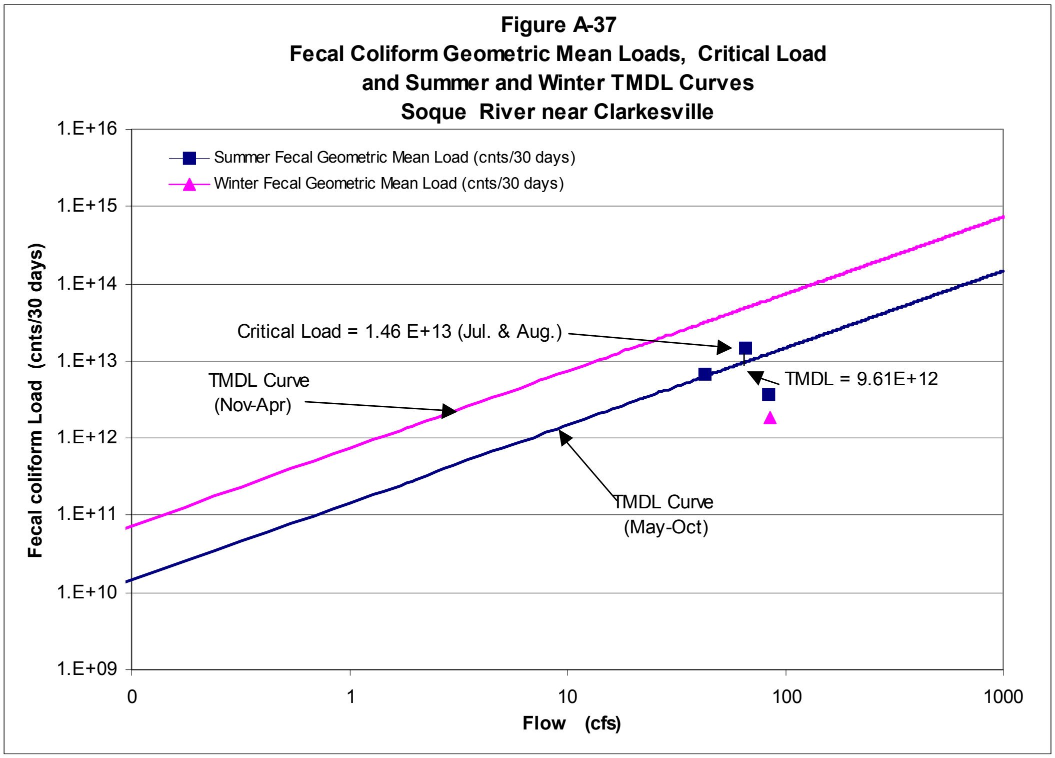

Table A-37. Data for Figure A-37, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
19-Jan-00	20	84.00	1.23E+12			
3-Feb-00	20	87.00	1.28E+12			
8-Feb-00	90	79.00	5.22E+12			
17-Feb-00	20	92.00	1.35E+12	29	85.50	1.83E+12
16-May-00	110	92.00	7.42E+12			
18-May-00	50	85.00	3.12E+12			
22-May-00	20	88.00	1.29E+12			
5-Jun-00	110	70.00	5.65E+12	59	83.75	3.62E+12
17-Jul-00	20	45.00	6.60E+11			
24-Jul-00	2200	69.00	1.11E+14			
31-Jul-00	420	92.00	2.83E+13			
8-Aug-00	460	56.00	1.89E+13	304	65.50	1.46E+13
11-Sep-00	80	42.00	2.46E+12			
18-Sep-00	110	32.00	2.58E+12			
25-Sep-00	1300	57.00	5.44E+13			
4-Oct-00	170	41.00	5.11E+12	210	43.00	6.62E+12

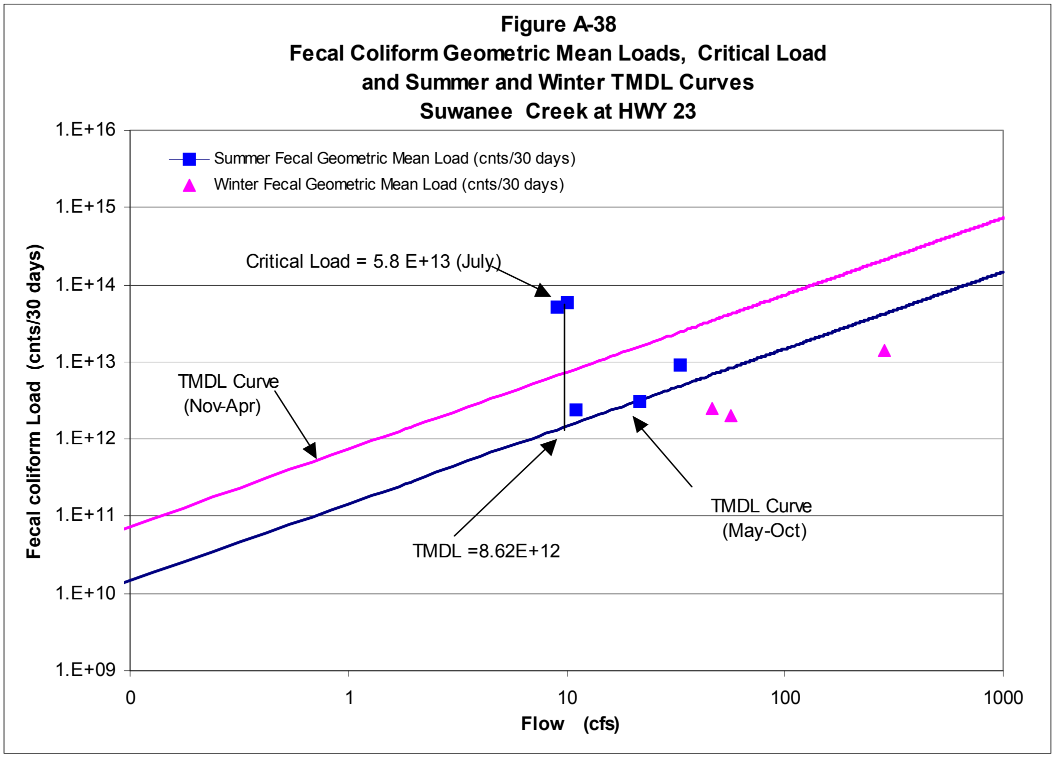
Figure A-38
Fecal Coliform Geometric Mean Loads, Critical Load
and Summer and Winter TMDL Curves
Suwanee Creek at HWY 23
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 5.8 E+13 (July)
TMDL Curve
(Nov-Apr)
TMDL Curve
(May-Oct)
TMDL =8.62E+12
Fecal coliform Load (cnts/30 days)
1.E+16
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
0
1
10
100
1000
Flow (cfs)

Table A-38. Data for Figure A-38, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
20-Jan-00	330	57.00	1.38E+13			
2-Feb-00	20	39.00	5.72E+11			
9-Feb-00	40	31.00	9.10E+11			
16-Feb-00	110	58.00	4.68E+12	73	46.25	2.49E+12
8-May-00	110	30.00	2.42E+12			
11-May-00	230	26.00	4.39E+12			
1-Jun-00	110	14.00	1.13E+12			
6-Jun-00	490	16.00	5.75E+12	192	21.50	3.03E+12
17-Jul-00	490	13.00	4.67E+12			
24-Jul-00	370	50.00	1.36E+13			
3-Aug-00	790	42.00	2.43E+13			
7-Aug-00	130	28.00	2.67E+12	369	33.25	9.01E+12
12-Sep-00	490	20.00	7.19E+12			
18-Sep-00	230	17.00	2.87E+12			
25-Sep-00	1800	102.00	1.35E+14			
3-Oct-00	9200	100.00	6.75E+14	1,169	59.75	5.12E+13
1-Jan-01	60	48.00	2.11E+12			
11-Jan-01	62	56.00	2.55E+12			
18-Jan-01	12	62.00	5.46E+11			
25-Jan-01	124	62.00	5.64E+12	49	57.00	2.03E+12
5-Apr-01	256	749.00	1.41E+14			
12-Apr-01	68	117.00	5.84E+12			
19-Apr-01	12	112.00	9.86E+11			
26-Apr-01	106	157.00	1.22E+13	69	283.75	1.43E+13
5-Jul-01	1600	118.00	1.38E+14			
12-Jul-01	290	38.00	8.08E+12			
19-Jul-01	220	18.00	2.90E+12			
26-Jul-01	32200	61.00	1.44E+15	1,346	58.75	5.80E+13
4-Oct-01	352	15.00	3.87E+12			
11-Oct-01	100	16.00	1.17E+12			
18-Oct-01	124	17.00	1.55E+12			
23-Oct-01	348	17.00	4.34E+12	197	16.25	2.35E+12

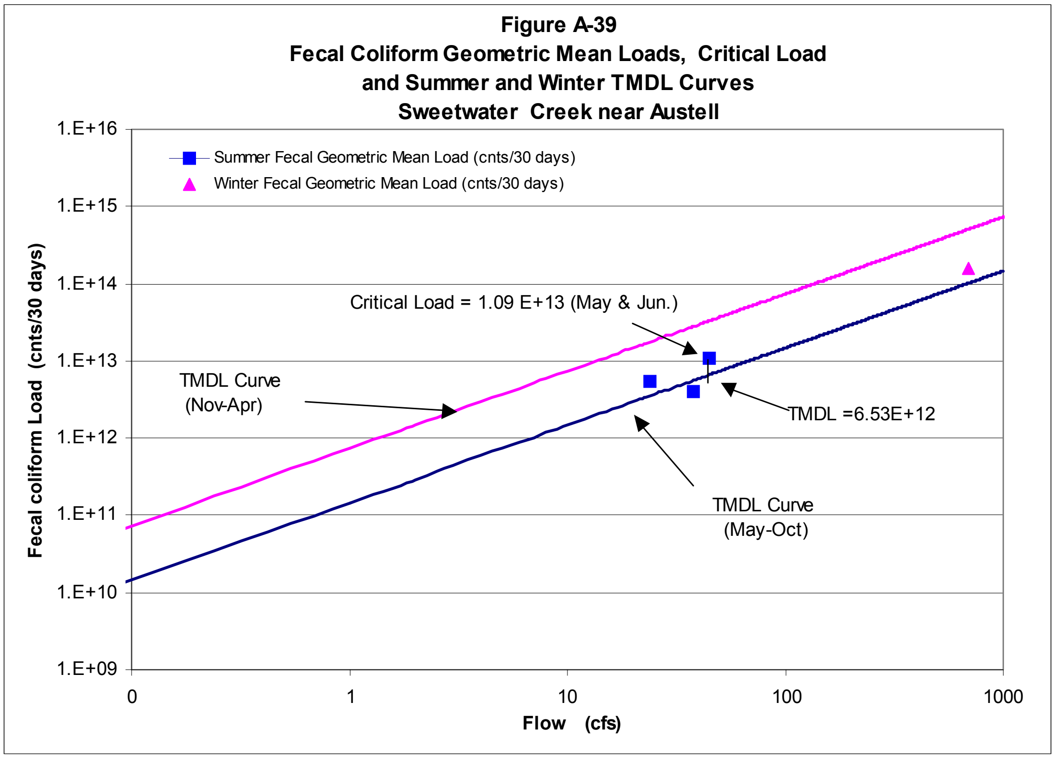

Table A-39. Data for Figure A-39, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
20-Mar-00	3300	1,560.00	3.78E+15			
22-Mar-00	490	952.00	3.42E+14			
30-Mar-00	70	121.00	6.21E+12			
12-Apr-00	80	156.00	9.15E+12	308	697.25	1.58E+14
9-May-00	1300	57.00	5.44E+13			
17-May-00	170	35.00	4.36E+12			
22-May-00	330	54.00	1.31E+13			
1-Jun-00	170	32.00	3.99E+12	334	44.50	1.09E+13
6-Jul-00	70	8.40	4.31E+11			
18-Jul-00	230	2.00	3.37E+11			
25-Jul-00	1100	8.00	6.46E+12			
1-Aug-00	490	77.00	2.77E+13	305	23.85	5.34E+12
19-Sep-00	130	13.00	1.24E+12			
21-Sep-00	80	10.00	5.87E+11			
26-Sep-00	790	111.00	6.43E+13			
16-Oct-00	50	18.00	6.60E+11	142	38.00	3.97E+12

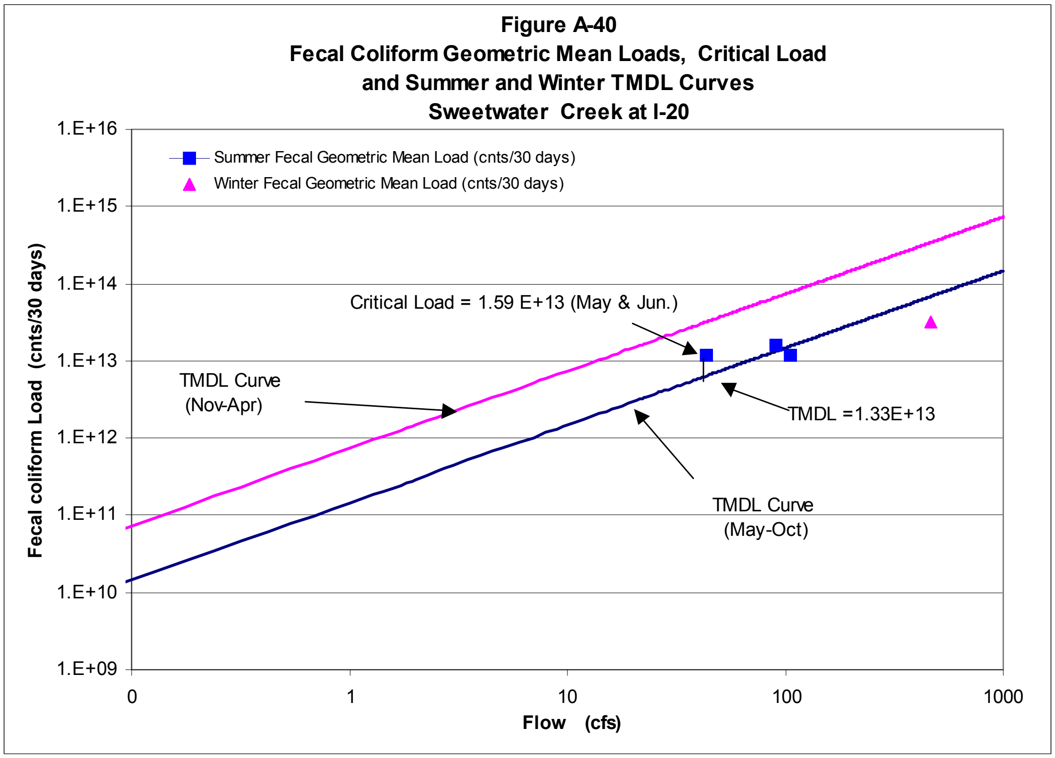
Figure A-40
Fecal Coliform Geometric Mean Loads, Critical Load
and Summer and Winter TMDL Curves
Sweetwater Creek at I-20
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 1.59 E+13 (May & Jun.)
TMDL Curve
(Nov-Apr)
TMDL =1.33E+13
TMDL Curve
(May-Oct)
Fecal coliform Load (cnts/30 days)
1.E+16
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
0
1
10
100
1000
Flow (cfs)

Table A-40. Data for Figure A-40, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
9-Mar-00	80	176.49	1.04E+13			
16-Mar-00	330	332.28	8.04E+13			
23-Mar-00	140	1,154.80	1.19E+14			
30-Mar-00	20	206.99	3.04E+12	93	467.64	3.18E+13
11-May-00	170	101.32	1.26E+13			
18-May-00	110	64.28	5.19E+12			
25-May-00	220	136.18	2.20E+13			
1-Jun-00	790	62.10	3.60E+13	239	90.97	1.59E+13
27-Jul-00	330	72.99	1.77E+13			
3-Aug-00	790	116.57	6.76E+13			
10-Aug-00	40	116.57	3.42E+12			
17-Aug-00	50	116.57	4.28E+12	151	105.67	1.17E+13
8-Nov-00	1245	43.58	3.98E+13			
16-Nov-00	220	43.58	7.03E+12			
30-Nov-00	490	43.58	1.57E+13			
7-Dec-00	130	43.58	4.16E+12	363	43.58	1.16E+13
10-Jan-01	1100	215.71	1.74E+14			
17-Jan-01	20	165.59	2.43E+12			
24-Jan-01	20	356.24	5.23E+12			
31-Jan-01	140	553.43	5.68E+13	89	322.74	2.10E+13
2-Apr-01	1100	380.21	3.07E+14			
10-Apr-01	80	348.62	2.05E+13			
17-Apr-01	1700	446.67	5.57E+14			
24-Apr-01	330	215.71	5.22E+13	471	347.80	1.20E+14

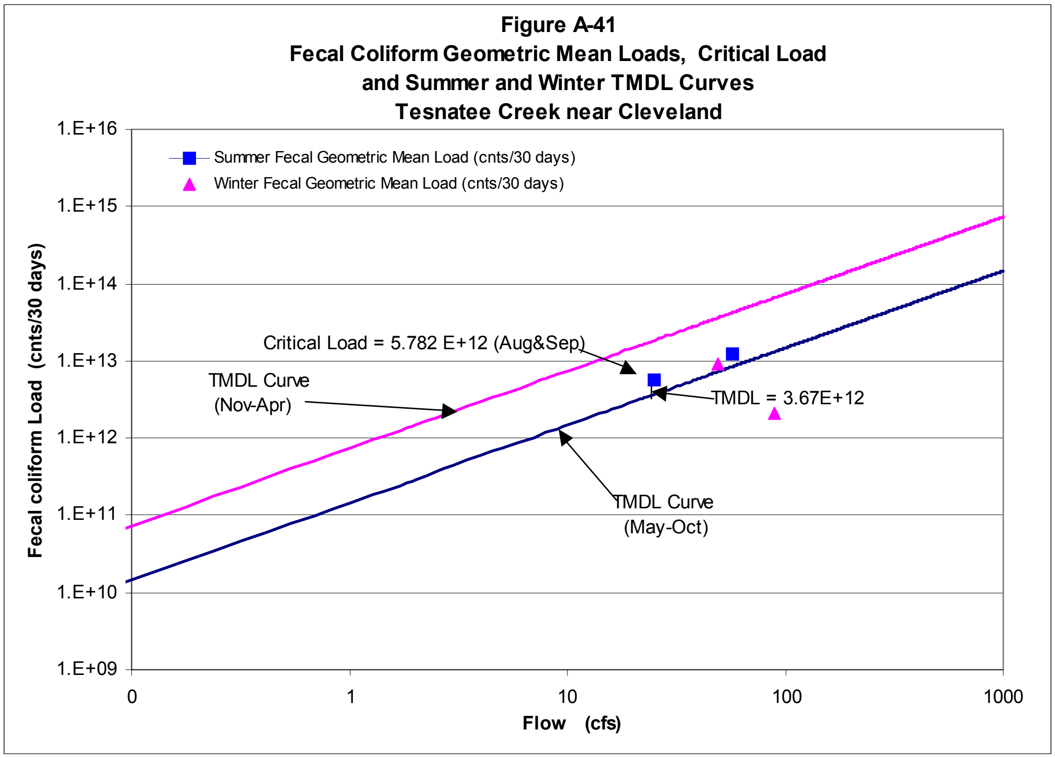

Table A-41. Data for Figure A-41, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
20-Jan-00	20	56.00	8.22E+11			
2-Feb-00	20	111.00	1.63E+12			
8-Feb-00	50	77.00	2.82E+12			
16-Feb-00	50	111.00	4.07E+12	32	88.75	2.06E+12
16-May-00	170	66.00	8.23E+12			
23-May-00	1100	72.00	5.81E+13			
8-Jun-00	80	49.00	2.88E+12			
13-Jun-00	490	42.00	1.51E+13	293	57.25	1.23E+13
15-Aug-00	360	21.00	5.55E+12			
23-Aug-00	170	26.00	3.24E+12			
30-Aug-00	490	26.00	9.35E+12			
12-Sep-00	330	27.00	6.54E+12	315	25.00	5.78E+12
6-Nov-00	330	31.00	7.50E+12			
13-Nov-00	490	49.00	1.76E+13			
28-Nov-00	110	62.00	5.00E+12			
29-Nov-00	230	54.00	9.11E+12	253	49.00	9.09E+12

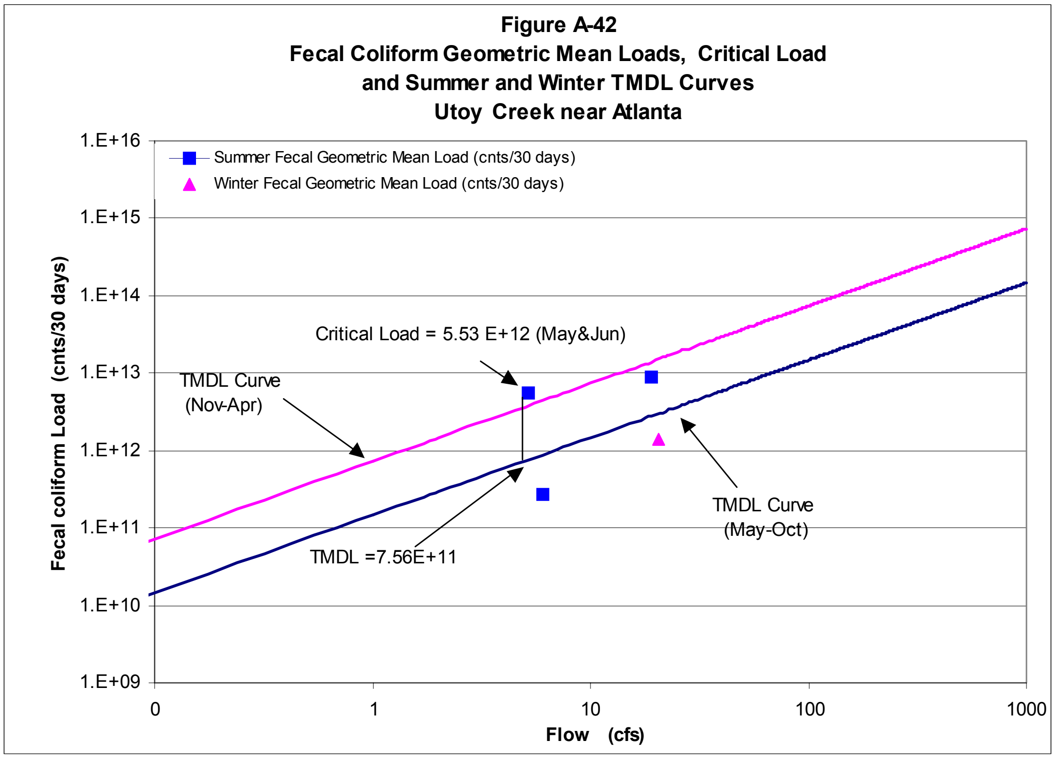

Table A-42. Data for Figure A-42, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
27-Jan-00	20	19.00	2.79E+11			
2-Feb-00	20	18.00	2.64E+11			
15-Feb-00	9200	27.00	1.82E+14			
24-Feb-00	20	18.00	2.64E+11	93	20.50	1.39E+12
4-May-00	2800	51.00	1.05E+14			
10-May-00	790	9.60	5.56E+12			
15-May-00	230	8.10	1.37E+12			
1-Jun-00	310	7.00	1.59E+12	630	18.93	8.75E+12
12-Jul-00	16000	8.40	9.86E+13			
19-Jul-00	330	2.40	5.81E+11			
26-Jul-00	1100	6.70	5.41E+12			
9-Aug-00	790	3.10	1.80E+12	1,464	5.15	5.53E+12
27-Sep-00	20	10.00	1.47E+11			
11-Oct-00	700	3.50	1.80E+12			
17-Oct-00	50	5.00	1.83E+11			
23-Oct-00	20	5.60	8.22E+10	61	6.03	2.70E+11

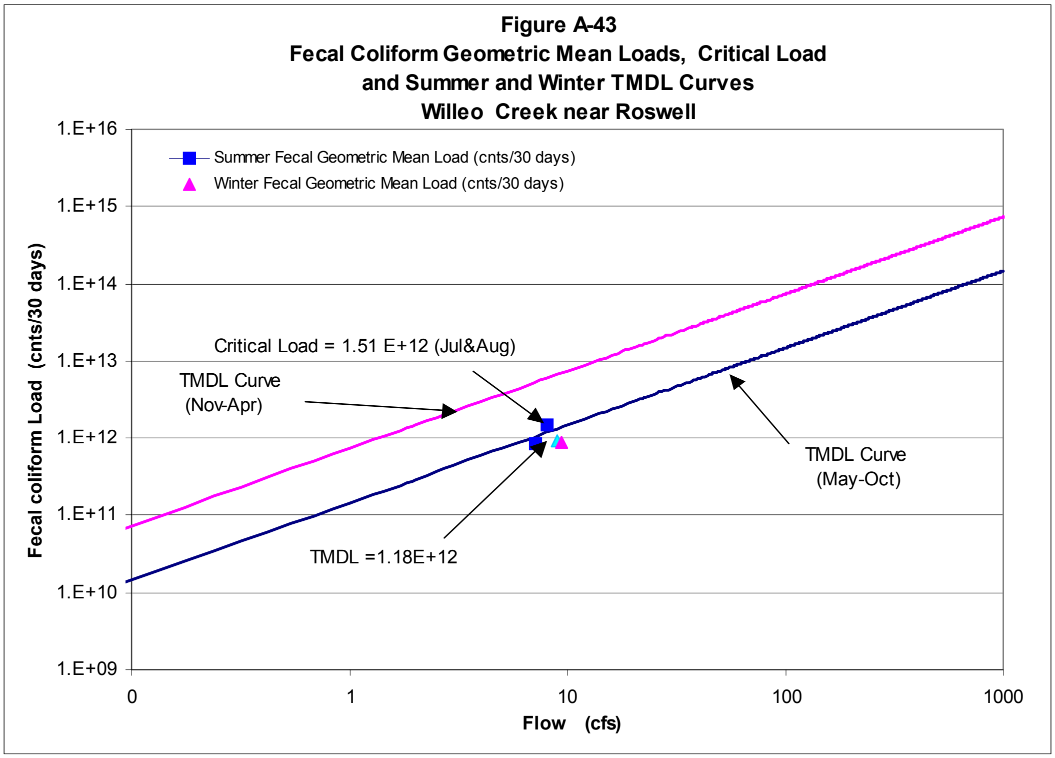

Table A-43. Data for Figure A-43, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Estimated Fecal Coliform Loading on Sample Day (cnts/30 days)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)
25-Jan-00	1100	12.00	9.68E+12			
3-Feb-00	50	8.10	2.97E+11			
7-Feb-00	130	7.50	7.15E+11			
16-Feb-00	40	10.00	2.93E+11	130	9.40	8.97E+11
8-May-00	80	7.70	4.52E+11			
11-May-00	230	7.30	1.23E+12			
31-May-00	220	7.00	1.13E+12			
6/5/2000	170	6.60	8.23E+11	162	7.15	8.49E+11
5-Jul-00	80	9.70	5.69E+11			
12-Jul-00	330	5.40	1.31E+12			
19-Jul-00	230	5.20	8.77E+11			
2-Aug-00	700	12.00	6.16E+12	255	8.08	1.51E+12
6-Nov-00	790	9.90	5.74E+12			
16-Nov-00	170	9.80	1.22E+12			
30-Nov-00	20	10.00	1.47E+11			
4-Dec-00	90	10.00	6.60E+11	125	9.93	9.08E+11

Appendix B

Summary of Limited Fecal Coliform Monitoring Data

Summary of Limited Fecal Coliform Monitoring Data

Imp aired Segment	Number of Observations	Geometric Mean (counts/100 mL)	Data Source
Arrow Creek	21	1,096.48	DeKalb County (1994-1995)
Ball Mill Creek	23	512.86	DeKalb County (1994-1995), CRMP (1992-1996)
Balus Creek	59	186.21	Lake Sidney Lanier Study
Bishop Creek			
Blue John Creek			
Bubbling Creek	23	707.95	DeKalb County (1994-1995), ARC storm water data
Burnt Fork Creek	23	891.25	DeKalb County (1994-1995)
Buttermilk Creek	103	380.19	Cobb County (1990-2002)
Chattahoochee River	15	26.92	WRDB (1998-2000)
Clear Creek			
Cracker Creek			
Foe Killer Creek			
Foxwood Branch			
Hilly Mill Creek	35	144.54	CRMP (1992-1996)
Hog Wallow Creek			
Lullwater Creek	23	3,388.44	DeKalb County (1994-1995)
March Creek	38	5,623.41	CRMP (1992-1996)
Mud Creek	94	275.42	Cobb County (1990-2002)
North Fork Balus Creek	28	120.23	City of Gainesville (1999-2001)
North Utoy Creek			
Olley Creek	140	446.68	Cobb County (1990-2002)
Pea Creek	12	245.47	CRMP (1992-1996)
Peavine Creek	46	2,570.40	DeKalb County (1994-1995)
Rocky Branch			
South Fork Peachtree Creek	52	2,238.72	DeKalb County (1994-1995), ARC storm water data, NAWQA
South Utoy Creek			
Sewell Mill Creek	96	204.17	Sanitary survey (1993), Cobb County-90/02, NAWQA
Tanyard Branch			
Tanyard Creek			
Tributary to Mud Creek			
Ward Creek	90	549.54	Cobb County (1990-2001)
Weracoba Creek	60	676.08	City of Columbus (1993-1994)
White Oak Creek	55	338.84	CRMP (1992-1996)
Woodall Creek			

Appendix C

Technical Details for Calculating TMDLs for Limited-Data Sites

Conceptual Approach

The approach to estimating fecal coliform bacteria TMDLs for the waterbodies lacking geometric mean data relies on a relationship to other similar or "equivalent" waterbodies that do have data. This provides an estimated TMDL that can be refined in future as additional site-specific data are collected.

Development of the TMDLs via an "equivalent" site approach needed to address three important issues:

1. Any site-specific monitoring data for a waterbody should also be incorporated, even if it is not sufficient for direct estimation of geometric means.

2. Differences in land use will result in different fecal coliform bacteria concentrations, an equivalent waterbody that provides a perfect match in landuse to a subject site is unlikely to be available.

3. The selection of an equivalent waterbody is likely to have a strong impact on the resulting TMDL estimates for a subject waterbody

Consideration of these three issues led to a corresponding set of objectives for the approach:

1. Site-specific and equivalent site data should be combined in a weighted approach that reflects the relative accuracy of information provided by each data source.

2. Differences in land use among watersheds should be addressed through use of a regionalization model that identifies the extent to which changes in geometric mean fecal coliform concentrations can be explained by changes in land use.

3. The influence of equivalent waterbody selection should be minimized through the use of multiple equivalent waterbodies for each subject waterbody.

These three objectives may be met through use of an Empirical Bayes regionalization analysis. This method combines two important concepts: Bayesian maximum likelihood techniques for combining sources of data (local and regional), and hierarchical regionalization techniques. The data combination step assumes that both the regional or equivalent site information and the available site-specific data provide information on the true local geometric mean. The two sources of data should be combined or weighted in accordance with the degree of precision or accuracy in each source. The regionalization step assumes that the true mean at any site is a result of random variability and a regression model on land use. Empirical Bayes techniques provide statistically optimal methods for computing both the data combination and regionalization steps from observed data.

Technical Basis

In the TMDL Curve method, the needed reductions for a given waterbody, and thus the allocations, are determined by the ratio

$$\text{Reduction} = \frac{\text{TMDL Curve Point}}{\text{Critical Load}} \tag{1}$$

where the critical load is the estimated 30-day fecal coliform load most exceeding the TMDL curve, and the TMDL curve point is calculated as the geometric mean water quality standard for fecal coliform bacteria times the 30-day average flow corresponding to the critical load estimate. Both the numerator and denominator of this equation can be written in terms of a critical geometric mean, C_{crit} and a corresponding critical flow, Q_{crit}:

$$\begin{aligned} \text{TMDL Curve Point} &= WQS \cdot Q_{crit} \\ \text{Critical Load} &= C_{crit} \cdot Q_{crit} \end{aligned} \tag{2}$$

For sites for which sufficient 30-day geometric means have not been collected, an estimate of C_{crit} is not available. For many waterbodies, some to many scattered observations are available, even though 30-day geometric means cannot be estimated. For other waterbodies, no site-specific data are available. In most cases, site-specific flow gaging is also not available. The approach estimates the TMDL for the sites without geometric mean data by adjusting the critical load, and thus the reduction estimate, from one or more equivalent sites that do have data.

In translating from an equivalent site to a subject site, it is important to account for changes in runoff concentrations associated with differences in land use, and for changes in flow associated with different basin size. The critical load at site *i* can be estimated in relation to calculated critical loads at *n* other sites through

$$\text{Critical Load}_{\text{i}} = \frac{1}{n}\sum_{j=1}^{n}\left[A_{ij} \cdot C_j \cdot Q_{crit,j} \cdot \frac{DA_i}{DA_j}\right] \tag{3}$$

in which A_{ij} is a factor (based on land use) that relates the geometric mean fecal coliform concentration at site *i* to that at site *j*, since a geometric mean is used), and *DA* represents the drainage area above the sample site.

The ratio DA_i/DA_j adjusts the flow from site j to site i. In the case where gage data are available, actual mean flows rather than drainage areas can be used for the ratio. Equation (3) thus translates both the critical geometric mean concentration and the associated critical flow to provide a new estimate of critical load at site *i*. Averaging over estimates obtained from *n* equivalent sites, the estimated reduction needed at site *i* is then, from (1):

$$\text{Reduction}_{\text{i}} = \sum_{\text{j=1}}^{\text{n}} \frac{\left[WQS \cdot Q_{crit,j} \cdot \frac{DA_i}{DA_j}\right]}{\left[A_{ij}\ G_j \cdot Q_{crit,j} \cdot \frac{DA_i}{DA_j}\right]} \tag{4}$$

The key task for completing this effort is determining the translation factor, A_{ij}, which relates the long term geometric mean at site *i* to that at site *j*. This factor can reasonably be assumed to vary with land use, but also to exhibit strong site-specific characteristics. For instance, a given site might tend to exhibit higher concentrations relative to an equivalent site than are expected from consideration of land use differences alone.

So, what is needed is a method that provides an appropriate weighting between limited site-specific data and a land-used based regression on equivalent sites. This situation is ideally suited for an empirical Bayes analysis (Berger, 1985; Morris, 1983). This is a technique for Bayesian updating that is based entirely in observed data (thus, "empirical").

It is assumed that the long-term geometric mean fecal coliform concentration at a given site (expressed in log space) is a function of underlying properties of land use in the watershed plus site-specific factors that are represented by random noise. A sample realization of the (log-space) geometric mean at site *i*, x_i is assumed to be normally distributed about a true mean, 2_i, with standard error of the estimate given by F_i. In statistical notation:

$$x_i \sim \mathrm{N}\left(\theta_i, \sigma_i^2\right) \tag{5}$$

The desired translation factor for use in Equations (3) and (4) above is then

$$A_{ij} = e^{\theta_i} / e^{\theta_j} \tag{6}$$

In a regional context, we assume that each of the true (but unknown) local site means arises from a regional regression on land characteristics, such that

$$\theta_i = \boldsymbol{y}_i^t \cdot \beta + \varepsilon_i \tag{7}$$

where ***y*** is a vector of land use characteristics, the **ß** are regression coefficients, and g_i is a normally-distributed error term, such that

$$\varepsilon_i \sim \mathrm{N}\left(0, \sigma_\pi^2\right) \tag{8}$$

Equations (7) and (8) constitute a standard linear regression model, written in vector notation. (Note that the vector **ß** includes an intercept value, in addition to coefficients on the regressors, and the first item in the vector ***y*** is a 1 corresponding to the intercept value.) The regionalization is accomplished by estimating **ß** and Φ_B from the data, i.e., across multiple sites. To simplify the mathematics, it is assumed that the F_i are known from the sample data, and uncertainty in the estimation of the F_i is ignored (Berger, 1985).

The desired maximum likelihood estimate of a geometric mean associated with a given site should range between the regression estimate, $\boldsymbol{y}_i^t$ **ß**, and the at-site observed geometric mean, x_i. If there are no monitoring data at a given site, the best estimator is simply the regression estimator. On the other hand, if there are sufficient data at a given site it is appropriate to use the observed geometric mean without regionalization. Weighting between these two end-members depends on the relative magnitudes of F_i and F_B, which express, respectively, the degree of uncertainty associated with the local and regional estimators. In a Bayesian sense, the best estimate is provided by the posterior distribution, incorporating the regional regression (as a prior) and the likelihood function of observed site data.

In a standard Bayes approach, the prior should be independent of the data used to form the likelihood function. Morris (1983) developed Empirical Bayes approximations to the posterior means and variances that take into account the errors introduced by estimating **ß** and F_B from the data. The maximum likelihood Empirical Bayes estimator of 2 is given by $:_{\mathrm{i}}^{\mathrm{EB}}$, with variance $V_{\mathrm{i}}^{\mathrm{EB}}$. These are estimated through the equations

$$\mathrm{E}(\theta_i) \quad = \quad \mu_i^{EB} = \quad x_i - \hat{\mathrm{B}}_{\mathrm{i}} \cdot \left(x_i - \boldsymbol{y}_i^t \hat{\beta}\right) \tag{9}$$

and

$$V_i^{EB} = \sigma_i^2 \cdot \left[1 - \frac{\left(p - \hat{l}_i\right)}{p} \hat{\mathrm{B}}_{\mathrm{i}}\right] + \frac{2}{p - l - 2} \hat{\mathrm{B}}_{\mathrm{i}}^2 \left(\frac{\hat{\sigma}_p^2 + \hat{\sigma}_\pi^2}{\sigma_i^2 + \hat{\sigma}_\pi^2}\right) \left(x_i - \boldsymbol{y}_i^t \hat{\beta}\right)^2 \tag{10}$$

In these equations, the parameter B_i is a Bayes factor that weights between the regional and local estimates. The x_I and F_i are, as noted above, the observed mean and variance of the logarithms of fecal coliform concentration data at site *i*. When no observations are available at a site, F_I^2 is assumed to be equal to the mean variance across all sites with data.

The vector of regression parameters, **ß**, is estimated by the standard least squares regression equation, written in matrix notation as

$$\hat{\beta} = \left(\boldsymbol{y}^t \boldsymbol{V}^{-1} \boldsymbol{y}\right)^{-1} \left(\boldsymbol{y}^t \boldsymbol{V}^{-1} \boldsymbol{x}\right) \tag{11}$$

where ***y***, representing the observed land characteristics, is a (*p* x *l*) matrix of *l* regressors at *p* sites, ***x*** is the (*p* x 1) vector of observed means at the *p* sites, and ***V*** is a (*p* x *p*) diagonal matrix with diagonal elements $V_{ii} = F_i^2 + F_B^2$. The regional variance is in turn estimated as

$$\hat{\sigma}_\pi^2 = \frac{\sum_{i=1}^{p} \left\{ \left[\left(p / (p - l)\right) \left(x_i - \boldsymbol{y}_i^t \hat{\beta}\right)^2 - \sigma_i^2 \right] / \left[\sigma_i^2 + \hat{\sigma}_\pi^2\right]^2 \right\}}{\sum_{i=1}^{p} \left(\sigma_i^2 + \hat{\sigma}_\pi^2\right)^{-2}} \tag{12}$$

and the remaining factors are

$$\hat{\mathrm{B}}_{\mathrm{i}} = \frac{(p - l - 2)}{(p - l)} \cdot \frac{\sigma_i^2}{\sigma_i^2 + \hat{\sigma}_\pi^2} \tag{13}$$

$$\hat{l}_i = p \left[\boldsymbol{y} \left(\boldsymbol{y}^t \boldsymbol{V}^{-1} \boldsymbol{y}\right)^{-1} \boldsymbol{y}^t \right]_{ii} / \left(\sigma_i^2 + \hat{\sigma}_\pi^2\right) \tag{14}$$

and

$$\hat{\sigma}_p^2 = \frac{\sum_{i=1}^{p} \sigma_i^2 / \left(\sigma_i^2 + \hat{\sigma}_\pi^2\right)}{\sum_{i=1}^{p} 1 / \left(\sigma_i^2 + \hat{\sigma}_\pi^2\right)} \tag{15}$$

These equations do not provide a closed form solution, as **ß** is involved in the equation for F_B, while □□ is required in the equation for **ß**. The equations must thus be solved by iteration: Start with a guess for F_B and use it to calculate **ß**, then use the estimate of **ß** to recalculate F_B. Convergence is usually rapid, with the proviso that, if F_B converges to a negative number, it is replaced by zero. All the necessary calculations have been incorporated into a spreadsheet.

Development of Regionalization Format

The technical approach can be applied to any type of linear regional regression model. Some experimentation was needed to determine the appropriate independent variables for use in the regression equation. Results of Atlanta-area studies such as the Atlanta Regional Stormwater Characterization Study (Quasenbarth, 1993; CDM, 1996; CH2M HILL, 1999) suggested that the most relevant information for urban areas is likely to be percent of the watershed area in residential and commercial/industrial/office land uses.

Data to support the regionalization were obtained from the Georgia Water Resources Database (WRDB), including extensive data from the Chattahoochee River Modeling Project, and supplemented by local (county and municipal) data. Though some of the data sources extend back as far as 1968, the regionalization was restricted to data from the last ten years (1992-2002). Land use data were aggregated to the scale of 12-digit hydrologic unit codes with some further delineation based on reach segments. The smaller sub-watersheds were assigned 13 digit alphanumeric codes. These 12 or 13 digit watersheds will be referred to simply as watersheds in the following discussion.

For each watershed the mean and variance of the fecal coliform data were calculated in log space. The log-space means were then plotted against the fraction of the local watershed in agricultural, rural, urban, or single family residential land use. Single independent variable regressions on fractions in individual land uses had poor explanatory power and high standard errors; however, there was a positive correlation between coliform concentration and both single family residential and urban land uses. Correlation against agricultural land use was weakly negative. Multiple regressions provided better results, and the final exploratory model used fraction of land in single family residential and urban land uses. This model has an adjusted R^2 of 49 percent, as shown in Figure 1, with both coefficients statistically significant.

In sum, the exploratory regression indicates a statistically-significant relationship between the long-term geometric mean of observed fecal coliform data and land use. This model then provides the format for the empirical Bayes regional regression. As expected, the regional regression information provides some useful information, but is not in itself sufficient to provide an accurate estimate of observations. For this reason the weighting of regional and local data based on relative precision, as is done in the Bayes approach, is particularly important.

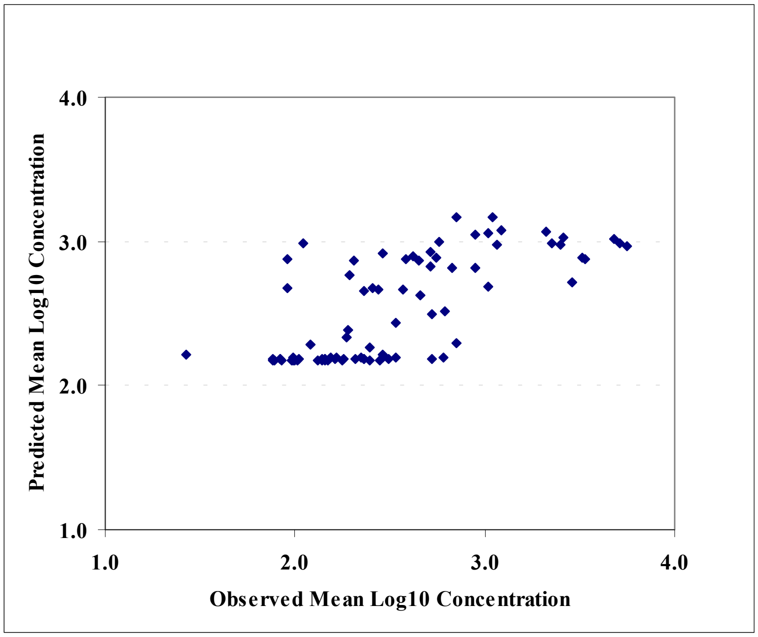

Figure 1. Predicted versus Observed Fecal Coliform Concentrations based on Land Use

Method Implementation

The methods described above were implemented in an Excel spreadsheet, using built-in matrix/array functions. The process consists of two general steps: Determination of the regionalization parameters and combination of site and regional data to estimate individual-site results.

The regionalization problem was broken into two sets. One set included the data from the Atlanta metropolitan area, the other set included sites outside the Atlanta metropolitan area. There are two reasons for taking this approach. First, there are likely to be systematic differences in the sources of bacterial pollution in this highly developed area. Second, the land use coverage in this area is obtained from the Atlanta Regional Commission (ARC) ESDIS coverage, which combines a variety of sources of high-accuracy information, including aerial photography interpretation, and is likely to differ in quality from the satellite imagery-derived MRLC data available for the remainder of the state.

Within the ARC area the regional regression used both fraction urban area and fraction single family residential area as independent variables. Outside the ARC area, the coefficient on single family residential area was not significantly different from zero. Therefore, the regionalization regression for sites in this area uses fraction urban area as a single independent variable. In both cases, only the local land use within the 12+-digit HUC corresponding to the listed segment was used in the regression, and not the entire upstream area land use, as concentrations are believed to be most strongly associated with local inputs. In three cases where the listed segment includes two or more 12+-digit HUCs, the land use distribution in the HUCs associated with the listed segment was combined for the purposes of the regression. The land use fractions associated with each site are shown in Table 1. Site fecal coliform data used

Table 1. Land Use Fractions used in Empirical Bayes Regionalization

Site	Location	HUC	Fraction Urban	Fraction Single Family Residential
Anneewakee Creek	House Creek to Lake Monroe (Douglas Co.)	031300020304A	0.0037	0.3004
Arrow Creek	Atlanta (Fulton Co.)	031300011201B	0.6500	0.3000
Aycocks Creek	Kaney Head Creek to Spring Creek (Miller Co.)	031300100405	0.0003	0.0000
Ball Mill Creek	Fulton/DeKalb Counties	031300010907B	0.0700	0.8500
Balus Creek	Gainesville (Hall Co.)	031300010803C	0.1026	0.0710
Beaver Creek	Spring Hill Creek to Flint River (Macon Co.)	031300060101	0.0100	0.0100
Bell Creek	Headwaters, d/s Thomaston, to Potato Creek (Upson Co.)	031300050908B	0.0800	0.1400
Big Creek	Hwy 400 to Chattahoochee River (Fulton Co.)	031300011004A	0.5600	0.2900
Big Slough	Near Pelham (Mitchell Co.)	031300080505	0.0000	0.0000
Bubbling Creek	DeKalb County	031300011203B	0.6600	0.2900
Buck Creek	Fox Branch to Flint River near Oglethorpe (Schley/Macon Co.)	031300060209	0.0002	0.0002
Bull Creek	Columbus (Muscogee Co.)	031300030104B	0.1800	0.3600
Burnt Fork Creek	DeKalb County	031300011202D	0.3600	0.5700
Buttermilk Creek	Cobb County	031300020208C	0.2000	0.5900
Camp Creek	Fulton County	031300020302	0.0800	0.2900
Camp Creek	Headwaters to Flint River (Clayton Co.)	031300050102	0.1100	0.5800
Centralhatchee Creek	Heard County	031300020407	0.0021	0.0031
Chattahoochee River	Ga. Hwy. 17, Helen to SR255 (White/Habersham Co.)	031300010102	0.0029	0.0012
Chattahoochee River	SR255 to Soquee River (White/Habersham Co.)	031300010106	0.0015	0.0017
Chattahoochee River	Morgan Falls Dam to Peachtree Creek (Fulton/Cobb Co.)	031300011101A	0.3100	0.4300
Chattahoochee River	Headwaters to Chattahoochee River (Cobb Co.)	031300011103A	0.3600	0.1100
Chattahoochee River	Utoy Creek to Pea Creek (Fulton/Douglas Co.)	031300020301	0.2300	0.5800
Chattahoochee River	Pea Creek to Wahoo Creek (Fulton Co.)	031300020307	0.5600	0.2000
Chattahoochee River	Pea Creek to Wahoo Creek (Fulton, Douglas, Coweta, Carroll Co.)	031300020312A	0.0029	0.0034
Chattahoochee River	Pea Creek to Wahoo Creek (Carroll Co.)	031300020401C	0.0300	0.0024
Chattahoochee River	Upatoi Creek to Railroad at Omaha (Chattahoochee/Stewart Co)	031300030606	0.0003	0.0000
Chattahoochee River	Downstream W. F. George, Dam (Clay Co.)	031300040101B	0.0100	0.0300
Cooleewahee Creek	Piney Woods Branch to Flint River near Newton (Dougherty/Baker Co.)	031300080304	0.0014	0.0003
Crawfish Creek	Douglas County	031300020308A	0.0000	0.0000
Crooked Creek	Tributary to Chattahoochee River (Gwinnett Co.)	031300010907C	0.6000	0.2600
Elkins Creek	Bull Creek to Flint River near Molena (Pike/Upson Co.)	031300050603	0.0009	0.0004
Fishpond Drain	U.S. Hwy. 84, Donalsonville to Wash Pond (Seminole Co.)	031300100802	0.0100	0.0100
Flat Creek	Headwaters Gainesville to Lake Lanier (Hall Co.)	031300010803B	0.2200	0.1000
Flat Shoal Creek	West Point (Troup/Harris Co.)	031300021007	0.0030	0.0012
Flint River	Hwy 138 to N. Hampton Road	031300050101A	0.1400	0.4300

Site	Location	HUC	Fraction Urban	Fraction Single Family Residential
Flint River	Road S1058/Woolsey Rd. to Horton Creek	031300050106B	0.0015	0.0034
Fowltown Creek	D/S Armena Rd. To Kinchafoonee Creek (Lee Co.)	031300070604	0.0012	0.0006
Gum Creek	Downstream Cordele to Lake Blackshear	031300060605B	0.0100	0.0100
Hannahatchee Creek	U.S. Hwy. 27 to Lake W.F. George (Stewart Co.)	031300030705	0.0005	0.0007
Hilly Mill Creek	Heard/Coweta Counties	031300020408C	0.0007	0.0002
Johns Creek	Headwaters to Chattahoochee River (Fulton Co.)	031300010906	0.1000	0.6600
Lanahassee Creek	W. Fork Lanahassee Creek to Kinchafoonee Creek (Webster Co.)	031300070203	0.0013	0.0002
Level Creek	Headwaters to Chattahoochee River (Gwinnett Co.)	031300010902B	0.0500	0.4900
Lime Creek	Little Lime Creek to Lake Blackshear (Sumter Co.)	031300060407	0.0000	0.0001
Long Cane Creek	Blue John Creek to Chattahoochee River	031300020912	0.0107	0.0110
Long Island Creek	Headwaters to Chattahoochee River (Fulton Co.)	031300011105B	0.1700	0.7900
Lullwater Creek	DeKalb County	031300011202C	0.1500	0.6700
Marsh Creek	Fulton County	031300011101B	0.2700	0.6100
Mobley Creek	Douglas County	031300020309B	0.0571	0.2857
Mossy Creek	Totherow Rd. near Clermont to Chattahoochee River (White/Hall Co.)	031300010302B	0.0100	0.0036
Mountain Oak Creek	Hamilton (Harris Co.)	031300021104B	0.0100	0.0001
Muckaloochee Creek	Little Muckaloochee Creek to Smithville Pond (Sumter Co.)	031300070903	0.0016	0.0016
Mud Creek	Ga. Hwy. 120 to Noses Creek (Cobb Co.)	031300020206C	0.0200	0.5900
Mulberry Creek	Ossahatchie Creek to Five Points Branch West near Mulberry Grove (Harris Co.)	031300021208B	0.0016	0.0001
Nancy Creek	Headwaters to Peachtree Creek, Atlanta (DeKalb/Fulton Co.)	031300011203A	0.2500	0.6500
New River	Corinth (Heard Co.)	031300020505B	0.0003	0.0001
Nickajack Creek	Headwaters to Chattahoochee River (Cobb Co.)	031300020102	0.1500	0.6100
North Fork Balus Creek	Gainesville (Hall Co.)	031300010803F	0.0500	0.0600
North Fork Peachtree Creek	Headwaters to Peachtree Creek, Gwinnett/DeKalb/Fulton Co.	031300011201C	0.3378	0.5405
Olley Creek	Cobb County	031300020207	0.2300	0.5400
Pataula Creek	Hodchodkee Creek to W.F. George Lake (Quitman/Clay Co.)	031300031508B	0.0002	0.0004
Patsiliga Creek	Beaver Cr. to Flint River, Butler (Taylor Co.)	031300051405	0.0100	0.0040
Pea Creek	Fulton County	031300020305	0.0013	0.1100
Peachtree Creek	I-85 to Chattahoochee River, Atlanta (Fulton Co.)	031300011204A	0.2700	0.6700
Peavine Creek	DeKalb County	031300011202B	0.2200	0.7500
Potato Creek	U.S. Hwy. 333 to Upson Co. Line (Lamar Co.)	031300050904B	0.0100	0.0040
Proctor Creek	Headwaters to Chattahoochee River, Atlanta (Fulton Co.)	031300020101C	0.4100	0.4300
Red Oak Creek	Little Red Oak Creek to Flint River near Imlac (Meriwether Co.)	031300050505	0.0016	0.0010

Site	Location	HUC	Fraction Urban	Fraction Single Family Residential
Rottenwood Creek	Headwaters to Chattahoochee River (Cobb Co.)	031300011104A	0.6700	0.1400
Sandy Creek	I-285 to Chattahoochee River (Fulton Co.)	031300020101B	0.1800	0.6300
Sewell Mill Creek	Cobb County	031300011103D	0.0511	0.8828
Soquee River	Goshen Creek to SR 17, Clarkesville (Habersham Co.)	031300010202	0.0004	0.0005
South Fork Peachtree Creek	Atlanta (Fulton Co.)	031300011202	0.3135	0.5196
Suwanee Creek	Mill Creek to Chattahoochee River (Gwinnett Co.)	031300010904	0.0600	0.0600
Sweetwater Creek	U/S Pine Valley Rd. to Noses Creek (Paulding/Cobb Co.)	031300020208	0.1625	0.4375
Swift Creek	Tobler Creek to Flint River (Upson Co.)	031300060608	0.0000	0.0000
Tesnatee Creek	Cleveland (White Co.)	031300010504	0.0100	0.0100
Turkey Creek	Pennahatchee Creek, NW Cordele to Flint River (Dooley Co.)	031300060507	0.0008	0.0010
Ulcohatchee Creek	Headwaters to Auchumpkee Creek (Crawford Co.)	031300051206	0.0011	0.0003
Utoy Creek	Atlanta (Fulton Co.)	031300020103A	0.1800	0.4200
Ward Creek	Cobb County	031300020205B	0.1300	0.7100
Weracoba Creek	Columbus (Muscogee Co.)	031300030104A	0.2800	0.4000
West Fork Little River	Headwaters to above Lake Lanier (White/Hall Co.)	031300010402A	0.0022	0.0024
White Oak Creek	Fulton County	031300020312B	0.0900	0.1900
Whitewater Creek	Headwaters to Little Whitewater Creek (Taylor Co.)	031300051503	0.0069	0.0001
Whitewater Creek	Big Whitewater Creek to Cedar Creek (Taylor/Macon Co.)	031300051507	0.0014	0.0012
Willeo Creek	Cobb/Fulton Counties	031300011102	0.0500	0.8600

in the regionalization consisted of the post-1992 data collected for the “limited data” TMDL sites, plus data provided by GA EPD for the TMDL Curve sites.

The empirical Bayes implementation yields the regionalization parameters shown in Table 2. These parameters are then used in Equation 9 to maximum likelihood estimates of 2 for each site. This in turn allows calculation of the translation factors through equation 6. The resulting TMDL estimates are provided in the main document.

Table 2. Regional Regression Parameter Estimates to Predict Long-Term Average Log base 10 Fecal Coliform Bacteria Concentration

Area	Intercept	Coefficient on fraction urban area	Coefficient on fraction single family residential
ARC	2.21	1.33	0.457
Outside ARC	2.13	2.73	NA

For both areas, the estimate of Φ_B is zero. This is a common occurrence in the method, and does not interfere with application. The implications are discussed by Berger (1985, p. 177) who states that the presence of a zero estimate of the regional or prior variance does not mean that there is no uncertainty in the estimate of the regional parameters. Rather, it implies a *lack* of information about F_B due to the fact that the likelihood function for F_B is quite flat.

The resulting empirical Bayes estimates of the site statistics are provided in Table 3.

Selection of Equivalent Site

Selection of equivalent sites proceeded with the following rules:

1. In the case where valid geometric mean data are available for a downstream segment within the same watershed, this site (or sites) was used as the equivalent site.

2. The total pool of equivalent sites available consisted of all the sites with completed TMDL estimates provided by GA EPD. Potential equivalent sites for segments within the Atlanta Metropolitan area were selected from other sites in the metro area; the pool for sites outside the metro area was other sites outside the metro area.

3. Where an equivalent site was not already present in a downstream segment, up to 5 equivalent sites were selected from within an approximately 10 mile radius, depending on availability. If the subject site is a headwater basin, preference was given to selection of equivalent sites that were also headwater basins, as these should have similar flow regimes.

4. If no equivalent sites were present within a 10 mile radius of the subject site, 1 or 2 equivalent sites were picked from the general pool of sites that had similar land use and drainage area size.

Selected equivalent sites for each limited-data site are identified in a table in the main report.

Translating Results to TMDLs

When a single equivalent site is used, estimation of the TMDL is straightforward. The procedure is the same as is used for the sites with valid geometric mean data, except that the estimates of critical load and associated flow are obtained from the equivalent site using the methods described in this appendix.

When multiple equivalent sites are used, the situation is somewhat more complicated, as each equivalent site may produce a different estimate of critical load and flow. The Bayes procedure described in this appendix is based, of necessity, on determining the relationship of long-term geometric means between sites. As a result, the primary output of this procedure is an estimate of the needed percent reduction, while the estimates of critical loads are less reliable because the regionalization reflects mean loads rather than critical loads. For this reason, the TMDL table entry for a limited-data site with multiple equivalent sites is filled in starting with the estimated percent reduction as the primary output and working

Table 3. Empirical Bayes Sufficient Statistics for Limited Data Sites (Expressed as Log base 10)

Site Name	HUC ID	μ EB (Equation 9)	V EB (Equation 10)
Atlanta Metro Area (ARC) Sites			
Ball Mill Creek	031300010907B	2.694	0.024
Hog Wallow Creek	031300011004B	2.830	0.358
Foe Killer Creek	031300011004C	2.795	0.350
Marsh Creek	031300011101B	2.898	0.062
Bishop Creek	031300011103B	2.792	0.349
Sewell Mill Creek	031300011103D	2.664	0.026
Foxwood Branch	031300011104C	2.704	0.329
Arrow Creek	031300011201B	3.211	0.018
South Fork Peachtree Creek	031300011202A, E	2.896	0.033
Peavine Creek	031300011202B	2.789	0.069
Lullwater Creek	031300011202C	2.738	0.061
Burnt Fork Creek	031300011202D	2.934	0.033
Bubbling Creek	031300011203B	3.206	0.028
Woodall Creek	031300011204B	3.245	0.462
Tanyard Branch	031300011204C	3.184	0.446
Clear Creek	031300011204D	3.029	0.406
North Utoy Creek	031300020103B	2.652	0.318
South Utoy Creek	031300020103C	2.719	0.333
Cracker Creek	031300020203C	2.670	0.322
Ward Creek	031300020205B	2.631	0.020
Trib to Mud Creek	031300020206B	2.425	0.270
Mud Creek	031300020206C	2.505	0.015
Olley Creek	031300020207	2.721	0.028
Buttermilk Creek	031300020208C	2.741	0.027
Pea Creek	031300020305	2.273	0.014
White Oak Creek	031300020312B	2.259	0.021
Turkey Creek	031300050302B	2.394	0.264
Non-ARC Sites			
Balus Creek	031300010803C, D, G	2.397	0.033
Mud Creek (S Hall)	031300010804B	2.244	0.178
North Fork Balus Creek	031300010803F	2.258	0.017
Hilly Mill Creek	031300020408C	2.132	0.020
Blue John Creek	031300020911A, F	2.305	0.187
Park Branch	031300020911D	2.472	0.213
Tanyard Creek	031300020911E	2.782	0.265
Rocky Branch	031300030101C	2.873	0.282
Weracoba Creek	031300030104A	2.885	0.038
Chattahoochee River	031300040101B	2.129	0.089
Big Slough	031300080505, 031300080506B	2.129	0.162

backward to fill in the other entries. The estimate of the TMDL is set at the average of the TMDL curve points determined in relationship to each of the equivalent sites. The estimate of “current” critical load is then set to a value such that ”current” load times percent reduction equals the TMDL. When more than one equivalent site is used, this procedure results in an estimate of “current” critical load that may differ somewhat from the average of the critical load estimates obtained from the equivalent sites, but is within the range of the critical load estimates from the equivalent sites.

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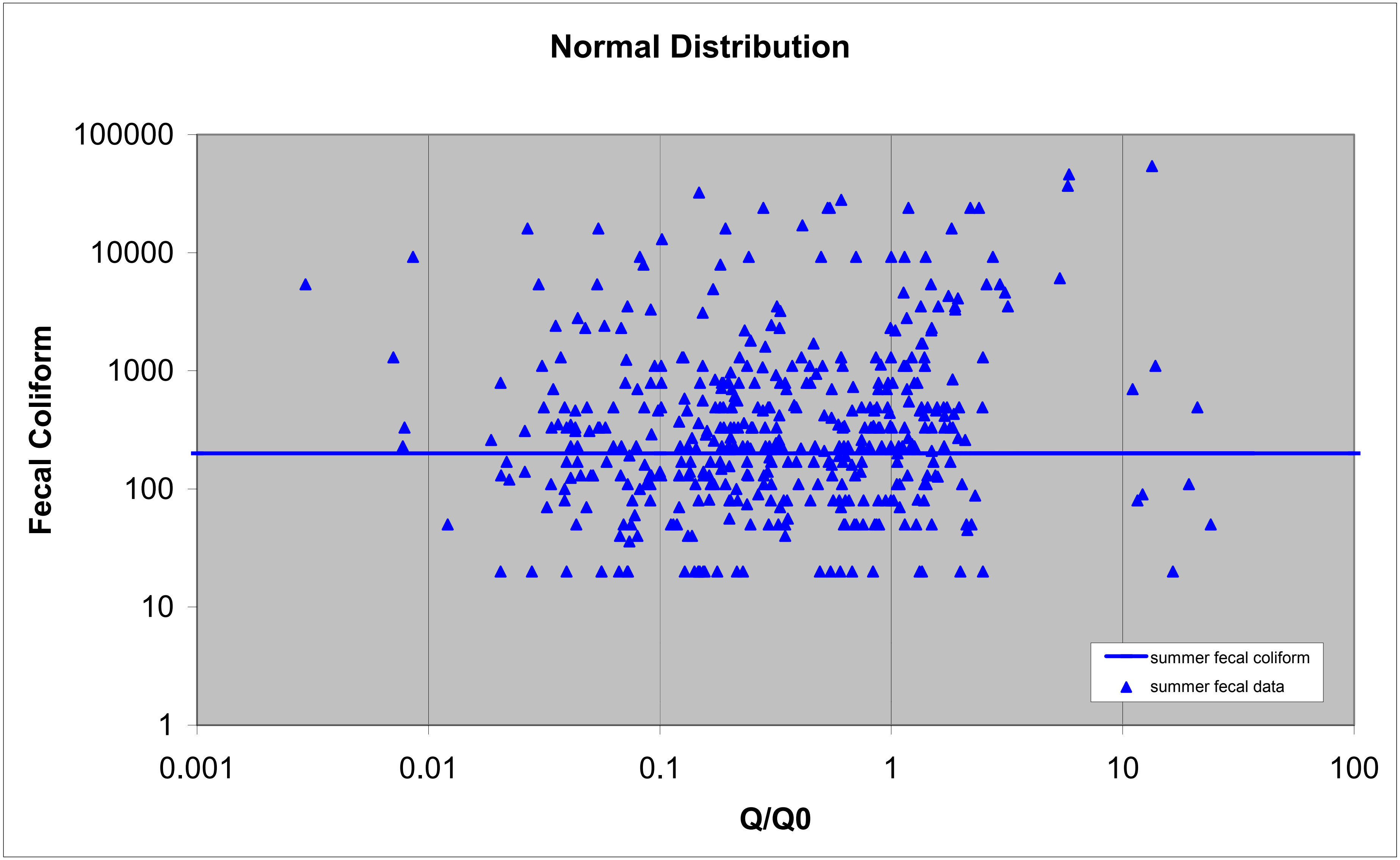
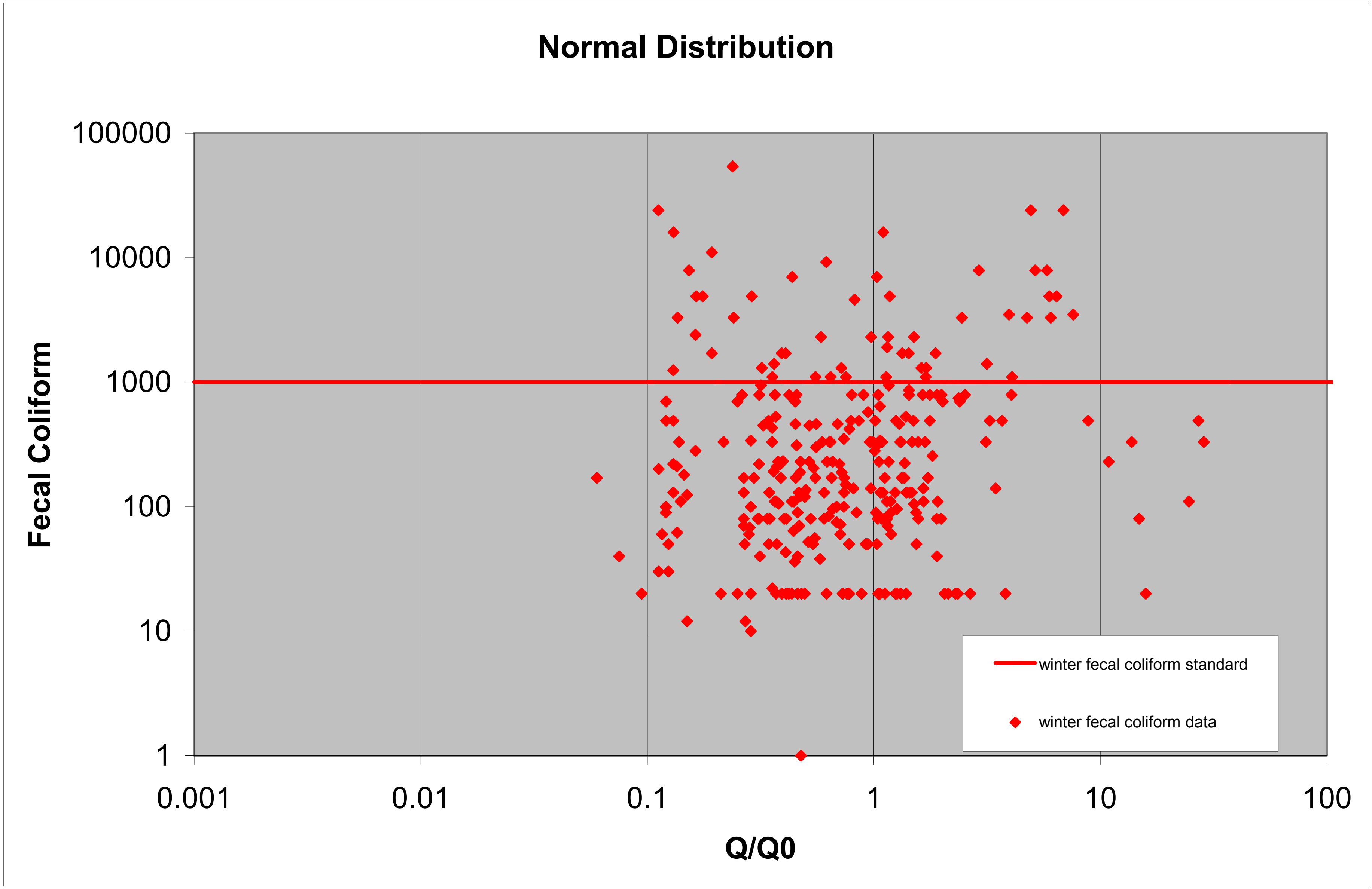
Appendix D

Normalized Flows Versus Fecal Coliform Plots


Normal Distribution
Fecal Coliform
100000
10000
1000
100
10
1
0.001
0.01
0.1
1
10
100
Q/Q0
summer fecal coliform
summer fecal data


Normal Distribution
Fecal Coliform
100000
10000
1000
100
10
1
0.001
0.01
0.1
1
10
100
Q/Q0
winter fecal coliform standard
winter fecal coliform data