Total Maximum Daily Load

Evaluation

for

Twelve Stream Segments

in the

Flint 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, supporting designated use, not supporting designated use, or assessment pending, depending on water quality assessment results. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* (GA EPD, 2010 – 2011). This document is available on the Georgia Environmental Protection Division (EPD) website.

Some of the 305(b) 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 TMDLs in this document are based on the 2012 303(d) listing, which is available on the EPD website. 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.

Every water in the State has one or more designated uses, and each designated use has water quality criteria established to protect it. The State of Georgia has placed twelve stream segments in the Flint River Basin on the 303(d) list of impaired waters because they were assessed as "not supporting" their designated use of "Fishing" due to violation of the fecal coliform water quality criteria. The water quality criteria for fecal coliform bacteria for a water with a designated use of fishing are as follows: For the months of May through October, when water contact recreation activities are expected to occur, fecal coliform counts are 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. For the months of November through April, fecal coliform counts are 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. A water is assessed as "not supporting" its use if more than 10% of the geometric means exceeded the water quality criteria cited above. If no geometric means are available, a water is assessed as "not supporting" its use if more than 10 percent of individual samples exceed the fecal coliform criteria.

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 accumulated fecal coliform bacteria that wash off land surfaces as a result of storm events.

The process of developing fecal coliform bacteria TMDLs for the Flint 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.

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 bacteria delivered to a stream is difficult to determine. However, the use of these management practices should improve stream water quality, and future monitoring will provide a measurement of TMDL implementation.

Fecal Coliform Loads and Required Fecal Coliform Load Reductions

Stream Segment	Current Load (counts/ 30 days)	TMDL Components					Percent Reduction
		WLA (counts/ 30 days)	WLAsw (counts/ 30 days)	LA (counts/ 30 days)	MOS (counts/ 30 days)	TMDL (counts/ 30 days)	
Beaver Creek	1.22E+12	-	-	5.10E+11	5.67E+10	5.67E+11	54
Brantley Creek	6.27E+11	2.19E+11	-	1.29E+11	1.00E+10	1.00E+11	84
Flint River - Horse Creek to Spring Creek	6.76E+14	1.73E+11	1.08E+13	2.79E+14	3.22E+13	3.22E+14	52
Flint River - Flat Shoals Road to Taylor County Line	3.49E+15	-	3.97E+13	5.89E+14	6.98E+13	6.98E+14	80
Ichawaynochaway Creek	3.77E+13	-	-	2.95E+13	3.28E+12	3.28E+13	13
Jesters Creek	1.02E+14	-	1.50E+12	1.45E+12	3.28E+11	3.28E+12	97
Line Creek	4.28E+12	3.66E+11	3.11E+11	1.74E+12	2.69E+11	2.69E+12	37
Little Ichawaynochaway Creek	4.59E+14	1.59E+09	-	3.18E+13	3.53E+12	3.53E+13	92
Morning Creek	2.04E+14	-	7.19E+12	1.58E+13	2.55E+12	2.55E+13	88
Pachitla Creek	3.10E+13	-	-	1.14E+13	1.27E+12	1.27E+13	59
Spring Creek	1.60E+13	2.96E+11	-	1.15E+13	1.31E+12	1.31E+13	18
Whitewater Creek	2.2E+12	-	1.02E+11	4.17E+11	5.77E+10	5.77E+11	74

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 depending on water quality assessment results, supporting designated use, not supporting designated use, or assessment pending. 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* (GA EPD, 2010 – 2011). This document is available on the Georgia Environmental Protection Division (EPD) website.

A subset of the water bodies that do not meet designated uses, those in Category 5 on the 305(b) list, are assigned to Georgia's 303(d) list, named after that section of the CWA. Water bodies included in 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 criteria. The TMDLs in this document are based on the 2012 303(d) listing, which is available on the EPD website. 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 that are 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 twelve streams in the Flint River Basin included on the 2012 303(d) list for exceedances of the fecal coliform standard criteria.

Table 1. Water Bodies Listed on the 2012 303(d) List for Fecal Coliform Bacteria in the Flint River Basin

Stream Segment	Location	Reach ID	Segment Length (miles)	Designated Use
Beaver Creek	Headwaters to Spring Creek	R031300051411	11	Fishing
Brantley Creek	Downstream Dawson WPCP to Chickasawhatchee Creek	R031300090808	6	Fishing
Flint River	Flat Shoals Road to Taylor County Line	R031300060103	43	Fishing
Flint River	Horse Creek to Spring Creek	R031300051101	16	Fishing
Ichawaynochaway Creek	Chickasawhatchee Creek to Flint River	R031300091004	16	Fishing
Jesters Creek	East Jesters Creek to Flint River	R031300050122	3	Fishing
Line Creek	Line Creek WPCP to Flat Creek	R031300050206	2	Fishing
Little Ichawaynochaway Creek	Collins Mill Creek to Ichawaynochaway Creek	R031300090201	8	Fishing
Morning Creek	Headwaters to Flint River	R031300050123	12	Fishing
Pachitla Creek	Parkins Creek to Bay Branch near Edison	R031300090501	5	Fishing
Spring Creek	SR62 near Arlington to Aycocks Creek	R031300100502	22	Fishing
Whitewater Creek	Headwaters to Lees Lake	R031300050213	6	Fishing

1.2 Watershed Description

The Flint River Basin is located in the western third of the State of Georgia, and is entirely within the boundaries of the State. The River drains an area of approximately 8,460 square miles. The Basin contains parts of the Piedmont and Coastal Plain physiographic provinces that extend throughout the southeastern United States. The Flint River originates in the south side of Fulton County, in metropolitan Atlanta, by Hartsfield International Airport (Figure 1). The river flows south to Lake Blackshear and then to Lake Seminole. At this point, the Flint converges with the Chattahoochee River in Lake Seminole at the Georgia-Florida border. The outflow from Lake Seminole forms the Apalachicola River in Florida, which ultimately discharges to the Gulf of Mexico.

The Flint River basin includes six United States Geologic Survey (USGS) eight-digit hydrologic units, HUC 03130005 – 03130010. Figure 1 shows the locations of these sub-basins. Figure 2 shows the locations of the listed segments and associated counties in HUCs 03130005 and 03130006. Figure 3 shows the locations of the listed segments and associated counties in HUCs 03130009 and 03130010.

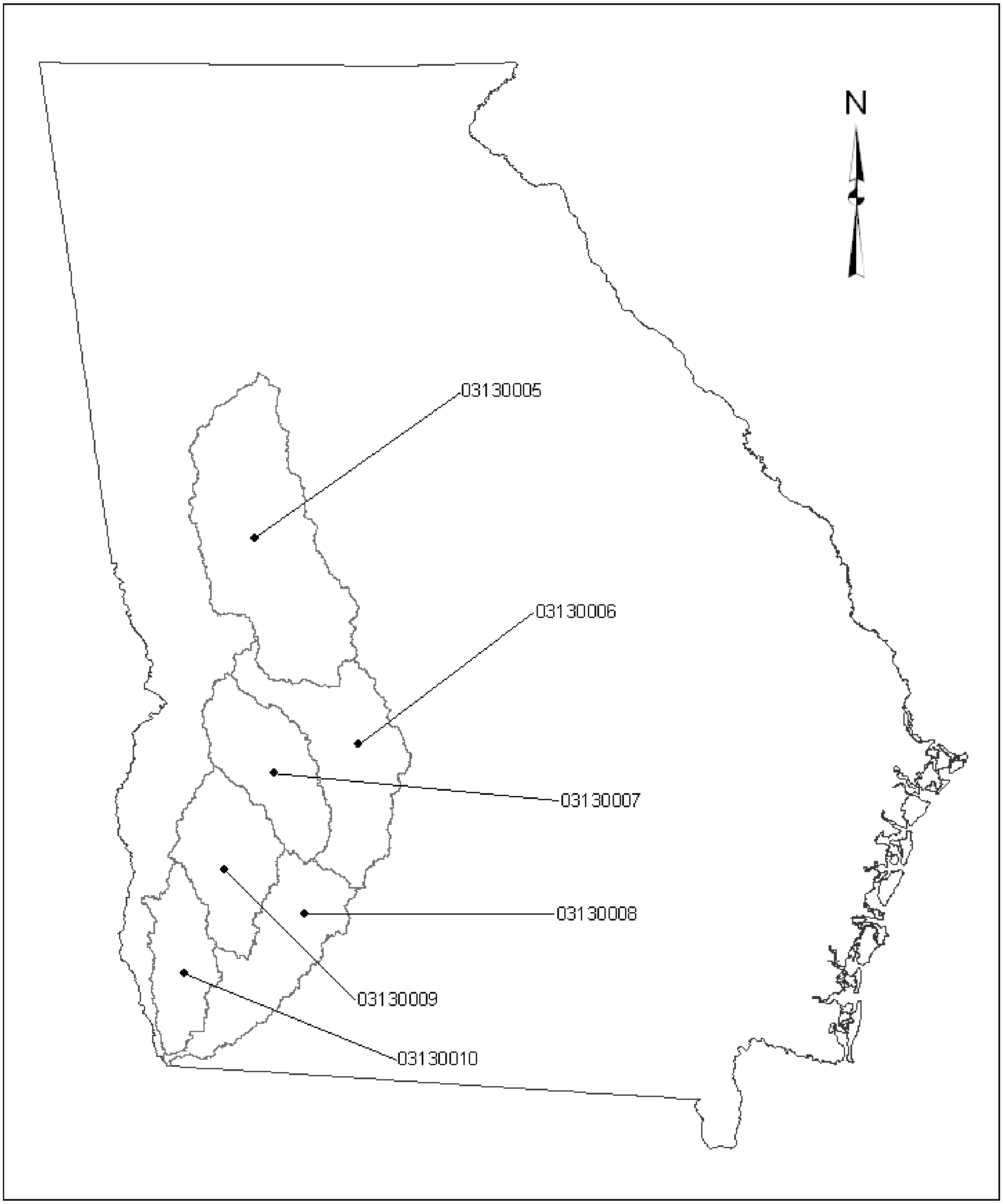
The land use characteristics of the Flint River Basin watersheds were determined using data from the Georgia Land Use Trends (GLUT) for Year 2008. This raster land use trend product was developed by the University of Georgia – Natural Resources Spatial Analysis Laboratory (NARSAL) and follows land use trends for years 1974, 1985, 1991, 1998, 2001, 2005 and 2008. The raster data sets were developed from Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+). Some of the NARSAL land use types were reclassified, aggregated into similar land use types, and used in the final watershed characterization. Table 2 lists the watershed land use distribution for the drainage areas of the twelve stream segments.

1.3 Water Quality Standard

The water use classification for the listed stream segments in the Flint River Basin is Fishing. The criterion violated is listed as fecal coliform. The potential causes 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, 2011), are:

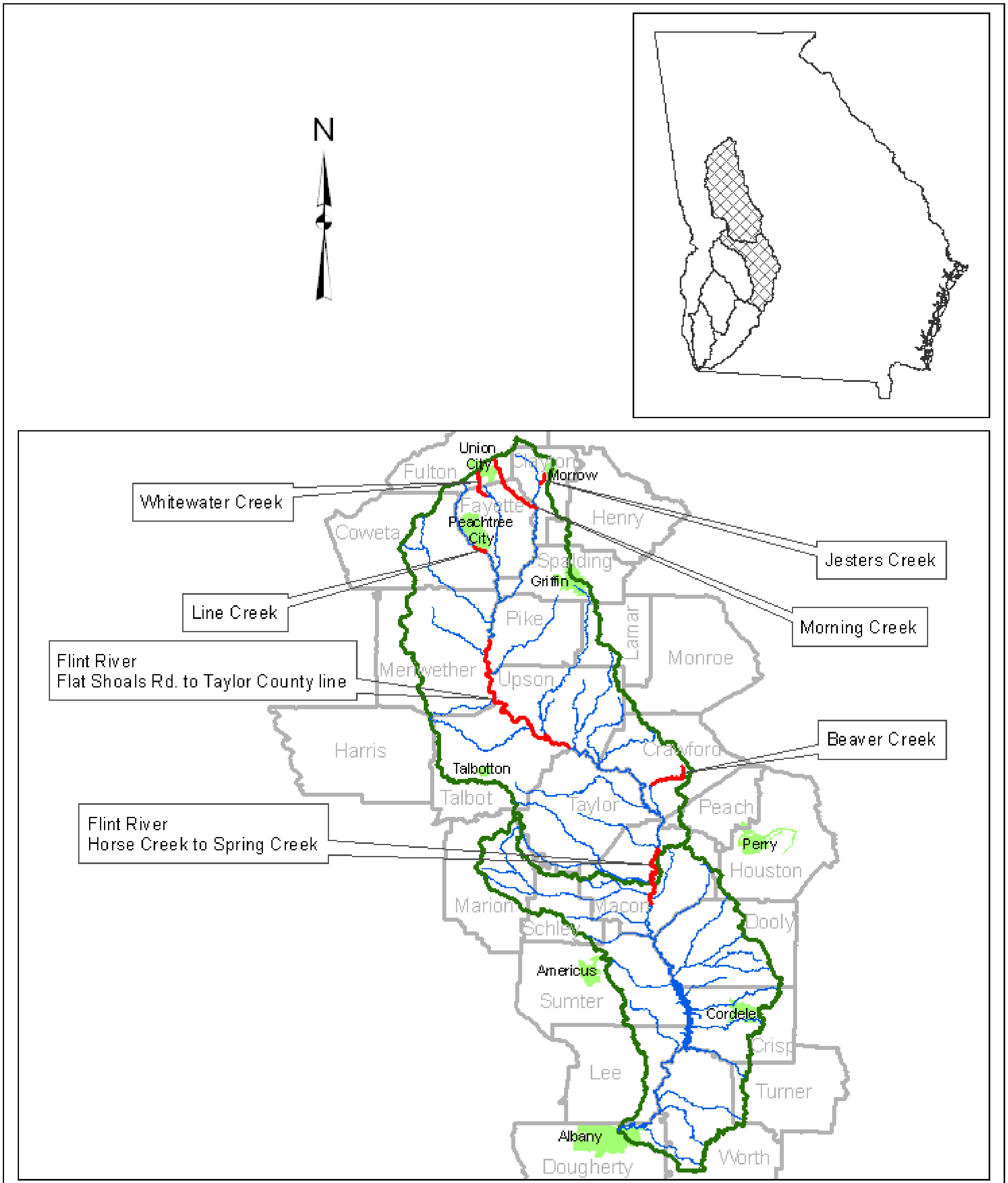
(c) Fishing: Propagation of Fish, Shellfish, Game and Other Aquatic Life; secondary contact recreation in and on the water; or for any other use requiring water of a lower quality:

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



TMDL Evaluation - Fecal Coliform
Flint River Basin

Figure 1. USGS 8-Digit Hucs for
Flint River Basin



**TMDL Evaluation - Fecal Coliform
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Figure 2. Impaired Stream Segments in HUCs 03130005 and 03130006

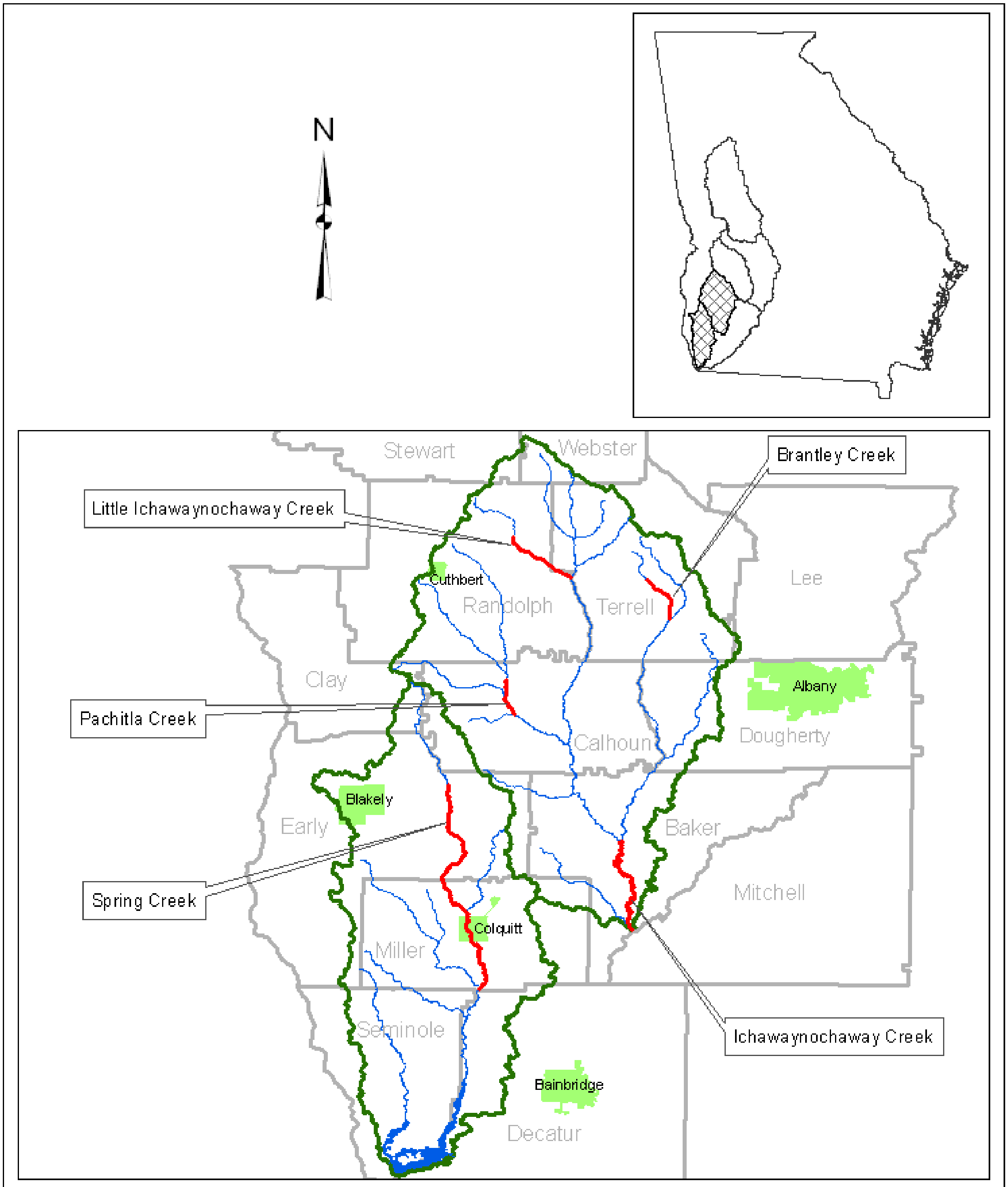

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Figure 3. Impaired Stream Segments in HUCs 03130009 and 03130010

Table 2. Flint River Basin Land Coverage

Stream/Segment	Land Use Categories - Acres (Percent)													
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total
Beaver Creek	141	336	53	7	45	493	2,069	7,767	2,101	1,030	585	1,168	24	15,820
	0.9%	2.1%	0.3%	0.04%	0.29%	3.1%	13.1%	49.1%	13.3%	6.5%	3.7%	7.4%	0.2%	100.0%
Brantley Creek	65	821	215	122	20	0	78	3,443	3,310	577	724	1,339	21	10,734
	0.6%	7.6%	2.0%	1.1%	0.2%	0.0%	0.7%	32.1%	30.8%	5.4%	6.7%	12.5%	0.2%	100.0%
Flint River - Horse Creek to Spring Creek	13,912	79,906	21,990	15,317	2,363	3,336	98,982	914,022	85,082	210,270	82,011	151,565	1,474	1,680,231
	0.8%	4.8%	1.3%	0.9%	0.1%	0.2%	5.9%	54.4%	5.1%	12.5%	4.9%	9.0%	0.09%	100.0%
Flint River - Flat Shoals Road to Taylor County Line	10,889	69,914	20,554	14,773	1,374	720	47,053	521,937	2,019	161,626	59,030	79,145	472	989,505
	1.1%	7.1%	2.1%	1.5%	0.14%	0.07%	4.8%	52.7%	0.2%	16.3%	6.0%	8.0%	0.05%	100.0%
Ichawaynochaway Creek	3,103	6,268	757	221	792	0	14,798	230,980	189,127	26,464	18,243	10,2090	3449	596,290
	0.5%	1.1%	0.1%	0.04%	0.1%	0.0%	2.5%	38.7%	31.7%	4.4%	3.1%	17.1%	0.6%	100.0%
Jesters Creek	14	2,246	1,077	1,185	483	360	60	843	0	54	1,082	301	5	7,711
	0.2%	29.1%	14.0%	15.4%	6.3%	4.7%	0.8%	10.9%	0.0%	0.7%	14.0%	3.9%	0.07%	100.0%
Line Creek	471	6,228	1,763	1,233	44	321	1,842	17,489	55	5,159	3,895	3,782	12	42,294
	1.1%	14.7%	4.2%	2.9%	0.1%	0.8%	4.4%	41.4%	0.1%	12.2%	9.2%	8.9%	0.03%	100.0%
Little Ichawaynochaway Creek	126	371	46	6	30	0	1,840	16,772	11,714	1,510	1,037	2,337	34	35,823
	0.4%	1.0%	0.1%	0.02%	0.08%	0.0%	5.1%	46.8%	32.7%	4.2%	2.9%	6.5%	0.09%	100.0%
Morning Creek	152	5,251	2,167	1,561	47	74	578	6,816	54	1,694	3,248	1,979	32	23,654
	0.6%	22.2%	9.2%	6.6%	0.2%	0.3%	2.4%	28.8%	0.2%	7.2%	13.7%	8.4%	0.1%	100.0%
Pachitla Creek	402	842	107	46	141	0	4,064	50,425	31,851	3,947	3,393	10,060	122	105,400
	0.4%	0.8%	0.1%	0.04%	0.1%	0.0%	3.9%	47.8%	30.2%	3.7%	3.2%	9.5%	0.1%	100.0%
Spring Creek	535	3,774	665	215	318	0	3,650	51,608	85,933	13,090	7,576	40,819	2,404	210588
	0.3%	1.8%	0.3%	0.1%	0.2%	0.0%	1.7%	24.5%	40.8%	6.2%	3.6%	19.4%	1.1%	100.0%
Whitewater Creek	46	1,206	486	394	1,394	836	181	2,232	1	768	614	414	2	8,575
	0.5%	14.1%	5.7%	4.6%	16.3%	9.7%	2.1%	26.0%	0.01%	9.0%	7.2%	4.8%	0.02%	100.0%

2.0 WATER QUALITY ASSESSMENT

Stream segments are placed on the 303(d) list as not supporting their water use classification based on water quality sampling data. A stream is placed on this list if more than 10% of the samples exceed the fecal coliform criteria. 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 used for TMDLs developed in this document were collected during calendar years 2010 and 2011 by EPD as part of the trend monitoring program. Additional data submitted by Clayton and Fulton Counties and the United States Geological Survey (USGS) was also assessed. These data 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. There are two basic kinds of NPDES permits: 1) municipal and industrial wastewater treatment facilities, and 2) regulated stormwater discharges.

3.1.1 Wastewater Treatment Facilities

In general, municipal and industrial 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 United States Environmental Protection Agency (USEPA) 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 USEPA 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.

Discharges from municipal and industrial wastewater treatment facilities can contribute fecal coliform to receiving waters. There are ten NPDES permitted discharges with a flow greater than 0.1 MGD identified in the Flint River Basin that could potentially impact streams on the 2012 303(d) list for fecal coliform bacteria. Table 3 provides the monthly average discharge flow and fecal coliform concentrations for these facilities. This data was obtained from calendar year 2011 Discharge Monitoring Reports (DMR). The permitted fecal coliform concentration is also included in this table.

Combined sewer systems convey a mixture of raw sewage and stormwater 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 five permitted CSO outfalls in the Flint River Basin. None of these CSO outfalls is upstream of the listed segments.

Table 3. NPDES Facilities Discharging Fecal Coliform Bacteria into Flint River Basin 303(d) Listed Stream Segments

Facility Name	NPDES Permit No.	Receiving Stream	303(d) Listed Segment	Actual 2011 Discharge		NPDES Permit Limits		Number of Fecal Coliform/ Flow Violations[b] 2009–2011
				Average Monthly Flow (MGD)[a]	Average Monthly FC (No./100mL)	Average Monthly Flow (MGD)	Average Monthly FC (No./100mL)	
Dawson WPCP	GA0021326	Brantley Creek	Brantley Creek	1.08	18.5	2.5	200	3/7
Marshallville WPCP	GA0047431	Spring Hill Creek	Flint River - Horse Creek to Spring Creek	0.03	59.71	0.12	200	1/15
Montezuma WPCP #2	GA0020486	Spring Creek		0.66	23	1.95	200	0
Oglethorpe Pond	GA0036919	Flint River		0.25	5.42	0.75	200	4/0
Peachtree City – Line Creek WPCP	GA0035777	Line Creek	Line Creek	0.63	5.42	Nov-April 1.1 May-Oct 0.7	Nov-April 200 May-Oct 23	0/1 2/9
Peachtree City - Rockaway WPCP	GA0046655	Line Creek Tributary		1.62	8.25	4	200	0/2
Shellman WPCP	GA0032361	Little Ichawaynochaway Creek Tributary	Little Ichawaynochaway Creek	0.026	10.8	0.15	200	0/2
Arlington - Pond #1 Wood Valley Road WPCP	GA0026204	Perry Creek	Spring Creek	0.09	2.5	0.4	200[c]	0[c]/18
Blakely WPCP	GA0025585	Baptist Branch		0.94	1.58	2	200	3/13
Colquitt WPCP	GA0047252	Spring Creek		0.20	8.33	0.4	200	0/10

Source: EPD

Notes: [a] Values shown are the annual average of the monthly average flows.
[b] Both monthly and weekly violations included.
[c] Fecal Coliform permit limit added in December 2010. Fecal violations only calculated for 2011.

3.1.2 Regulated Stormwater Discharges

Some stormwater runoff is covered under the NPDES Permit Program as a point source. Some industrial facilities included under the program will have limits similar to traditional NPDES-permitted dischargers, whereas others establish controls: "to the maximum extent practicable" (MEP). Currently, regulated stormwater discharges that may contain fecal coliform bacteria consist of those associated with industrial activities and large, medium, and small municipal separate storm sewer systems (MS4s) that serve populations of 50,000 or more.

3.1.2.1 Industrial General Stormwater NPDES Permit

Stormwater discharges associated with industrial activities are currently covered under the 2012 General Storm Water NPDES Permit (GAR050000), also called the Industrial General Permit (IGP). This permit requires visual monitoring of stormwater discharges, site inspections, implementation of Best Management Practices (BMPs), and record keeping. The IGP requires that stormwater discharging into an impaired stream segment or within one linear mile upstream of, and within the same watershed as, any portion of an impaired stream segment identified as "not supporting" its designated use(s), must satisfy the requirements of Appendix C of the 2012 IGP if the pollutant(s) of concern for which the impaired stream segment has been listed may be exposed to stormwater as a result of industrial activity at the site. If a facility is covered under Appendix C of the IGP, then benchmark monitoring for the pollutant(s) of concern is required.

3.1.2.2 MS4 NPDES Permits

Stormwater 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 stormwater discharge under Phase I. This includes 58 permittees in Georgia.

Phase I MS4 permits require the prohibition of non-stormwater 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 Stormwater Management Plan (SWMP) outlining appropriate controls is required by and referenced in the permit. There are 15 Phase I MS4s in the Flint River Basin (Table 4).

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

Name	River Basins
Atlanta	Flint, Chattahoochee, Ocmulgee
Clayton County	Flint, Ocmulgee
College Park	Flint, Chattahoochee
East Point	Flint, Chattahoochee, Ocmulgee
Fairburn	Flint, Chattahoochee
Forest Park	Flint, Ocmulgee
Fulton County	Flint, Chattahoochee, Ocmulgee, Coosa
Hapeville	Flint, Ocmulgee
Jonesboro	Flint, Ocmulgee
Lake City	Flint, Ocmulgee
Lovejoy	Flint, Ocmulgee
Morrow	Flint, Ocmulgee
Palmetto	Flint, Chattahoochee
Riverdale	Flint
Union City	Flint, Chattahoochee

Source: Nonpoint Source Program, EPD, 2011

Small MS4s serving urbanized areas are required to obtain a stormwater permit under the Phase II stormwater regulations. An urbanized area is defined as an area with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. Twenty-nine counties, 58 cities, and 5 Department of Defense facilities are permitted under the Phase II regulations in Georgia. There are 15 Phase II MS4s in the Flint River Basin (Table 5).

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

Name	River Basins
Albany	Flint
Cordele	Flint
Coweta County	Flint, Chattahoochee
Dougherty County	Flint
Fayette County	Flint
Fayetteville	Flint
Griffin	Flint, Ocmulgee
Hampton	Flint, Ocmulgee
Henry County	Flint, Ocmulgee
Lee County	Flint
Leesburg	Flint
Newnan	Flint, Chattahoochee
Peachtree City	Flint
Tyrone	Flint
Spalding County	Flint, Ocmulgee

Source: Nonpoint Source Program, EPD, 2012

Table 6 lists the Phase I or Phase II MS4 city or county urbanized areas upstream of listed segments in the Flint River Basin. The table provides the total area of this watershed and the percentage of the watershed that is MS4 city or county urbanized area.

Table 6. Percentage of MS4 City or County Urbanized Area Upstream of 303(d) Listed Segments in the Flint River Basin

Stream Segment	Location	Total Area (square miles)	% In MS4 Urbanized Area
Flint River	Flat Shoals Road to Taylor County Line	139.75	5.3
Flint River	Horse Creek to Spring Creek	139.63	9.0
Jesters Creek	East Jesters Creek to Flint River	8.73	72.5
Line Creek	Line Creek WPCP to Flat Creek	14.29	21.6
Morning Creek	Headwaters to Flint River	16.53	44.7
Whitewater Creek	Headwaters to Lees Lake	3.78	28.2

3.1.3 Concentrated Animal Feeding Operations

Under the Clean Water Act, Concentrated Animal Feeding Units (CAFOs) are defined as point sources of pollution and are therefore subject to NPDES permit regulations. From 1999 through 2001, Georgia adopted rules for permitting swine and non-swine liquid manure animal feeding operations (AFOs). Georgia rules require medium size AFOs with more than 300 animal units (AU) but less than 1000 AU to apply for a non-discharge State land application system (LAS) waste disposal permit. Large operations with more than 1000 AU must apply for an NPDES permit (also non-discharge) as a CAFO. Table 7 presents the swine and non-swine liquid manure CAFOs located upstream of the listed segments in the Flint River Basin that are registered or have land application permits.

Table 7. Registered Liquid Manure CAFOs Upstream of 303(d) Listed Segments in the Flint River Basin

Name	303(d) Listed Stream Segment	County	Animal Type	Total Number of Animals	Permit No.
Barrington Dairy	Flint River Horse Creek to Spring Creek	Macon	Dairy	2901	GAG930000
Big Hill Dairy		Macon	Dairy	?	GAU700000
Outback Dairy		Macon	Dairy	90305	GAU700000
Peachy, Joe I.	Little Ichawaynochaway Creek	Randolph	Dairy	72983	GAU700000

Source: GA Dept. of Agriculture, 2012

In 2002, the USEPA promulgated expanded NPDES permit regulations for CAFOs that added dry manure poultry operations larger than 125,000 broilers or 82,000 layers. Georgia is consistently among the top three states in the U.S. in terms of poultry operations. The majority of poultry farms are dry manure operations where the manure is stored for a time and then land applied. Freshly stored litter can be a nonpoint source of fecal coliform. However, land applied litter that was previously stored for an extended length of time typically exhibits very low fecal coliform levels. Table 8 presents the dry manure poultry operations located upstream of the listed segments in the Flint River Basin that have submitted an application for the General NPDES Permit GAG930000.

Table 8. Registered Dry Manure Poultry Operations Upstream of 303(d) Listed Segments in the Flint River Basin

Name	303(d) Listed Stream Segment	County	Number of Animals (thousands)	Permit Status
Phu Farm	Flint River	Taylor	152	P
Binh Farm (Binh Poultry)	Flint River Horse Creek to Spring Creek	Taylor	125	NAI
Brandon Farm		Marion	141	P
Bryan's Run Poultry, Inc.		Marion	200	P
C & K Farms		Macon	174	P
Chapman Farms		Marion	144	P
Dominic Le Poultry Farm		Macon	165	P
Gardner Poultry		Marion	142	P
Gin Creek Farm & D & D Poultry		Marion	260	P
Long Le		Macon	142	P
Lunn Farm		Taylor	231	P
Mayan Farm		Macon	168	I
Morning Dew Poultry Farm		Macon	136	I
Nguyen, Binh T		Macon	162	NAI
Persimmon Farm		Macon	56	NAI
Rainbow Farm		Marion	141	P
Read Oak Farm		Macon	253	P
Rodgers Poultry		Schely	197	P
Shoal Creek Poultry		Marion	143	P
SVL Farm		Macon	168	I
Thanh T.(Angela) Ho		Taylor	190	NAI
Triple Oaks Farm		Macon	200	P
Van Son Farm		Macon	162	I
Wendell Swartzentruber		Macon	150	NAI
Xaisana Farm		Macon	160	I
Xuan-Ha Thi Ho		Macon	178	NAI
Bug's Hollow	Ichawaynochaway Creek	Baker	180	NAI
Toal Enterprises, Inc (T & C Farms)	Pachitla Creek	Calhoun	264	P

Source: GA Dept. of Agriculture, 2012
Notes: I = Issued
P = permit pending
NAI = needs additional information for application

The USEPA CAFO regulations were successfully appealed in 2005 and revised to comply with the court decision. That decision limits permitting to actual discharges rather than those with a potential to discharge. Georgia's rules will be revised by the end of 2012 to incorporate the USEPA revisions. The NPDES permitted CAFO community is expected to be markedly reduced; however, the revised state rules will continue LAS permitting of medium size liquid manure AFOs and extend LAS permitting to large liquid manure AFOs with more than 1000 AU, unless they elect to obtain an NPDES permit.

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 stormwater runoff may be collected in 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 watersheds. 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. Recently, rapidly expanding feral swine populations have become a significant presence in the floodplain areas of all the major rivers in Georgia. Population estimates of these animal species in Georgia are currently not available.

White-tailed deer populations are abundant throughout the Flint River Basin. Fecal coliform bacteria contributions to water bodies from deer are generally considered to be 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 for terrestrial birds (GA WRD, 2007). However, feces deposited on the land surface can result in the introduction of fecal coliform to streams during runoff events. Between storm events, considerable decomposition of the fecal matter might occur, resulting in a decrease in the associated fecal coliform numbers.

3.2.2 Agricultural Livestock

Agricultural livestock are a potential source of fecal coliform to streams in the Flint River Basin. The animals grazing on pastureland deposit their feces onto land surfaces, where it can then 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 9 provides the estimated number of beef cattle, dairy cattle, goats, horses, swine, sheep, and chickens reported by county. These data were provided by the Natural Resources Conservation Service (NRCS).

Table 9. 2009 Estimated Agricultural Livestock Populations in the Flint River Basin

County	Livestock								
	Beef Cattle	Dairy Cattle	Swine	Sheep	Horses	Goats	Chickens -Layers	Chickens-Broilers Sold	Chickens-Breeders
Baker	4,100	50	50	-	20	450	176,000	8,280,000	-
Calhoun	4,500	-	30	-	40	-	-	6,048,000	-
Chattahoochee	-	-	-	-	-	-	-	-	-
Clay	5,000	-	20	-	40	60	-	-	-
Clayton	-	-	-	-	-	2,000	-	-	-
Colquitt	14,450	500	40	50	120	1,500	294,000	61,991,050	462,000
Coweta	3,750	350	-	25	500	200	-	-	-
Crawford	1,500	-	-	-	200	200	-	12,525,500	-
Crisp	3,900	-	280	-	200	1,300	-	2,721,600	-
Decatur	5,000	700	230	-	-	1,000	80,000	8,160,000	-
Dooly	2,000	275	350	-	50	200	-	8,784,000	-
Dougherty	2,000	-	-	175	100	500	-	460,000	-
Early	14,600	-	30	-	120	90	-	368,000	-
Fayette	195	-	-	10	248	260	-	-	-
Fulton	6,000	-	-	50	-	150	-	-	-
Grady	7,250	1,235	115	25	680	935	83,700	8,797,500	321,600
Henry	7,345	-	-	45	750	275	-	-	-
Houston	800	350	-	20	275	275	-	3,795,000	-
Lamar	2,700	200	25	25	350	1,500	-	8,112,500	-
Lee	3,000	3,000	50	-	75	200	-	-	-
Macon	3,000	12,000	-	-	400	800	286,000	32,340,000	352,000
Marion	2,700	-	20	400	30	900	42,000	9,823,000	56,000
Meriwether	7,000	180	-	375	300	3,600	-	-	-
Miller	11,000	-	1,000	-	50	250	-	900,000	-
Mitchell	9,475	4,100	1,020	60	940	375	160,000	25,932,500	-
Monroe	3,850	200	-	40	300	1,200	-	10,898,349	-
Peach	800	-	-	-	225	100	-	-	-
Pike	2,600	220	-	75	400	200	-	3,510,000	-
Randolph	2,300	190	60	-	50	75	-	-	-
Schley	750	-	200	-	-	125	20,000	18,867,200	-
Seminole	3,800	99	250	-	300	450	-	-	-
Spalding	1,700	350	-	-	200	100	-	1,020,000	-
Stewart	1,000	-	20	-	150	200	-	1,292,500	-
Sumter	2,000	2,400	-	35	500	1,200	-	7,963,200	90,000
Talbot	7,000	40	500	-	250	100	-	-	-
Taylor	4,000	-	100	-	300	500	-	7,762,500	-
Terrell	5,700	-	100	15	350	250	-	-	-
Turner	7,500	-	-	60	200	2,500	-	4,400,000	-
Upson	3,700	400	-	15	400	1,200	-	7,280,000	-
Webster	2,500	-	50	10	125	250	-	493,500	-
Worth	9,000	950	10	15	250	1,850	20,000	2,070,000	-

Source: NRCS, 2011

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 bacteria enter streams by direct washoff from the land surface, or the runoff may be diverted to a stormwater collection system and discharged through a discrete outlet structure. For large, medium, and small urban areas (populations greater than 50,000), the stormwater outlets are regulated under MS4 permits (see Section 3.1.2). For smaller urban areas, the stormwater 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 bacteria may also enter streams from leaky sewer pipes, or during storm events when inflow and infiltration can cause sewer overflows.

3.2.3.1 Leaking Septic Systems

A portion of the fecal coliform contributions in the Flint River Basin may be attributed to failure of septic systems and illicit discharges of raw sewage. Table 10 presents the number of septic systems in each county of the Flint River Basin existing in 2006 and the number existing in 2011, based in part on U.S. Census data, and 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 five-year period from 2007 through 2011 is given. These data show an increase in the number of septic systems in all of the counties. Often, this is a reflection of population increases outpacing the expansion of sewage collection systems.

Table 10. Estimated Number of Septic Systems in the Flint River Basin

County	Existing Septic Systems (2006)[1]	Existing Septic Systems (2011)	Number of Septic Systems Installed (2007 to 2011)	Number of Septic Systems Repaired (2007 to 2011)
Baker	1,860	1,945	85	44
Calhoun	1,181	1,227	46	17
Chattahoochee	1,154	1,212	58	14
Clay	1,184	1,272	88	7
Clayton	14,173	14,225	52	539
Colquitt	12,145	12,873	728	447
Coweta	29,026	31,430	2404	645
Crawford	4,294	4,480	186	72
Crisp	5,338	5,539	201	112
Decatur	9,246	9,764	518	288
Dooly	2,467	2,556	89	36
Dougherty	8,929	9,184	255	355
Early	4,032	4,203	171	67
Fayette	20,149	20,786	640	484
Fulton	27,491	28,039	548	436
Grady	7,667	8,225	558	206
Henry	37,217	38,419	1202	404
Houston	17,597	18,434	837	451
Lamar	5,499	5,794	295	89
Lee	8,788	9,495	707	388
Macon	2,476	2,579	103	25
Marion	2,263	2,411	148	27
Meriwether	8,658	9,033	375	122
Miller	2,481	2,609	128	59
Mitchell	6,970	7,398	428	203
Monroe	9,114	9,730	616	158
Peach	6,294	6,595	301	57
Pike	7,020	7,506	486	101
Randolph	1,681	1,771	90	7
Schley	1,339	1,459	120	13
Seminole	4,559	4,647	88	67
Spalding	15,809	16,437	628	366
Stewart	1,018	1,084	66	11
Sumter	6,615	6,837	222	136
Talbot	2,748	2,888	140	27
Taylor	2,678	2,855	177	8
Terrell	2,751	2,831	80	38
Turner	2,002	2,091	89	22
Upson	8,158	8,411	253	304
Webster	1,174	1,268	94	4
Worth	7,284	7,284	0	179

Source: The Georgia Dept. of Human Resources, Division of Public Health, 2012
Notes: [1] Adjusted from State Water Plan values

3.2.3.2 Land Application Systems

Some communities and industries use land application systems (LAS) for their wastewater. These facilities are required through LAS permits to dispose of their treated wastewater by land application, and to operate as non-discharging systems, that do not contribute wastewater runoff to surface waters. However, sometimes these facilities exceed the ground percolation rate when applying the wastewater, or encounter unexpected precipitation, resulting in surface runoff from the field. This runoff could contribute fecal coliform bacteria to nearby surface waters. Runoff of stormwater might also carry surface residual containing fecal coliform bacteria. There are six permitted LAS system with flows greater than 0.1 MGD identified in the Flint River Basin that could potentially impact streams on the 2012 303(d) list for fecal coliform bacteria (Table 11).

Table 11. Permitted Land Application Systems Upstream of 303(d) Listed Segments in the Flint River Basin

LAS Name	303(d) Listed Stream Segment	County	Permit No.	Type	Flow (MGD)
Manchester LAS	Flint River Flat Shoals Rd. to Taylor County line	Meriwether	GA02-081	Municipal	0.812
Southern Mills Inc. - Plant Ray - 1		Upson	GA01-578	Industrial	0.5
McIntosh Trail Village	Line creek	Coweta	GA03-663	PID	0.25
Peachtree City - Rockaway LAS		Fayette	GA02-299	Municipal	1.0
Southern Mills Inc. - Plant Ray - 2	Morning Creek	Fulton	GA01-578	Industrial	0.5
American Proteins, Inc.	Pachitla Creek	Randolph	GA01-509	Industrial	0.345

Source: Permitting Compliance and Enforcement Program, EPD, Atlanta, Georgia, 2011

3.2.3.3 Landfills

Leachate from landfills may contain fecal coliform bacteria that could at some point reach 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 143 known landfills in the Flint River Basin. Of these, 14 are active landfills, 5 are in closure and 124 are inactive or closed. Table 12 presents the landfills that are upstream of the 303(d) listed stream segments.

Table 12. Landfills Upstream of 303(d) Listed Segments in the Flint River Basin

Name	303(d) Listed Stream Segment	County	Permit No.	Status
Crawford Co. - Co. Rd. 48	Beaver Creek	Crawford	-	Inactive
City of Dawson Sanitary Landfill	Brantley Creek	Terrell	135-004D(SL)	Closed
Terrell Co. US 82 E Dawson		Terrell	135-005D(SL)	Closed
Molena	Flint River Flat Shoals Road to Taylor County line	Pike	-	Inactive
Watson Tire Landfill		Upson	145-009D(L)	Inactive
Allied Services, LLC SR90/SR137	Flint River Horse Creek to Spring Creek	Taylor	133-003D(SL)	Operating
Ellaville		Schley	-	Inactive
Macon Co.		Macon	-	Inactive
Macon Co. (Montezuma)		Macon	-	Inactive
Middle Georgia SMWA Regional		Macon	094-009D(MSWL)	Operating
Oglethorpe (South)		Macon	-	Inactive
Oglethorpe (West)		Macon	-	Inactive
SR 26 E PH1		Schley	123-002D(SL)	Closed
SR 49 N No. 3		Macon	094-005D(SL)	Closed
Hawkinstown Road	Ichawaynochaway Creek	Baker	-	Inactive
Hwy. 200		Baker	-	Inactive
Forest Park	Jesters Creek	Clayton	031-012D(L)	Inactive
Forest Park - Jones Road Ext.		Clayton	031-023D(L)	Closed
Forest Park - Jones Road PH3		Clayton	031-031D(L)	Closed
Fountain School		Clayton	-	Inactive
Shellman	Little Ichawaynochaway Creek	Randolph	-	Inactive
B.F.I., Inc. Roberts Road	Morning Creek	Fayette	056-004D(SL)	Inactive
B.F.I., Inc. Roberts Road		Fayette	056-008D(SL)	Inactive
B.F.I., Inc. Roberts Road		Fayette	056-011D(SL)	Inactive
BFI Roberts Road PH2		Fayette	056-012D(SL)	Closed
Brooksville Rd. C/D Landfill	Patchily Creek	Randolph	120-002D(SL)	Closed
Blakely - Howell St. - Pitt Rd.	Spring Creek	Early	049-002D(SL)	Closed
Boykin		Miller	-	Inactive
Colquitt		Miller	-	Inactive
CR 37 - Sheffield		Miller	100-004D(SL)	Closed
Damascus		Early	-	Inactive

Source: Land Protection Branch, GA DNR, 2011

4.0 ANALYTICAL APPROACH

The process of developing fecal coliform TMDLs for the Flint 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.

The available field measurements and water quality data used to develop the TMDLs for this document did not include stream flow data for many of the sites. Therefore, stream flows for these sites were estimated using data from a nearby USGS gaged stream. The nearby stream had relatively similar watershed characteristics, including landuse, slope, and drainage area. The stream flows were estimated by multiplying the gaged flow by the ratio of the listed stream drainage area to the gaged stream drainage area. Table 13 provides the USGS stream gages used to estimate the flows for each of the listed stream segments.

Table 13. Stream Segments with Estimated Flows and Corresponding USGS Flow Gages

Stream Segment	Location	USGS Station Name	Station No.
Beaver Creek	Headwaters to Spring Creek	Turkey Creek at Byromville, GA	02349900
Brantly Creek	Downstream Dawson WPCP to Chickasawhatchee Creek	Chickasawhatchee Creek, near Albany, GA	02354350
Flint River	Flat Shoals Road to Taylor County Line	Average of Flint River Below Big Branch, near Molena, GA and Flint River at US 19, near Carsonville, GA	02344872 & 02347500
Jesters Creek	East Jesters Creek to Flint River	South River at Forrest Park Road, at Atlanta, GA	02203655
Line creek	Line Creek WPCP to Flat Creek	Line creek Below GA 54, near Peachtree City, GA	02344605
Little Ichawaynochaway Creek	Collins Mill Creek to Ichawaynochaway Creek	Pachitla Creek, near Edison, GA	02353400
Morning Creek	Headwaters to Flint River	South River at Forrest Park Road, at Atlanta, GA	02203655
Spring Creek	SR 62 near Arlington to Aycocks Creek	Spring Creek, near iron City, GA	02203603
Whitewater Creek	Headwaters to Lees Lake	South River at Springdale Road, at Atlanta, GA	02203603

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:

$$L_{critical} = C_{geomean} \times Q_{mean}$$

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 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 standard, 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:

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

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

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:

$$TMDL_{critical} = C_{standard} \times Q_{mean}$$

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

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 percent load reduction can be expressed as follows:

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

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 it is the seasonal fecal coliform standard. A TMDL is the sum of the individual waste load allocations (WLAs) for 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 a margin 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

5.1.1 Wastewater Treatment Facilities

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 with flows greater than 0.1 MGD from municipal and industrial wastewater treatment systems with NPDES effluent limits for fecal coliform bacteria. There are ten of these facilities in the Flint River Basin watershed that discharge into or upstream of a listed segment. The maximum allocated fecal coliform loads for these wastewater treatment facilities are given in Table 14. These WLA loads were calculated from the permitted flows and permitted fecal coliform concentrations. These were expressed as an accumulated load 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 14. WLAs for the Flint River Basin

Facility Name	Permit No.	Receiving Stream	Listed Stream Segment	WLA (counts/30 days)
Dawson WPCP	GA0021326	Brantley Creek	Brantley Creek	2.19E+11
Marshallville WPCP	GA0047431	Spring Hill Creek	Flint River - Horse Creek to Spring Creek	6.26E+09
Montezuma WPCP #2	GA0020486	Spring Creek		1.02E+11
Oglethorpe Pond	GA0036919	Flint River		6.48E+10
Peachtree City - Line Creek WPCP	GA0035777	Line Creek	Line Creek	1.83E+10
Peachtree City - Rockaway WPCP	GA0046655	Line Creek Tributary		3.47E+11
Shellman WPCP	GA0032361	Little Ichawaynochaway Creek Tributary	Little Ichawaynochaway Creek	1.59E+09
Arlington - Pond #1 Wood Valley Road WPCP	GA0026204	Perry Creek	Spring Creek	3.19E+10
Blakely WPCP	GA0025585	Baptist Branch		2.19E+11
Colquitt WPCP	GA0047252	Spring Creek		4.55E+10

5.1.2 Regulated Stormwater Discharges

State and Federal Rules define stormwater discharges covered by NPDES permits as point sources. However, stormwater discharges are from diffuse sources and there are multiple stormwater outfalls. Stormwater 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 stormwater NPDES permits is not to treat the water after collection, but to reduce the exposure of stormwater to pollutants by implementing various controls. It would be infeasible and prohibitively expensive to control pollutant discharges from each stormwater outfall. Therefore, stormwater NPDES permits require the establishment of controls or BMPs to reduce the pollutants entering the environment.

The waste load allocations from stormwater discharges associated with MS4s (WLAsw) are estimated based on the percentage of urban area in each watershed covered by the MS4 stormwater 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 stormwater runoff from the regulated urban area is collected by the municipal separate storm sewer systems.

5.1.3 Confined Animal Feeding Operations

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

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 stormwater (non-permitted).

The LA is calculated as the remaining portion of the TMDL load available, after allocating the WLA, WLAsw, and the MOS, using the following equation:

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

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, leaking sewer system collection lines, and 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 15 presents the total load allocation expressed as counts per 30 days for the 303(d) listed streams located in the Flint 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. 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 (Carter, 1982), and the appropriate drainage area. 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 15.

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.

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

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

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

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

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 (WLA and WLA_{sw}) and nonpoint (LA) 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 the permitted facility to the WLA was not the maximum presented in Table 14, 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 (WLA and WLA_{sw}), LAs, MOSs, and percent load reductions for the Flint River Basin listed stream segments are presented in Table 15.

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. 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 15. 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)	
Beaver Creek	1.22E+12	-	-	5.10E+11	5.67E+10	5.67E+11	54
Brantley Creek	6.27E+11	2.19E+11	-	1.29E+11	1.00E+10	1.00E+11	84
Flint River - Flat Shoals Rd. to Taylor County Line	6.76E+14	1.73E+11	1.08E+13	2.79E+14	3.22E+13	3.22E+14	52
Flint River - Horse Creek to Spring Creek	3.49E+15	-	3.97E+13	5.89E+14	6.98E+13	6.98E+14	80
Ichawaynochaway Creek	3.77E+13	-	-	2.95E+13	3.28E+12	3.28E+13	13
Jesters Creek	1.02E+14	-	1.50E+12	1.45E+12	3.28E+11	3.28E+12	97
Line Creek	4.28E+12	3.66E+11	3.11E+11	1.74E+12	2.69E+11	2.69E+12	37
Little Ichawaynochaway Creek	4.59E+14	1.59E+09	-	3.18E+13	3.53E+12	3.53E+13	92
Morning Creek	2.04E+14	-	7.19E+12	1.58E+13	2.55E+12	2.55E+13	88
Pachitla Creek	3.10E+13	-	-	1.14E+13	1.27E+12	1.27E+13	59
Spring Creek	1.60E+13	2.96E+11	-	1.15E+13	1.31E+12	1.31E+13	18
Whitewater Creek	2.2E+12	-	1.02E+11	4.17E+11	5.77E+10	5.77E+11	74

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.

6.0 RECOMMENDATIONS

The TMDL process consists of an evaluation of the subwatersheds for each 303(d) listed stream segment to identify, as best as possible, the sources of the fecal coliform loads causing the stream to exceed instream standards. 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 part of a long-term process to reduce fecal coliform loading to meet water quality standards in the Flint 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. Sampling is conducted statewide by EPD personnel in Atlanta, Brunswick, Cartersville, and Tifton. Additional sites are added as necessary.

The TMDL Implementation Plan will outline an appropriate water quality monitoring program for the listed streams in the Flint 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 limited data resulted in the listing.

6.2 Fecal Coliform Management Practices

Based on the findings of the source assessment, NPDES point source fecal coliform loads from wastewater treatment facilities usually do not significantly contribute to the impairment of the listed stream segments. This is because most facilities are required to treat to levels corresponding to instream water quality criteria. 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, especially waterfowl can be a significant 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, where applicable.

6.2.1 Point Source Approaches

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

In accordance with 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 fecal coliform in their discharge will be given end-of-pipe limits to meet the applicable water quality standard. 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

EPD is responsible for administering and enforcing laws to protect the waters of the State. EPD is the lead agency for implementing the State's Nonpoint Source Management Program. Regulatory responsibilities that have a bearing on nonpoint source pollution include establishing water quality standards and use classifications, assessing and reporting water quality conditions, and regulating land use activities 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

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 such as livestock populations by subwatershed, animal access to streams, manure storage and application practices 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.

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 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 Flint 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;

- Maintain compliance with stormwater 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. An allocation to a point source discharger does not automatically result in a permit limit or a monitoring requirement. Through its NPDES permitting process, EPD will determine whether a new or existing discharger has a reasonable potential of discharging fecal coliform levels equal to or greater than the total allocated load. The results of this reasonable potential analysis will determine the specific type of requirements in an individual facility's NPDES permit. As part of its analysis, EPD will use its USEPA approved 2003 NPDES Reasonable Potential Procedures to determine whether monitoring requirements or effluent limitations are necessary.

Georgia is working with local governments, agricultural and forestry agencies, such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission, to foster the implementation of best management practices to address nonpoint sources. In addition, public education efforts will be targeted to individual stakeholders to provide information regarding the use of best management practices to protect water quality.

6.4 Public Participation

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

7.0 INITIAL TMDL IMPLEMENTATION PLAN

7.1 Initial TMDL Implementation Plan

This plan identifies applicable State-wide programs and activities that may be employed to manage point and nonpoint sources of bacteria loads for twelve segments in the Flint River Basin. Local watershed planning and management initiatives will be fostered, supported, or developed through a variety of mechanisms. Implementation may be addressed by Watershed Improvement Projects, assessments for Section 319 (h) grants, the local development of watershed protection plans, or "Targeted Outreach" initiated by EPD. These initiatives will supplement or possibly replace this initial implementation plan.

7.2 Impaired Segments

This initial plan is applicable to the following waterbodies that were added to Georgia's 303(d) list available on the EPD website (www.gaepd.org):

Water Bodies Listed on the 2012 303(d) List for Fecal Coliform Bacteria in the Flint River Basin

Stream Segment	Location	Reach ID	Segment Length (miles)	Designated Use
Beaver Creek	Headwaters to Spring Creek	R031300051411	11	Fishing
Brantley Creek	Downstream Dawson WPCP to Chickasawhatchee Creek	R031300090808	6	Fishing
Flint River	Flat Shoals Road to Taylor County Line	R031300060103	43	Fishing
Flint River	Horse Creek to Spring Creek	R031300051101	16	Fishing
Ichawaynochaway Creek	Chickasawhatchee Creek to Flint River	R031300091004	16	Fishing
Jesters Creek	East Jesters Creek to Flint River	R031300050122	3	Fishing
Line Creek	Line Creek WPCP to Flat Creek	R031300050206	2	Fishing
Little Ichawaynochaway Creek	Collins Mill Creek to Ichawaynochaway Creek	R031300090201	8	Fishing
Morning Creek	Headwaters to Flint River	R031300050123	12	Fishing
Pachitla Creek	Parkins Creek to Bay Branch near Edison	R031300090501	5	Fishing
Spring Creek	SR62 near Arlington to Aycocks Creek	R031300100502	22	Fishing
Whitewater Creek	Headwaters to Lees Lake	R031300050213	6	Fishing

Fecal coliform bacteria are used as an indicator of the potential presence of pathogens in a stream. The current water quality standard [*State of Georgia's Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03(6)(c)(iii) (GA EPD, 2011)] states that four or more water samples collected within a 30-day period that have a geometric mean for fecal coliform either in excess of 200 Colony Forming Units (CFU) per 100 milliliters from May through October, or in excess of 1000 (CFU) per 100 milliliters from November through April are in violation of the bacteria water quality standard. In addition, a single sample in excess of 4000 (CFU) per 100 milliliters from November through April can also provide a basis for adding a stream segment to the 303(d) listing.

7.3 Potential Sources

An important part of the TMDL analysis is the identification of potential source categories. A source assessment characterizes the known and suspected bacteria sources in the watershed.

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. Point sources of bacteria include NPDES permittees discharging treated wastewater and stormwater. Nonpoint sources of bacteria are diffuse sources that cannot be identified as entering the water body at a single location. These sources generally involve land use activities that contribute bacteria to streams during a rainfall runoff event.

NPDES point source fecal coliform loads from wastewater treatment facilities usually do not contribute to impairments. This is because these facilities are required to treat to levels corresponding to instream water quality criteria. However, point sources can and do fail, which may contribute to bacteria loads through leaks and overflows from sanitary sewer systems, CAFOs, or leachate from operational landfills.

Nonpoint sources of fecal coliform in urban areas include wastes that are attributable to domestic animals, illicit discharges of sanitary waste, leaking septic systems, runoff from improper disposal of waste materials, and leachate from closed landfills. In non-urban areas, potential sources of fecal coliform may include animals grazing in pastures, dry manure storage facilities and lagoons, chicken litter storage areas, and direct access of livestock to streams. Wildlife, especially waterfowl, can be a significant source of fecal coliform bacteria.

7.4 Management Practices and Activities

EPD is responsible for administering and enforcing laws to protect the waters of the State and is the lead agency for implementing the State's Nonpoint Source Management Program. Georgia is working with local governments, agricultural and forestry agencies such as the Georgia Department of Agriculture, the Natural Resource Conservation Service (NRCS), the Georgia Soil and Water Conservation Commission (GSWCC), and the Georgia Forestry Commission (GFC) to foster implementation of BMPs that address nonpoint source pollution. The following management practices are recommended to reduce fecal coliform loads to stream segments:

- Sustained compliance with NPDES permit limits and requirements where applicable;
- Adoption of NRCS Conservation Practices for primarily agricultural lands;
- Application of BMPs appropriate to specific non-urban and urban land uses;
- Further development and streamlining of local jurisdictional mechanisms for identifying, reporting, and correcting illicit connections, breaks, and other sanitary sewer system problems;
- Adoption of local ordinances (i.e. septic tanks, stormwater, etc.) that address local water quality; and
- Ongoing public education efforts on the sources of fecal coliform and common sense approaches to lessen the impact of this contaminant on surface waters.

Public education efforts target individual stakeholders to provide information regarding the use of BMPs to protect water quality. EPD will continue efforts to increase awareness and educate the public about the impact of human activities on water quality.

7.5 Monitoring

EPD encourages local governments and municipalities to develop water quality monitoring programs. These programs can help pinpoint various fecal coliform sources, as well as verify the 303(d) stream segment listings. This will be particularly valuable for those segments where listing was based on limited data. In addition, regularly scheduled sampling will determine if there has been some improvement in the water quality of the listed stream segments. EPD is available to assist in completing a monitoring plan, preparing a Sampling Quality Assurance Plan (SQAP), and/or providing necessary training as needed.

7.6 Future Action

This Initial TMDL Implementation Plan includes a general approach to pollutant source identification as well as management practices to address pollutants. In the future, EPD will continue to determine and assess the appropriate point and non-point source management measures needed to achieve the TMDLs and also to protect and restore water quality in impaired waterbodies.

For point sources, 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 stormwater will be implemented in the form of best management practices in the NPDES permits. Contributions of bacteria from regulated communities may also be managed using permit requirements such as watershed assessments, watershed protection plans, and long term monitoring. These measures will be directed through current point source management programs.

EPD will work to support Watershed Improvement Projects (WIPs) that address non-point source pollution. This is a process whereby EPD and/or Regional Commissions or other agencies or local governments, under a contract with EPD, will develop a Watershed Management Plan intended to address water quality at the small watershed level (HUC 10 or smaller). These plans will be developed as resources and willing partners become available. The development of these plans may be funded via several grant sources, including but not limited to, Clean Water Act Section 319(h), Section 604(b), and/or Section 106 grant funds. These plans are intended for implementation upon completion.

Any Watershed management Plan that specifically address waterbodies contained within this TMDL will supersede the Initial TMDL Implementation Plan once EPD accepts the plan. Future Watershed Management Plans intended to address this TMDL and other water quality concerns, written by EPD and for which EPD and/or the EPD Contractor are responsible, will contain at a minimum the US EPA's 9 Elements of Watershed Planning:

1) An identification of the sources or groups of similar sources contributing to nonpoint source pollution to be controlled to implement load allocations or achieve water quality standards. Sources should be identified at the subcategory level with estimates of the extent to which they are present in the watershed (e.g., X numbers of cattle feedlots needing upgrading, Y acres of row crops needing improved bacteria control, or Z linear miles of eroded streambank needing remediation);

2) An estimate of the load reductions expected for the management measures;

3) A description of the NPS management measures that will need to be implemented to achieve the load reductions established in the TMDL or to achieve water quality standards;

4) An estimate of the sources of funding needed, and/or authorities that will be relied upon, to implement the plan;

5) An information/education component that will be used to enhance public understanding of and participation in implementing the plan;

6) A schedule for implementing the management measures that is reasonably expeditious;

7) A description of interim, measurable milestones (e.g., amount of load reductions, improvement in biological or habitat parameters) for determining whether management measures or other control actions are being implemented;

8) A set of criteria that can be used to determined whether substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether the plan needs to be revised; and;

9) A monitoring component to evaluate the effectiveness of the implementation efforts, measured against the criteria established under item (8).

The public will be provided an opportunity to participate in the development of Watershed Management Plans that address impaired waters and to comment on them before they are finalized.

EPD will continue to offer technical and financial assistance (when and where available) to complete Watershed Management Plans that address the impaired waterbodies listed in this and other TMDL documents. Assistance may include but will not be limited to:

- Assessments of pollutant sources within watersheds;
- Determinations of appropriate management practices to address impairments;
- Identification of potential stakeholders and other partners;
- Developing a plan for outreach to the general public and other groups;
- Assessing the resources needed to implement the plan upon completion; and
- Other needs determined by the lead organization responsible for plan development.

EPD will also make this same assistance available, if needed, to proactively address water quality concerns. This assistance may be in the way of financial, technical, or other aid and may be requested and provided outside of the TMDL process or schedule.

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Appendix A

30-day Geometric Mean Fecal Coliform Monitoring Data

Water Quality Monitoring Stations

Stream Segment	Location	EPD Monitoring Station No.	Monitoring Station Description
Beaver Creek	Headwaters to Spring Creek	1105130501	Beaver Creek at Zenith Mill Road near Roberta, GA
Brantley Creek	Downstream Dawson WPCP to Chickasawhatchee Creek	1109070202	Brantley Creek at CR 133 near Herod, GA
Flint River	Flat Shoals Road to Taylor County Line	1105070502	Flint River at Sprewell Bluff State Park
Flint River	Horse Creek to Spring Creek	1106010701	Flint River at SR 26 near Montezuma
Ichawaynochaway Creek	Chickasawhatchee Creek to Flint River	1109100101	Ichawaynochaway Creek at SR 91 near Newton, GA
Jesters Creek	East Jesters Creek to Flint River	N/A	Jesters Creek at Battle Creek Road (2002-2006) Jesters Creek at Nottingham Road (2008-2009)
Line Creek	Line Creek WPCP to Flat Creek	1105020302	Line Creek At Georgia Highway 85 Near Senoia
Little Ichawaynochaway Creek	Collins Mill Creek to Ichawaynochaway Creek	1109020201	Little Ichawaynochaway Creek at CR 3 near Shellman, GA
Morning Creek	Headwaters to Flint River	1105010301	Morning Creek at SR 54 near Fayetteville, GA
Pachitla Creek	Parkins Creek to Bay Branch near Edison	1109050401	Pachitla Creek at SR 37 near Edison, GA
Spring Creek	SR62 near Arlington to Aycocks Creek	1110050101	Spring Creek at SR 91 near Colquitt, GA
Whitewater Creek	Headwaters to Lees Lake	N/A	Whitewater Creek near Fayette County Line

Figure A-1
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
1105130501 Beaver Creek at Zenith Mill Road near Roberta, Georgia

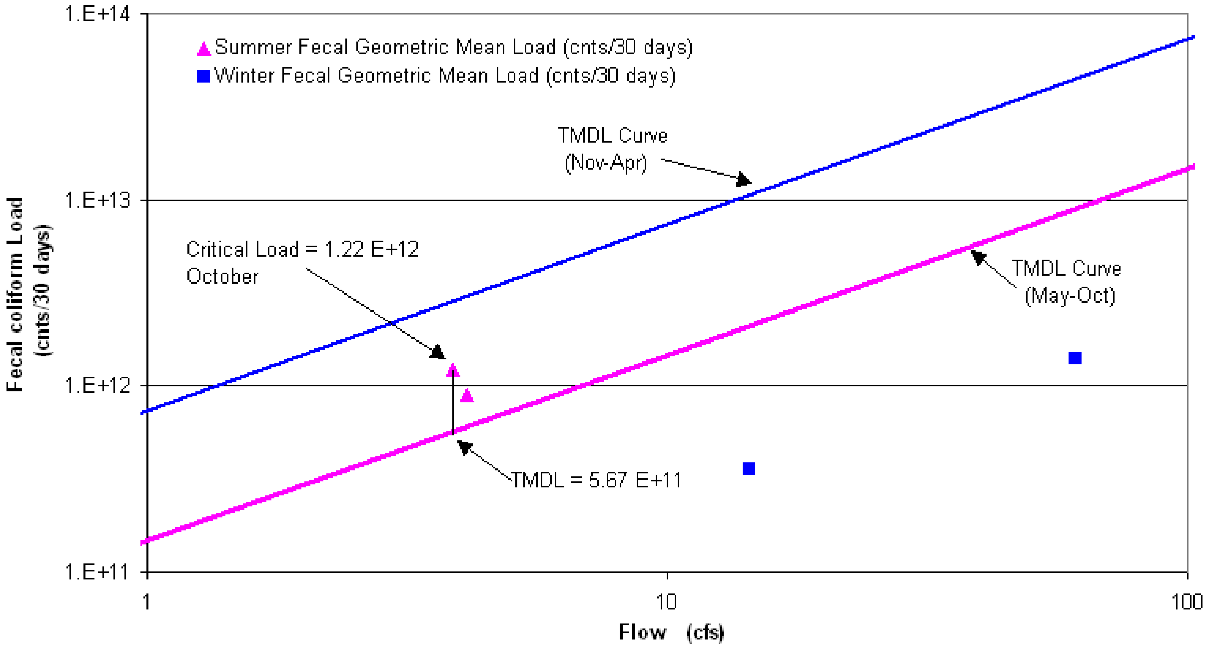


Table A-1. Data for Figure A-1

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)
Date	Fecal	Q	Geomean	Mean Flow	Current TMDL	TMDL
2/2/2010	30	89.9				
2/4/2010	80	65.6				
2/11/2010	20	51.7				
2/25/2010	20	36.7	31.3	61.0	1.40E+12	4.48E+13
4/12/2010	20	13.4				
4/14/2010	40	11.9				
4/20/2010	40	9.8				
4/28/2010	40	22.2	33.6	14.3	3.54E+11	1.05E+13
7/5/2010	230	4.0				
7/12/2010	170	4.0				
7/15/2010	500	5.1				
7/20/2010	400	3.4	297.4	4.1	9.00E+11	6.05E+11
10/5/2010	130	3.4				
10/26/2010	500	3.5				
10/28/2010	2300	5.0				
11/3/2010	230	3.6	**430.6**	**3.9**	**1.22E+12**	**5.67E+11**

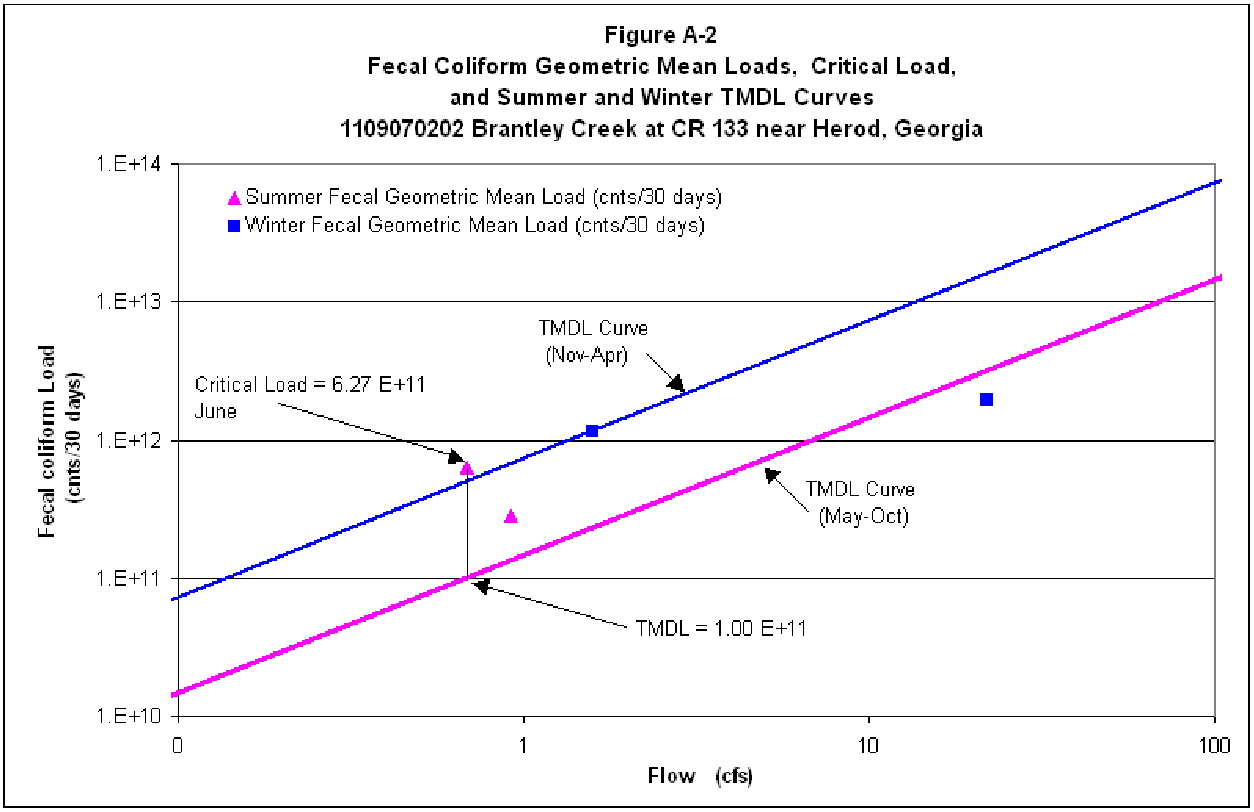


Table A-2. Data for Figure A-2

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)
Date	Fecal	Q	Geomean	Mean Flow	Current TMDL	TMDL
3/7/2011	130	24.2				
3/8/2011	300	22.3				
3/15/2011	130	24.4				
3/23/2011	40	17.1	119.3	22.0	1.93E+12	1.62E+13
6/2/2011	1700	0.6				
6/8/2011	500	0.7				
6/14/2011	1300	0.7				
6/29/2011	2200	0.7	**1248.7**	**0.7**	**6.27E+11**	**1.00E+11**
9/7/2011	500	1.1				
9/14/2011	500	0.9				
9/20/2011	700	0.8				
9/27/2011	170	1.0	415.3	0.9	2.81E+11	1.35E+11
12/5/2011	500	1.6				
12/6/2011	800	1.7				
12/13/2011	2400	2.1	986.5	1.6	1.15E+12	1.16E+12

Figure A-3
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
1105070502 Flint River at Sprewell Bluff State Park

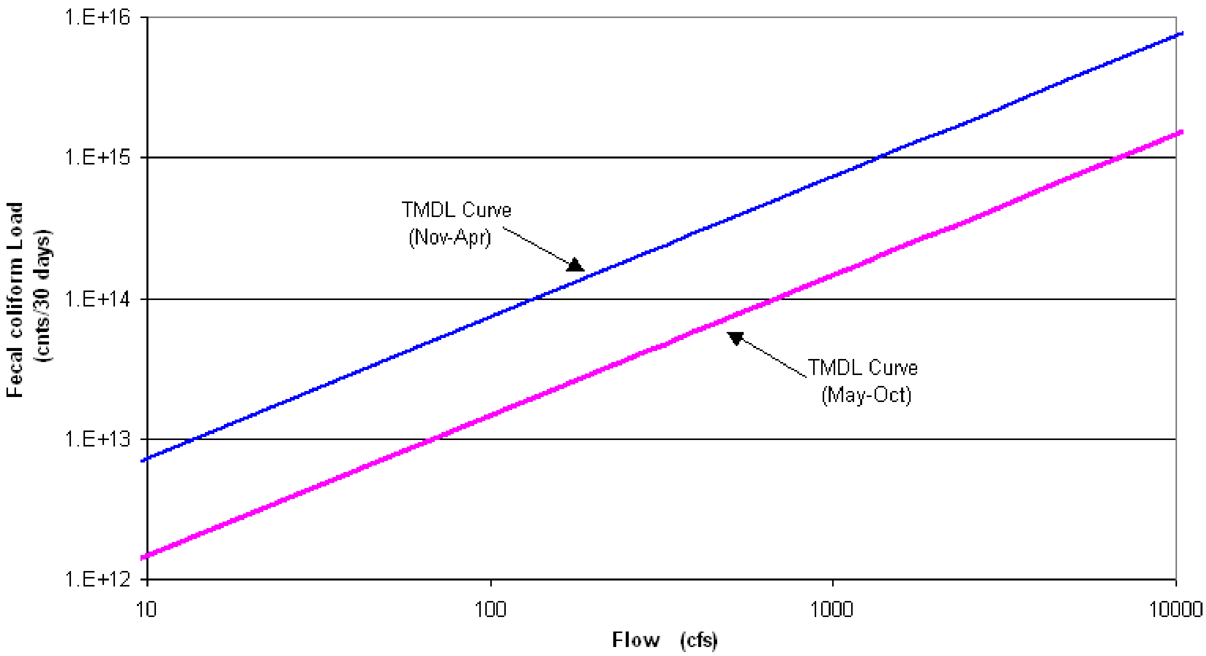


Table A-3. Data for Figure A-3

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)
Date	Fecal	Q	Geomean	Mean Flow	Current TMDL	TMDL
2/3/2010	20	2381.8				
2/10/2010	170	3441.8				
2/18/2010	20	1843.1				
2/23/2010	130	2435.0	54.5	2525.4	1.01E+14	1.85E+15
4/5/2010	170	1156.8				
4/8/2010	20	1067.4				
4/19/2010	20	776.0				
4/21/2010	40	896.9	40.6	974.3	2.90E+13	7.15E+14
7/6/2010	40	336.1				
7/13/2010	110	876.0				
7/21/2010	230	621.9				
7/28/2010	300	1233.3	132.0	766.8	7.43E+13	1.13E+14
10/6/2010	800	164.1				
10/13/2010	130	123.5				
10/20/2010	130	112.1				
11/1/2010	300	755.3	252.4	288.7	5.35E+13	4.24E+13
1/5/2011	80	1331.4				
1/18/2011	20	796.4				
1/20/2011	20	784.4				
2/1/2011	20	721.5	28.3	908.4	1.89E+13	6.67E+14
4/5/2011	300	2008.1				
4/11/2011	20	1156.7				
4/19/2011	20	1287.5				
4/28/2011	5000	951.0	156.5	1350.8	1.55E+14	9.91E+14
7/12/2011	400	303.7				
7/13/2011	130	260.5				
7/26/2011	80	154.1				
8/2/2011	80	124.5	135.1	210.7	2.09E+13	3.09E+13
10/3/2011	40	82.0				
10/19/2011	110	83.6				
10/24/2011	70	77.9				
10/27/2011	20	73.6	49.8	79.3	2.90E+12	1.16E+13
1/10/2012	20	432.0				
1/12/2012	70	618.6				
1/18/2012	40	411.1				
1/24/2012	500	2666.3	72.7	1032.0	5.51E+13	7.58E+14
4/28/2011	5000	951.0	**5000.0**	**951.0**	**3.49E+15**	**6.98E+14**

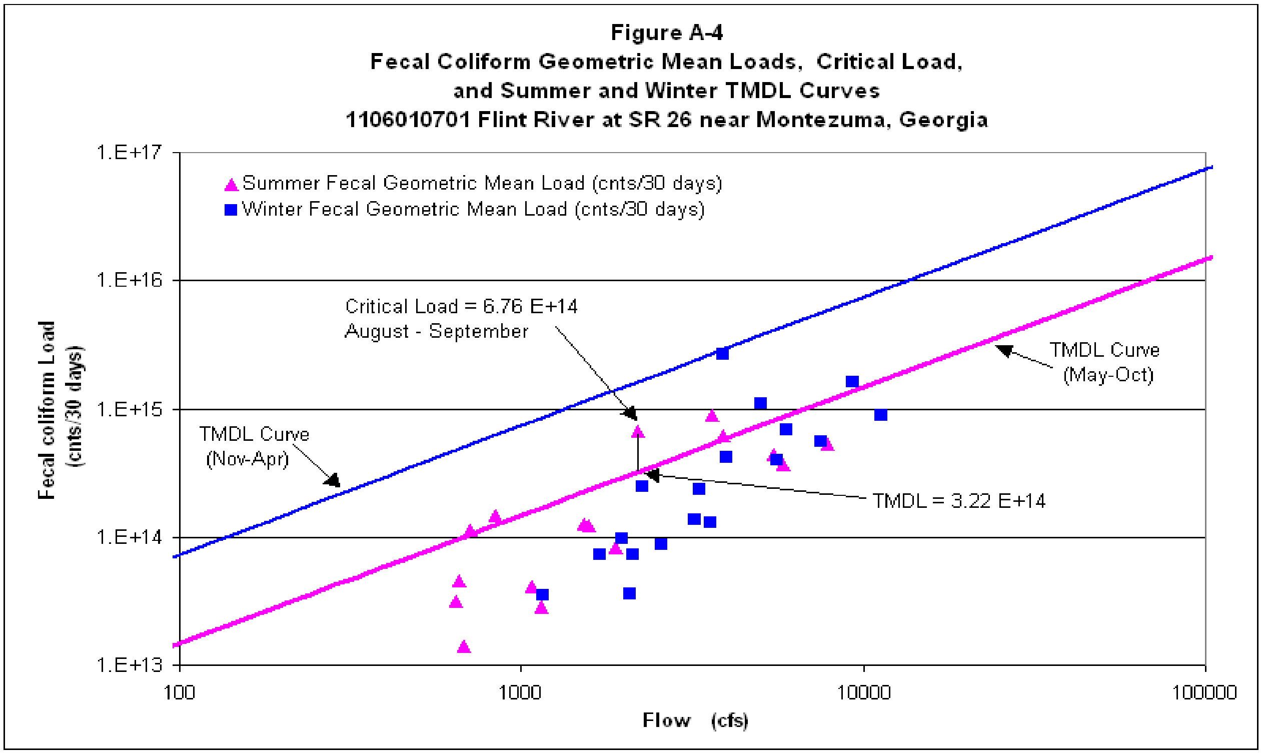


Figure A-4
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
1106010701 Flint River at SR 26 near Montezuma, Georgia
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 6.76 E+14
August - September
TMDL Curve
(May-Oct)
TMDL Curve
(Nov-Apr)
TMDL = 3.22 E+14
Fecal coliform Load
(cnts/30 days)
1.E+17
1.E+16
1.E+15
1.E+14
1.E+13
100
1000
10000
100000
Flow (cfs)

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)
Date	Fecal	Q	Geomean	Mean Flow	Current TMDL	TMDL
2/10/2003	460	4780.0				
2/11/2003	70	4040.0				
2/18/2003	3300	6110.0				
3/4/2003	70	5220.0	293.7	5037.5	1.09E+15	3.70E+15
5/14/2003	330	18300.0				
5/20/2003	80	4070.0				
6/3/2003	20	2690.0				
6/10/2003	140	6260.0	92.7	7830.0	5.33E+14	1.15E+15
7/8/2003	70	12400.0				
7/22/2003	50	2850.0				
7/29/2003	170	2710.0				
8/5/2003	230	3910.0	108.2	5467.5	4.34E+14	8.03E+14
11/18/2003	70	1340.0				
12/2/2003	20	2500.0				
12/9/2003	20	1910.0				
12/16/2003	170	2710.0	46.7	2115.0	7.25E+13	1.55E+15
2/3/2004	20	2780.0				
2/11/2004	490	7260.0				
2/18/2004	460	8840.0				
2/23/2004	20	3510.0	97.4	5597.5	4.00E+14	4.11E+15
3/16/2004	20	2230.0				
3/24/2004	20	2000.0				
3/29/2004	1300	1850.0				
4/14/2004	40	1830.0	67.5	1977.5	9.80E+13	1.45E+15
6/8/2004	50	1050.0				
6/16/2004	130	1280.0				
6/23/2004	80	1480.0				
7/7/2004	300	2270.0	111.8	1520.0	1.25E+14	2.23E+14
8/11/2004	500	1330.0				
8/18/2004	1700	1790.0				
8/24/2004	130	1280.0				
9/8/2004	280	4380.0	**419.4**	**2195.0**	**6.76E+14**	**3.22E+14**
2/1/2005	130	3930.0				
2/8/2005	70	6290.0				
2/15/2005	80	5460.0				
3/1/2005	790	8250.0	154.9	5982.5	6.80E+14	4.39E+15
3/29/2005	1300	12400.0				
4/5/2005	20	20200.0				
4/12/2005	40	8400.0				
4/19/2005	130	3890.0	107.8	11222.5	8.88E+14	8.24E+15
5/17/2005	70	2280.0				
6/14/2005	140	6940.0				
6/21/2005	40	2590.0				
6/28/2005	20	2090.0				
7/12/2005	490	11600.0	86.1	5805.0	3.67E+14	8.52E+14
3/20/2006	20	2610.0				
4/3/2006	20	2600.0				
4/10/2006	270	3130.0				
4/17/2006	40	1970.0	45.6	2577.5	8.63E+13	1.89E+15
5/3/2006	40	1640.0				
5/8/2006	230	1700.0				
5/15/2006	70	2870.0				
5/22/2006	20	1350.0	59.9	1890.0	8.31E+13	2.77E+14
8/14/2006	130	745.0				
8/24/2006	1300	777.0				
8/28/2006	270	1000.0				
9/11/2006	70	825.0	237.7	836.8	1.46E+14	1.23E+14
11/15/2006	40	965.0				
11/29/2006	20	1200.0				
12/6/2006	40	1360.0				
12/13/2006	90	1080.0	41.2	1151.3	3.48E+13	8.45E+14

Table A-4. Data for Figure A-4 (Cont.)

1/24/2007	800	5010.0				
1/30/2007	20	2640.0				
2/7/2007	20	3160.0				
2/14/2007	270	2500.0	96.4	3327.5	2.35E+14	2.44E+15
3/14/2007	20	2540.0				
3/20/2007	40	2340.0				
3/28/2007	20	1850.0				
4/11/2007	20	1550.0	23.8	2070.0	3.61E+13	1.52E+15
7/9/2007	20	737.0				
7/16/2007	20	805.0				
7/23/2007	40	642.0				
8/6/2007	40	535.0	28.3	679.8	1.41E+13	9.98E+13
9/19/2007	40	865.0				
9/26/2007	90	657.0				
10/2/2007	110	563.0				
10/17/2007	50	501.0	66.7	646.5	3.17E+13	9.49E+13
1/17/2008	140	2210.0				
1/23/2008	1100	3110.0				
1/29/2008	20	1690.0				
2/14/2008	170	2010.0	151.3	2255.0	2.50E+14	1.66E+15
2/27/2008	270	7380.0				
3/5/2008	110	3080.0				
3/13/2008	80	3500.0	141.8	3992.5	4.15E+14	2.93E+15
5/7/2008	20	1010.0				
5/15/2008	110	1670.0				
5/29/2008	80	896.0				
6/5/2008	40	710.0	51.5	1071.5	4.05E+13	1.57E+14
7/16/2008	40	609.0				
7/24/2008	80	970.0				
7/31/2008	80	518.0				
8/14/2008	300	535.0	93.6	658.0	4.52E+13	9.66E+13
1/28/2009	40	1810.0				
2/12/2009	20	1550.0				
2/19/2009	80	1540.0				
2/25/2009	170	1920.0	57.4	1705.0	7.19E+13	1.25E+15
3/24/2009	80	4080.0				
4/8/2009	80	12600.0				
4/16/2009	800	9140.0				
4/22/2009	20	4430.0	100.6	7562.5	5.58E+14	5.55E+15
7/29/2009	170	691.0				
8/5/2009	500	797.0				
8/12/2009	1300	714.0				
8/26/2009	20	620.0	216.8	705.5	1.12E+14	1.04E+14
9/23/2009	300	5510.0				
9/30/2009	230	1850.0				
10/7/2009	800	2080.0				
10/21/2009	230	4970.0	335.7	3602.5	8.88E+14	5.29E+14
1/12/2010	20	4040.0				
1/19/2010	1100	8610.0				
2/3/2010	170	9810.0				
2/9/2010	800	14900.0	233.9	9340.0	1.60E+15	6.86E+15
3/23/2010	20	5380.0				
4/7/2010	40	3340.0				
4/14/2010	90	3110.0				
4/20/2010	80	2450.0	49.0	3570.0	1.28E+14	2.62E+15
5/10/2010	140	5520.0				
5/17/2010	500	2640.0				
5/24/2010	130	3620.0				
6/7/2010	230	3810.0	213.9	3897.5	6.12E+14	5.72E+14
7/6/2010	40	1650.0				
7/19/2010	140	1980.0				
7/26/2010	300	1310.0				
8/2/2010	80	1330.0	107.7	1567.5	1.24E+14	2.30E+14
1/18/2011	700	1980.0				
1/20/2011	500	2080.0				
2/2/2011	900	1980.0				
2/8/2011	2300	9560.0	922.6	3900.0	2.64E+15	2.86E+15
3/23/2011	40	2980.0				
4/6/2011	180	4530.0				
4/13/2011	80	2830.0				
4/19/2011	20	2460.0	58.3	3200.0	1.37E+14	2.35E+15
5/9/2011	40	1550.0				
5/16/2011	20	1180.0				
5/23/2011	20	1030.0				
6/6/2011	80	797.0	33.6	1139.3	2.81E+13	1.67E+14

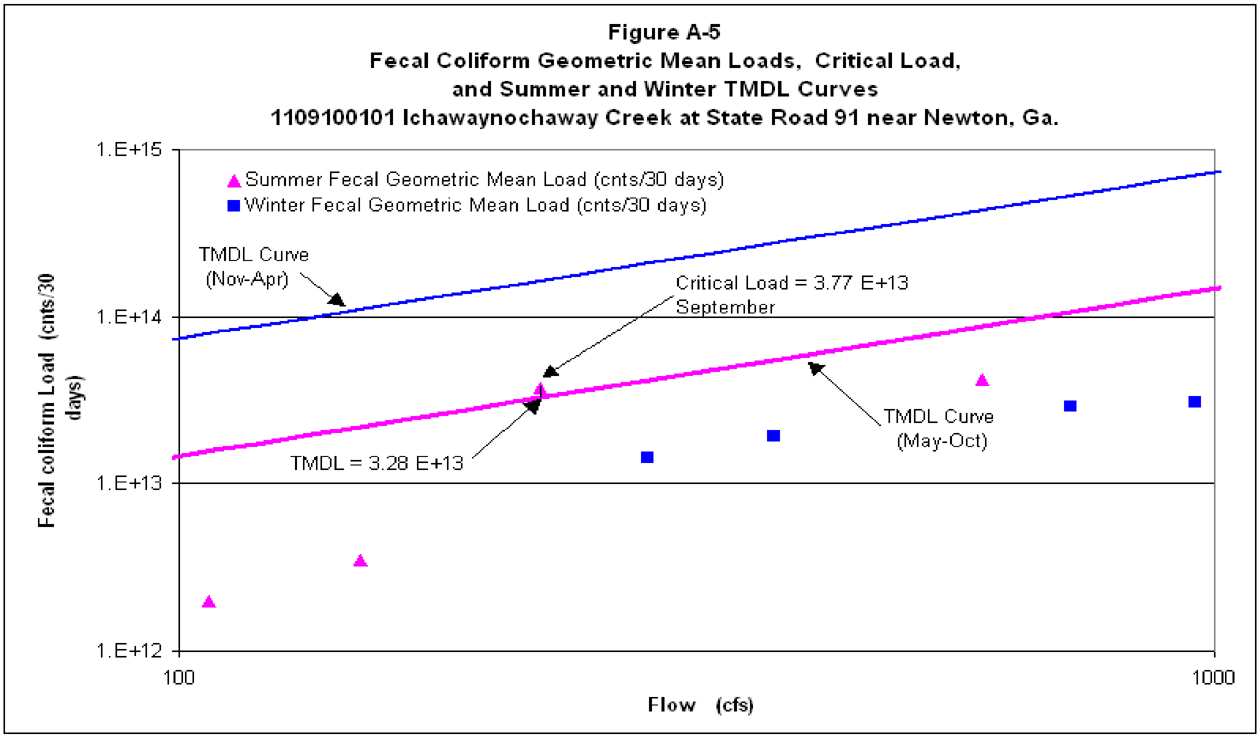


Table A-5. Data for Figure A-5

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)
Date	Fecal	Q	Geomean	Mean Flow	Current TMDL	TMDL
1/24/2000	130	574.0				
2/3/2000	20	784.0				
2/10/2000	20	530.0				
2/17/2000	170	1020.0	54.5	727.0	2.91E+13	5.34E+14
5/11/2000	50	201.0				
5/17/2000	50	181.0				
5/24/2000	20	129.0				
6/8/2000	20	87.0	31.6	149.5	3.47E+12	2.19E+13
7/20/2000	20	115.0				
7/27/2000	20	132.0				
8/3/2000	20	101.0				
8/17/2000	50	80.0	25.1	107.0	1.98E+12	1.57E+13
11/8/2000	80	156.0				
11/14/2000	70	312.0				
11/20/2000	80	350.0				
12/7/2000	50	318.0	68.8	284.0	1.43E+13	2.08E+14
3/8/2010	20	966.0				
3/16/2010	230	1300.0				
3/22/2010	20	844.0				
3/24/2010	40	720.0	43.8	957.5	3.08E+13	1.41E+14
6/8/2010	230	1360.0				
6/17/2010	55	329.0				
6/23/2010	40	368.0				
6/29/2010	170	334.0	96.3	597.8	4.23E+13	8.77E+13
9/7/2010	140	154.0				
9/20/2010	70	112.0				
9/28/2010	220	277.0				
9/30/2010	1300	350.0	**230.1**	**223.3**	**3.77E+13**	**3.28E+13**
12/13/2010	110	362.0				
12/14/2010	40	412.0				
12/16/2010	130	379.0				
12/29/2010	40	350.0	69.2	375.8	1.91E+13	2.76E+14

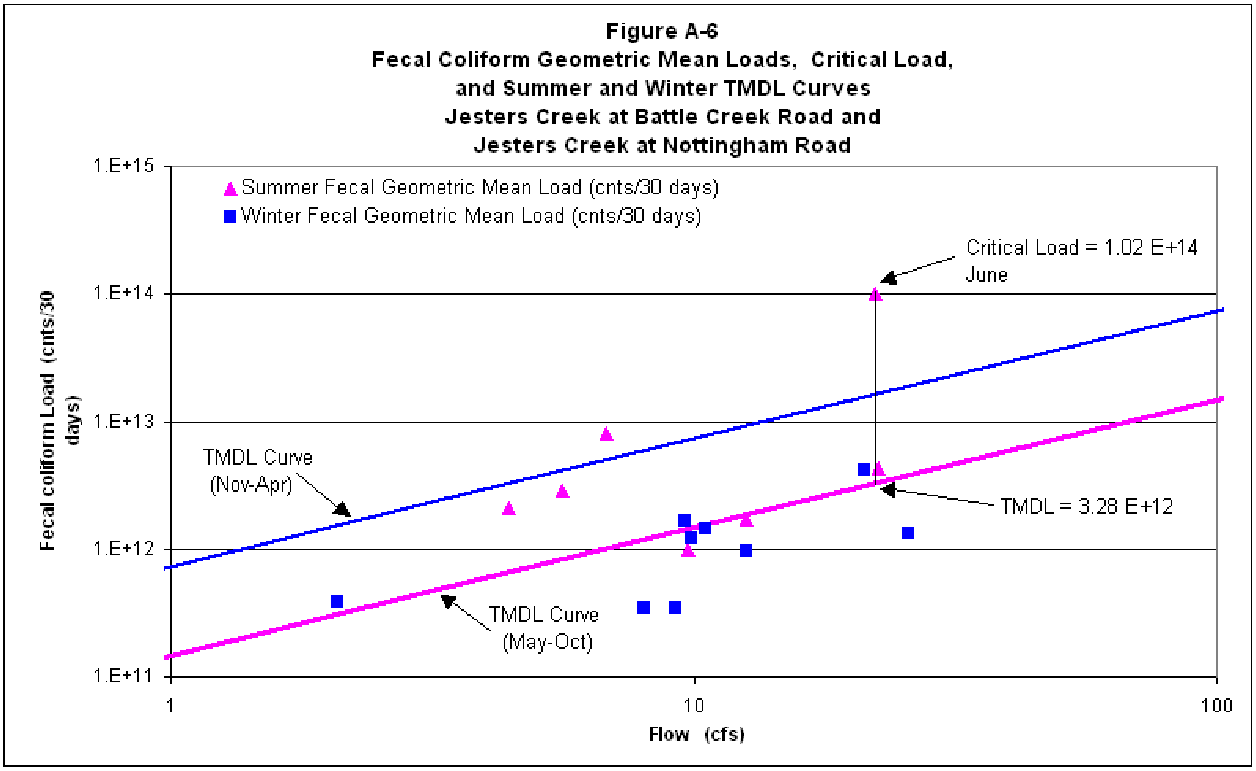


Figure A-6
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
Jesters Creek at Battle Creek Road and
Jesters Creek at Nottingham Road
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 1.02 E+14
June
TMDL Curve
(Nov-Apr)
TMDL = 3.28 E+12
TMDL Curve
(May-Oct)
Fecal coliform Load (cnts/30 days)
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1
10
100
Flow (cfs)

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)
Date	Fecal	Q	Geomean	Mean Flow	Current TMDL	TMDL
7/10/2002	290	10.5				
7/17/2002	120	16.1				
7/22/2002	100	7.8				
7/30/2002	340	16.1	185.5	12.6	1.72E+12	1.85E+12
3/11/2003	40	7.8				
3/13/2003	20	6.5				
3/17/2003	30	44.4				
3/19/2003	1000	44.4	70.0	25.8	1.33E+12	1.89E+13
3/21/2003	1400	24.4				
3/25/2003	1	9.1				
3/27/2003	400	8.7				
3/31/2003	205	8.3	103.5	12.6	9.60E+11	9.27E+12
4/3/2003	170	6.1				
4/7/2003	1290	58.8				
4/9/2003	335	13.9				
4/15/2003	70	5.7	267.8	21.1	4.15E+12	1.55E+13
4/5/2005	50	13.9				
4/14/2005	1500	10.9				
4/19/2005	60	8.3				
4/25/2005	260	9.1	184.9	10.6	1.43E+12	7.75E+12
6/21/2005	13400	74.5				
6/23/2005	2500	5.2				
6/27/2005	700	5.2				
6/29/2005	64000	4.3	**6224.2**	**22.3**	**1.02E+14**	**3.28E+12**
9/22/2005	300	3.4				
9/27/2005	400	3.7				
9/29/2005	4050	3.6				
10/6/2005	14000	16.6	1615.1	6.8	8.07E+12	9.99E+11
12/16/2005	1	15.2				
12/19/2005	110	5.7				
12/21/2005	200	5.7				
12/23/2005	540	5.7	58.7	8.1	3.47E+11	5.92E+12
3/1/2006	20	10.5				
3/9/2006	10	7.8				
3/16/2006	70	8.3				
3/23/2006	490	10.5	51.2	9.3	3.48E+11	6.80E+12
6/14/2006	800	4.8				
6/20/2006	100	3.4				
6/22/2006	1560	3.4				
6/29/2006	1300	6.1	634.7	4.4	2.07E+12	6.51E+11
9/12/2006	150	4.8				
9/18/2006	700	9.6				
9/21/2006	3100	3.8				
9/26/2006	750	4.3	702.9	5.6	2.90E+12	8.25E+11
3/4/2008	60	9.4				
3/11/2008	490	11.6				
3/18/2008	610	8.3				
3/24/2008	45	10.1	168.5	9.9	1.22E+12	7.24E+12
6/5/2008	20	6.8				
6/9/2008	115	19.5				
6/17/2008	490	5.6				
6/19/2008	345	7.1	140.4	9.8	1.01E+12	1.43E+12
9/9/2008	230	3.3				
9/15/2008	220	78.5				
9/18/2008	245	4.5				
9/2/2008	365	4.1	259.4	22.6	4.31E+12	3.32E+12
12/4/2008	155	2.2				
12/16/2008	120	1.7				
12/22/2008	750	1.8				
12/30/2008	280	2.6	250.0	2.1	3.83E+11	1.53E+12
3/4/2009	200	2.3				
3/12/2009	300	17.3				
3/19/2009	100	14.7				
3/24/2009	500	4.1	234.0	9.6	1.65E+12	7.05E+12

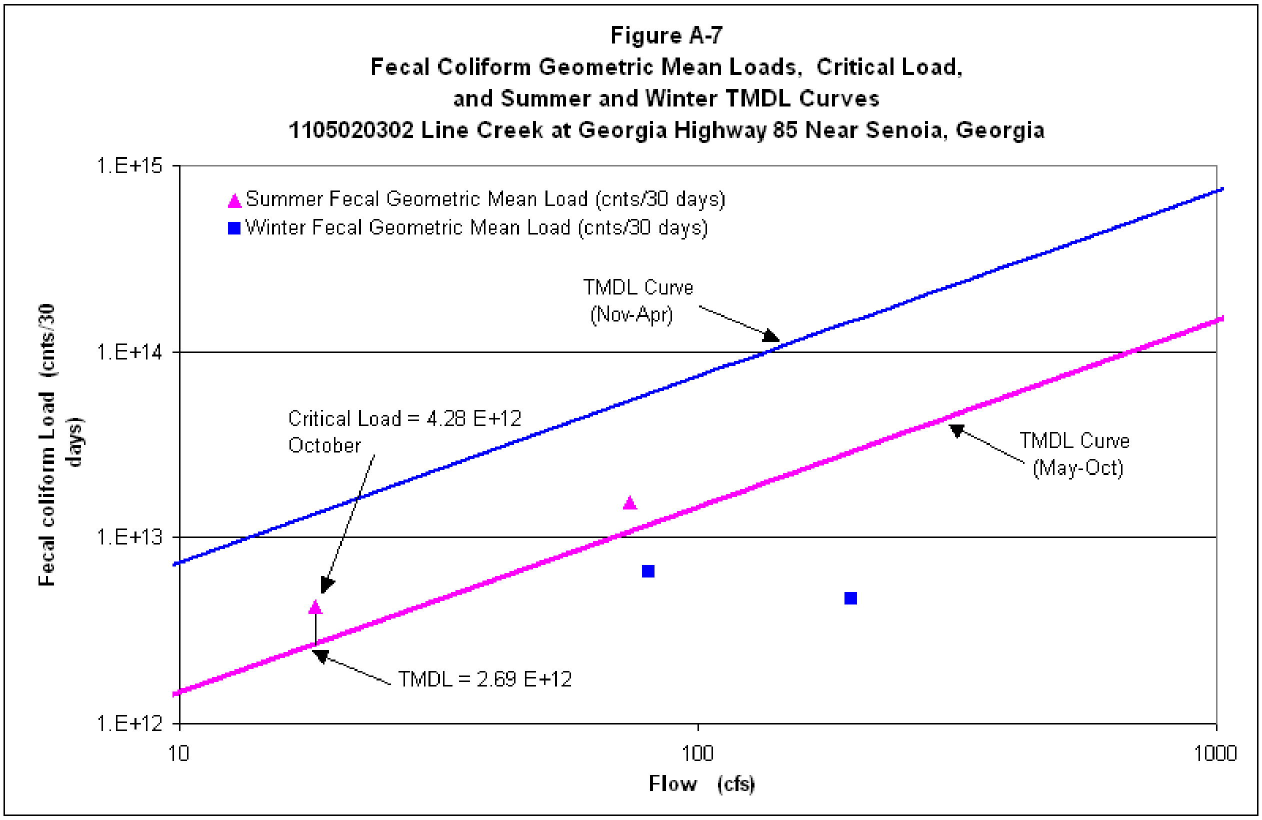


Table A-7. Data for Figure A-7

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)
Date	Fecal	Q	Geomean	Mean Flow	Current TMDL	TMDL
2/3/2010	20	188.0				
2/10/2010	20	216.0				
2/18/2010	40	134.0				
2/23/2010	70	251.0	32.5	197.3	4.71E+12	1.45E+14
4/5/2010	40	93.0				
4/8/2010	20	75.0				
4/19/2010	230	68.0				
4/21/2010	800	85.0	110.1	80.3	6.49E+12	5.89E+13
7/6/2010	130	7.0				
7/13/2010	2300	255.7				
7/21/2010	170	19.2				
7/28/2010	130	13.7	285.1	73.9	1.55E+13	1.08E+13
10/6/2010	500	8.1				
10/13/2010	230	8.2				
10/20/2010	300	7.9				
11/1/2010	300	49.0	**319.0**	**18.3**	**4.28E+12**	**2.69E+12**

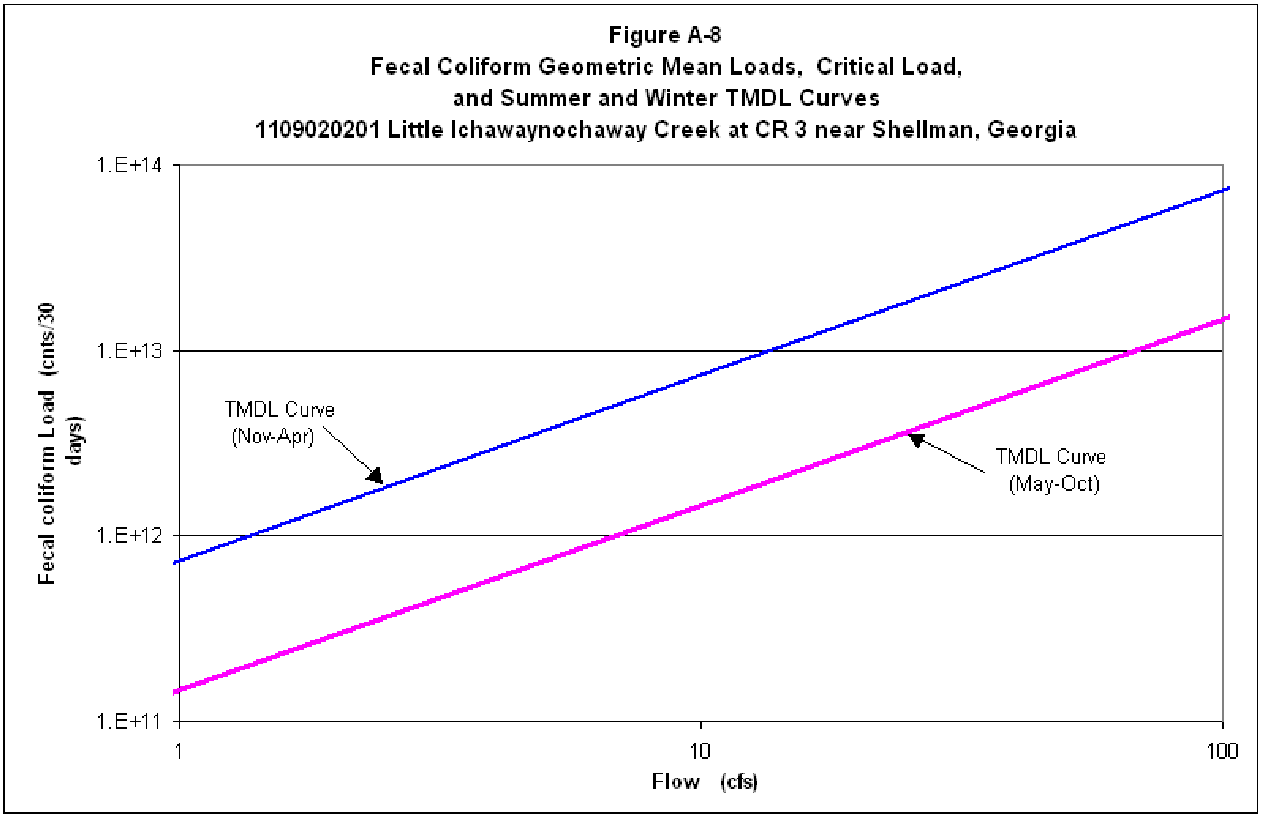


Table A-8. Data for Figure A-8

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)
Date	Fecal	Q	Geomean	Mean Flow	Current TMDL	TMDL
5/13/2010	500	42.2				
5/24/2010	800	24.3	447.2	104.6	3.43E+13	1.54E+13
9/1/2010	500	21.9				
9/21/2010	800	9.7				
9/22/2010	800	9.5				
9/29/2010	700	32.6	688.0	18.4	9.31E+12	2.71E+12
12/1/2010	13000	48.1				
12/6/2010	20	31.2				
12/13/2010	800	49.7				
12/27/2010	230	35.6	467.7	41.2	1.41E+13	3.02E+13
3/7/2011	300	55.1				
3/8/2011	300	43.3				
3/15/2011	3000	43.7				
3/23/2011	230	33.4	499.2	43.9	1.61E+13	3.22E+13
6/2/2011	1200	1.6				
6/8/2011	360	1.9				
6/14/2011	300	2.8				
6/29/2011	500	5.0	504.5	2.8	1.04E+12	4.13E+11
9/7/2011	40	13.3				
9/14/2011	225	5.4				
9/20/2011	20	6.0				
9/27/2011	70	8.7	59.6	8.4	3.65E+11	1.23E+12
12/1/2010	13000	48.1	**13000.0**	**48.1**	**4.59E+14**	**3.53E+13**

Figure A-9
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
1105010301 Morning Creek at SR 54 near Fayetteville, Georgia

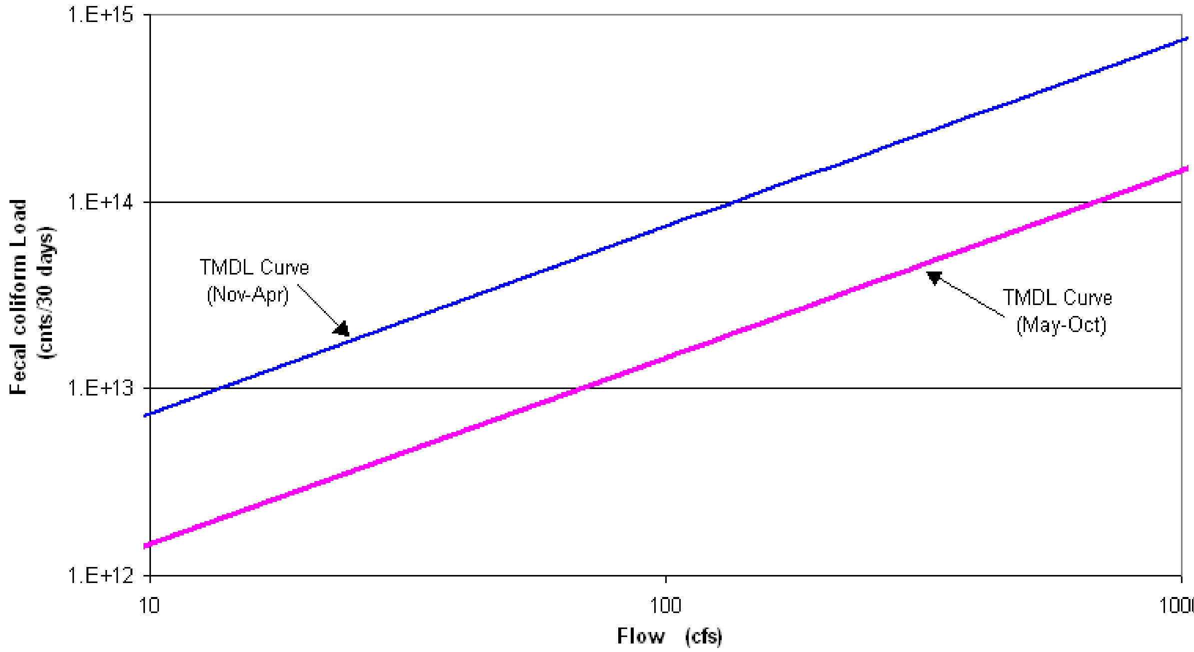


Table A-9. Data for Figure A-9

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)
Date	Fecal	Q	Geomean	Mean Flow	Current TMDL	TMDL
7/10/2002	41	7.6				
7/17/2002	115	11.7				
7/22/2002	750	5.7				
7/30/2002	130	11.7	146.4	9.2	9.88E+11	1.35E+12
3/11/2003	20	32.9				
3/13/2003	70	27.5				
3/17/2003	330	186.7				
3/19/2003	230	186.7	101.5	108.5	8.08E+12	7.96E+13
3/21/2003	1240	102.5				
3/25/2003	60	38.4				
3/27/2003	700	36.6				
3/31/2003	440	34.8	389.1	53.1	1.52E+13	3.90E+13
4/3/2003	120	25.6				
4/7/2003	310	247.1				
4/9/2003	40	58.6				
4/15/2003	28	23.8	80.3	88.8	5.24E+12	6.52E+13
4/5/2005	60	58.6				
4/14/2005	160	45.8				
4/19/2005	30	34.8				
4/25/2005	230	38.4	90.2	44.4	2.94E+12	3.26E+13
6/21/2005	90	313.0				
6/23/2005	720	22.0				
6/27/2005	440	22.0				
6/29/2005	13000	18.1	780.3	93.8	5.37E+13	1.38E+13
9/22/2005	140	14.3				
9/27/2005	150	15.6				
9/29/2005	460	15.0				
10/6/2005	1265	69.6	332.5	28.6	6.98E+12	4.20E+12
12/16/2005	2000	64.1				
12/19/2005	50	23.8				
12/21/2005	10	23.8				
12/23/2005	70	23.8	91.5	33.9	2.27E+12	2.49E+13
3/1/2006	80	43.9				
3/9/2006	40	32.9				
3/16/2006	130	34.8				
3/23/2006	260	43.9	102.0	38.9	2.91E+12	2.86E+13
6/14/2006	360	20.1				
6/20/2006	300	14.3				
6/22/2006	950	14.5				
6/29/2006	140	25.6	346.2	18.6	4.73E+12	2.73E+12
9/12/2006	160	20.1				
9/18/2006	120	40.3				
9/21/2006	90	16.1				
9/26/2006	980	17.9	202.9	23.6	3.52E+12	3.47E+12
2/3/2010	70	45.8				
2/10/2010	2300	56.7				
2/18/2010	40	40.3				
2/23/2010	500	49.4	238.2	48.1	8.40E+12	3.53E+13
4/5/2010	230	32.9				
4/8/2010	30	95.2				
4/19/2010	40	27.5				
4/21/2010	8000	34.8	216.8	47.6	7.57E+12	3.49E+13
7/6/2010	300	15.9				
7/13/2010	5000	382.6				
7/21/2010	500	22.0				
7/28/2010	360	20.1	720.8	110.2	5.83E+13	1.62E+13
10/6/2010	300	10.8				
10/13/2010	500	8.4				
10/20/2010	170	8.6				
11/1/2010	270	12.8	288.1	10.2	2.15E+12	1.49E+12
4/21/2010	8000	34.8	**8000.0**	**34.8**	**2.04E+14**	**2.55E+13**

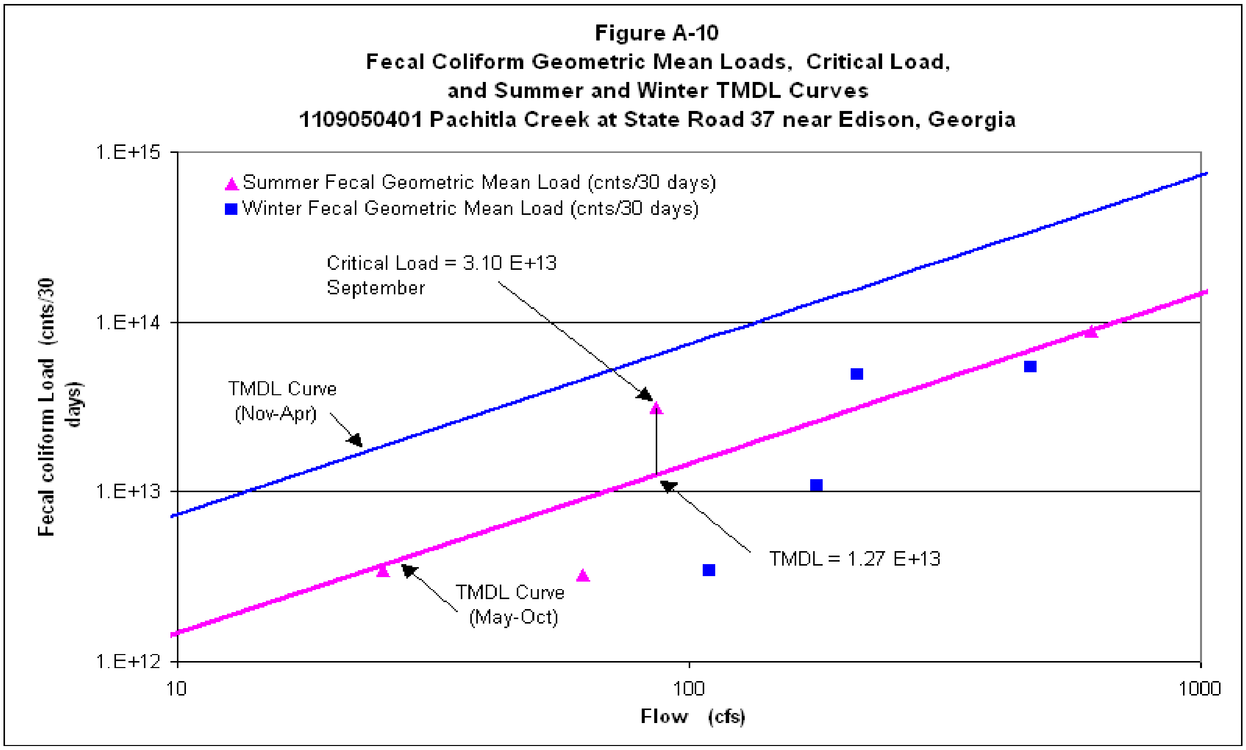


Table A-10. Data for Figure A-10

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)
Date	Fecal	Q	Geomean	Mean Flow	Current TMDL	TMDL
2/22/2000	70	134.0				
3/7/2000	20	128.0				
3/14/2000	80	145.0				
3/21/2000	430	304.0	83.3	177.8	1.09E+13	1.30E+14
4/4/2000	20	154.0				
4/11/2000	20	94.0				
4/19/2000	20	80.0	43.1	109.3	3.46E+12	8.03E+13
6/13/2000	56	20.0				
6/21/2000	90	24.0				
6/28/2000	790	38.0				
7/11/2000	230	19.0	174.0	25.3	3.22E+12	3.71E+12
9/19/2000	110	42.0				
9/26/2000	140	117.0				
10/4/2000	20	48.0				
10/17/2000	20	42.0	49.8	62.3	2.28E+12	9.14E+12
3/4/2010	170	596.0				
3/10/2010	80	427.0				
3/25/2010	300	372.0	159.8	465.0	5.45E+13	6.83E+13
5/4/2010	40	1420.0				
5/6/2010	700	701.0				
5/13/2010	230	209.0				
5/24/2010	230	118.0	196.2	612.0	8.81E+13	8.98E+13
9/1/2010	210	106.0				
9/21/2010	1100	48.0				
9/22/2010	500	46.0				
9/29/2010	500	145.0	**490.2**	**86.3**	**3.10E+13**	**1.27E+13**
12/1/2010	1400	268.0				
12/6/2010	40	155.0				
12/13/2010	800	255.0				
12/27/2010	220	174.0	315.1	213.0	4.93E+13	1.56E+14

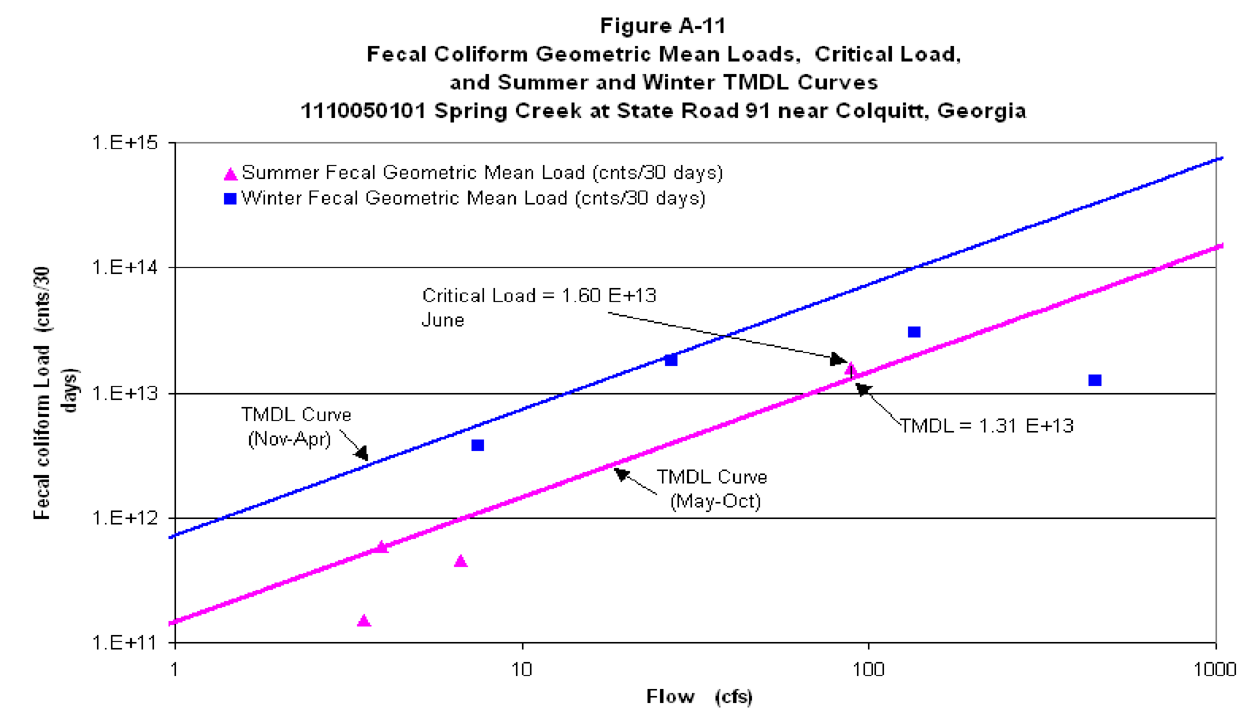


Table A-11. Data for Figure A-11

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)
Date	Fecal	Q	Geomean	Mean Flow	Current TMDL	TMDL
1/20/2000	110	85.0				
2/2/2000	130	152.0				
2/9/2000	330	109.0				
2/16/2000	230	195.0	181.5	135.3	1.80E+13	9.93E+13
5/10/2000	230	14.0				
5/17/2000	130	5.7				
5/24/2000	20	3.5				
6/7/2000	130	3.5	93.9	6.7	4.60E+11	9.80E+11
7/19/2000	20	3.5				
7/26/2000	20	3.5				
8/2/2000	130	3.5				
8/16/2000	230	3.5	58.8	3.5	1.51E+11	5.14E+11
11/7/2000	490	20.0				
11/14/2000	490	24.0				
11/20/2000	790	30.0				
12/6/2000	790	34.0	622.2	27.0	1.23E+13	1.98E+13
3/8/2010	40	492.1				
3/16/2010	80	496.4				
3/22/2010	170	423.4				
3/24/2010	130	393.0	91.7	451.2	3.04E+13	6.62E+13
6/8/2010	500	190.9				
6/17/2010	270	82.6				
6/23/2010	110	50.7				
6/29/2010	240	32.5	**244.3**	**89.2**	**1.60E+13**	**1.31E+13**
9/7/2010	110	7.5				
9/20/2010	300	2.1				
9/28/2010	230	2.3				
9/30/2010	230	3.9	204.4	3.9	5.92E+11	5.79E+11
12/13/2010	2300	7.5				
12/14/2010	500	6.9				
12/16/2010	230	7.5				
12/29/2010	800	8.0	678.2	7.5	3.72E+12	5.48E+12

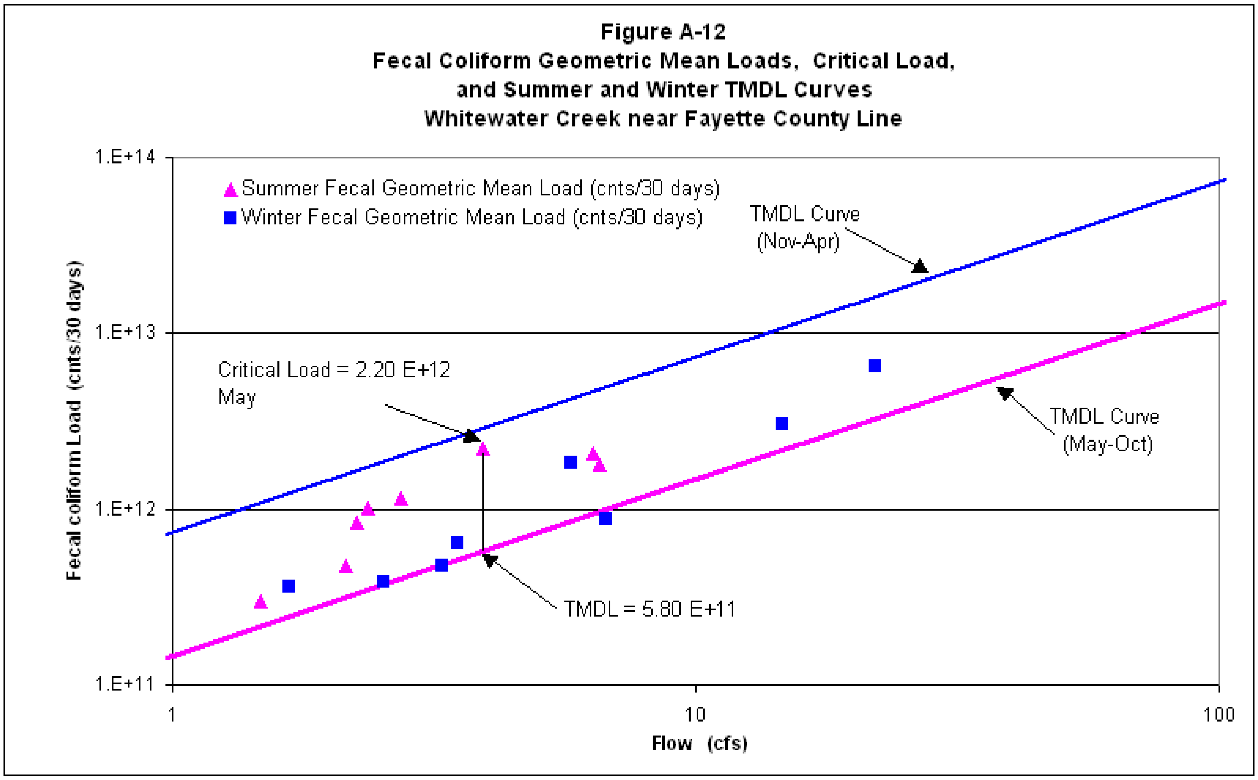


Figure A-12
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
Whitewater Creek near Fayette County Line
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
TMDL Curve (Nov-Apr)
Critical Load = 2.20 E+12 May
TMDL Curve (May-Oct)
TMDL = 5.80 E+11
1.E+14
1.E+13
1.E+12
1.E+11
Fecal coliform Load (cnts/30 days)
1
10
100
Flow (cfs)

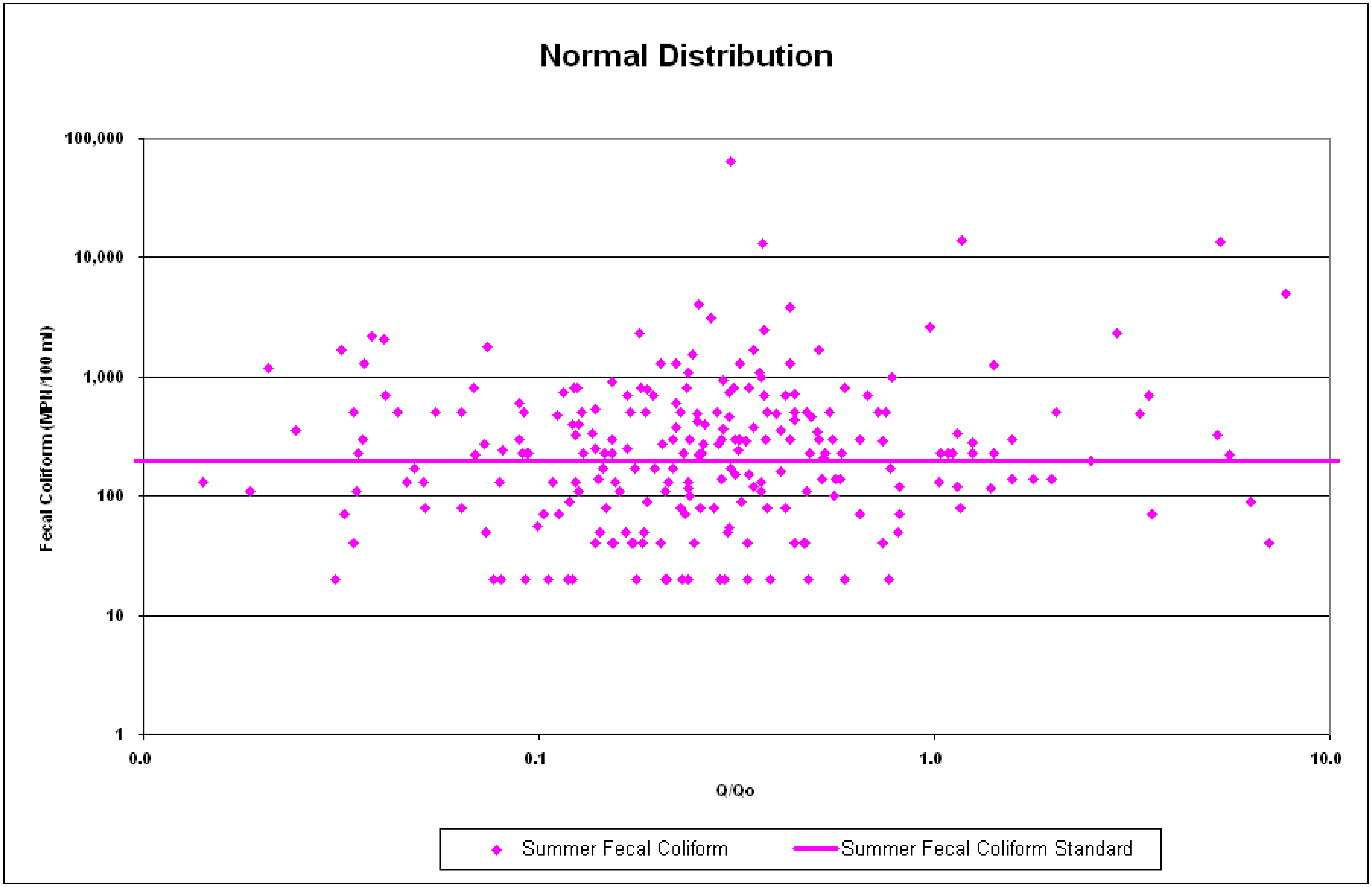
Table A-12. Data for Figure A-12

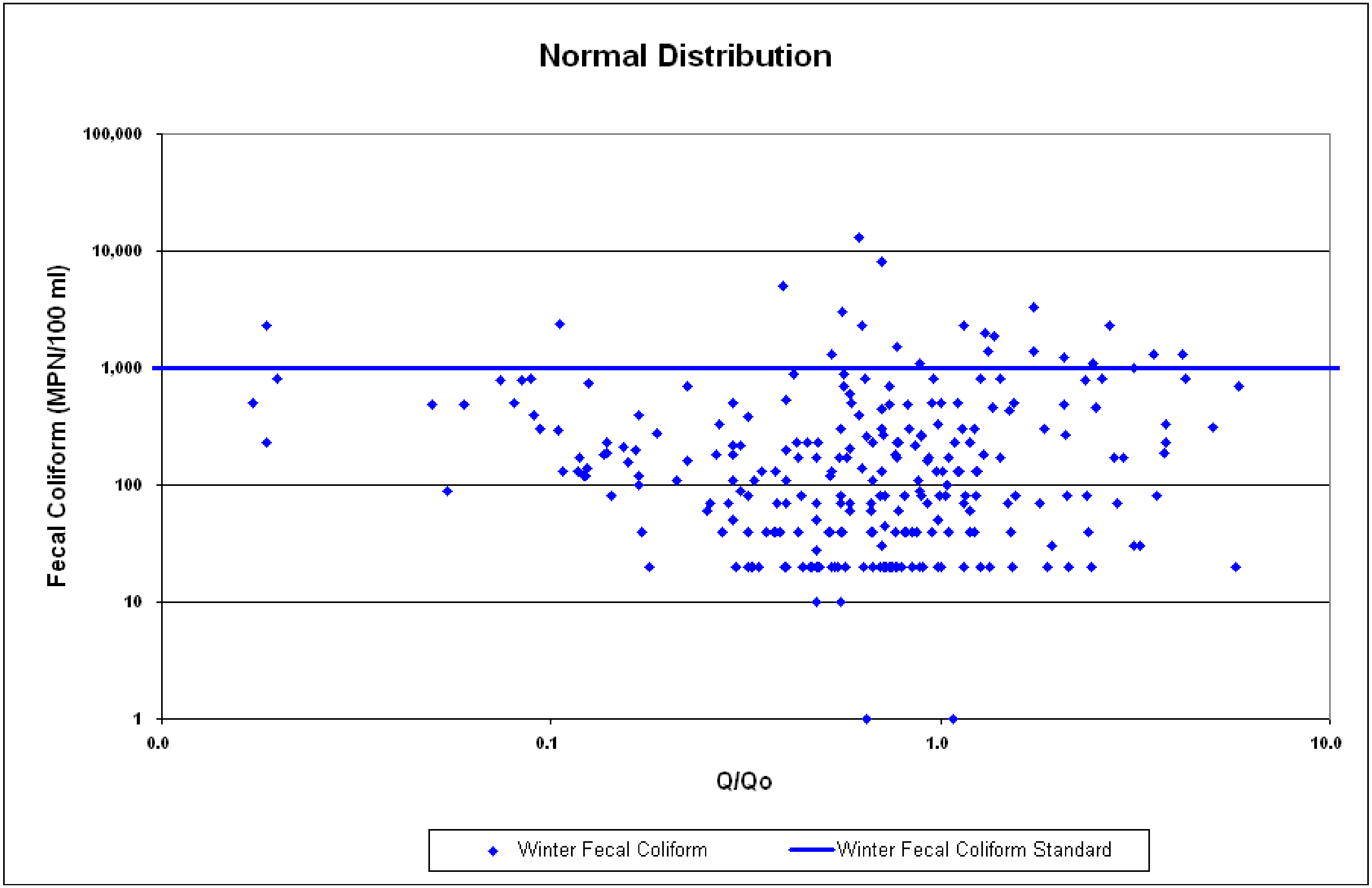
Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
6/20/2007	3800	5.7				
6/27/2007	460	6.5				
7/3/2007	600	3.0				
7/11/2007	1000	10.4	443.1	6.4	2.1E+12	9.4E+11
8/7/2007	290	4.4				
8/14/2007	300	4.3				
8/21/2007	120	4.6				
8/28/2007	2600	12.9	372.0	6.6	1.8E+12	9.6E+11
11/6/2007	110	3.9				
11/13/2007	180	3.9				
11/19/2007	60	3.3				
11/27/2007	700	3.0	247.3	3.5	6.4E+11	2.6E+12
2/7/2008	180	3.5				
2/14/2008	120	2.2				
2/21/2008	190	49.9				
2/28/2008	160	3.0	279.2	14.6	3.0E+12	1.1E+13
5/2/2008	250	2.2				
5/9/2008	800	3.1				
5/16/2008	1700	4.6				
5/23/2008	300	5.7	**761.7**	**3.9**	**2.2E+12**	**5.8E+11**
8/5/2008	600	1.2				
8/12/2008	1100	4.8				
8/21/2008	1800	1.0				
8/27/2008	900	2.0	510.7	2.3	8.4E+11	3.3E+11
11/4/2008	300	1.2				
11/11/2008	140	1.6				
11/18/2008	170	1.6				
11/25/2008	400	2.2	298.0	1.7	3.6E+11	1.2E+12
2/3/2009	400	1.2				
2/12/2009	290	1.4				
2/18/2009	1900	18.3				
2/25/2009	100	2.2	433.7	5.8	1.8E+12	4.2E+12
5/5/2009	490	3.3				
5/12/2009	380	3.0				
5/19/2009	230	2.0				
5/27/2009	700	2.6	577.9	2.7	1.2E+12	4.0E+11
8/4/2009	330	1.6				
8/11/2009	2100	0.5				
8/18/2009	250	1.8				
8/26/2009	540	1.8	277.1	1.5	3.0E+11	2.2E+11
11/2/2009	190	4.3				
11/9/2009	230	3.9				
11/17/2009	380	3.0				
11/24/2009	210	2.0	199.4	3.3	4.8E+11	2.4E+12
2/2/2010	180	10.2				
2/9/2010	110	8.9				
2/16/2010	220	3.9				
2/23/2010	220	4.1	175.9	6.7	8.7E+11	9.9E+11
5/4/2010	380	4.6				
5/11/2010	340	1.8				
5/18/2010	230	1.2				
5/26/2010	270	1.0	299.3	2.1	4.7E+11	3.2E+11
8/2/2010	800	2.4				
8/9/2010	700	2.2				
8/17/2010	430	3.3				
8/24/2010	480	1.5	583.1	2.4	1.0E+12	3.5E+11
11/3/2010	2300	8.3				
11/11/2010	90	0.7				
11/23/2010	180	1.8				
11/30/2010	700	77.6	401.9	22.1	6.5E+12	1.6E+13
2/2/2011	900	5.5				
2/9/2011	120	1.6				
2/17/2011	130	1.4				
2/22/2011	130	1.6	206.7	2.5	3.8E+11	1.9E+12

.

Appendix B

Normalized Flows Versus Fecal Coliform Plots


Normal Distribution
100,000
10,000
1,000
100
10
1
Fecal Coliform (MPN/100 ml)
0.0
0.1
1.0
10.0
Q/Qo
Summer Fecal Coliform
Summer Fecal Coliform Standard


Normal Distribution
Fecal Coliform (MPN/100 ml)
100,000
10,000
1,000
100
10
1
0.0
0.1
1.0
10.0
Q/Qo
Winter Fecal Coliform
Winter Fecal Coliform Standard