Total Maximum Daily Load

Evaluation

for

Eleven Stream Segments

in the

Chattahoochee River Basin

for

Fecal Coliform

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

Submitted by:
The Georgia Department of Natural Resources
Environmental Protection Division
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EXECUTIVE SUMMARY

The State of Georgia assesses its waterbodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed waterbodies are placed into one of three categories, supporting designated use, not supporting designated use, or assessment pending, depending on water quality assessment results. These waterbodies 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 2012-2013* (GA EPD, 2014). This document is available on the Georgia Environmental Protection Division (GA EPD) website.

The subset of the water bodies that do not meet designated uses on the 305(b) list are also assigned to Georgia's 303(d) list, named after that section of the CWA. Although the 305(b) and 303(d) lists are two distinct requirements under the CWA, Georgia reports both lists in one combined format called the Integrated 305(b)/303(d) List, which is found in Appendix A of *Water Quality in Georgia 2012-2013* (GA EPD, 2014). Water bodies on the 303(d) list are denoted as Category 5, and 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 2014 303(d) listing, which is available on the GA 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 waterbody 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 eleven stream segments in the Chattahoochee River Basin on the 303(d) list of impaired waters because they were assessed as "not supporting" their designated uses of "Fishing" or "Drinking Water" 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. Waterbodies in Georgia are assessed based on the 305(b)/303(d) Listing Assessment Methodology included in Appendix A of *Water Quality in Georgia 2012-2013* (GA EPD, 2014). A waterbody 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 listed segments in the Chattahoochee River Basin 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 (wastewater, construction, industrial stormwater, and/or MS4) permit limits and requirements;
- Implementation of recommended Water Quality management practices in the *Middle Chattahoochee Regional Water Plan* (GA EPD, 2017) ;
- Implementation of required Action Items in the *Water Resource Management Plan* developed by the Metro-North Georgia Water Planning District (MNGWPD, 2017)
- Implementation of *Georgia's Best Management Practices for Forestry* (GFC, 2009);
- Implementation of *Best Management Practices for Georgia Agriculture* (GSWCC, 2013) and Adoption of National Resource Conservation Service (NRCS) Conservation Practices for agriculture;
- Implementation of the *Georgia Better Back Roads Field Manual* (GA RCDC, 2009) and adoption of additional practices for proper unpaved road maintenance;
- Implementation of individual Erosion and Sedimentation Control Plans for land disturbing activities; and application of the *Manual for Erosion and Sediment Control in Georgia* (GSWCC, 2016)
- Implementation of the *Georgia Stormwater Management Manual* (ARC, 2016) to facilitate prevention and mitigation of stream bank erosion due to increased stream flow and velocities caused by urban runoff through structural storm water BMP installation.
- Where applicable, implementation of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual* (CCSMPC, 2009).

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)	
Blue Creek	2.62E+11	-	-	1.81E+10	2.01E+09	2.01E+10	92.3
Bull Creek	2.14E+13	-	1.00E+10	2.27E+10	3.64E+09	3.64E+10	99.8
Dram Creek	2.14E+13	-	5.18E+11	5.65E+11	1.20E+11	1.20E+12	94.4
East Double Branch	1.82E+10	-	6.12E+08	3.25E+08	1.04E+08	1.04E+09	94.3
Lindsey Creek	3.61E+10	-	3.69E+09	2.07E+09	6.40E+08	6.40E+09	82.3
Mill Branch	4.52E+11	-	5.48E+09	6.13E+09	1.29E+09	1.29E+10	97.1
Roaring Branch	5.37E+09	-	8.10E+08	5.13E+08	1.47E+08	1.47E+09	72.6
Tiger Creek	8.45E+11	-	1.39E+10	5.64E+10	7.81E+09	7.81E+10	90.8
Tributary to Bull Creek	6.77E+10	-	1.43E+09	1.06E+09	2.76E+08	2.76E+09	95.9
Turkey Creek	1.69E+12	-	5.40E+11	3.93E+11	1.04E+11	1.04E+12	38.6
Weracoba Creek	5.99E+11	-	1.21E+10	6.10E+09	2.02E+09	2.02E+10	96.6

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its waterbodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed waterbodies are placed into one of three categories, supporting designated use, not supporting designated use, or assessment pending, depending on water quality assessment results. These waterbodies 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 2012-2013* (GA EPD, 2014). This document is available on the Georgia Environmental Protection Division website.

The subset of the water bodies that do not meet designated uses on the 305(b) list are also assigned to Georgia's 303(d) list, named after that section of the CWA. Although the 305(b) and 303(d) lists are two distinct requirements under the CWA, Georgia reports both lists in one combined format called the Integrated 305(b)/303(d) List, which is found in Appendix A of *Water Quality in Georgia 2012-2013* (GA EPD, 2014). Water bodies on the 303(d) list are denoted as Category 5, and 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 2014 303(d) listing, which is available on the GA 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.

The 303(d) list identifies the stream segments 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 eleven streams in the Chattahoochee River Basin included on the 2014 303(d) list for exceedances of the fecal coliform standard criteria.

Table 1. Stream Segments Listed on the 2014 303(d) List for Fecal Coliform Bacteria in the Chattahoochee River Basin

Stream Segment	Location	Reach ID	Segment Length (miles)	Designated Use
Blue Creek	Headwaters to Yellowjacket Creek	GAR031300020707	6	Drinking Water
Bull Creek	Cooper Creek to Dram Branch	GAR031300030114	2	Fishing
Dram Creek	Tributary to Bull Creek, Columbus	GAR031300030109	2	Fishing
East Double Branch	Headwaters to Double Branch	GAR031300030117	2	Fishing
Lindsey Creek	Headwaters to Bull Creek, Columbus	GAR031300030101	6	Fishing
Mill Branch	Headwaters to Bull Creek	GAR031300030118	2	Fishing
Roaring Branch	Upstream Columbus Foundaries	GAR031300021303	1	Fishing
Tiger Creek	Headwaters to Uptatoi Creek, Columbus	GAR031300030306	5	Fishing

Stream Segment	Location	Reach ID	Segment Length (miles)	Designated Use
Tributary to Bull Creek	Headwaters to Bull Creek	GAR031300030119	1	Fishing
Turkey Creek	Tributary to Bull Creek, Columbus	GAR031300030103	1	Fishing
Weracoba Creek	Headwaters to Wynnton Road	GAR031300030120	4	Fishing

1.2 Watershed Description

The Chattahoochee River Basin is located primarily in west Georgia and east Alabama, with a small portion in north Florida. It occupies an area of 8,770 square miles, of which 6,140 square miles (70%) lie in Georgia (figure 1). The Chattahoochee River Basin falls within the Level III Blue Ridge, Piedmont, and Coastal Plain Ecoregions that extend throughout the southeastern United States. The Chattahoochee River originates in the southeast corner of Union County, in north Georgia, within the Blue Ridge Mountains. The river flows southwest to Lake Sidney Lanier, then through the Atlanta metropolitan area to West Point Lake where it forms the border between Georgia and Alabama. It continues flowing south through Walter F. George Reservoir and converges with the Flint River in Lake Seminole, at the Georgia-Florida border. The outflow from Lake Seminole forms the Apalachicola River in Florida, which ultimately discharges to the Gulf of Mexico.

The Chattahoochee River Basin includes four United States Geologic Survey (USGS) eight-digit hydrologic units, HUC 03130001 – 03130004. Figure 2 shows the locations of the four hydrologic units in the Chattahoochee River Basin. Figures 3 and Figure 4 show the locations of the 303(d) listed segments and associated counties in these HUCs.

The land use characteristics of the Chattahoochee 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 eleven stream segments.

1.3 State Water Planning

The Georgia Legislature enacted the Metropolitan North Georgia Water Planning District Act in 2001 to create the Metropolitan North Georgia Water Planning District (MNGWPD) to preserve and protect water resources in the 15-county metropolitan Atlanta area. The MNGWPD is charged with the development of comprehensive regional and watershed specific water resource management plans to be implemented by local governments in the metropolitan Atlanta area. The MNGWPD issued its first water resource management plan documents in 2003.

In 2004, the Georgia Legislature enacted the Comprehensive State-wide Water Management Planning Act to ensure management of water resources in a sustainable manner to support the state's economy, to protect public health and natural systems, and to enhance the quality of life for all citizens on a state-wide level. GA EPD later developed the 2008 Comprehensive State-wide Water Management Plan, which established Georgia's ten Regional Water Planning

Councils (RWPCs) and laid the groundwork for the RWPCs to develop their own Regional Water Plans. The boundaries of these ten RWPCs, in addition to the MNGWPD, are shown in Figure 5.

In 2011, each RWPC finished development of individualized Regional Water Plans, which were later adopted following GA EPD review. These Regional Water Plans identify a range of actions or management practices to help meet the state's water quality and water supply challenges. The MNGWPD and each RWPC subsequently updated and revised their respective management plan documents in 2017. Implementation of these plans is critical to meeting Georgia's water resource challenges. The specific Regional Water Plan(s) applicable to this TMDL are discussed in Sections 6 and 7.

1.4 Water Quality Standard

The water use classifications for the listed stream segments in the Chattahoochee River Basin are Fishing and Drinking Water. 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)(a)(i) and (c)(iii) (GA EPD, 2016), are:

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

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

(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:

1. 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 these surface waters since a number of factors which are beyond the control of any State regulatory agency contribute to elevated levels of bacteria.
2. For waters designated as shellfish growing areas by the Georgia DNR Coastal Resources Division, 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 National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish, 2007 Revision (or most recent version), Interstate Shellfish Sanitation Conference, U.S. Food and Drug Administration.

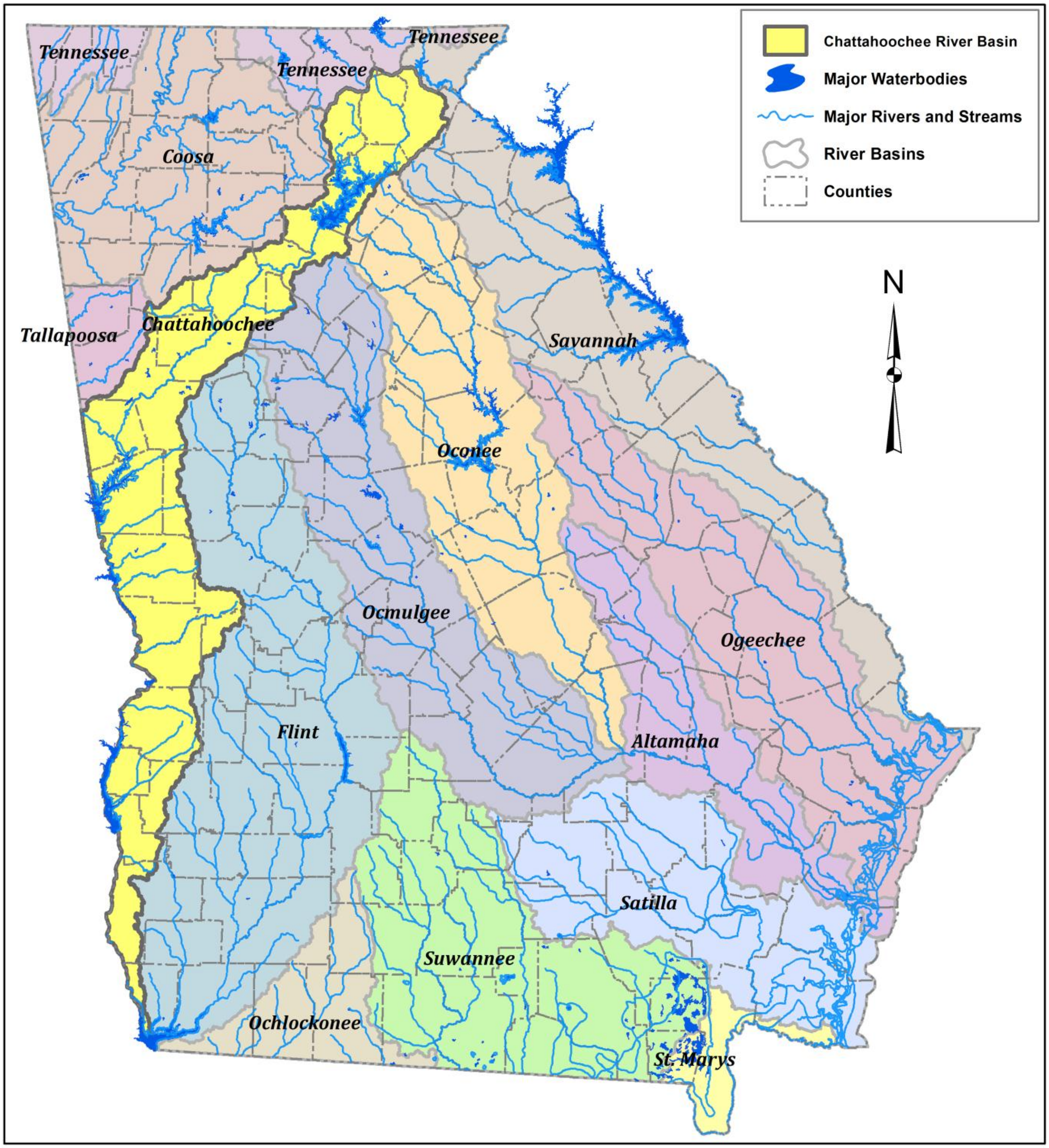


Figure 1. Chattahoochee River Basin and the River Basins of Georgia

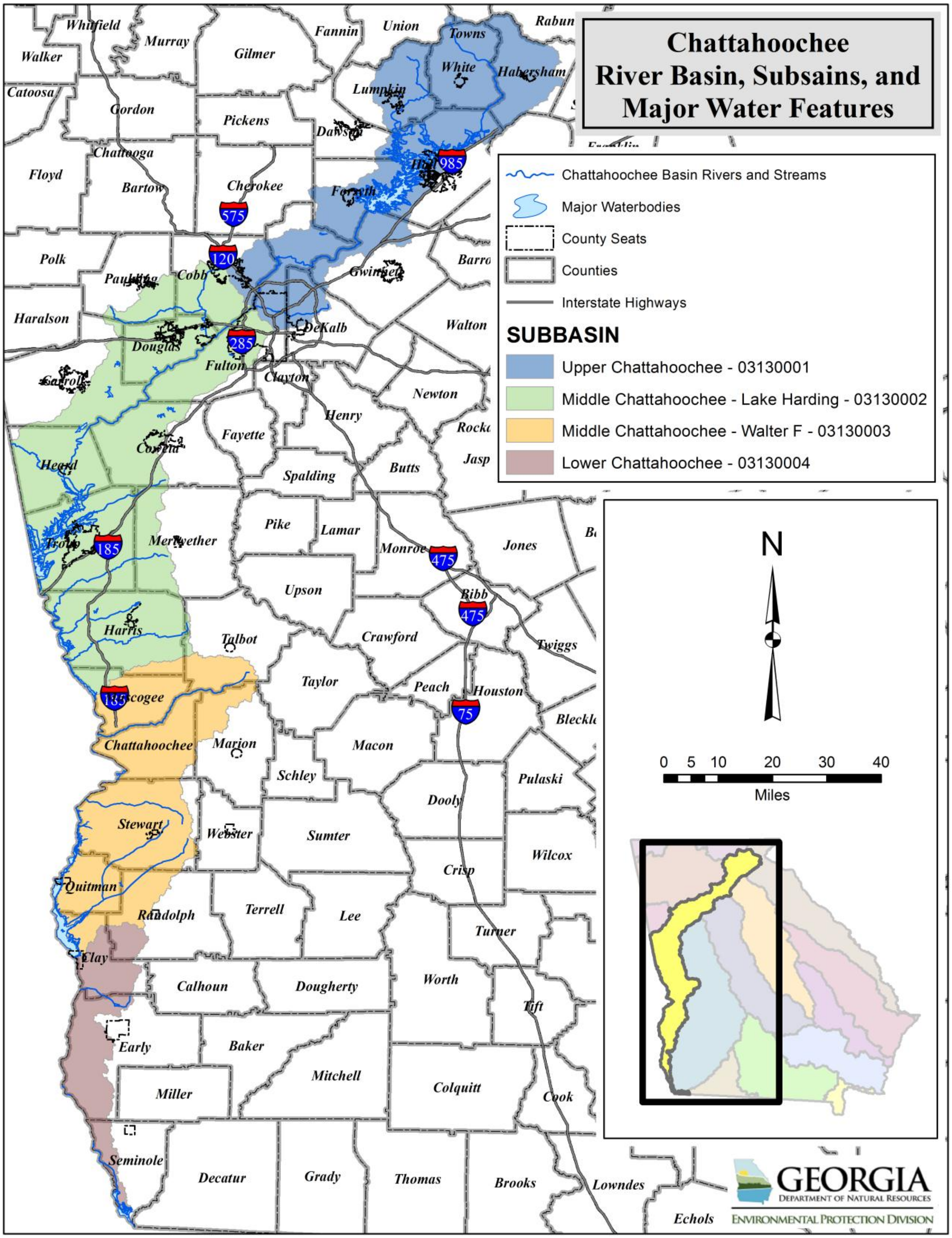


Figure 2. USGS 8-Digit HUCs for Chattahoochee River Basin

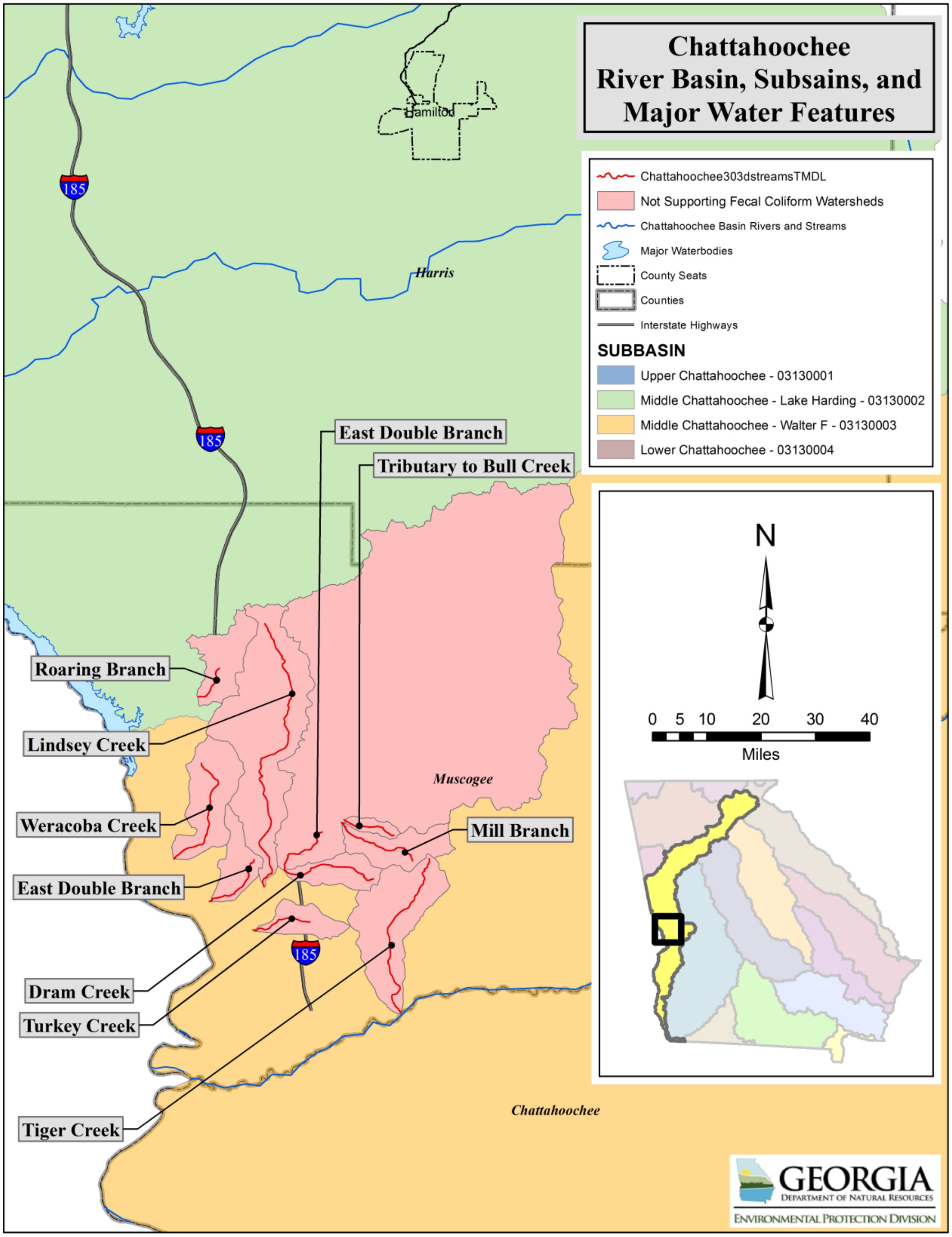


Figure 3. Impaired Stream Segments in Middle Chattahoochee River Sub-basin

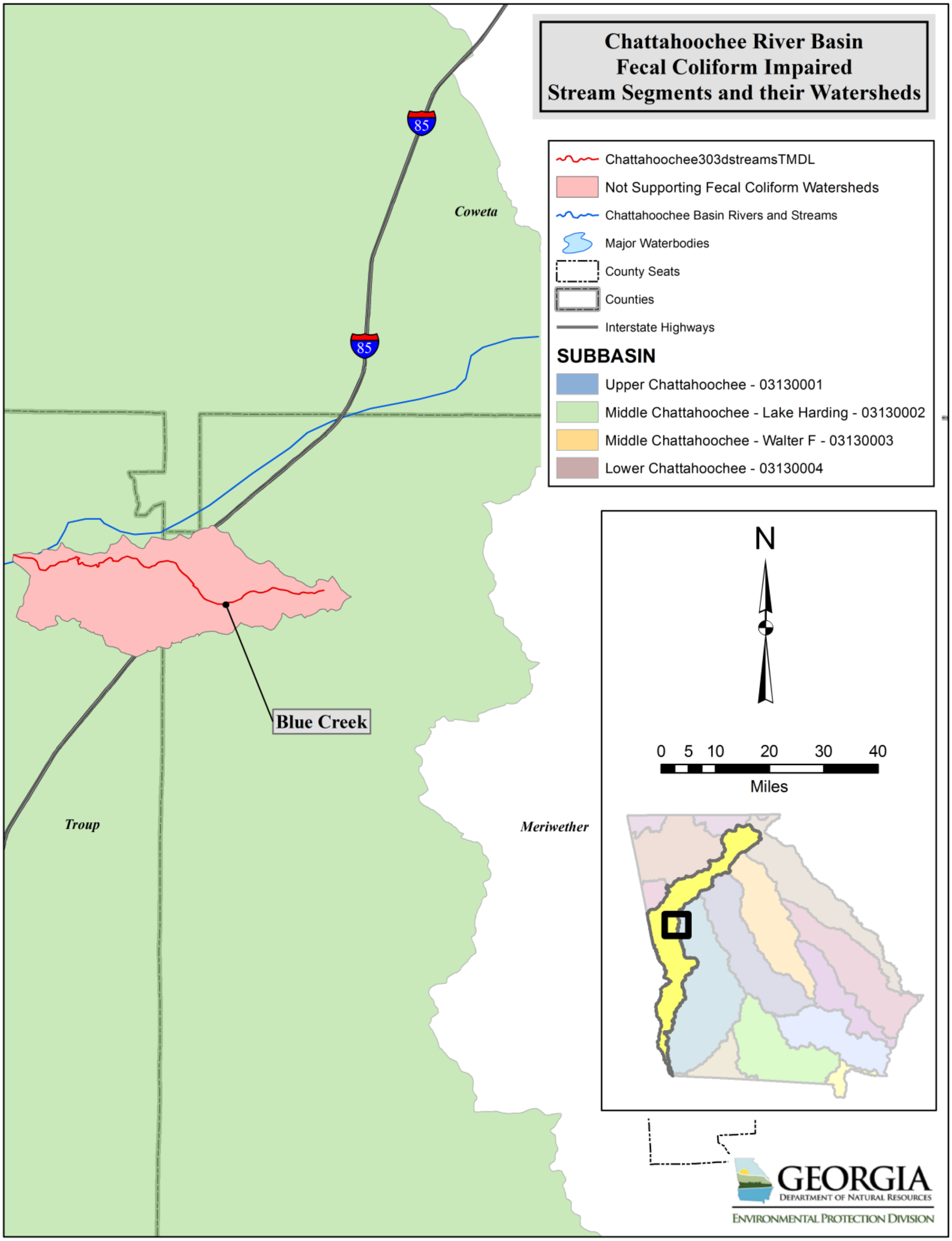


Figure 4. Impaired Stream Segments in Middle Chattahoochee – Lake Harding River Sub-basin

Table 2. Land Coverage for Watersheds of the 303(d) Listed Segments

Stream/Segment	Land Use Categories - Acres (Percent)												Total
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	
Blue Creek	62	264	42	23	8	604	2,759	0	690	137	263	0	4,851
	1.3%	5.4%	0.9%	0.5%	0.2%	12.4%	56.9%	0.0%	14.2%	2.8%	5.4%	0.0%	100.0%
Bull Creek	372	7,557	3,037	1,158	97	696	14,189	1,313	924	3,529	1,145	13	34,028
	1.1%	22.2%	8.9%	3.4%	0.3%	2.0%	41.7%	3.9%	2.7%	10.4%	3.4%	0.0%	100.0%
Dram Creek	0	374	65	61	0	3	240	49	3	143	0	0	938
	0.0%	39.9%	6.9%	6.5%	0.0%	0.3%	25.6%	5.2%	0.3%	15.3%	0.0%	0.0%	100.0%
East Double Branch	0	536	150	66	0	1	54	9	0	158	0	0	974
	0.0%	55.0%	15.4%	6.8%	0.0%	0.1%	5.5%	0.9%	0.0%	16.2%	0.0%	0.0%	100.0%
Lindsey Creek	22	2,479	1,183	1,190	7	31	357	57	21	624	13	2	5,987
	0.4%	41.4%	19.8%	19.9%	0.1%	0.5%	6.0%	1.0%	0.4%	10.4%	0.2%	0.0%	100.0%
Mill Branch	0	572	148	22	2	2	292	129	7	150	0	0	1,324
	0.0%	43.2%	11.2%	1.7%	0.1%	0.2%	22.0%	9.8%	0.5%	11.4%	0.0%	0.0%	100.0%
Roaring Branch	6	475	355	294	3	28	96	2	31	81	4	0	1,376
	0.4%	34.6%	25.8%	21.3%	0.2%	2.1%	6.9%	0.2%	2.3%	5.9%	0.3%	0.0%	100.0%
Tiger Creek	2	510	124	37	11	100	1,767	220	26	197	134	0	3,128
	0.1%	16.3%	4.0%	1.2%	0.3%	3.2%	56.5%	7.0%	0.8%	6.3%	4.3%	0.0%	100.0%
Tributary to Bull Creek	0	139	39	14	2	3	42	4	0	40	0	0	283
	0.0%	48.9%	13.9%	5.0%	0.7%	0.9%	15.0%	1.3%	0.1%	14.1%	0.0%	0.0%	100.0%
Turkey Creek	2	400	121	74	1	0	120	21	1	95	0	0	834
	0.2%	48.0%	14.5%	8.8%	0.2%	0.0%	14.4%	2.5%	0.1%	11.4%	0.0%	0.0%	100.0%
Weracoba Creek	0	1,035	301	247	0	0	87	15	2	386	0	1	2,075
	0.0%	49.9%	14.5%	11.9%	0.0%	0.0%	4.2%	0.7%	0.1%	18.6%	0.0%	0.0%	100.0%

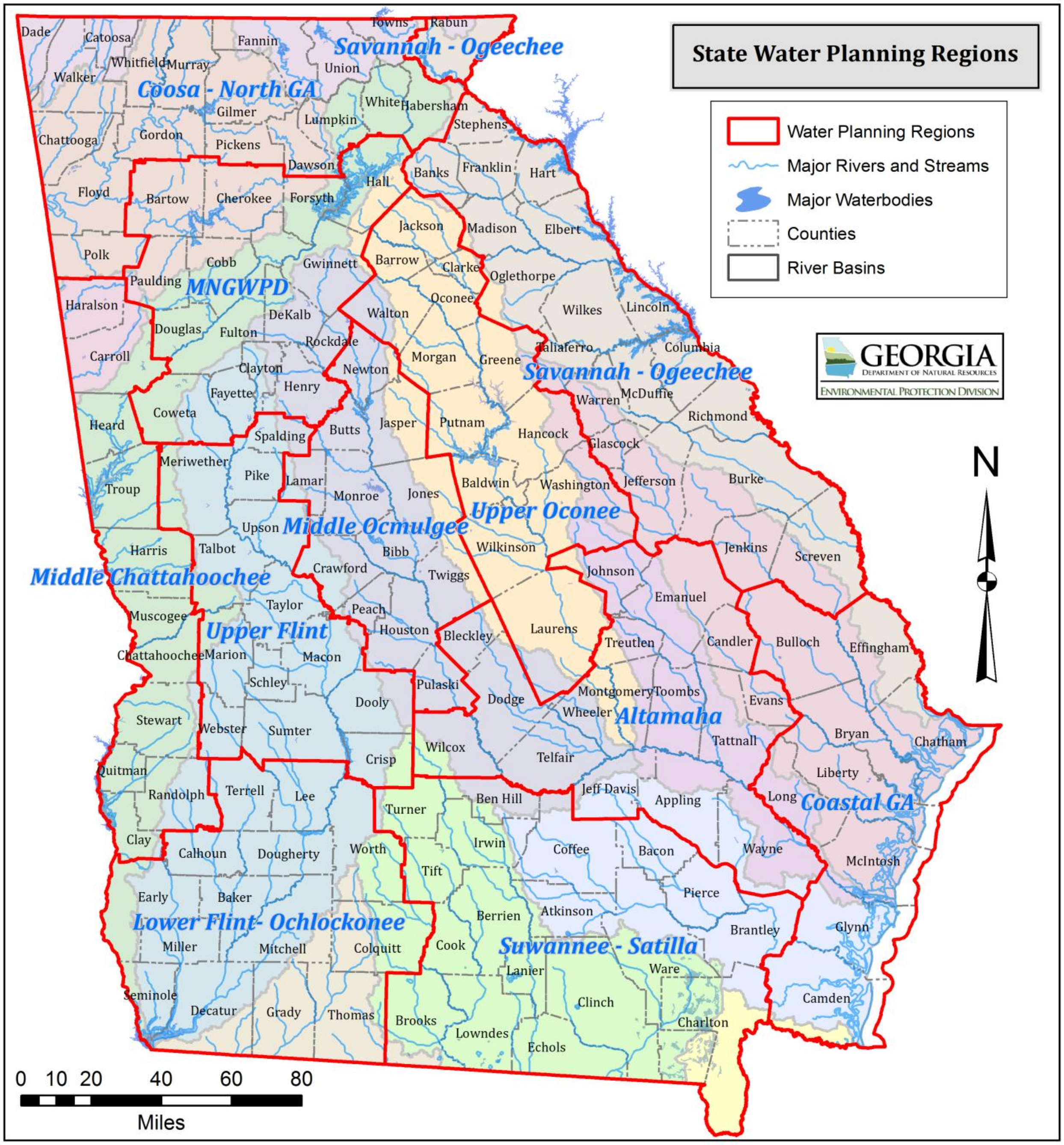


Figure 5. Boundaries of the Regional Water Planning Councils and the Metropolitan North Georgia Water Planning District.

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 calculated geometric means exceed the fecal coliform criteria. If sampling data do not allow for the calculation of 30-day geometric means, a stream is placed on the list if more than 10% of the individual samples exceed the 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 development of the TMDLs in this document were collected during calendar years 2011 and 2014, by or on behalf of GA EPD, as part of the trend monitoring program. Additional earlier data are included when available. A summary of sampling station locations and sampling dates are given in Table 3. The raw data are presented in Appendix A.

Table 3. Fecal Coliform Sampling Stations and Dates

Stream Segment	Location	GA EPD Monitoring Station No.	Monitoring Station Description	Sample Date Range
Blue Creek	Headwaters to Yellowjacket Creek	1202070201 (RV_12_4282)	Blue Creek at County Line Rd (AKA Sims Rd) near Hogansville, GA	01/2012-10/2012
Bull Creek	Cooper Creek to Dram Branch	N/A (Columbus Consolidated Govt.)	Bull Creek - Dead End of Woodburn Drive (Bull#2)	02/2011-03/2014
Dram Creek	Tributary to Bull Creek - Columbus	N/A (Columbus Consolidated Govt.)	Dram Creek - at Linden Circle (Dram#2)	02/2011-03/2014
East Double Branch	Headwaters to Double Branch	N/A (Columbus Consolidated Govt.)	Double Branch Creek - MLK Jr. Blvd. And Roosevelt St. (DBLBR#2)	02/2011-03/2014
Lindsey Creek	Headwaters to Bull Creek - Columbus	N/A (Columbus Consolidated Govt.)	Lindsay Creek - Boxwood Blvd at Midtown Drive (LINS#2)	02/2011-03/2014
Mill Branch	Headwaters to Bull Creek	N/A (Columbus Consolidated Govt.)	Mill Branch Creek - at Floyd Road Culvert (MILL#2)	02/2011-03/2014
Roaring Branch	U/S Columbus Foundaries	N/A (Columbus Consolidated Govt.)	Roaring Branch Creek - Bradley Park Drive at Whitesville Road	02/2011-03/2014
Tiger Creek	Headwaters to Uptatoi Creek, Columbus	N/A (Columbus Consolidated Govt.)	Tiger Creek - St. Marys Road at Ft. Benning Line (TIGR#1)	02/2011-03/2014
Tributary to Bull Creek	Headwaters to Bull Creek	N/A (Columbus Consolidated Govt.)	Unnamed Trib to Bull - Floyd Road at Booth Street (FLYDBTH)	02/2011-03/2014
Turkey Creek	Tributary to Bull Creek - Columbus	N/A (Columbus Consolidated Govt.)	Turkey Creek Intersection of Brennan Rd/Cusseta Rd Outfall (TURK#2)	02/2011-03/2014
Weracoba Creek	Headwaters to Wynnton Road	N/A (Columbus Consolidated Govt.)	Weracoba Creek - Wynnton Road at Warren Williams Road (WERA#2)	02/2011-03/2014

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 no NPDES permitted discharges with flow greater than 0.1 million gallons per day (MGD) identified in the watersheds of the listed segments in the Chattahoochee River Basin that could potentially impact streams on the 2014 303(d) list for fecal coliform bacteria.

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. The City of Atlanta has permitted CSO outfalls in the upper portion of the Chattahoochee River Basin, but none of these CSO outfalls are upstream of the listed segments.

Columbus Water Works (CWW) also operates CSO facilities in the Chattahoochee River Basin under NPDES permit number GA0036838. The CWW CSO system operates two large primary treatment facilities designed to capture CSO flows from rain events 0.63 inches per hour and under. When rainfall rates are greater than 0.63 inches per hour, CWW is authorized to discharge CSO effluent from eleven (11) minor outfalls. Under these conditions, ten (10) of the minor outfalls discharge to the Chattahoochee River and Outfall 013 discharges to Weracoba Creek. From best available data, and information provided by CWW, it has been determined that Outfall 013 discharges to Weracoba Creek in the portion of stream that is been enclosed in a box culvert, south of Wynnton Road. This discharge is assumed to be immediately downstream of the segment being evaluated in this TMDL evaluation.

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 limit pollution: "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

Storm water discharges associated with industrial activities are currently covered under the 2017 NPDES General Permit for Stormwater Discharges Associated with Industrial Activity (GAR050000) also called the Industrial General Permit (IGP). This permit requires visual monitoring of storm water discharges, site inspections, implementation of Best Management Practices (BMPs), preparation of a Storm Water Pollution Prevention Plan (SWPPP), and annual reporting. 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 2017 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. Delineations of both supporting and not supporting waterbodies are provided on the GA EPD website, and are available in ESRI ArcGIS shapefile format or in KMZ format for use in Google Earth. Interested parties may evaluate their proximity to not supporting waterbodies by utilizing these geospatial files.

3.1.2.2 MS4 NPDES Permits

The collection, conveyance, and discharge of diffuse storm water to local water bodies by a public entity is regulated in Georgia by the NPDES MS4 permits. These MS4 permits have been issued under two phases. Phase I MS4 permits cover medium and large cities, and counties with populations over 100,000. Each individual Phase I MS4 permit requires the prohibition of non-storm water discharges (i.e., illicit discharges) into the storm sewer systems and controls to reduce the discharge of pollutants to the maximum extent practicable, including the use of management practices, control techniques and systems, as well as design and engineering methods (Federal Register, 1990). A site-specific Storm Water Management Plan (SWMP) outlining appropriate controls is required by and referenced in the permit. A program to monitor and control pollutants in storm water discharges from industrial facilities, construction sites, and highly visible pollutant sources that exist within the MS4 area must be implemented under the permit. Additionally, monitoring of not supporting streams, public education and involvement, post-construction storm water controls, low impact development, and annual reporting requirements must all be addressed by the permittee on an ongoing basis. As of 2017, fifty-seven (57) counties and municipalities are covered by Phase I MS4 permits in Georgia.

Small MS4s serving urbanized areas are required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an 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. As of 2015, Seventy-three (73) municipalities, thirty-five (35) counties, five (5) Department of Defense facilities, and the Georgia Department of Transportation (GDOT) are permitted under the Phase II storm water regulations in Georgia. All municipal Phase II permitees are authorized to discharge under Storm Water General Permit GAG610000. Department of Defense facilities are authorized to discharge under Storm Water General Permit GAG480000. GDOT owned or operated facilities are authorized to discharge under Storm Water General Permit GAR041000. Under these general permits, each permittee must design and implement a SWMP that incorporates BMPs that focus on public education and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction storm water management, and pollution prevention in municipal operations. Table 4 lists the permitted MS4s that discharge into stream segments not supporting their designated use for fecal coliform.

Table 4. Permitted MS4s in the Chattahoochee River Basin Discharging to Watersheds of the 303(d) Listed Segments

MS4 Permittee	Permit Number	Permit Phase
Columbus Consolidated Government	GAS000202	1
U.S. Army Fort Benning	GAG480000	2

Source: Nonpoint Source Program, GA EPD, 2017

Table 5 lists the Phase I and Phase II MS4 city or county urbanized areas upstream of listed segments in the Chattahoochee River Basin. Urbanized areas include land uses identified as lawns, parks, and greenspace, as well as residential, commercial, industrial, and transportation facilities. The table provides the total area of this watershed and the percentage of the watershed that is a MS4 city or county urbanized area.

Table 5. Percentage of MS4 City or County Urbanized Area Upstream of 303(d) Listed Segments in the Chattahoochee River Basin

303(d) Listed Stream Segment	Location	Total Area (square miles)	% In MS4 Urbanized Area
Bull Creek	Cooper Creek to Dram Branch	53.2	43.7%
Dram Creek	Tributary to Bull Creek - Columbus	1.5	68.4%
East Double Branch	Headwaters to Double Branch	1.5	93.4%
Lindsey Creek	Headwaters to Bull Creek - Columbus	9.4	91.5%
Mill Branch	Headwaters to Bull Creek	2.1	67.4%
Roaring Branch	U/S Columbus Foundaries	2.2	87.5%
Tiger Creek	Headwaters to Uptatoi Creek, Columbus	4.9	28.2%

303(d) Listed Stream Segment	Location	Total Area (square miles)	% In MS4 Urbanized Area
Tributary to Bull Creek	Headwaters to Bull Creek	0.4	82.2%
Turkey Creek	Tributary to Bull Creek - Columbus	1.3	82.7%
Weracoba Creek	Headwaters to Wynnton Road	3.2	95.0%

3.1.3 Concentrated Animal Feeding Operations

Under the Clean Water Act, Concentrated Animal Feeding Operations (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 required medium size AFOs with more than 300 animal units (AU), but less than 1,000 AU, to apply for a non-discharge state land application system (LAS) waste disposal permit. Large operations with more than 1000 AU were required to apply for an NPDES permit (also non-discharge) as a CAFO. The USEPA CAFO regulations were successfully appealed in 2005. They were revised to comply with the court's decision that NPDES permits only be required for actual discharges. Georgia's rules were amended on August 7, 2012, to reflect the USEPA revisions. 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 1,000 AU, unless they elect to obtain an NPDES permit. There are no known liquid manure CAFO located in the watershed of the listed segments in the Chattahoochee River Basin that have NPDES or land application permits.

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. In accordance with the Georgia rule amendment discussed above, the general permit covering these facilities has been terminated and they are no longer covered under any permit. 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 previously stored for an extended length of time typically exhibits very low fecal coliform levels. There are no known dry manure poultry operations located in the watershed of the listed segments in the Chattahoochee River Basin.

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 significance of wildlife as a source of fecal coliform bacteria in streams varies considerably depending on the animal species present in the watershed. Based on information provided by the Wildlife Resources Division (WRD) of GA DNR, the greatest wildlife sources of fecal coliform are the animals that spend a large portion of their time in or around aquatic habitats. Of these, waterfowl, especially ducks and geese, are considered to be the most significant source, because when present, they are typically found in large numbers on the water surface. Other 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 substantial presence in the floodplain areas of the major rivers in Georgia.

White-tailed deer populations are abundant throughout the Chattahoochee River Basin. Fecal coliform bacteria contributions to waterbodies 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 Chattahoochee 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 6 provides the estimated number of beef cattle, dairy cattle, goats, horses, swine, sheep, and chickens reported by county.

Table 6. Estimated Agricultural Livestock Populations in Counties Containing the Watersheds of the Listed Segments in the Flint River Basin

County	Livestock							
	Beef Cattle	Dairy Cattle	Swine	Sheep	Horses	Goats	Chickens Layers	Chickens-Broilers Sold
Harris	4,350	-	-	300	775	500	-	-
Meriwether	10,000	300	155	500	450	1,000	-	-
Muscogee	200	-	-	-	63	-	-	-
Troup	5,350	300	-	200	700	150	-	-

Source: Center for Agribusiness and Economic Development, UGA 2015

3.2.3 Urban Development

Fecal coliform bacteria 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 Chattahoochee River Basin may be attributed to failure of septic systems and illicit discharges of raw sewage. Table 7 presents the number of septic systems in counties containing the watershed of the 303(d) listed segments in the Chattahoochee River Basin existing at the end of 2009 and the number existing at the end of 2013. This is based on data provided by the Georgia Department of Public Health and information obtained from the U.S. Census. In addition, an estimate of the number of septic systems installed and repaired during the period from 2009 through 2013 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 7. Estimated Number of Septic Systems in Counties Containing the Watersheds of the Listed Segments in the Flint River Basin

County	Existing Septic Systems (2009)	Existing Septic Systems (2013)	Number of Septic Systems Installed (2009 to 2013)	Number of Septic Systems Repaired (2009 to 2013)
Harris	14,531	14,983	452	244
Meriwether	9,033	9,143	110	89
Muscogee	3,142	3,214	72	34
Troup	17,535	17,823	288	512

Source: The Georgia Dept. of Public Health, Environmental Health Section, 2014

3.2.3.2 Land Application Systems

Some communities and industries use land application systems (LAS) for wastewater disposal. 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 effluent runoff to surface waters. However, sometimes the soil's percolation rate is exceeded when applying the wastewater, or encountering excess precipitation, resulting in runoff. 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 no permitted LAS systems with a flow greater than 0.1 MGD identified in the watersheds of the listed segments in the Chattahoochee River Basin that could potentially impact the stream segments in this TMDL.

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 5 known landfills in the watersheds of the listed segments in the Chattahoochee River Basin. Of these, 2 are operating landfills, and 3 are inactive or closed. Table 8 presents the 5 landfills in the watersheds of the listed segments.

Table 8. Landfills in the Watersheds of 303(d) Listed Segments

Name	303(d) Listed Segment	County	Permit No.	Status
Tyler Buena Vista Rd.	Mill Branch & Bull Creek	Muscogee	106-004D(L)	Inactive
Columbus, Pine Grove MSWL	Bull Creek	Muscogee	106-016D(MSWL)	Operating
Columbus Schatulga Rd W Fill PH2		Muscogee	106-011D (SL)	Closed
Hogansville - Blue Creek Rd.		Troup	141-009D(SL)	Closed
Greenbow, LLC Turkey Run Municipal Solid Waste Landfill		Meriwether	099-019D(MSWL)	Operating

Source: Land Protection Branch, GA DNR, 2015

4.0 ANALYTICAL APPROACH

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

- The current critical fecal coliform load to the stream under 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 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. 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 9 provides the USGS stream gages used to estimate the flows for each of the listed stream segments.

Table 9. 303(d) Listed Stream Segments with Corresponding USGS Flow Gages Used to Estimate Flows

Name	Location	Station No.	USGS Station Name	Drainage Area (sq mile)
Blue Creek	Headwaters to Yellowjacket Creek	02338840	Yellowjacket Creek-Hammett Rd, BLW Hogansville, GA	91
		02338660	New River At GA 100, Near Corinth, GA	127
Bull Creek	Cooper Creek to Dram Branch	02339495	Oseligee Creek near Lanett, AL	86
Dram Creek	Tributary to Bull Creek - Columbus	02339495	Oseligee Creek near Lanett, AL	86
East Double Branch	Headwaters to Double Branch	02339495	Oseligee Creek near Lanett, AL	86
Lindsey Creek	Headwaters to Bull Creek - Columbus	02339495	Oseligee Creek near Lanett, AL	86
Mill Branch	Headwaters to Bull Creek	02339495	Oseligee Creek near Lanett, AL	86

Name	Location	Station No.	USGS Station Name	Drainage Area (sq mile)
Roaring Branch	U/S Columbus Foundaries	02339495	Oseligee Creek near Lanett, AL	86
Tiger Creek	Headwaters to Uptatoi Creek, Columbus	02339495	Oseligee Creek near Lanett, AL	86
Tributary to Bull Creek	Headwaters to Bull Creek	02339495	Oseligee Creek near Lanett, AL	86
Turkey Creek	Tributary to Bull Creek - Columbus	02339495	Oseligee Creek near Lanett, AL	86
Weracoba Creek	Headwaters to Wynnton Road	02339495	Oseligee Creek near Lanett, AL	86

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 during the sampling period.

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:

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

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

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 LOAD

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 bacteria standard. A TMDL is the sum of the individual wasteload 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 waterbody. 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, and to understand the fate and transport of the pollutant(s) 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.

Watershed-based plans may be developed to address and assess both point and nonpoint sources. These plans establish a schedule or timetable for the installation and evaluation of source control measures, data collection, and assessment of water quality standard attainment. Future monitoring of the listed segment water quality may 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 Wasteload Allocations

5.1.1 Wastewater Treatment Facilities

The wasteload allocation (WLA) 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 end-of-pipe effluent limits established 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. Wetland fecal permit limits are monitored prior to discharge to the wetlands. In addition, the permits include routine monitoring and reporting requirements.

There are no facilities in the Chattahoochee River Basin that discharge into or within 25 miles upstream of listed segments.

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 wasteload allocations from stormwater discharges (WLAsw) associated with MS4s 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 or is non-permitted sheet flow or diffuse 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 MS4s. This can be represented by the following equation:

$$WLA_{SW} = Q_{WLAsw} \times C_{standard}$$

where: WLA_{SW} = Wasteload Allocation for permitted storm water runoff from all MS4 urban areas

Q_{WLAsw} = Runoff from all MS4 urban areas conveyed through permitted storm water structures

$Q_{WLAsw} = \Sigma Q_{urban} \times 0.7$

ΣQ_{urban} = Sum of all storm water runoff from MS4 urban

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

For stormwater permits, compliance with the terms and conditions of the permit is effective implementation of the WLA to the Maximum Extent Practicable (MEP), and demonstrates consistency with the assumptions and requirements of the TMDL. GA EPD acknowledges that progress with the assumptions and requirements of the TMDL by stormwater permittees may take one or more permit iterations. Achieving the TMDL reductions may constitute compliance with a storm water management plan (SWMP) or a storm water pollution prevention plan (SWPPP), provided the MEP definition is met, even where the numeric percent reduction may not be achieved so long as reasonable progress is made toward attainment of water quality standards using an iterative BMP process.

5.1.3 Concentrated Animal Feeding Operations

Wet manure facilities are either included under an LAS General Permit or an NPDES General Permit. A small number of wet manure operations have an individual NPDES permit. Dry manure facilities are not required to obtain permits. Presently, there are no wet or dry manure CAFOs located in the watershed of the listed segments in the Chattahoochee River Basin 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 10 presents the total load allocation expressed as counts per 30 days for the 303(d) listed streams located in the Chattahoochee River Basin for the current critical condition.

In the future, 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 10 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 10.

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:

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

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

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

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 a permitted facility to the WLA is not the maximum, but rather is the product of the fecal coliform permitted limit and the average monthly discharge at the time of the critical load. However, there are no permitted facilities in the watershed of the 303(d) listed segments. The current critical loads and corresponding TMDLs, WLAs (WLA and WLA_{sw}), LAs, MOSs, and percent load reductions for the Chattahoochee River Basin listed stream segments are presented in Table 10.

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 10. 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)	
Blue Creek	2.62E+11	-	-	1.81E+10	2.01E+09	2.01E+10	92.3
Bull Creek	2.14E+13	-	1.00E+10	2.27E+10	3.64E+09	3.64E+10	99.8
Dram Creek	2.14E+13	-	5.18E+11	5.65E+11	1.20E+11	1.20E+12	94.4
East Double Branch	1.82E+10	-	6.12E+08	3.25E+08	1.04E+08	1.04E+09	94.3
Lindsey Creek	3.61E+10	-	3.69E+09	2.07E+09	6.40E+08	6.40E+09	82.3
Mill Branch	4.52E+11	-	5.48E+09	6.13E+09	1.29E+09	1.29E+10	97.1
Roaring Branch	5.37E+09	-	8.10E+08	5.13E+08	1.47E+08	1.47E+09	72.6
Tiger Creek	8.45E+11	-	1.39E+10	5.64E+10	7.81E+09	7.81E+10	90.8
Tributary to Bull Creek	6.77E+10	-	1.43E+09	1.06E+09	2.76E+08	2.76E+09	95.9
Turkey Creek	1.69E+12	-	5.40E+11	3.93E+11	1.04E+11	1.04E+12	38.6
Weracoba Creek	5.99E+11	-	1.21E+10	6.10E+09	2.02E+09	2.02E+10	96.6

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 Chattahoochee River Basin. Implementation strategies will be reviewed and the TMDLs will be refined, as necessary, in the next phase (next five-year cycle). The phased approach will support progress toward water quality standards attainment in the future. In accordance with USEPA TMDL guidance, these TMDLs may be revised based on 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 GA EPD personnel in Atlanta, Brunswick, Cartersville, and Tifton. Additional monitoring sites are added as necessary.

In the case where a watershed-based plan has been developed for a listed stream segment, an appropriate water quality monitoring program will be outlined. 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 treated wastewater permit requirements;
- Compliance with NPDES MS4 permit requirements, where applicable;

- Ensure storm water management plans are in place and being implemented by the local governments located in the watershed;

- Implementation of recommended water quality management practices in the *Middle Chattahoochee Regional Water Plan (GA EPD, 2017)*

- Adoption of NRCS Conservation Practices; and

- Application of Best Management Practices (BMPs) appropriate to agricultural or or urban land uses, where applicable.

6.2.1 Point Source Approaches

The NPDES permit program provides a basis for municipal, industrial, and stormwater permits, monitoring and compliance with permit limitations, and appropriate enforcement actions for violations. In accordance with GA EPD rules and regulations, all discharges from point source facilities are required to be in compliance with the conditions of their NPDES permit at all times. Municipal and industrial wastewater treatment facilities with the potential for fecal coliform in their discharge are 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. Wetland fecal permit limits are monitored prior to discharge to the wetlands. In addition, the permits include routine monitoring and reporting requirements.

Achieving the TMDL reductions may constitute compliance with a SWMP or SWPPP, provided the MEP definition is met, even where the numeric percent reduction may not be achieved so long as reasonable progress is made toward attainment of water quality standards using an iterative BMP process.

6.2.2 Nonpoint Source Approaches

GA EPD is the lead agency for implementing the State's Nonpoint Source Management Program, as described in Georgia's *Statewide Nonpoint Source Management Plan* (GA EPD, 2014). GA EPD will continue to work with local governments, agricultural, and forestry agencies such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission to foster the implementation of BMPs that address nonpoint source pollution. The following sections describe programs in place and recommendations which should result in reducing nonpoint source loads of selenium and selenium compounds in Georgia's surface waters.

6.2.2.1 Agricultural Sources

GA EPD should coordinate with other agencies that are responsible for agricultural activities in the state to address issues concerning fecal coliform loading from agricultural lands. It is recommended that information 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. GA EPD designated the GSWCC as the lead agency for agricultural Nonpoint Source Management in the State. The GSWCC develops nonpoint source management programs and conducts educational activities to promote conservation and protection of land and water devoted to agricultural uses.

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

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

6.2.2.2 Urban Sources

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

- Uphold requirements that all new and replacement sanitary sewerage 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;

- 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, GA 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, GA 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 that time, the TMDL will be available on the GA EPD website, a copy of the TMDL will be provided on request, and the public will be invited to provide comments on the TMDL.

7.0 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 segments in the Chattahoochee 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-Based Plans or other assessments funded by Section 319(h) grants, the local development of watershed protection plans, or "Targeted Outreach" initiated by GA EPD. These initiatives will supplement or possibly replace this initial implementation plan. Implementation actions should also be guided by the recommended management practices and actions contained within each applicable Regional Water Plan developed as part of *Georgia's Comprehensive State-wide Water Management Plan* implementation (Georgia Water Council, 2008).

7.1 Impaired Segments

This initial plan is applicable to the following water bodies that were added to Georgia's 2014 Integrated 305(b)/303(d) list of not supporting waters in *Water Quality in Georgia 2012-2013* (GA EPD, 2014) available on the GA EPD website. The following tables summarize the descriptive information provided in the 303(d) list.

Waterbodies Listed on the 2014 303(d) list for Fecal Coliform Bacteria in the Chattahoochee River Basin

Stream Segment	Location	Reach ID	Segment Length (miles)	Designated Use
Blue Creek	Headwaters to Yellowjacket Creek	GAR031300020707	6	Drinking Water
Bull Creek	Cooper Creek to Dram Branch	GAR031300030114	2	Fishing
Dram Creek	Tributary to Bull Creek, Columbus	GAR031300030109	2	Fishing
East Double Branch	Headwaters to Double Branch	GAR031300030117	2	Fishing
Lindsey Creek	Headwaters to Bull Creek, Columbus	GAR031300030101	6	Fishing
Mill Branch	Headwaters to Bull Creek	GAR031300030118	2	Fishing
Roaring Branch	Upstream Columbus Foundaries	GAR031300021303	1	Fishing
Tiger Creek	Headwaters to Uptatoi Creek, Columbus	GAR031300030306	5	Fishing
Tributary to Bull Creek	Headwaters to Bull Creek	GAR031300030119	1	Fishing
Turkey Creek	Tributary to Bull Creek, Columbus	GAR031300030103	1	Fishing
Weracoba Creek	Headwaters to Wynnton Road	GAR031300030120	4	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)] 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.

7.2 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 waterbody 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.

7.3 Management Practices and Activities

GA 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:

- Compliance with future NPDES treated wastewater permit requirements;
- Sustain compliance with NPDES MS4 permit requirements, where applicable;
- Compliance with future NPDES Industrial General Permit requirements, including where applicable, achieving benchmark levels for monitored constituents;
- Ensure storm water management plans are in place and being implemented by the local governments, and by the industrial facilities located in the watershed;

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

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

- Adoption of local ordinances (i.e. septic tanks, storm water, etc.) that address local water quality;

- Continue efforts to increase public awareness and education regarding the impact of human activities on water quality, ranging from industrial and municipal discharges to individual's activities in residential neighborhoods;

- Implement Erosion and Sedimentation Control Plans for land disturbing activities; and application of the *Manual for Erosion and Sediment Control in Georgia* (GSWCC, 2014);

- Continue working with Federal, State, and local agencies and owners of sites where cleanup measures are necessary, and in developing control measures to prevent future releases of constituents of concern;

- Implementation of recommended Water Quality management practices in the *Middle Chattahoochee Regional Water Plan (GA EPD, 2017)*);

- Adoption of NRCS Conservation Practices for primarily agricultural lands;

- Application of Best Management Practices (BMPs) appropriate to both urban and rural land uses, where applicable; 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.

7.4 Monitoring

GA 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. GA EPD is available to assist in providing technical guidance regarding the preparation of monitoring plans and Sampling Quality Assurance Plans (SQAP).

7.5 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, GA 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.

GA EPD will work to support watershed restoration, improvement and protection projects that address nonpoint source pollution. This is a process whereby GA EPD and/or Regional Commissions or other agencies or local governments, under a contract with GA 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 addresses a waterbody contained within this TMDL will supersede this Initial TMDL Implementation Plan for that waterbody once GA EPD accepts and/or approves the plan. Watershed Management Plans intended to address this TMDL and other water quality concerns, prepared for GA EPD, and for which GA EPD and/or the GA 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 determine 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.

GA EPD will continue to offer technical and financial assistance (when and where available) to complete Watershed Management Plans that address the impaired water bodies 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.

GA 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.

REFERENCES

Carter, R.F., 1982. Storage Requirements for Georgia Streams, USGS, Water Resources Investigations, Open File Report 82-557.

Federal Register, 1990. Federal Register, Part II: Environmental Protection Agency, Vol. 55, No. 222, November 16, 1990.

GA Dept. of Agriculture, 2017. GA EPD NPDES LAS Operation Info List May 2017, Department of Agriculture, Livestock and Poultry Field Forces. May 2017.

GA Dept. of Public Health, 2016. Most Current Summary Data Septic Inspections 2016-08-06, Department of Public Health, Environmental Health Section. August 2016.

GA EPD, 1997. *Chattahoochee River Basin Management Plan 1997,* State of Georgia, Department of Natural Resources, Environmental Protection Division, Water Protection Branch.

GA EPD, 2014. *Water Quality in Georgia 2012-2013*, Georgia Department of Natural Resources, Environmental Protection Division, Watershed Protection Branch.

GA EPD, 2014. Personal Communications with State of Georgia, Department of Natural Resources, Environmental Protection Division, Land Protection Branch. April 2014.

GA EPD, 2015. *State of Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6*, State of Georgia, Department of Natural Resources, Environmental Protection Division, Water Protection Branch, amended October 2015.

GA EPD, 2017. *Middle Chattahoochee Regional Water Plan,* Adopted by GA EPD November 2011, Revised June 2017.

GA EPD, 2017. Solid Waste Facility Information, State of Georgia, Department of Natural Resources, Environmental Protection Division, Land Protection Branch.

GA WRD, 2007. Personal Communications with Region IV Office, Wildlife Resources Division, Georgia Department of Natural Resources, Thomson, GA, May 2007.

Georgia Water Council, 2008. Georgia Comprehensive State-wide Water Management Plan, Atlanta, Georgia, January 2008.

UGA, 2015. Animal Inventory, Center for Agribusiness and Economic Development, College of Agriculture and Environmental Sciences, University of Georgia, 304A Lumpkin House, Athens, Georgia 30605.

USEPA, 1991. *Guidance for Water Quality-Based Decisions*: The TMDL Process, EPA 440/4-91-001, U.S. Environmental Protection Agency, Assessment and Watershed Protection Division, Washington, D.C.

Appendix A

30-day Geometric Mean Fecal Coliform Monitoring Data

Water Quality Monitoring Stations

Stream Segment	Location	GA EPD Monitoring Station No.	Monitoring Station Description	Sample Date Range
Blue Creek	Headwaters to Yellowjacket Creek	1202070201 (RV_12_4282)	Blue Creek at County Line Rd (AKA Sims Rd) near Hogansville, GA	01/2012-10/2012
Bull Creek	Cooper Creek to Dram Branch	N/A (Columbus Consolidated Govt.)	Bull Creek - Dead End of Woodburn Drive (Bull#2)	02/2011-03/2014
Dram Creek	Tributary to Bull Creek - Columbus	N/A (Columbus Consolidated Govt.)	Dram Creek - at Linden Circle (Dram#2)	02/2011-03/2014
East Double Branch	Headwaters to Double Branch	N/A (Columbus Consolidated Govt.)	Double Branch Creek - MLK Jr. Blvd. And Roosevelt St. (DBLBR#2)	02/2011-03/2014
Lindsey Creek	Headwaters to Bull Creek - Columbus	N/A (Columbus Consolidated Govt.)	Lindsay Creek - Boxwood Blvd at Midtown Drive (LINS#2)	02/2011-03/2014
Mill Branch	Headwaters to Bull Creek	N/A (Columbus Consolidated Govt.)	Mill Branch Creek - at Floyd Road Culvert (MILL#2)	02/2011-03/2014
Roaring Branch	U/S Columbus Foundaries	N/A (Columbus Consolidated Govt.)	Roaring Branch Creek - Bradley Park Drive at Whitesville Road	02/2011-03/2014
Tiger Creek	Headwaters to Uptatoi Creek, Columbus	N/A (Columbus Consolidated Govt.)	Tiger Creek - St. Marys Road at Ft. Benning Line (TIGR#1)	02/2011-03/2014
Tributary to Bull Creek	Headwaters to Bull Creek	N/A (Columbus Consolidated Govt.)	Unnamed Trib to Bull - Floyd Road at Booth Street (FLYDBTH)	02/2011-03/2014
Turkey Creek	Tributary to Bull Creek - Columbus	N/A (Columbus Consolidated Govt.)	Turkey Creek Intersection of Brennan Rd/Cusseta Rd Outfall (TURK#2)	02/2011-03/2014
Weracoba Creek	Headwaters to Wynnton Road	N/A (Columbus Consolidated Govt.)	Weracoba Creek - Wynnton Road at Warren Williams Road (WERA#2)	02/2011-03/2014

Figure A-1
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer/Winter TMDL Curves
1202070201 Blue Creek - County Line RD (AKA Sims Rd) near Hoganville, GA

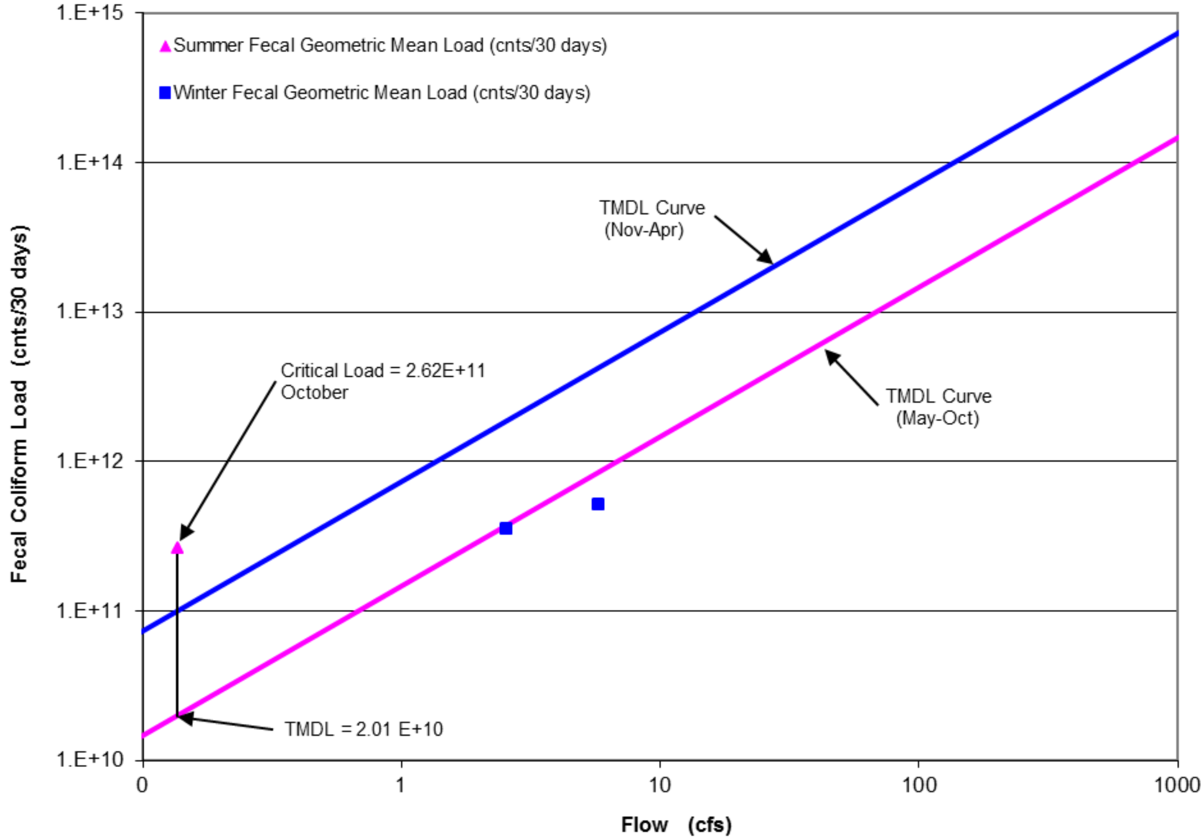


Table A-1. Data for Figure A-1

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)
3.Jan.12	230	2.74				
11.Jan.12	130	5.97				
17.Jan.12	40	2.89				
25.Jan.12	180	11.63	121	5.8	5.17E+11	4.26E+12
4.Apr.12	80	3.34				
19.Apr.12	300	3.28				
24.Apr.12	230	2.28				
30.Apr.12	230	1.32	189	2.6	3.54E+11	1.88E+12
3.Oct.12	8000	0.15				
15.Oct.12	5000	0.24				
22.Oct.12	2300	0.08				
24.Oct.12	**500**	**0.08**	**2604**	**0.1**	**2.62E+11**	**2.01E+10**

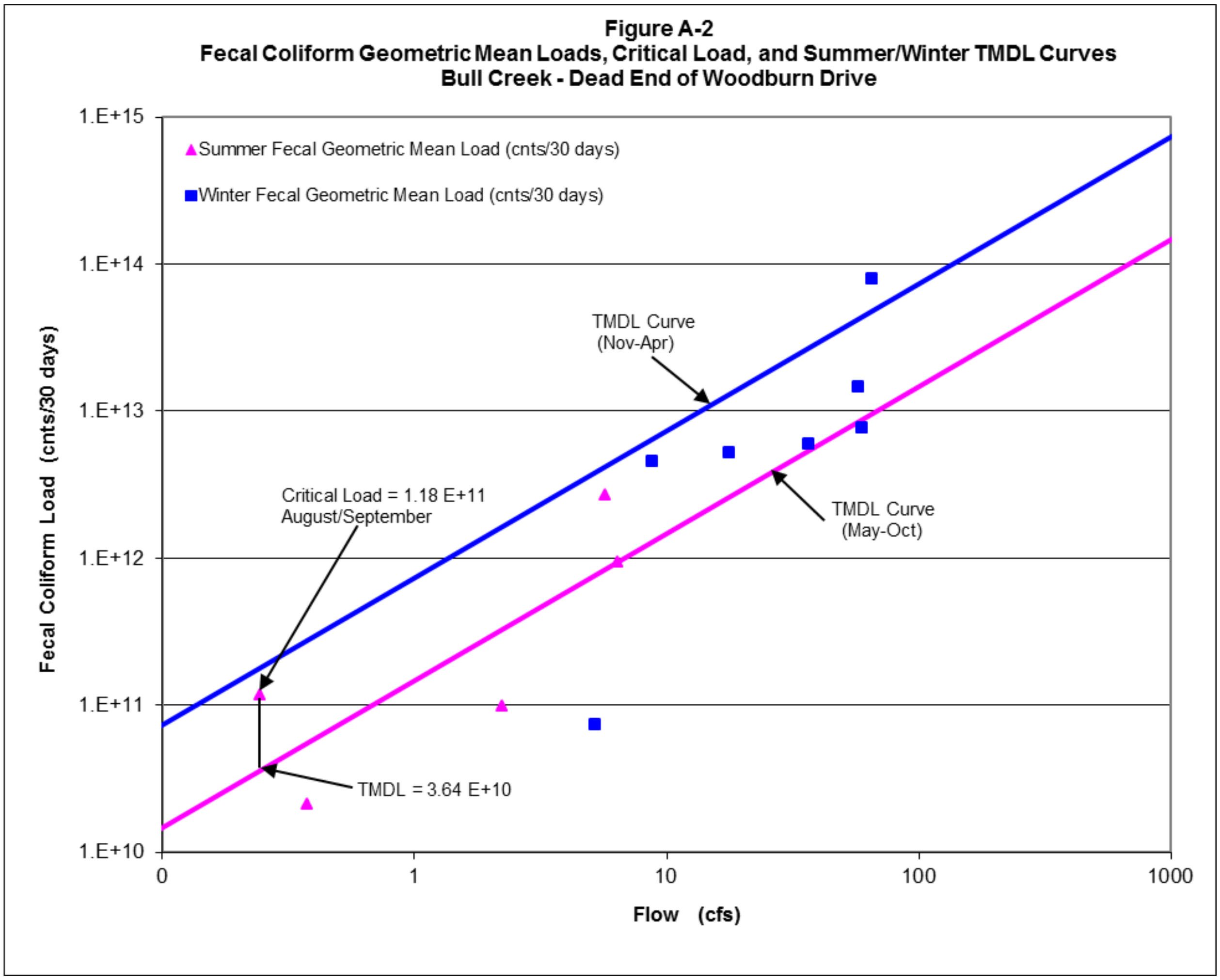


Figure A-2
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer/Winter TMDL Curves
Bull Creek - Dead End of Woodburn Drive
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
TMDL Curve
(Nov-Apr)
Critical Load = 1.18 E+11
August/September
TMDL Curve
(May-Oct)
TMDL = 3.64 E+10
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
0
1
10
100
1000
Flow (cfs)
Fecal Coliform Load (cnts/30 days)

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)
9.Feb.11	210	57.78				
14.Feb.11	260	34.15				
16.Feb.11	209	28.18				
17.Feb.11	210	26.09	221.3	36.6	5.94E+12	2.68E+13
10.May.11	260	4.79				
7.Jun.11	45	1.03				
8.Jun.11	18	0.95	59.5	2.3	9.86E+10	3.32E+11
15.Aug.11	4000	0.17				
18.Aug.11	220	0.21				
1.Sep.11	1009	0.12				
13.Sep.11	**200**	**0.50**	**649.2**	**0.2**	**1.18E+11**	**3.64E+10**
5.Dec.11	773	7.57				
15.Dec.11	4800	10.83				
19.Dec.11	300	8.37				
20.Dec.11	230	8.12	711.3	8.7	4.55E+12	6.40E+12
23.Feb.12	655	50.83				
28.Feb.12	200	78.77				
6.Mar.12	400	68.31				
20.Mar.12	270	32.74	344.9	57.7	1.46E+13	4.23E+13
24.May.12	330	15.26				
19.Jun.12	200	3.70				
21.Jun.12	240	2.28				
22.Jun.12	10100	1.91	632.4	5.8	2.69E+12	8.50E+11
22.Aug.12	36	0.64				
11.Sep.12	118	0.34				
12.Sep.12	109	0.29				
13.Sep.12	73	0.25	76.2	0.4	2.13E+10	5.58E+10
19.Nov.12	5	4.68				
20.Nov.12	5	6.03				
4.Dec.12	100	4.73				
5.Dec.12	55	5.46	19.3	5.2	7.39E+10	3.84E+12
4.Mar.13	250	51.88				
6.Mar.13	127	48.61				
11.Mar.13	100	40.74				
26.Mar.13	310	96.61	177.1	59.5	7.73E+12	4.36E+13
24.Aug.13	18	13.78				
29.Aug.13	280	8.68				
17.Sep.13	571	1.61				
19.Sep.13	530	1.91	197.6	6.5	9.42E+11	9.53E+11
18.Dec.13	330	14.77				
19.Dec.13	280	12.31				
8.Jan.14	590	20.92				
9.Jan.14	460	22.77	397.9	17.7	5.17E+12	1.30E+13
20.Mar.14	9200	67.08				
23.Mar.14	11600	66.46				
27.Mar.14	300	33.23				
31.Mar.14	230	92.92	1647.3	64.9	7.85E+13	4.77E+13

Figure A-3
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer/Winter TMDL Curves
Dram Creek - At Linden Creek

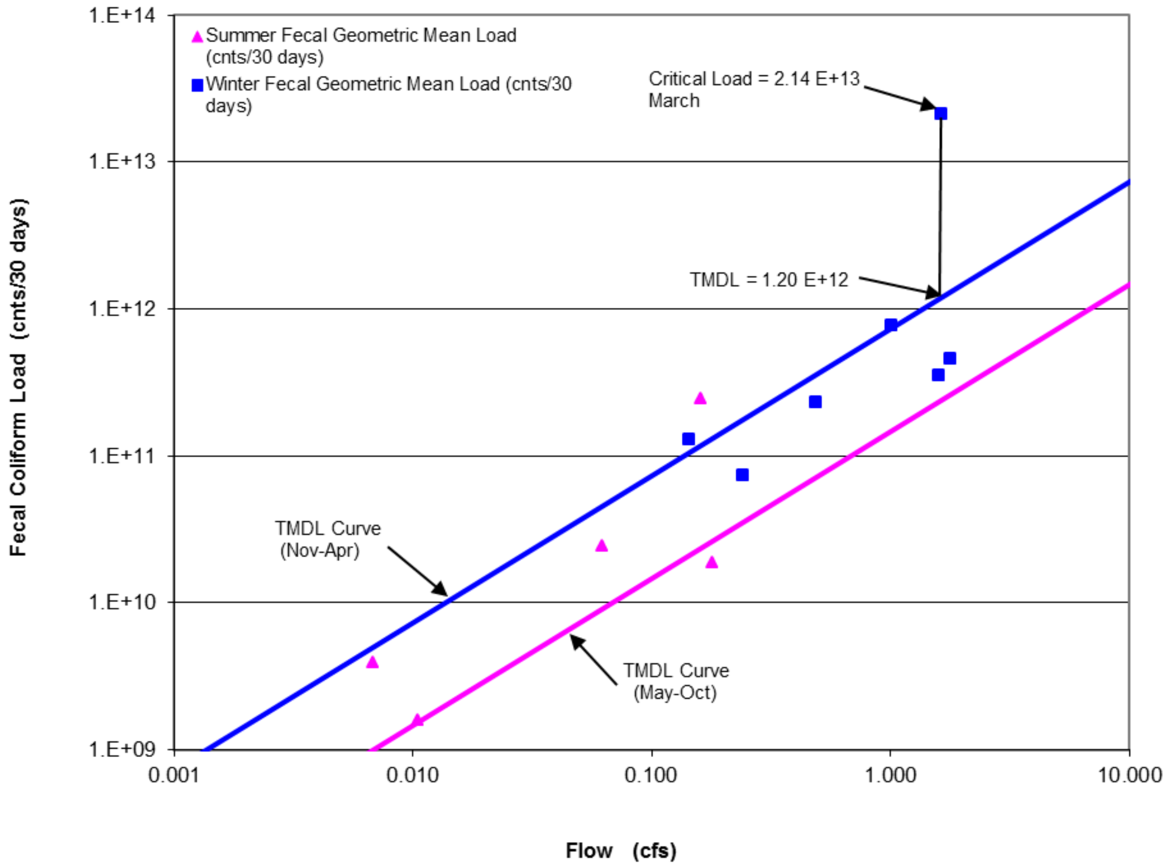


Table A-3. Data for Figure A-3

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)
9.Feb.11	1045	1.59				
14.Feb.11	270	0.94				
16.Feb.11	310	0.78				
17.Feb.11	13600	0.72	1044.3	1.0	7.72E+11	7.40E+11
10.May.11	36	0.13				
7.Jun.11	10400	0.03				
8.Jun.11	400	0.03	531.0	0.1	2.43E+10	9.14E+09
15.Aug.11	400	0.00				
18.Aug.11	300	0.01				
1.Sep.11	20000	0.00				
13.Sep.11	155	0.01	781.0	0.0	3.91E+09	1.00E+09
5.Dec.11	682	0.21				
15.Dec.11	230	0.30				
19.Dec.11	370	0.23				
20.Dec.11	510	0.22	414.8	0.2	7.32E+10	1.76E+11
23.Feb.12	45	1.40				
28.Feb.12	782	2.17				
6.Mar.12	627	1.88				
20.Mar.12	390	0.90	304.6	1.6	3.55E+11	1.17E+12
24.May.12	4700	0.42				
19.Jun.12	1000	0.10				
21.Jun.12	350	0.06				
22.Jun.12	12200	0.05	2116.6	0.2	2.48E+11	2.34E+10
22.Aug.12	2700	0.02				
11.Sep.12	218	0.01				
12.Sep.12	118	0.01				
13.Sep.12	27	0.01	208.1	0.0	1.60E+09	1.54E+09
19.Nov.12	520	0.13				
20.Nov.12	530	0.17				
4.Dec.12	2400	0.13				
5.Dec.12	3300	0.15	1215.5	0.1	1.29E+11	1.06E+11
4.Mar.13	17500	1.43				
6.Mar.13	16100	1.34				
11.Mar.13	17700	1.12				
26.Mar.13	**20000**	**2.66**	**17771.2**	**1.6**	**2.14E+13**	**1.20E+12**
27.Aug.13	5	0.38				
29.Aug.13	370	0.24				
17.Sep.13	540	0.04				
19.Sep.13	420	0.05	143.1	0.2	1.88E+10	2.63E+10
18.Dec.13	773	0.41				
19.Dec.13	1382	0.34				
8.Jan.14	500	0.58				
9.Jan.14	340	0.63	652.8	0.5	2.34E+11	3.58E+11
20.Mar.14	210	1.85				
23.Mar.14	390	1.83				
27.Mar.14	440	0.92				
31.Mar.14	410	2.56	348.6	1.8	4.58E+11	1.31E+12

Figure A-4
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer/Winter TMDL Curves
East Double Branch Creek - MLK Jr. Blvd. And Roosevelt St.

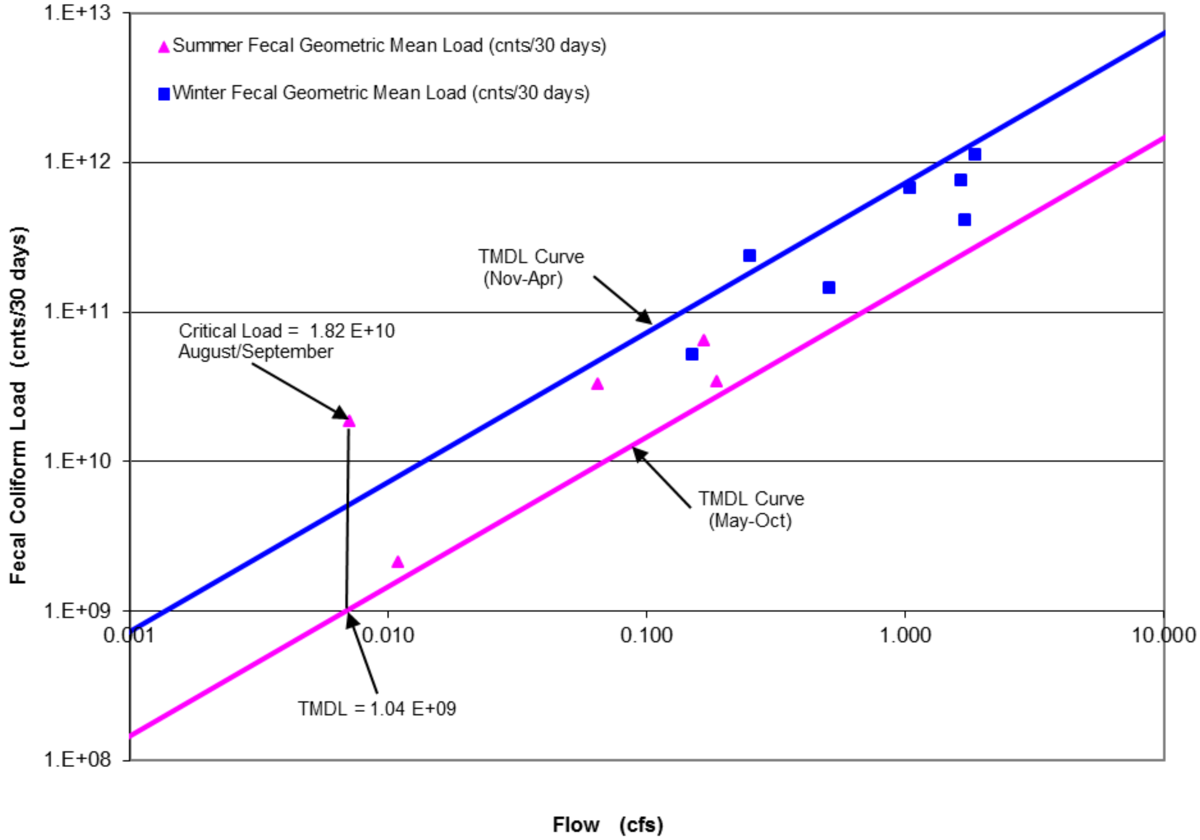


Table A-4. Data for Figure A-4

Date	Observed Fecal Coliform (counts/100 mL)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 mL)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
9.Feb.11	470	1.65				
14.Feb.11	973	0.98				
16.Feb.11	627	0.81				
17.Feb.11	2100	0.75	880.9	1.047	6.77E+11	7.68E+11
10.May.11	2200	0.14				
7.Jun.11	410	0.03				
8.Jun.11	350	0.03	680.9	0.065	3.23E+10	9.49E+09
15.Aug.11	3000	0.00				
18.Aug.11	5000	0.01				
1.Sep.11	20000	0.00				
13.Sep.11	**500**	**0.01**	**3499.6**	**0.007**	**1.82E+10**	**1.04E+09**
5.Dec.11	5200	0.22				
15.Dec.11	530	0.31				
19.Dec.11	2000	0.24				
20.Dec.11	520	0.23	1301.2	0.250	2.39E+11	1.83E+11
23.Feb.12	736	1.46				
28.Feb.12	100	2.26				
6.Mar.12	955	1.96				
20.Mar.12	2200	0.94	627.1	1.651	7.60E+11	1.21E+12
24.May.12	2300	0.44				
19.Jun.12	1500	0.11				
21.Jun.12	200	0.07				
22.Jun.12	109	0.05	523.7	0.166	6.37E+10	2.43E+10
22.Aug.12	420	0.02				
11.Sep.12	145	0.01				
12.Sep.12	210	0.01				
13.Sep.12	350	0.01	258.7	0.011	2.07E+09	1.60E+09
19.Nov.12	155	0.13				
20.Nov.12	300	0.17				
4.Dec.12	791	0.14				
5.Dec.12	1355	0.16	472.5	0.150	5.19E+10	1.10E+11
4.Mar.13	220	1.49				
6.Mar.13	410	1.39				
11.Mar.13	260	1.17				
26.Mar.13	510	2.77	330.7	1.703	4.13E+11	1.25E+12
27.Aug.13	73	0.39				
29.Aug.13	290	0.25				
17.Sep.13	700	0.05				
19.Sep.13	240	0.05	244.2	0.186	3.33E+10	2.73E+10
18.Dec.13	782	0.42				
19.Dec.13	200	0.35				
8.Jan.14	718	0.60				
9.Jan.14	200	0.65	387.1	0.507	1.44E+11	3.72E+11
20.Mar.14	580	1.92				
23.Mar.14	2500	1.90				
27.Mar.14	400	0.95				
31.Mar.14	791	2.66	823.0	1.859	1.12E+12	1.36E+12

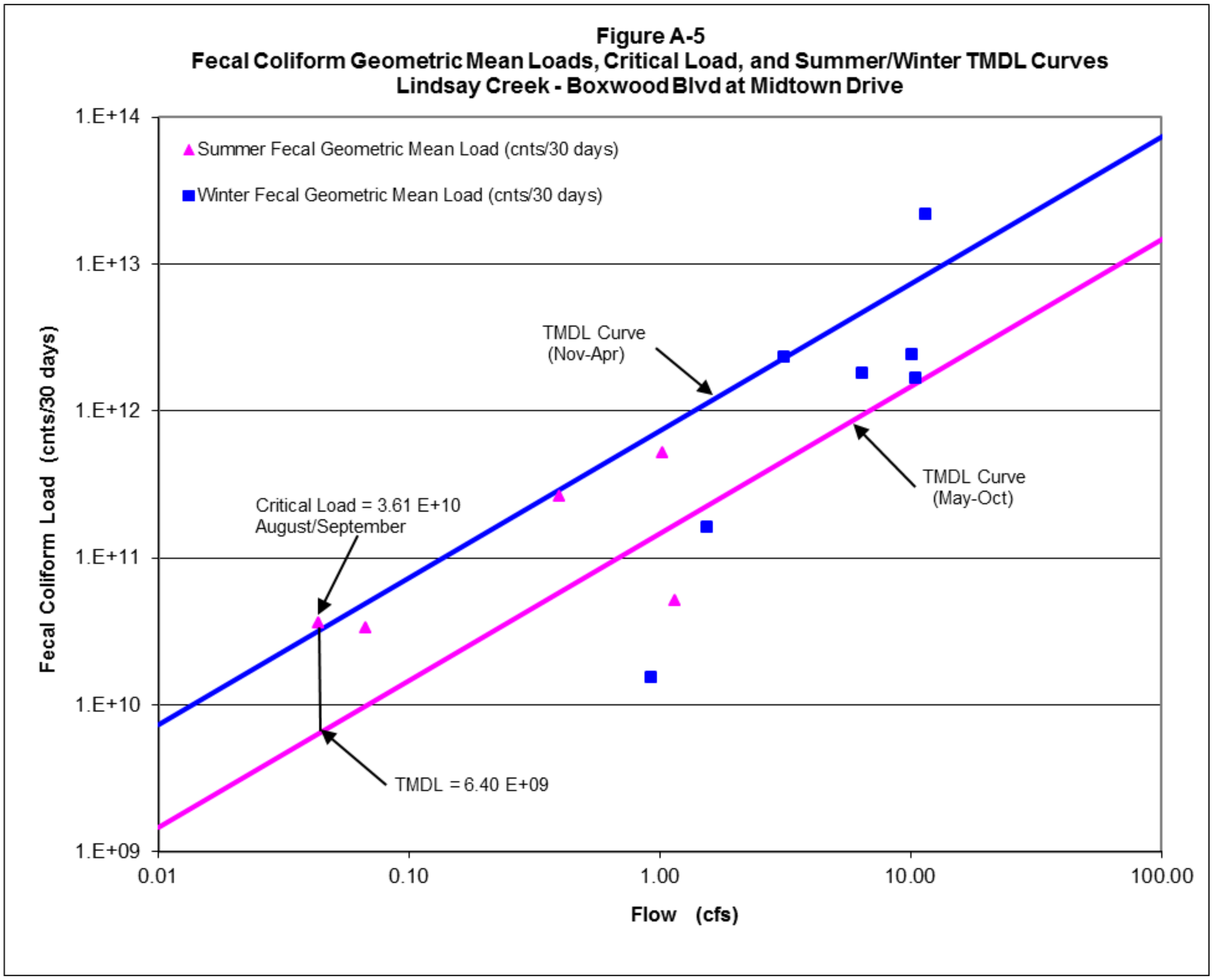


Figure A-5
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer/Winter TMDL Curves
Lindsay Creek - Boxwood Blvd at Midtown Drive
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
TMDL Curve
(Nov-Apr)
TMDL Curve
(May-Oct)
Critical Load = 3.61 E+10
August/September
TMDL = 6.40 E+09
Fecal Coliform Load (cnts/30 days)
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
0.01
0.10
1.00
10.00
100.00
Flow (cfs)

Table A-5. Data for Figure A-5

Date	Observed Fecal Coliform (counts/100 mL)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 mL)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
9.Feb.11	892	10.17				
14.Feb.11	109	6.01				
16.Feb.11	480	4.96				
17.Feb.11	440	4.59	378.5	6.4	1.79E+12	4.72E+12
10.May.11	590	0.84				
7.Jun.11	2100	0.18				
8.Jun.11	600	0.17	905.9	0.4	2.64E+11	5.83E+10
15.Aug.11	300	0.03				
18.Aug.11	145	0.04				
1.Sep.11	18700	0.02				
13.Sep.11	**2000**	**0.09**	**1129.4**	**0.0**	**3.61E+10**	**6.40E+09**
5.Dec.11	270	1.33				
15.Dec.11	136	1.91				
19.Dec.11	100	1.47				
20.Dec.11	118	1.43	144.3	1.5	1.63E+11	1.13E+12
23.Feb.12	420	8.94				
28.Feb.12	100	13.86				
6.Mar.12	118	12.02				
20.Mar.12	2200	5.76	323.1	10.1	2.41E+12	7.45E+12
24.May.12	2100	2.69				
19.Jun.12	400	0.65				
21.Jun.12	460	0.40				
22.Jun.12	590	0.34	691.0	1.0	5.17E+11	1.49E+11
22.Aug.12	109	0.11				
11.Sep.12	340	0.06				
12.Sep.12	16400	0.05				
13.Sep.12	360	0.04	683.9	0.1	3.36E+10	9.82E+09
19.Nov.12	27	0.82				
20.Nov.12	27	1.06				
4.Dec.12	5	0.83				
5.Dec.12	73	0.96	22.7	0.9	1.53E+10	6.75E+11
4.Mar.13	118	9.13				
6.Mar.13	360	8.55				
11.Mar.13	250	7.17				
26.Mar.13	210	17.00	217.3	10.5	1.67E+12	7.68E+12
27.Aug.13	5	2.43				
29.Aug.13	18	1.53				
17.Sep.13	250	0.28				
19.Sep.13	627	0.34	61.3	1.1	5.14E+10	1.68E+11
18.Dec.13	20000	2.60				
19.Dec.13	20000	2.17				
8.Jan.14	5	3.68				
9.Jan.14	520	4.01	1009.9	3.1	2.31E+12	2.29E+12
20.Mar.14	5100	11.80				
23.Mar.14	4400	11.69				
27.Mar.14	5700	5.85				
21.Mar.14	340	16.35	2568.0	11.4	2.15E+13	8.38E+12

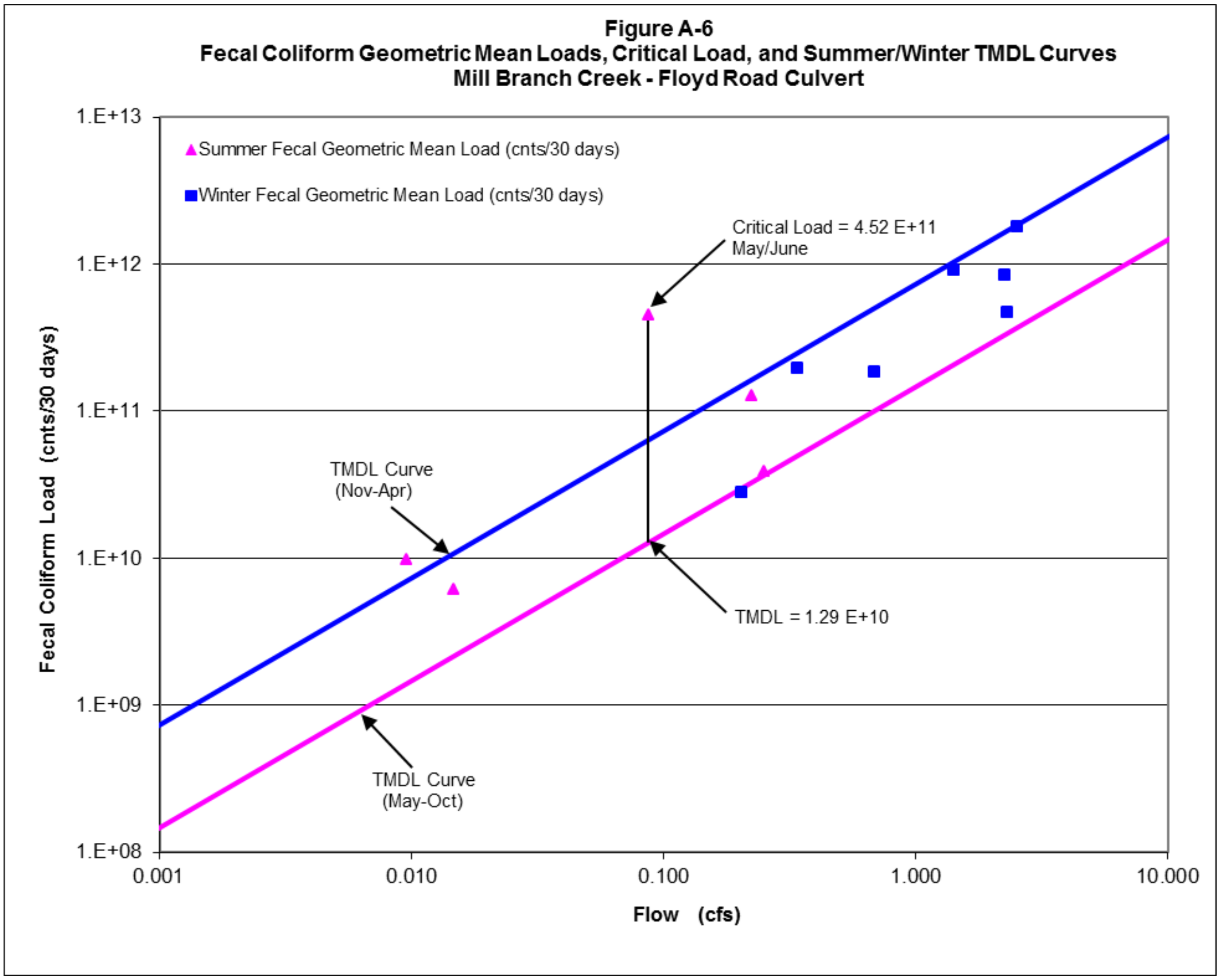


Figure A-6
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer/Winter TMDL Curves
Mill Branch Creek - Floyd Road Culvert
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 4.52 E+11
May/June
TMDL Curve
(Nov-Apr)
TMDL = 1.29 E+10
TMDL Curve
(May-Oct)
Fecal Coliform Load (cnts/30 days)
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
1.E+08
0.001
0.010
0.100
1.000
10.000
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)
9.Feb.11	2000	2.25				
14.Feb.11	2300	1.33				
16.Feb.11	590	1.10				
17.Feb.11	210	1.02	868.9	1.4	9.07E+11	1.04E+12
10.May.11	4800	0.19				
7.Jun.11	5500	0.04				
8.Jun.11	**13000**	**0.04**	**7001.4**	**0.1**	**4.52E+11**	**1.29E+10**
15.Aug.11	2000	0.01				
18.Aug.11	300	0.01				
1.Sep.11	20000	0.00				
13.Sep.11	300	0.02	1377.4	0.0	9.75E+09	1.42E+09
5.Dec.11	2800	0.29				
15.Dec.11	590	0.42				
19.Dec.11	390	0.33				
20.Dec.11	590	0.32	785.2	0.3	1.96E+11	2.49E+11
23.Feb.12	430	1.98				
28.Feb.12	718	3.07				
6.Mar.12	370	2.66				
20.Mar.12	600	1.27	511.7	2.2	8.43E+11	1.65E+12
24.May.12	570	0.59				
19.Jun.12	2000	0.14				
21.Jun.12	420	0.09				
22.Jun.12	718	0.07	765.7	0.2	1.27E+11	3.31E+10
22.Aug.12	260	0.02				
11.Sep.12	700	0.01				
12.Sep.12	927	0.01				
13.Sep.12	609	0.01	566.2	0.0	6.15E+09	2.17E+09
19.Nov.12	370	0.18				
20.Nov.12	370	0.23				
4.Dec.12	64	0.18				
5.Dec.12	136	0.21	185.8	0.2	2.77E+10	1.49E+11
4.Mar.13	240	2.02				
6.Mar.13	260	1.89				
11.Mar.13	280	1.59				
26.Mar.13	340	3.76	277.6	2.3	4.72E+11	1.70E+12
27.Aug.13	27	0.54				
29.Aug.13	230	0.34				
17.Sep.13	540	0.06				
19.Sep.13	590	0.07	210.9	0.3	3.91E+10	3.71E+10
18.Dec.13	955	0.57				
19.Dec.13	300	0.48				
8.Jan.14	210	0.81				
9.Jan.14	300	0.89	366.5	0.7	1.85E+11	5.05E+11
20.Mar.14	827	2.61				
23.Mar.14	550	2.59				
27.Mar.14	560	1.29				
31.Mar.14	3300	3.62	957.5	2.5	1.78E+12	1.85E+12

Figure A-7
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer/Winter TMDL Curves
Roaring Branch Creek - Bradley Park Drive at Whitesville Road

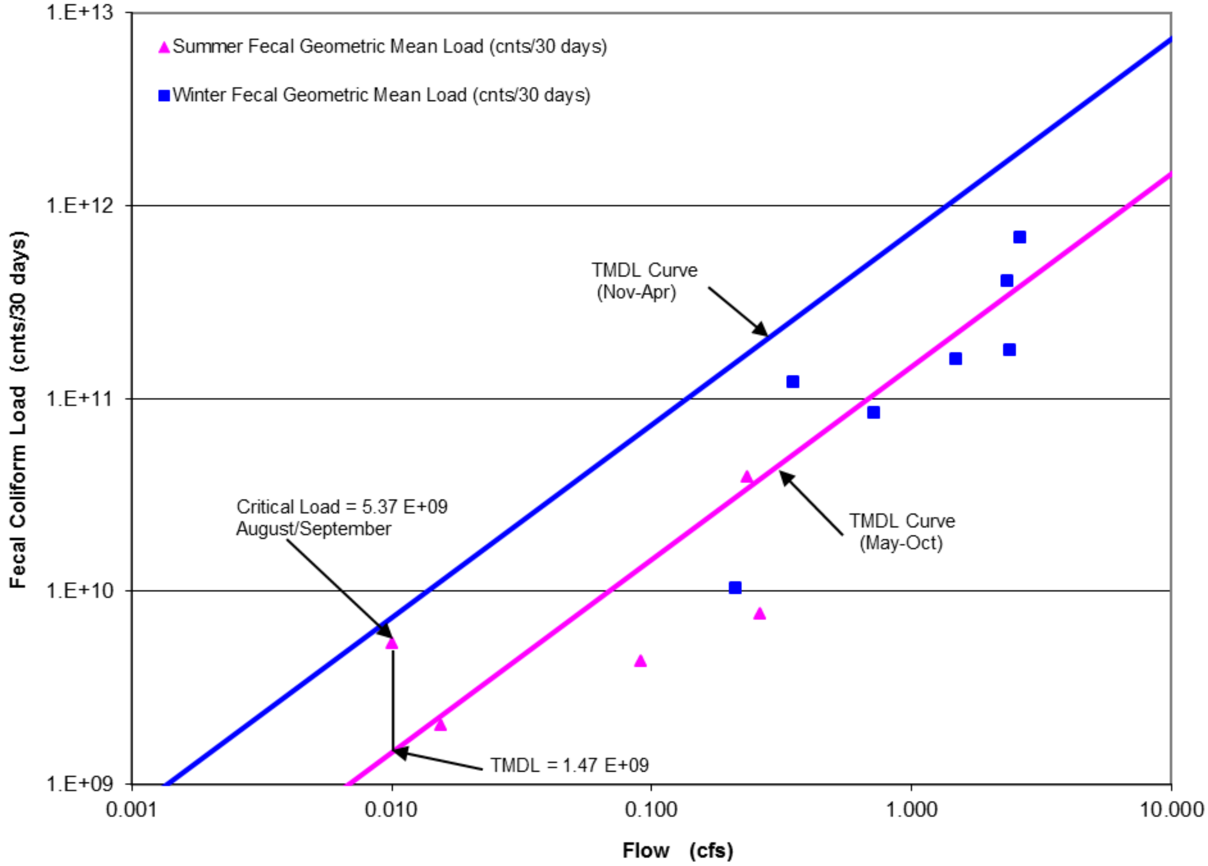


Table A-7. Data for Figure A-7

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)
9.Feb.11	189	2.34				
14.Feb.11	164	1.38				
16.Feb.11	127	1.14				
17.Feb.11	118	1.06	146.8	1.5	1.59E+11	1.09E+12
10.May.11	55	0.19				
7.Jun.11	55	0.04				
8.Jun.11	91	0.04	65.1	0.1	4.36E+09	1.34E+10
15.Aug.11	4500	0.01				
18.Aug.11	400	0.01				
1.Sep.11	791	0.00				
13.Sep.11	**200**	**0.02**	**730.5**	**0.0**	**5.37E+09**	**1.47E+09**
5.Dec.11	718	0.31				
15.Dec.11	200	0.44				
19.Dec.11	580	0.34				
20.Dec.11	600	0.33	472.8	0.4	1.22E+11	2.59E+11
23.Feb.12	100	2.06				
28.Feb.12	240	3.19				
6.Mar.12	260	2.76				
20.Mar.12	500	1.32	236.3	2.3	4.05E+11	1.71E+12
24.May.12	410	0.62				
19.Jun.12	400	0.15				
21.Jun.12	100	0.09				
22.Jun.12	164	0.08	227.7	0.2	3.91E+10	3.44E+10
22.Aug.12	845	0.03				
11.Sep.12	36	0.01				
12.Sep.12	145	0.01				
13.Sep.12	230	0.01	178.5	0.0	2.01E+09	2.26E+09
19.Nov.12	64	0.19				
20.Nov.12	36	0.24				
4.Dec.12	82	0.19				
5.Dec.12	109	0.22	67.4	0.2	1.05E+10	1.55E+11
4.Mar.13	36	2.10				
6.Mar.13	91	1.97				
11.Mar.13	82	1.65				
26.Mar.13	380	3.91	100.5	2.4	1.77E+11	1.77E+12
27.Aug.13	18	0.56				
29.Aug.13	5	0.35				
17.Sep.13	230	0.06				
19.Sep.13	118	0.08	39.5	0.3	7.62E+09	3.86E+10
18.Dec.13	191	0.60				
19.Dec.13	118	0.50				
8.Jan.14	136	0.85				
9.Jan.14	218	0.92	160.8	0.7	8.44E+10	5.25E+11
20.Mar.14	230	2.71				
23.Mar.14	260	2.69				
27.Mar.14	2100	1.34				
31.Mar.14	127	3.76	355.4	2.6	6.85E+11	1.93E+12

Figure A-8
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer/Winter TMDL Curves
Tiger Creek - St. Marys Road at Ft. Benning Line

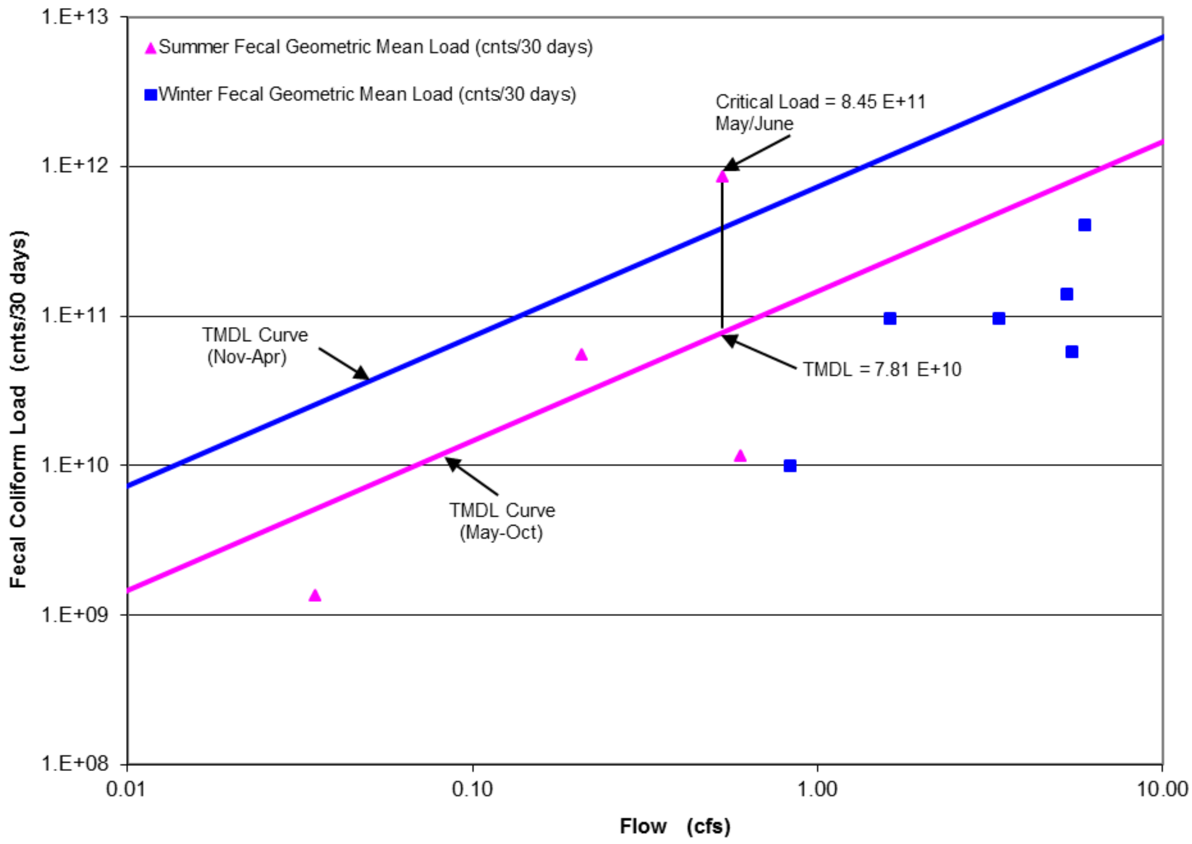


Table A-8. Data for Figure A-8

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)
9.Feb.11	27	5.31				
14.Feb.11	36	3.14				
16.Feb.11	127	2.59				
17.Feb.11	18	2.40	38.6	3.4	9.52E+10	2.47E+12
10.May.11	155	0.44				
7.Jun.11	973	0.10				
8.Jun.11	300	0.09	356.3	0.2	5.43E+10	3.05E+10
15.Dec.11	18	1.00				
19.Dec.11	5	0.77				
20.Dec.11	45	0.75	15.9	0.8	9.80E+09	6.15E+11
23.Feb.12	45	4.67				
28.Feb.12	18	7.24				
6.Mar.12	55	6.28				
20.Mar.12	36	3.01	35.6	5.3	1.38E+11	3.89E+12
24.May.12	3100	1.40				
19.Jun.12	1200	0.34				
21.Jun.12	727	0.21				
22.Jun.12	**8100**	**0.18**	**2163.4**	**0.5**	**8.45E+11**	**7.81E+10**
22.Aug.12	27	0.06				
11.Sep.12	330	0.03				
12.Sep.12	45	0.03				
13.Sep.12	18	0.02	51.8	0.035	1.33E+09	5.13E+09
4.Mar.13	5	4.77				
6.Mar.13	5	4.47				
11.Mar.13	18	3.75				
26.Mar.13	91	8.88	14.2	5.5	5.71E+10	4.01E+12
27.Aug.13	18	1.27				
29.Aug.13	5	0.80				
17.Sep.13	45	0.15				
19.Sep.13	109	0.18	25.8	0.6	1.13E+10	8.76E+10
18.Dec.13	109	1.36				
19.Dec.13	27	1.13				
8.Jan.14	510	1.92				
9.Jan.14	27	2.09	79.8	1.6	9.53E+10	1.19E+12
20.Mar.14	73	6.17				
23.Mar.14	82	6.11				
27.Mar.14	136	3.06				
31.Mar.14	91	8.54	92.8	6.0	4.06E+11	4.38E+12

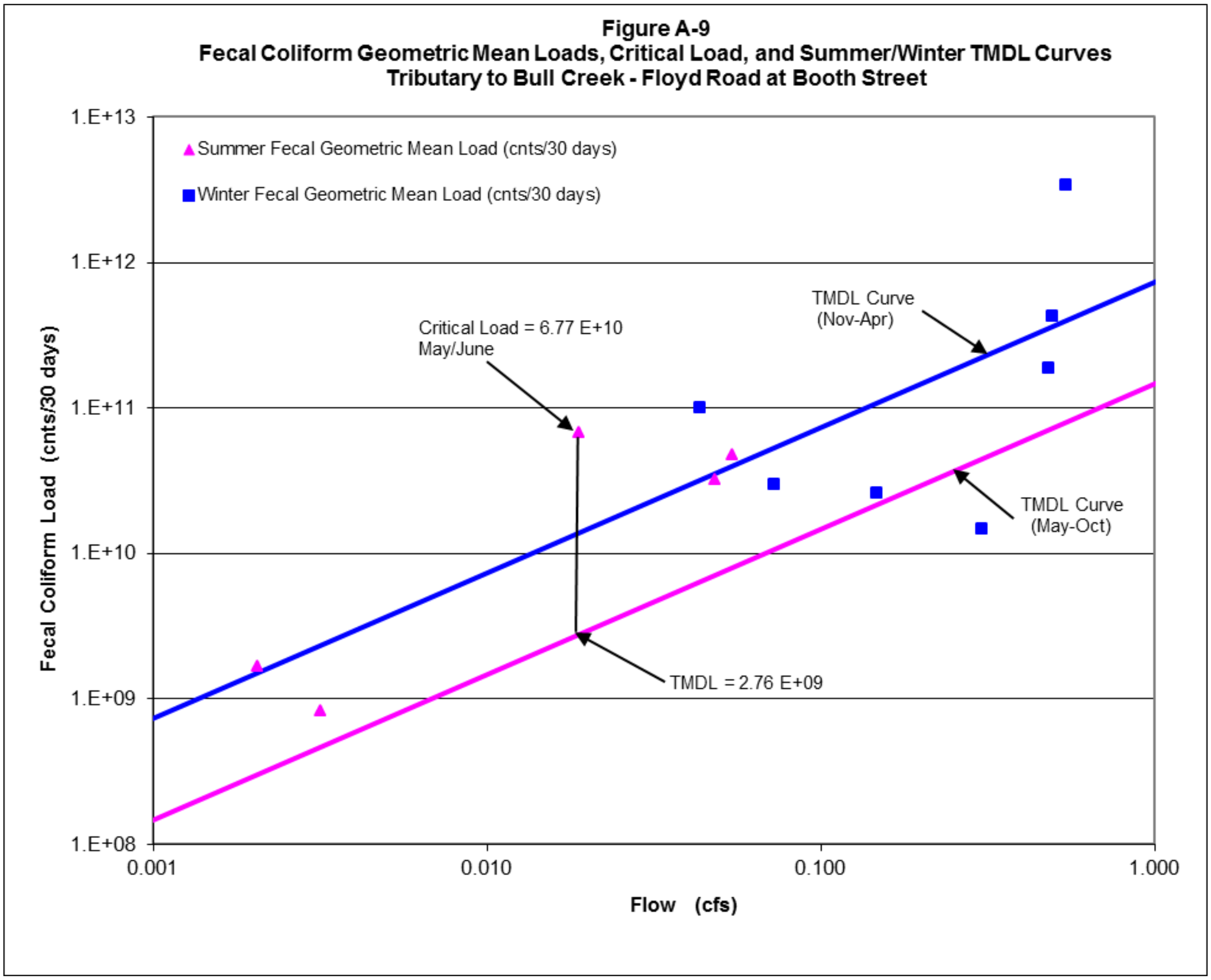


Figure A-9
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer/Winter TMDL Curves
Tributary to Bull Creek - Floyd Road at Booth Street
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 6.77 E+10
May/June
TMDL Curve
(Nov-Apr)
TMDL Curve
(May-Oct)
TMDL = 2.76 E+09
Fecal Coliform Load (cnts/30 days)
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
1.E+08
0.001
0.010
0.100
1.000
Flow (cfs)

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)
9.Feb.11	27	0.48				
14.Feb.11	430	0.28				
16.Feb.11	36	0.23				
17.Feb.11	45	0.22	65.9	0.3	1.47E+10	2.23E+11
10.May.11	5000	0.04				
7.Jun.11	5900	0.01				
8.Jun.11	**4000**	**0.01**	**4904.9**	**0.0**	**6.77E+10**	**2.76E+09**
15.Aug.11	380	0.00				
18.Aug.11	400	0.00				
1.Sep.11	16800	0.00				
13.Sep.11	600	0.00	1112.6	0.0	1.68E+09	3.03E+08
5.Dec.11	550	0.06				
15.Dec.11	2100	0.09				
19.Dec.11	410	0.07				
20.Dec.11	210	0.07	561.6	0.1	2.99E+10	5.33E+10
23.Feb.12	2000	0.42				
28.Feb.12	500	0.66				
6.Mar.12	320	0.57				
20.Mar.12	260	0.27	537.1	0.5	1.89E+11	3.52E+11
24.May.12	570	0.13				
19.Jun.12	6000	0.03				
21.Jun.12	350	0.02				
22.Jun.12	590	0.02	916.7	0.0	3.24E+10	7.07E+09
22.Aug.12	936	0.01				
11.Sep.12	480	0.00				
12.Sep.12	300	0.00				
13.Sep.12	118	0.00	355.1	0.0	8.25E+08	4.65E+08
19.Nov.12	2400	0.04				
20.Nov.12	3900	0.05				
4.Dec.12	3000	0.04				
5.Dec.12	3400	0.05	3125.9	0.0	9.99E+10	3.20E+10
4.Mar.13	2900	0.43				
6.Mar.13	845	0.40				
11.Mar.13	280	0.34				
26.Mar.13	2800	0.80	1177.3	0.5	4.28E+11	3.63E+11
27.Aug.13	600	0.11				
29.Aug.13	782	0.07				
17.Sep.13	280	0.01				
19.Sep.13	16300	0.02	1209.7	0.1	4.80E+10	7.94E+09
18.Dec.13	964	0.12				
19.Dec.13	210	0.10				
8.Jan.14	200	0.17				
9.Jan.14	82	0.19	240.0	0.1	2.60E+10	1.08E+11
20.Mar.14	16200	0.56				
23.Mar.14	2000	0.55				
27.Mar.14	14000	0.28				
31.Mar.14	11600	0.77	8516.9	0.5	3.38E+12	3.97E+11

Figure A-10
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer/Winter TMDL Curves
Turkey Creek - Intersection of Brennan Rd/Cusseta Rd Outfall

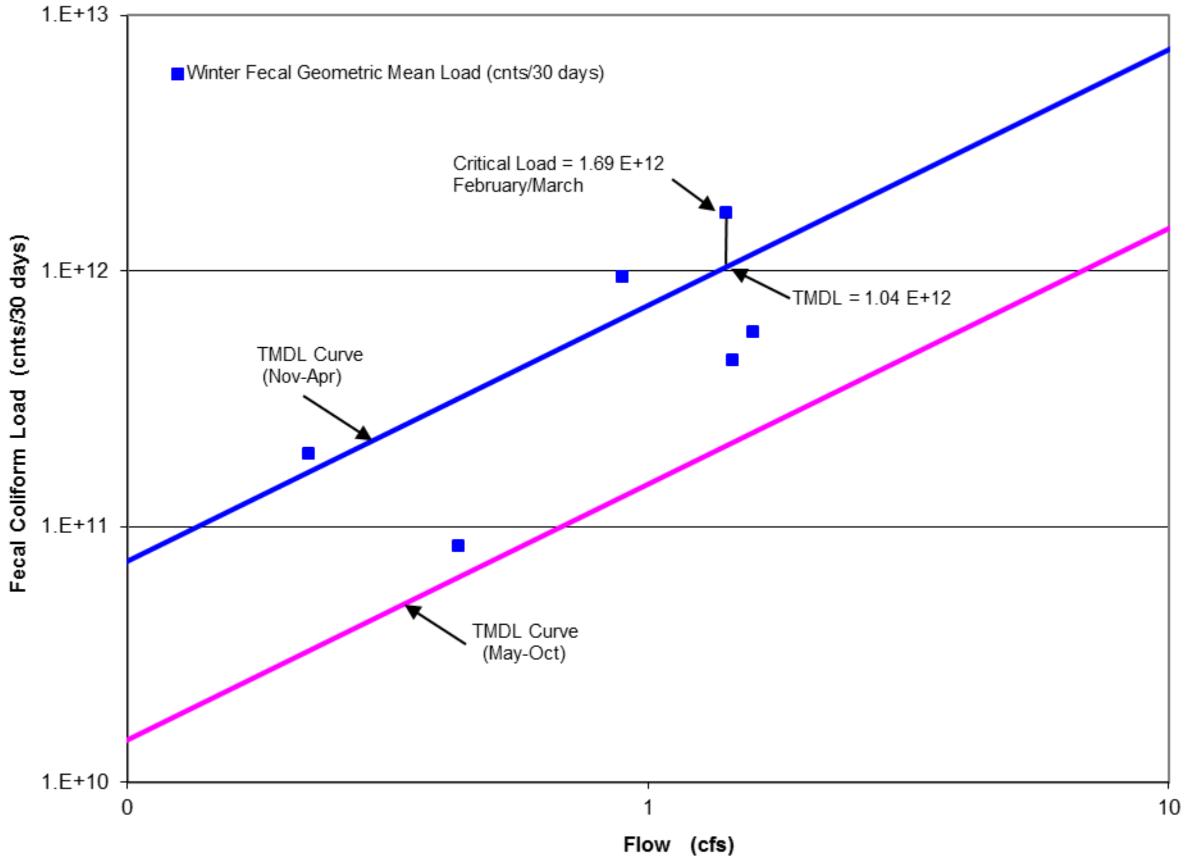


Table A-10. Data for Figure A-10

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)
9.Feb.11	776	1.42				
14.Feb.11	2200	0.84				
16.Feb.11	4300	0.69				
17.Feb.11	590	0.64	1442.6	0.9	9.48E+11	6.57E+11
15.Dec.11	5900	0.27				
19.Dec.11	530	0.21				
20.Dec.11	520	0.20	1175.9	0.2	1.93E+11	1.64E+11
23.Feb.12	2800	1.25				
28.Feb.12	1155	1.93				
6.Mar.12	836	1.67				
20.Mar.12	**2600**	**0.80**	**1628.3**	**1.4**	**1.69E+12**	**1.04E+12**
4.Mar.13	240	1.27				
6.Mar.13	691	1.19				
11.Mar.13	200	1.00				
26.Mar.13	918	2.37	417.7	1.5	4.47E+11	1.07E+12
18.Dec.13	290	0.36				
19.Dec.13	182	0.30				
8.Jan.14	230	0.51				
9.Jan.14	390	0.56	262.3	0.4	8.35E+10	3.18E+11
20.Mar.14	500	1.64				
23.Mar.14	700	1.63				
27.Mar.14	420	0.81				
31.Mar.14	410	2.28	495.5	1.6	5.79E+11	1.17E+12

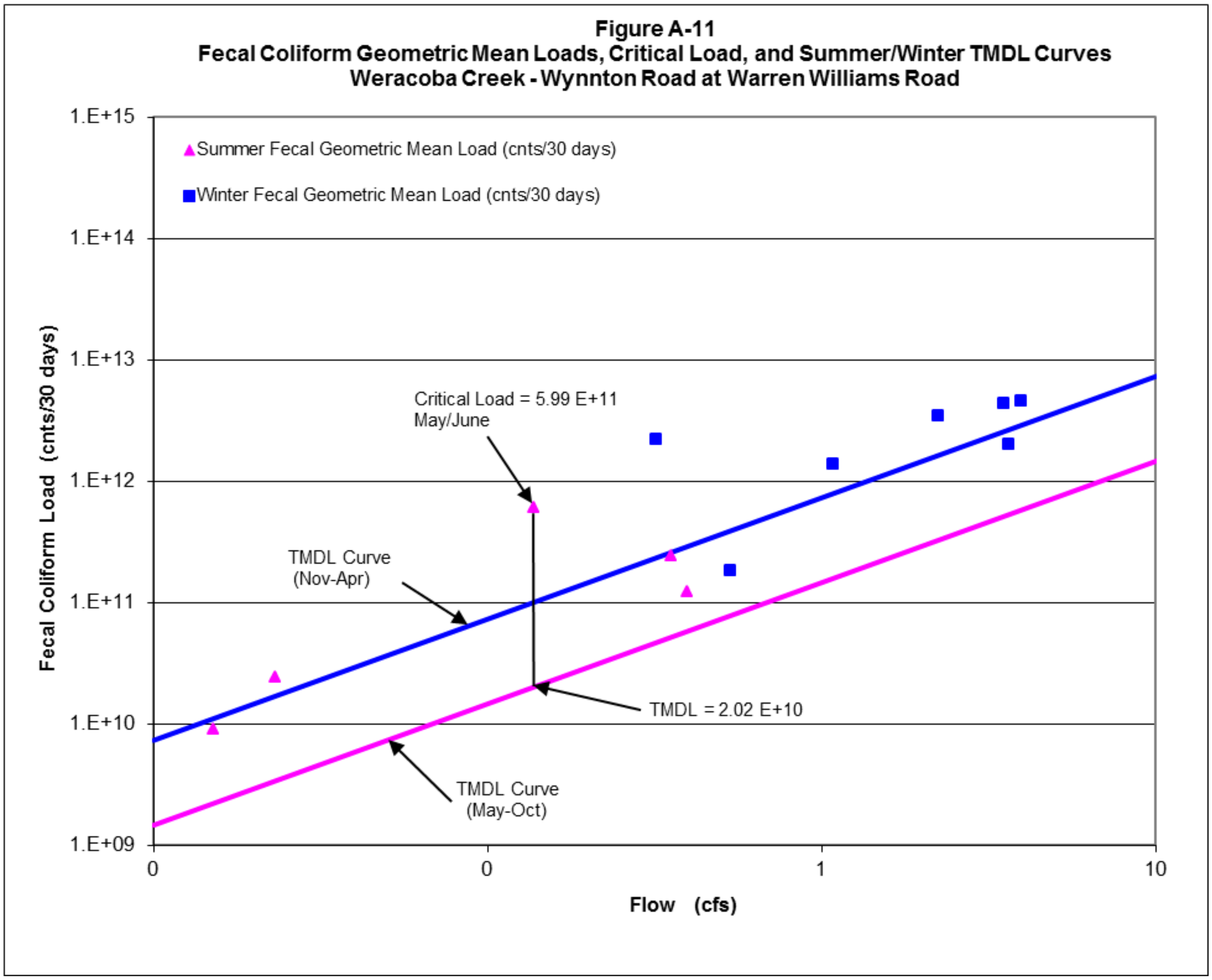


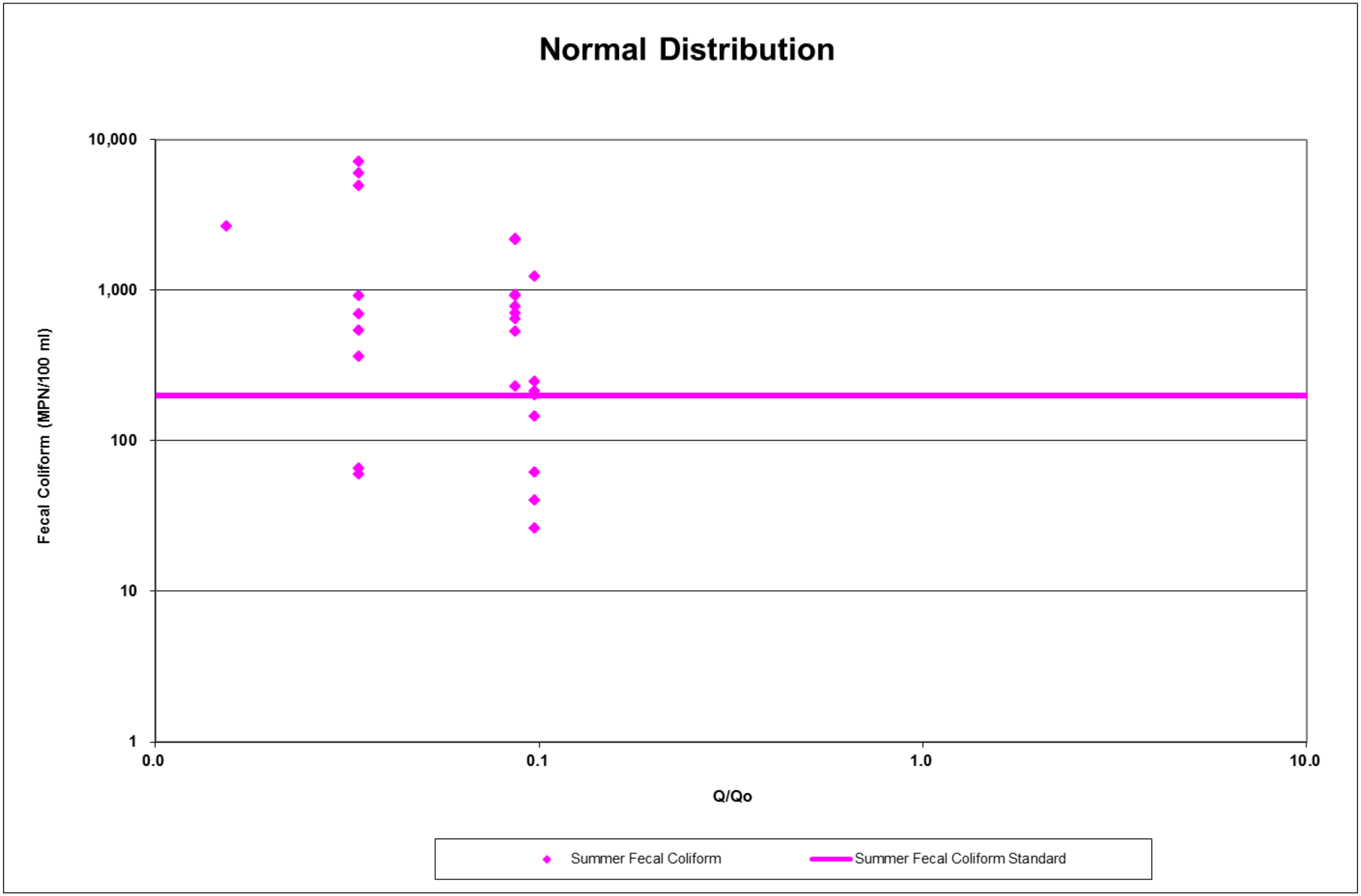
Figure A-11
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer/Winter TMDL Curves
Weracoba Creek - Wynnton Road at Warren Williams Road
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 5.99 E+11
May/June
TMDL Curve
(Nov-Apr)
TMDL = 2.02 E+10
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.E+10
1.E+09
0
0
1
10
Flow (cfs)

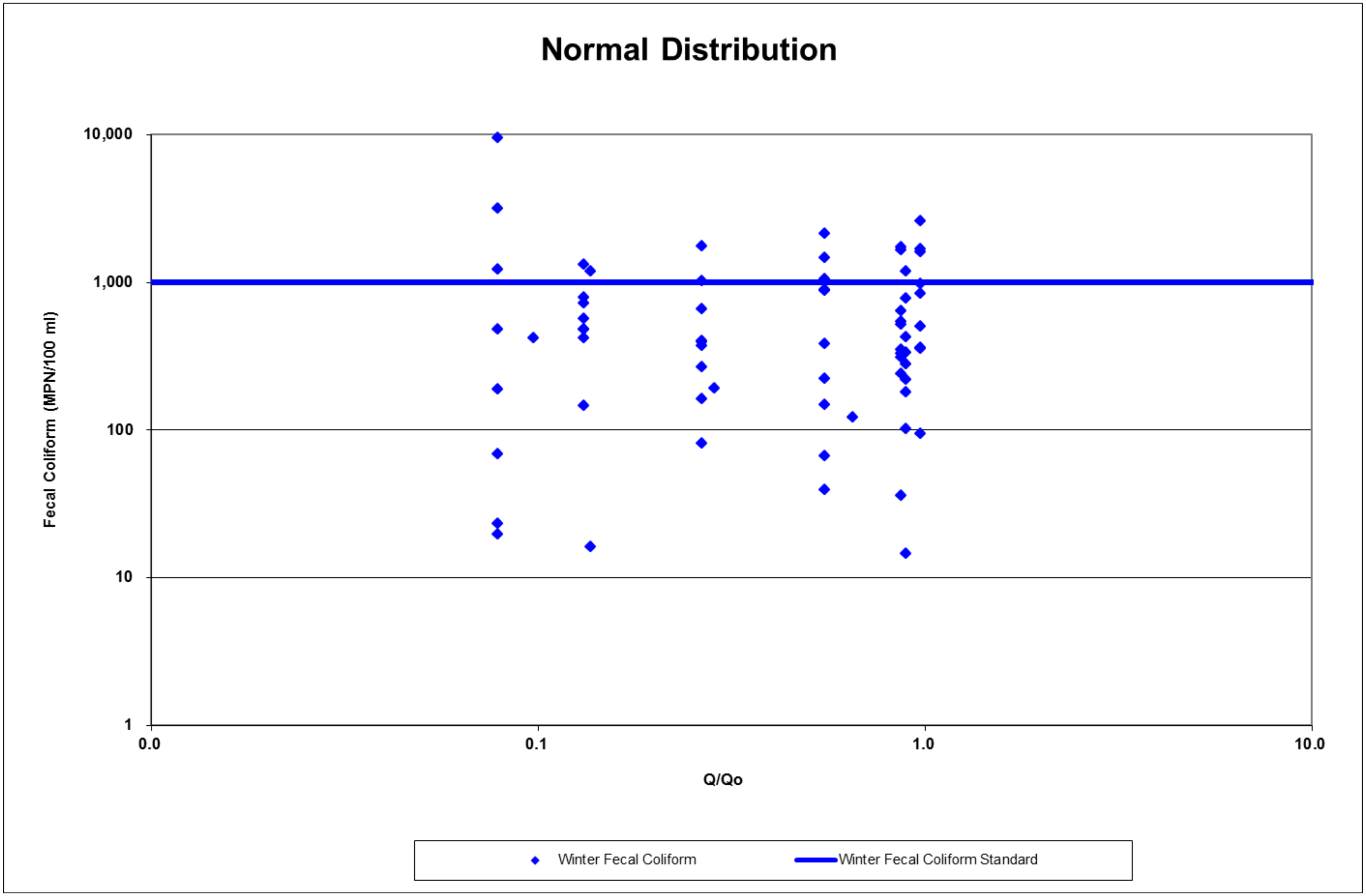
Table A-11. Data for Figure A-11

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)
9.Feb.11	2700	3.52				
14.Feb.11	2800	2.08				
16.Feb.11	2800	1.72				
17.Feb.11	936	1.59	2109.8	2.2	3.45E+12	1.64E+12
10.May.11	520	0.29				
7.Jun.11	20000	0.06				
8.Jun.11	**20000**	**0.06**	**5925.0**	**0.1**	**5.99E+11**	**2.02E+10**
15.Aug.11	350	0.01				
18.Aug.11	200	0.01				
1.Sep.11	20000	0.01				
13.Sep.11	300	0.03	805.0	0.0151	8.92E+09	2.22E+09
5.Dec.11	580	0.46				
15.Dec.11	973	0.66				
19.Dec.11	200	0.51				
20.Dec.11	440	0.50	472.1	0.5	1.84E+11	3.90E+11
23.Feb.12	2100	3.10				
28.Feb.12	440	4.80				
6.Mar.12	1464	4.16				
20.Mar.12	6300	2.00	1708.6	3.5	4.41E+12	2.58E+12
24.May.12	2100	0.93				
19.Jun.12	500	0.23				
21.Jun.12	200	0.14				
22.Jun.12	3300	0.12	912.4	0.4	2.36E+11	5.18E+10
22.Aug.12	791	0.04				
11.Sep.12	764	0.02				
12.Sep.12	1082	0.02				
13.Sep.12	5800	0.02	1395.5	0.0	2.37E+10	3.40E+09
19.Nov.12	2700	0.29				
20.Nov.12	15200	0.37				
4.Dec.12	11900	0.29				
5.Dec.12	16400	0.33	9460.2	0.3	2.21E+12	2.34E+11
4.Mar.13	755	3.16				
6.Mar.13	2600	2.96				
11.Mar.13	340	2.48				
26.Mar.13	510	5.89	763.8	3.6	2.03E+12	2.66E+12
27.Aug.13	5	0.84				
29.Aug.13	82	0.53				
17.Sep.13	6600	0.10				
19.Sep.13	11000	0.12	415.4	0.4	1.21E+11	2.91E+11
18.Dec.13	964	0.90				
19.Dec.13	480	0.75				
8.Jan.14	5300	1.28				
9.Jan.14	3800	1.39	1747.2	1.1	1.38E+12	7.92E+11
20.Mar.14	2400	4.09				
23.Mar.14	460	4.05				
27.Mar.14	2100	2.03				
31.Mar.14	2800	5.67	1596.2	4.0	4.64E+12	2.91E+12

Appendix B

Normalized Flows Versus Fecal Coliform Plots


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