Total Maximum Daily Load

Evaluation

for

Thirty-Two Stream Segments

in the

Savannah 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 one of three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* every two years.

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

The State of Georgia has identified thirty-two (32) stream segments located in the Savannah 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. There is also a single sample maximum criteria (4000 counts per 100 milliliters) for the months of November through April. The water use classification of all of the impacted streams is Fishing.

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 wash off as a result of storm events.

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

- The current critical fecal coliform load to the stream under existing conditions;
- The TMDL for similar conditions under which the current critical 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. The Loading Curve Approach was used to determine the current fecal coliform load and TMDL. The fecal coliform loads and required reductions for each of the listed segments are summarized in the table below.

Fecal Coliform Loads and Required Fecal Coliform Load Reductions

Stream Segment	Current Load (counts/ 30 days)	TMDL Components					Percent Reduction
		WLA (counts/ 30 days)[1]	WLAsw (counts/ 30 days)	LA (counts/ 30 days)	MOS (counts/ 30 days)	TMDL (counts/ 30 days)	
Beaverdam Creek	2.68E+13	9.37E+10		7.64E+12	8.59E+11	8.59E+12	68
Brier Creek - Big Brier Creek to Sweetwater Creek near Thomson	3.01E+12			1.16E+12	1.28E+11	1.28E+12	57
Brier Creek - Hwy 305 to MacIntosh Creek	2.23E+13	2.37E+11	9.67E+11	1.05E+13	1.30E+12	1.30E+13	42
Broad River - SR 281 to Scull Shoal Creek near Danielsville	1.13E+16			3.12E+15	3.46E+14	3.46E+15	69
Broad River - Hwy 77 to Clarks Hill Lake	4.58E+16		3.14E+13	1.26E+16	1.41E+15	1.41E+16	69
Brushy Creek	1.02E+13	9.83E+10		4.92E+12	5.58E+11	5.58E+12	45
Buck Creek	1.01E+16	1.62E+11		6.76E+14	7.51E+13	7.51E+14	93
Cedar Creek	3.82E+12			8.85E+11	9.84E+10	9.84E+11	74
Clark Creek	1.22E+12			4.41E+11	4.90E+10	4.90E+11	60
Cold Water Creek	1.67E+13			2.59E+12	2.88E+11	2.88E+12	83
Crawford Creek	1.30E+12			3.57E+11	3.96E+10	3.96E+11	69
Falling Creek	3.51E+12			1.06E+12	1.17E+11	1.17E+12	67
Hudson River - Mountain Creek to Webb Creek near Homer	4.76E+13			6.08E+12	6.75E+11	6.75E+12	86
Hudson River - Black Creek to Nails Creek near Fort Lamar	3.33E+14	1.39E+11		3.68E+13	4.10E+12	4.10E+13	88
Little River	1.08E+13			5.22E+12	5.80E+11	5.80E+12	46
Long Creek	2.73E+12			9.22E+11	1.02E+11	1.02E+12	62
McBean Creek	8.56E+12		8.58E+11	1.45E+12	2.57E+11	2.57E+12	70
Middle Fork Broad River	6.94E+13			1.30E+13	1.45E+12	1.45E+13	79
North Fork Broad River	1.83E+14			1.61E+13	1.79E+12	1.79E+13	90
Panther Creek	1.79E+12			9.25E+11	1.03E+11	1.03E+12	42
Reed Creek - Upstream Lake Hartwell	9.99E+11			1.85E+11	2.06E+10	2.06E+11	79
Reed Creek - Rd S1727 to Bowen Pond near Martinez	3.93E+12	6.51E+11	1.73E+11	7.43E+10	9.98E+10	9.98E+11	75
Reedy Creek	6.66E+12			1.98E+12	2.20E+11	2.20E+12	67
Runs Branch (Ebenezer Creek)	2.83E+13			1.86E+13	2.06E+12	2.06E+13	27
Shoal Creek	6.79E+13		2.36E+12	1.01E+12	3.74E+11	3.74E+12	94
South Fork Broad River -Brush Creek to Beaverdam Creek near Comer	1.33E+14		1.84E+11	6.32E+12	7.23E+11	7.23E+12	95
South Fork Broad River - Clouds Creek to Fork Creek near Carlton	1.88E+13		1.09E+11	6.66E+12	7.52E+11	7.52E+12	60
Spirit Creek	3.79E+12	8.09E+11	1.12E+12	4.81E+11	2.68E+11	2.68E+12	29
Tallulah River	1.68E+13			5.15E+12	5.73E+11	5.73E+12	66
Toccoa Creek	1.02E+13			1.82E+12	2.02E+11	2.02E+12	80
Uchee Creek	7.50E+12		3.29E+11	2.64E+12	3.30E+11	3.30E+12	56
Warwoman Creek	7.59E+12		2.34E+11	1.88E+12	2.35E+11	2.35E+12	69

Notes: [1] The assigned fecal coliform load from each NPDES permitted facility for WLA was determined as the product of the fecal coliform permit limit and the facility average monthly discharge at the time of the critical load.

Management practices that may be used to help reduce fecal coliform source loads include:

- Compliance with NPDES permit limits and requirements;
- Adoption of NRCS Conservation Practices; and
- Application of Best Management Practices (BMPs) appropriate to reduce nonpoint sources.

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 one of three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that addresses the assessment process, and are published in *Water Quality in Georgia* every two years (GA EPD, 2002-2003).

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 restore and maintain water quality.

The list identifies the waterbodies as either partially supporting or not supporting their 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 Savannah River Basin included on the 303(d) list for exceedances of the fecal coliform standard criteria. A total of four stream segments were listed as partially supporting their designated use and 28 stream segments were listed as not supporting their designated use.

1.2 Watershed Description

The Savannah River Basin encompasses more than 10,570 square miles and the river forms the border between the states of South Carolina and Georgia. The Savannah River begins in the Blue Ridge Mountains of north Georgia and South Carolina where the Seneca and Tugaloo rivers meet and flow into Lake Hartwell. The Savannah River then flows southeast for more than 300 miles to the Atlantic Ocean. Upstream of Augusta, the river flows through Clarks Hill Reservoir and Lake Stephens. The river flows through three geographically distinct ecoregions, beginning its meandering path in the Blue Ridge, flowing through the rich soils of the Piedmont, and ending in the Coastal Plain where it forms a braided network of tidal creeks that empty into the Atlantic Ocean.

Table 1. Water Bodies Listed for Fecal Coliform Bacteria in the Savannah River Basin

Stream Segment	Location	Segment Length (miles)	Designated Use	Listing
Beaverdam Creek	Confluence of North & South Beaverdam Creeks to Savannah River near Elberton (Elbert Co)	22	Fishing	NS
Brier Creek	Big Brier Creek to Sweetwater Creek near Thomson (McDuffie Co)	3	Fishing	NS
Brier Creek	Hwy 305 to MacIntosh Creek (Burke Co)	19	Fishing	PS
Broad River	SR 281 to Scull Shoal Creek near Danielsville (Madison Co)	5	Fishing	NS
Broad River	Hwy 77 to Clarks Hill Lake (Elbert Co)	15	Fishing	NS
Brushy Creek	SR 80 (Rd S1571) west Wrens to Brier Creek (Jefferson/Burke Co)	15	Fishing	NS
Buck Creek	Downstream Sylvania WPCP to Savannah River (Screven Co)	12	Fishing	NS
Cedar Creek	Little Cedar Creek to Savannah River near Montevideo (Hart Co)	4	Fishing	NS
Clark Creek	Greensboro Branch to Long Creek near Tignall (Wilkes Co)	6	Fishing	NS
Cold Water Creek	SR 77 to Little Cold Water Creek near Ruckersville (Elbert Co)	6	Fishing	NS
Crawford Creek	Upstream Lake Hartwell near Lavonia (Franklin Co)	4	Fishing	PS
Falling Creek	Dry Fork Creek to Broad River near Fortsonia (Elbert Co)	4	Fishing	NS
Hudson River	Mountain Creek to Webb Creek near Homer (Banks Co)	13	Fishing	NS
Hudson River	Black Creek to Nails Creek near Fort Lamar (Franklin/Madison Co)	8	Fishing	NS
Little River	Confluence of N & S Forks to Kettle Creek near Washington (Taliaferro/Wilkes Co)	6	Fishing	PS
Long Creek	Macks Creek to Clark Creek (Wilkes Co)	3	Fishing	NS
McBean Creek	Poorly Branch to Savannah River (Richmond/Burke Co)	14	Fishing	NS
Middle Fork Broad River	Nancy Town Creek to Hunters Creek (Banks/Franklin Co)	13	Fishing	NS
North Fork Broad River	Unawatti Creek to Broad River near Carnesville (Franklin Co)	5	Fishing	NS
Panther Creek	Upstream Lake Yonah (Habersham/Stephens Co)	9	Fishing	NS
Reed Creek	Upstream Lake Hartwell (Hart Co)	5	Fishing	NS
Reed Creek	Rd S1727 to Bowen Pond near Martinez (Columbia Co)	8	Fishing	NS
Reedy Creek	Warren Co line to Brier Creek near Wrens (Jefferson Co)	12	Fishing	NS
Runs Branch (Ebenezer Creek)	Cowpen Creek to Little Ebenezer Creek near Clyo (Effingham Co)	11	Fishing	NS
Shoal Creek	Poolers Creek to Lake Hartwell, Parkertown (Hart Co)	1	Fishing	NS
South Fork Broad River	Brush Creek to Beaverdam Creek near Comer (Madison Co)	3	Fishing	NS
South Fork Broad River	Clouds Creek to Fork Creek near Carlton (Madison/Oglethorpe Co)	7	Fishing	NS
Spirit Creek	McDade Pond to Savannah River (Richmond Co)	7	Fishing	PS
Tallulah River	Upstream Lake Burton (Rabun Co)	11	Fishing	NS
Toccoa Creek	Little Toccoa Creek to Lake Hartwell (Stephens Co)	3	Fishing	NS
Uchee Creek	Tudor Branch to upstream Little River near Evans (Columbus Co)	3	Fishing	NS
Warwoman Creek	Sarah’s Creek to Chattooga River (Rabun Co)	4	Fishing	NS

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

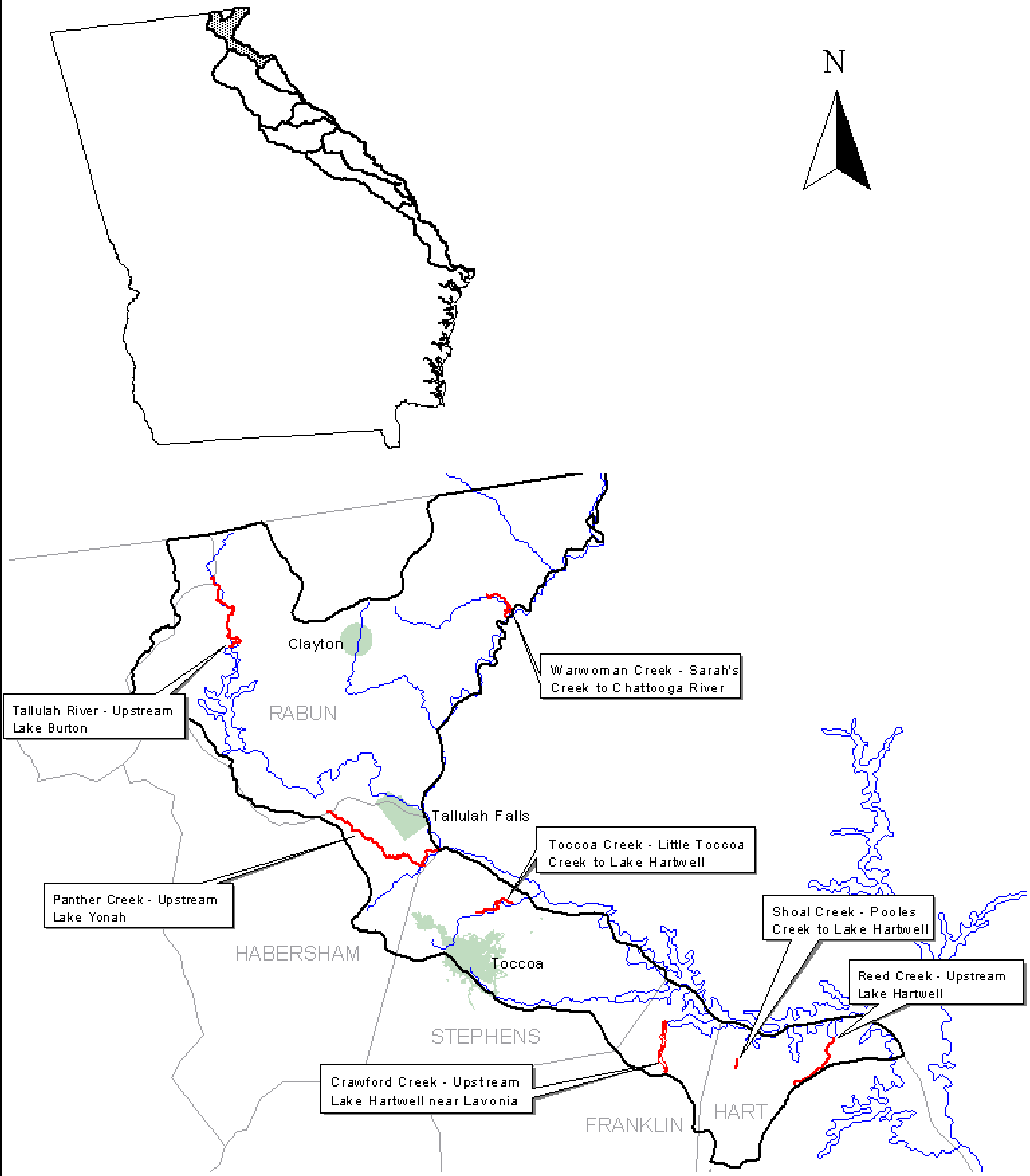
The USGS has divided the Savannah basin into nine sub-basins, or Hydrologic Unit Codes (HUCs). Figures 1-5 show the locations of theses sub-basins in Georgia, the impaired segments within each sub-basin, and the associated counties within each sub-basin.

The land use characteristics of the Savannah River Basin watersheds were determined using data from the National Land Cover Dataset (NLCD) for Georgia. This coverage was produced from Landsat Thematic Mapper digital images developed in 1995. Land use classification is based on a modified Anderson level one and two system. Table 2 lists the watershed land coverage distribution of the 32 stream segments on the 303(d) list.

1.3 Water Quality Standard

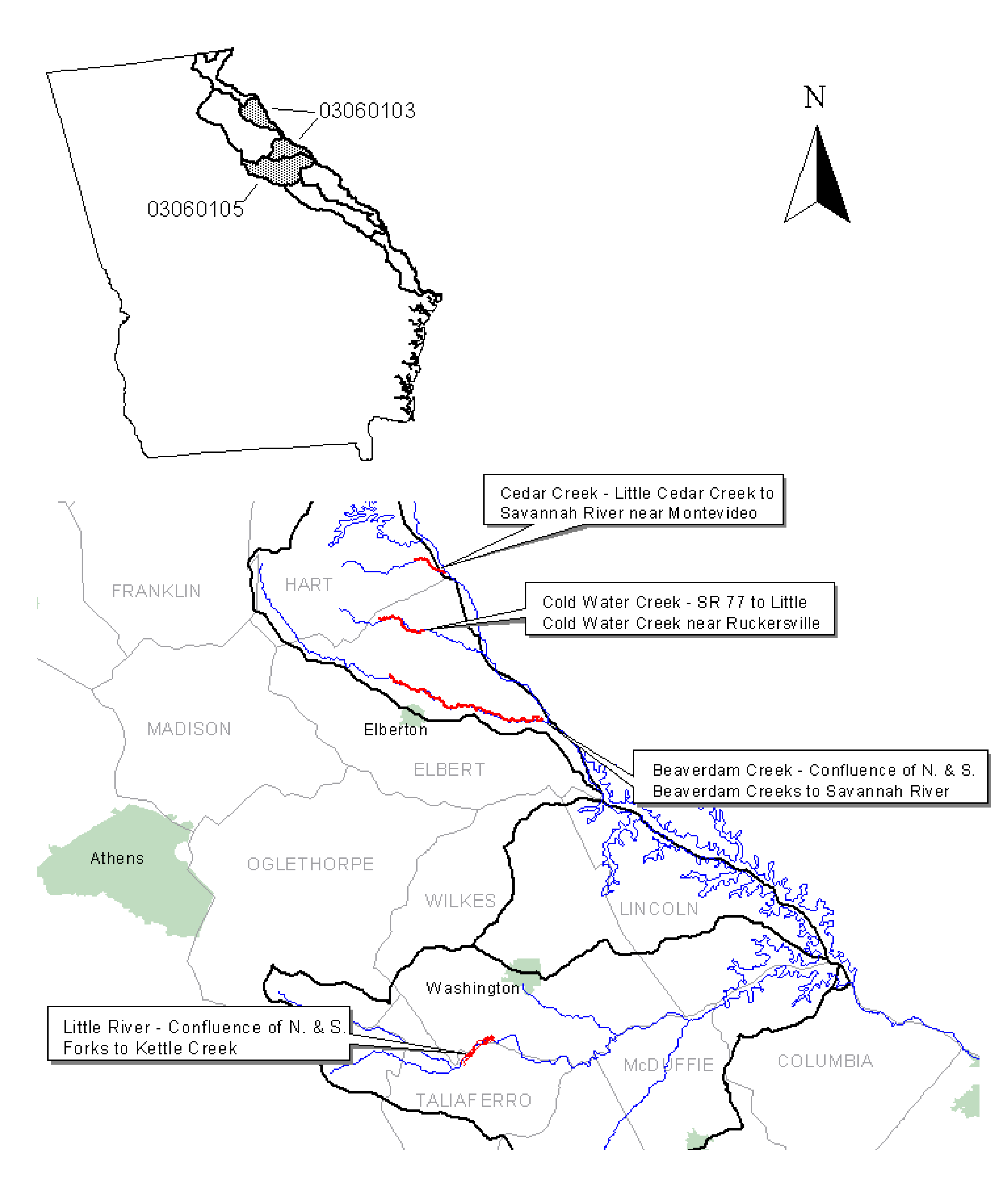
The water use classification for the listed stream segments in the Savannah River Basin is Fishing. The criterion violated is listed as fecal coliform. The potential cause(s) listed include urban runoff, nonpoint sources, and municipal facilities. The use classification water quality standards for fecal coliform bacteria, as stated in the *State of Georgia's Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03(6)(c)(iii) (GA EPD, 2002), are:

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).

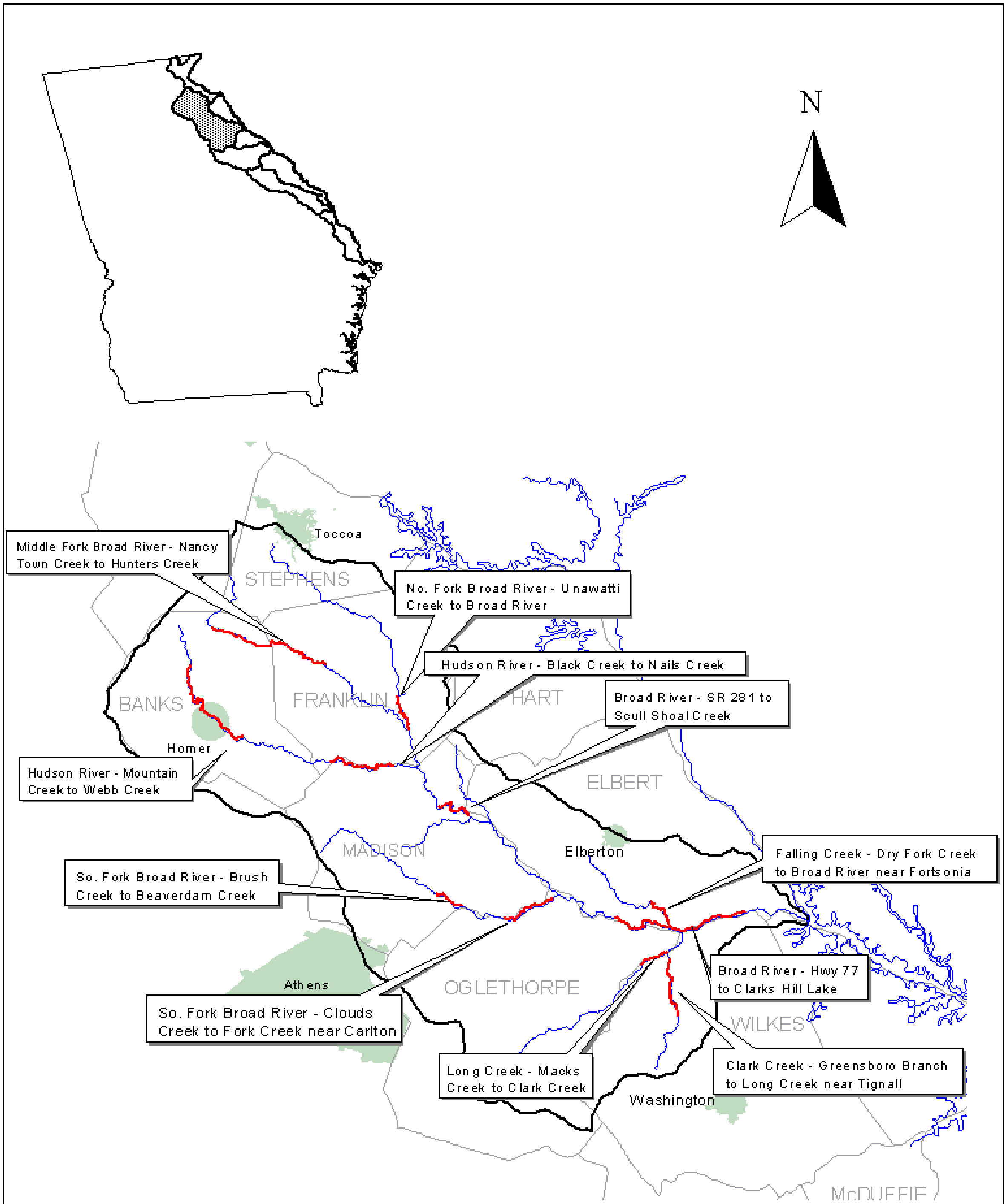


TMDL Evaluation - Fecal Coliform
Savannah River Basin

Figure 1. Impaired Stream Segments in HUC 03060102

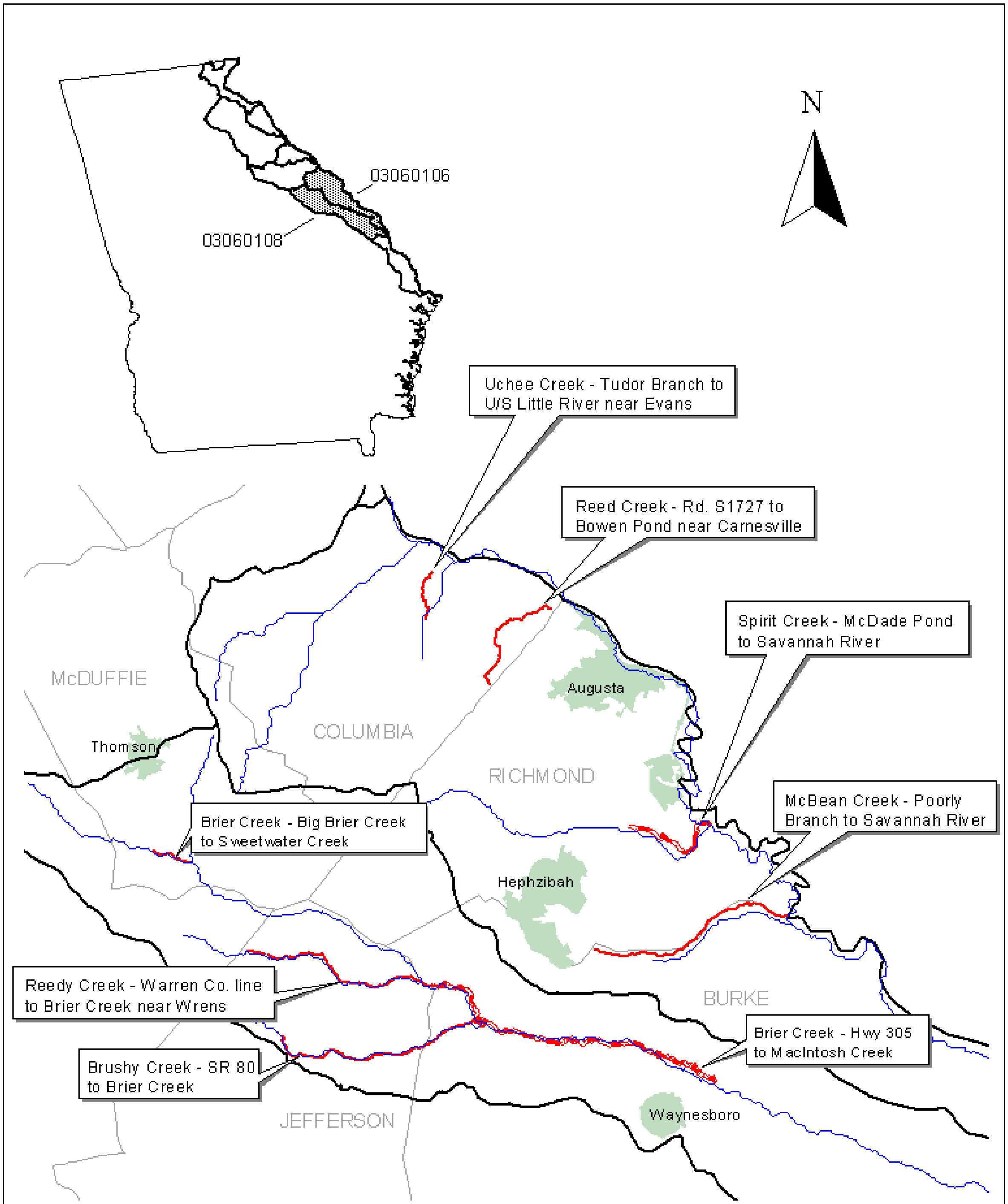


TMDL Evaluation - Fecal Coliform Savannah River Basin	Figure 2. Impaired Stream Segments in HUCs 03060103 and 03060105



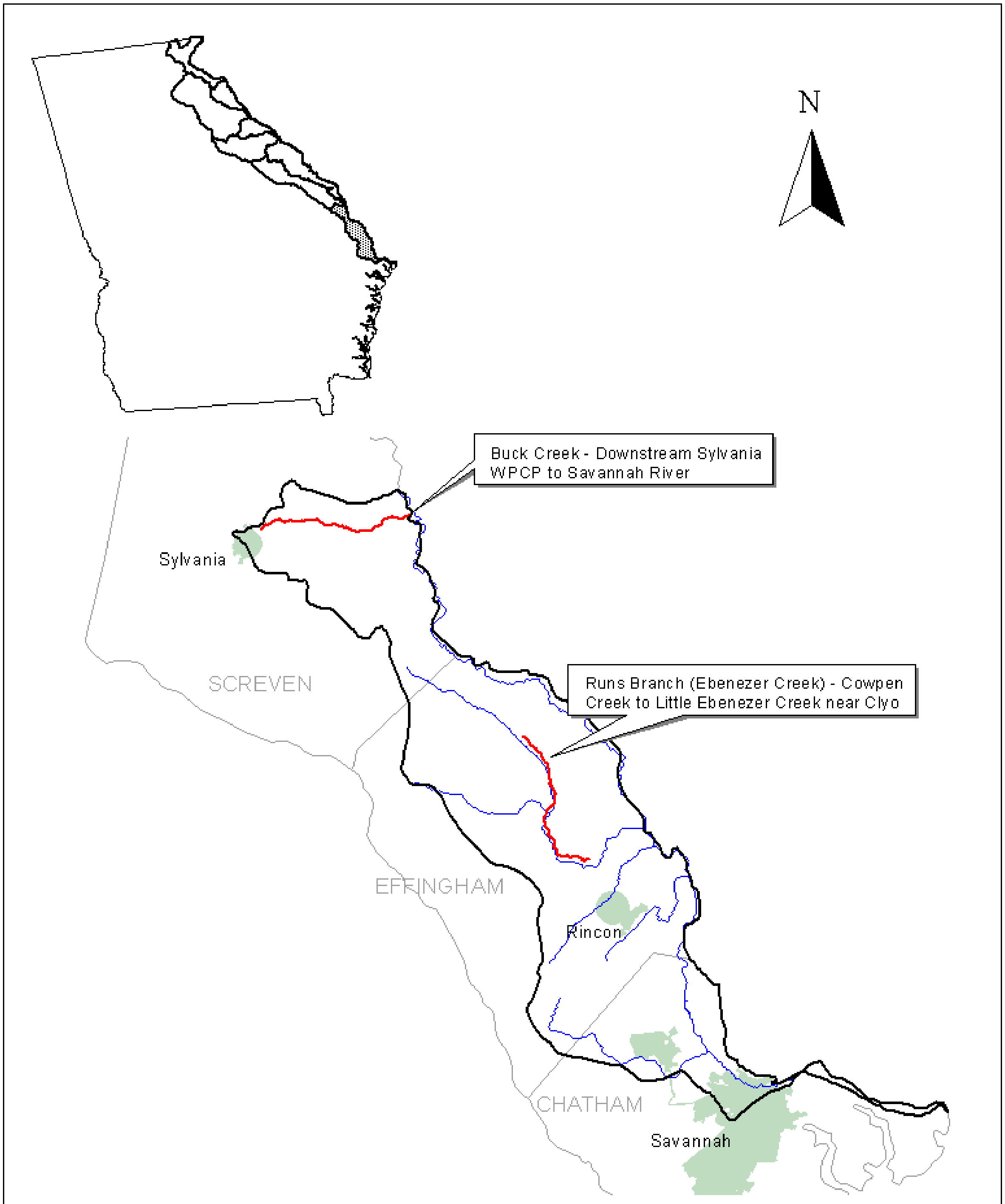
TMDL Evaluation - Fecal Coliform
Savannah River Basin

Figure 3. Impaired Stream Segments in HUC 03060104



TMDL Evaluation - Fecal Coliform
Savannah River Basin

Figure 4. Impaired Stream Segments in HUCs 03060106 and 03060108



TMDL Evaluation - Fecal Coliform
Savannah River Basin

Figure 5. Impaired Stream Segments in HUC 03060109

Table 2. Savannah River Basin Land Coverage

Stream/Segment	Landuse Categories - Acres (Percent)													
	Open Water	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
Beaverdam Creek	3,629	1,284	622	78	22	753	44,668	8,770	18,264	274	461	26	78,853	NLCD
	(4.6)	(1.6)	(0.8)	(0.1)	(0.0)	(1.0)	(56.6)	(11.1)	(23.2)	(0.3)	(0.6)	(0.0)		
Brier Creek	124	719	350	42	152	1,583	24,163	7,450	632	54	530	3	35,801	NLCD
Big Brier Creek to Sweetwater Creek	(0.3)	(2.0)	(1.0)	(0.1)	(0.4)	(4.4)	(67.5)	(20.8)	(1.8)	(0.2)	(1.5)	(0.0)		
Brier Creek	1,164	1,394	718	267	2,209	23,644	113,059	60,136	4,841	197	24,752	226	232,607	NLCD
Hwy 305 to MacIntosh Creek	(0.5)	(0.6)	(0.3)	(0.1)	(0.9)	(10.2)	(48.6)	(25.9)	(2.1)	(0.1)	(10.6)	(0.1)		
Broad River	1,498	3,253	2,608	177	110	1,496	298,698	33,563	75,476	2,254	1,277	58	420,468	NLCD
SR 281 to Scull Shoal Creek near Danielsville	(0.4)	(0.8)	(0.6)	(0.0)	(0.0)	(0.4)	(71.0)	(8.0)	(18.0)	(0.5)	(0.3)	(0.0)		
Broad River	3,326	6,920	3,933	515	835	19,027	682,642	71,553	149,420	3,296	3,409	143	945,021	NLCD
Hwy 77 to Clarks Hill Lake	(0.4)	(0.7)	(0.4)	(0.1)	(0.1)	(2.0)	(72.2)	(7.6)	(15.8)	(0.3)	(0.4)	(0.0)		
Brushy Creek	137	507	343	36	257	2,008	16,272	16,780	844	74	3,753	7	41,017	NLCD
	(0.3)	(1.2)	(0.8)	(0.1)	(0.6)	(4.9)	(39.7)	(40.9)	(2.1)	(0.2)	(9.1)	(0.0)		
Buck Creek	147	777	55	14	-	1,225	14,074	9,716	1,299	43	5,283	64	32,698	NLCD
	(0.4)	(2.4)	(0.2)	(0.0)	(0.0)	(3.7)	(43.0)	(29.7)	(4.0)	(0.1)	(16.2)	(0.2)		
Cedar Creek	198	888	255	19	123	6	12,578	3,845	4,876	259	123	6	23,175	NLCD
	(0.9)	(3.8)	(1.1)	(0.1)	(0.5)	(0.0)	(54.3)	(16.6)	(21.0)	(1.1)	(0.5)	(0.0)		
Clark Creek	58	91	24	7	-	1,566	27,447	1,413	2,453	16	167	2	33,244	NLCD
	(0.2)	(0.3)	(0.1)	(0.0)	(0.0)	(4.7)	(82.6)	(4.3)	(7.4)	(0.0)	(0.5)	(0.0)		
Cold Water Creek	55	24	3	12	-	-	11,935	3,790	6,518	33	71	2	22,442	NLCD
	(0.2)	(0.1)	(0.0)	(0.1)	(0.0)	(0.0)	(53.2)	(16.9)	(29.0)	(0.1)	(0.3)	(0.0)		
Crawford Creek	59	11	64	3	-	-	2,354	517	983	-	6	1	3,998	NLCD
	(1.5)	(0.3)	(1.6)	(0.1)	(0.0)	(0.0)	(58.9)	(12.9)	(24.6)	(0.0)	(0.2)	(0.0)		
Falling Creek	68	1,096	324	44	79	290	21,222	2,446	3,108	187	78	6	28,947	NLCD
	(0.2)	(3.8)	(1.1)	(0.2)	(0.3)	(1.0)	(73.3)	(8.4)	(10.7)	(0.6)	(0.3)	(0.0)		
Hudson River	9	33	57	1	-	23	33,990	2,517	6,556	144	100	1	43,432	NLCD
Mountain Creek to Webb Creek near Homer	(0.0)	(0.1)	(0.1)	(0.0)	(0.0)	(0.1)	(78.3)	(5.8)	(15.1)	(0.3)	(0.2)	(0.0)		
Hudson River	680	1,247	1,082	51	-	195	141,393	13,686	33,569	1,484	633	20	194,041	NLCD
Black Creek to Nails Creek near Fort Lamar	(0.4)	(0.6)	(0.6)	(0.0)	(0.0)	(0.1)	(72.9)	(7.1)	(17.3)	(0.8)	(0.3)	(0.0)		
Little River	234	423	45	43	13	4,381	86,191	4,605	3,773	57	316	9	100,091	NLCD
	(0.2)	(0.4)	(0.0)	(0.0)	(0.0)	(4.4)	(86.1)	(4.6)	(3.8)	(0.1)	(0.3)	(0.0)		

Stream/Segment	Open Water	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)													
Long Creek	169	313	85	48	93	10,109	107,628	5,768	8,649	216	336	8	133,422	NLCD
McBean Creek	322	328	64	72	-	5,930	27,792	13,890	1,722	24	6,296	95	56,535	NLCD
	(0.6)	(0.6)	(0.1)	(0.1)	(0.0)	(10.5)	(49.2)	(24.6)	(3.0)	(0.0)	(11.1)	(0.2)		
Middle Fork Broad River	222	37	62	12	-	842	60,074	3,424	6,762	46	241	6	71,727	NLCD
	(0.3)	(0.1)	(0.1)	(0.0)	(0.0)	(1.2)	(83.8)	(4.8)	(9.4)	(0.1)	(0.3)	(0.0)		
North Fork Broad River	256	753	746	47	-	-	38,758	7,441	16,736	331	131	16	65,214	NLCD
	(0.4)	(1.2)	(1.1)	(0.1)	(0.0)	(0.0)	(59.4)	(11.4)	(25.7)	(0.5)	(0.2)	(0.0)		
Panther Creek	18	10	18	-	-	66	19,900	250	691	40	7	-	21,001	NLCD
	(0.1)	(0.0)	(0.1)	(0.0)	(0.0)	(0.3)	(94.8)	(1.2)	(3.3)	(0.2)	(0.0)	(0.0)		
Reed Creek	30.0	2.0	4.0	2.0	-	-	1,811.0	713.0	689.0	1.0	19.0	-	3,271.0	NLCD
Upstream Lake Hartwell	(0.9)	(0.1)	(0.1)	(0.1)	(0.0)	(0.0)	(55.4)	(21.8)	(21.1)	(0.0)	(0.6)	(0.0)		
Reed Creek	78	4,638	417	50	116	530	2,934	135	76	148	112	1	9,236	NLCD
Rd S1727 To Bowen Pond near Martinez	(0.8)	(50.2)	(4.5)	(0.5)	(1.3)	(5.7)	(31.8)	(1.5)	(0.8)	(1.6)	(1.2)	(0.0)		
Reedy Creek	128	34	54	44	616	3,605	19,302	10,654	510	-	2,906	6	37,860	NLCD
	(0.3)	(0.1)	(0.1)	(0.1)	(1.6)	(9.5)	(51.0)	(28.1)	(1.3)	(0.0)	(7.7)	(0.0)		
Runs Branch (Ebenezer Creek)	229	683	29	25	-	5,394	51,346	24,687	3,300	19	33,657	415	119,783	NLCD
	(0.2)	(0.6)	(0.0)	(0.0)	(0.0)	(4.5)	(42.9)	(20.6)	(2.8)	(0.0)	(28.1)	(0.3)		
Shoal Creek	24	23	6	9	-	-	4,591	2,295	3,568	1	39	3	10,558	NLCD
	(0.2)	(0.2)	(0.1)	(0.1)	(0.0)	(0.0)	(43.5)	(21.7)	(33.8)	(0.0)	(0.4)	(0.0)		
South Fork Broad River	458	1,296	509	55	57	159	48,918	8,537	22,252	284	341	21	82,887	NLCD
Brush Creek to Beaverdam Creek near Comer	(0.6)	(1.6)	(0.6)	(0.1)	(0.1)	(0.2)	(59.0)	(10.3)	(26.8)	(0.3)	(0.4)	(0.0)		
South Fork Broad River	322	328	64	72	-	5,930	27,792	13,890	1,722	24	6,296	95	56,535	NLCD
Clouds Creek to Fork Creek near Carlton	(0.6)	(0.6)	(0.1)	(0.1)	(0.0)	(10.5)	(49.2)	(24.6)	(3.0)	(0.0)	(11.1)	(0.2)		
Spirit Creek	253	2,314	169	60	606	4,629	19,263	5,840	593	643	2,689	45	37,104	NLCD
	(0.7)	(6.2)	(0.5)	(0.2)	(1.6)	(12.5)	(51.9)	(15.7)	(1.6)	(1.7)	(7.2)	(0.1)		
Tallulah River	5	2	1	-	-	9	37,177	19	339	-	-	-	37,552	NLCD
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(99.0)	(0.1)	(0.9)	(0.0)	(0.0)	(0.0)		

Stream/Segment	Landuse Categories - Acres (Percent)													
	Open Water	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
Toccoa Creek	38	430	161	11	-	194	16,010	315	449	78	13	42	17,741	NLCD
	(0.2)	(2.4)	(0.9)	(0.1)	(0.0)	(1.1)	(90.2)	(1.8)	(2.5)	(0.4)	(0.1)	(0.2)		
Uchee Creek	328	2,243	453	105	128	3,478	27,916	4,425	367	69	617	6	40,135	NLCD
	(0.8)	(5.6)	(1.1)	(0.3)	(0.3)	(8.7)	(69.6)	(11.0)	(0.9)	(0.2)	(1.5)	(0.0)		
Warwoman Creek	1	-	-	-	-	126	10,028	22	98	-	-	-	10,276	NLCD
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(1.2)	(97.6)	(0.2)	(1.0)	(0.0)	(0.0)	(0.0)		

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. There is also a single sample maximum criterion (4000 counts per 100 milliliters) for the months of November through April.

Fecal coliform data were collected during calendar years 1997, 1998, 2002, and 2003. Sources of these data include the following:

- United States Geological Survey (USGS) basin water quality data, 1997, 1998, and 2002;
- Georgia Environmental Protection Division (GA EPD) Trend Monitoring data, 2002; and
- Chatham County and City of Savannah Water Quality Reassessment, 2003.

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

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 wash off as a result of storm events.

3.1 Point Source Assessment

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

3.1.1 Wastewater Treatment Facilities

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

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

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

Municipal and industrial wastewater treatment facilities’ discharges may contribute fecal coliform to receiving waters. There are 33 NPDES permitted discharges with flows greater than 0.1 MGD identified in the Savannah River Basin that discharge treated municipal wastewater. Table 3 provides the monthly average discharge flows and fecal coliform concentrations for the municipal and industrial treatment facilities, obtained from calendar year 2002 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. There are no permitted CSO outfalls in the Savannah River Basin.

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

Facility Name	NPDES Permit No.	Receiving Stream	Actual 2002 Discharge		NPDES Permit Limits		Number of Violations July 1998-June 2002
			Average Monthly Flow (MGD)[1]	Geometric Mean (No./ 100 mL)[2]	Average Monthly Flow (MGD)	Average Monthly FC (No./ 100mL)	
Augusta-Butler Creek Messerly WPCP	GA0037621	Butler Creek	27.24	26.7	46.1	200	3
Augusta-Spirit Creek WPCP	GA0047147	Spirit Creek	4.01	25.4	2.24	200	1
Clayton WPCP	GA0020923	Stekoa Creek Tributary	0.50	6.5	0.8	200	0
Columbia Co - Crawford WPCP	GA0031984	Crawford Creek	0.97	3.3	1.5	200	0
Columbia Co - Little River WPCP	GA0047775	Savannah River	2.19	3.8	1.5	200	0
Columbia Co - Kiokee Creek WPCP	GA0038342	Kiokee Creek	0.03	3.6	0.3	200	0
Columbia Co - Reed WPCP	GA0031992	Reed Creek	3.06	5.2	4.6	200	0
Commerce - Northside WPCP	GA0026247	Beaver Dam Creek Tributary	0.68	29.0	1.05	200	2
DHR Gracewood Hospital	GA0022161	Spirit Creek	0.15	12.3	0.5	200	0
Elberton - Falling Creek WPCP	GA0025682	Falling Creek Tributary	0.52	24.0	0.9	200	0
Elberton - Fortson Creek WPCP	GA0025631	Fortson Creek Tributary	0.44	27.3	0.6	200	2
Franklin Springs Pond	GA0050172	Haynes Creek Tributary	0.06	Not measured	0.1	No FC permit limit	0
Garden City WPCP	GA0031038	Savannah River	0.98	12.0	2.0	200	0
Harlem WPCP	GA0020389	Uchee Creek	0.13	10.2	0.25	200	0
Lavonia WPCP	GA0047589	Bear Creek To Unawatti Tributary	0.24	8.7	1.32	200	0
Lee Arrendale Correctional Inst.	GA0022209	Tributary To Hudson River	0.22	10.3	0.25	200	0
Lincolnton WPCP	GA0049450	Reedy Creek Tributary	0.27	60.1	0.26	200	0
Rincon WPCP	GA0046442	Sweigoffer Creek	0.33	14.0	0.5	200	0
Royston WPCP	GA0021491	Hannah Creek	0.30	Not measured	0.5	No FC permit limit	0
Sardis WPCP	GA0020893	Chandler Mill Branch	0.07	Not measured	0.1	No FC permit limit	0

Facility Name	NPDES Permit No.	Receiving Stream	Actual 2002 Discharge		NPDES Permit Limits		Number of Violations July 1998-June 2002
			Average Monthly Flow (MGD)[1]	Geometric Mean (No./ 100 mL)[2]	Average Monthly Flow (MGD)	Average Monthly FC (No./ 100mL)	
Savannah - President Street WPCP	GA0025348	Savannah River	18.80	4.0	27.0	200	0
Savannah - Travis Field WPCP	GA0020427	Savannah River	0.94	10.9	1.5	200	2
Savannah - Wilshire/Windsor WPCP	GA0020443	Savannah River	2.72	2.8	4.5	200	0
Sylvania WPCP	GA0021385	Buck Creek	0.67	146.9	1.51	200	0
Thomson WPCP	GA0020974	Whites Creek	1.15	70.6	2.5	200	0
Toccoa - Eastanollee Creek WPCP	GA0021814	Eastanollee Creek To Tugaloo	0.92	139.0	1.45	200	11
Toccoa Creek WPCP	GA0021806	Toccoa Creek	0.19	47.0	0.41	200	0
Tybee Island WPCP	GA0020061	Savannah River	0.78	16.5	1.0	100	5
USA Hunter AFB STP	GA0027588	Savannah River	0.46	22.9	1.25	200	5
Washington WPCP	GA0031101	Rocky Creek	1.08	17.5	4.0	200	0
Waynesboro WPCP	GA0020231	McIntosh Creek Tributary	0.95	17.5	2.0	200	8
Waynesboro WPCP (Seasonal)	GA0038466	Brier Creek Tributary	1.04[3]	33.3[3]	2.0	200	0
Wrens WPCP	GA0021857	Brushy Creek	0.54	32.2	0.48	200	0

Source: EPA PCS Website (2002) and the GA EPD Regional Offices

Notes: [1] Values shown are the annual average of the monthly average flows.
[2] Values shown are the annual average of the monthly geometric means.
[3] Seasonal discharges only occurred during December 2003 and January and February 2004.

3.1.2 Regulated Storm Water Discharges

Some storm water runoff is covered under the NPDES Permit Program. It is considered a diffuse source of pollution. Unlike other NPDES permits that establish end-of-pipe limits, storm water NPDES permits establish controls "to the maximum extent practicable" (MEP). Currently, regulated storm water discharges that may contain fecal coliform bacteria consist of those associated with industrial activities including construction sites disturbing one acre or greater, and large, medium, and small municipal separate storm sewer systems (MS4s) that serve populations of 50,000 or more.

Storm water discharges associated with industrial activities are currently covered under a General Storm Water NPDES Permit. This permit requires visual monitoring of storm water discharges, site inspections, implementation of 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 the state of Georgia that had a population of greater than 100,000 at the time of the 1990 Census, are permitted for their storm water discharge under Phase I. This includes 60 permittees in Georgia, with about 45 located in the greater Atlanta metro area. Table 4 lists those counties and communities in the Savannah River Basin that are covered by Phase I General Storm Water Permits.

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

Name	Permit No.	Watershed
Bloomingdale	GAS000207	Savannah
Chatham County	GAS000206	Ogeechee, Savannah
Garden City	GAS000208	Ogeechee, Savannah
Pooler	GAS000209	Ogeechee, Savannah
Port Wentworth	GAS000210	Savannah
Augusta-Richmond County	GAS000200	Savannah
Savannah	GAS000205	Ogeechee, Savannah
Tybee	GAS000212	Ogeechee, Savannah

Source: Nonpoint Source Program, GA EPD, 2003

Phase I MS4 permits require the prohibition of non-storm water discharges (i.e., illicit discharges) into the storm sewer systems and controls to reduce the discharge of pollutants to the maximum extent practicable, including the use of management practices, control techniques and systems, as well as 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.

As of March 10, 2003, small MS4s serving urbanized areas are 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. Thirty counties and 56 communities are permitted under the Phase II regulations in Georgia. Table 5 lists those counties and communities located in the Savannah River Basin that are covered by the Phase II General Storm Water Permit, GAG610000.

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

Name	Watershed
Augusta - Columbia County	Savannah
Grovetown	Savannah
Hephzibah	Savannah

Source: Nonpoint Source Program, GA EPD, 2004

3.1.3 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 being contained in a limited area. Processed agricultural manure from confined hog, dairy cattle, and select poultry operations is generally collected in lagoons. It is then applied to pastureland and cropland as a fertilizer during the growing season, at rates that often vary monthly.

In 1990, the State of Georgia began registering CAFOs. Many of the CAFOs were issued land application or NPDES permits for treatment of wastewaters generated from their operations. The type of permit issued depends on the operation size (i.e., number of animal units). Table 6 presents the swine and non-swine (primarily dairies) CAFOs located in the Savannah River Basin that are registered or have land application permits.

Table 6. Registered CAFOs in the Savannah River Basin

Name	City	County	Animal Type	Total No. of Animals	Permit No.
Beasley Farms	Lavonia	Hart	Swine	1,960	GAU700000
Boling Farm	Homer	Banks	Swine	2,800	GA0038172
Boyceland Dairy Farm	Blythe	Burke	Dairy	480	GAU700000
Bridges Farm (J.M. Bridges)	Lexington	Oglethorpe	Swine	3,750	Pending
Dean Pierce	Stephens	Oglethorpe	Swine	3,840	GA0038229
Gold Kist Pork Stephens Gilt Center	Stephens	Oglethorpe	Swine	1,600	GAU700000
Harmony Grove Dairy Farm, L.L.C.	Hephzibah	Burke	Dairy	650	GAU700000
Harmony Grove Dairy, L.L.C.	Waynesboro	Burke	Dairy	950	GAG930000
Hillcrest Farms Inc.	Dearing	McDuffie	Dairy	340	GAU700000
Hudson Farms	Elberton	Elbert	Swine	4,000	GA0037915
Indian Creek Farm	Lexington	Oglethorpe	Swine	1,200	GAU700000
Kinder Dairy	Royston	Hart	Dairy	400	GAU700000
Lee Arrendale State Prison	Alto	Banks	Swine	4,000	GA0038245
Martin Dairy Farm	Bowersville	Hart	Dairy	600	GAU700000
Mossland Farms, Inc.	Stephens	Oglethorpe	Swine	2,475	GAU700000
Smith Dairy Farms Inc.	Rayle	Wilkes	Dairy	750	GAG930007
Smith's Egg Farm	Lavonia	Franklin	Poultry	170,000	GAG930002
Still Water Farm	Danielsville	Madison	Swine	1,300	GAU700000

Name	City	County	Animal Type	Total No. of Animals	Permit No.
Stocks Farms Inc.	Crawford	Oglethorpe	Swine	1,950	GAU700000
Taliaferro Co. Farm L.L.C.	Sharon	Taliaferro	Swine	2,450	GAU700000
Thompson Brother's Dairy	Warrenton	Warren	Dairy	250	GAU700000
Twin Line Dairies	Dewey Rose	Elbert	Dairy	1,000	GAG930001
Walker Turkey Farm, Inc.	Lexington	Oglethorpe	Swine	3,750	Pending
Whitaker Farm	Harlem	McDuffie	Dairy	300	GAU700000

Source: Permitting Compliance and Enforcement Program, EPD, GA EPD, 2004

3.2 Nonpoint Source Assessment

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

- Wildlife
- Agricultural Livestock
  - Animal grazing
  - Animal access to streams
  - Application of manure to pastureland and cropland
- Urban Development
  - Leaking sanitary sewer lines
  - 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 GA DNR, the animals that spend a large portion of their time in or around aquatic habitats are 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 racoons, beavers, muskrats, and to a lesser extent, river otters and minks. Population estimates of these animal species in Georgia are currently not available.

White-tailed deer have a significant presence throughout the Savannah River Basin. The 2001 deer census for counties in the Savannah River Basin is presented in Table 7.

Table 7. Deer Census Data in the Savannah River Basin

County	2001-2005 Optimum population (number/sq mi)
Banks	40
Burke	35
Chatham	20
Clarke	15
Columbia	25
Effingham	35
Elbert	35
Franklin	40
Glascock	35
Greene	35
Habersham	25
Hart	35
Jackson	30
Jefferson	35
Jenkins	35
Lincoln	35
Madison	35
McDuffie	35
Oglethorpe	35
Rabun	20
Richmond	25
Screven	35
Stephens	35
Taliaferro	35
Towns	20
Warren	35
Wilkes	35

Source: Wildlife Resources Division, GA DNR, 2001

Fecal coliform bacteria contributions from deer to water bodies are generally considered less significant than that of waterfowl, racoons, and beavers. This is because a greater portion of their time is spent in terrestrial habitats. This also holds true for other terrestrial mammals such as squirrels and rabbits, and terrestrial birds (GA WRD, 2002). 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 the warm, humid environments typical of the southeast.

3.2.2 Agricultural Livestock

Agricultural livestock are a potential source of fecal coliform to streams in the Savannah River Basin. The animals grazing on pastureland deposit their feces onto land surfaces, where it can be transported during storm events to nearby streams. Animal access to pastureland 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 periodically confined. In addition, agricultural livestock will often have direct access to streams that pass through their pastures, and can thus impact water quality in a more direct manner (USDA, 2002).

Table 8 provides the estimated number of beef cattle, dairy cattle, goats, horse, swine, sheep, and chickens by category reported by county. These data were provided by the Natural Resources Conservation Service (NRCS) and are based on 2003 data.

Table 8. Estimated Agricultural Livestock Populations in the Savannah River Basin

County	Livestock								
	Beef Cattle	Dairy Cattle	Goats	Horses	Hogs	Sheep	Chickens-Layers	Chickens-Broilers Sold	Chickens-Breeders
Banks	12,250	-	4,000	1,175	870	200	12,595,200	490,000	552,000
Burke	10,950	2,500	1,200	550	50	25	-	-	-
Chatham	400	-		60	-		-	-	-
Clarke	3,700	200	300	500	500	100	211,200	-	-
Columbia	3,200	115	200	1,425	-		-	-	-
Effingham	3,500	-	800	850	400		-	-	-
Elbert	9,700	1,600	600	350	-	60	2,275,000	240,000	-
Franklin	16,025	-	500	1,700	50	75	19,200,000	1,160,000	240,000
Glascock	4,000	-	500	55	150		-	-	-
Greene	8,190	3,100	175	305	-		1,434,000	-	-
Habersham	8,950	-	1,400	1,000	3,620	100	15,000,000	800,000	1,200,000
Hart	17,950	1,601	945	128	1,000		8,857,600	3,120,000	240,000
Jackson	30,250	-	500	575	-		11,520,000	1,800,000	792,000
Jefferson	11,800	1,200	2,500	80	500	10	-	-	-
Jenkins	4,574	2,300	300	25	1,000		-	50,000	-
Lincoln	3,800	325	750	335	-	30	-	-	-
Madison	17,750	420	1,015	2,300	925	200	14,625,000	300,000	120,000
McDuffie	4,850	650	600	800	100	200	-	-	-
Oglethorpe	16,600	1,500	700	1,300	16,500	300	6,016,000	250,000	-
Rabun	2,250	-	200	225	-	100	1,280,000	-	-
Richmond	3,400	280	450	450	50		-	-	-
Screven	8,000	200	2,000	300	600	100	-	-	-
Stephens	7,950	170		135	-		2,688,000	180,000	-
Taliaferro	-	-		-	-		-	-	-
Towns	5,050	-	175	535	700	30	72,000	-	-
Warren	8,260	1,450	1,950	2,200	1,050		-	-	-
Wilkes	16,794	3,100	1,000	225	3,465	15	1,245,500	-	-

Source: NRCS, 2003

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, leaking septic systems, runoff from improper disposal of waste materials, and leachate from both operational 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 large, medium, and small urban areas (populations greater than 50,000), 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.

In addition to urban animal sources of fecal coliform, there may be illicit 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 combined sewer overflows discharge.

3.2.3.1 Leaking Septic Systems

A portion of the fecal coliform in the Savannah River Basin may be attributed to failure of septic systems and illicit discharges of raw sewage. Table 9 presents the number of septic systems in each county of the Savannah River Basin existing in 1990, based on U.S. 1990 Census Data, and the number existing in 2002, based on the Georgia Department of Human Resources, Division of Public Health data. In addition, an estimate of the number of septic systems installed and repaired during the twelve-year period from 1990 to 2002 is given.

Table 9. Number of Septic Systems in the Savannah River Basin

County	Existing Septic Systems (1990)	Existing Septic Systems (2002)	No. of Septic Systems Installed (1990 to 2002)	No. of Septic Systems Repaired (1990 to 2002)
Banks	2,588	3,596	1,008	75
Burke	7,992	10,352	2,360	288
Chatham	11,987	14,183	2,196	750
Clarke	7,183	10,219	3,036	914
Columbia	7,977	12,585	4,608	431
Effingham	7,547	14,047	6,500	1,300
Elbert	4,436	6,790	2354	183
Franklin	5,800	8,200	2,400	NA
Glascock	708	918	210	6
Greene	2,759	5,129	2,370	228
Habersham	3,340	10,200	6,860	600
Hart	221	594	3,369	52
Jackson	8,505	15,481	6,976	453
Jefferson	3,551	5,051	1,500	45
Jenkins	1,026	1,801	775	17

County	Existing Septic Systems (1990)	Existing Septic Systems (2002)	No. of Septic Systems Installed (1990 to 2002)	No. of Septic Systems Repaired (1990 to 2002)
Lincoln	2,745	4,245	1,500	NA
Madison	7,647	9,724	2,077	386
McDuffie	4,664	6,962	2,298	191
Oglethorpe	3,448	6,075	2627	117
Rabun	6,044	10,076	4,032	294
Richmond	12,304	19,544	7,240	4,342
Screven	6,005	7,383	1,378	29
Stephens	4,348	7,727	3,275	246
Taliaferro	551	691	140	NA
Warren	1,395	1,825	430	72
Wilkes	2,257	2,891	634	NA

Source: 1990 Census Data, and the Georgia Dept. of Human Resources, Div. of Public Health, 2004

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 this period. 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).

3.2.3.2 Land Application Systems

Many smaller communities use land application systems (LASs) for treatment of their sanitary wastewaters. These facilities are required through LAS permits to treat all their wastewater by land application and are to be properly operated as non discharging systems that contribute no runoff to nearby surface waters. However, runoff during storm events may carry surface residual containing fecal coliform bacteria to nearby surface waters. 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 fifteen permitted LAS systems located in the Savannah River Basin (Table 10).

Table 10. Permitted Land Application Systems in the Savannah River Basin

LAS Name	County	Permit No.	Type	Flow (MGD)
Atlanta International Drag	Banks	GA02-023	Municipal	0.07
Banks County Industrial LAS	Banks	GA02-181	Municipal	0.045
Coastal Water & Sewer Co.	Effingham	GA02-234	Private	0.13
Columbia County Prison	Columbia	GA02-002	Municipal	0.01
Crider Poultry, Lincoln	Lincoln	GA01-570	Industrial	0.11
Dearing LAS	McDuffie	GA02-007	Municipal	0.09
Fieldale Corp.	Stephens	GA01-369	Industrial	
Franklin County LAS	Franklin	GA02-065	Municipal	0.075

LAS Name	County	Permit No.	Type	Flow (MGD)
Grovetown LAS	Columbia	GA02-222	Municipal	0.58
Hartwell LAS	Hart	GA02-114	Municipal	1.75
Norwood LAS	Warren	GA02-258	Municipal	0.05
Savannah Reuse LAS	Chatham	GA02-198	Municipal	2.0
Springfield LAS	Effingham	GA0020770	Municipal	0.5
Terra Renewal Services	Elbert	GA01-507	Industrial	
Thomson LAS	McDuffie	GA02-252	Municipal	0.171
Twin Dairies, Inc.	Elbert	GA01-436	Industrial	0.01

Source: Permitting Compliance and Enforcement Program, GA EPD, 2004

3.2.3.3 Landfills

Leachate from landfills may contain fecal coliform bacteria that may at some point discharge into surface waters. Sanitary (or municipal) landfills are the most likely to serve as a source of fecal coliform bacteria. These types of landfills 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 most 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, excluding inert landfills, are now required to install environmental monitoring systems for groundwater and methane sampling. There are 102 known landfills in the Savannah River Basin (Table 11). Of these, 12 are active landfills, 2 have been permitted and are currently under construction, and 89 are inactive or closed. As shown in the Table 11, many of the older, inactive landfills were never permitted.

Table 11. Landfills in the Savannah River Basin

Name	County	Permit No.	Type	Status
Alto Prison	Banks		Not Applicable	Inactive
Banks County - Rucker Road, Homer	Banks		Not Applicable	Inactive
Chambers R&B Landfill Inc. - Site no. 2	Banks	006-009D	Municipal Solid Waste Landfill	Active
Chambers R&B Landfill Inc.	Banks	006-006D	Sanitary Landfill	Closed
R & B Wastes, Inc. - CR83, Homer	Banks	006-008P	Materials Recovery Facility	Inactive
Burke County - Clarke Road	Burke	017-002D	Sanitary Landfill	Active
Sardis	Burke		Not Applicable	Inactive
Waynesboro	Burke		Not Applicable	Inactive
Clifton Equipment Rental Company, Inc.	Chatham	025-030D	Dry Trash Landfill	Closed
Continental Can	Chatham		Not Applicable	Inactive
GA DOT - Hutchinson Island	Chatham	025-067D	Dry Trash Landfill	Inactive
Garden City Landfill	Chatham	025-017D	Dry Trash Landfill	Inactive
Port Wentworth - Augustine Creek	Chatham	025-046D	Dry Trash Landfill	Closed
Port Wentworth	Chatham		Not Applicable	Inactive
Savannah - Cherokee Hills	Chatham		Not Applicable	Inactive
Savannah – Pate Ave.	Chatham	025-009D	Dry Trash Landfill	Inactive
Savannah Beach	Chatham		Not Applicable	Inactive

Name	County	Permit No.	Type	Status
Savannah Regional Industrial Landfill	Chatham	025-072D	Industrial Landfill	Active
Tremont Road	Chatham		Not Applicable	Inactive
Tybee Island - Polk Ave. - Van Horne Dr.	Chatham	025-048D	Dry Trash Landfill	Closed
Columbia County - I-20	Columbia		Not Applicable	Inactive
Columbia County - Baker Place Road Phase 1	Columbia	036-010D	Sanitary Landfill	Ceased accepting waste
Columbia County - Baker Place Road Phase 2	Columbia	036-010D	Municipal Solid Waste Landfill	Active
Columbia County - Sample & Son	Columbia	036-017D	Construction and Demolition Landfill	Active
Cooper Cliatt - Hwy 232	Columbia		Not Applicable	Inactive
Elliots Cont. Ser. Inc.	Columbia		Not Applicable	Inactive
Grovetown - Newmantown Road	Columbia	036-006D	Dry Trash Landfill	Closed
Gus Dunn - Washington Road & Kiokee Creek	Columbia		Not Applicable	Inactive
Harlem - Hinton Wilson Road	Columbia		Not Applicable	Inactive
Harlem – Lamkin Road	Columbia	036-007D	Dry Trash Landfill	Ceased accepting waste
Harlem - Blythe Road Landfill	Columbia	036-003D	Dry Trash Landfill	Inactive
Harry Mills – Fury's Ferry Road	Columbia		Not Applicable	Inactive
Reeves - Frontage - Buff Roads	Columbia	036-012D	Dry Trash Landfill	Closed
Sullivan - Hartsfield Road	Columbia		Not Applicable	Inactive
Effingham County - SR 119 W Springfield	Effingham	051-007D	Dry Trash Landfill	Closed
Rincon	Effingham		Not Applicable	Inactive
Springfield	Effingham		Not Applicable	Inactive
Westwood Heights	Effingham		Not Applicable	Inactive
Bobby Brown State Park	Elbert		Not Applicable	Inactive
Bowman	Elbert		Not Applicable	Inactive
Elberton – Elbert County	Elbert		Not Applicable	Inactive
Hull Chapel Rd Phase 1	Elbert	052-008D	Sanitary Landfill	Ceased accepting waste
Old Middleton Road Phase 1	Elbert	052-002D	Sanitary Landfill	Closed
Old Middleton Road Phase 2	Elbert	052-006D	Sanitary Landfill	Closed
Carnesville	Franklin		Not Applicable	Inactive
Franklin County - Harrison Bridge MRF	Franklin	059-010P	Materials Recovery Facility	Inactive
Harrison Bridge Road Phase 1	Franklin	059-008D	Sanitary Landfill	Active
Lavonia - Bear Creek Road Phase 1	Franklin	059-006D	Sanitary Landfill	Closed
Lavonia - Bear Creek Road Phase 2	Franklin	059-009D	Sanitary Landfill	Closed
Poplar Springs	Franklin		Not Applicable	Inactive
Royston	Franklin		Not Applicable	Inactive
SR 13 MSWL	Habersham	068-020D	Sanitary Landfill	Active
SR 172 S Phase 1&2	Hart	073-002D	Sanitary Landfill	Inactive
SR 173 S Phase 3	Hart	073-005D	Sanitary Landfill	Closed
Commerce - Pigeon St.	Jackson	078-007D	Dry Trash Landfill	Closed
Lincoln County - CR 121 - Prater	Lincoln	090-004D	Sanitary Landfill	Closed
Lincoln County - Petersburg Road	Lincoln	090-002D	Sanitary Landfill	Inactive
Lincolnton	Lincoln		Not Applicable	Inactive
Madison County	Madison	095-003D	Sanitary Landfill	Inactive
Madison County	Madison	095-008D	Sanitary Landfill	Inactive

Name	County	Permit No.	Type	Status
Madison County - Sanitary Landfill Phase 2&3	Madison	095-006D	Sanitary Landfill	Closed
James - SR 17 S	McDuffie	097-009D	Dry Trash Landfill	Ceased accepting waste
McDuffie County - Mesena Road Phase 1	McDuffie	097-007D	Sanitary Landfill	Closed
McDuffie County - Wrightsboro Road/Moore Road	McDuffie	097-012D	Sanitary Landfill	Permit issued; Construction begun
McDuffie County - Dallas Dr.	McDuffie	097-004D	Sanitary Landfill	Inactive
McDuffie County - Dallas Dr. Landfill	McDuffie	097-006D	Dry Trash Landfill	Inactive
National Homes (Pass - Brailsford)	McDuffie		Not Applicable	Inactive
Royal Trucking Co. (Pass - Brailsford)	McDuffie		Not Applicable	Inactive
Williams - Mesena Road	McDuffie	097-010D	Dry Trash Landfill	Ceased accepting waste
US 78 C&D landfill	Oglethorpe	109-002D	Sanitary Landfill	Active
US 78 Phase 1	Oglethorpe	109-002D	Sanitary Landfill	Inactive
Hwy 441	Rabun	119-001D	Sanitary Landfill	Inactive
Rabun County Dump	Rabun		Not Applicable	Inactive
Rabun County- Boggs Mountain Road C&D Landfill	Rabun	119-006D	Construction and Demolition Landfill	Active
Rabun County – Eastman Mtn Road #2	Rabun	119-005D	Sanitary Landfill	Closed
Augusta - Goodrich Street	Richmond	121-012D	Dry Trash Landfill	Closed
Blackstone - Harrison - Wheeler Road	Richmond		Not Applicable	Inactive
Old Augusta Site	Richmond		Not Applicable	Inactive
Richmond County - Hwy 56 Loop	Richmond		Not Applicable	Inactive
Richmond County – Corr. Inst Landfil	Richmond		Not Applicable	Inactive
Richmond County – Dean Bridge Road Phase 2	Richmond	121-015D	Sanitary Landfill	Ceased accepting waste
Richmond County - Dean Bridge Road Phase 2B	Richmond	121-016D	Sanitary Landfill	Inactive
Richmond County - Dean Bridge Road Phase 2C	Richmond	121-016D	Sanitary Landfill	Active
Richmond County - RCC1 - Arkard Street	Richmond	121-001D	Sanitary Landfill	Inactive
Richmond County - RCC1 - Arkard Street	Richmond	121-011D	Sanitary Landfill	Closed
Richmond County - RCC1 - Arkard Street Phase 2	Richmond	121-009D	Sanitary Landfill	Inactive
U.S. Army - Ft. Gordon - Gibson Road Phase 1-3	Richmond	121-014D	Sanitary Landfill	Active
U.S. Army - Ft. Gordon 17th Street	Richmond	121-010D	Sanitary Landfill	Closed
Buena Vista Road Dump	Stephens		Not Applicable	Inactive
Martin	Stephens		Not Applicable	Inactive
SR 145 Phase 2 & 3	Stephens	127-003D	Sanitary Landfill	Active
Stephens County - SR 145 Phase 2 & 3	Stephens	127-002D	Sanitary Landfill	Inactive
Stephens County - (Co. Farm Road)	Stephens		Not Applicable	Inactive
Toccoa	Stephens		Not Applicable	Inactive
Taliaferro County - CR 10 Phase 1	Taliaferro	131-002D	Sanitary Landfill	Closed
Taliaferro County - CR 10 Phase 2	Taliaferro	131-003D	Sanitary Landfill	Ceased accepting waste
Taliaferro County - US 278 Crawfordville	Taliaferro	131-001D	Sanitary Landfill	Closed
Camak	Warren		Not Applicable	Inactive
Norwood	Warren		Not Applicable	Inactive
Washington	Wilkes		Not Applicable	Inactive
Wilkes County - CR40 Phase 2	Wilkes	157-004D	Municipal Solid Waste Landfill	Permit issued; Construction begun
Wilkes County - CR 40	Wilkes	157-003D	Sanitary Landfill	Closed

Source: Land Protection Branch, GA DNR, 2003

4.0 ANALYTICAL APPROACH

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

- The current critical fecal coliform load to the stream under existing 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 Loading Curve Approach was used to determine the current fecal coliform load and the TMDL. For the 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).

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. This 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.

The current critical loads were determined using fecal coliform data collected within a 30-day period to calculate the geometric means, and multiplying these values by the arithmetic means 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, with samples collected at least 24 hours apart. To reflect this in the load calculation, the fecal coliform loads are expressed as 30-day accumulated loads with units of counts per 30 days. This is described by the equation below:

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

Where:

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

The current estimated 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, these loads do 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 only represent the worst-case scenario that occurred among the time periods sampled.

The maximum fecal coliform 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 illustrate that the TMDL is a continuum for the range of flows (Q) that can occur in the stream over time. There are two TMDL curves shown in these figures. One represents the summer TMDL for the period May through October when the 30-day geometric mean standard is 200 counts/100 mL. The second curve represents the winter TMDL for the period November through April when the 30-day geometric mean standard is 1,000 counts/100 mL. The equations for these two TMDL curves are:

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

$$TMDL_{winter} = 1{,}000 \text{ counts (as a 30-day geometric mean)/100 mL} * Q$$

The graphs show 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 exceeds the TMDL curve by the greatest amount. This critical TMDL can be represented by the following equation:

$$TMDL_{critical} = C_{standard} * Q_{mean}$$

Where:

$TMDL_{critical}$ = critical fecal coliform TMDL load

$C_{standard}$ = seasonal fecal coliform standard (as a 30-day geometric mean)
summer - 200 counts/100 mL
winter - 1,000 counts/ 100 mL

Q_{mean} = stream flow as an 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. There is also a single sample maximum criterion (4,000 counts per 100 milliliters) for the months of November through April. If a single sample exceeds the maximum criterion, and the seasonal geometric mean criteria is also exceeded, then the TMDL is based on the criteria exceedance requiring the largest load reduction. The load reduction can be expressed as follows:

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

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) from point sources and load allocations (LAs) for nonpoint sources, as well as 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 whether adequate data are 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 (USEPA, 1991). A phased TMDL requires additional data be collected to determine if load reductions required by the TMDL are leading to the attainment of water quality standards.

The TMDL Implementation Plan establishes 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, to 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 contains 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 situations 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 is the portion of the receiving water's loading capacity that is allocated to existing or future point sources. WLAs are provided to the point sources from municipal and industrial wastewater treatment systems with NPDES effluent limits. There are ten active NPDES permitted facilities with fecal coliform permit limits in the Savannah River Basin watershed that discharge into listed segments or have permit violations upstream of a listed segment. The maximum allocated fecal coliform loads for these municipal wastewater treatment facilities are given in Table 12. These WLA loads were calculated from the permitted or design flows and permitted fecal coliform concentrations. If the permit had no fecal coliform limit, a concentration of 200 counts/100 mL was used. These were expressed as accumulated loads over a 30-day period, and presented in units of counts per 30 days. If a facility expands its capacity and the permitted flow increases, the wasteload allocation for the facility would increase in proportion to the flow.

Table 12. WLAs for the Savannah River Basin

Facility Name	Permit No.	Receiving Stream	Listed Stream Segment	WLA (counts/30 days)
Augusta-Spirit Creek WPCP	GA0047147	Spirit Creek	Spirit Creek - McDade Pond to Savannah River	5.10E+11
Columbia Co - Reed WPCP	GA0031992	Reed Creek	Reed Creek - Rd S1727 to Bowen Pond near Martinez	1.05E+12
Commerce - Northside WPCP	GA0026247	Beaver Dam Creek Tributary	Hudson River - Black Creek to Nails Creek near Fort Lamar	2.39E+11
DHR Gracewood Hospital	GA0022161	Spirit Creek	Spirit Creek - McDade Pond to Savannah River	1.14E+11
Elberton - Fortson Cr WPCP	GA0025631	Fortson Creek Tributary	Beaverdam Creek - Confluence of N & S Beaverdam Creeks to Savannah River near Elberton	1.37E+11
Franklin Springs Pond	GA0050172	Haynes Creek Tributary	Broad River - SR 281 to Scull Shoal Creek near Danielsville	2.28E+10
Sardis WPCP	GA0020893	Chandler Mill Branch	Brier Creek - Hwy 305 to MacIntosh Creek	2.28E+10
Sylvania WPCP	GA0021385	Buck Creek	Buck Creek - Downstream Sylvania WPCP to Savannah River	3.44E+11
Waynesboro WPCP	GA0020231	McIntosh Creek Trib.	Brier Creek - Hwy 305 to MacIntosh Creek	4.55E+11
Wrens WPCP	GA0021857	Brushy Creek	Brushy Creek - SR 80 (Rd S1571) west Wrens to Brier Creek	1.09E+11

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 the 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 control pollutant discharges from each storm water outfall. Therefore, storm water NPDES permits require the establishment of controls or BMPs to reduce the pollutants entering the environment.

The waste load allocations from storm water discharges associated with MS4s (WLAsw) are estimated based on the percentage of urban area in each watershed covered by the MS4 storm water permit. At this time, the portion of each watershed that goes directly to a permitted storm sewer and that which 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 storm water runoff from the regulated urban area is collected by the municipal separate storm sewer systems.

CAFOs are located within the Savannah River Basin (see Section 3.1.3). These facilities are either included under an LAS General Permit or an NPDES General Permit. A small number have an individual NPDES permit. However, presently no CAFOs discharge wastewater and therefore, they were not provided a WLA.

This TMDL will use a phased approach. Future phases of 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 as to which BMPs are needed and how the water quality standards can be achieved.

5.2 Load Allocations

The load allocation 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; and
- 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, using 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 13 presents the total load allocation expressed as counts per 30 days, or as winter instantaneous maximum counts for the 303(d) listed streams located in the Savannah River Basin for the current critical condition. In the future, after additional data has been collected, it may be possible to partition the load allocation by source.

5.3 Seasonal Variation

The Georgia fecal coliform criteria are seasonal. One set of criteria 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 13 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/Q_o) versus fecal coliform are shown in Appendix B. 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 modeling assumptions to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For this TMDL, an explicit MOS of 10 percent of the TMDL was used. The MOS values are presented in Table 13.

5.5 Total Fecal Coliform Load

The fecal coliform TMDL for the listed stream segment is dependent on the time of year, the stream flow, and the applicable state water quality standard. No listed stream segments are interstate waters.

The maximum seasonal fecal coliform loads for Georgia are given below:

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

$$TMDL_{winter} = 1{,}000 \text{ counts (as a 30-day geometric mean)}/100 \text{ mL} * Q$$

$$TMDL_{winter} = 4{,}000 \text{ counts (instantaneous)} /100 \text{ mL} * Q$$

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). For these calculations, the fecal load contributed by each facility to the WLA was not the maximum presented in Table 12, but rather was the product of the fecal coliform permitted limit and the average monthly discharge at the time of the critical load. The current critical loads and corresponding TMDLs, WLAs, LAs, MOSs, and percent load reductions for the Savannah River Basin 303(d) listed stream segments are presented in Table 13.

The relationships of the current critical loads to the TMDLs are shown graphically in Appendix A. The vertical distance between the two values represents the load reductions necessary to achieve the TMDLs. If no TMDL or Critical Load is given on the graphs in Appendix A, the TMDL given in Table 13 is based on the instantaneous maximum standard. As a consequence of the localized nature of the load evaluations, the calculated fecal coliform 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.

Evaluation of the relationship between instream 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.

Table 13. Fecal Coliform Loads and Required Fecal Coliform Load Reductions

Stream Segment	Current Load (counts/ 30 days)	TMDL Components					Percent Reduction
		WLA (counts/ 30 days)[1]	WLAsw (counts/ 30 days)	LA (counts/ 30 days)	MOS (counts/ 30 days)	TMDL (counts/ 30 days)	
Beaverdam Creek	2.68E+13	9.37E+10		7.64E+12	8.59E+11	8.59E+12	68
Brier Creek - Big Brier Creek to Sweetwater Creek near Thomson	3.01E+12			1.16E+12	1.28E+11	1.28E+12	57
Brier Creek - Hwy 305 to MacIntosh Creek	2.23E+13	2.37E+11	9.67E+11	1.05E+13	1.30E+12	1.30E+13	42
Broad River - SR 281 to Scull Shoal Creek near Danielsville	1.13E+16			3.12E+15	3.46E+14	3.46E+15	69
Broad River - Hwy 77 to Clarks Hill Lake	4.58E+16		3.14E+13	1.26E+16	1.41E+15	1.41E+16	69
Brushy Creek	1.02E+13	9.83E+10		4.92E+12	5.58E+11	5.58E+12	45
Buck Creek	1.01E+16	1.62E+11		6.76E+14	7.51E+13	7.51E+14	93
Cedar Creek	3.82E+12			8.85E+11	9.84E+10	9.84E+11	74
Clark Creek	1.22E+12			4.41E+11	4.90E+10	4.90E+11	60
Cold Water Creek	1.67E+13			2.59E+12	2.88E+11	2.88E+12	83
Crawford Creek	1.30E+12			3.57E+11	3.96E+10	3.96E+11	69
Falling Creek	3.51E+12			1.06E+12	1.17E+11	1.17E+12	67
Hudson River - Mountain Creek to Webb Creek near Homer	4.76E+13			6.08E+12	6.75E+11	6.75E+12	86
Hudson River - Black Creek to Nails Creek near Fort Lamar	3.33E+14	1.39E+11		3.68E+13	4.10E+12	4.10E+13	88
Little River - Confluence of North & South Forks of Kettle Creek near Washington	1.08E+13			5.22E+12	5.80E+11	5.80E+12	46
Long Creek	2.73E+12			9.22E+11	1.02E+11	1.02E+12	62
McBean Creek	8.56E+12		8.58E+11	1.45E+12	2.57E+11	2.57E+12	70
Middle Fork Broad River	6.94E+13			1.30E+13	1.45E+12	1.45E+13	79
North Fork Broad River	1.83E+14			1.61E+13	1.79E+12	1.79E+13	90
Panther Creek	1.79E+12			9.25E+11	1.03E+11	1.03E+12	42
Reed Creek - Upstream Lake Hartwell	9.99E+11			1.85E+11	2.06E+10	2.06E+11	79
Reed Creek - Rd S1727 To Bowen Pond near Martinez	3.93E+12	6.51E+11	1.73E+11	7.43E+10	9.98E+10	9.98E+11	75
Reedy Creek	6.66E+12			1.98E+12	2.20E+11	2.20E+12	67
Runs Branch (Ebenezer Creek)	2.83E+13			1.86E+13	2.06E+12	2.06E+13	27
Shoal Creek	6.79E+13		2.36E+12	1.01E+12	3.74E+11	3.74E+12	94
South Fork Broad River - Brush Creek to Beaverdam Creek near Comer	1.33E+14		1.84E+11	6.32E+12	7.23E+11	7.23E+12	95
South Fork Broad River - Clouds Creek to Fork Creek near Carlton	1.88E+13		1.09E+11	6.66E+12	7.52E+11	7.52E+12	60
Spirit Creek	3.79E+12	8.09E+11	1.12E+12	4.81E+11	2.68E+11	2.68E+12	29
Tallulah River	1.68E+13			5.15E+12	5.73E+11	5.73E+12	66
Toccoa Creek	1.02E+13			1.82E+12	2.02E+11	2.02E+12	80
Uchee Creek	7.50E+12		3.29E+11	2.64E+12	3.30E+11	3.30E+12	56
Warwoman Creek	7.59E+12		2.34E+11	1.88E+12	2.35E+11	2.35E+12	69

Notes: [1] The assigned fecal coliform load from each NPDES permitted facility for WLA was determined as the product of the fecal coliform permit limit and the facility average monthly discharge at the time of the critical load.

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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. 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 Savannah 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 the results of future monitoring and source characterization data efforts. The following recommendations emphasize 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. The GA EPD has adopted a basin approach to water quality management that divides Georgia's major river basins into five groups. This approach provides for additional sampling work to be focused on one of the five basin groups each year and offers a five-year planning and assessment cycle. The Savannah and Ogeechee River Basins were the subjects of focused monitoring in 2002 and will again receive focused monitoring in 2007.

The TMDL Implementation Plan will outline an appropriate water quality-monitoring program for the listed streams in the Savannah River Basin. The monitoring program will be developed to help identify the various fecal coliform sources. The monitoring program may 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.

6.2 Fecal Coliform Management Practices

Typically, municipal wastewater treatment facilities are required to treat to levels corresponding to instream water quality criteria and are not usually sources for fecal coliform impairment. However, based on the source assessment, some wastewater treatment facilities were found to have fecal coliform permit violations, and thus may have contributed to the stream segment listings. 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 both operational 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; and
- 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 GA EPD 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. An exception is constructed wetland systems, which have a natural level of fecal coliform input from animals attracted to the artificial wetlands. In addition, the permits will include routine monitoring and reporting requirements.

6.2.2 Nonpoint Source Approaches

The GA EPD is responsible for administering and enforcing laws to protect the waters of the State. The GA EPD is the lead agency for implementing the State's Nonpoint Source Management Program. Regulatory responsibilities that have a bearing on nonpoint source pollution include establishing water quality standards and use classifications, assessing and reporting water quality conditions, and regulating land use activities that may affect water quality. Georgia is working with local governments, agricultural and forestry agencies such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission, to foster the implementation of BMPs to 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 GA 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:

- University of Georgia (UGA) - Cooperative Extension Service;
- Georgia Soil and Water Conservation Commission (GSWCC); and
- Natural Resources Conservation Service (NRCS).

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 GA 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 NRCS works with federal, state, and local governments to provide financial and technical assistance to farmers. The NRCS develops standards and specifications for BMPs that are to be used to improve, protect, and/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.

The NRCS is also providing technical assistance to the GSWCC and the GA EPD 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 Savannah 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 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; and

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

6.3 Reasonable Assurance

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

6.4 Public Participation

A thirty-day public notice will be provided for this TMDL. During this time, the availability of the TMDL will be public noticed, a copy of the TMDL will be provided upon request, and the public will be invited to provide comments on the TMDL. This TMDL will be modified to address the comments received.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

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

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

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

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

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

5. The deadline for development of a Revised TMDL Implementation Plan is the end of December 2006.

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

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

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

8. The Revised TMDL Implementation Plan will supersede this Initial TMDL Implementation Plan once GA EPD approves the Revised TMDL Implementation Plan.

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	_	_	_		_		_		

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

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Appendix A

30-day Geometric Mean Fecal Coliform Monitoring Data

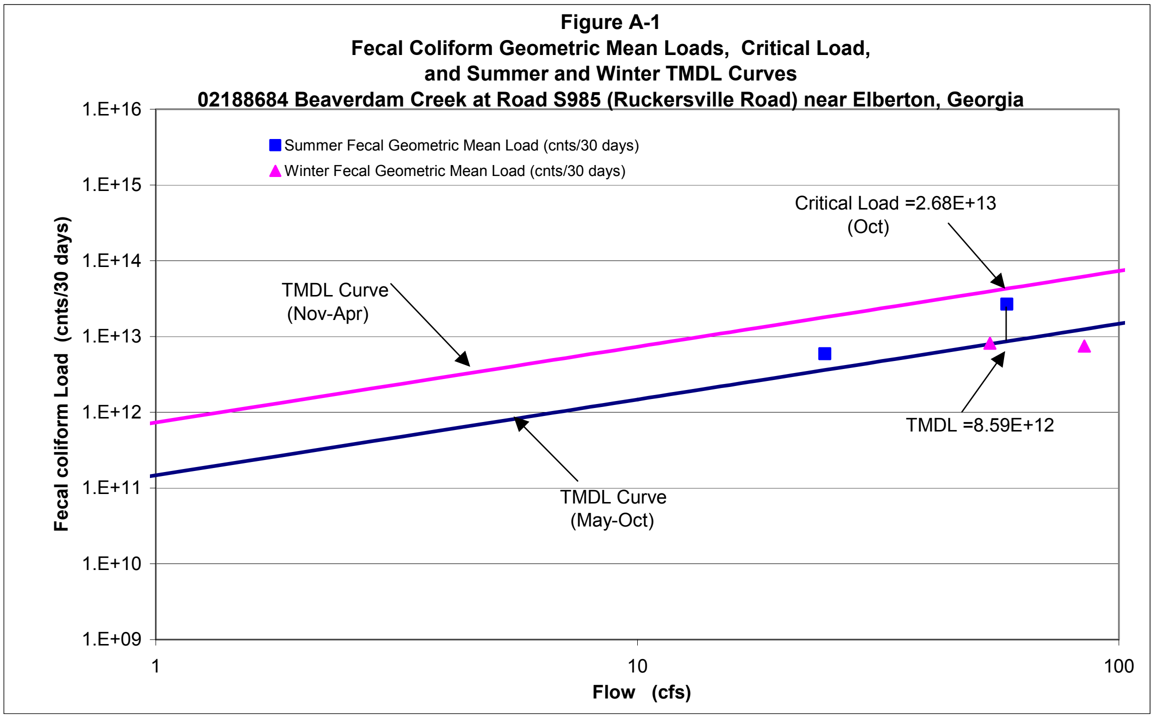


Table A-1. Data for Figure A-1

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
10-Jan-02	490	32.0				
17-Jan-02	20	27.0				
23-Jan-02	1100	113.0				
6-Feb-02	170	44.0	207	54.0	8.20E+12	3.96E+13
2-Apr-02	80	164.0				
8-Apr-02	110	58.0				
11-Apr-02	170	66.0				
17-Apr-02	140	51.0	120	84.8	7.48E+12	6.22E+13
27-Aug-02	50	9.1				
4-Sep-02	1100	13.0				
11-Sep-02	270	10.0				
18-Sep-02	790	66.0	329	24.5	5.92E+12	3.60E+12
2-Oct-02	230	29.0				
17-Oct-02	1700	76.0				
23-Oct-02	490	25.0				
30-Oct-02	790	104.0	624	58.5	2.68E+13	8.59E+12

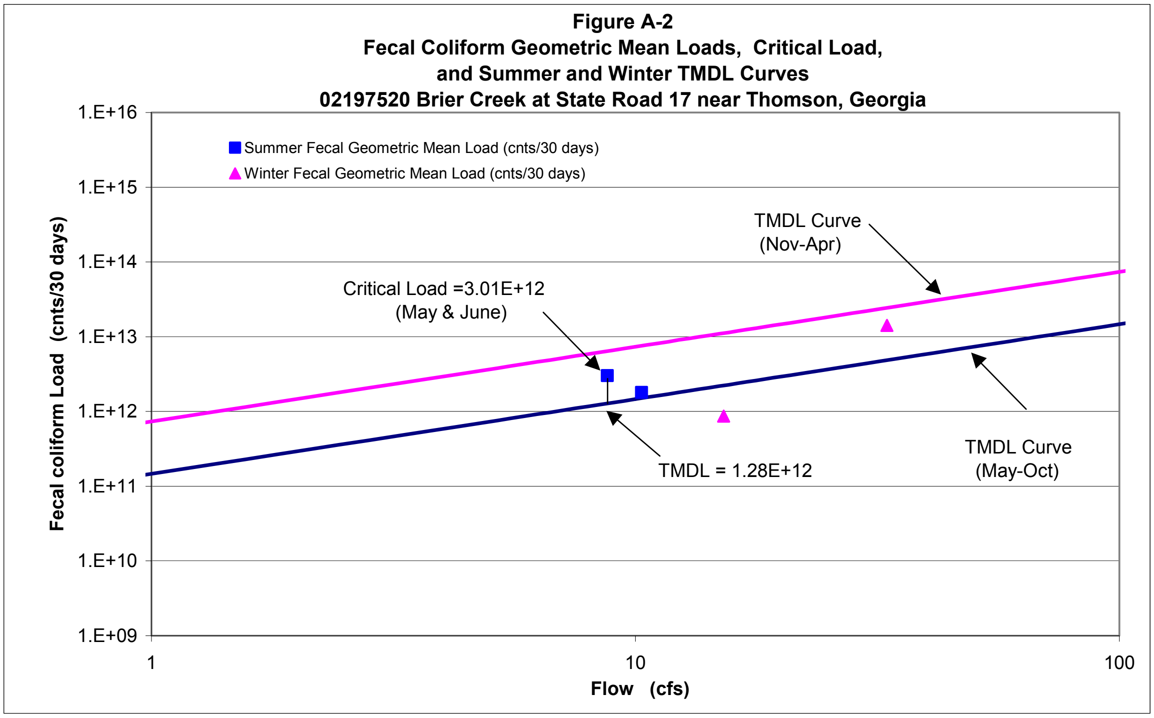


Table A-2. Data for Figure A-2

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
28-Feb-02	230	5.4				
4-Mar-02	1300	81.0				
14-Mar-02	490	26.0				
18-Mar-02	790	20.0	583	33.1	1.42E+13	2.43E+13
20-May-02	1300	20.0				
4-Jun-02	230	4.0				
10-Jun-02	490	2.3				
20-Jun-02	330	8.7	469	8.8	3.01E+12	1.28E+12
12-Aug-02	490	5.5				
19-Aug-02	1300	4.7				
26-Aug-02	70	19.0				
9-Sep-02	70	12.0	236	10.3	1.79E+12	1.51E+12
2-Dec-02	110	6.9				
3-Dec-02	50	11.0				
10-Dec-02	20	12.0				
17-Dec-02	330	31.0	78	15.2	8.67E+11	1.12E+13

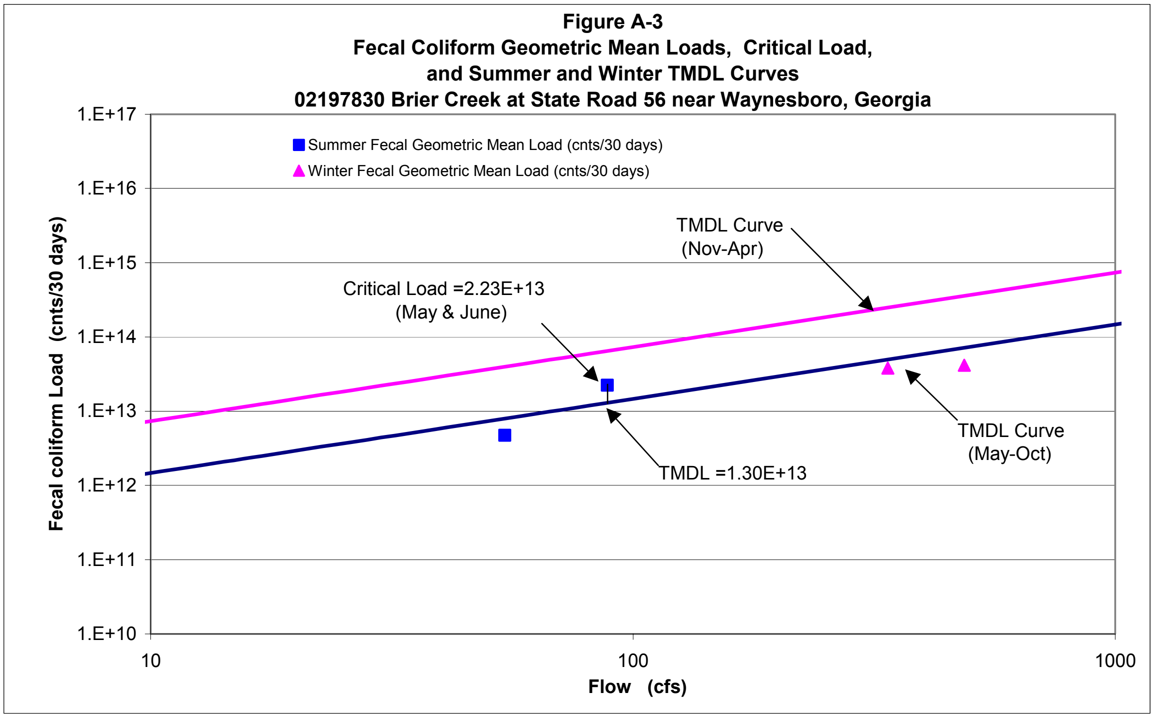


Table A-3. Data for Figure A-3

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
26-Feb-02	20	202.0				
6-Mar-02	490	598.0				
12-Mar-02	169	294.0				
20-Mar-02	330	256.0	153	337.5	3.79E+13	2.48E+14
22-May-02	1300	153.0				
4-Jun-02	790	82.0				
12-Jun-02	80	57.0				
19-Jun-02	170	62.0	344	88.5	2.23E+13	1.30E+13
14-Aug-02	50	44.0				
21-Aug-02	110	63.0				
27-Aug-02	330	56.0				
11-Sep-02	110	54.0	119	54.3	4.73E+12	7.96E+12
21-Nov-02	170	667.0				
3-Dec-02	80	241.0				
11-Dec-02	170	322.0				
19-Dec-02	80	716.0	117	486.5	4.16E+13	3.57E+14

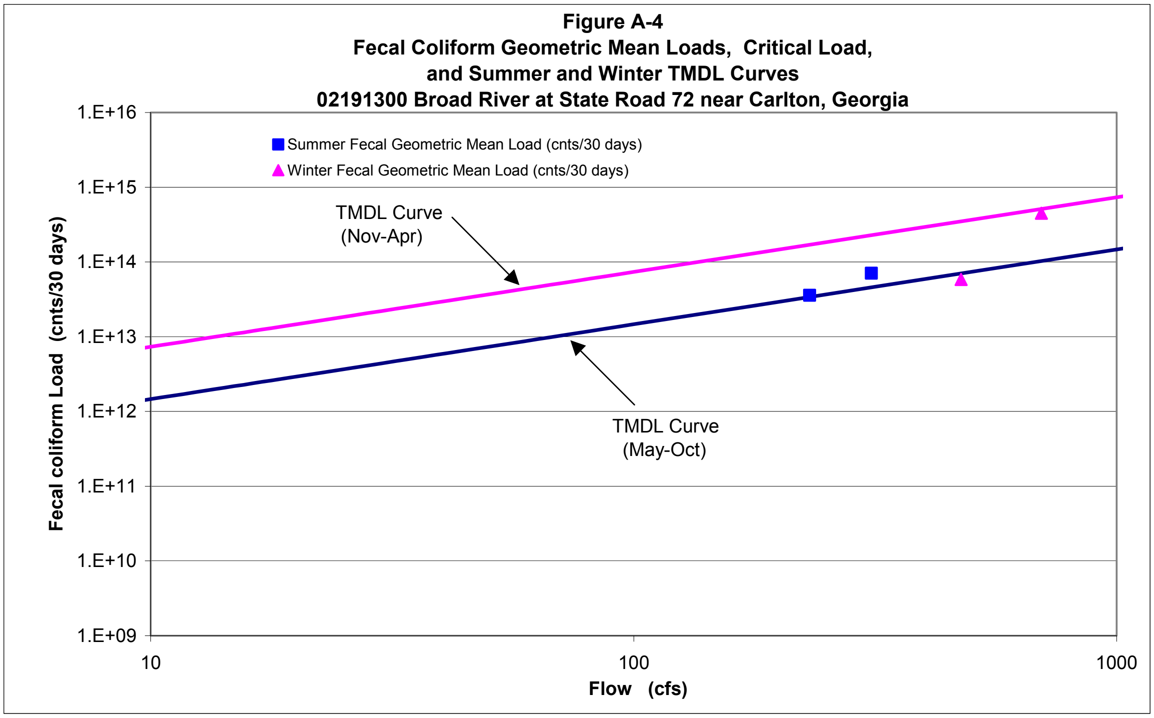


Table A-4. Data for Figure A-4

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
9-Jan-02	430	264.0				
16-Jan-02	80	220.0				
24-Jan-02	1300	1130.0				
7-Feb-02	**13000**	1180.0	873	698.5	4.48E+14	5.13E+14
3-Apr-02	2400	108.0				
9-Apr-02	130	622.0				
15-Apr-02	50	656.0				
18-Apr-02	50	520.0	167	476.5	5.84E+13	3.50E+14
27-Aug-02	230	63.0				
4-Sep-02	330	103.0				
12-Sep-02	20	39.0				
18-Sep-02	1300	720.0	211	231.3	3.58E+13	3.39E+13
3-Oct-02	170	421.0				
21-Oct-02	170	220.0				
23-Oct-02	130	215.0				
31-Oct-02	2400	387.0	308	310.8	7.03E+13	4.56E+13

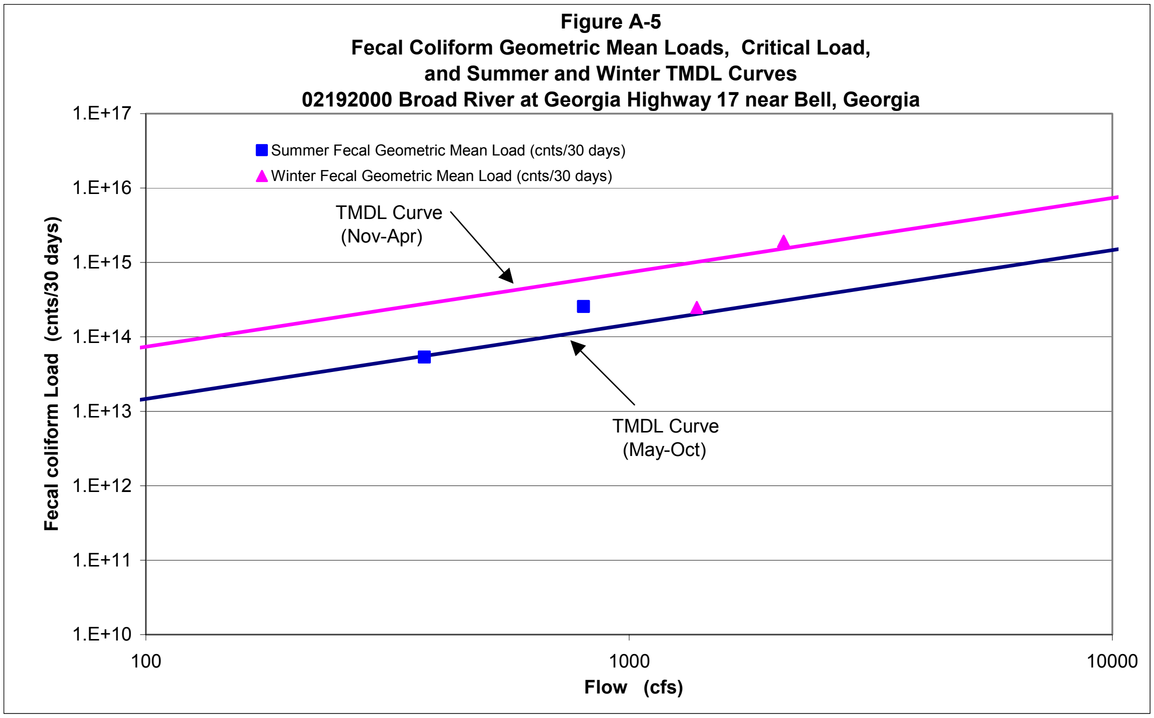


Table A-5. Data for Figure A-5

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
9-Jan-02	790	638.0				
16-Jan-02	50	473.0				
24-Jan-02	4900	2440.0				
7-Feb-02	**13000**	4800.0	1259	2087.8	1.93E+15	1.53E+15
3-Apr-02	1400	2360.0				
9-Apr-02	80	1030.0				
15-Apr-02	230	1240.0				
18-Apr-02	140	894.0	245	1381.0	2.48E+14	1.01E+15
27-Aug-02	110	59.0				
5-Sep-02	80	111.0				
12-Sep-02	230	28.0				
18-Sep-02	700	1310.0	194	377.0	5.37E+13	5.53E+13
3-Oct-02	140	572.0				
21-Oct-02	210	652.0				
23-Oct-02	220	614.0				
31-Oct-02	5400	1380.0	432	804.5	2.55E+14	1.18E+14

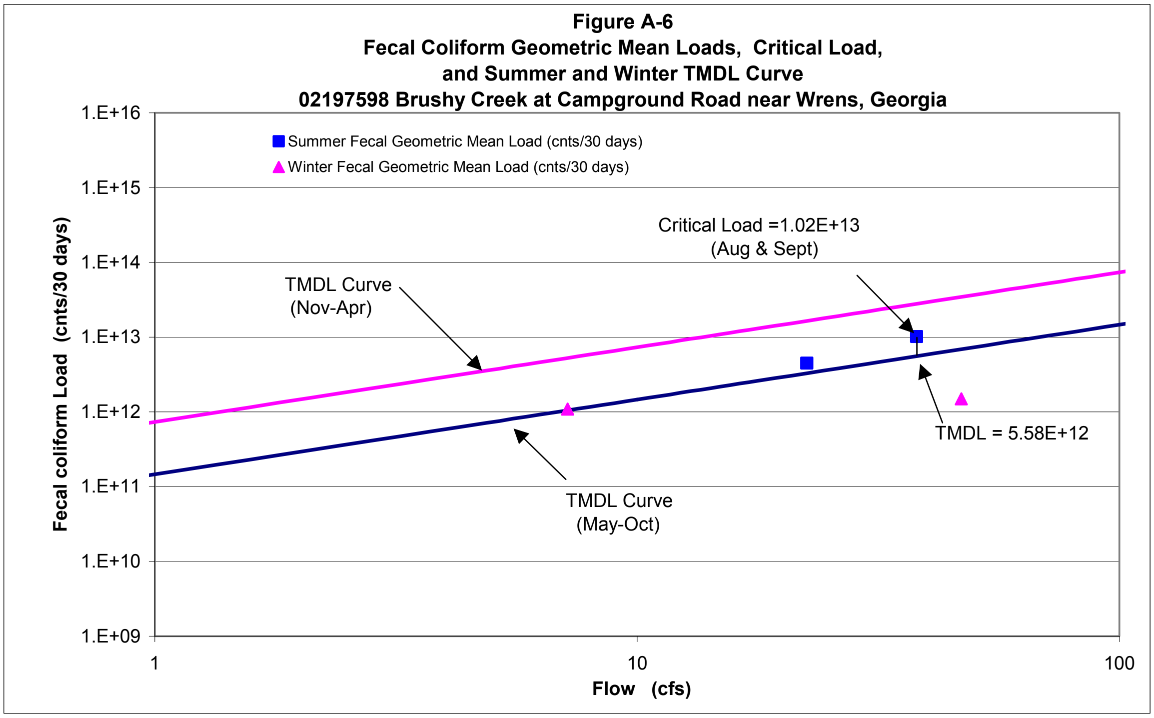


Table A-6. Data for Figure A-6

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
28-Feb-02	294	4.4				
4-Mar-02	170	10.0				
14-Mar-02	460	8.5				
18-Mar-02	80	5.8	207	7.2	1.09E+12	5.27E+12
20-May-02	60	19.0				
4-Jun-02	1100	22.0				
10-Jun-02	490	25.0				
20-Jun-02	170	24.0	272	22.5	4.50E+12	3.30E+12
12-Aug-02	330	32.0				
19-Aug-02	330	41.0				
27-Aug-02	330	38.0				
9-Sep-02	490	41.0	364	38.0	1.02E+13	5.58E+12
2-Dec-02	20	45.0				
3-Dec-02	110	45.0				
10-Dec-02	20	55.0				
17-Dec-02	80	43.0	43	47.0	1.49E+12	3.45E+13

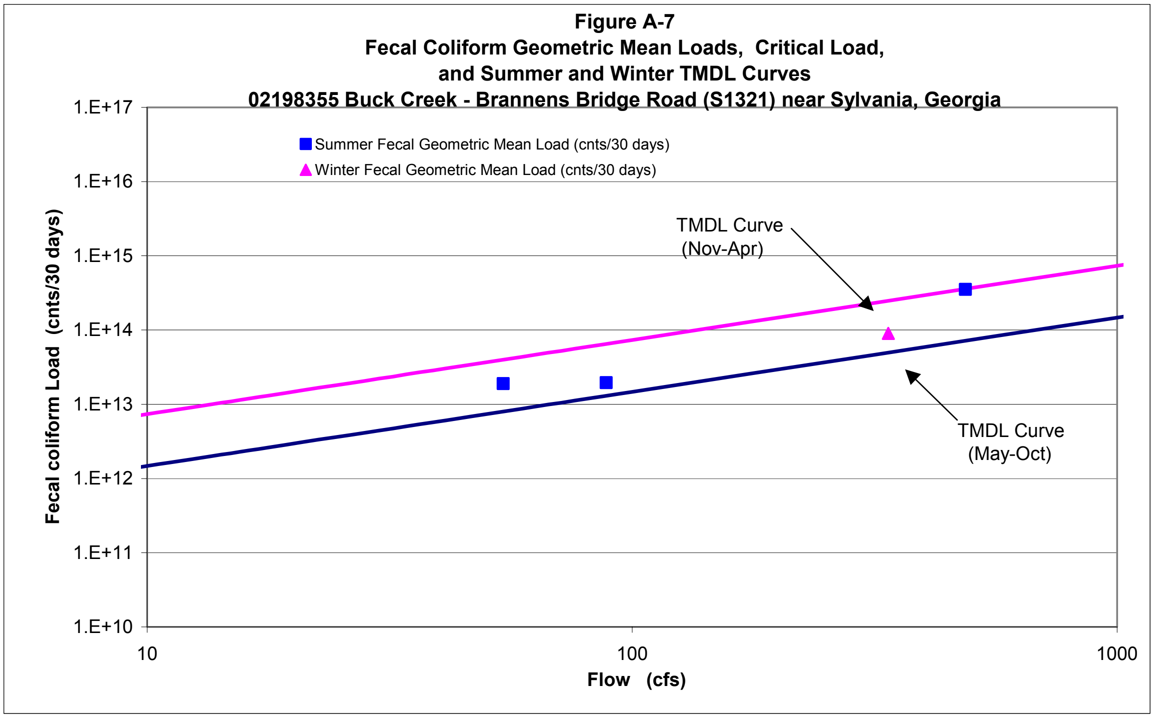


Table A-7. Data for Figure A-7

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
12-Feb-02	50	202.0				
19-Feb-02	80	598.0				
26-Feb-02	82	294.0				
5-Mar-02	**54000**	256.0	365	337.5	9.04E+13	2.48E+14
28-May-02	40	153.0				
11-Jun-02	170	82.0				
18-Jun-02	110	57.0				
25-Jun-02	11000	62.0	301	88.5	1.96E+13	1.30E+13
6-Aug-02	460	44.0				
13-Aug-02	1100	63.0				
20-Aug-02	460	56.0				
3-Sep-02	220	54.0	476	54.3	1.89E+13	7.96E+12
2-Oct-02	490	667.0				
8-Oct-02	17000	241.0				
16-Oct-02	50	322.0				
22-Oct-02	2300	716.0	989	486.5	3.53E+14	7.14E+13

Figure A-8
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02187440 Cedar Creek at Rd. S1724 (State Rd. 77 Spur) nr Montevideo, GA

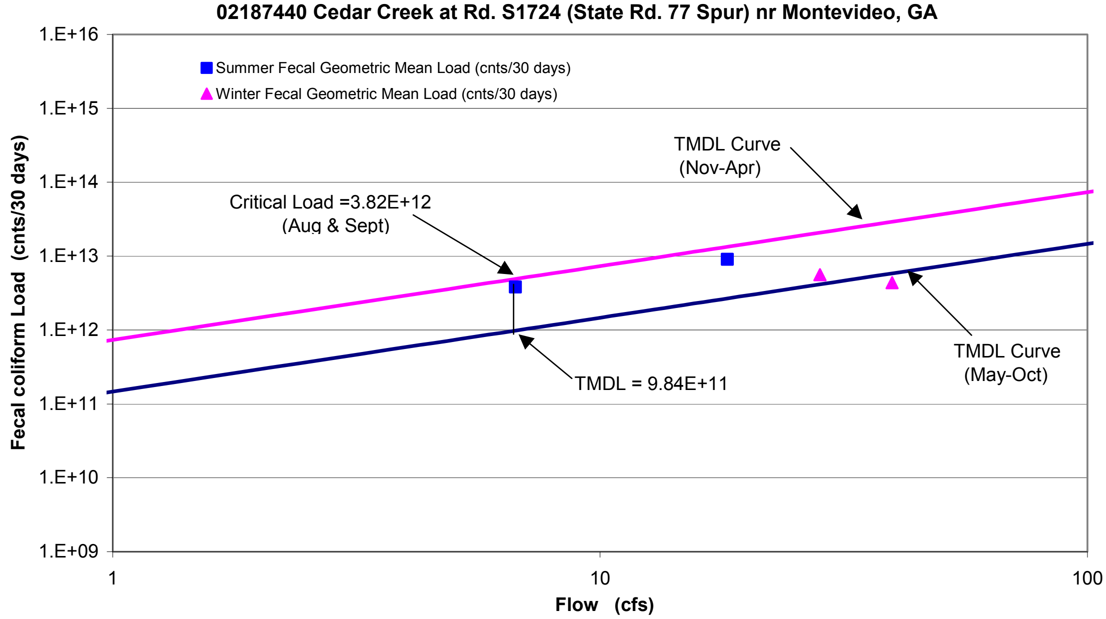


Table A-8. Data for Figure A-8

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
10-Jan-02	220	14.0				
17-Jan-02	490	14.0				
23-Jan-02	20	65.0				
6-Feb-02	230	66.0	149	39.8	4.35E+12	2.92E+13
2-Apr-02	170	41.0				
8-Apr-02	490	20.0				
11-Apr-02	130	26.0				
17-Apr-02	490	26.0	270	28.3	5.60E+12	2.07E+13
28-Aug-02	230	4.2				
4-Sep-02	700	5.1				
11-Sep-02	4600	3.5				
19-Sep-02	490	14.0	776	6.7	3.82E+12	9.84E+11
2-Oct-02	1100	11.0				
17-Oct-02	790	20.0				
23-Oct-02	220	13.0				
30-Oct-02	1100	29.0	677	18.3	9.07E+12	2.68E+12

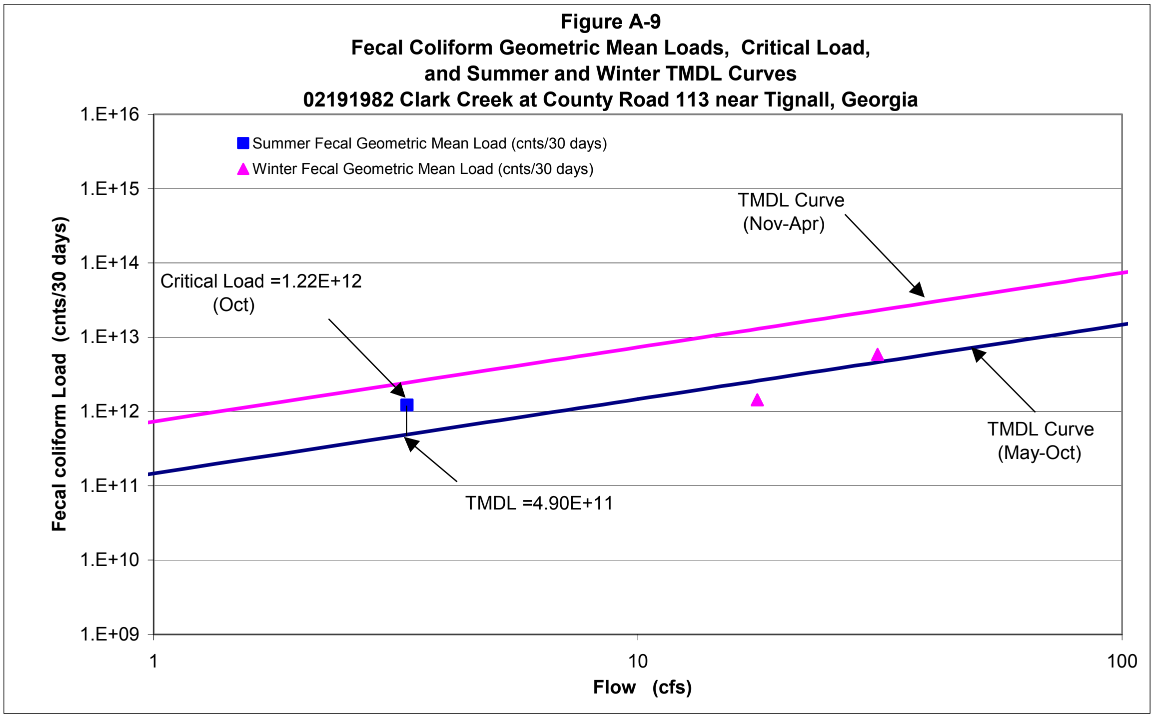


Table A-9. Data for Figure A-9

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
16-Jan-02	330	9.6				
24-Jan-02	330	24.0				
13-Feb-02	70	19.0				
14-Feb-02	20	18.0	111	17.7	1.44E+12	1.30E+13
3-Apr-02	1100	50.0				
9-Apr-02	230	23.0				
15-Apr-02	130	30.0				
18-Apr-02	130	22.0	256	31.3	5.87E+12	2.29E+13
18-Sep-02	700	0.6				
3-Oct-02	330	0.7				
21-Oct-02	490	4.5				
23-Oct-02	790	2.5				
31-Oct-02	490	5.6	500	3.3	1.22E+12	4.90E+11

Figure A-10
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02187760 Cold Water Creek at County Road 193 near Ruckersville, Georgia

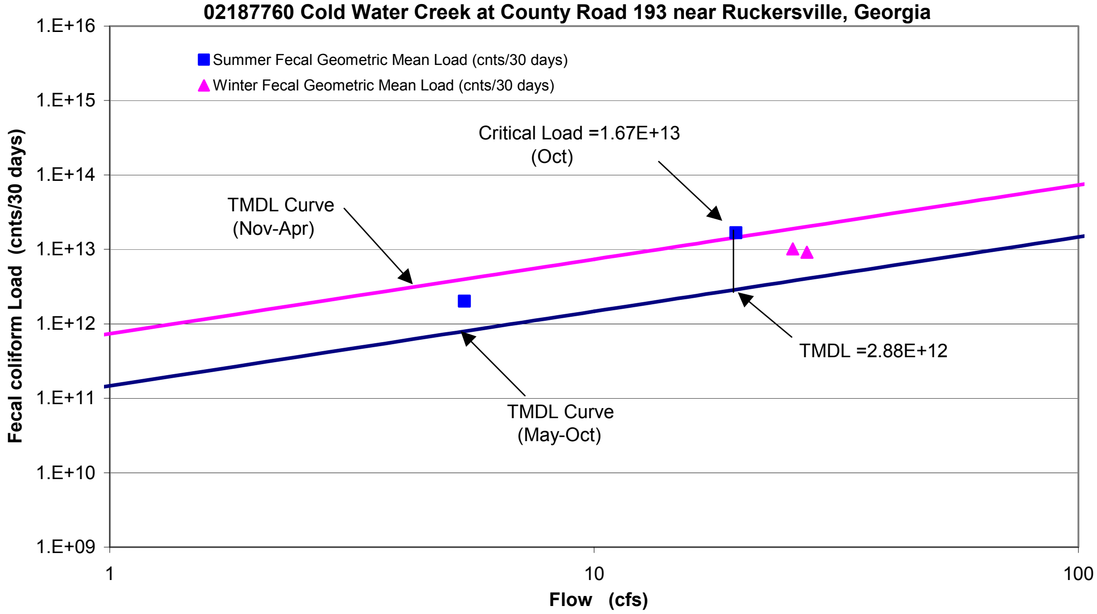


Table A-10. Data for Figure A-10

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
10-Jan-02	170	12.0				
17-Jan-02	220	6.9				
23-Jan-02	4900	74.0				
6-Feb-02	460	10.0	539	25.7	1.02E+13	1.89E+13
2-Apr-02	330	50.0				
8-Apr-02	1700	19.0				
11-Apr-02	330	19.0				
17-Apr-02	230	22.0	454	27.5	9.17E+12	2.02E+13
28-Aug-02	70	3.6				
4-Sep-02	790	2.7				
11-Sep-02	1100	6.1				
18-Sep-02	1100	9.2	509	5.4	2.02E+12	7.93E+11
2-Oct-02	490	11.0				
17-Oct-02	1300	3.7				
23-Oct-02	260	8.8				
30-Oct-02	11000	55.0	1162	19.6	1.67E+13	2.88E+12

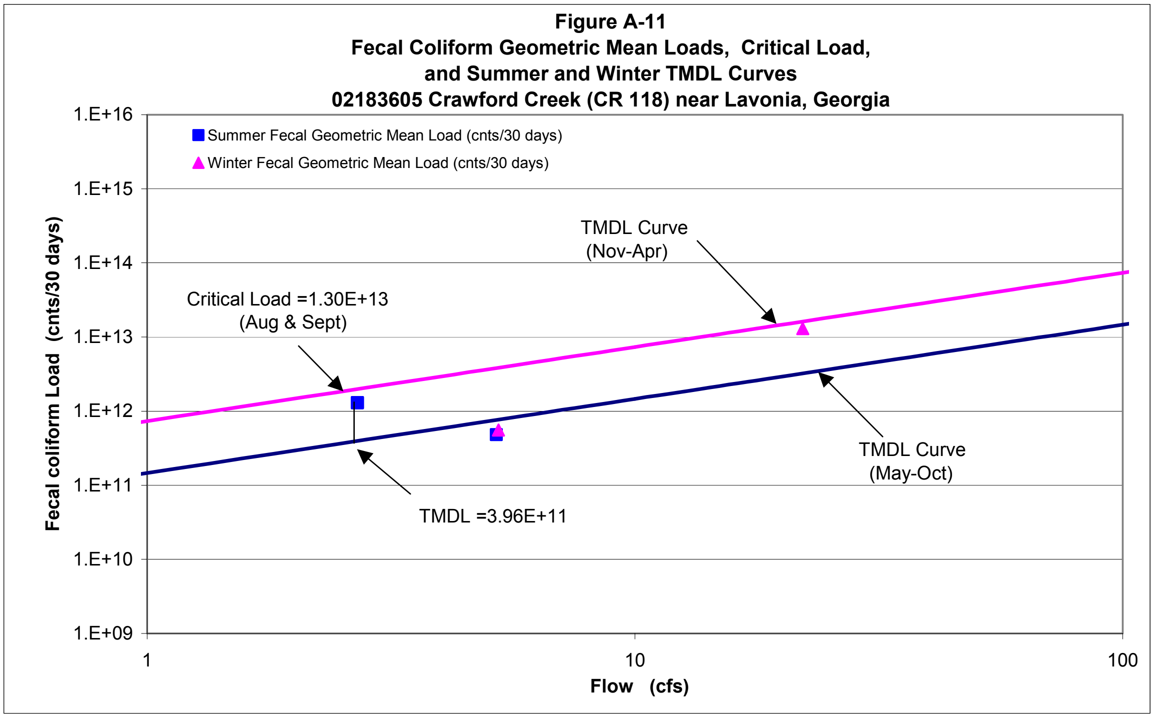


Table A-11. Data for Figure A-11

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Aug-97	110	1.1				
15-Sep-97	490	3.3				
17-Sep-97	490	3.2				
25-Sep-97	7000	3.2	656	2.7	1.30E+12	3.96E+11
10-Dec-97	140	5.5				
18-Dec-97	170	3.9				
29-Dec-97	140	6.7				
6-Jan-98	130	4.9	144	5.3	5.56E+11	3.85E+12
6-Jan-98	130	4.9				
14-Jan-98	130	6.4				
27-Jan-98	3500	17.0				
4-Feb-98	7000	60.1	802	22.1	1.30E+13	1.62E+13
14-May-98	120	6.0				
19-May-98	330	5.6				
26-May-98	80	4.9				
9-Jun-98	80	4.2	126	5.2	4.82E+11	7.64E+11

**Figure A-12
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02191800 Falling Creek at Elbert Co. Road 50 near Fortsonia, GA**

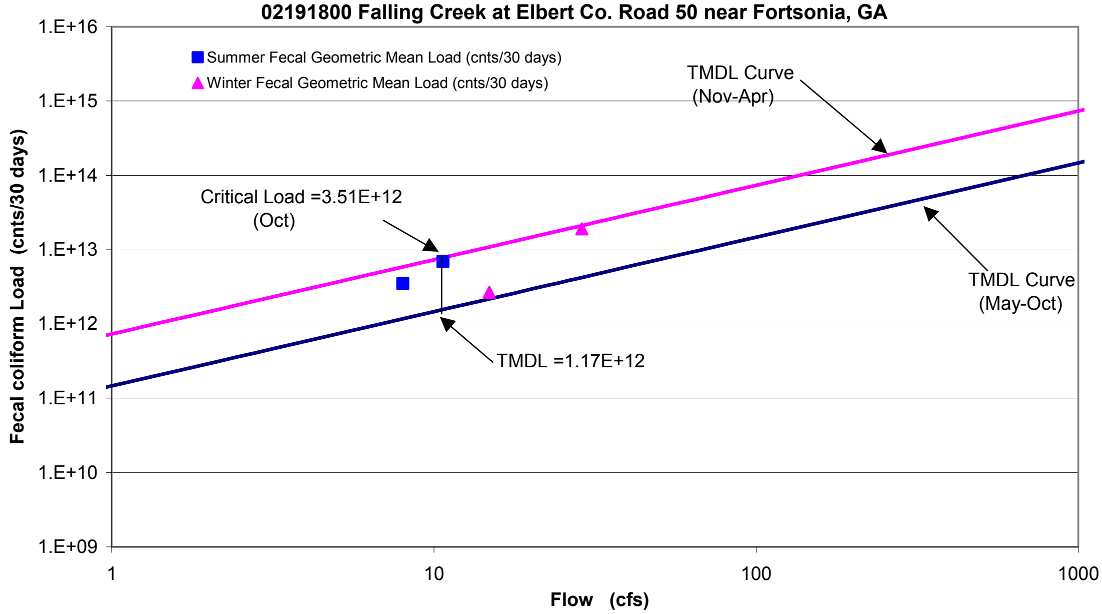


Table A-12. Data for Figure A-12

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
9-Jan-02	1300	8.8				
16-Jan-02	50	7.4				
24-Jan-02	1300	19.0				
7-Feb-02	7900	80.0	904	28.8	1.91E+13	2.11E+13
3-Apr-02	490	22.0				
9-Apr-02	330	14.0				
15-Apr-02	130	14.0				
18-Apr-02	170	9.4	244	14.9	2.67E+12	1.09E+13
27-Aug-02	790	24.0				
5-Sep-02	1100	1.0				
18-Sep-02	790	7.0	882	10.7	6.91E+12	7.83E+12
3-Oct-02	1300	4.6				
21-Oct-02	1300	15.0				
23-Oct-02	230	5.0				
31-Oct-02	330	7.4	598	8.0	3.51E+12	1.17E+12

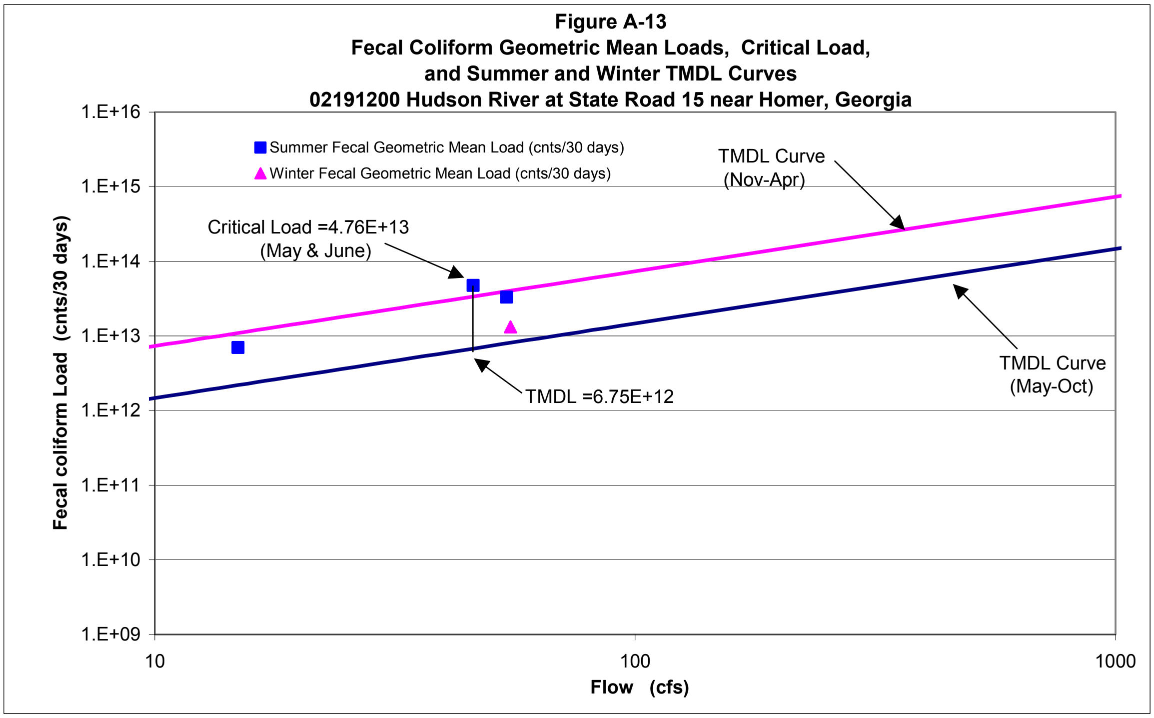


Table A-13. Data for Figure A-13

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
29-Jan-02	790	75.0				
5-Feb-02	130	49.0				
12-Feb-02	490	57.0				
19-Feb-02	230	39.0	328	55.0	1.32E+13	4.04E+13
7-May-02	1700	59.0				
14-May-02	11000	57.0				
23-May-02	460	39.0				
4-Jun-02	460	29.0	1410	46.0	4.76E+13	6.75E+12
20-Aug-02	130	9.2				
27-Aug-02	7900	27.0				
3-Sep-02	330	16.0				
10-Sep-02	490	7.4	638	14.9	6.98E+12	2.19E+12
2-Oct-02	460	40.0				
7-Oct-02	170	31.0				
15-Oct-02	490	34.0				
30-Oct-02	13000	111.0	840	54.0	3.33E+13	7.93E+12

Figure A-14
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02191239 Hudson River at State Road 106 at Fort Lamar, Georgia

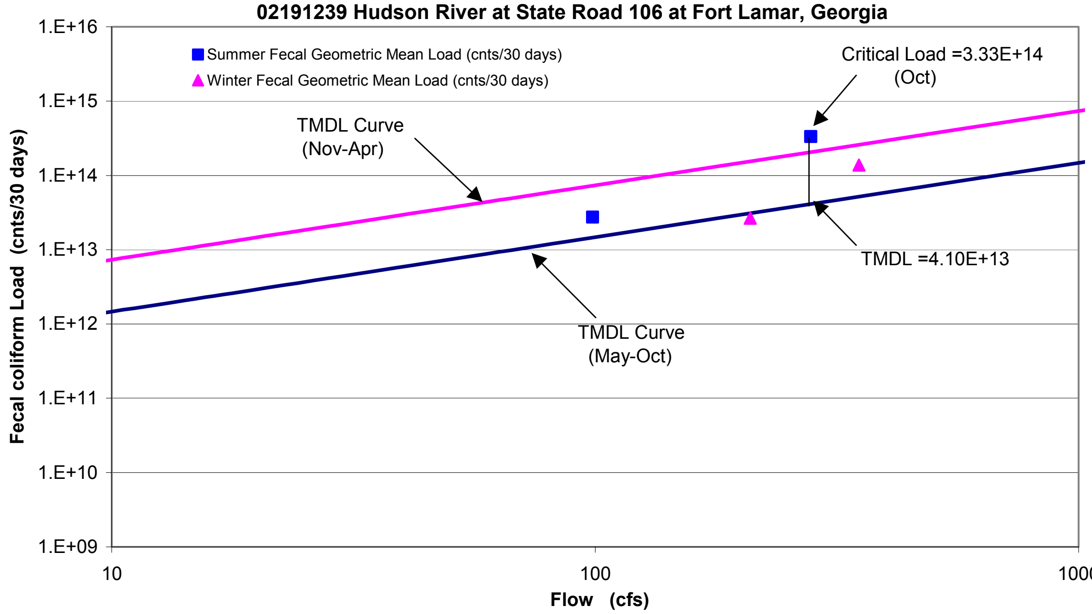


Table A-14. Data for Figure A-14

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
15-Jan-02	170	111.0				
22-Jan-02	790	402.0				
11-Feb-02	330	175.0				
14-Feb-02	20	149.0	173	209.3	2.65E+13	1.54E+14
1-Apr-02	3300	757.0				
4-Apr-02	220	278.0				
10-Apr-02	490	187.0				
16-Apr-02	230	184.0	535	351.5	1.38E+14	2.58E+14
29-Aug-02	430	50.0				
3-Sep-02	460	48.0				
10-Sep-02	130	33.0				
17-Sep-02	790	264.0	378	98.8	2.74E+13	1.45E+13
1-Oct-02	490	109.0				
17-Oct-02	1700	244.0				
22-Oct-02	490	135.0				
29-Oct-02	17000	629.0	1623	279.3	3.33E+14	4.10E+13

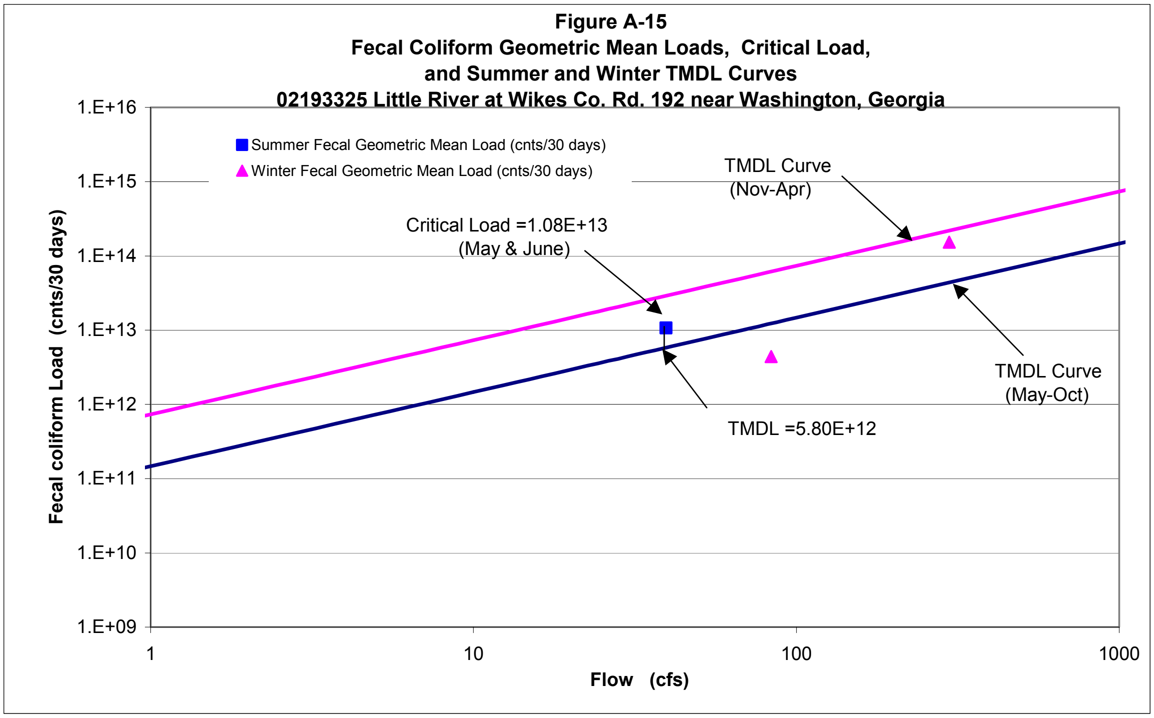


Table A-15. Data for Figure A-15

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
28-Feb-02	330	52.0				
4-Mar-02	4600	840.0				
14-Mar-02	700	206.0				
18-Mar-02	230	92.0	703	297.5	1.54E+14	2.18E+14
20-May-02	220	50.0				
4-Jun-02	790	37.0				
10-Jun-02	330	45.0				
20-Jun-02	330	26.0	371	39.5	1.08E+13	5.80E+12
2-Jul-02	330	27.0				
22-Jul-02		12.0				
29-Aug-02	1100	4.2				
9-Sep-02	330	6.2				
2-Dec-02	50	59.0				
4-Dec-02	80	58.0				
9-Dec-02	20	66.0				
16-Dec-02	330	151.0	72	83.5	4.39E+12	6.13E+13

Figure A-16
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02191975 Long Creek at Wilkes Co. Rd. 109 near Tignall, Georgia

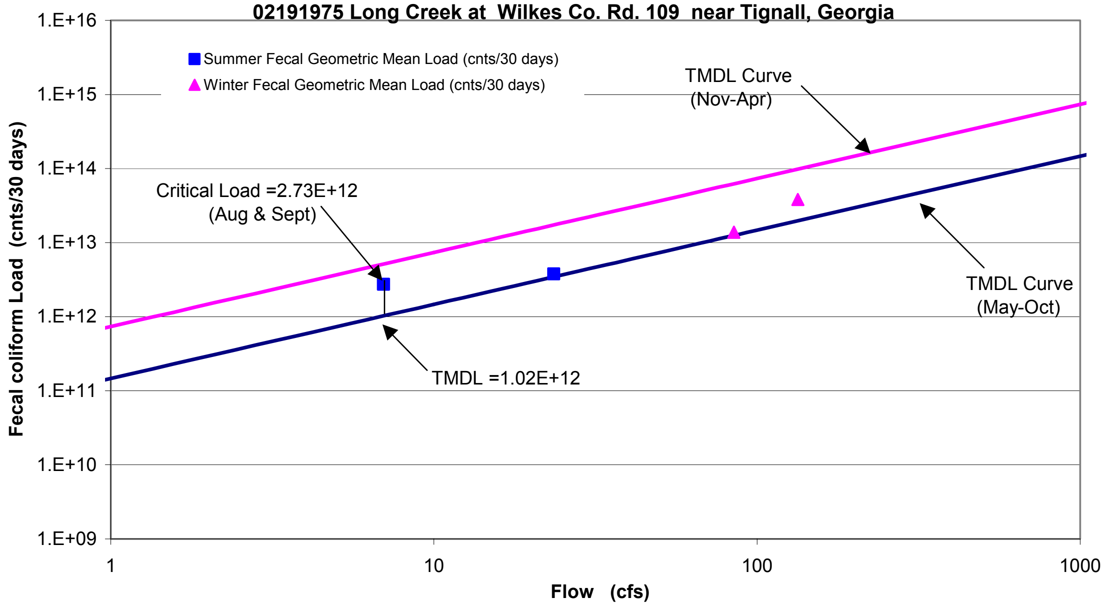


Table A-16. Data for Figure A-16

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
16-Jan-02	230	44.0				
24-Jan-02	790	120.0				
13-Feb-02	50	92.0				
14-Feb-02	270	83.0	223	84.8	1.38E+13	6.22E+13
3-Apr-02	330	220.0				
9-Apr-02	80	88.0				
15-Apr-02	1100	146.0				
18-Apr-02	790	81.0	389	133.8	3.82E+13	9.82E+13
27-Aug-02	790	0.4				
5-Sep-02	170	2.0				
12-Sep-02	1300	0.5				
18-Sep-02	460	25.0	532	7.0	2.73E+12	1.02E+12
3-Oct-02	130	15.0				
21-Oct-02	330	17.0				
23-Oct-02	110	21.0				
31-Oct-02	490	41.0	219	23.5	3.78E+12	1.72E+13

Figure A-17
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02197200 McBean Creek at State Road 56 at McBean, Georgia

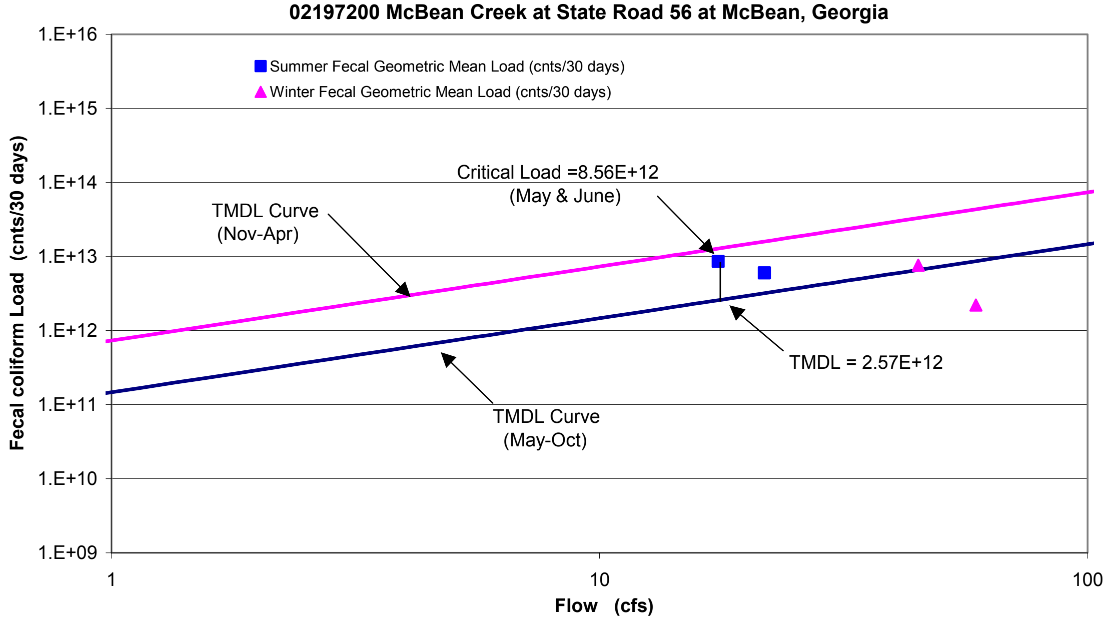


Table A-17. Data for Figure A-17

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
26-Feb-02	220	40.0				
6-Mar-02	430	50.0				
12-Mar-02	130	44.0				
20-Mar-02	230	46.0	231	45.0	7.62E+12	3.30E+13
22-May-02	270	27.0				
4-Jun-02	1700	23.0				
12-Jun-02	330	10.0				
19-Jun-02	1300	10.0	666	17.5	8.56E+12	2.57E+12
14-Aug-02	230	18.0				
21-Aug-02	330	28.0				
27-Aug-02	790	23.0				
11-Sep-02	330	18.0	375	21.8	5.99E+12	3.19E+12
21-Nov-02	20	59.0				
3-Dec-02	130	50.0				
12-Dec-02	20	71.0				
19-Dec-02	130	56.0	51	59.0	2.21E+12	4.33E+13

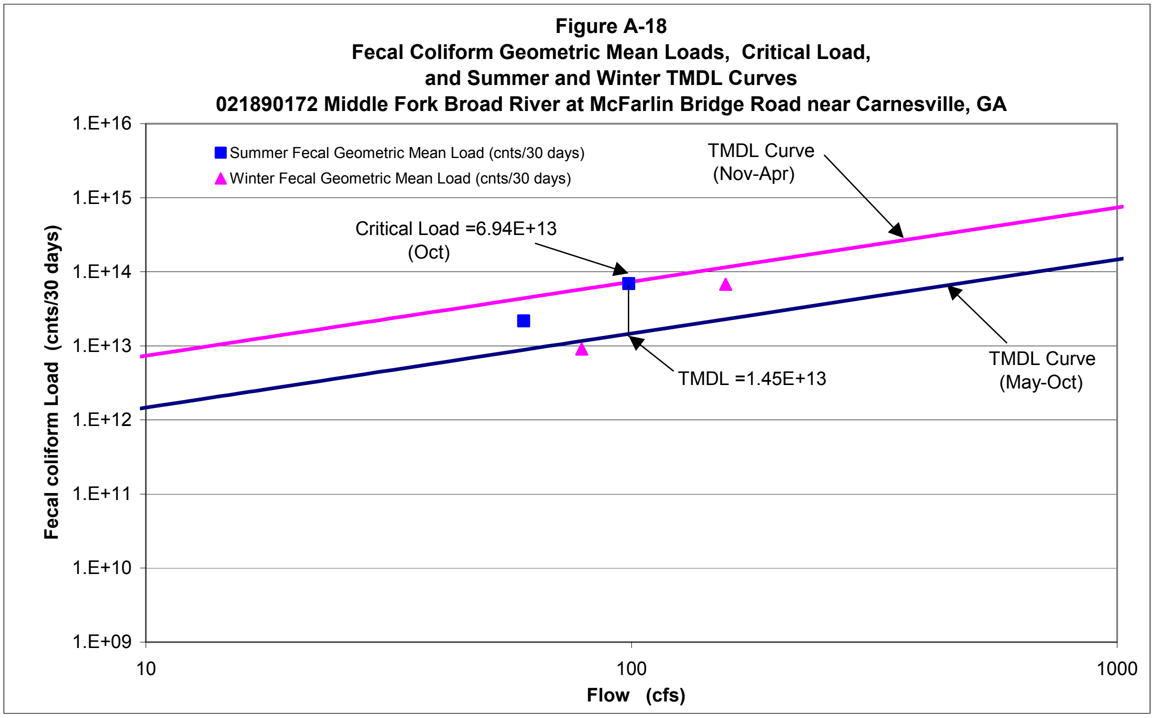


Table A-18. Data for Figure A-18

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
15-Jan-02	80	39.0				
22-Jan-02	2200	155.0				
11-Feb-02	170	66.0				
14-Feb-02	20	56.0	156	79.0	9.07E+12	5.80E+13
1-Apr-02	4900	347.0				
4-Apr-02	330	121.0				
10-Apr-02	230	87.0				
16-Apr-02	330	70.0	592	156.3	6.79E+13	1.15E+14
28-Aug-02	490	21.0				
3-Sep-02	330	20.0				
10-Sep-02	330	12.0				
17-Sep-02	1100	187.0	492	60.0	2.17E+13	8.81E+12
1-Oct-02	330	65.0				
17-Oct-02	330	137.0				
22-Oct-02	700	57.0				
29-Oct-02	11000	136.0	957	98.8	6.94E+13	1.45E+13

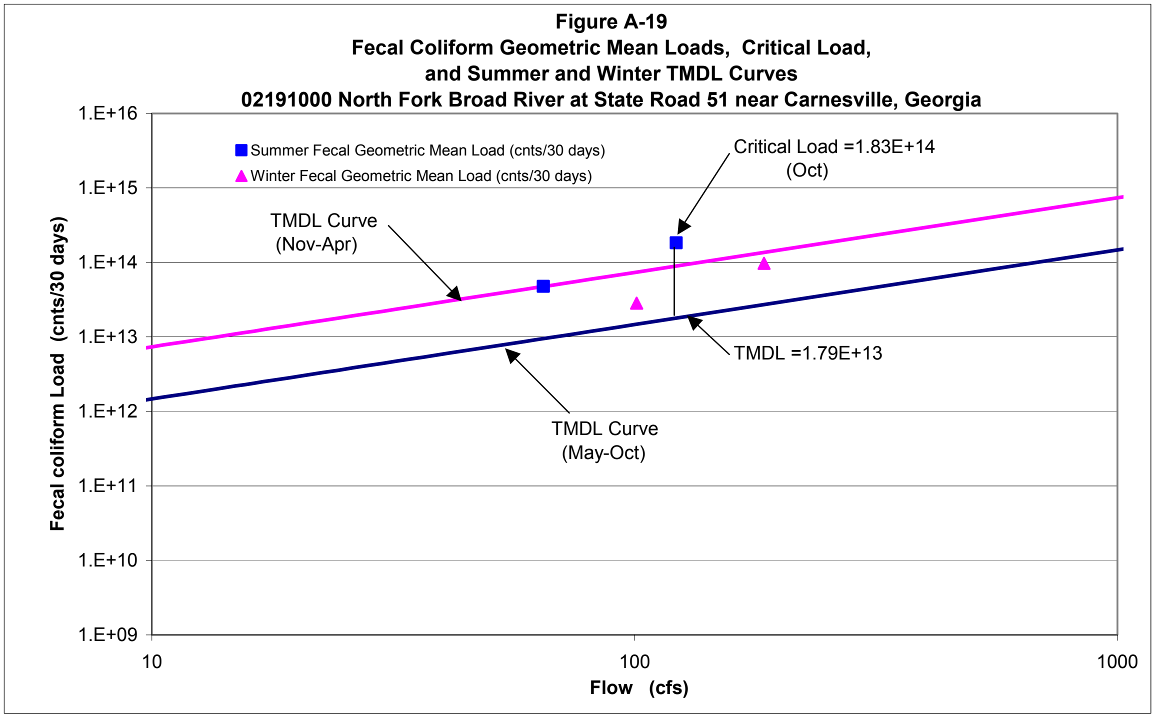


Table A-19. Data for Figure A-19

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
15-Jan-02	220	63.0				
22-Jan-02	3500	172.0				
11-Feb-02	1400	91.0				
14-Feb-02	20	78.0	383	101.0	2.84E+13	7.41E+13
1-Apr-02	2300	331.0				
4-Apr-02	490	155.0				
10-Apr-02	330	133.0				
16-Apr-02	700	123.0	714	185.5	9.73E+13	1.36E+14
28-Aug-02	1700	38.0				
3-Sep-02	460	26.0				
10-Sep-02	460	18.0				
17-Sep-02	2800	177.0	1002	64.8	4.76E+13	9.51E+12
1-Oct-02	790	80.0				
17-Oct-02	1300	153.0				
22-Oct-02	1300	81.0				
29-Oct-02	13000	174.0	2041	122.0	1.83E+14	1.79E+13

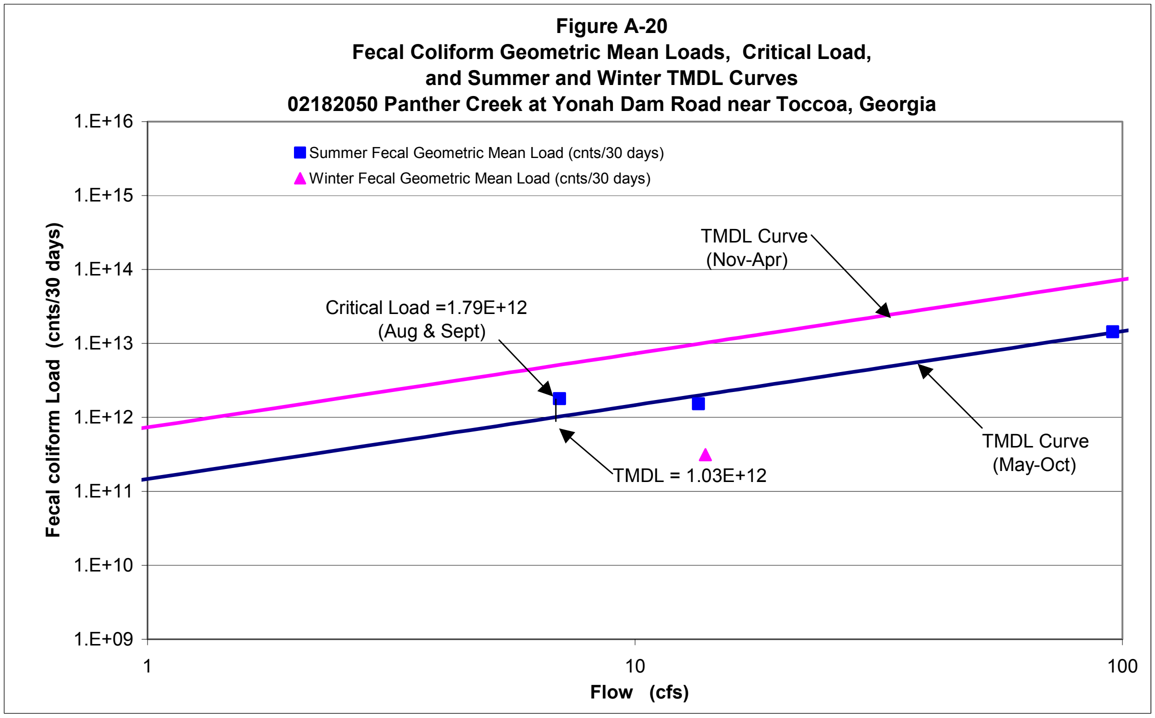


Table A-20. Data for Figure A-20

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
31-Jan-02	20	33.0				
7-Feb-02	110	8.8				
14-Feb-02	20	7.0				
21-Feb-02	20	7.0	31	14.0	3.14E+11	1.02E+13
9-May-02	130	7.0				
16-May-02	220	33.0				
22-May-02	50	7.0				
6-Jun-02	398	7.0	154	13.5	1.53E+12	1.98E+12
22-Aug-02	330	7.0				
5-Sep-02	80	7.0				
12-Sep-02	790	7.0				
18-Sep-02	700	7.0	348	7.0	1.79E+12	1.03E+12
1-Oct-02	50	122.0				
9-Oct-02	230	7.0				
17-Oct-02	220	120.0				
29-Oct-02	700	133.0	205	95.5	1.44E+13	1.40E+13

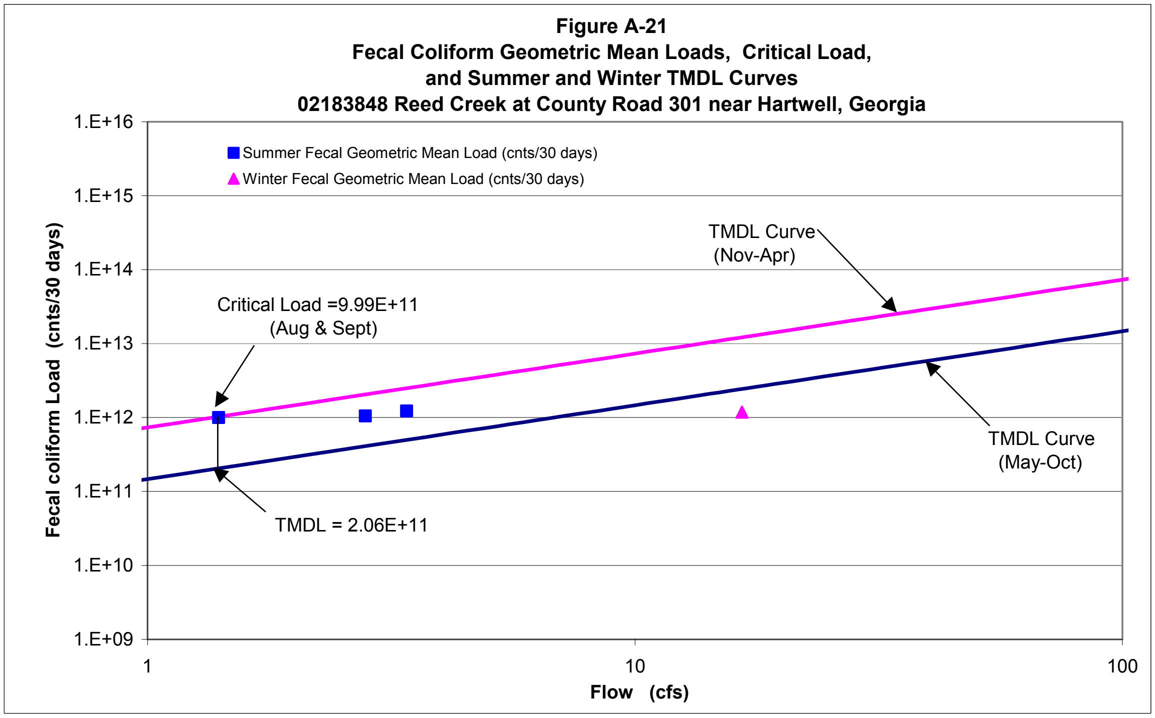


Table A-21. Data for Figure A-21

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
31-Jan-02	490	30.0				
7-Feb-02	70	30.0				
14-Feb-02	20	3.3				
21-Feb-02	130	3.0	97	16.6	1.18E+12	1.22E+13
9-May-02	220	4.9				
16-May-02	1300	2.8				
22-May-02	490	1.5				
6-Jun-02	490	2.0	512	2.8	1.05E+12	4.11E+11
22-Aug-02	330	1.0				
5-Sep-02	790	1.7				
12-Sep-02	4900	1.0				
18-Sep-02	700	1.9	972	1.4	9.99E+11	2.06E+11
1-Oct-02	1100	2.8				
9-Oct-02	1700	1.5				
17-Oct-02	630	1.0				
29-Oct-02	50	8.3	493	3.4	1.23E+12	4.99E+11

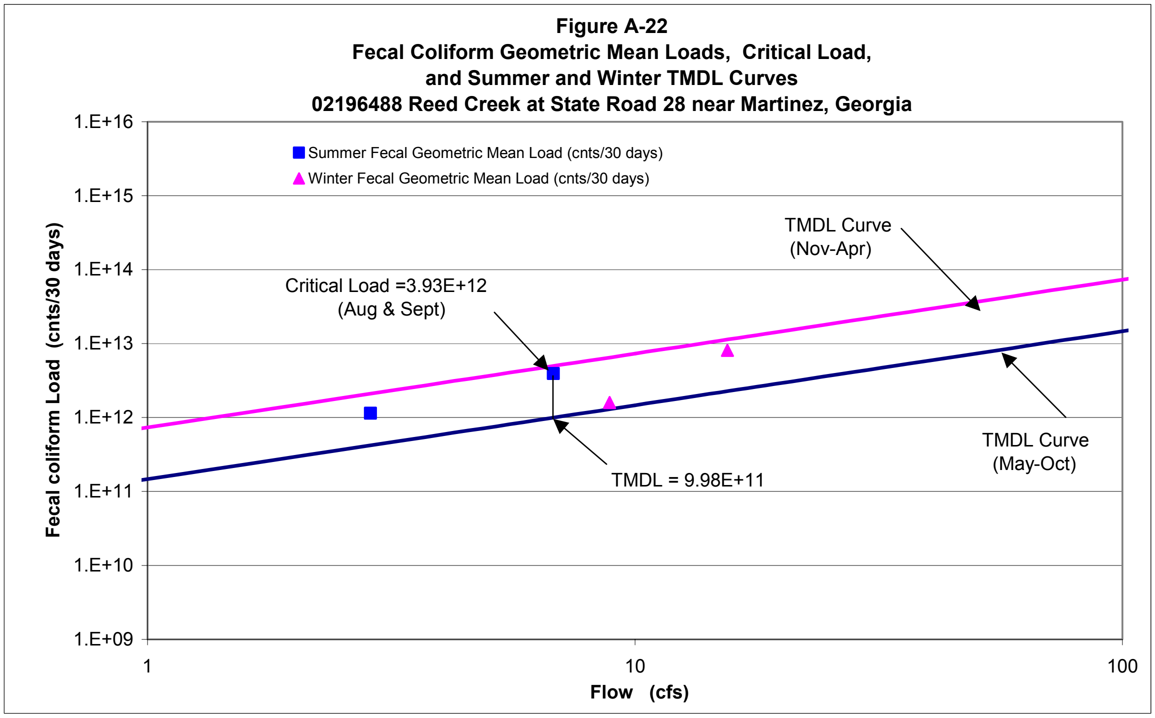


Table A-22. Data for Figure A-22

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
27-Feb-02	330	5.2				
7-Mar-02	584	4.7				
13-Mar-02	790	18.0				
21-Mar-02	1700	34.0	713	15.5	8.10E+12	1.14E+13
23-May-02	490	6.7				
5-Jun-02	1100	0.9				
13-Jun-02	700	1.5				
18-Jun-02	230	2.4	543	2.9	1.14E+12	4.21E+11
15-Aug-02	20	1.1				
22-Aug-02	490	4.2				
28-Aug-02	17000	20.0				
12-Sep-02	2300	1.9	787	6.8	3.93E+12	9.98E+11
20-Nov-02	460	3.5				
2-Dec-02	20	5.0				
11-Dec-02	1700	16.0				
18-Dec-02	230	11.0	245	8.9	1.60E+12	6.51E+12

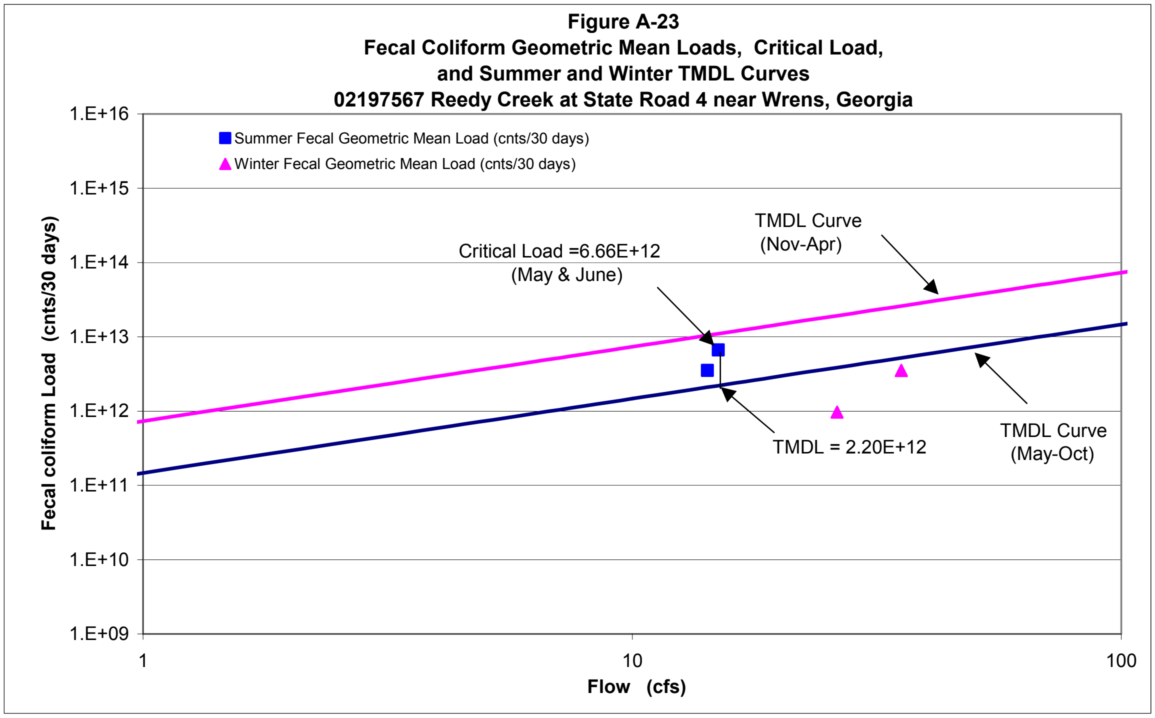


Table A-23. Data for Figure A-23

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
28-Feb-02	70	24.0				
4-Mar-02	310	62.0				
14-Mar-02	220	31.0				
18-Mar-02	70	25.0	135	35.5	3.52E+12	2.61E+13
20-May-02	490	22.0				
4-Jun-02	2300	14.0				
10-Jun-02	700	12.0				
20-Jun-02	170	12.0	605	15.0	6.66E+12	2.20E+12
12-Aug-02	490	16.0				
19-Aug-02	170	13.0				
27-Aug-02	340	13.0				
9-Sep-02	460	15.0	338	14.3	3.53E+12	2.09E+12
2-Dec-02	50	23.0				
3-Dec-02	80	24.0				
10-Dec-02	20	26.0				
17-Dec-02	80	32.0	50	26.3	9.69E+11	1.93E+13

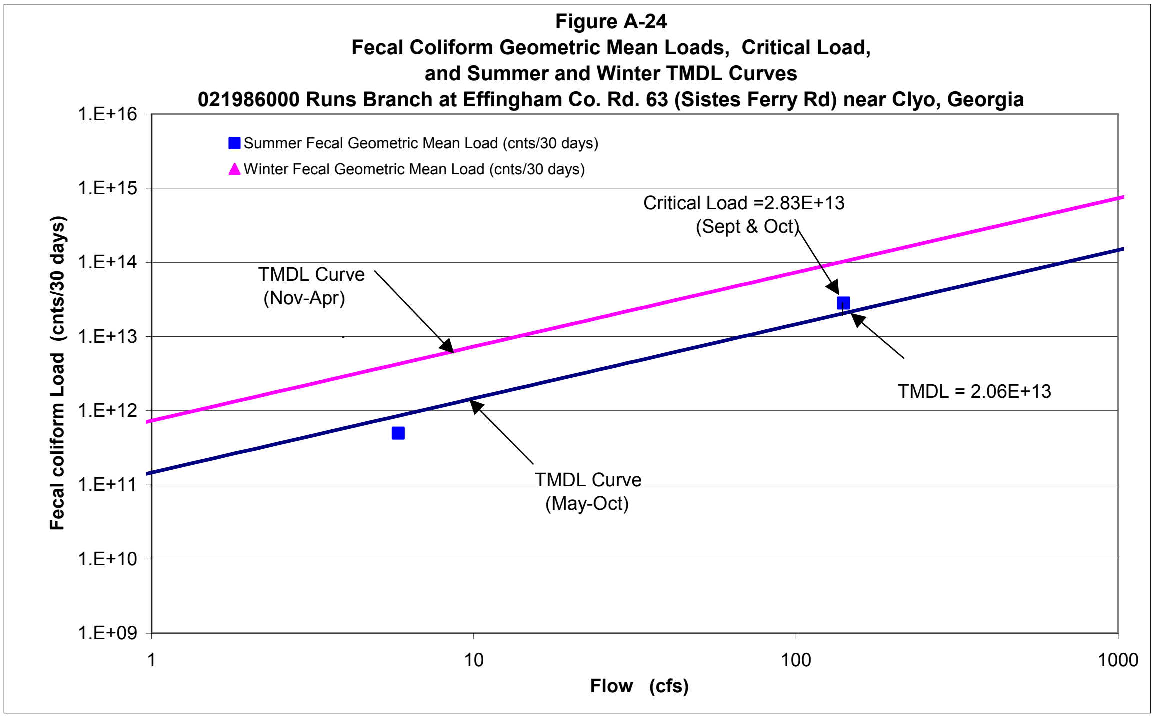


Table A-24. Data for Figure A-24

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
26-Aug-97	230	19.0				
2-Sep-97	20	0.2				
9-Sep-97	50	0.1				
23-Sep-97	790	4.0	116	5.8	4.96E+11	8.55E+11
23-Sep-97	790	4.0				
8-Oct-97	110	0.2				
14-Oct-97	50	158.0				
21-Oct-97	1300	400.0	274	140.6	2.83E+13	2.06E+13
7-Mar-02	1100	2.1				
18-Apr-02		4.3				
30-May-02	20	1.0				
13-Jun-02	20	1.0				
20-Jun-02	20	1.0				
13-Nov-02		81.0				
19-Dec-02		42.0				

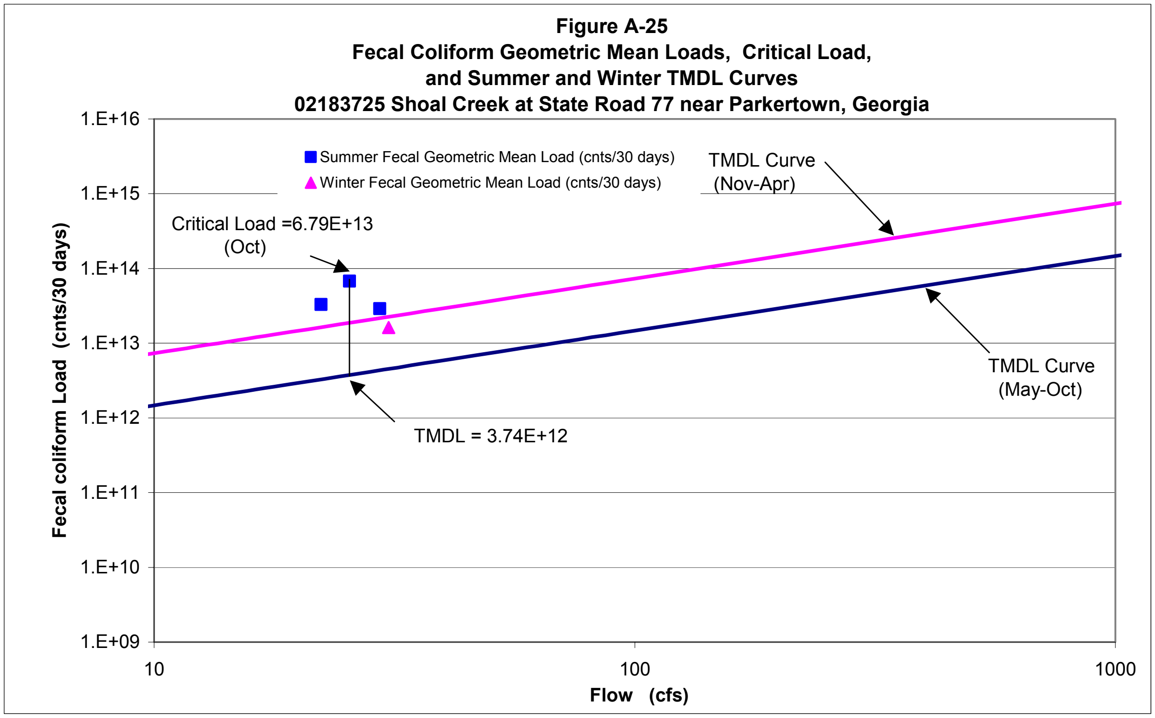


Table A-25. Data for Figure A-25

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
31-Jan-02	700	15.0				
7-Feb-02	24000	70.0				
14-Feb-02	20	17.0				
21-Feb-02	790	21.0	718	30.8	1.62E+13	2.26E+13
9-May-02	1700	28.0				
16-May-02	790	19.0				
22-May-02	940	21.0				
6-Jun-02	13000	21.0	2013	22.3	3.29E+13	3.27E+12
22-Aug-02	630	17.0				
5-Sep-02	330	11.0				
12-Sep-02	700	10.0				
18-Sep-02	22000	80.0	1338	29.5	2.90E+13	4.33E+12
1-Oct-02	1300	22.0				
9-Oct-02	630	20.0				
17-Oct-02	2300	26.0				
29-Oct-02	92000	34.0	3628	25.5	6.79E+13	3.74E+12

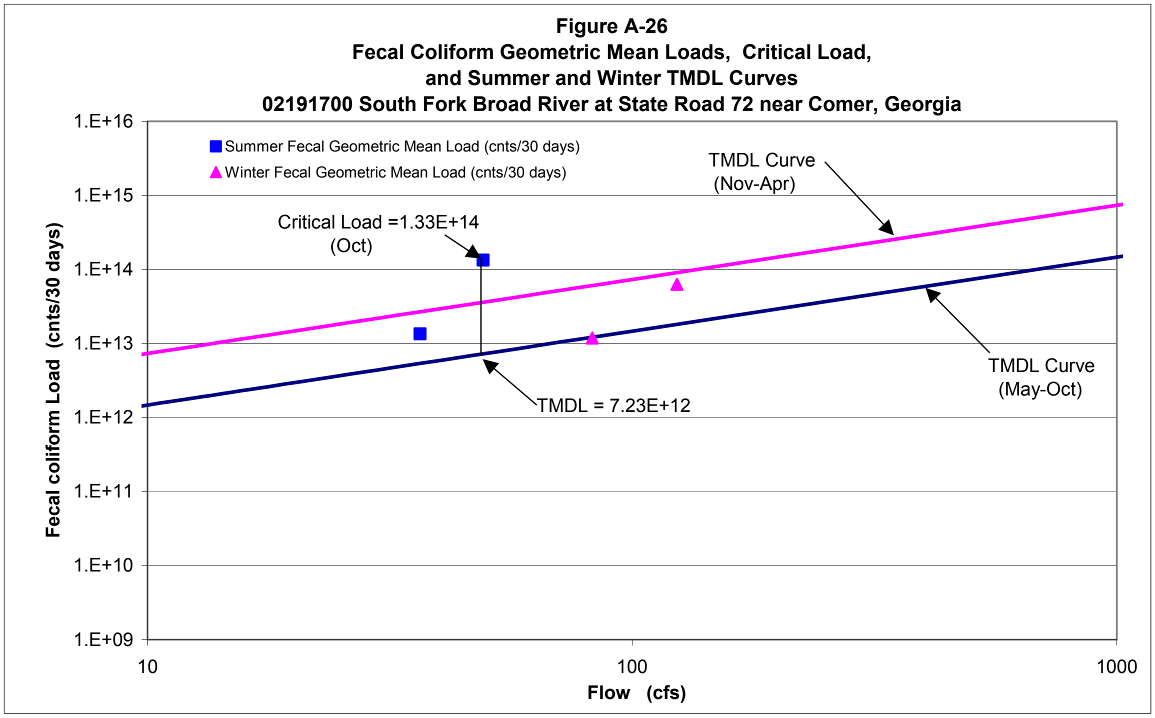


Table A-26. Data for Figure A-26

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
15-Jan-02	170	32.0				
22-Jan-02	1300	145.0				
11-Feb-02	330	94.0				
14-Feb-02	20	60.0	195	82.8	1.19E+13	6.07E+13
1-Apr-02	4600	247.0				
4-Apr-02	310	111.0				
10-Apr-02	490	70.0				
16-Apr-02	330	67.0	693	123.8	6.29E+13	9.08E+13
29-Aug-02	790	13.0				
3-Sep-02	340	16.0				
10-Sep-02	490	11.0				
17-Sep-02	490	106.0	504	36.5	1.35E+13	5.36E+12
1-Oct-02	3300	14.0				
17-Oct-02	3300	70.0				
22-Oct-02	1300	46.0				
29-Oct-02	13000	67.0	3683	49.3	1.33E+14	7.23E+12

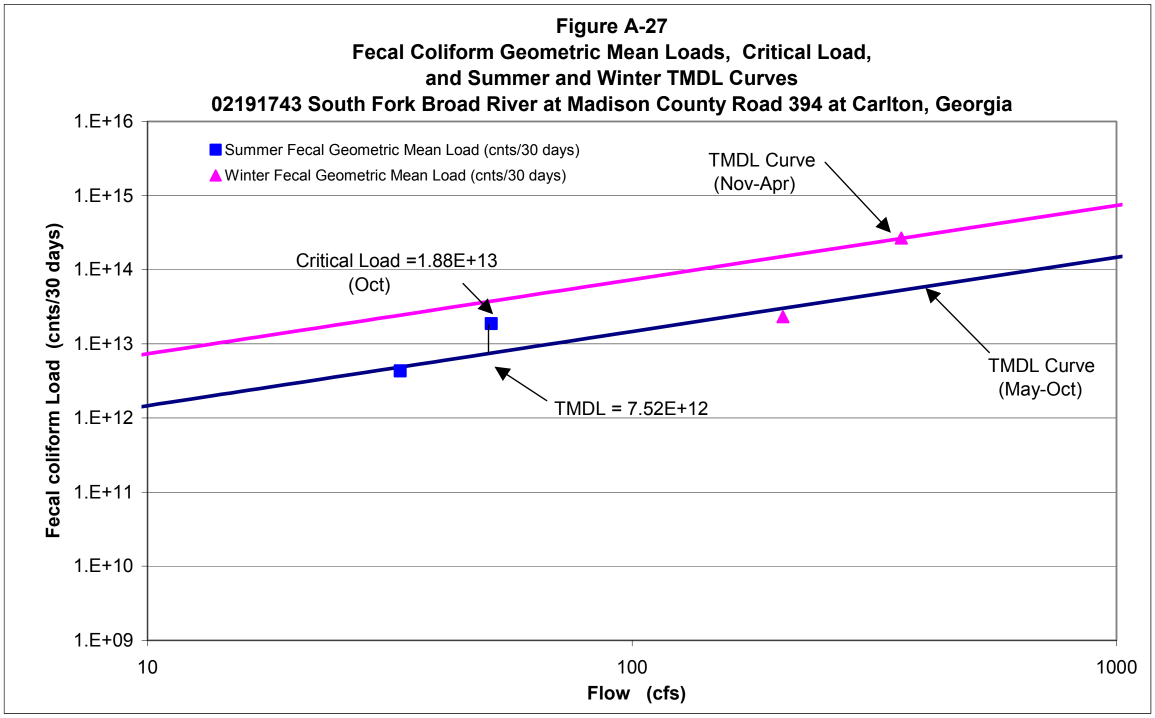


Table A-27. Data for Figure A-27

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
9-Jan-02	1700	86.0				
16-Jan-02	70	62.0				
24-Jan-02	940	220.0				
7-Feb-02	9400	1070.0	1013	359.5	2.67E+14	2.64E+14
3-Apr-02	490	318.0				
9-Apr-02	110	176.0				
15-Apr-02	80	183.0				
18-Apr-02	130	143.0	154	205.0	2.32E+13	1.50E+14
27-Aug-02	110	14.0				
4-Sep-02	80	14.0				
12-Sep-02	230	14.0				
18-Sep-02	490	91.0	177	33.3	4.33E+12	4.88E+12
3-Oct-02	330	27.0				
21-Oct-02	490	58.0				
23-Oct-02	790	40.0				
31-Oct-02	490	80.0	500	51.3	1.88E+13	7.52E+12

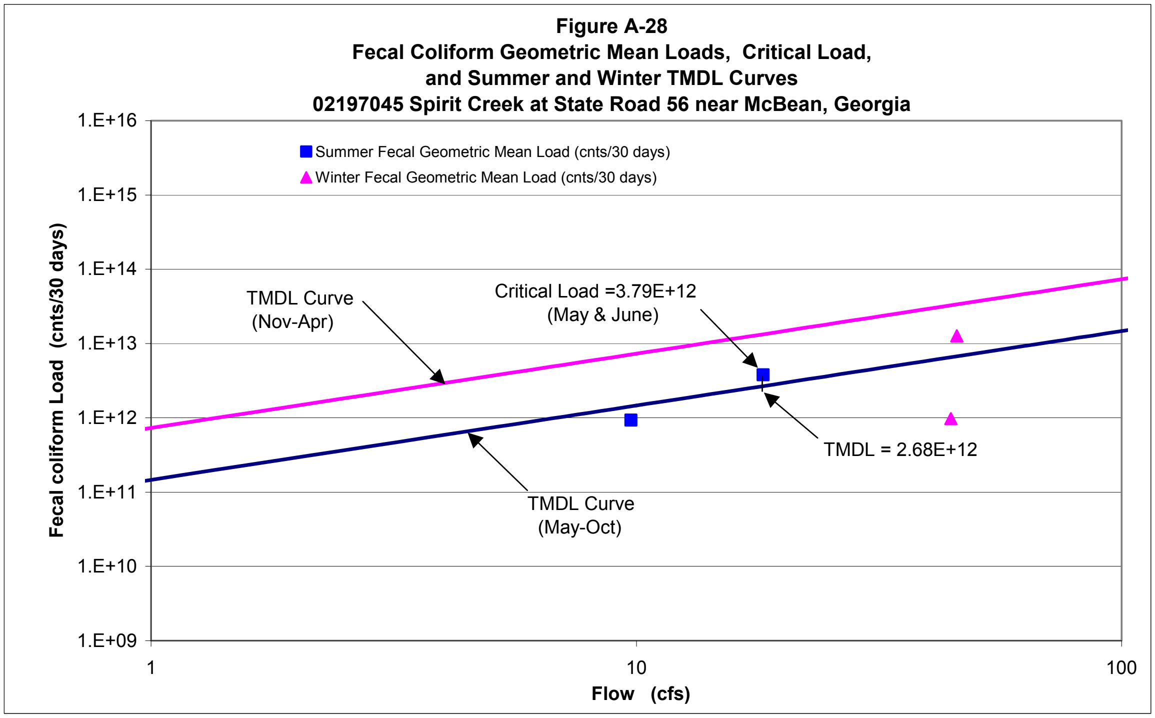


Table A-28. Data for Figure A-28

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
27-Feb-02	490	35.0				
7-Mar-02	50	42.0				
13-Mar-02	1700	66.0				
21-Mar-02	490	40.0	378	45.8	1.27E+13	3.36E+13
23-May-02	110	23.0				
5-Jun-02	170	20.0				
13-Jun-02	700	14.0				
18-Jun-02	490	16.0	283	18.3	3.79E+12	2.68E+12
15-Aug-02	20	7.0				
22-Aug-02	490	12.0				
27-Aug-02	330	10.0				
11-Sep-02	90	10.0	131	9.8	9.35E+11	1.43E+12
20-Nov-02	20	54.0				
2-Dec-02	50	32.0				
12-Dec-02	20	46.0				
19-Dec-02	40	46.0	30	44.5	9.77E+11	3.27E+13

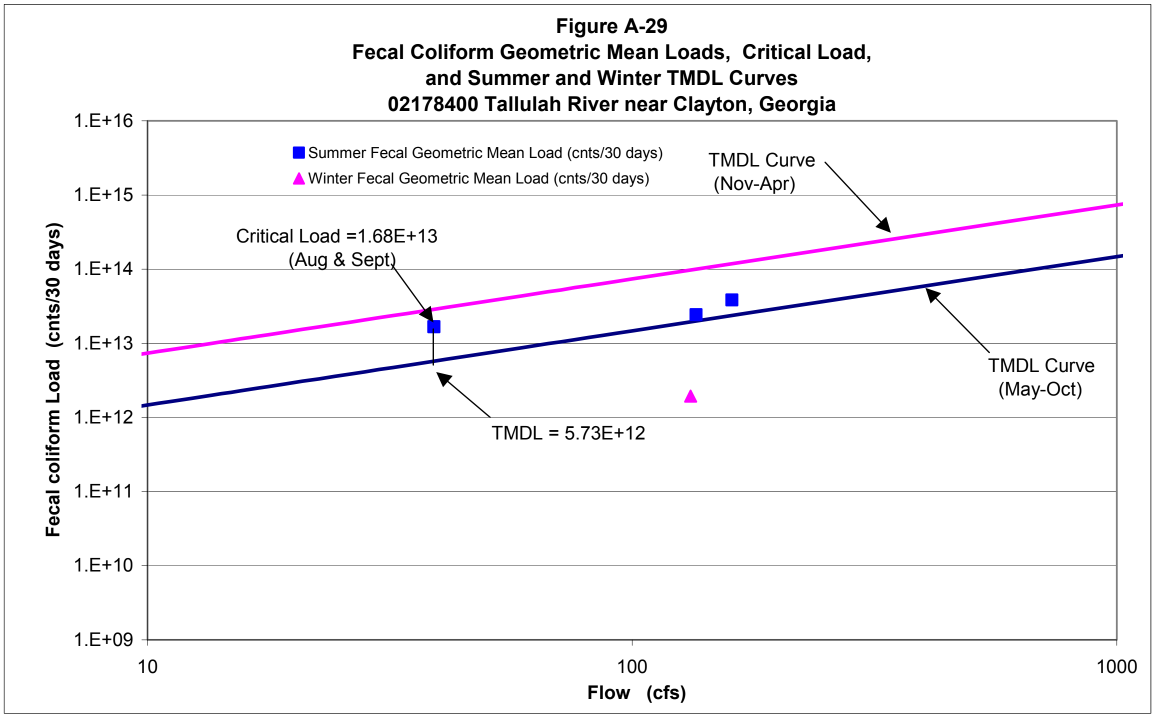


Table A-29. Data for Figure A-29

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
30-Jan-02	20	177.0				
13-Feb-02	20	137.0				
20-Feb-02	20	111.0				
25-Feb-02	20	103.0	20	132.0	1.94E+12	9.69E+13
8-May-02	70	200.0				
15-May-02	700	148.0				
21-May-02	70	142.0				
5-Jun-02	3300	153.0	326	160.8	3.85E+13	2.36E+13
21-Aug-02	490	36.0				
28-Aug-02	330	50.0				
4-Sep-02	330	40.0				
11-Sep-02	2200	30.0	585	39.0	1.68E+13	5.73E+12
1-Oct-02	50	139.0				
8-Oct-02	310	79.0				
16-Oct-02	700	244.0				
28-Oct-02	330	80.0	245	135.5	2.43E+13	1.99E+13

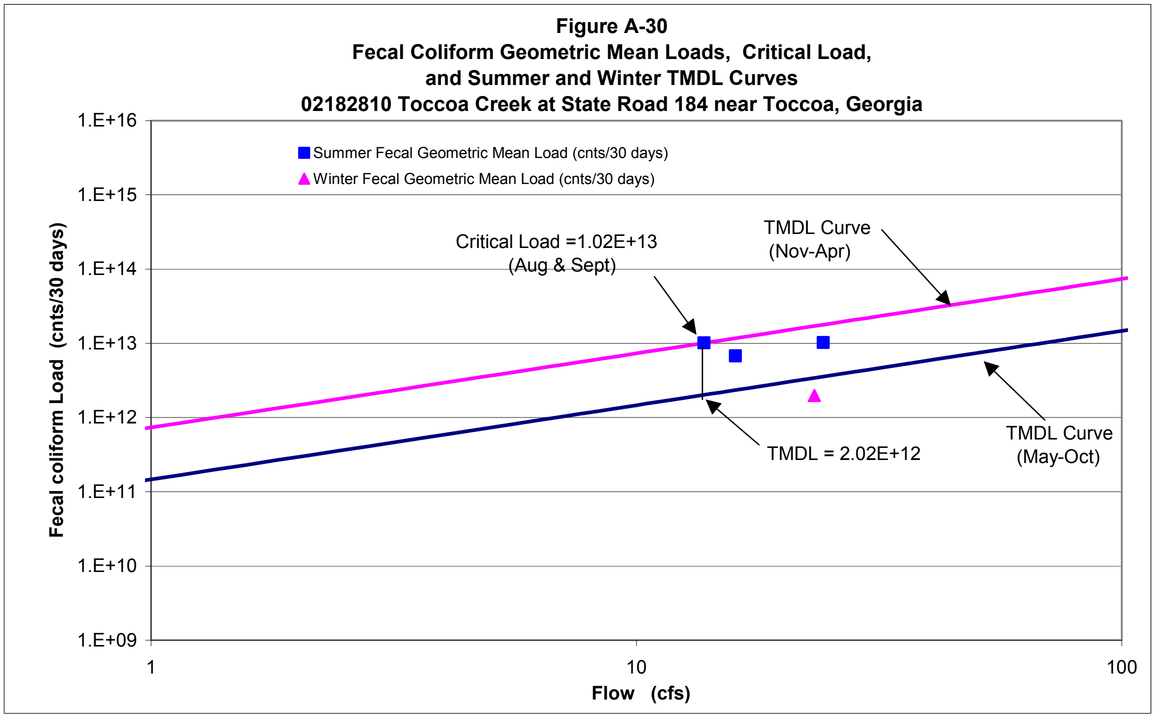


Table A-30. Data for Figure A-30

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
31-Jan-02	50	17.0				
7-Feb-02	790	46.0				
14-Feb-02	20	12.0				
21-Feb-02	230	18.0	116	23.3	1.98E+12	1.71E+13
9-May-02	790	21.0				
16-May-02	294	13.0				
22-May-02	210	15.0				
6-Jun-02	2300	15.0	579	16.0	6.80E+12	2.35E+12
22-Aug-02	330	4.1				
5-Sep-02	80	9.0				
12-Sep-02	1100	10.0				
18-Sep-02	35000	32.0	1004	13.8	1.02E+13	2.02E+12
1-Oct-02	460	19.0				
9-Oct-02	700	15.0				
17-Oct-02	490	34.0				
29-Oct-02	700	29.0	576	24.3	1.03E+13	3.56E+12

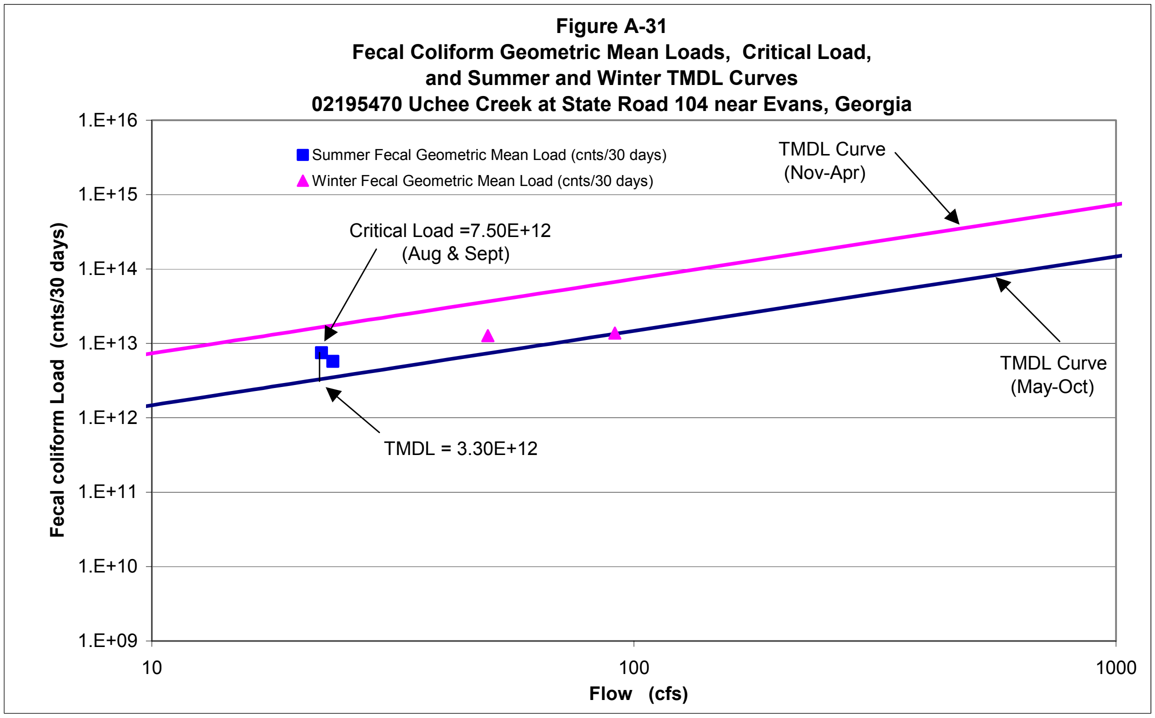


Table A-31. Data for Figure A-31

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
27-Feb-02	110	28.0				
7-Mar-02	130	45.0				
13-Mar-02	460	77.0				
21-Mar-02	2200	49.0	347	49.8	1.27E+13	3.65E+13
23-May-02	490	27.0				
5-Jun-02	630	28.0				
13-Jun-02	170	21.0				
18-Jun-02	220	19.0	328	23.8	5.71E+12	3.49E+12
15-Aug-02	460	11.0				
22-Aug-02	130	24.0				
28-Aug-02	2300	36.0				
11-Sep-02	310	19.0	454	22.5	7.50E+12	3.30E+12
20-Nov-02	80	190.0				
3-Dec-02	220	49.0				
11-Dec-02	220	54.0				
18-Dec-02	460	72.0	205	91.3	1.38E+13	6.70E+13

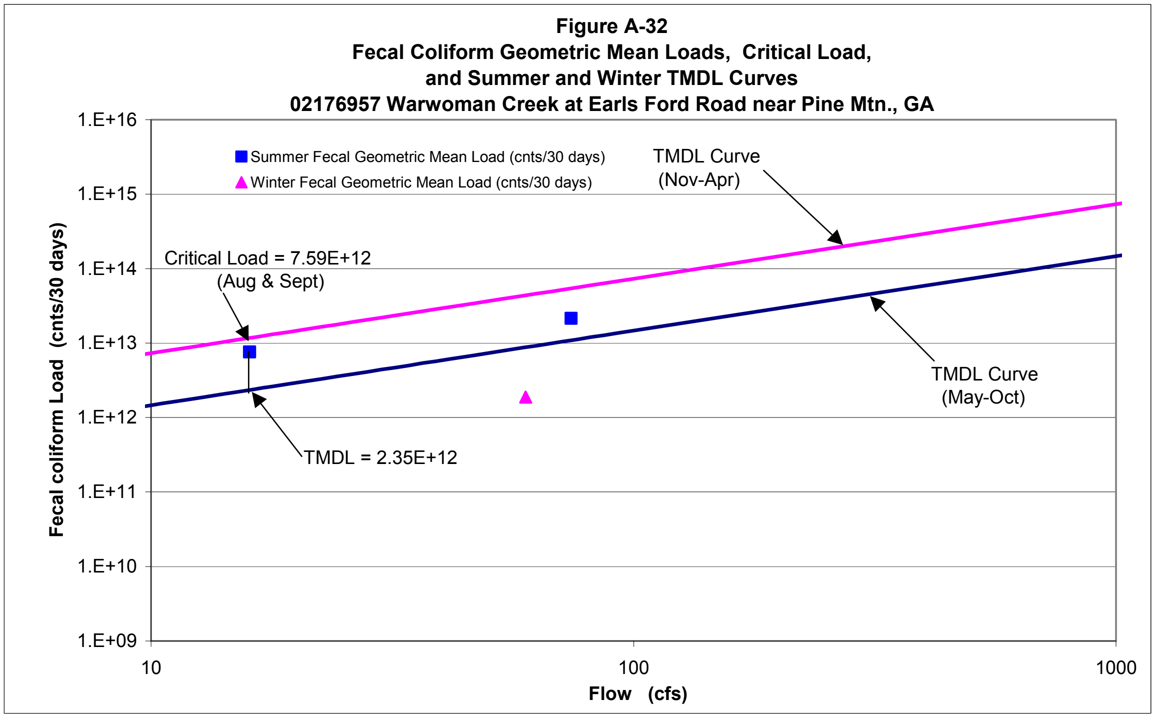
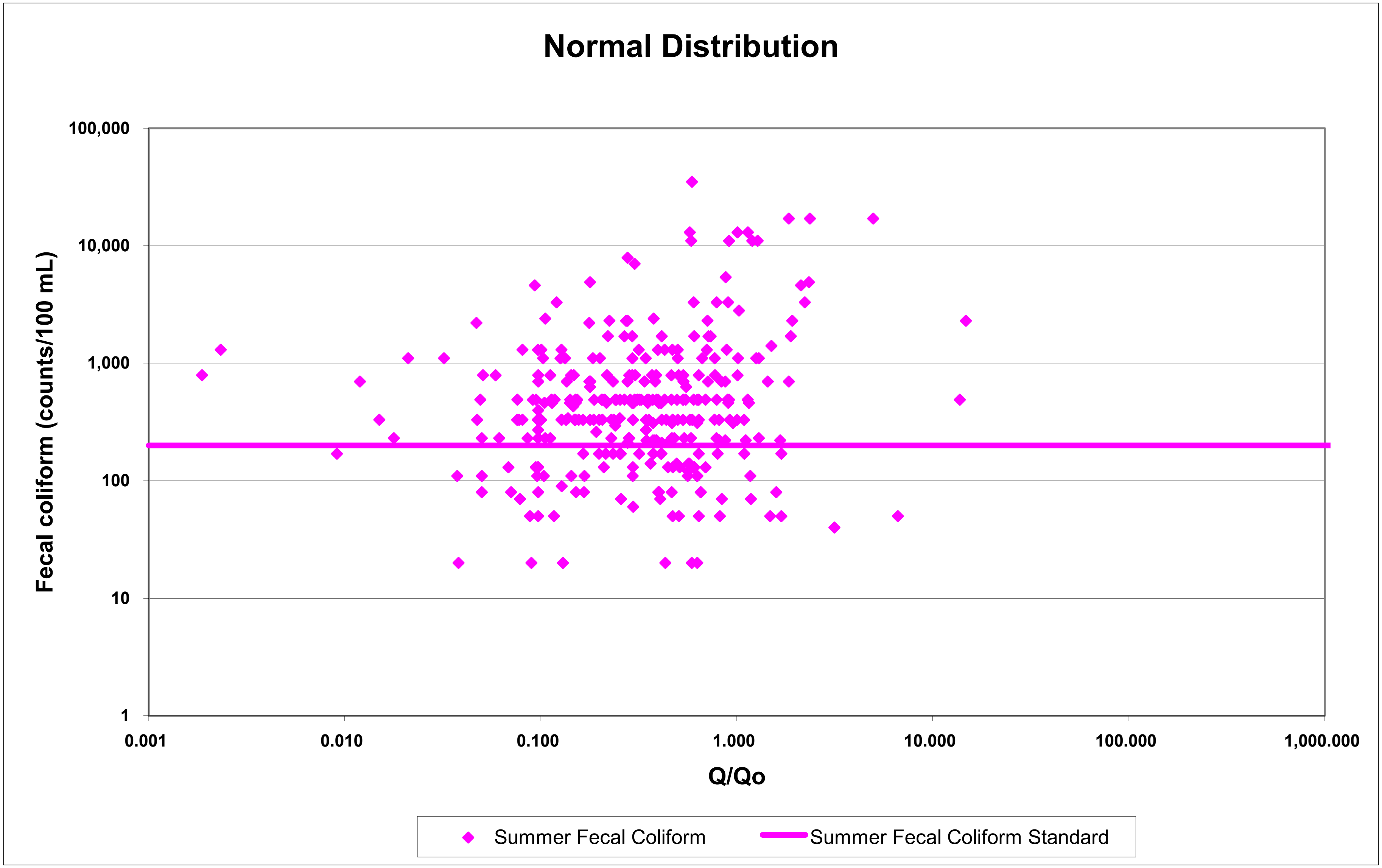


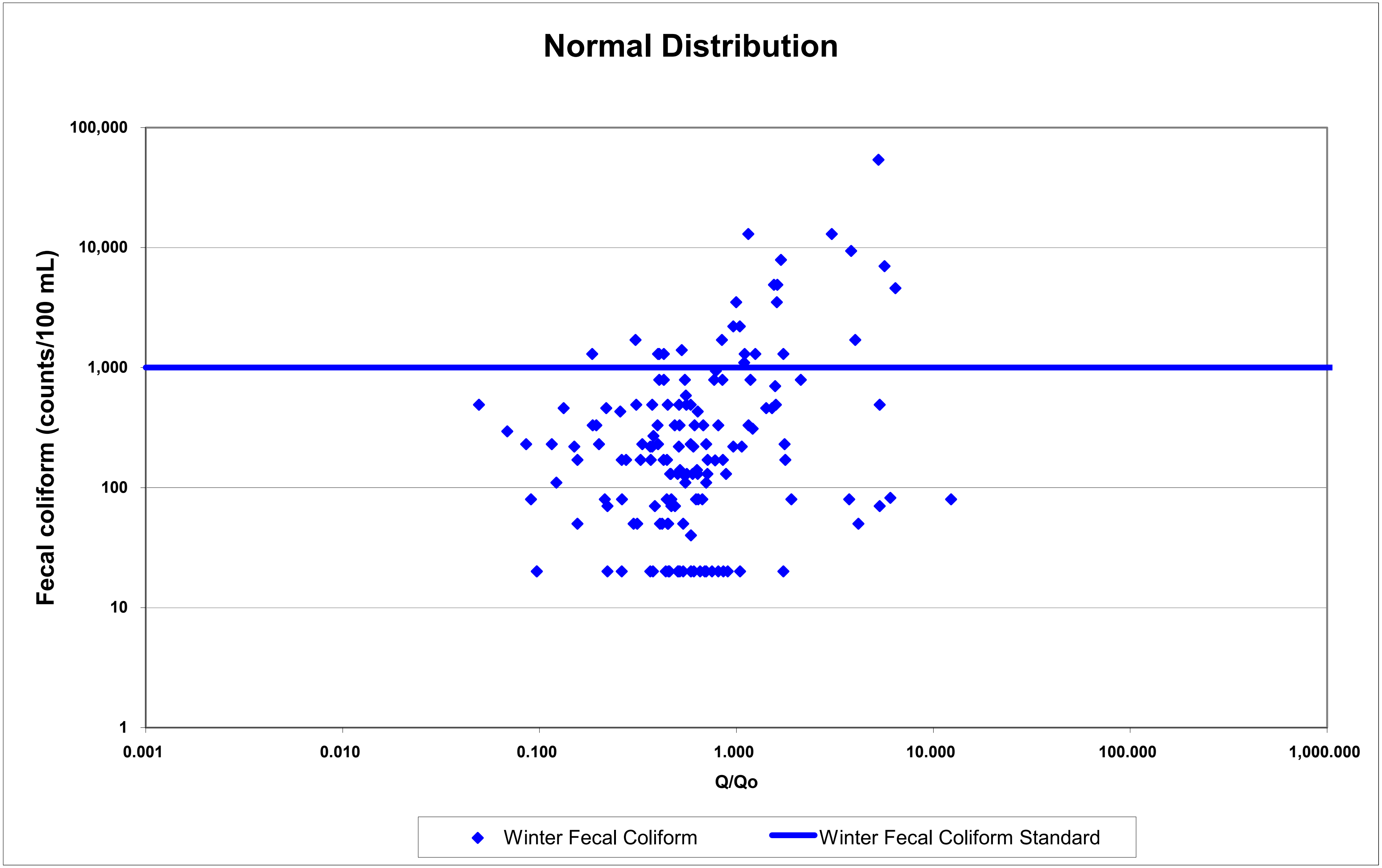
Table A-32. Data for Figure A-32

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
30-Jan-02	170	76.0				
13-Feb-02	20	67.0				
20-Feb-02	50	50.0				
25-Feb-02	20	46.0	43	59.8	1.88E+12	4.39E+13
8-May-02	170	85.0				
15-May-02	310	67.0				
21-May-02	140	61.0				
5-Jun-02	3300	84.0	395	74.3	2.15E+13	1.09E+13
21-Aug-02	330	16.0				
28-Aug-02	490	27.0				
4-Sep-02	490	16.0				
11-Sep-02	2200	5.0	646	16.0	7.59E+12	2.35E+12
28-Oct-02	110	67.0				

Appendix B

Normalized Flows Versus Fecal Coliform Plots


Normal Distribution
Fecal coliform (counts/100 mL)
100,000
10,000
1,000
100
10
1
0.001
0.010
0.100
1.000
10.000
100.000
1,000.000
Q/Qo
Summer Fecal Coliform
Summer Fecal Coliform Standard


Normal Distribution
Fecal coliform (counts/100 mL)
100,000
10,000
1,000
100
10
1
0.001
0.010
0.100
1.000
10.000
100.000
1,000.000
Q/Qo
Winter Fecal Coliform
Winter Fecal Coliform Standard