FINAL

Pathogen (Fecal Coliform) TMDLs

Rabbit Creek	AL/03160205-020_01
Dog River	AL/03160205-020_02

Alabama Department of Environmental Management
Water Quality Branch
Water Division

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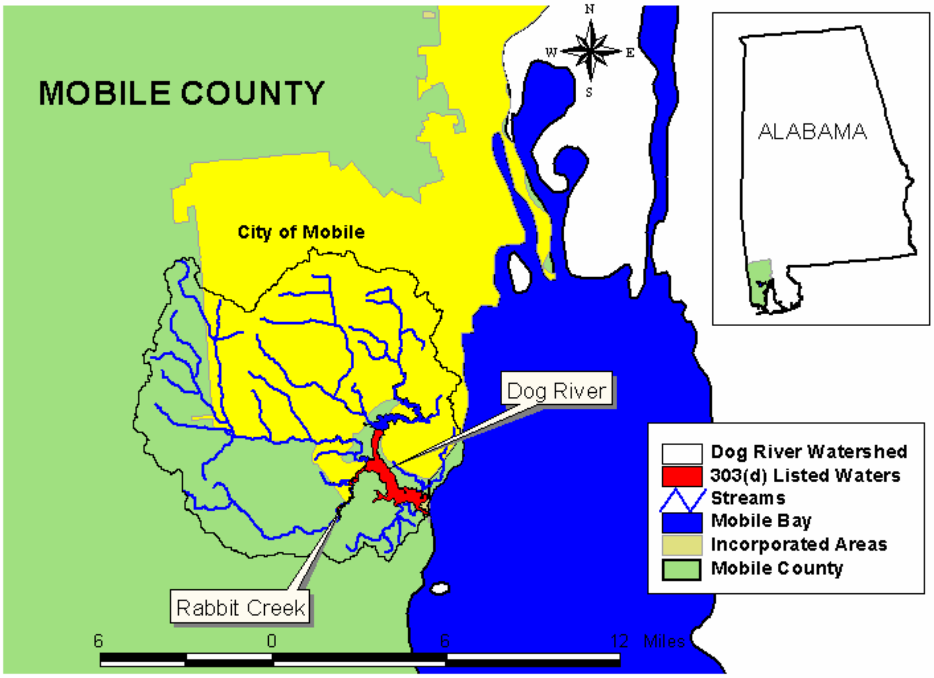

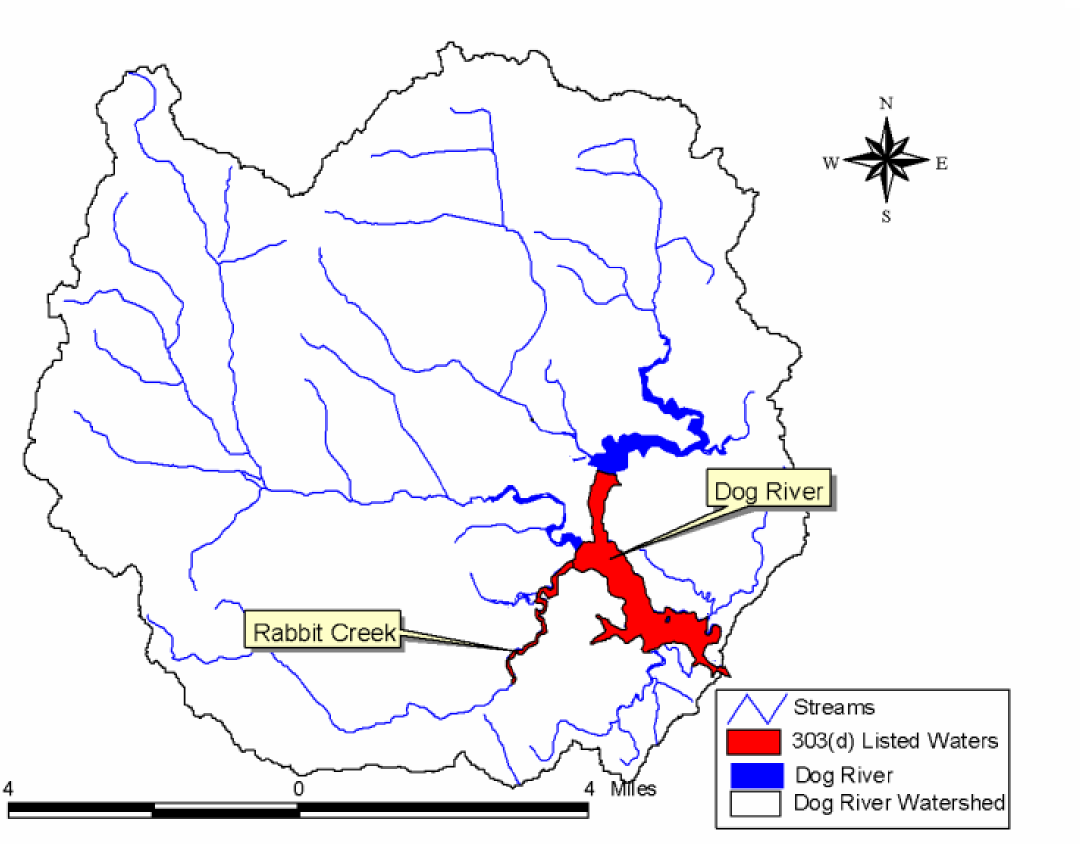

List of Abbreviations

ADEM	Alabama Department of Environmental Management
BMP	Best Management Practices
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
GIS	Geographic Information System
HSPF	Hydrological Simulation Program - FORTRAN
HUC	Hydrologic Unit Code
LA	Load Allocation
LSPC	Loading Simulation Program C++
MAWSS	Mobile Area Water and Sewer Service
MGD	Million Gallons per Day
MOS	Margin of Safety
MPN	Most Probable Number
MRLC	Multi-Resolution Land Characteristic
MS4	Municipal Separate Stormwater System
NED	National Elevation Database
NHD	National Hydrography Dataset
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
RF3	Reach File 3
SSOs	Sanitary Sewer Overflows
STORET	Storage Retrieval database
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WCS	Watershed Characterization System
WLA	Waste Load Allocation

1.0 Executive Summary

Rabbit Creek and Dog River are located in the southwest portion of Alabama in Mobile County. The majority of the 87 sq. mi. Dog River watershed lies within the incorporated area of the City of Mobile (pop. 198,915). A small portion of the 15.5 sq. mi. Rabbit Creek watershed is within the city limits; the remainder is unincorporated yet has a significant population.

Dog River is a shallow, brackish bay connected by a small channel to Mobile Bay. The downstream portion of Rabbit Creek, a major tributary to Dog River, is also tidally influenced. Rabbit Creek and Dog River have been included on the State of Alabama’s §303(d) list of impaired waters since 1996. Both segments are listed as impaired by pathogen pollution (fecal coliform bacteria) due to urban runoff/storm sewers and sanitary sewer collection system failure. The use classification of Rabbit Creek is Fish and Wildlife. The listed segment of Dog River is classified as Fish and Wildlife/Swimming.

The following report presents the results of the Total Maximum Daily Load (TMDL) analysis for pathogens for these segments. The TMDL is in accordance with ADEM water quality criteria for Fish and Wildlife, “the bacteria of the fecal coliform group shall not exceed a geometric mean of 1,000/100ml October-May or 100/100ml June-September in coastal waters; nor exceed a maximum of 2,000/100ml in any sample,” in Rabbit Creek; and Swimming, “the bacteria of the fecal coliform group shall not exceed a geometric mean of 100/100ml year round; nor exceed a maximum of 2,000/100ml in any sample,” in Dog River.

The calculated TMDL is shown in Tables 1-1 and 1-2.

Table 1-1. Maximum Allowable Pollutant Loads

Impaired Segment	Existing Load (counts/day)	MS4 WLA (% reduction)	Direct WLA (% reduction)	LA (% reduction)	TMDL (counts/day)
Rabbit Creek	1.8×10^{11}	54%	0%	54%	8.3×10^{10}
Dog River	4.3×10^{12}	83%	0%	83%	7.2×10^{11}

Table 1-2. Pollutant Load Reductions by Source

Impaired Segment	Overflows	Other Direct Sources*	Urban Nonpoint Sources
Rabbit Creek	100%	85%	50%
Dog River	100%	85%	50%

*Direct sources may include failing septic tanks or unknown persistent sources.

The United States Fish and Wildlife Service have documented the endangered Florida manatee (*Trichechus manatus latirostris*) and the endangered Alabama redbelly turtle (*Pseudemys alabamensis*) in Dog River. Also, the threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*) may occur in Dog River. The TMDLs proposed for Dog River are organic enrichment and low dissolved oxygen in a separate document and pathogens in this document. The manatee and turtle are air-breathing vegetarians, so it is doubtful that they would be directly affected by organic enrichment or low dissolved oxygen. However, pathogens may affect these species, particularly if their immune systems are compromised or they are injured. The Gulf sturgeon is a bottom dwelling species that is probably used to some degree of low dissolved oxygen. It may also be affected by pathogens in certain circumstances. The Alabama redbelly turtle has been found at the mouth of Rabbit Creek. The Florida manatee and the Gulf sturgeon may occur in Rabbit Creek.

2.0 Basis for §303(d) Listing

2.1 Introduction

Section 303(d) of the Clean Water Act (CWA) as amended by the Water Quality Act of 1987 and EPA's Water Quality Planning and Management Regulations [(Title 40 of the Code of Federal Regulations (CFR), Part 130)] require states to identify waterbodies which are not meeting water quality criteria applicable to their designated use classifications. The identified waters are prioritized based on severity of pollution with respect to designated use classifications. Total maximum daily loads (TMDLs) for all pollutants causing violation of applicable water quality criteria are established for each identified water. Such loads are established at levels necessary to implement the applicable water quality criteria with seasonal variations and margins of safety. The TMDL process establishes the allowable loading of pollutants, or other quantifiable parameters for a waterbody, based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Alabama has identified Rabbit Creek as being impaired by fecal coliform for a length of 3.0 miles as reported on the 1996 §303(d) list of impaired waters. Dog River is also listed as impaired by fecal coliform for a length of 4.0 miles. Table 2-1 shows characteristics of the listed segments.

Table 2-1. Segments on the 303(d) List Impaired by Pathogens

Waterbody Name (ID)	Support Status	Use Classification(s)	Sources of Impairment	Size	Downstream/ Upstream Locations
Rabbit Creek (03160205-020_01)	Non	Fish & Wildlife	Urban runoff/Storm sewers Onsite wastewater systems	3.0 mi.	Dog River / AL Hwy. 163
Dog River	Non	Fish & Wildlife	Land development	4.0 mi.	Mobile River /

(03160205-020_02)		Swimming	Urban runoff/Storm sewers Onsite wastewater systems		4 miles upstream

The TMDLs developed for Rabbit Creek and Dog River illustrate the steps that can be taken to address a waterbody impaired by high fecal coliform levels. These TMDLs is consistent with a phased-approach: estimates are made of needed pollutant reductions, load reduction controls will be implemented, and water quality monitored for plan effectiveness. Flexibility is built into the plan so that load reduction targets and control actions can be reviewed if monitoring indicates continuing water quality problems.

2.2 Problem Definition

For many years, both watersheds have experienced major and frequent sanitary sewer overflows (SSOs) from the collection systems of the Mobile Area Water and Sewer Service (MAWSS). In addition, Rabbit Creek has a large number of onsite wastewater (septic) systems installed in locations with a very high water table, resulting in direct discharge to groundwater. Rabbit Creek has also been impacted by illicit discharges of effluent pumped from septic tank service trucks (ADEM, 2002). Extremely high levels of fecal coliform bacteria have been measured at sites in both watersheds, representing a major urban component of nonpoint source fecal coliform loading.

<u>Waterbodies Impaired:</u> Rabbit Creek and Dog River

<u>Water Quality Criterion Violation:</u> Bacteria

<u>Pollutant of Concern:</u> Fecal Coliform

<u>Water Use Classifications:</u> Fish and Wildlife (Rabbit Creek)
Fish and Wildlife/Swimming (Dog River)

The impaired stream segment in Rabbit Creek is classified as Fish and Wildlife. In Dog River, the impaired segment is classified as Fish and Wildlife/Swimming. The locations of the classified zones are shown in Figure 2-1.

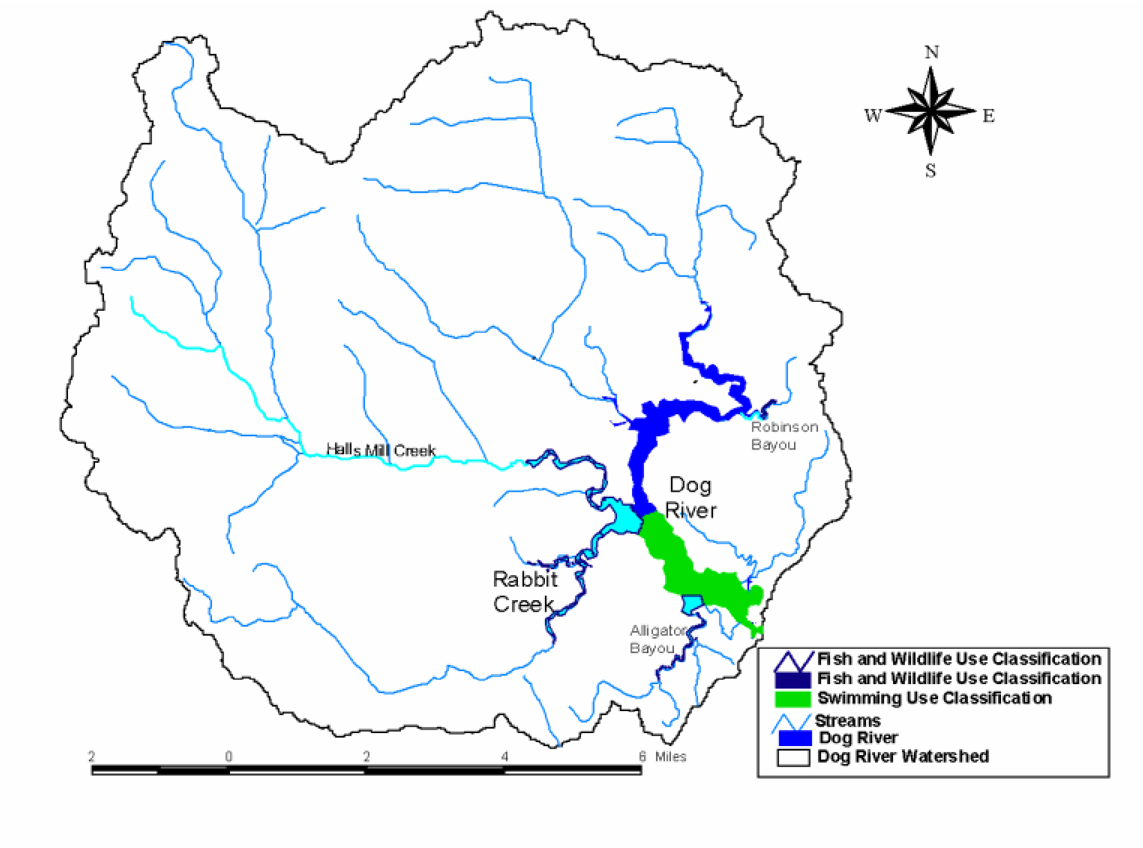

Figure 2-1. Use Classification in the Dog River Watershed, Including Rabbit Creek

<u>Fish and Wildlife Use Classification</u>

Usage of waters in the Fish and Wildlife classification is described in ADEM Admin. Code R. 335-6-10-.09(5)(a), (b), (c), and (d).

(a) Best usage of waters:

Fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming and water-contact sports or as a source of water supply for drinking or food processing purposes.

(b) Conditions related to best usage:

The waters will be suitable for fish, aquatic life and wildlife propagation. The quality of salt and estuarine waters to which this classification is assigned will also be suitable for the propagation of shrimp and crabs.

(c) Other usage of waters:

It is recognized that the waters may be used for incidental water contact and recreation during June through September, except that water contact is strongly discouraged in the vicinity of discharges or other conditions beyond the control of the Department or the Alabama Department of Public Health.

(d) Conditions related to other usage:

The waters, under proper sanitary supervision by the controlling health authorities, will meet accepted criteria of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports.

Alabama's water quality criteria document (ADEM Admin. Code R. 335-6-10-.09-(5)(e)7.) states: "Bacteria of the fecal coliform group shall not exceed a geometric mean of 1,000/100 ml; nor exceed a maximum of 2,000/100 mL in any sample. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours. For incidental water contact and recreation during June through September, the bacterial quality of water is acceptable when a sanitary survey by the controlling health authorities reveals no source of dangerous pollution and when the geometric mean fecal coliform organism density does not exceed 100/100 mL in coastal waters and 200/100 mL in other waters. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours. When the geometric mean fecal coliform organism density exceeds these levels, the bacterial water quality shall be considered acceptable only if a second detailed sanitary survey and evaluation discloses no significant public health risk in the use of the waters. Waters in the immediate vicinity of discharges of sewage or other wastes likely to contain bacteria harmful to humans, regardless of the degree of treatment afforded these wastes, are not acceptable for swimming or other whole body water-contact sports."

Swimming Use Classification

Usage of waters in the Swimming classification is described in ADEM Admin. Code R. 335-6-10-.09(3)(a) and (b).

(a) Best usage of waters:

Swimming and other whole body water-contact sports. In assigning this classification to waters intended for swimming and water-contact sports, the Commission will take into consideration the relative proximity of discharges of wastes and will recognize the potential hazards involved in locating swimming areas close to waste discharges. The Commission will not assign this classification to waters, the bacterial quality of which is dependent upon adequate disinfection of waste and where the interruption of such treatment would render the water unsafe for bathing.

(b) Conditions related to best usage:

The waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports. The quality of waters will also be suitable for the propagation of fish, wildlife and aquatic life. The quality of salt waters and estuarine waters to which this classification is assigned will be suitable for the propagation and harvesting of shrimp and crabs.

Alabama's water quality criteria document (ADEM Admin. Code R. 335-6-10-.09-(3)(c)6.) states: "Waters in the immediate vicinity of discharges of sewage or other wastes likely to contain bacteria harmful to humans, regardless of the degree of treatment afforded these wastes (refer to ADEM Admin. Code R. 335-6-10-.09-(3)(a)), are not acceptable for swimming or other whole body water-contact sports. In all other areas, the bacterial quality of water is acceptable when a sanitary survey by the controlling health authorities reveals no source of dangerous pollution and when the geometric mean fecal coliform organism density does not exceed 100/100 mL in coastal waters and 200/100 mL in other waters. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours. When the geometric mean fecal coliform organism density exceeds these levels, the bacterial water quality shall be considered acceptable only if a second detailed sanitary survey and evaluation discloses no significant public health risk in the use of the waters. The policy of nondegradation of high quality waters shall be stringently applied to bacterial quality or recreational waters."

3.0 Technical Basis for TMDL Development

3.1 Water Quality Target Identification

The water quality target for pathogen TMDLs is determined by a stream's use classification and the water quality criteria described in Section 2.2. The water quality criteria for pathogens, or bacteria, in impaired segments are based on fecal coliform concentrations. Due to the potential for recreational contact in the summer months, there is a seasonal variation in the water quality criteria for segments classified as Fish and Wildlife (F&W). The F&W criteria consider two forms of compliance: first, the instantaneous fecal coliform concentration may not exceed a maximum of 2,000/100mL; second, for Rabbit Creek the geometric mean of the fecal coliform concentration may not exceed 1,000/100mL during October to May or 100/100mL during June to September, since the listed segment qualifies as coastal water. The Dog River listed segment is classified for Swimming. The Swimming classification requires a geometric mean of the fecal coliform concentration may not exceed 100/100ml year round.

3.2 Source Assessment

A source assessment is an important part of defining the TMDL for any pollutant. The data and sources must be understood to be able to distinguish between point and nonpoint source impacts. Typically, point source impacts can be quantified through permit limits and/or direct measurements at a certain location. The potential for nonpoint source pollution can be assessed by examining the extent of human activity in a watershed. This assessment can include evaluation of maps of land use classification, population density, numbers of onsite wastewater systems, and the amount of agricultural activity.

3.2.1 General Sources of Fecal Coliform

Fecal coliform loadings originate from 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 source contributions can typically be attributed to the following sources:

- Municipal wastewater facilities,
- Municipal Separate Storm Sewers (MS4s),
- Illicit discharges, and
- Leaking or overflowing sewers.

Municipal wastewater treatment facilities are permitted through the National Pollutant Discharge Elimination System (NPDES). Larger treatment facilities have chlorination systems that remove fecal coliform in the effluent before it is discharged. Treatment facilities treat human waste received from the collection system and then discharge their effluent into a nearby stream.

Municipal Separate Stormwater Systems (MS4s) are also point sources regulated by the NPDES program. Discharge from stormwater pipes or conveyances can potentially include urban runoff high in fecal coliform and other pollutants.

Illicit discharges are facilities or persons that discharge fecal coliform when not permitted or in violation of a defined permit limit by exceeding the fecal coliform concentration.

In urban settings, sewer lines typically run parallel to the stream in the floodplain. If there is a leaking or overflowing sewer line, high concentrations of fecal coliform can flow into the stream or leach into the groundwater. Groundwater monitoring wells may signal if there are leaking sewer lines contributing to fecal coliform.

Nonpoint sources of fecal coliform do not have one discharge point, but rather, occur over the entire length of a stream or waterbody. On the land surface, fecal coliform accumulate over time and then washes off during rain events. As the runoff transports the sediment over the land surface, more fecal coliform are collected and carried to the stream. Fecal coliform may also die and decay while accumulating. The net loading into the stream is determined by the local watershed hydrology. Nonpoint sources of fecal coliform can be attributed to the following list of contributors:

- Urban runoff,
- Onsite wastewater (septic) systems in urban or rural areas,
- Wildlife and waterfowl,
- Manure application to row crops and/or pasture,
- Confined Animal Feeding Operations (CAFOs) and livestock grazing.

Fecal coliform loading from urban areas is potentially attributable to multiple sources including storm water runoff, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, and domestic animals. Onsite wastewater (septic) systems are common in unincorporated areas, may exist in some urban areas, and may be direct or indirect sources of pathogen pollution via ground and surface waters. Onsite wastewater systems have the potential to deliver fecal coliform loads to surface waters due to system failure and malfunction.

Wildlife deposit feces onto land surfaces where it can be transported during storm events to nearby streams. Wildlife deposits can be from a wide range of species in Alabama, including deer, raccoons, opossum, and waterfowl.

3.2.2 Point Sources in the Rabbit Creek and Dog River Watershed

ADEM maintains a database of current NPDES permits and GIS files that locate each permitted outfall. This database includes municipal, semi-public/private, industrial, mining, and industrial storm water. For Rabbit Creek and Dog River, no point sources are permitted to discharge fecal coliform bacteria, although the Phase I Stormwater Municipal Separate Storm Sewer (MS4) permit issued in 2001 requires Mobile area municipalities to control nonpoint source pollution from storm sewers.

Municipal sanitary sewer collection systems operated by the Mobile Area Water and Sewer Service (MAWSS) serve the area and deliver waste to facilities discharging outside the watershed. Table 3-1 shows the permitted municipal point sources in the watershed that have collection systems upstream of the impaired segments.

Table 3-1. Point Sources located within the Dog River watershed, including Rabbit Creek

NPDES Permit	Type of Facility	Facility Name	Significant Contributor (Yes/No)
AL0023078	Municipal	Mobile Bill Ziebach WWTP/collection system	Yes
AL0023086	Municipal	Mobile Clifton Williams WWTP/collection system	Yes
ALS000002	MS4	Greater Mobile Area Municipal Separate Storm Sewer System	Yes *
ALS000007	MS4	City of Mobile, AL DOT	Yes *

* Note: In the MS4 service area, pollutant loads which could include urban runoff and/or failing septic systems are considered in the Load Allocations. Unpermitted sources such as illicit discharges and sanitary sewer overflows have a 100% reduction and are not considered part of the Wasteload Allocations or Load Allocations.

The Mobile Ziebach and Williams WWTPs, operated by MAWSS, receive wastewater from collection systems located within the Dog River watershed including Rabbit Creek. Table 3-2 lists the design flows for the point sources that have collection systems within the Dog River and Rabbit Creek watersheds. Figure 3-1 shows the location of each facility serving areas within the impaired watershed.

Table 3-2. NPDES Design Flows for Point Sources

NPDES Permit	Facility Name	Design Flow (mgd)	Receiving Waterbody
AL0023078	Mobile Bill Ziebach WWTP	2	Mobile Bay
AL0023086	Mobile Clifton Williams WWTP	28	Mobile Bay

Although both of the municipal plants serving the Dog River watershed, including Rabbit Creek, discharge to other waterbodies, their collection systems have frequently failed. System failures have resulted in overflows and leaks discharging untreated sewage to drainage ditches and streams. Collection system operators are required to report these unpermitted discharge events to ADEM.

The locations of reported sanitary sewer overflows from the MAWSS collection systems in the years 1997-April 2002 are shown in Figure 3-1. A detailed list of these overflows as reported is shown in Appendix 9-3. The overflow events were reported to result from various causes listed in Table 3-3. Reported volumes are listed in Table 3-4.

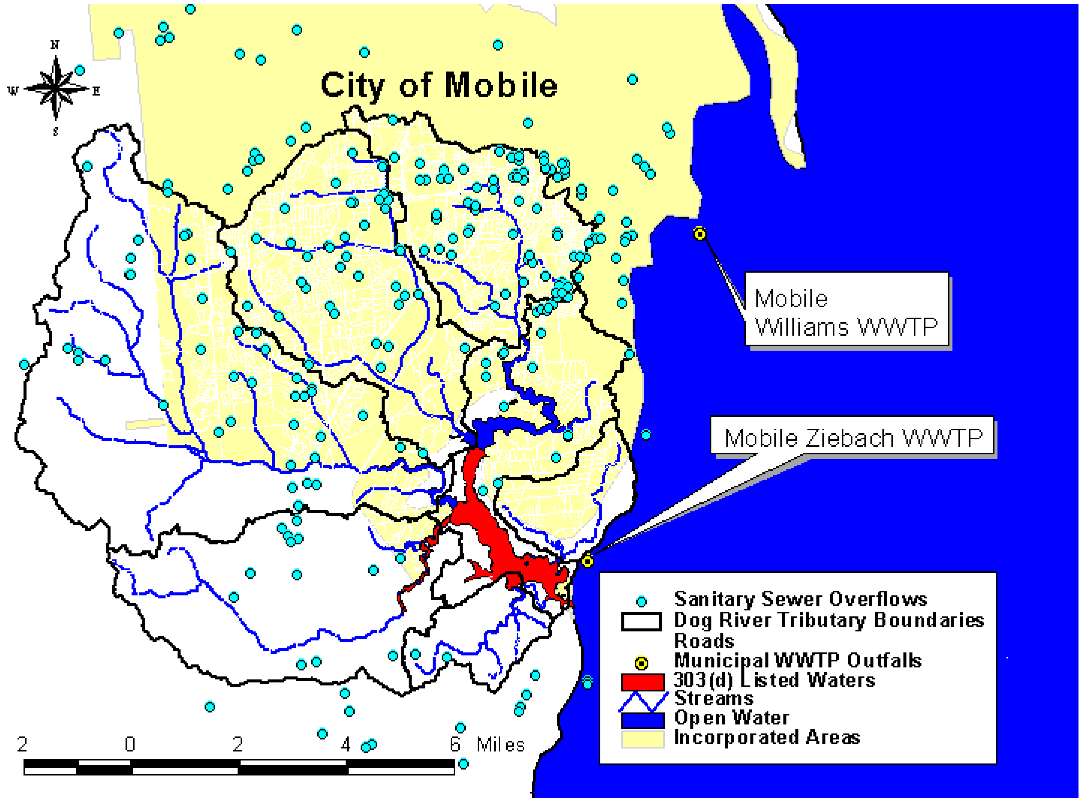

Figure 3-1. Municipal WWTPs with Collection Systems and Sanitary Sewer Overflows Within the Dog River and Rabbit Creek Watersheds

Table 3-3. Reasons Given for MAWSS System SSOs from 2000 to April 2002

Reason for Spill	#	% of Total
Infiltration & Inflow	46	31%
Grease / Blockage	76	51%
Broken Line	19	13%
Pump Station Failure	2	1%
Other	5	3%
Total	148	100%

Table 3-4. SSO Volumes Discharged to the Dog River and Rabbit Creek from 1997-April 2002

YEAR	Alligator Bayou		Dog River		Eslava Creek		Halls Mill Creek		Moore Creek		Rabbit Creek	
	#	Volume (gal)	#	Volume (gal)	#	Volume (gal)	#	Volume (gal)	#	Volume (gal)	#	Volume (gal)
1997	0	0	11	101,420	5	58,450	2	47,000	0	0	3	216,428
1998	0	0	4	65,900	18	231,650	11	300,975	13	365,925	10	140,430
1999	0	0	2	15,125	2	10,000	10	2,236,900	3	24,000	12	265,785
2000	0	0	1	1,800	7	148,190	16	2,429,450	5	182,925	1	36,000
2001	2	9,420	4	14,440	51	1,110,769	18	804,969	17	88,385	7	351,380
2002	0	0	3	5,750	6	8,070	0	0	10	8,075	0	0

A Consent Decree, prompted by violations of the CWA due to SSOs and finalized in April 2002, ordered MAWSS to comply with the CWA by instituting certain collection system maintenance and preventative planning procedures on a strict schedule. The new programs mandated in the Consent Decree require MAWSS to identify and repair leaks and failures, establish a capacity assurance program, provide service to low-income areas, and perform water quality monitoring. These programs are designed to eliminate unpermitted discharges and spills that should ultimately decrease fecal coliform loads to receiving streams. The Consent Decree is discussed further in Section 6.2.

3.2.3 Non-Point Sources in the Dog River Watershed

A land use map of the Dog River watershed is presented in Figure 3-2. The predominant land uses within the watershed are Forest and Urban. Their respective percentages of the total watershed are 30% and 13%. Complete land use distribution is shown in Table 3-5. Each land use type has the potential to contribute to pathogen loading in the watershed due to fecal matter on the land surface that potentially can be washed into the receiving waters of the watershed.

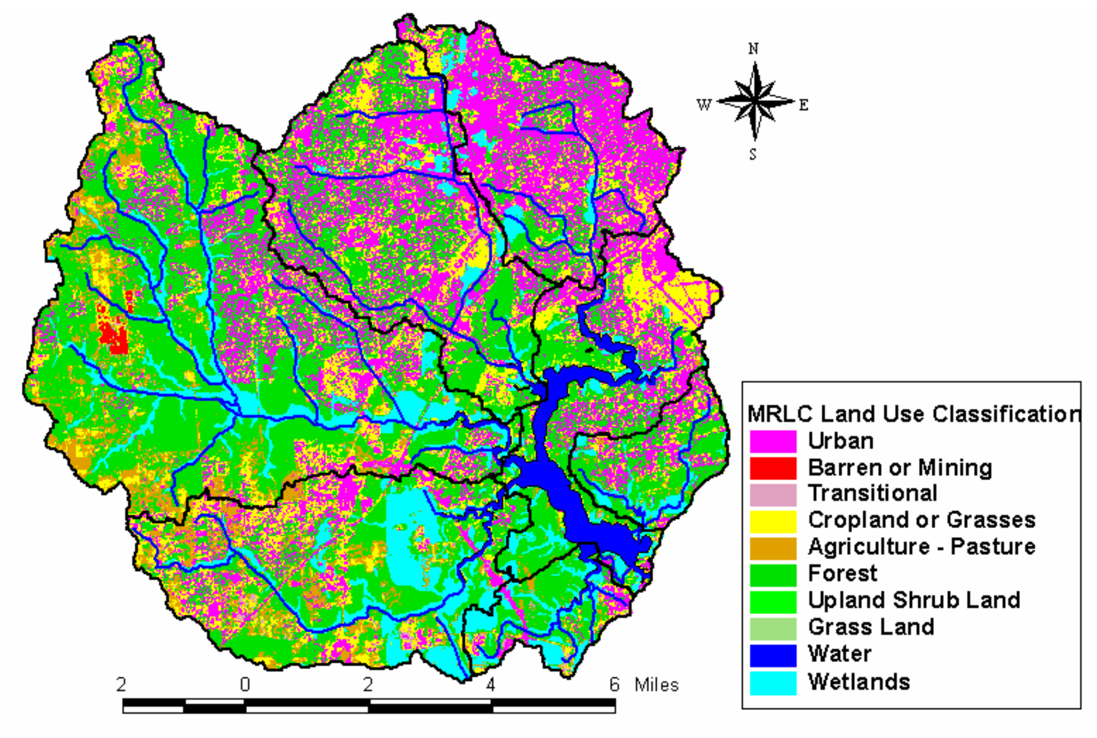

Figure 3-2. Land Use Distribution in the Dog River Watershed

Table 3-5. Land use Acreage Distribution for Major Tributaries of Dog River

Subwatershed	Crop-land	High Density Urban	High Density Residential	Low Density Residential	Mining/ Bare Soil	Trans-itional	Forest	Pasture	Water	Total Acres
Alligator Bayou	41	117	0	49	0	23	1,237	131	64	1,664
Dog River	62	474	195	989	1	12	2,641	1,225	1,344	6,943
Eslava Creek	86	320	497	2,143	0	12	1,394	703	7	5,162
Halls Mill Creek	1,144	367	373	2,247	138	193	12,853	2,982	152	20,449
Moore Creek	266	1,500	768	2,430	6	76	4,500	1,820	71	11,436
Perch Creek	42	28	68	442	0	11	1,456	293	7	2,348
Rabbit Creek	462	463	193	721	0	132	4,825	1,941	98	8,835
Total Acres	2,103	3,269	2,094	9,021	145	459	28,906	9,095	1,743	56,837
Percentage	3.7%	5.8%	3.7%	15.9%	0.3%	0.8%	50.9%	16.0%	3.1%	100%

Onsite wastewater (septic) systems are common throughout the watershed and may be direct or indirect sources of pathogens via ground and surface waters. A high percentage of the citizens in the Dog River watershed rely on septic systems for wastewater treatment (Bureau of the Census 1990, 2000). Figure 3-3 illustrates the total number of onsite systems identified in the 1990 Census. This analysis assumes that the onsite systems are distributed evenly within each tract. This distribution estimates greater than 7800 onsite septic systems in the Dog River watershed in 1990.

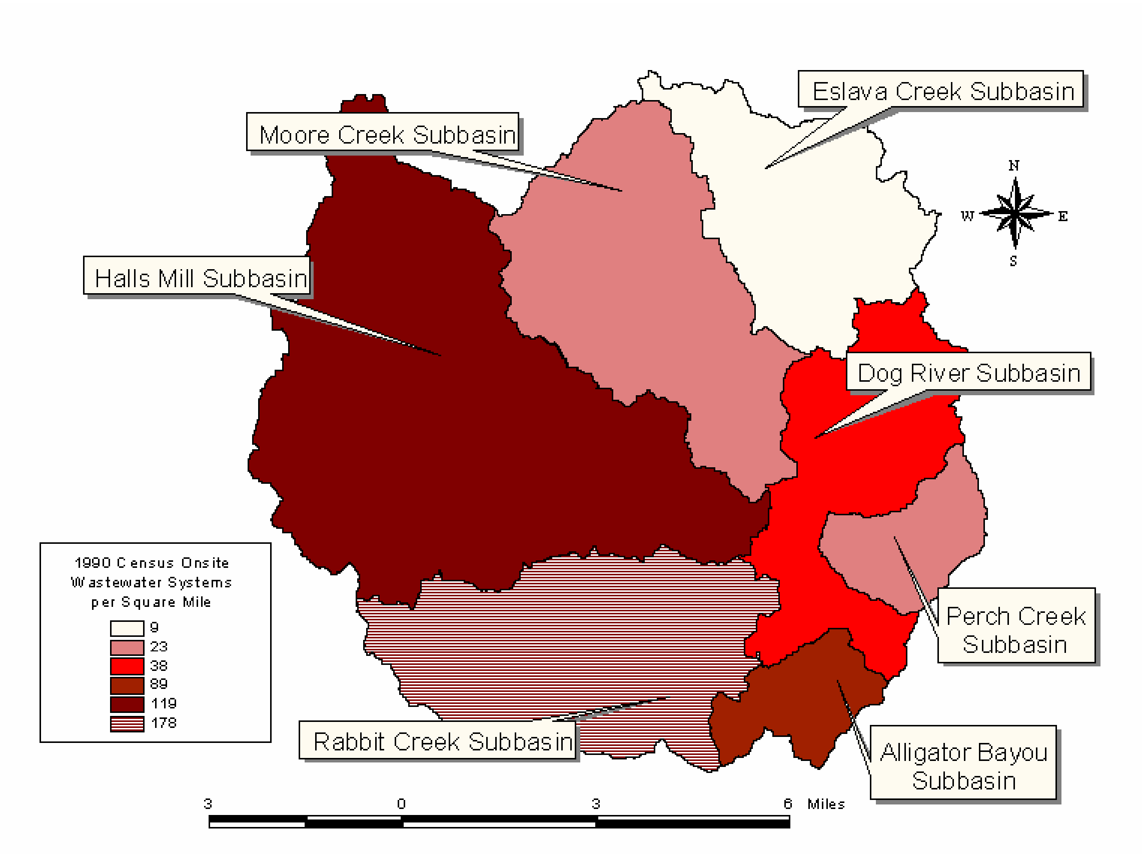

Figure 3-3. Onsite Septic Systems from 1990 Census

Onsite septic systems have the potential to deliver fecal coliform loads to surface waters due to system failure and malfunction. The Mobile area is also problematic because the height of the water table limits percolation and filtration—in many cases septage mixes directly with groundwater. To evaluate this loading, it is necessary to identify where septic tanks are located and to estimate what proportion of septics are malfunctioning.

The number of septic systems in the Dog River watershed, by tract (Bureau of the Census 1990), is shown in Table 3-6. The current number can be estimated by population growth. The density of septic systems (number per acre) was determined for each tributary watershed, or subwatershed, within the Dog River watershed based on the GIS overlap of census tracts (Figure 3-4). It was assumed that septic systems are distributed evenly throughout each tract. If the subbasin population decreased between 1990 and 2000, then the number of onsite systems was assumed constant; see Table 3-8. After estimating the number of septic systems per subwatershed, the number of failing systems per subwatershed was determined in order to calculate fecal coliform loading. These TMDLs assumes that 10% of the onsite systems in the watershed are contributing fecal coliform to surface waters. The percentage of onsite systems contributing fecal coliform was determined after several conversations with the ADEMs Mobile Field Office and Mobile County Department of Public Health. Table 3-7 summarizes fecal loadings by subwatershed and Figure 3-5 shows the corresponding subwatershed location.

Table 3-6. Wastewater Treatment Options by 1990 Census Tract

Census Tract	1990 Population	Persons per Household	Number of Housing Units	Public Sewer	Onsite Wastewater System	Other	Area (mi^2)	2000 Population (estimated*)
9.03	1,782	2.68	762	754	0	8	0.3	1,806
13.02	4,001	3.19	1,367	1,237	116	14	0.7	4,055
14	3,002	2.73	1,256	1,256	0	0	0.7	3,042
15.01	3,067	2.75	1,180	1,160	9	11	0.5	3,108
15.02	1,781	2.95	621	601	0	20	0.3	1,805
16	555	3.19	195	195	0	0	3.4	562
17	3,372	2.39	1,527	1,474	53	0	2.3	3,417
18	2,878	2.73	1,169	1,140	29	0	2.1	2,917
19.01	2,403	2.88	898	793	105	0	2.8	2,435
19.02	3,368	2.63	1,387	1,300	80	7	2.4	3,413
20	1,665	2.69	663	524	139	0	4.3	1,687
21	3,623	2.66	1,453	1,437	16	0	1.8	3,672
22	2,588	2.49	1,044	1,037	7	0	1.1	2,623
23.01	2,591	2.72	1,063	1,023	22	18	0.6	2,626
23.02	2,292	3.13	813	807	0	6	0.7	2,323
24	3,874	2.65	1,679	1,662	12	5	0.9	3,926
25.01	3,699	2.1	1,970	1,945	12	13	1.1	3,749
25.02	2,743	2.01	1,268	1,268	0	0	0.9	2,780
27	2,573	2.47	1,212	1,206	6	0	1.2	2,608
28	4,389	2.16	2,164	2,138	26	0	1.3	4,448
29	3,248	2.15	1,664	1,655	9	0	1.7	3,292
30	3,017	2.36	1,314	1,270	44	0	3.8	3,058
31	4,641	2.57	1,894	1,826	68	0	2.4	4,703
32.02	2,717	2.4	1,157	1,149	8	0	0.7	2,754
32.03	3,406	2.23	1,736	1,727	9	0	1.1	3,452
32.04	3,799	1.86	2,280	2,274	6	0	1.0	3,850
32.05	3,105	2.32	1,578	1,568	10	0	0.8	3,147
33.01	2,735	1.9	1,442	1,438	4	0	0.9	2,772
33.02	4,324	2.39	1,636	1,616	20	0	2.1	4,382
35.01	3,304	2.54	1,330	1,295	35	0	1.8	3,348
35.02	2,496	2.53	1,069	1,057	12	0	1.5	2,530
36.06	3,072	2.13	1,540	1,499	41	0	1.1	3,113
36.07	3,304	2.09	1,685	1,670	15	0	0.6	3,348
37.03	1,333	2.96	426	426	0	0	1.5	1,351
37.04	2,587	2.66	1,070	934	136	0	1.3	2,622
37.05	2,909	2.52	1,192	1,156	36	0	1.4	2,948
37.06	3,601	2.52	1,476	1,452	24	0	1.1	3,649
37.07	4,474	2.36	2,006	1,989	17	0	1.1	4,534
37.08	3,092	2.92	1,112	1,087	25	0	1.8	3,134
37.09	5,086	2.74	1,923	1,780	143	0	2.9	5,154
37.1	4,423	2.59	1,768	1,696	66	6	2.0	4,482
64.02	4,368	3.05	1,582	178	1,379	25	6.2	5,246
64.03	1,927	2.95	679	330	349	0	6.6	2,314
64.04	4,011	2.94	1,412	446	947	19	6.3	4,817
64.05	4,265	3.13	1,340	842	490	8	3.5	5,122
65	2,713	3.08	2,713	63	2,615	35	75.8	3,258
68.01	4,423	3.1	1,488	99	1,389	0	8.4	5,312
68.02	7,685	2.79	2,976	1,090	1,886	0	6.6	9,230
69.01	6,183	2.83	2,374	559	1,799	16	6.6	7,426
70	4,445	2.73	1,814	331	1,475	8	15.3	5,338
71.01	3,757	6.82	1,461	239	1,176	46	5.8	4,512
71.02	2,533	2.89	912	426	486	0	13.2	3,042
71.03	3,068	2.75	1,248	11	1,219	18	19.8	3,685

*2000 Population by tract was estimated by applying the percent change in Municipal population between the 2000 and 1990 Census populations to the 1990 population.

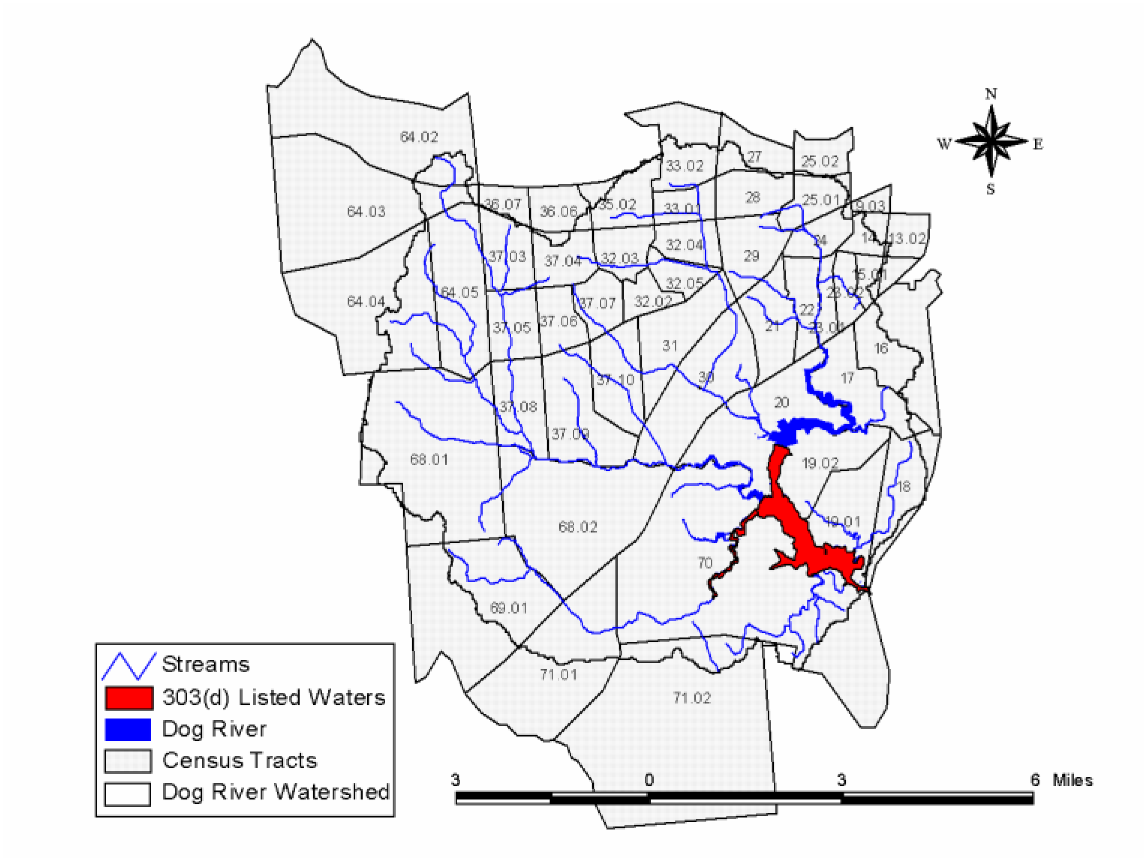

Figure 3-4. 1990 Census Tracts

Table 3-7. Estimated Fecal Loads due to Failing Onsite Wastewater Systems for Tributary Watersheds

Subbasin	2000 Population (estimated*)	2000 Onsite Wastewater System (estimated*)	Failing Septic	People Served	Septic Flow (gal/day)	Fecal Load (counts/day)	Fecal Load (counts/yr)
Alligator Bayou	3173	673	67	185	12946	4.90E+09	1.79E+12
Dog River	14259	625	62	171	11943	4.52E+09	1.65E+12
Eslava Creek	25217	89	9	23	1591	6.02E+08	2.20E+11
Halls Mill Creek	47176	5341	534	1561	109269	4.14E+10	1.51E+13
Moore Creek	46609	448	45	109	7604	2.88E+09	1.05E+12
Perch Creek	4100	128	13	36	2501	9.47E+08	3.45E+11
Rabbit Creek	10121	2981	298	899	62896	2.38E+10	8.69E+12

*2000 Population by tract was estimated by applying the percent change in Municipal population between the 2000 and 1990 Census populations to the 1990 population. 2000 Onsite Wastewater Systems were estimated from the 2000 population estimates using the people per household and percentage of household units with onsite systems in the 1990 Census.

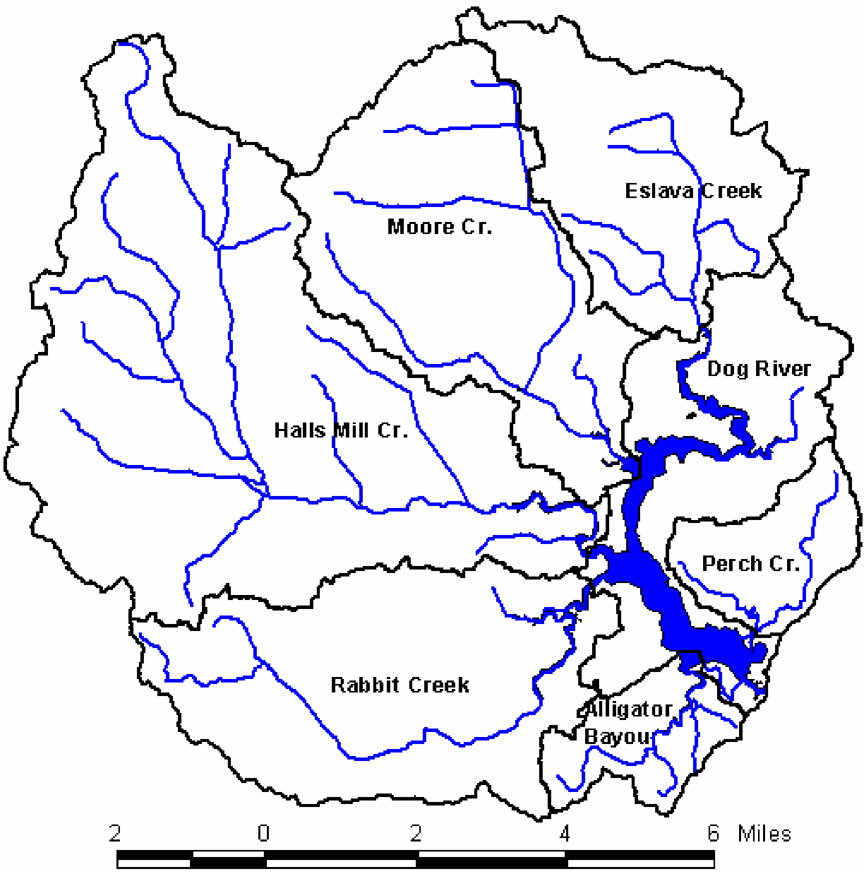

Figure 3-5. Major Tributary Delineations in the Dog River Watershed

Table 3-8. Population Change for Municipalities in Mobile County

Municipal Designation	1990 Population	2000 Population	% Change
City of Prichard	34,311	28,633	-16.50%
City of Mobile	196,278	198,915	1.30%
City of Chickasaw	6,649	6,364	-4.30%
City of Saraland	11,751	12,288	4.60%
Unincorporated County	114,711	137,767	20.10%
Mobile County	378,643	399,843	5.60%

*Data provided by the Mobile County Chamber of Commerce based on US Census Bureau data.

3.3 Loading Capacity – Linking Numeric Water Quality Targets and Pollutant Sources

EPA regulations define loading, or assimilative capacity, as the greatest amount of loading that a waterbody can receive without violating water quality standards (40 CFR Part 130.2(f)).

Using both the instantaneous and geometric mean fecal coliform water quality criteria, TMDL model analyses were performed for a period of two years to evaluate the continuous loading conditions within the watershed. These were accomplished by dynamic simulations aimed at meeting the fecal coliform target by limiting source contributions of point or nonpoint sources. Simulations reflect the effects of the combination of NPS loads and SSOs on water column fecal coliform concentration. The evaluations also considered an implicit margin of safety (MOS) based on conservative modeling assumptions. The final acceptable simulation in which an allocation scenario meets water quality criteria represents the TMDL (and loading capacity of the waterbody).

In addition to loading capacity, the linkage between the nonpoint source loading model developed for Dog River and Rabbit Creek and the in-stream fecal coliform simulations was achieved by estimating the sources of fecal coliform to the system.

3.4 Data Availability and Analysis

A wide range of data and information were used to characterize the Dog River watershed and the in-stream conditions. The categories of data used include physiographic data that describe the physical conditions of the watershed, environmental monitoring data that identify potential pollutant sources and their contribution, and in-stream water quality monitoring data.

3.4.1. Watershed Characterization Data

Three types of spatial watershed information are utilized in this TMDL development. These are:

- Digital Elevation Data (DEM)
- MLRC Landuse Coverage
- National Hydrography Database Reach Network (NHD).

Figure 3-6 presents a spatial contour plot of the DEM data. The DEM outlines the gradients seen in the system and highlights the low slope and grade of the land surface. Figure 3-7 presents the NHD stream network in the Dog River watershed. The DEM and NHD provide the general connectivity and routing within the system for both the watershed and in-stream receiving water model.

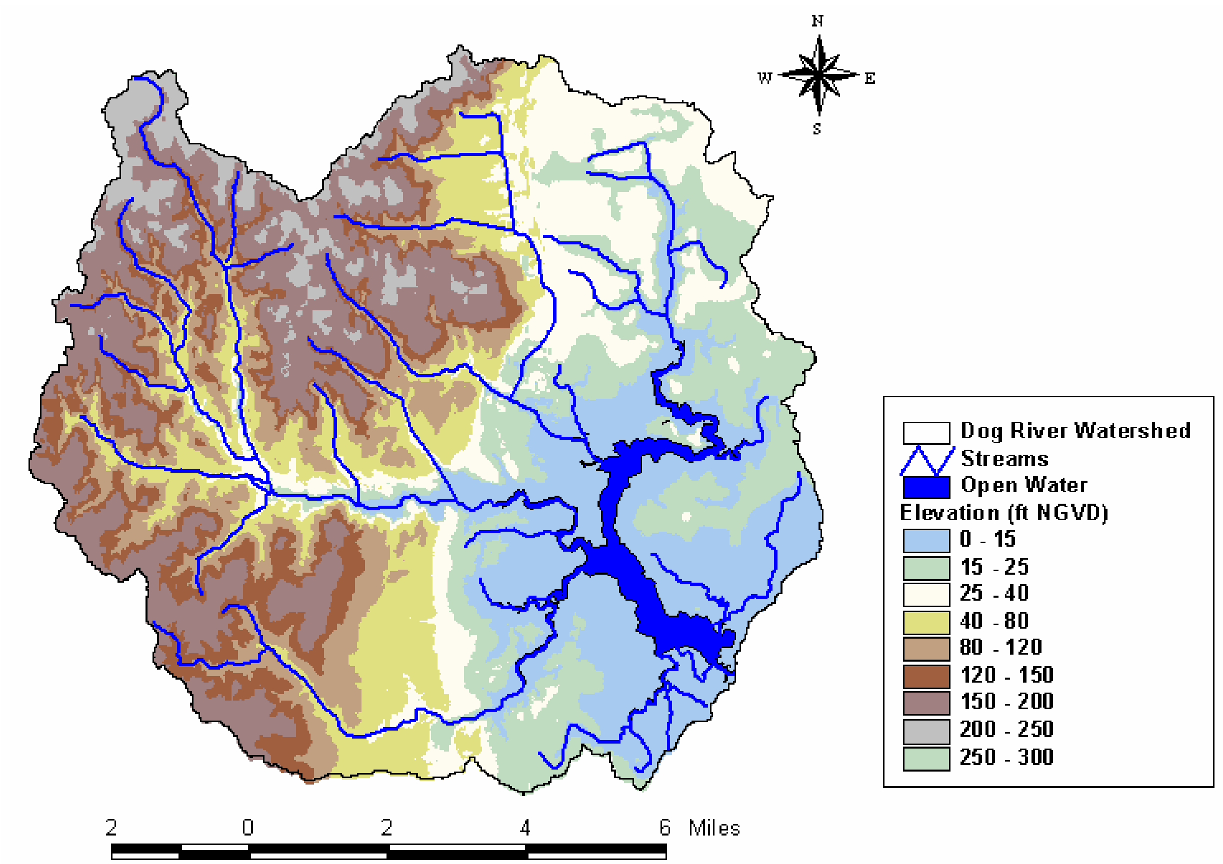

Figure 3-6. Elevation Profile of the Dog River and Rabbit Creek Watersheds

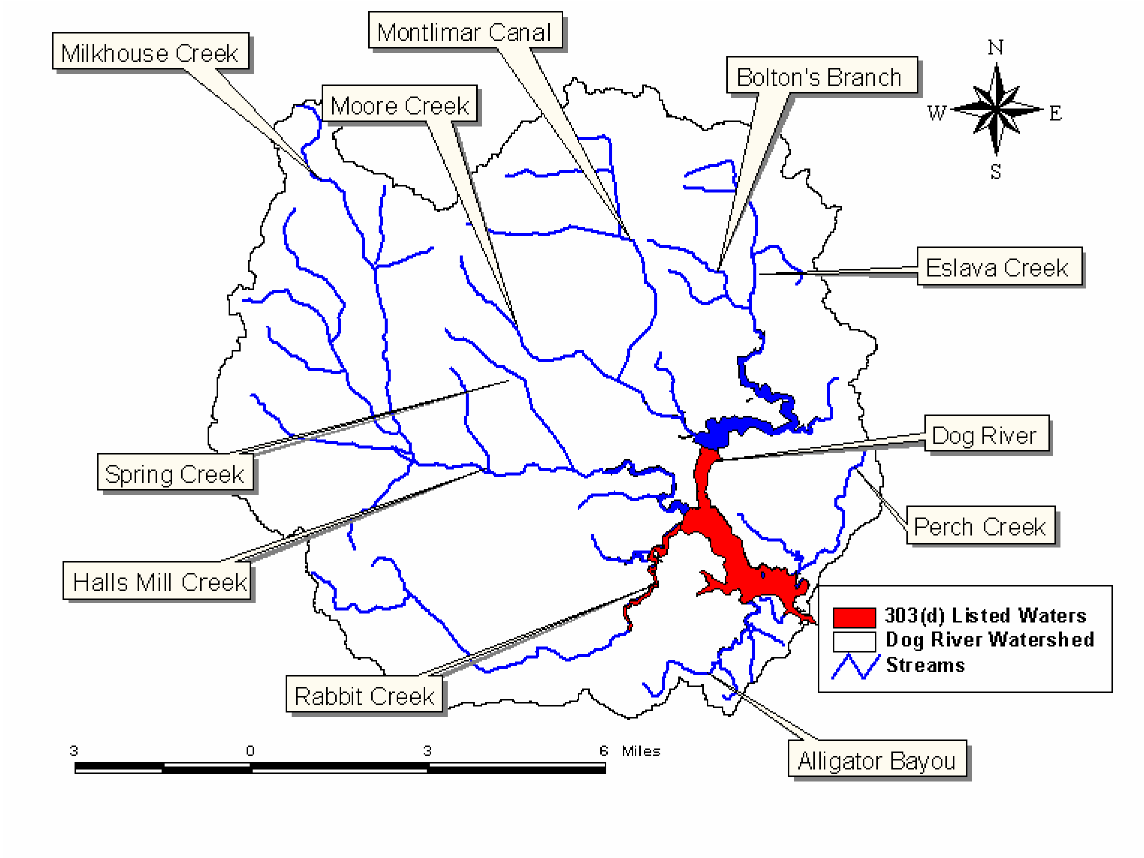

Figure 3-7. National Hydrography Dataset (NHD) Data

3.4.2 In-Stream Flow Data

Although there have been no continuous flow gages in operation for many years, stations located in neighboring watersheds can provide an index to hydrologic conditions necessary for the calibration of watershed simulations. Table 3-9 lists the USGS streamflow station used in this study and the corresponding period of record. This station was the only source of hydrograph data to characterize conditions in the watershed. Figure 3-8 shows the location of the USGS streamflow station used in the analysis. Output plots from the watershed model showing the hydrologic calibration for the period of record are shown in Appendix 9-3.

Table 3-9. USGS Station Employed in TMDL Development

Longitude	Latitude	USGS ID	Station Description	Period of Record
88.215	30.7416	247100550	Eightmile Creek at Highpoint Blvd.	10/1/1996-9/30/2000

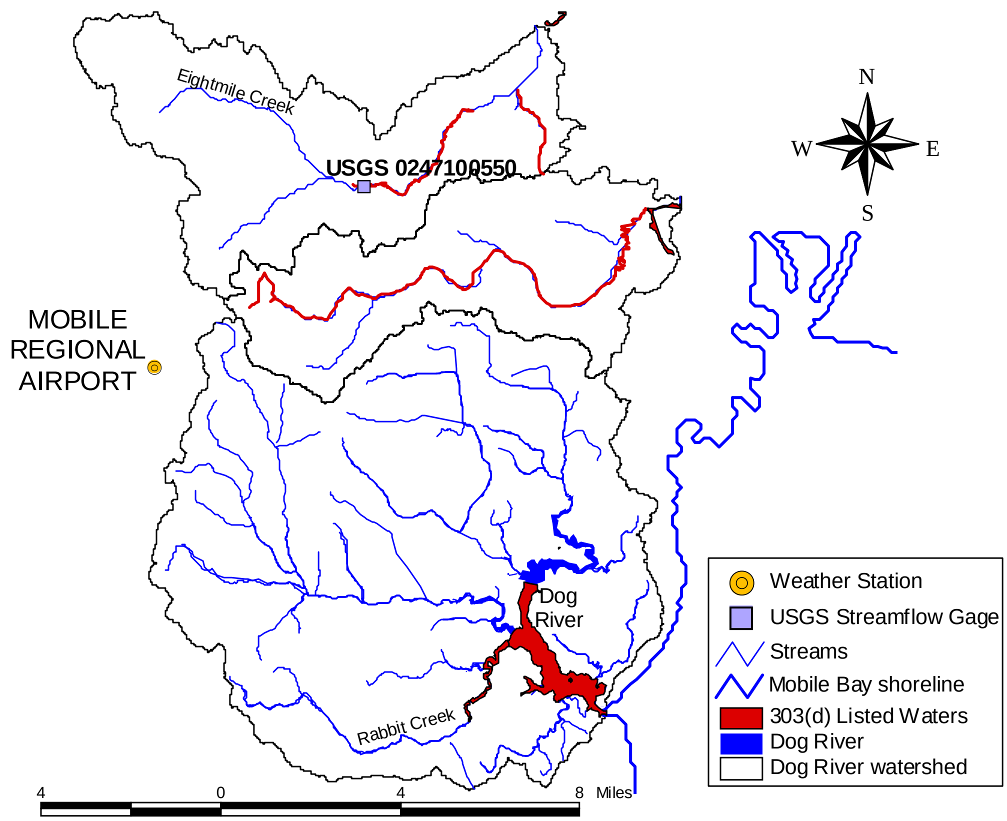

Figure 3-8. USGS Streamflow Gage and Weather Station Locations

3.4.3 Meteorological Data

Meteorological data are a critical component of the watershed model and the in-stream model. The following meteorological parameters are necessary for the watershed and in-stream water quality model:

- Rainfall,
- Air temperature, and
- Wind speed and direction

Long-term hourly data of these parameters is available at a National Climatic Data Center (NCDC) weather station located at the Mobile Regional Airport, also shown in Figure 3-8.

3.4.4 In-Stream Water Quality

Water quality data applied in the TMDL development was collected in several intensive monitoring programs, the earliest of which is "A Survey of the Dog River Watershed" of the ADEM Coastal Program (ADEM, 1994 and 1995). The Survey presents "an overview of land use practices and aquatic resources in the basin." A long-term ambient station, DR-001, has been sampled monthly since 1978 in Dog River. An ADEM intensive survey characterized the conditions in Rabbit Creek in July and October 2001.

Figures 3-9 and 3-10 present the locations of the water quality stations in the Dog River watershed. Examination of the fecal coliform data (listed in Appendix 9-3) from the stations confirms that water quality criteria were violated in the 303(d)-listed regions. The collection, preservation, and analysis of water samples were in accordance with approved quality assurance and quality control (QA/QC) plans and guidelines of ADEM

Data at DR-001, DGRM-001, DGRM-002, RBTM-001, RBTM-002, RBTM-003, and RBTM-004 were collected by ADEM Montgomery and Mobile Field Offices. In addition, frequent samples of fecal coliform and enterococcus were gathered at station ALBA by the Mobile Field Office as part of its Beach Monitoring Program. In recent years, enterococcus has become a preferred indicator of bacteria from human origins (EPA 2001). Enterococcus samples were analyzed by the Alabama Department of Public Health Mobile Laboratory.

A citizen's group, the Dog River Clearwater Revival has also sampled numerous sites in the Dog River watershed for E. coli, total coliform, and blue-greens (cyanobacteria). Because all microbial analyses can aid in the assessment of pathogen pollution, this data has been shown in Appendix 9-1 for comparison purposes, but only fecal coliform data was used in model calibration to collaborate with the water quality criteria defined by the State.

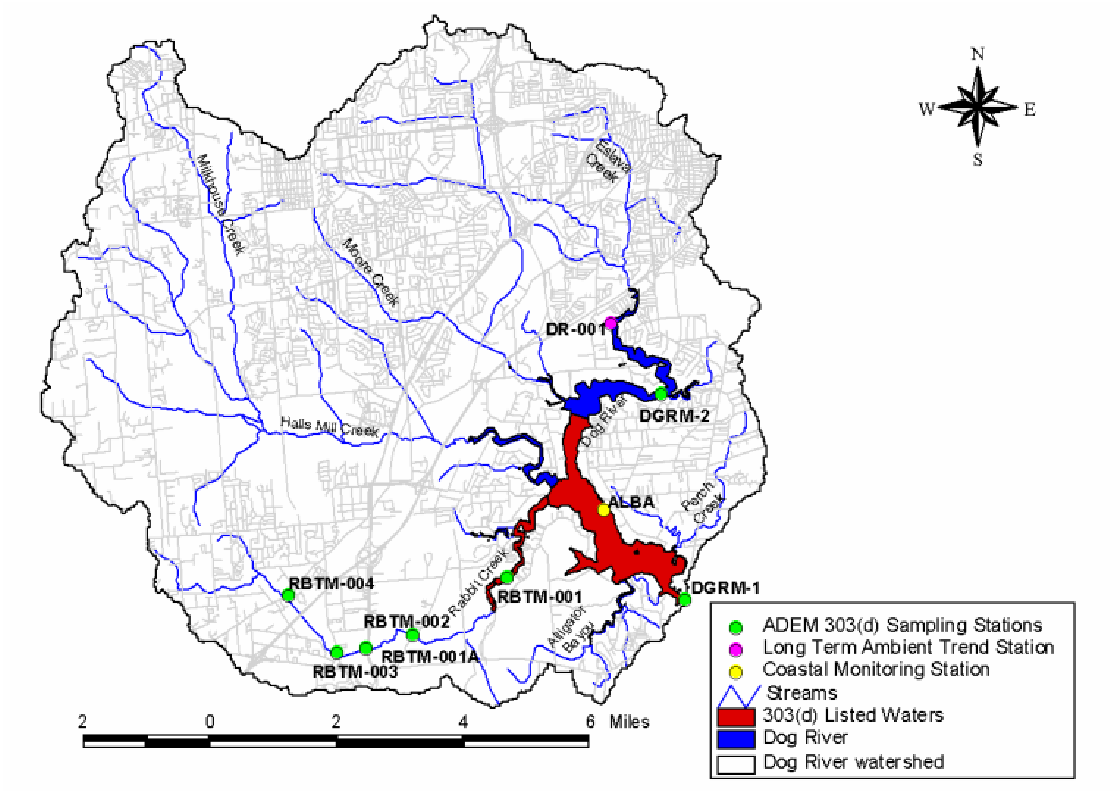

Figure 3-9. ADEM Sampling Stations

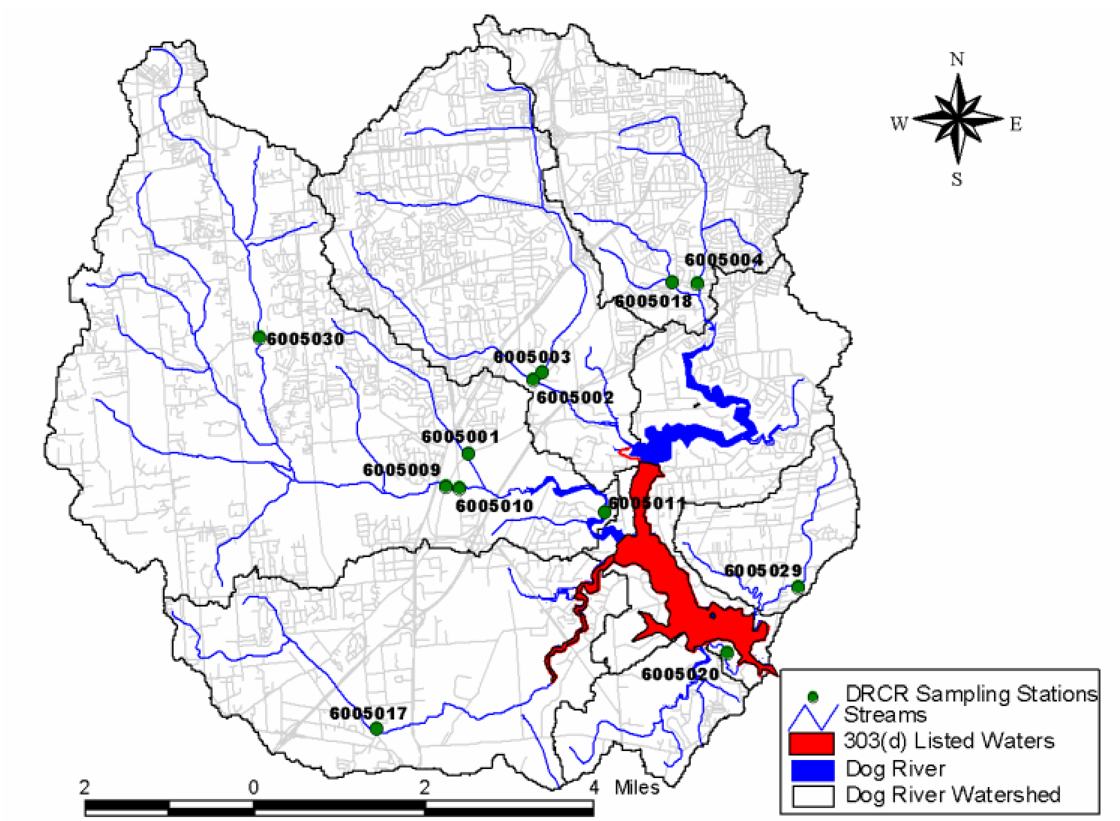

Figure 3-10. Dog River Clearwater Revival Sampling Stations

3.4.5 Point Source Discharge Data

There are no NPDES permitted point sources with pathogen loads discharging to the Dog River watershed. However, the NPDES Phase I Stormwater permit ALS000002 was assigned to the Mobile area in 2001 in order to regulate urban stormwater discharge from the MS4. The permit encompasses the entire Dog River watershed, including Rabbit Creek. Although the City of Mobile has located many MS4 outfalls, no distinction is made in the model between MS4 and nonpoint sources of fecal coliform.

Sanitary sewer overflows are simulated as point sources in the model at their reported locations and volumes. Details on these discharges are presented in Appendix 9-4. The concentration of fecal coliform in the effluent was assumed to be 10^7 counts per 100ml based on literature values (Metcalf and Eddy, 1991).

The Ziebach WWTP discharges to Mobile Bay near the mouth of Dog River. Tidal inflows can transport the ambient concentrations of fecal coliform from Mobile Bay, including the diluted discharge from the Ziebach and Williams WWTPs, into the listed segment of Dog River. For the purposes of model development, an ambient level of 50 fecal coliform counts per 100ml was assumed to represent the concentration in Mobile Bay at the model boundary, based on EPA samples taken in 2000 and 2001 (EPA, 2002).

4.0 Model Development

Establishing the relationship between in-stream water quality and source loading is an important component of TMDL development. It allows the estimation of the relative contribution of sources to total pollutant loading and the evaluation of potential changes to water quality resulting from implementation of various management options. This relationship can be developed using a variety of techniques ranging from qualitative assumptions based on scientific principles to numerical computer modeling. For these TMDLs a system of models was developed to allow the determination of the watershed loads to the listed reaches, the in-stream flow and transport within the listed reaches, and the in-stream distribution of fecal coliform. The system of models includes the following:

- Loading Simulation Program in C++ (LSPC) – to quantify the watershed loads of fecal coliform bacteria to the watershed tributaries and
- Environmental Fluid Dynamics Code (EFDC) – to simulate the flow, transport and decay of fecal coliform within the tidal zone of the listed reaches.

The EFDC model is capable of simulating the complex circulation in tidal waterbodies, including the density effects of salinity. General descriptions of each of the models along with brief descriptions of the model calibrations and applications follow.

4.1 Watershed Model – LSPC

A calibrated hydrologic-response and pollutant-loading model determines the watershed loads to the receiving waters. First, the model is calibrated for the hydrologic response of the watershed to rainfall and background source flows. During periods of precipitation, rainfall governs hydrology and subsequent loads of pathogens delivered to the stream via overland flow. During dry periods, storage associated with past events and subsurface inflows govern the system hydrology. In each case a subsequent load is transported (via output) to the receiving water model. The development of a TMDL that accounts for the nonpoint source impacts upon the system requires the quantification of the total watershed load and its distribution.

4.1.1 Hydrology Model Selection, Set Up and Calibration

The Loading Simulation Program C++ (LSPC) was used to represent the source-response linkage in the Dog River watershed based on the considerations described previously, analysis of the monitoring data, review of the literature, and past modeling experience. LSPC is a comprehensive data management and modeling system that is capable of representing loading from nonpoint and point sources and simulating in-stream processes. The program is based on the Mining Data Analysis System (MDAS), with modifications for non-mining applications such as nutrient and fecal coliform modeling. MDAS was developed by EPA Region 3 through mining TMDL applications in Region 3.

LSPC is a system designed to support TMDL development for areas impacted by nonpoint and point sources. The most critical component of LSPC to TMDL development is the dynamic watershed model, because it provides the linkage between source contributions, in-stream response during routing of flows, and delivery of loads to receiving waters. This comprehensive watershed model is used to simulate watershed hydrology and pollutant transport, as well as, stream hydraulics and in-stream water quality. It is capable of simulating flow, sediment, metals, nutrients, pesticides, and other conventional pollutants, as well as temperature and pH for pervious and impervious lands and waterbodies. LSPC was configured for the Dog River watershed to simulate a series of hydrologically-connected subwatersheds contributing loads to their respective reaches. Configuration of the model involved subdivision of the Dog River and Rabbit Creek watersheds into modeling units and continuous simulation of flow and water quality for these units using meteorological, land use, and in-stream data. The only pollutant simulated is fecal coliform. This section describes the configuration process and key components of the model in greater detail.

The watershed was divided into 50 subbasins to represent watershed loadings and resulting concentrations of fecal coliform delivered to the stream segments. These subwatersheds represent hydrologic boundaries. The division was based on the 30m resolution National Elevation Dataset (NED) from USGS, stream connectivity from the National Hydrography Dataset (NHD) stream coverage, and the locations of monitoring stations. The delineation of the 50 subbasins is shown in Appendix 9-4.

The hydrology of the LSPC model was calibrated for the period of record 10/1/96-9/30/00 at USGS 0247100550 on Eightmile Creek, the nearest long-term streamflow gage with a continuous record. An example is shown in Figure 4-1.

Figure 4-1: LSPC Hydrologic Calibration for 2000 (note end of USGS data)

The hydrology calibration was performed prior to water quality calibration. Model parameters were adjusted to represent the hydrologic cycle until acceptable agreement was achieved between simulated flows and historic stream flow data measured at USGS 0247100550 for the same period of time. Model parameters adjusted include: evapotranspiration, infiltration, upper and lower zone storage, groundwater storage and recession rates, and interflow discharge.

Modeled flow was also compared to flow observations available at RBTM-002 in Rabbit Creek above the tidal zone as shown in Figure 4-2. Additional hydrologic calibration plots are presented in Appendix 9-3.

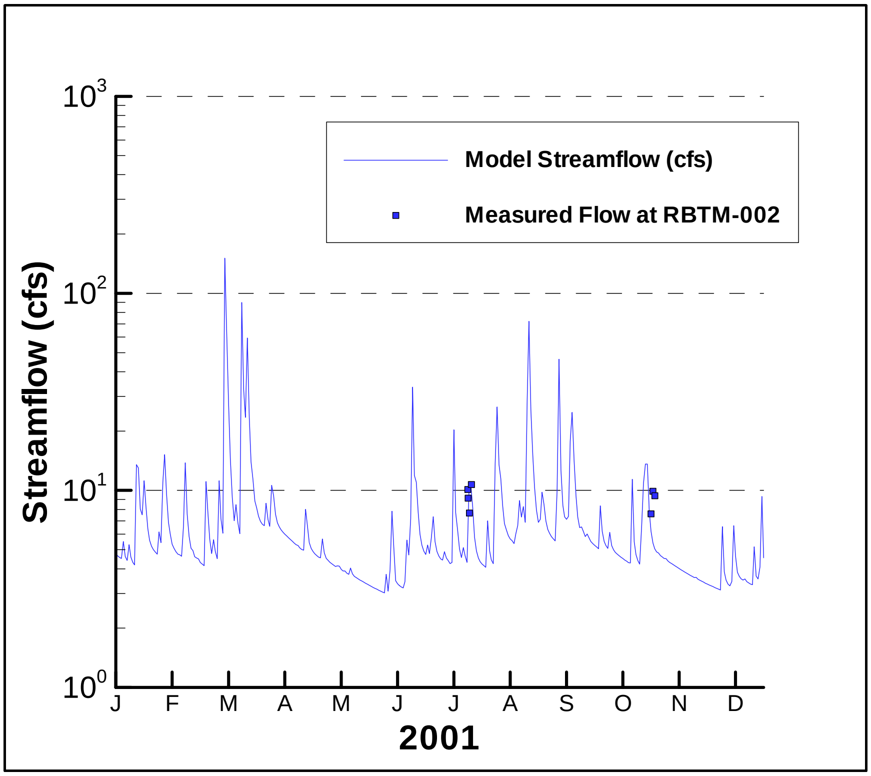

Figure 4-2: Comparison of Hydrologic Predictions with Measured Flow in Rabbit Creek

4.1.2 Water Quality Model Selection, Set Up and Calibration

LSPC was selected for fecal coliform analysis in order to: a) simulate the time varying nature of deposition on land surfaces and transport to receiving waters; and b) incorporate seasonal effects on the production and fate of fecal coliform.

For modeling purposes, the pathogen sources are represented by the following components:

- runoff loads from land uses (build-up and washoff due to runoff) and
- direct source loads from failing septic systems and SSOs.

Typically, nonpoint sources are characterized by buildup and washoff processes: pollutants are deposited on the land surface, where they accumulate and are available for runoff during storm events. These nonpoint sources are represented in the model as land-based runoff from each land use category to account for its contribution to loading within the watersheds. Accumulation rates (mass per acre per day) can be calculated for each land use based on all sources contributing fecal coliform to the surface of the land use.

The LSPC model is a build-up and wash-off model that represents the pollutant by accumulating the pollutant over time, storing the pollutant to some maximum limit, and then transporting the pollutant through overland flow to the stream. The model represents these processes with an accumulation rate (ACQOP) and the storage limit (SQOLIM). WSQOP is defined as the rate of surface runoff (inches per hour) that results in 90 percent washoff in one hour. The lower the value, the more easily washoff occurs. This parameter is user-defined and was determined for each land use by EPA-recommended ranges. The ACQOP and SQOLIM can be varied monthly or be a constant through the simulation. If specific data such as timing of manure applications, livestock rotations, and crop rotations are known, these rates can be calculated monthly. For the Dog River watershed modeling, the rates were input as constant values.

The continuous representation of nonpoint source loading of fecal coliform was predicted empirically in the Dog River watershed based on discrete measured data. The buildup/washoff components for each land use were calibrated to duplicate the observed peak concentrations in Rabbit Creek, while also accurately representing conditions in the other tributaries of Dog River. Residual low-flow baseline concentrations were also adjusted based on observed values. These adjustments to nonpoint source loadings were performed while incorporating the estimated loadings of SSOs and failing septic tanks into the total simulated output (Figure 4-3).

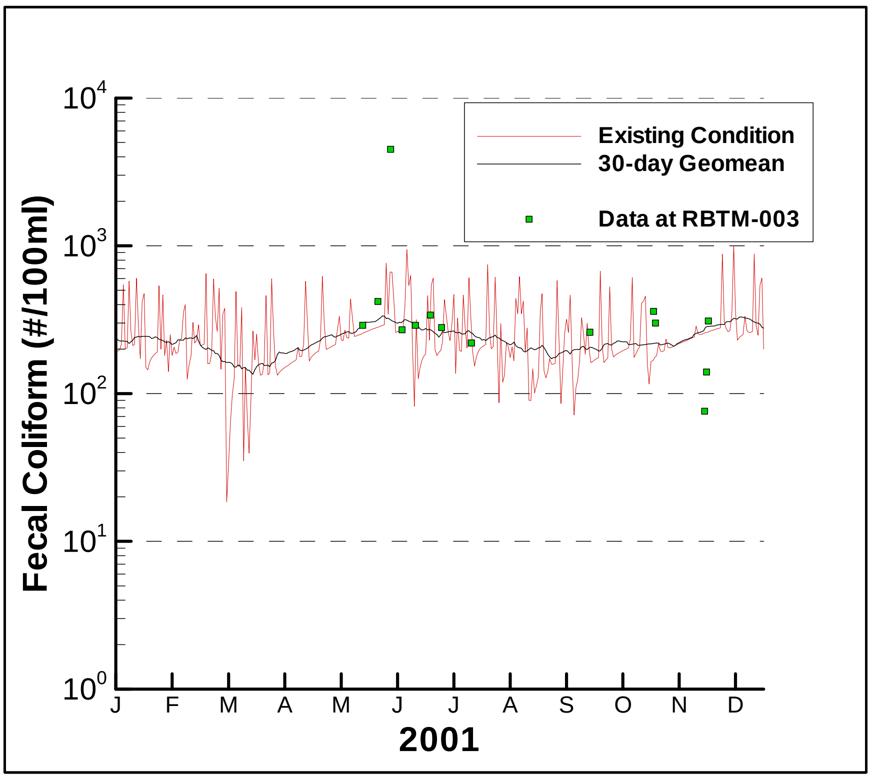

Figure 4-3: Simulated fecal coliform concentrations in Rabbit Creek

Failing septic systems represent a nonpoint source that can contribute pathogens to receiving waterbodies through surface or subsurface malfunctions. The estimated number of septic systems was calculated from the number of onsite wastewater systems identified from the 1990 census and population change between the 1990 and 2000 Census. To provide for a margin of safety accounting for the uncertainty of the number, location, and behavior (e.g., surface vs. subsurface failures; proximity to stream) of the failing systems, failing septic systems are represented in the model as direct sources of fecal coliform to the stream reaches. Contributions from failing septic system discharges are included in the model with a representative flow and concentration, which were quantified based on the following information:

- Number of failing septic systems in each subwatershed.
- Estimated population served by the septic systems (an average per household, calculated from 1990 and 2000 Bureau of the Census data).
- An average daily discharge of 70 gallons/person/day (Horsley & Witten, 1996).
- Septic effluent concentration of 10,000 counts/liter (Horsley & Witten, 1996).

Water quality was calibrated by comparing observed in-stream concentrations of fecal coliform with modeled concentrations. The calibration consisted of executing the watershed model, comparing water quality time series output to available water quality observation data, and adjusting model parameters within a reasonable range. The parameters adjusted to obtain a calibrated model include the build-up and washoff rates of fecal coliform on the land surface, and direct loads from sanitary sewer overflows and failing septic systems.

Model simulations were run for 2000 and 2001. This time period was selected based on the availability and relevance of the observed data to the current conditions in the watershed. The model was calibrated for the year 2001, which represents both high and low flow periods, and uses data from the 2001 Rabbit Creek Intensive Studies (ADEM, 2001).

4.2 Receiving Water Model – Environmental Fluid Dynamics Code (EFDC)

Section 4.1 presented the watershed model utilized to develop continuous overland flows and pollutant concentrations to be input to the receiving water model. The receiving water model takes the pollutant loads from the watershed model (including nonpoint source loads, transported SSOs, and estimated septic loads), and accounts for the transport and transformation of material as it moves through the system. In the case of fecal coliform, the model simulates for the advective transport and dispersion of the input loads. Attenuation of fecal coliform loads is simulated by a first-order exponential decay.

4.2.1 Hydrodynamic Model Selection, Set Up and Calibration (EFDC)

A hydrodynamic model was developed to simulate the flow, velocity and transport in the listed reaches. The EFDC model was applied with 61 grid cells, each with four vertical layers.

The Environmental Fluid Dynamics Code (EFDC) is a general purpose modeling package for simulating 1-D, 2-D, and 3-D flow and transport in surface water systems including: rivers, lakes, estuaries, reservoirs, wetlands and near shore to shelf scale coastal regions. The EFDC model was originally developed at the Virginia Institute of Marine Science for estuarine and coastal applications and is considered public domain software. The EFDC code has been extensively tested and documented.

Solutions for flow and transport can be made on multiple scales, i.e. 1-D or 2-D, within the EFDC modeling package. These models solve the 1-D/2-D continuity, momentum, and transport equations. The models use the efficient numerical solution routines within the more general 2-D/3-D EFDC hydrodynamic model, as well as transport, dispersion, and meteorological forcing functions. In addition, EFDC allows for specification of time variable water surface elevation at an open boundary, i.e. allowing a time-dependent Mobile Bay water surface elevation as a boundary condition. Specific details on the model equations, solution techniques and assumptions may be found in Hamrick (1996).

Inputs to the EFDC Dog River and Rabbit Creek hydrodynamic model include the following:

- Model grid and geometry,
- Mobile Bay tidal water surface elevation (Figure 4-4), and
- Flows at headwaters and distributed flows from watershed.

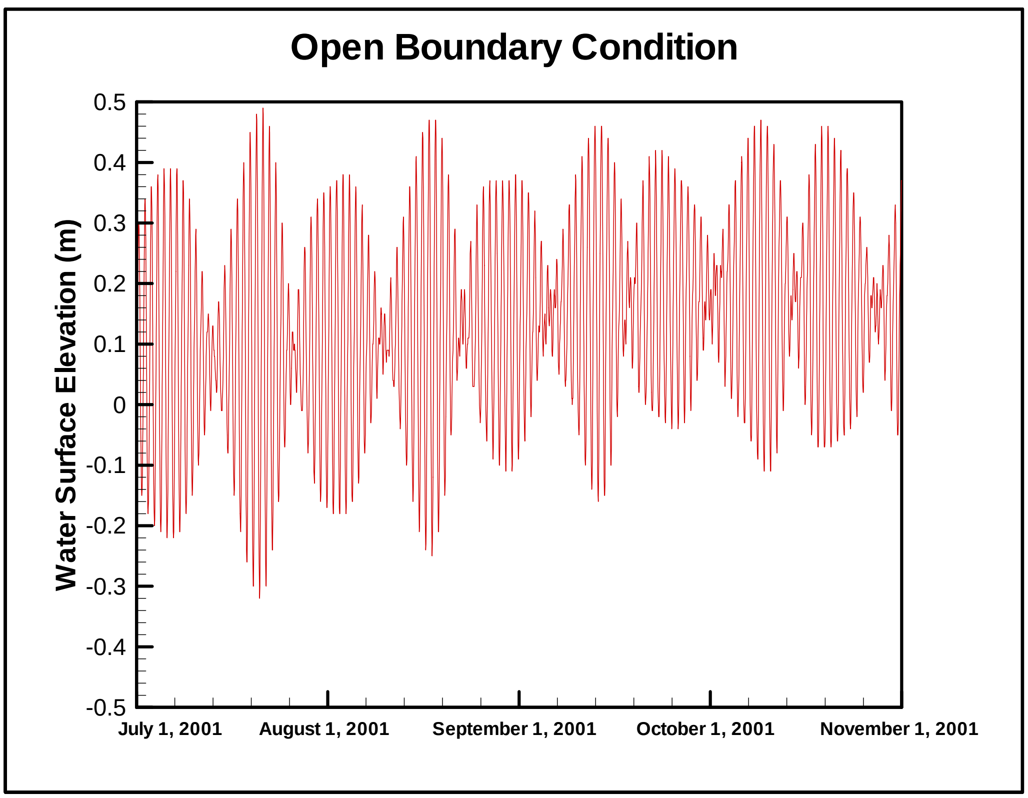

Figure 4-4. Projected Astronomic Tides in Mobile Bay at Fowl River

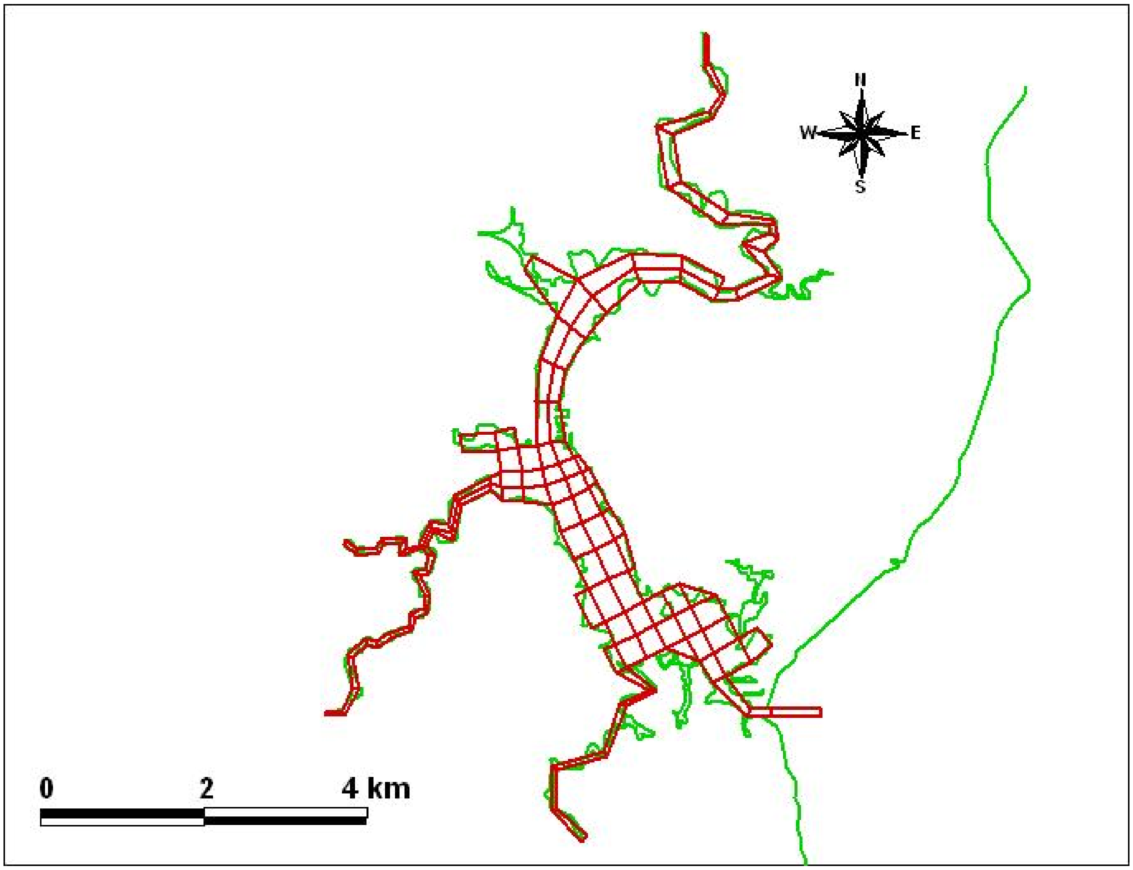

Figure 4-5. Extents of In-Stream Model Grid

The model grid was developed based upon the shorelines from USGS Topographic Maps, measured cross-sectional information from ADEM, bathymetry from NOAA, elevation data from the 30m resolution USGS National Elevation Dataset (NED), and stream connectivity from the National Hydrography Dataset (NHD) stream coverage. Figure 4-5 presents the extent of the EFDC model grid with the 2-D and 1-D portions of the grid identified. The grid covers all of the listed reaches along with those stream sections required to provide overall connectivity between the listed segments and tributary inputs. Figure 4-6 shows the bathymetry of the EFDC grid.

The lower boundary of the model grid, the mouth of Dog River at Mobile Bay, is controlled by the tidal surface boundary.

Flow inputs to the system consist of 11 tributary flows from the LSPC watershed model.

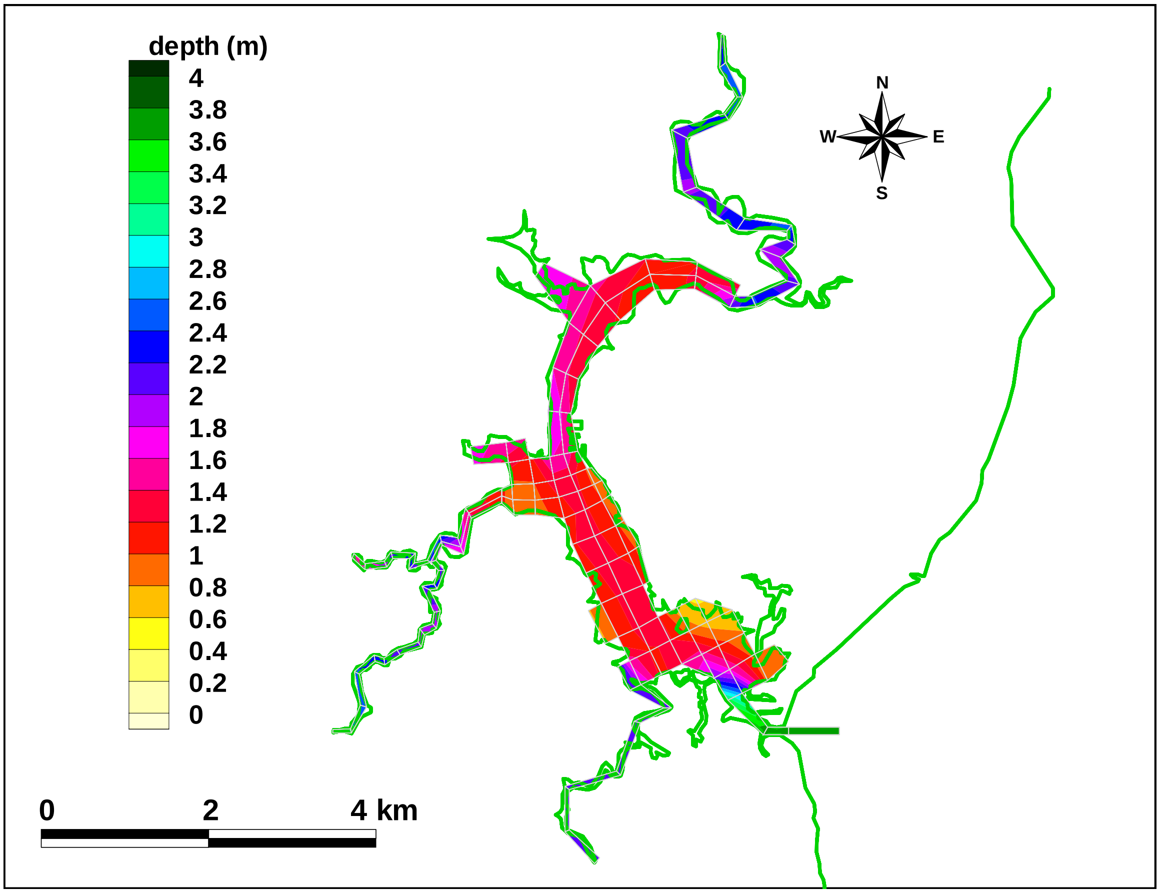

Figure 4-6. Bathymetry of the EFDC Model Grid (Smoothed Plot)

Tidal EFDC simulations of Dog River and Rabbit Creek result in time-series outputs of fecal coliform concentration at specified grid cells. This simulation includes the effects of the 50 counts/100ml open boundary condition at the mouth.

Results of the simulation are shown in Figure 4-3. Note that the magnitude of simulated overflows depends on the accuracy of reported overflows, and also the assumed bacteria concentration of the discharge.

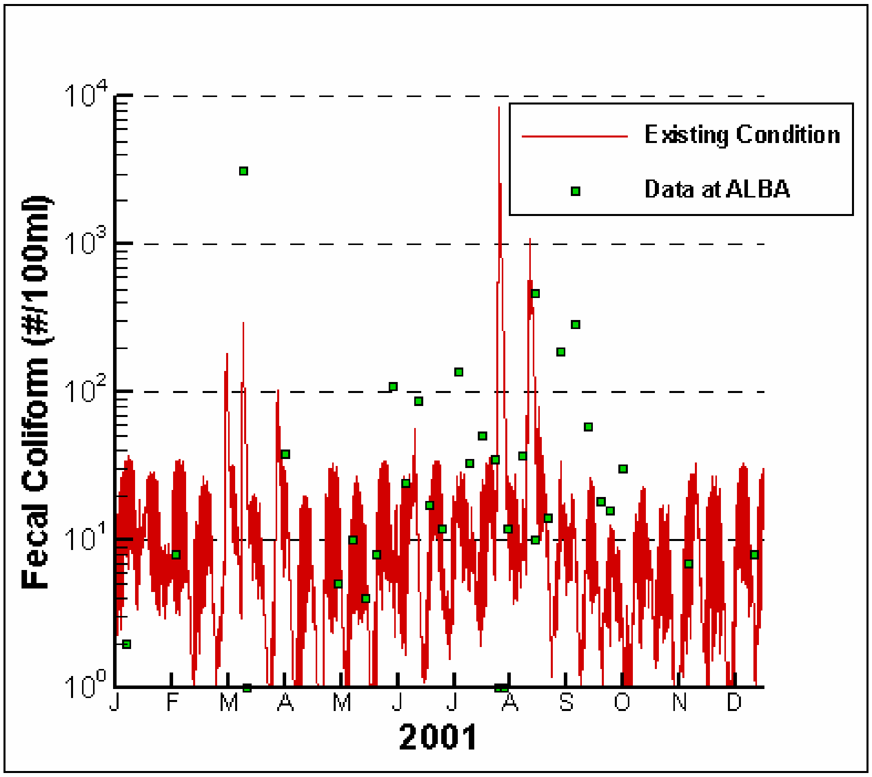

Figure 4-7. Simulated Fecal Coliform Concentrations for 2001 at ALBA

4.3 Critical Conditions

Data analysis shows that the critical condition occurs after intense storm events when fecal coliform is transported from the land surface, tributaries, and directly from sanitary sewer overflows into the listed segments. The calendar year 2001, including intense storm events that caused numerous SSO discharges, was utilized to represent the worst case conditions for the purpose of determining these TMDLs. The simulations were performed with time-dependent daily fluctuations of the Mobile Bay tidal boundary of water surface elevation, simulated inflows from the LSPC model with simulated concentrations, transport by complex circulation, and first-order exponential decay.

For the purposes of these TMDLs, the critical condition of fecal coliform loading to Dog River and Rabbit Creek occurred in a 30-day period from July 20 to August 19, 2001, which experienced numerous SSOs throughout the watershed totaling over 2.3 million gallons of reported raw effluent spills. Geometric mean fecal coliform concentrations at affected tributaries are shown in Figure 4-8.

4.4 Margin of Safety (MOS)

There are two methods for incorporating a MOS in TMDL analysis: a) by implicitly incorporating the MOS using conservative model assumptions to develop allocations; or

b) by explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations. An implicit MOS was incorporated in this TMDL.

This TMDL considers the worst-case conditions of major sanitary sewer overflows in wet periods and constant failing septic system discharge in dry periods. Conservative modeling assumptions used include: 10% of septic system loads discharging directly into the streams, conservative estimates of in-stream decay, and all land areas considered to be connected directly to streams.

Watershed loads simulated to develop this TMDL were reduced to bring tributary inputs into compliance with instream water quality criteria for fecal coliform *before flowing into tidal segments of Dog River and Rabbit Creek.* This conservative assumption is especially protective because bacteria decay at a greater rate when exposed to sunlight in the receiving waters (USEPA 2001).

4.5 Seasonal Variation

Seasonal variation is considered in the development of the Dog River and Rabbit Creek pathogens TMDLs because the allocation runs are performed over an entire calendar year. The model simulates the response of fecal coliform loads under various hydrologic and meteorological conditions, thus fully evaluating the potential seasonal variations.

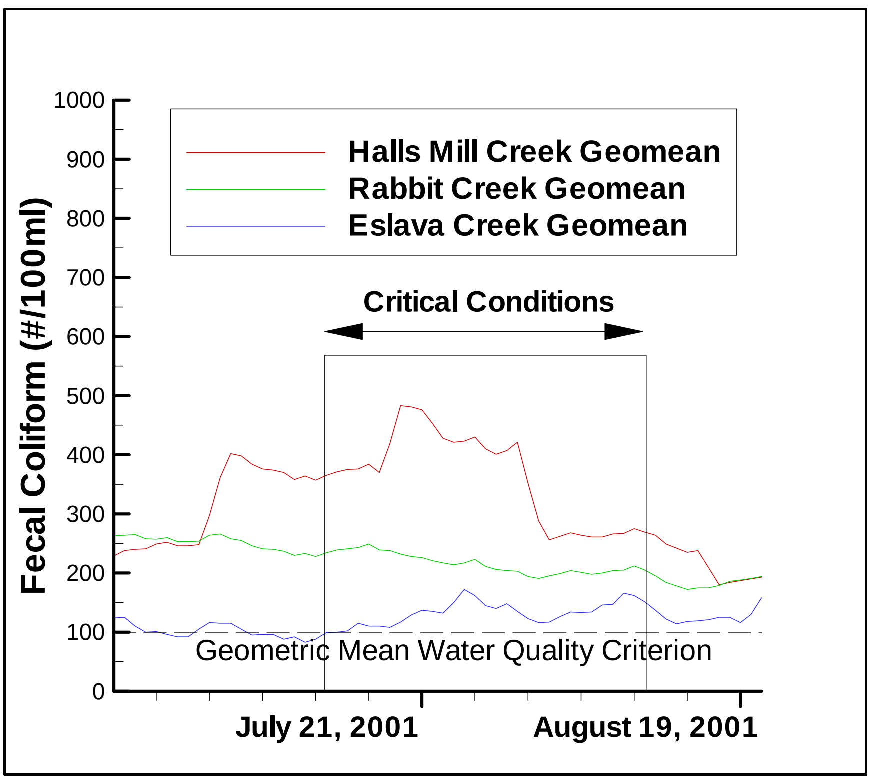

Figure 4-8. 30-day geometric mean concentrations in selected tributaries to Dog River, including Rabbit Creek, during the critical conditions (7/21/01-8/19/01)

5.0 TMDL Development

This section presents the TMDLs developed for fecal coliform for the Dog River watershed, including Rabbit Creek. *The TMDLs are presented as geometric mean loads for the 30-day critical period, in accordance with the 30-day geometric mean water quality criteria for waters classified as Fish and Wildife or Swimming.* Model output for 2001 was used to determine the TMDLs and allocation scenarios because the modeled water quality during 2001 represented critical conditions. The year 2001 was chosen to determine TMDLs and allocation scenarios because it was representative of typical weather conditions, but still contained intense storm events.

A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality criteria, in this case Alabama's water quality criteria for fecal coliform concentrations. TMDLs can be expressed in terms of mass per time or by other appropriate measures. TMDLs are comprised of the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly of explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is denoted by the equation:

$$\text{TMDL} = \text{WLAs} + \text{LAs} + \text{MOS}$$

In order to develop the TMDL presented herein, the following approach was taken:

- Define TMDL endpoints,
- Simulate baseline conditions, and
- Determine the TMDL and necessary source reduction allocations.

5.1 TMDL Endpoints

TMDL endpoints represent the in-stream water quality targets used in quantifying TMDLs and their individual components. For these TMDLs the same endpoint is considered for both listed segments—the geometric mean fecal coliform concentration of 100 counts/100ml, is the summer WQC for Rabbit Creek, classified as Fish and Wildlife; and the same criterion applies year-round to the listed segment of Dog River, classified as Swimming.

5.2 Baseline Conditions

The calibrated models provided the basis for performing the allocation analysis. The first step in the analysis involved simulation of baseline conditions. Baseline conditions represent existing nonpoint source loading and SSO conditions. The existing load for the listed segments is represented as the sum of the daily discharge load of the direct nonpoint sources, the SSOs, and the daily indirect load from all land uses (e.g., surface runoff) for 2001. The baseline conditions allow for an evaluation of in-stream water quality under critical conditions.

The model was run for baseline conditions from January 1, 2000 through December 31, 2001. Predicted concentrations of fecal coliform for the listed waterbodies and their tributaries were compared directly to the TMDL endpoints. This comparison allowed evaluation of the expected magnitude and frequency of exceedance under a range of hydrologic and environmental conditions, including dry, wet, and average conditions.

5.3 TMDLs and Source Allocations

A top-down methodology was followed to develop the TMDLs and allocate loads to sources. Tributaries to Dog River, including Rabbit Creek, were assessed for potential impacts of loading on water quality in the tidally-influenced listed segments. Loading contributions were reduced from applicable sources for these waterbodies and TMDLs were developed.

Evaluation of the net impact of the sanitary sewer overflows on fecal coliform was first evaluated by removing them from the system. Projected nonpoint source runoff was also reduced to eliminate short-term violations of the instantaneous WQC. Further reductions to the estimated steady sources of fecal coliform, represented by failing septic systems, were necessary to reduce the geometric mean concentrations in watershed tributaries to within compliance of the 100 counts/100ml WQC (Figures 5-1 and 5-2).

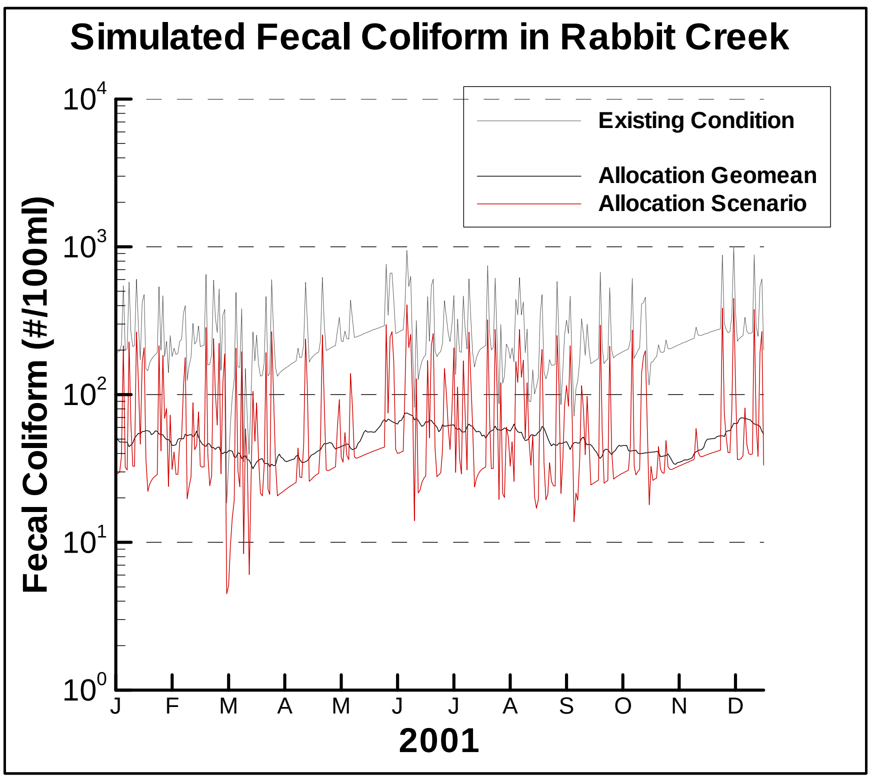

Figure 5-1 Existing condition and allocation scenario for Rabbit Creek

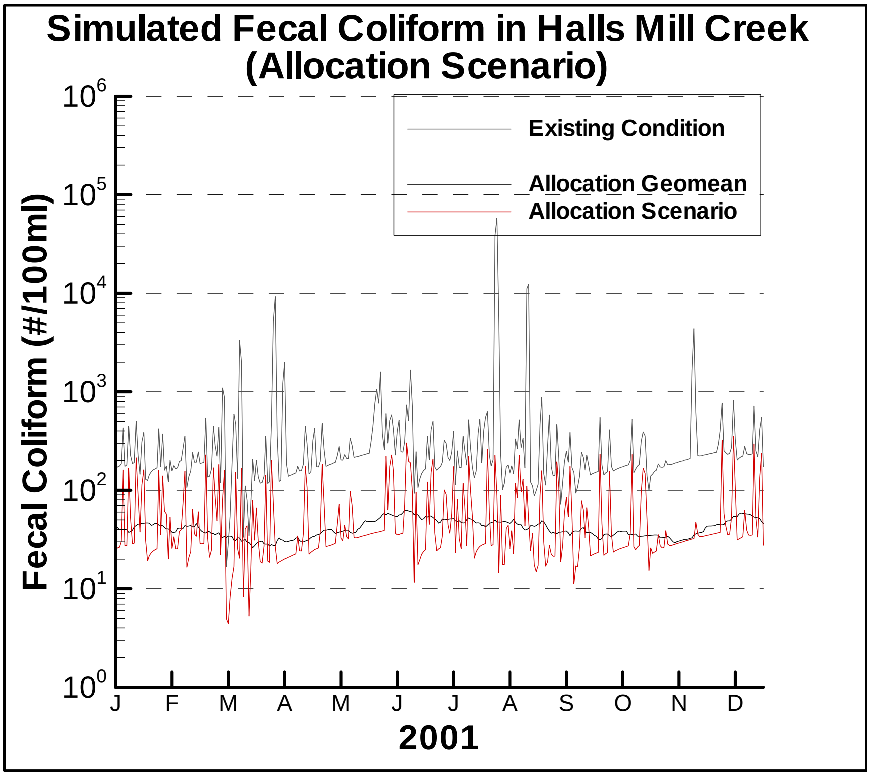

Figure 5-2 Existing condition and allocation scenario for Halls Mill Creek

5.4 Wasteload Allocations (WLAs)

As discussed in Section 3.2.2, there are no permitted point source discharges of fecal coliform bacteria within the Dog River watershed, although MAWSS sanitary sewer collection system has experienced frequent failures and requires corrective action.

Since the contribution of fecal coliform loads discharged from the MS4 system described in the NPDES Phase I Stormwater MS4 permit for the Mobile area cannot at present be discerned from either SSOs or nonpoint source runoff, the WLAs for Dog River and Rabbit Creek are implicit based on compliance with the applicable water quality criteria for fecal coliform. Necessary reductions in land-surface runoff of fecal coliform that may be conveyed through such an MS4 system are addressed in the load allocation.

5.5 Load Allocation (LA)

The loading reductions necessary to meet the TMDL were achieved by eliminating sewer overflows from the modeling scenario, reducing the estimated failing septic load by 50 percent, and reducing the amount of nonpoint source fecal coliform runoff by 50 percent.

Since the majority of exceedences of the instantaneous water quality criterion of 2000 counts/100ml occurred as a result of the overflows, the instantaneous criterion was not violated when no overflows occurred.

Steady high concentrations of fecal coliform in Rabbit Creek and Halls Mill Creek indicate that failing septic systems or other constant sources are responsible for frequent violations of the 100 counts/100ml geometric mean standard. 50 percent reductions in estimated septic discharge reduced the geometric mean to within compliance.

5.6 TMDL Results

The TMDL is the maximum allowable fecal coliform load to the listed segments under critical conditions that will not exceed the designated endpoint. Since the applicable water quality criteria require that fecal coliform concentrations may not exceed a geometric mean of 100 counts/100ml based on at least five samples within a 30-day period, these TMDLs are presented as 30-day geometric mean loads based on the total tributary inflows that occurred during the critical condition (7/21/2001-8/19/2001).

Since no continuous streamflow gauge has been operational in the watershed since 1983, the tributary flows were predicted using a watershed model calibrated to nearby Eightmile Creek, as described in Section 4.1. Predicted total tributary inflows to Rabbit Creek and Dog River are shown in Figure 5-3.

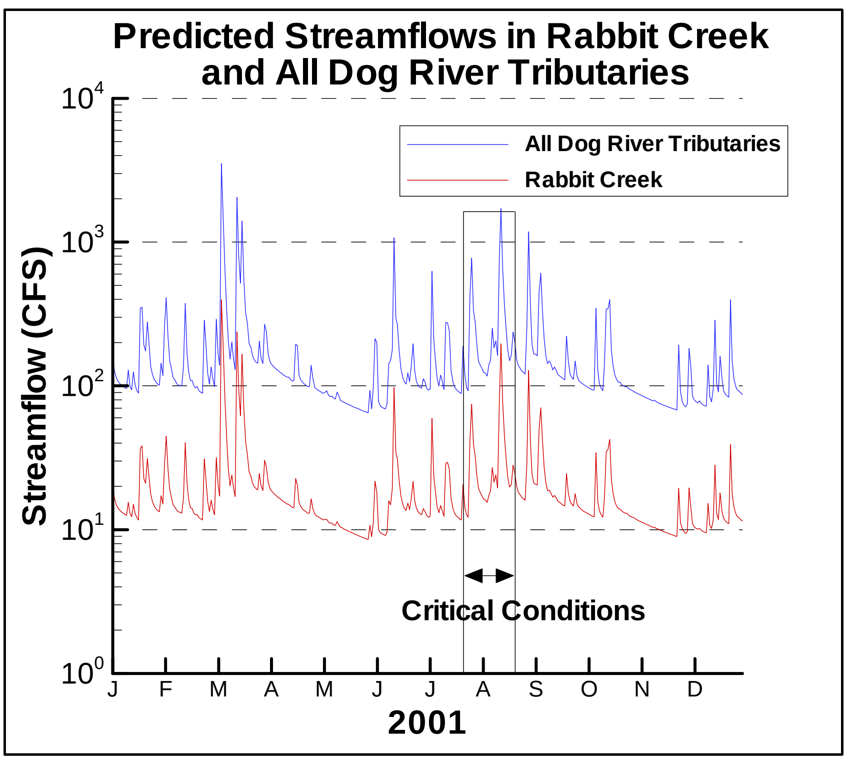

Figure 5-3. Predicted watershed streamflows in Rabbit Creek and Dog River

The TMDLs were calculated to be the load that would occur in the critical condition concurrent with the flows during that 30-day period, if the fecal coliform concentration were equal to the water quality endpoint. Table 5-1 shows the TMDLs based on the total tributary streamflows in the critical period. Overall reductions necessary to comply with the TMDL are listed in Table 5-2. Reductions that are predicted to meet the TMDL have been allocated to the source categories as shown in Table 5-3.

Table 5-1. Total Maximum Daily Loads of fecal coliform in the listed segments of Dog River and Rabbit Creek (7/21/2001-8/19/2001)

Impaired Segment	TMDL (counts/ day)	Direct WLA (% reduction)	MS4 WLA (% reduction)	LA (% reduction)
Rabbit Creek	8.3×10^{10}	0%	54%	54%
Dog River	7.2×10^{11}	0%	83%	83%

Table 5-2. Existing loads of fecal coliform and necessary percent reductions

Impaired Segment	30-Day Average Flow (CFS)	Existing 30-Day Geometric Mean Concentration (counts/100ml)	Existing Load (counts/day)	TMDL (counts/ day)	Percent Reduction
Rabbit Creek	34	214	1.8×10^{11}	8.3×10^{10}	54%
Dog River	295	591	4.3×10^{12}	7.2×10^{11}	83%

Table 5-3 Allocations necessary to meet the TMDL by source category

Impaired Segment	Overflows	Other Direct Sources*	Urban Nonpoint Source Runoff
Rabbit Creek	100%	85%	50%
Dog River	100%	85%	50%

* Direct sources may include failing septic tanks or unknown persistent sources

6.0 TMDL Implementation

6.1 Non-Point Source Approach

The Dog River watershed is impaired by nonpoint sources and sanitary sewer overflows. For 303(d) listed waters impaired by nonpoint source (NPS) pollutants, necessary reductions will be sought during TMDL implementation using a phased approach. Voluntary, incentive-based mechanisms will be used to implement NPS management measures in order to assure that measurable reductions in pollutant loadings can be achieved for the targeted impaired waters. Cooperation and active participation by the general public and various industry, business, and environmental groups is critical to successful implementation of TMDLs. Local citizen-led and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. Therefore, TMDL implementation activities will be coordinated through interaction with local entities in conjunction with Clean Water Partnership efforts.

The primary TMDL implementation mechanism used will employ concurrent education and outreach, training, technology transfer, and technical assistance with incentive-based pollutant management measures. The State and local governments will take the primary lead in the TMDL implementation. The ADEM Office of Education and Outreach (OEO) will assist in the implementation of TMDLs in cooperation with public and private stakeholders. Planning and oversight will be provided by or coordinated with the ADEM's Section 319 nonpoint source grant program in conjunction with other local, state, and federal resource management and protection programs and authorities. The CWA Section 319 grant program may provide limited funding to specifically ascertain NPS pollution sources and causes, identify and coordinate management programs and resources, present education and outreach opportunities, promote pollution prevention, and implement needed management measures to restore impaired waters.

Depending on the pollutant of concern, resources for corrective actions may be provided, as applicable, by the Alabama Cooperative Extension System (education and outreach); the USDA-Natural Resources Conservation Service (NRCS) (technical assistance) and Farm Services Agency (FSA) (federal cost-share funding); and the Alabama Soil and Water Conservation Committee (state agricultural cost share funding and management measure implementation assistance) through local Soil and Water Conservation Districts, or Resource Conservation and Development Councils (funding, project implementation, and coordination). Additional assistance from such agencies as the Alabama Department of Public Health (septic systems), Alabama Department of Agriculture and Industries, and the Alabama Department of Industrial Relations and Dept of Interior - Office of Surface Mining (abandoned minelands), Natural Heritage Program and US Fish and Wildlife Service (threatened and endangered species), may also provide practical TMDL implementation delivery systems, programs, and information. Land use and urban sprawl issues will be addressed through the Nonpoint Education Source for Municipal Officials

(NEMO) outreach program. Memorandums of Agreement (MOAs) may be used as a tool to formally define roles and responsibilities.

Additional public/private assistance is available through the Alabama Clean Water Partnership Program (CWP). The CWP program uses a local citizen-based environmental protection approach to coordinate efforts to restore and protect the state's resources in accordance with the goals of the Clean Water Act. Interaction with the state or river basin specific CWP will facilitate TMDL implementation by providing improved and timely communication and information exchange between community-based groups, units of government, industry, special interest groups, and individuals. The CWP can assist local entities to plan, develop, and coordinate restoration strategies that holistically meet multiple needs, eliminate duplication of efforts, and allow for effective and efficient use of available resources to restore the impaired waterbody or watershed.

Other mechanisms that are available and may be used during implementation of this TMDL include local regulations or ordinances related to zoning, land use, or storm water runoff controls. Local governments can provide funding assistance through general revenues, bond issuance, special taxes, utility fees, and impact fees. If applicable, reductions from point sources will be addressed by the NPDES permit program. The Alabama Water Pollution Control Act empowers ADEM to monitor water quality, issue permits, conduct inspections, and pursue enforcement of discharge activities and conditions that threaten water quality. In addition to traditional "end-of-pipe" discharges, the ADEM NPDES permit program addresses animal feeding operations and land application of animal wastes. For certain water quality improvement projects, the State Clean Water Revolving Fund (SRF) can provide low interest loans to local governments.

Long-term physical, chemical, and biological improvements in water quality will be used to measure TMDL implementation success. As may be indicated by further evaluation of stream water quality, the effectiveness of implemented management measures may necessitate revisions of this TMDL. ADEM will continue to monitor water quality according to the rotational river basin monitoring schedule as resources allow. In addition, assessments may include local citizen-volunteer monitoring through the Alabama Water Watch Program and/or data collected by agencies, universities, or other entities using standardized monitoring and assessment methodologies. Core management measures will include, but not be limited to: water quality improvements and designated use support, preserving and enhancing public health, enhancing ecosystems, pollution prevention and load reductions, implementation of NPS controls, and public awareness and attitude/behavior changes.

6.2 Point Source Approach

Point source reductions to meet the TMDLs for the Dog River watershed should begin with full compliance with the MAWSS Consent Decree to reduce SSOs (Consent Decree 2002). In the first quarter of 2002, MAWSS began development of programs outlined in the Consent Decree (MAWSS 2002). These programs require MAWSS to identify and repair leaky sewer connections, provide service to low-income areas, and perform water quality monitoring.

MAWSS has proposed methods to determine wastewater collection and transmission capacity. Plans are being developed to convey flows from the Ziebach Wastewater Collection System and future customers in the Dog River watershed to the Williams WWTP. These plans include modifications to the Perch Creek Pump Station, a new force and lift station to take the Ziebach Wastewater Treatment Plant out of service.

A hydraulic model of the sewer basins served by MAWSS is being developed to determine the capacity of collection systems and what is require for future growth. New development may be limited until capacity assessments have been finalized for wastewater collection and treatment systems.

Preventative maintenance and rehabilitation to collection systems to decrease the occurrence of SSOs is already underway. Sewer lines are cleaned after overflows and the cause for failure is noted. A public service announcement to educate the public on proper grease disposal has aired on television. Force mains are to be simulated to predict the locations of air pockets. Levels of hydrogen sulfide are being measured at lift stations and manholes as a part of the Corrosion Control Program. The equipment on pump stations is also being inspected for preventative maintenance.

MAWSS has contracted with TAI Environmental Services to implement a water quality assessment program. This program includes routine monitoring of Halls Mill Creek and Eslava Creek in the Dog River Watershed. Monitoring will also be performed to determine unknown sources of pollution and the impact of unpermitted discharges to receiving waters.

A long-term plan is being developed for a regional WWTP to provide service for the Cities of Mobile, Prichard, Chickasaw, and Saraland. The goal of this plan is to reduce the number of discharges and provide for growth over the next 50 years.

Final compliance of the Consent Decree, Civil Action 02-0058-CB-S, is September 2007 (Consent Decree 2002). Implementation of programs outlined in the Consent Decree should decrease pathogen loads in the Dog River watershed.

6.3 MS4 Considerations

A large area in Mobile and Baldwin Counties has been issued an MS4 Phase I Stormwater permit (NPDES ALS000002). According to NPDES Permit No. ALS000002, the Mobile Area MS4 permit area is defined below.

"This permit covers all areas within the corporate boundaries of Mobile and Baldwin Counties that were designated by the Department [ADEM] and all municipalities named as permittees. The designated area in Mobile and Baldwin Counties are as follows:

The portion of Mobile County designated as part of the Greater Mobile Area Storm Sewer System consists of all unincorporated areas of Mobile County within the boundaries defined as: beginning as the mouth of the south fork Deer River and extending west to southwest corner of Section 18, Township 6 South, Range 2 West, then north to northwest corner, Section 6, Township 2 South, Range 2 West, then east to the Mobile County line, then south along county line to U.S. Highway 90 bridge."

In the MS4 service area, pollutant loads which could include urban runoff and/or failing septic systems are considered in the Load Allocations. Unregulated sources such as illicit discharges and sanitary sewer overflows have a 100% reduction and are not considered part of the Wasteload Allocations or Load Allocations.

6.4 T&E Documented Species

The United States Fish and Wildlife Service have documented the endangered Florida manatee (*Trichechus manatus latirostris*) and the endangered Alabama redbelly turtle (*Pseudemys alabamensis*) in Dog River. Also, the threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*) may occur in Dog River. The TMDLs proposed for Dog River are organic enrichment and low dissolved oxygen in a separate document and pathogens in this document. The manatee and turtle are air-breathing vegetarians, so it is doubtful that they would be directly affected by organic enrichment or low dissolved oxygen. However, pathogens may affect these species, particularly if their immune systems are compromised or they are injured. The Gulf sturgeon is a bottom dwelling species that is probably used to some degree of low dissolved oxygen. It may also be affected by pathogens in certain circumstances. The Alabama redbelly turtle has been found at the mouth of Rabbit Creek. The Florida manatee and the Gulf sturgeon may occur in Rabbit Creek.

7.0 Follow Up Monitoring

ADEM has adopted a basin approach to water quality management; an approach that divides Alabama’s fourteen major river basins into five groups. Each year, the ADEM water quality resources are concentrated in one of the basin groups. One goal is to continue to monitor §303(d) listed waters. This monitoring will occur in each basin according to the schedule in Table 7-1. The Dog River and Rabbit Creek watersheds are located in the Mobile basin group.

Table 7-1. Monitoring Schedule for Alabama River Basins

River Basin Group	Scheduled Year
Cahaba and Black Warrior	2002
Tennessee	2003
Choctawhatchee, Chipola, Perdido-Escambia & Chattahoochee	2004
Tallapoosa, Alabama and Coosa	2005
Escatawpa, Upper Tombigbee, Lower Tombigbee and Mobile	2006

Monitoring will help further characterize water quality conditions resulting from the abatement of SSOs and implementation of best management practices in the watershed.

8.0 Public Participation

As part of the public participation process, a public notice/review period was provided for the subject TMDLs. Any additional information supporting the TMDLs was made available to the public upon request. The public was invited to provide comments on the draft TMDL. Based on public comments received during the public notice period, appropriate revisions were made and the TMDLs were finalized March 2005.

Appendix 9.1 - References

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Appendix 9.2 - Bacteria Monitoring Stations

Table 9.1 Water Quality Sampling Stations

Year	Station	Stream Section	Road Crossing	Latitude	Longitude	Duplicity
Long Term Monitoring (1978-1999 & 2001)	DR-001	Dog River	Luscher Park	30.62861	-88.1014	
1993	HMC-93	Halls Mill	near Point Rd.	30.59683	-88.12693	
1993	EC1-93	Eslava Creek	Holcombe Ave	30.66378	-88.09272	
1993	EC2-93	Eslava Creek	I-10	30.63595	-88.09579	
1993	RB1-93	Robinson Bayou	near Pickell Dr.	30.61016	-88.08289	
1993	MC1-93	Moore Creek	Lipscombs Landing	30.61778	-88.12538	
1993	MC2-93	Moore Creek	Linksman Golf Course	30.61243	-88.11598	
1993	HMC1-93	Halls Mill	500 meters Upstream of Dog River	30.59415	-88.12526	
1993	HMC2-93	Halls Mill	I-10	30.60508	-88.14938	
1993	RC1-93	Rabbit Creek	Upstream Rangeline Rd.	30.57143	-88.13852	
1993	RC2-93	Rabbit Creek	200 meters Upstream of Dog River	30.5892	-88.12333	
1993	RSB-93	Rattlesnake Bayou	Upstream Rangeline Rd.	30.58382	-88.14403	
1993	ECSA-93	Eslava Creek	Sage Ave	30.67371	-88.1145	
1993	ECPH-93	Eslava Creek	Pinehill Drive	30.67	-88.09698	
1993	ECMV-93	Eslava Creek	McVay Drive	30.64367	-88.09682	same as 6005004
1993	BBHM-93	Bolton Branch	Halls Mill Rd.	30.6514	-88.10622	
1993	BBN-93	Bolton Branch	Navco Rd.	30.64486	-88.10264	same as 6005018
1993	BBMV-93	Bolton Branch	McVay Drive	30.64572	-88.10295	
1993	BBT1-93	Bolton Branch	Halls Mill Rd.	30.64529	-88.1122	
1993	HMD-93	Halls Mill	Demotropolis Rd	30.60606	-88.15687	same as 6005010
1993	HMHM-93	Halls Mill	Halls Mill Rd.	30.60683	-88.16015	same as 6005009
1993	MCPV-93	Montlimar Creek	Pleasant Valley Rd.	30.6614	-88.13153	
1993	MCHM-93	Moore Creek	Halls Mill Rd.	30.62674	-88.13611	
1993	MCLL-93	Moore Creek	Lloyd's Landing	30.61952	-88.1277	
1999	6005004	Eslava Creek	McVay Drive	30.643717	-88.096817	same as ECMV-93
1999	6005010	Halls Mill	Demotropolis Rd	30.606017	-88.15705	same as HMD-93
1999	6005009	Halls Mill	Halls Mill Rd.	30.607133	-88.16005	same as HMHM-93
1999	6005003	Montlimar Creek	Azalea Rd.	30.628433	-88.135233	
1999	6005002	Moore Creek	Halls Mill Rd.	30.627367	-88.136967	
1999	6005001	Spring Creek	Halls Mill Rd.	30.613133	-88.15435	

Table 9-1 (continued)

Year	Station	Stream Section	Road Crossing	Latitude	Longitude	Duplicity
2000	ALBA	Dog River	ALBA Club	30.586666	-88.106667	
2000	6005018	Bolton Branch	Navco Rd.	30.64568	-88.10298	
2000	6005020	Dog River	near Timberlane Rd.	30.5687	-88.0976	
2000	6005004	Eslava Creek	McVay Drive	30.643717	-88.096817	same as ECMV-93
2000	6005010	Halls Mill	Demotropolis Rd	30.606017	-88.15705	same as HMD-93
2000	6005009	Halls Mill	Halls Mill Rd.	30.607133	-88.16005	same as HMHM-93
2000	6005003	Montlimar Creek	Azalea Rd.	30.628433	-88.135233	
2000	6005002	Moore Creek	Halls Mill Rd.	30.627367	-88.136967	
2000	6005029	Perch Creek	McNalley Park	30.582467	-88.077033	
2000	6005017	Rabbit Creek	Carol Plantation Rd.	30.55877	-88.181	same as RBTM-003
2000	6005001	Spring Creek	Halls Mill Rd.	30.613133	-88.15435	
2000	6005011	Halls Mill	Cypress Shores	30.6031	-88.131983	
2001	RBTM-001	Rabbit Creek	Al Hwy 193	30.573	-88.1348	
2001	RBTM-001A	Rabbit Creek	Hwy 90	30.559066	-88.1729666	
2001	RBTM-002	Rabbit Creek	Todd Acres Rd.	30.56156	-88.1607	
2001	RBTM-003	Rabbit Creek	Carol Plantation Rd.	30.55877	-88.181	same as 6005017
2001	RBTM-004	Rabbit Creek	Old Pascagoula Rd.	30.57326	-88.1933	
2001	ALBA	Dog River	ALBA Club	30.586666	-88.106667	
2001	DGRM-1	Dog River	Al Hwy 163	30.56493	-8808765	
2001	DGRM-2	Dog River	near Riverside Dr.	30.61175	-88.08965	
2001	6005018	Bolton Branch	Navco Rd.	30.64568	-88.10298	
2001	6005020	Dog River	near Timberlane Rd.	30.5687	-88.0976	
2001	6005004	Eslava Creek	McVay Drive	30.643717	-88.096817	same as ECMV-93
2001	6005010	Halls Mill	Demotropolis Rd	30.606017	-88.15705	same as HMD-93
2001	6005009	Halls Mill	Halls Mill Rd.	30.607133	-88.16005	same as HMHM-93
2001	6005030	Milkhouse Creek	Cottage Hill	30.639967	-88.200867	
2001	6005003	Montlimar Creek	Azalea Rd.	30.628433	-88.135233	
2001	6005002	Moore Creek	Halls Mill Rd.	30.627367	-88.136967	
2001	6005029	Perch Creek	McNalley Park	30.582467	-88.077033	
2001	6005017	Rabbit Creek	Carol Plantation Rd.	30.55877	-88.181	same as RBTM-003
2001	6005001	Spring Creek	Halls Mill Rd.	30.613133	-88.15435	

Table 9.1 (continued)

Year	Station	Stream Section	Road Crossing	Latitude	Longitude	Duplicity
2002	ALBA	Dog River	ALBA Club	30.586666	-88.106667	
2002	6005018	Bolton Branch	Navco Rd.	30.64568	-88.10298	
2002	6005004	Eslava Creek	McVay Drive	30.643717	-88.096817	same as ECMV-93
2002	6005030	Milkhouse Creek	Cottage Hill	30.639967	-88.200867	
2002	6005003	Montlimar Creek	Azalea Rd.	30.628433	-88.135233	
2002	6005002	Moore Creek	Halls Mill Rd.	30.627367	-88.136967	
2002	6005029	Perch Creek	McNalley Park	30.582467	-88.077033	
2002	6005017	Rabbit Creek	Carol Plantation Rd.	30.55877	-88.181	same as RBTM-003
2002	6005001	Spring Creek	Halls Mill Rd.	30.613133	-88.15435	

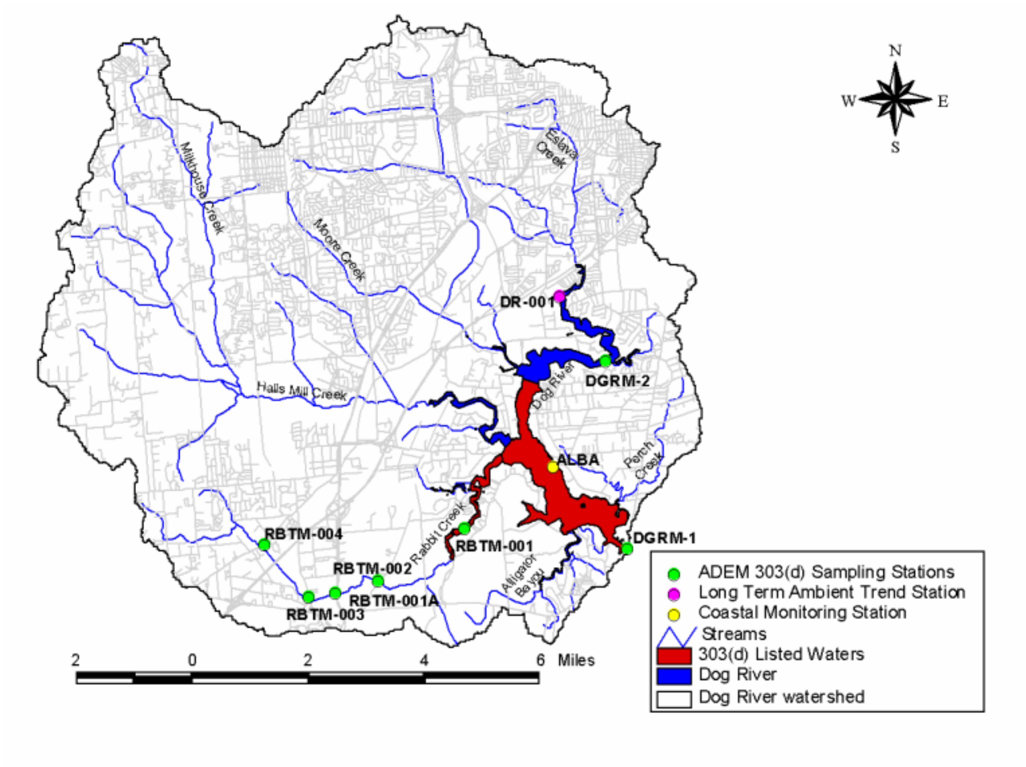


Figure 9-1 ADEM Bacteria Sampling Stations

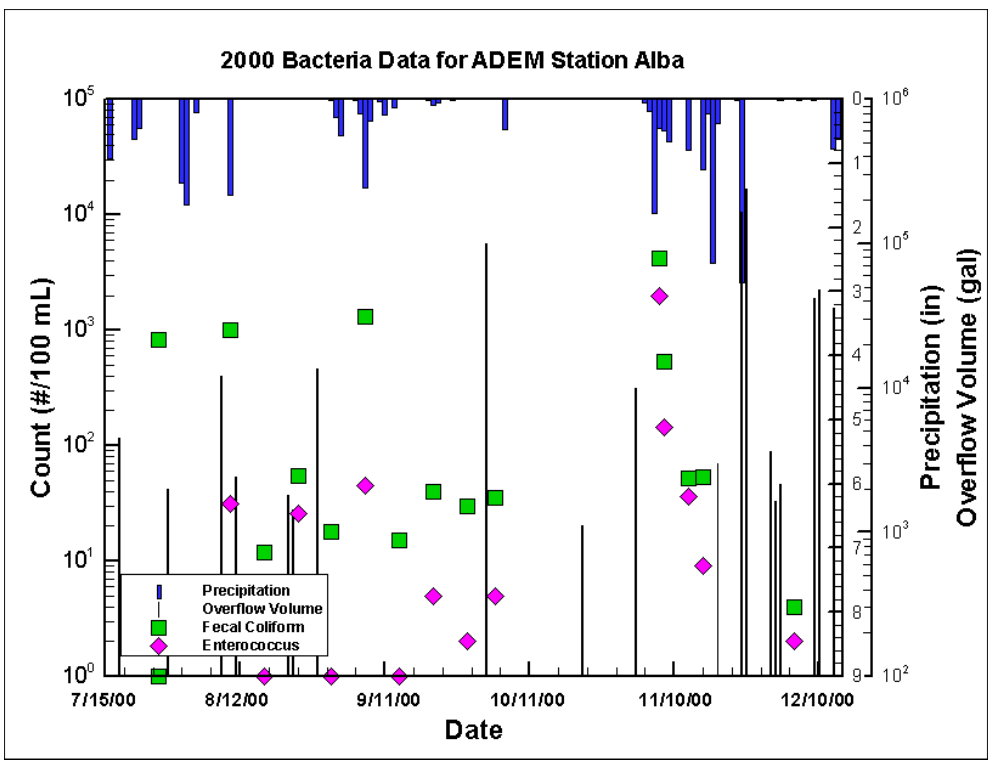


Figure 9-2. 2000 Bacteria data collected for the Beach Monitoring Program at Alba

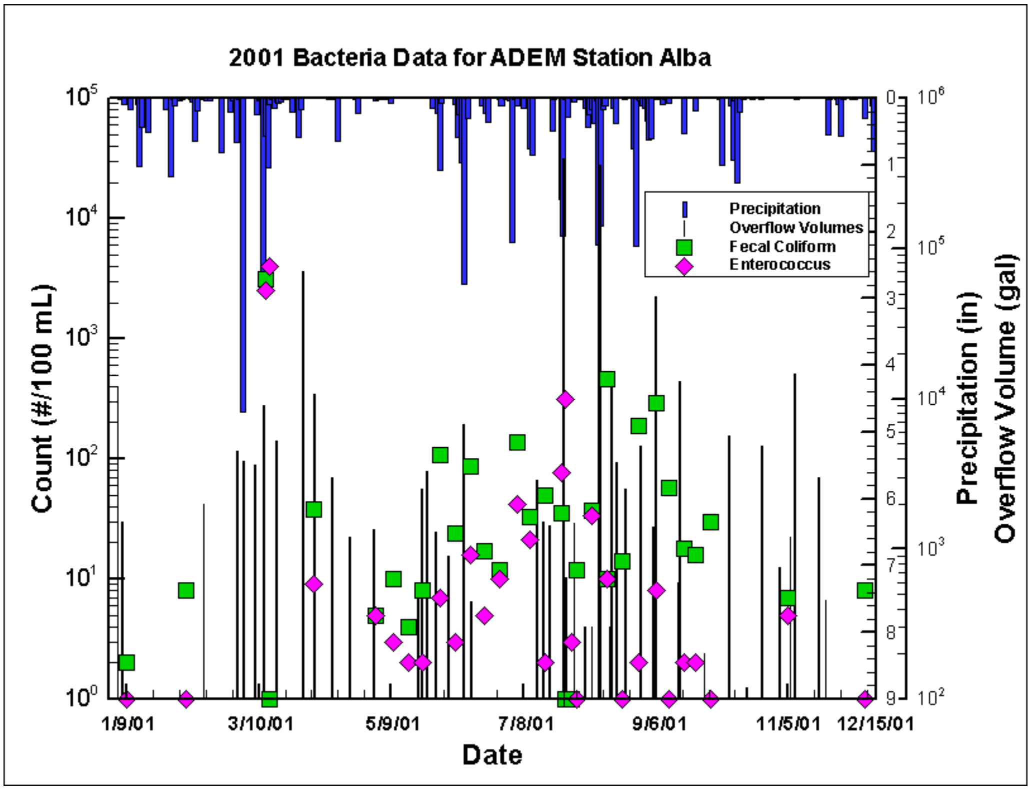
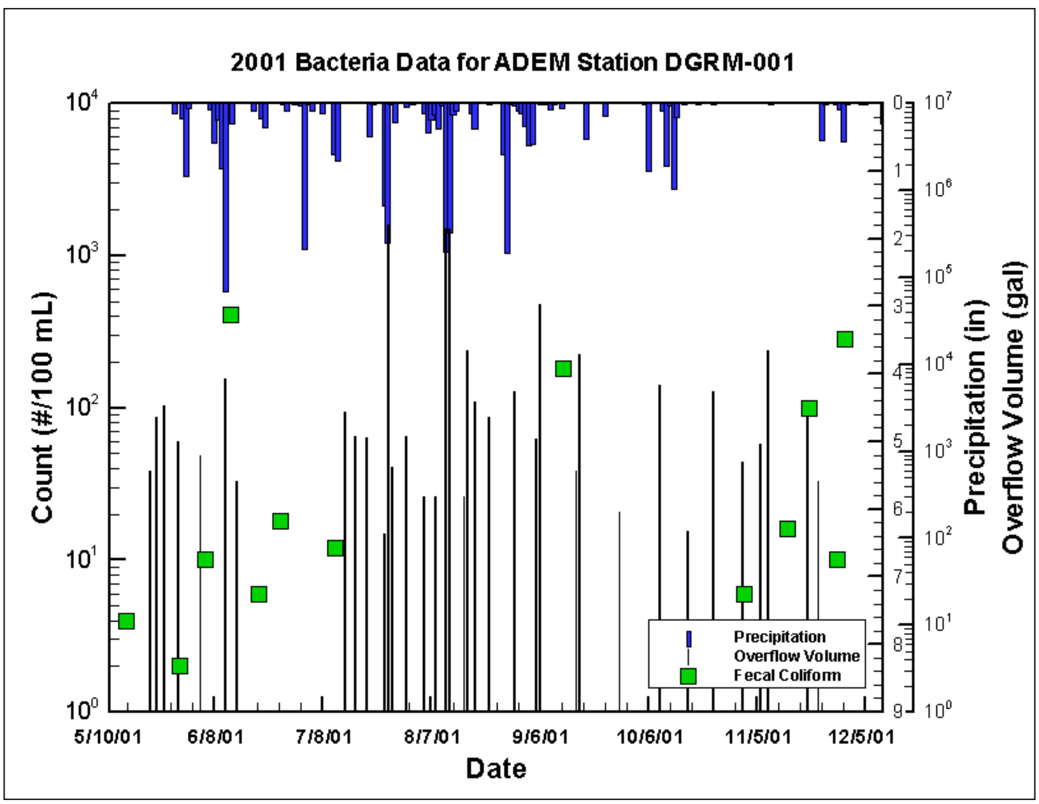


Figure 9-3. 2001 Bacteria data collected for the Beach Monitoring Program at Alba



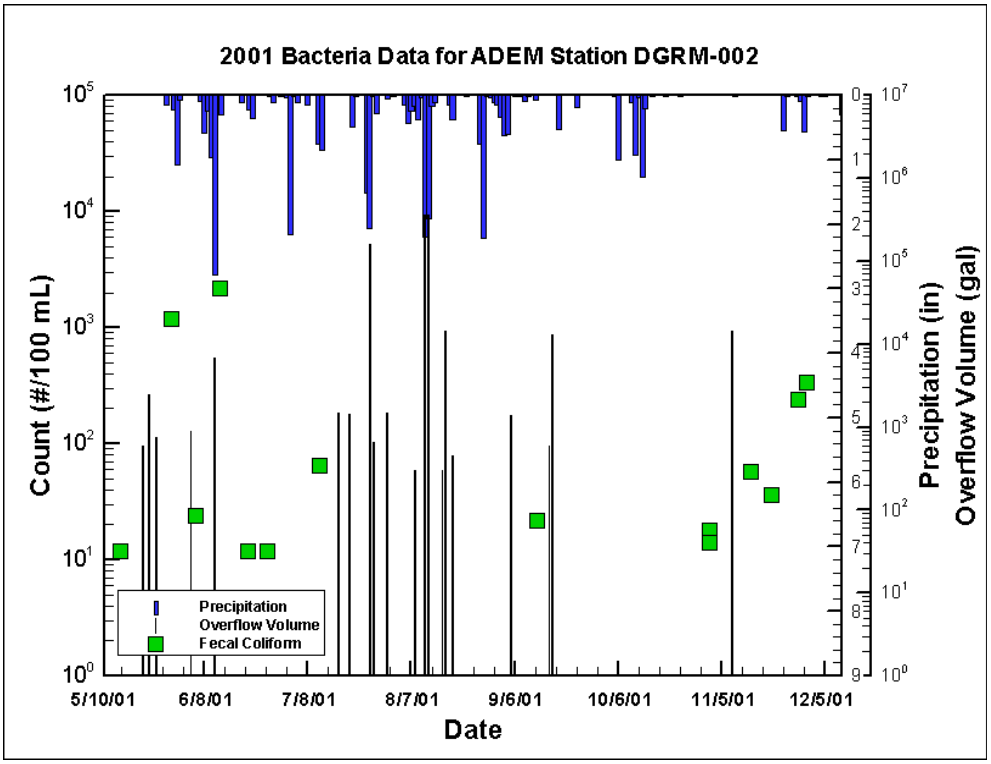


Figure 9-4. 2001 Bacteria data collected on Dog River at AL Hwy. 163

Fig

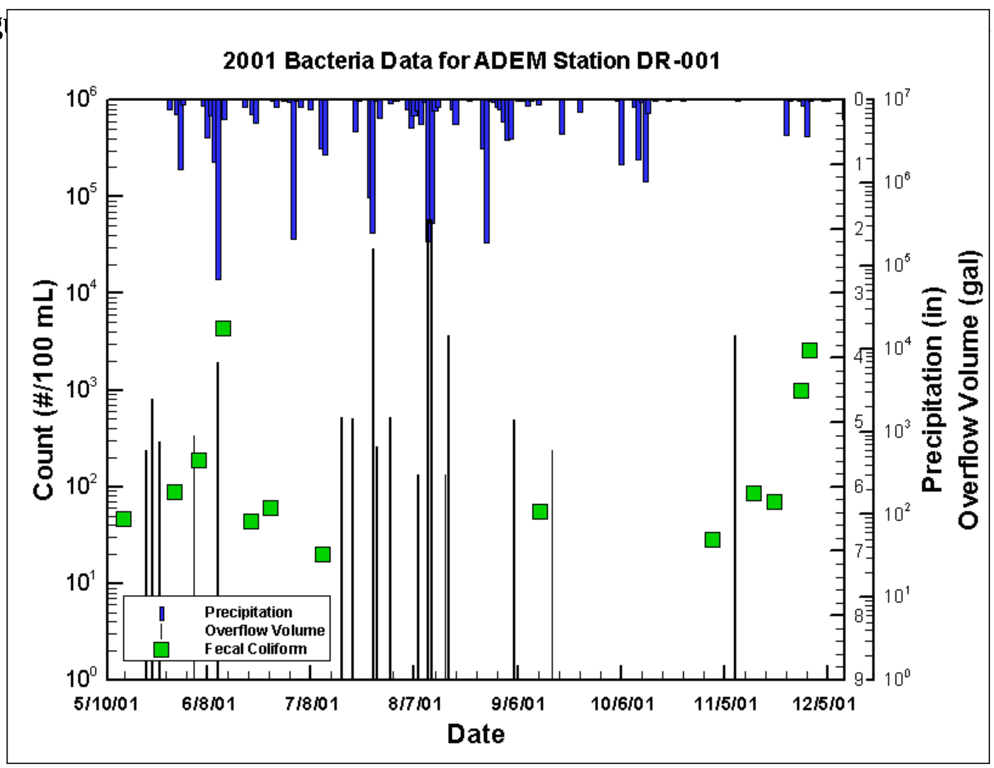

2001 Bacteria Data for ADEM Station DR-001
Count (#/100 mL)
Precipitation (in)
Overflow Volume (gal)
Date
5/10/01
6/8/01
7/8/01
8/7/01
9/6/01
10/6/01
11/5/01
12/5/01
Precipitation
Overflow Volume
Fecal Coliform

Figure 9-6. 2001 Bacteria data collected on Dog River at Luscher Park

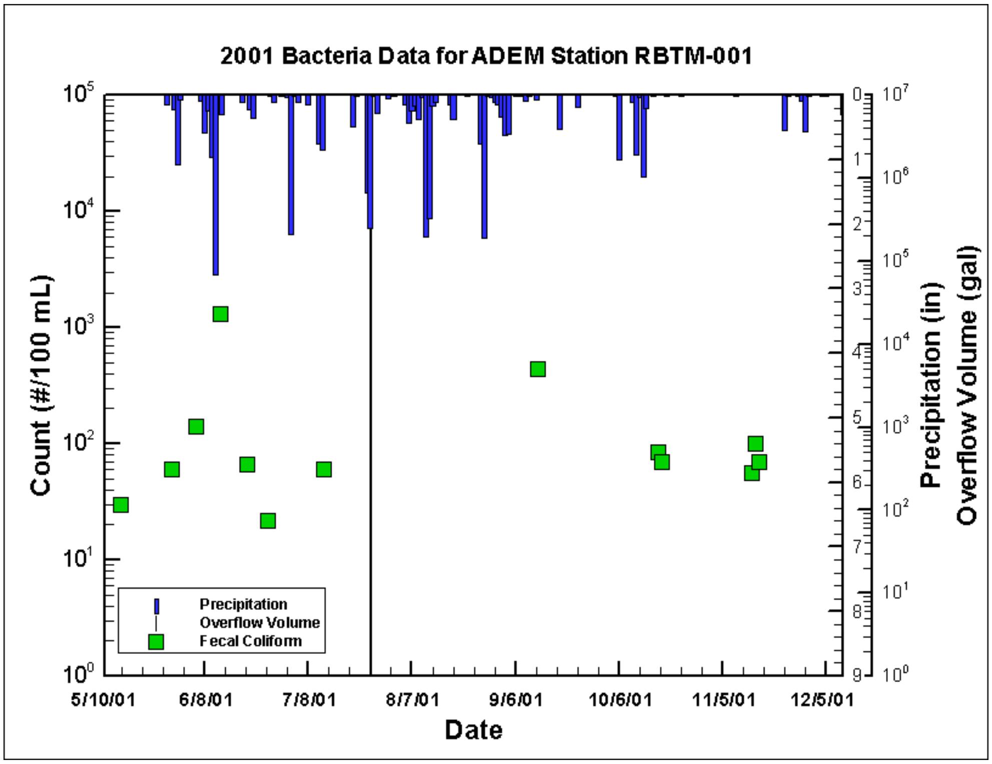


Figure 9-7. 2001 Bacteria Data collected on Rabbit Creek at AL Hwy 193.

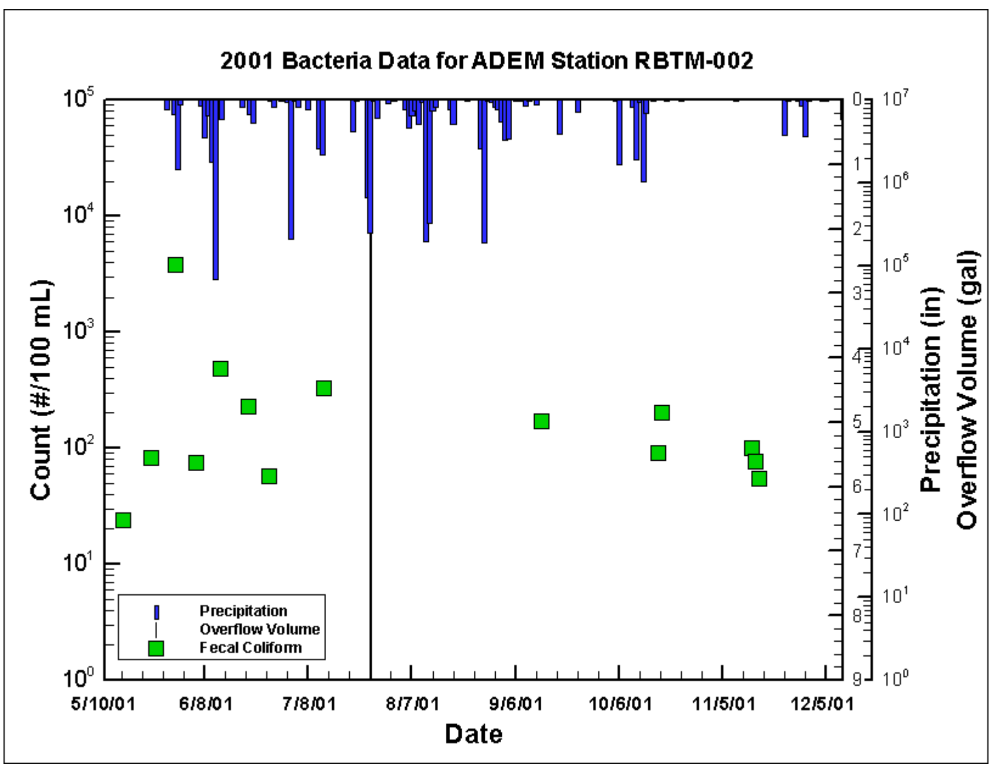


Figure 9-8. 2001 Bacteria Data collected on Rabbit Creek at Todd Acres Rd.

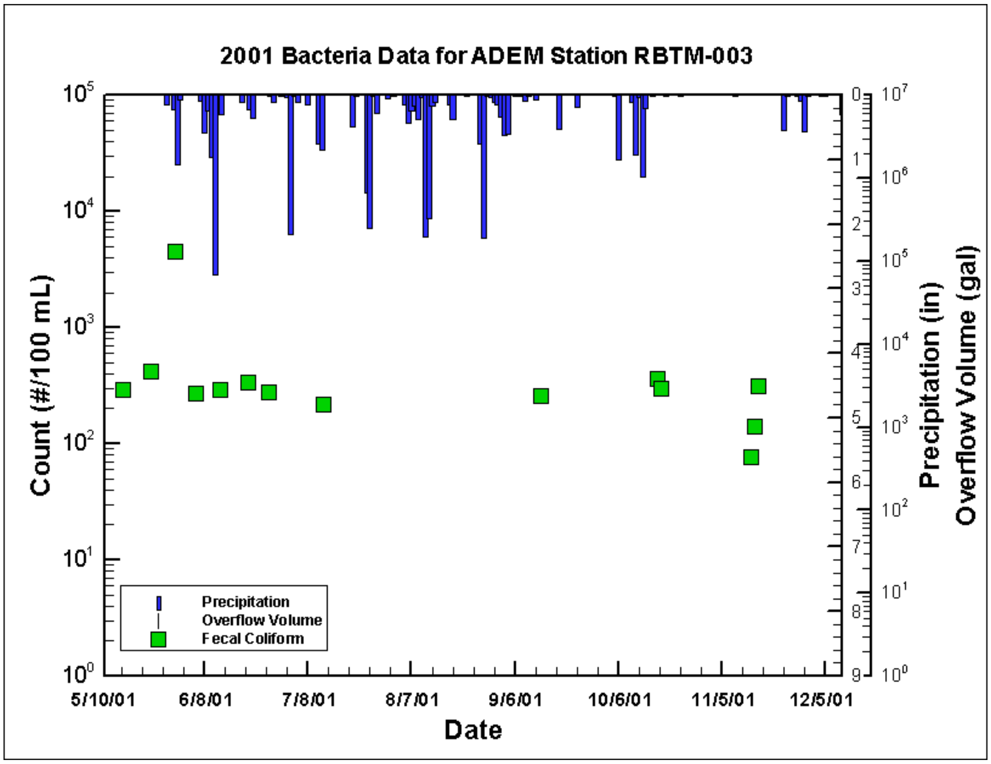


Figure 9-9. 2001 Bacteria data collected on Rabbit Creek at Carol Plantation Rd.

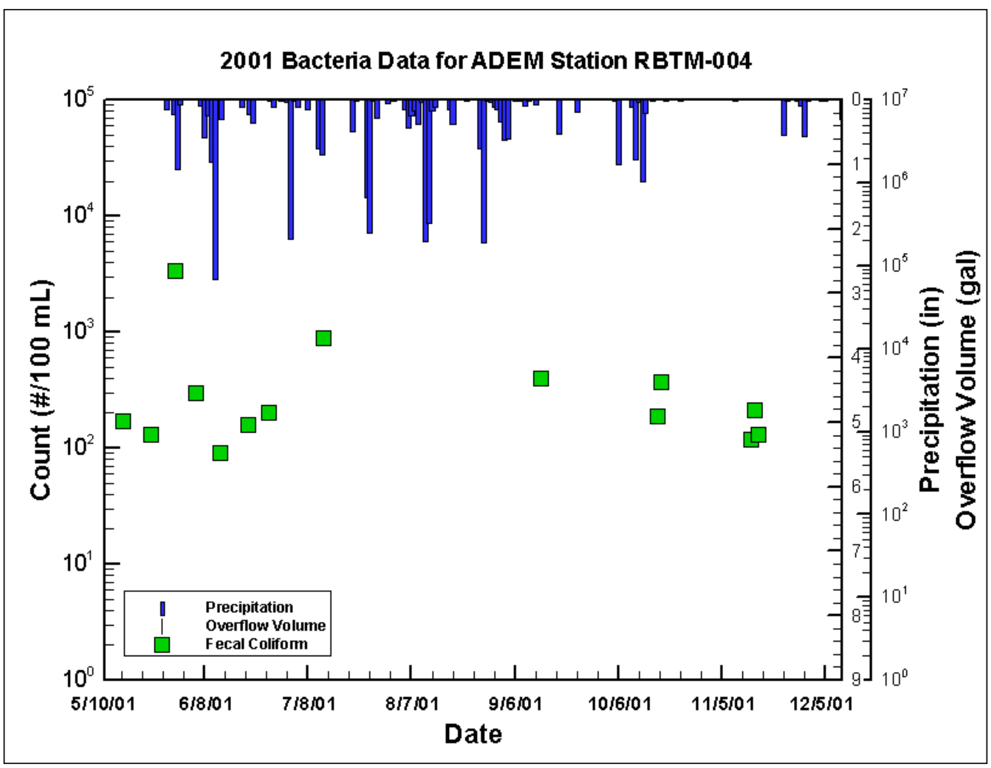


Figure 9-10. 2001 Bacteria data collected on Rabbit Creek at Old Pascagoula Rd.

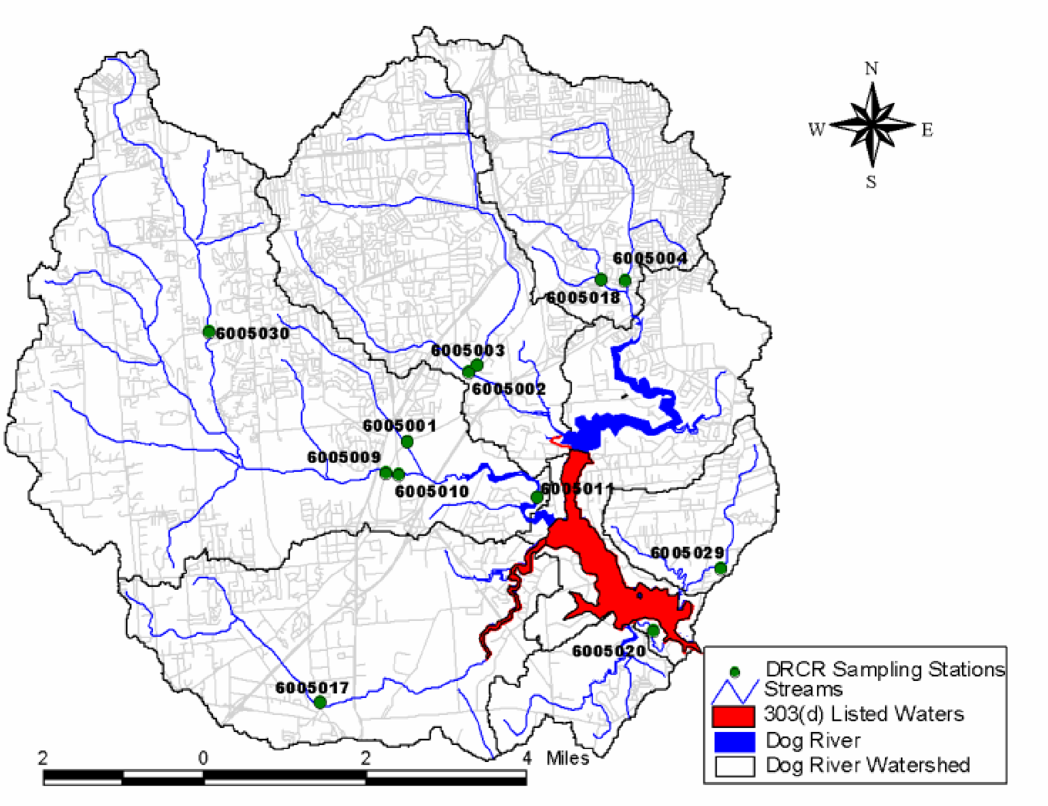


Figure 9-11. Dog River Clearwater Revival Bacteria Sampling Stations

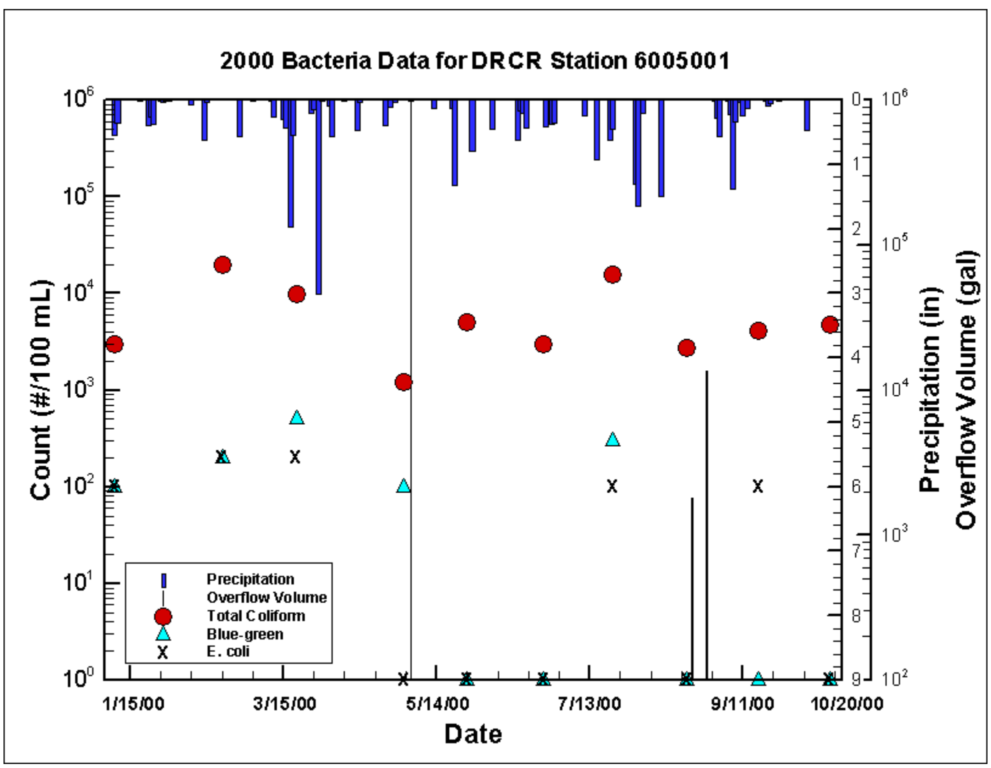


Figure 9-12. DRCR Bacteria Sampling Station on Spring Creek at Halls Mill

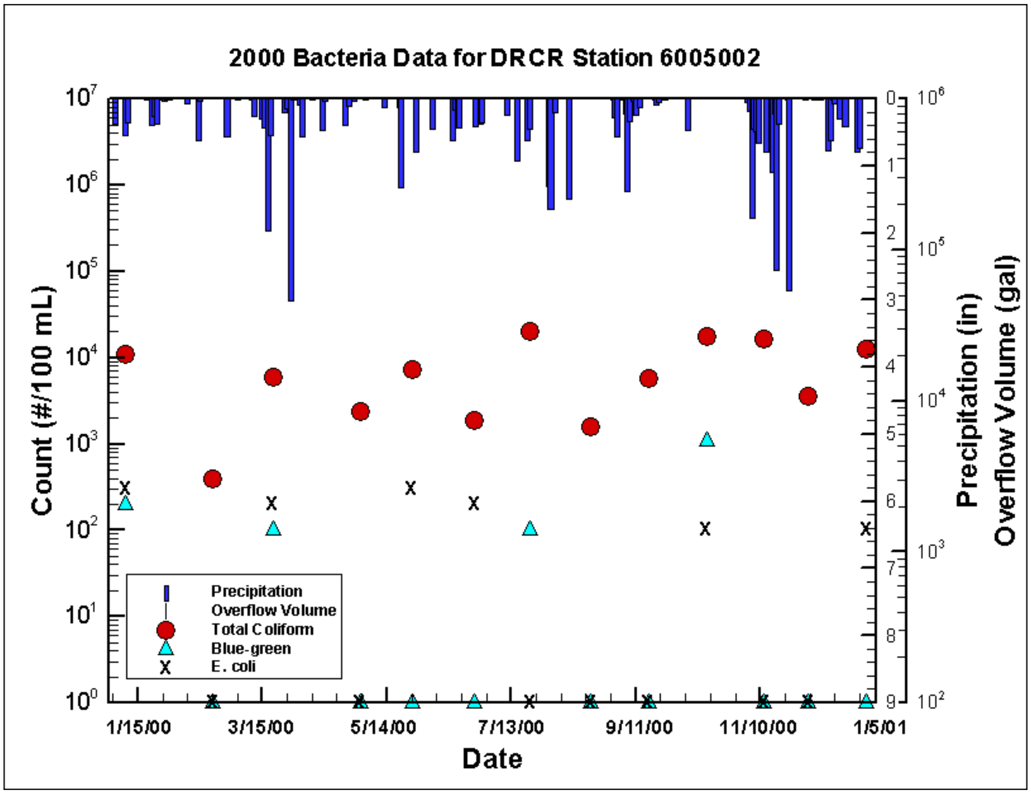


Figure 9-13. DRCR Bacteria Sampling Station on Moore Creek at Halls Mill

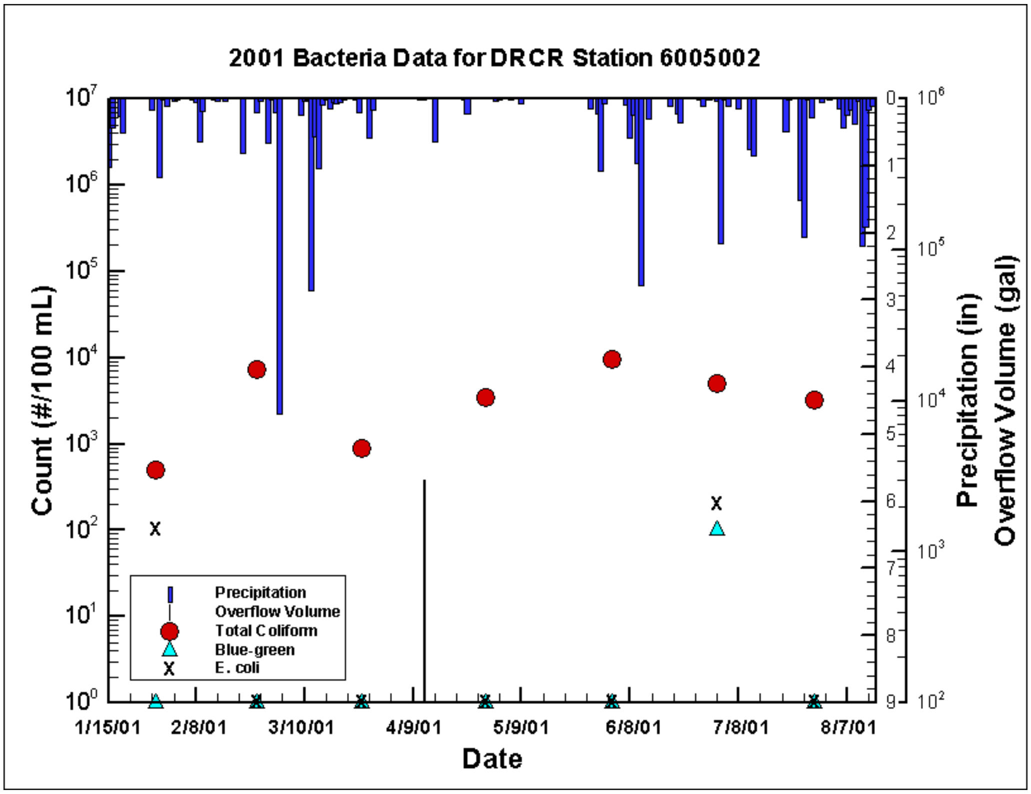
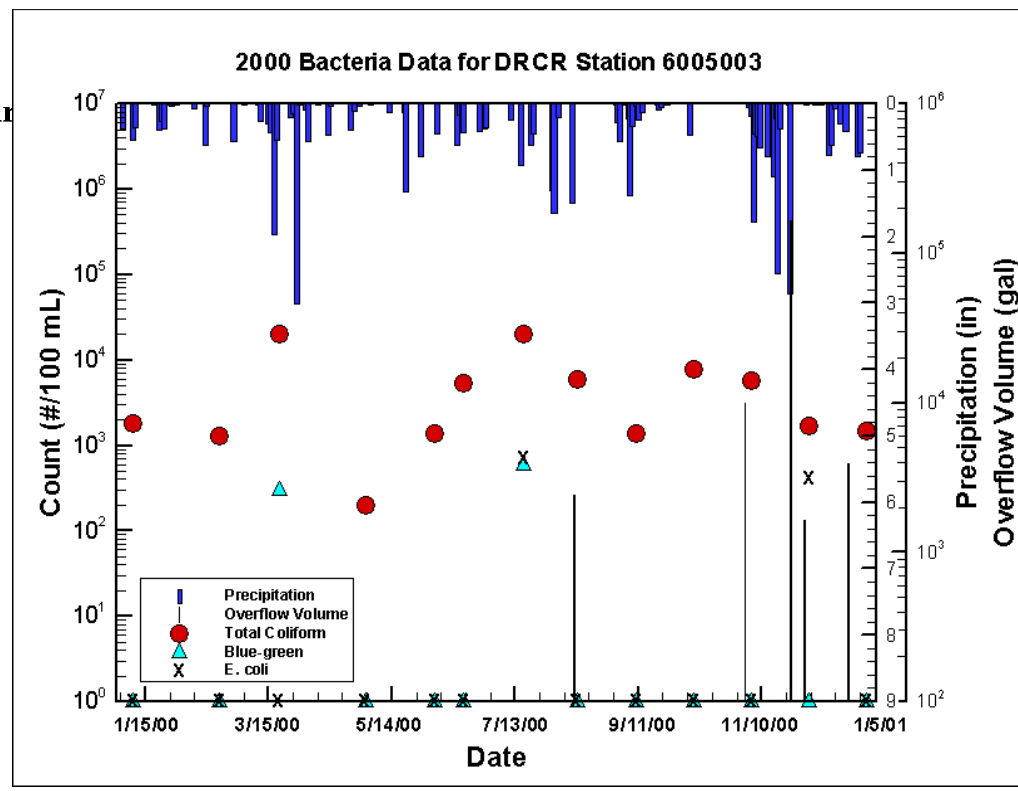


Figure 9-14. DRCR Bacteria Sampling Station on Moore Creek at Halls Mill

Figur **Rd.**


2000 Bacteria Data for DRCR Station 6005003
Count (#/100 mL)
Precipitation (in)
Overflow Volume (gal)
Date
1/15/00
3/15/00
5/14/00
7/13/00
9/11/00
11/10/00
1/5/01
Precipitation
Overflow Volume
Total Coliform
Blue-green
E. coli

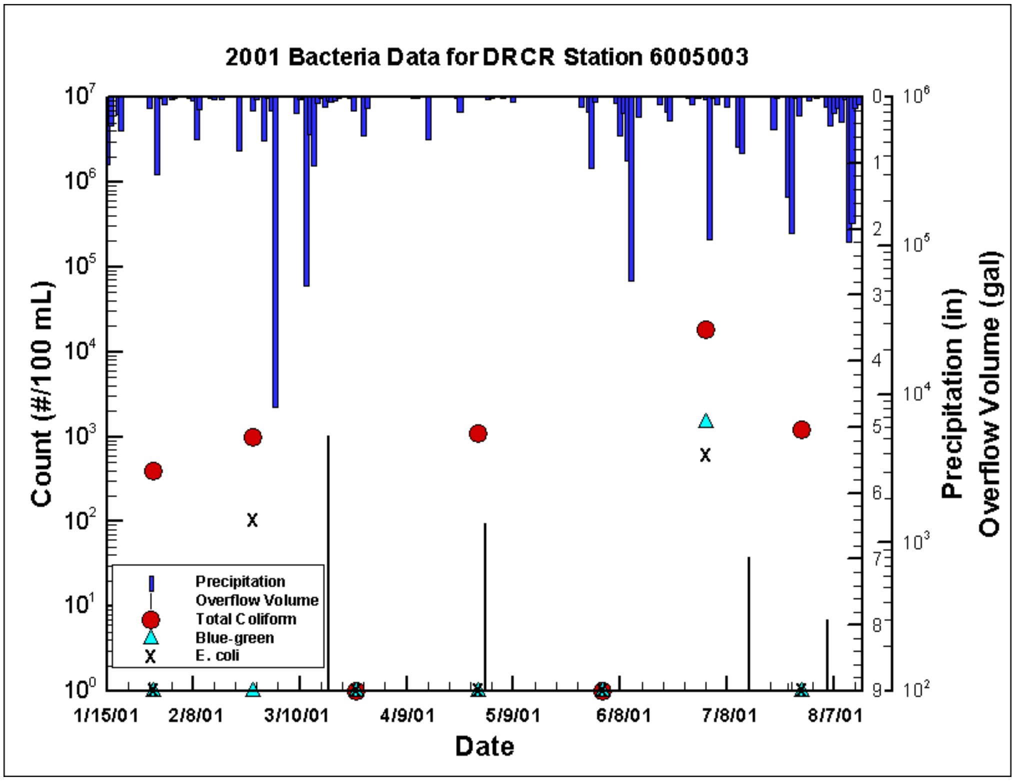
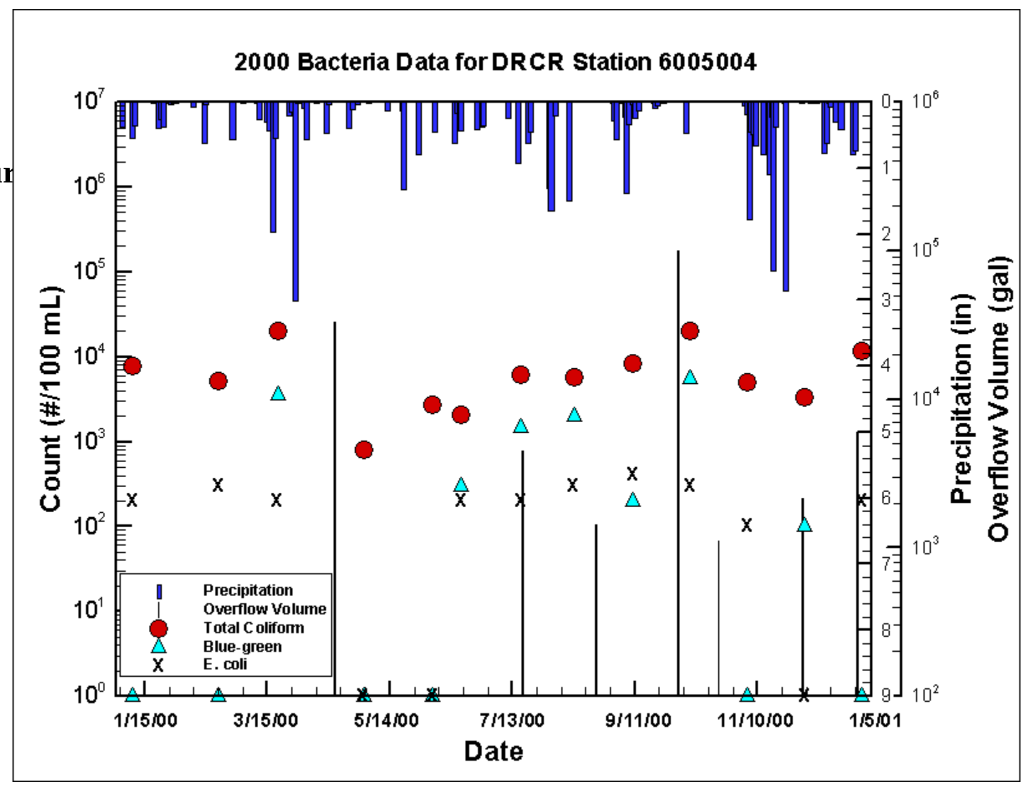
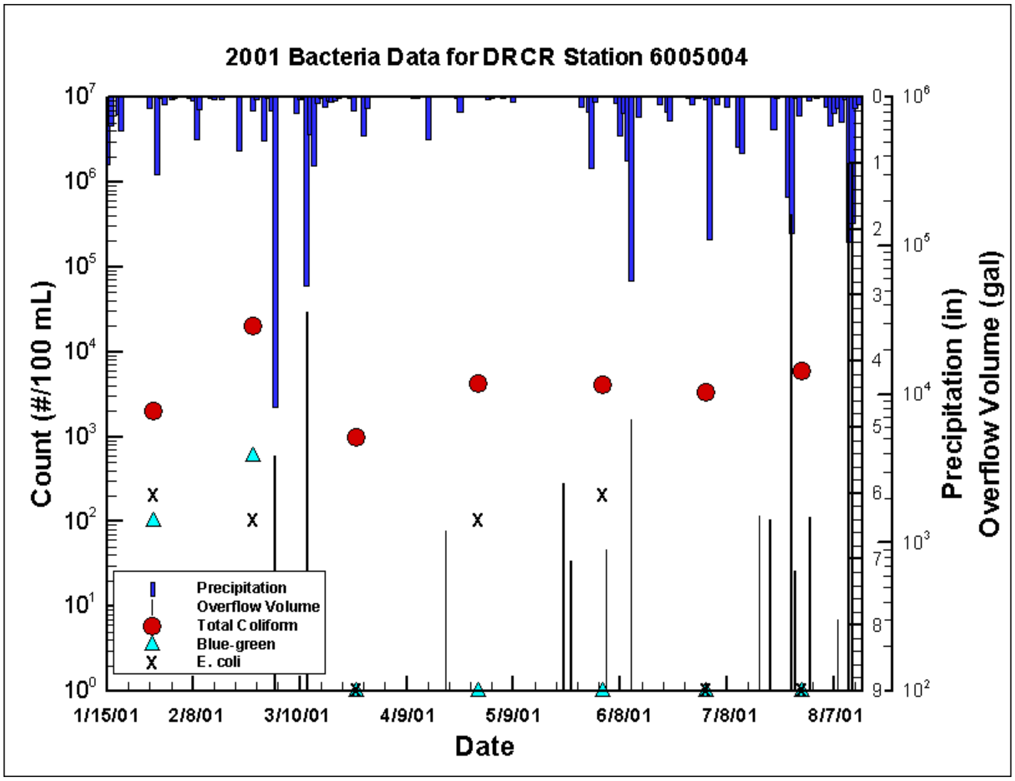
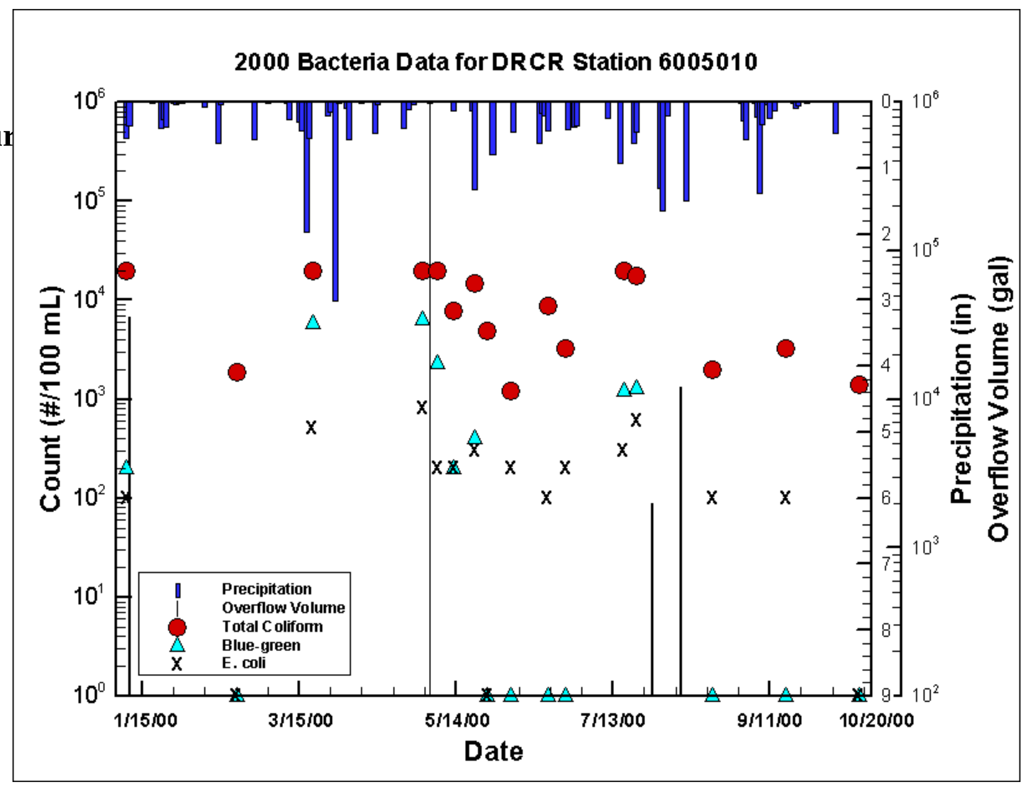


Figure 9-16. DRCR Bacteria Sampling Station on Montlimar Creek at Azalea Rd.

Figur


2000 Bacteria Data for DRCR Station 6005004
Count (#/100 mL)
Precipitation (in)
Overflow Volume (gal)
Date
1/15/00
3/15/00
5/14/00
7/13/00
9/11/00
11/10/00
1/5/01
Precipitation
Overflow Volume
Total Coliform
Blue-green
E. coli


2001 Bacteria Data for DRCR Station 6005004
Count (#/100 mL)
Precipitation (in)
Overflow Volume (gal)
Date
1/15/01
2/8/01
3/10/01
4/9/01
5/9/01
6/8/01
7/8/01
8/7/01
Precipitation
Overflow Volume
Total Coliform
Blue-green
E. coli


2000 Bacteria Data for DRCR Station 6005010
Count (#/100 mL)
Precipitation (in)
Overflow Volume (gal)
Date
1/15/00
3/15/00
5/14/00
7/13/00
9/11/00
10/20/00
Precipitation
Overflow Volume
Total Coliform
Blue-green
E. coli

Figur

Figur **d.**

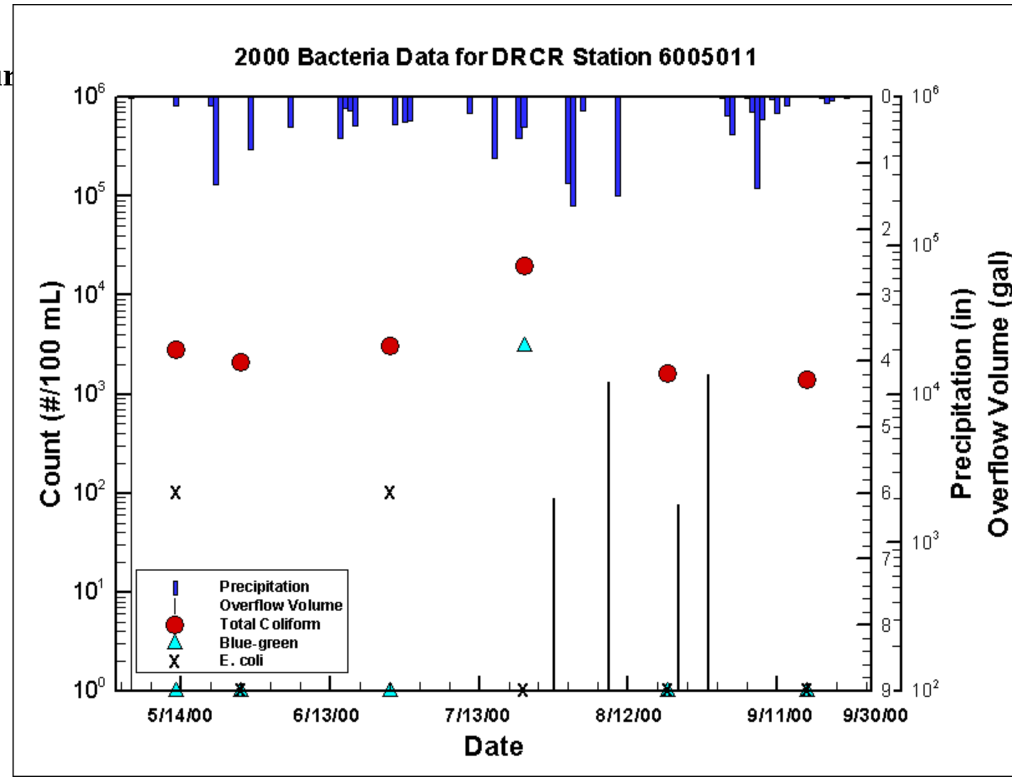
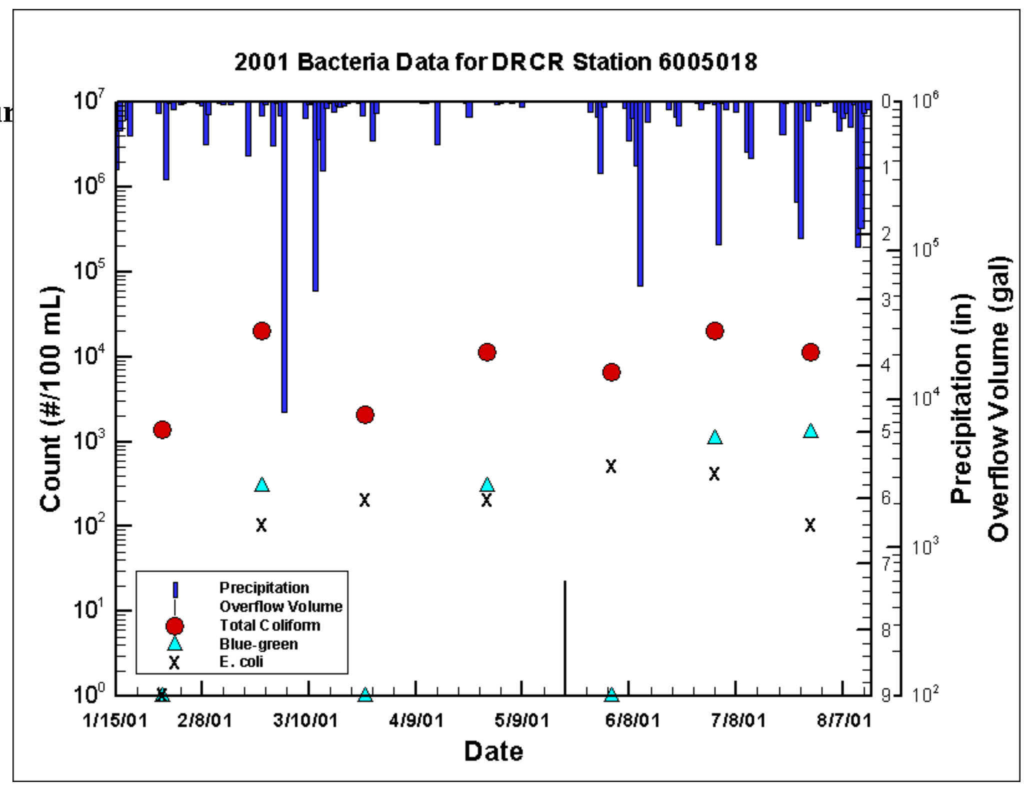


Figure 9-20. DRCR Bacteria Sampling Station on Halls Mill at Cypress Shores

Figur


2001 Bacteria Data for DRCR Station 6005018
Count (#/100 mL)
Precipitation (in)
Overflow Volume (gal)
Date
1/15/01
2/8/01
3/10/01
4/9/01
5/9/01
6/8/01
7/8/01
8/7/01
Precipitation
Overflow Volume
Total Coliform
Blue-green
E. coli

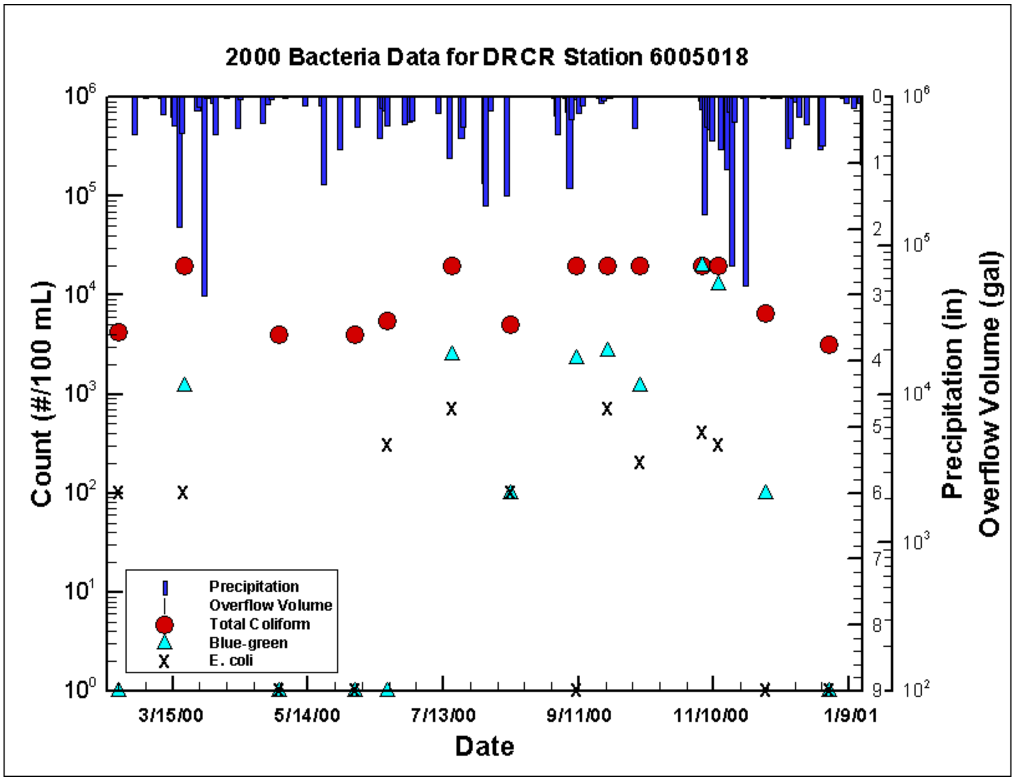


Figure 9-22. DRCR Bacteria Sampling Station on Bolton Branch at Navco Rd.

Appendix 9.3. Watershed Model Calibrations

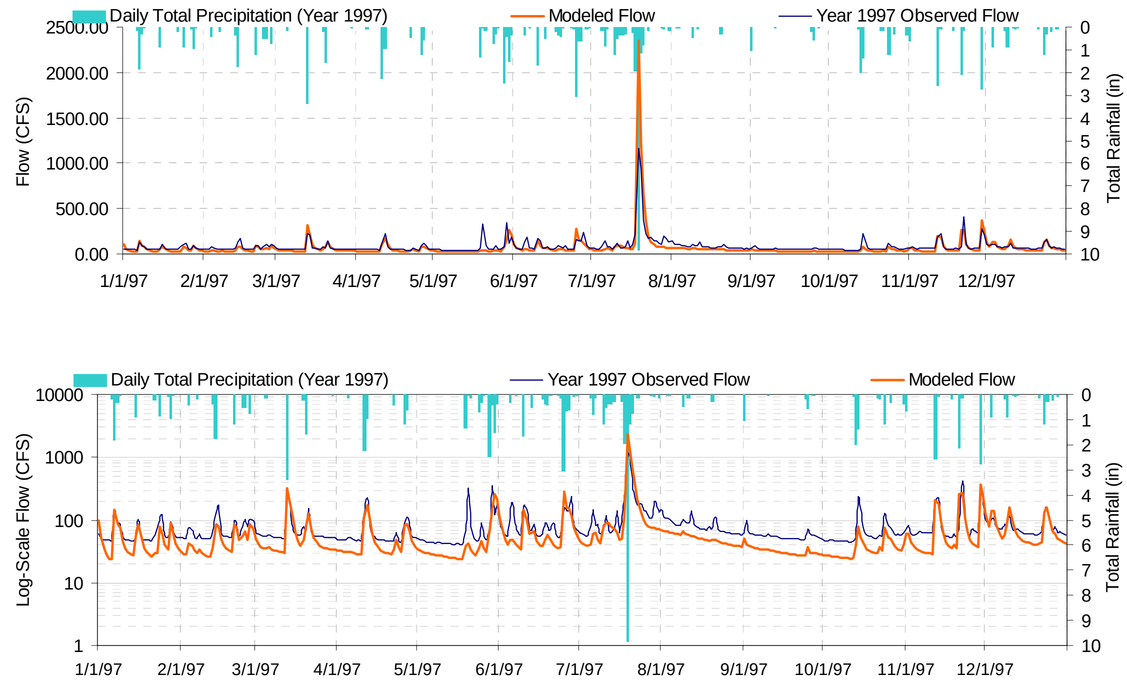


Figure 9-23. LSPC Model Hydrology Calibration at Eightmile Creek, 1997

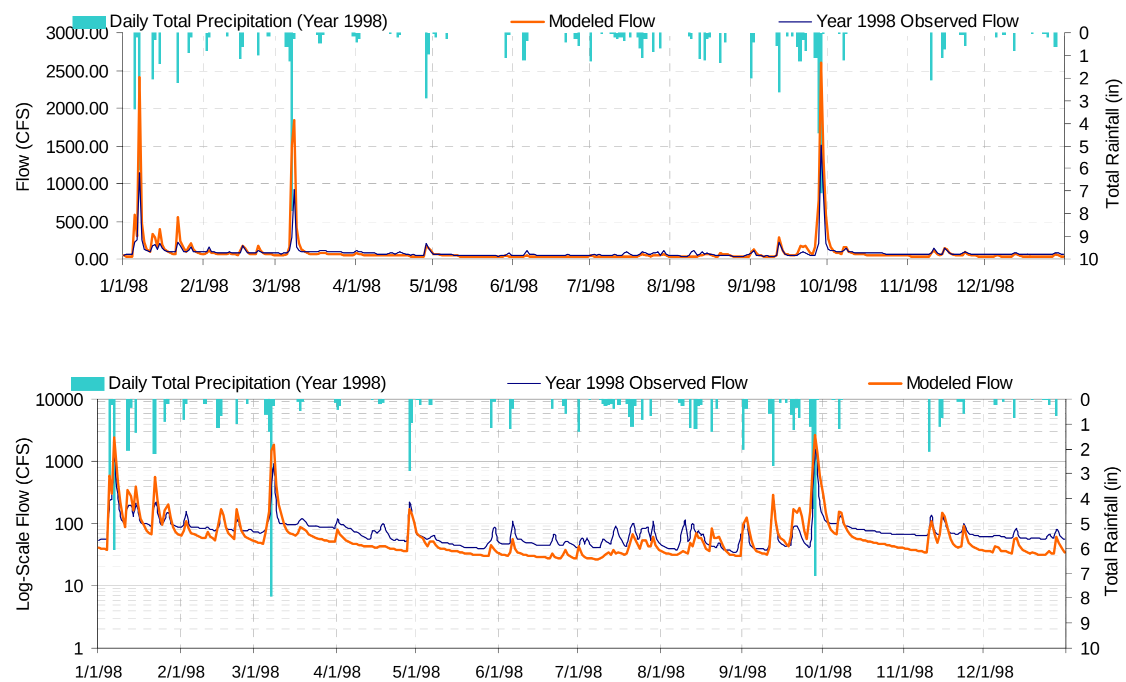


Figure 9-24. LSPC Model Hydrology Calibration at Eightmile Creek, 1998

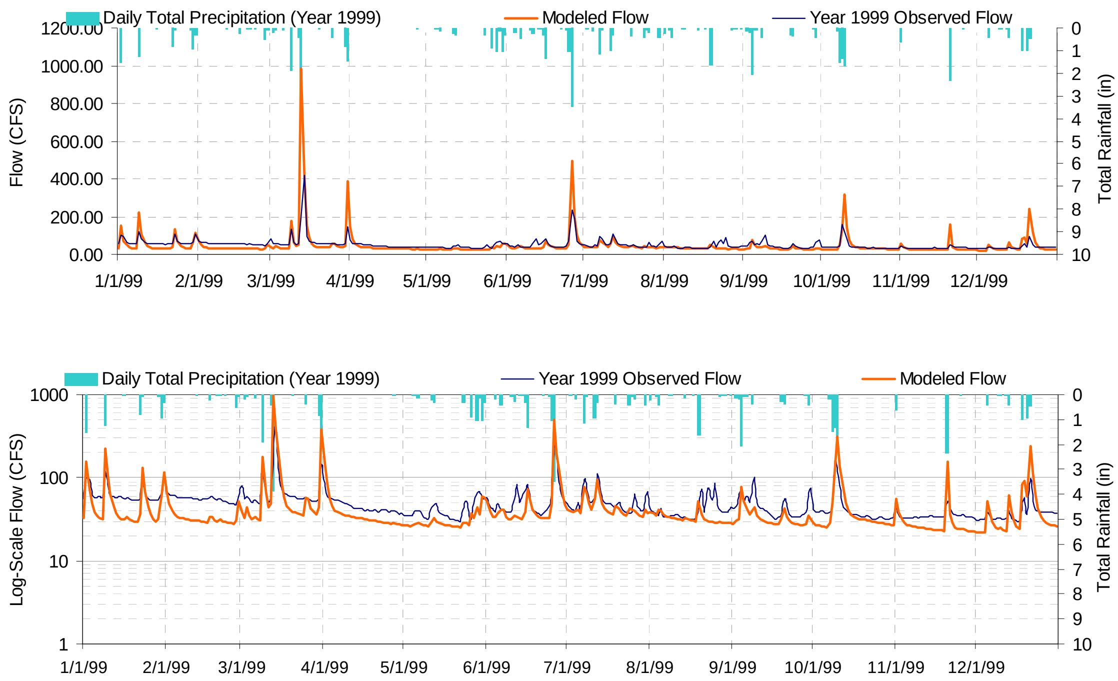


Figure 9-25 LSPC Model Hydrology Calibration at Eightmile Creek, 1999

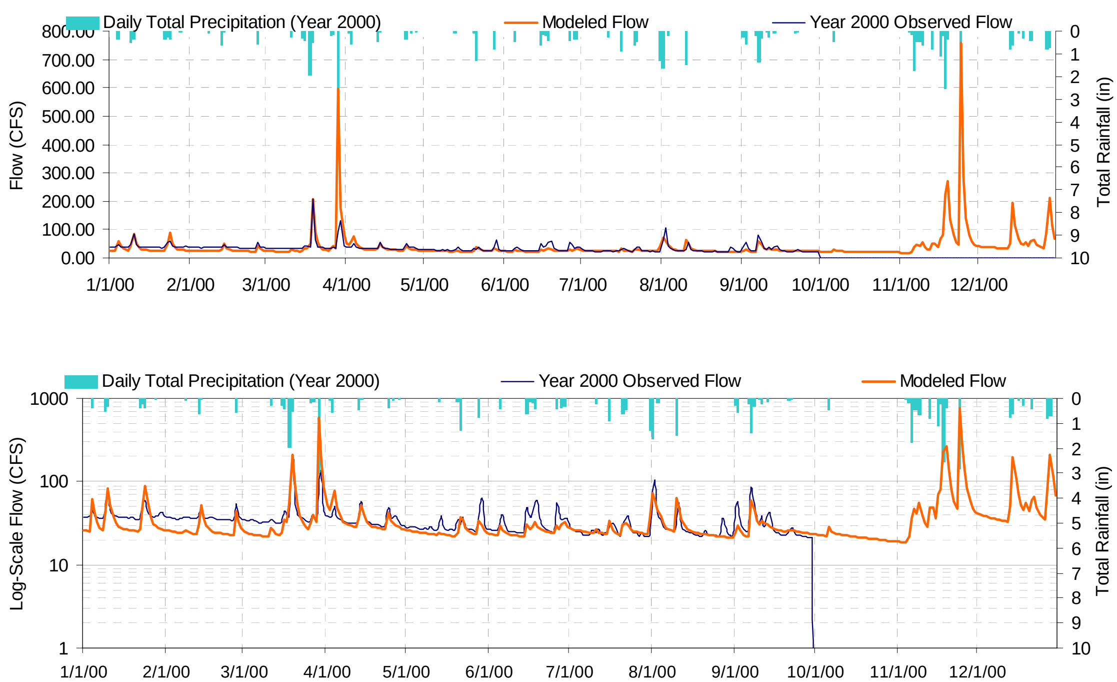


Figure 9-26 LSPC Model Hydrology Calibration at Eightmile Creek, 2000 (end of data).

Appendix 9.4 - Model Subbasins and Sanitary Sewer Overflows

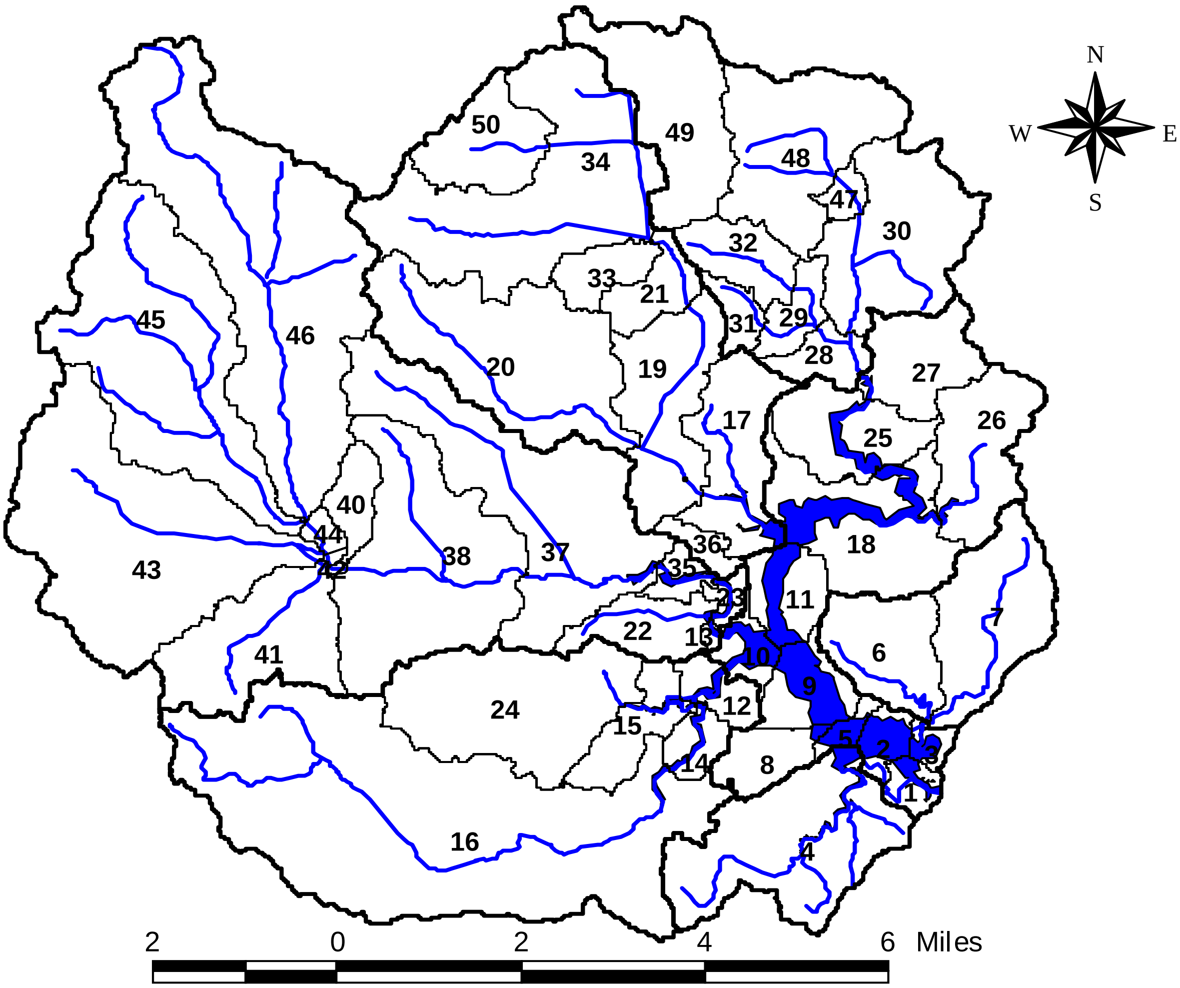


Figure 9-27. Subbasin delineations for LSPC watershed model

Table 9-2 Fecal Coliform loads in 2000 from Septic Systems based on the estimated 2000 population

Subbasin	2000 Population (estimated*)	2000 Onsite Wastewater System (estimated*)	Failing Septic	People Served	Septic Flow (gal/day)	Fecal Load (counts/day)	Fecal Load (counts/yr)
1	313	57	6	16	1113	4.21E+08	1.54E+11
2	446	37	4	10	729	2.76E+08	1.01E+11
3	300	7	1	2	148	5.60E+07	2.04E+10
4	3173	673	67	185	12946	4.90E+09	1.79E+12
5	226	25	2	7	488	1.85E+08	6.74E+10
6	1805	50	5	14	988	3.74E+08	1.36E+11
7	2296	78	8	22	1513	5.73E+08	2.09E+11
8	531	165	16	45	3151	1.19E+09	4.35E+11
9	741	108	11	30	2079	7.87E+08	2.87E+11
10	472	76	8	21	1450	5.49E+08	2.00E+11
11	879	20	2	5	380	1.44E+08	5.25E+10
12	388	120	12	33	2299	8.70E+08	3.18E+11
13	61	12	1	3	224	8.49E+07	3.10E+10
14	341	106	11	29	2023	7.66E+08	2.79E+11
15	701	217	22	59	4151	1.57E+09	5.73E+11
16	5627	1630	163	525	36748	1.39E+10	5.08E+12
17	3776	25	2	6	450	1.70E+08	6.21E+10
18	2973	56	6	15	1031	3.90E+08	1.42E+11
19	4628	52	5	13	877	3.32E+08	1.21E+11
20	10325	216	22	54	3784	1.43E+09	5.23E+11
21	2501	7	1	2	129	4.87E+07	1.78E+10
22	708	219	22	60	4187	1.58E+09	5.78E+11
23	328	18	2	5	345	1.31E+08	4.77E+10
24	3064	908	91	253	17675	6.69E+09	2.44E+12
25	2684	17	2	4	303	1.15E+08	4.19E+10
26	2258	35	4	10	670	2.54E+08	9.25E+10
27	2437	21	2	6	403	1.52E+08	5.57E+10
28	1847	11	1	3	195	7.38E+07	2.69E+10
29	1577	8	1	2	154	5.84E+07	2.13E+10
30	12196	36	4	10	700	2.65E+08	9.67E+10
31	808	3	0	1	53	2.00E+07	7.30E+09
32	1364	9	1	2	140	5.28E+07	1.93E+10
33	1935	4	0	1	63	2.38E+07	8.69E+09
34	13869	70	7	16	1088	4.12E+08	1.50E+11
35	461	33	3	9	625	2.37E+08	8.63E+10
36	600	3	0	1	50	1.89E+07	6.89E+09
37	8400	545	54	139	9750	3.69E+09	1.35E+12
38	7048	672	67	185	12962	4.91E+09	1.79E+12
39	34	6	1	2	109	4.13E+07	1.51E+10

Table 9-2 (continued)

Subbasin	2000 Population (estimated*)	2000 Onsite Wastewater System (estimated*)	Failing Septic	People Served	Septic Flow (gal/day)	Fecal Load (counts/day)	Fecal Load (counts/yr)
40	1094	21	2	6	403	1.52E+08	5.56E+10
41	2950	762	76	225	15745	5.96E+09	2.18E+12
42	56	2	0	1	51	1.92E+07	7.00E+09
43	7981	1827	183	563	39387	1.49E+10	5.44E+12
44	292	8	1	2	167	6.34E+07	2.31E+10
45	4881	783	78	238	16678	6.31E+09	2.30E+12
46	12879	433	43	123	8636	3.27E+09	1.19E+12
47	813	3	0	1	50	1.91E+07	6.96E+09
48	6612	19	2	4	299	1.13E+08	4.13E+10
49	4797	32	3	7	488	1.85E+08	6.74E+10
50	4178	40	4	10	676	2.56E+08	9.34E+10

*2000 Population by tract was estimated by applying the percent change in municipal population between the 2000 and 1990 Census populations to the 1990 population. 2000 Onsite Wastewater Systems were estimated from the 2000 population estimates.

Table 9-3 Sanitary Sewer Overflows Reported by MAWSS (1997 – April 2002)

Date of Spill	Reported Cause	Duration	Estimated Reported Volume (gallons)	Location	Reported Stream Impacted*
4/2/97			12750	Crenshaw Street--500 block	Bolton Branch
6/16/98			5200	833 Southern Oaks Apartments	Bolton Branch
2/16/99			5000	Emelda Drive 903	Bolton Branch
3/13/97			5600	1450 Avon Circle (manhole behind this address)	Dog River
3/13/97			5600	Englewood Street and Linwood Drive West	Dog River
3/13/97			5600	Englewood Lift Station (manhole outside)	Dog River
3/13/97			5600	1459 Linwood Drive West (manhole behind)	Dog River
3/21/97			10500	Scenic Drive Lift Station	Dog River
4/14/97			9600	Riviere du Chien Lift Station #74	Dog River
7/19/97			18720	2456 Venetia Road	Dog River
7/20/97			5600	Englewood Lift Station (manhole outside station	Dog River
7/20/97			5600	Englewood Street and Linwood Drive West	Dog River
7/20/97			5600	1450 Avon Circle (manhole in rear)	Dog River
10/7/97			15000	Columbus Avenue Lift Station	Dog River
1/7/98			16600	1350 Gulffield Drive East	Dog River
1/7/98			16600	1710 Gulffield Drive North	Dog River
1/7/98			16600	1301 Gulffield Drive East	Dog River
1/7/98			16600	1702 Gulffield Drive West	Dog River
1/26/98			12500	Park at Gimon Circle	Dog River
5/27/98			8000	3011 McGough	Dog River
5/30/98			12000	3007 McGough Drive	Dog River
7/26/98			8400	Scenic Drive L/S #48	Dog River
9/16/98			42500	Days Inn (DIP) L/S #79	Dog River
9/16/98			37500	Dauphin Island Pkwy 1705 & Gone with the Wind	Dog River
12/9/98			9000	Days Inn DIP #79	Dog River
12/29/98			15000	Days Inn DIP #79	Dog River
12/7/99			6000	Kent Road 3608	Dog River
1/7/98			12500	Homewood Street and Westwood Street	Eslava Creek
1/7/98			12500	Poydras Avenue and Ralston Road	Eslava Creek

Table 9-3 (continued)

Date of Spill	Reported Cause	Duration	Estimated Reported Volume (gallons)	Location	Reported Stream Impacted*
1/7/98			19750	224 Westwood at Creek	Eslava Creek
1/7/98			12500	Elizabeth and Mohawk	Eslava Creek
1/7/98			12500	Homewood & Mohawk	Eslava Creek
1/7/98			12500	Briley Street and West Collins	Eslava Creek
1/7/98			12500	Esplanade and Ralston Road	Eslava Creek
1/26/98			12500	225 Crenshaw Street	Eslava Creek
1/26/98			12500	Conti and Demouy (in intersection)	Eslava Creek
2/9/98			6000	1209 Buena Drive	Eslava Creek
9/13/98			7750	1005 Woodlawn Drive West	Eslava Creek
10/7/98			9000	119 Esplanade Avenue	Eslava Creek
12/7/98			9000	Ralston Road Lift Station	Eslava Creek
3/13/99			5000	Gulf Field Dr 1710	Eslava Creek
5/30/97			9600	3723 Riviere du Chien Rd.	Halls Mill Creek
1/21/98			15000	Yorkwood Drive at Spring Creek	Halls Mill Creek
9/23/98			6000	Wiley Orr Road	Halls Mill Creek
2/23/99			10500	I-10 West Inn Road	Halls Mill Creek
3/9/99			10000	Wiley Orr Road	Halls Mill Creek
3/20/99			15500	Coronado Ct 2800	Halls Mill Creek
6/3/99			6000	Wall Street (1st manhole south of The Timbers)	Halls Mill Creek
7/8/99			700000	Highway 90 5101	Halls Mill Creek
7/8/99			700000	Halls Mill Road 5118	Halls Mill Creek
7/8/99			700000	Halls Mill Lift Station	Halls Mill Creek
11/6/99			9000	Azalea Road 1374	Halls Mill Creek
1/23/99			5150	Airport Blvd 6801 (Providence Hospital)	Milkhouse Branch
1/24/99			26000	Airport Blvd 6801 (Providence Hospital	Milkhouse Branch
1/27/99			30000	Airport Blvd 6801 (Providence Hospital)	Milkhouse Branch
2/2/99			250000	Airport Blvd 6801 (behind Providence Hospital)	Milkhouse Branch
10/9/97			36000	Cottage Hill Road--200 ft west of Blue Ridge Bl	Milkhouse Creek
10/13/97			11000	Cottage Hill Road--200 ft. west of Blue Ridge B	Milkhouse Creek

Table 9-3 (continued)

Date of Spill	Reported Cause	Duration	Estimated Reported Volume (gallons)	Location	Reported Stream Impacted*
2/7/98			6250	6605 Sugar Creek Drive South	Milkhouse Creek
2/9/98			7500	6724 Candle Light Court	Milkhouse Creek
2/12/98			10125	Schillinger Road	Milkhouse Creek
3/3/98			7350	6420 Wall Street	Milkhouse Creek
6/14/98			25500	6100 Pine Needle Drive South	Milkhouse Creek
8/20/98			7500	Wall Street	Milkhouse Creek
8/28/98			6500	Wall Street	Milkhouse Creek
2/1/99			12600	Wall Street	Milkhouse Creek
4/19/99			49500	Wall Street	Milkhouse Creek
3/14/97			19500	Brookley/Golf Lane Lift Station	Mobile Bay
5/29/97			7000	Golf Lane Lift Station	Mobile Bay
1/19/98			12600	Cheshire Drive L/S #35	Montlimar Creek
3/18/98			15000	Behind Davidson High in creek-Pleasant Valley R	Montlimar Creek
4/24/98			6000	230 Redwood Place	Montlimar Creek
4/26/98			9000	Redwood Place Building	Montlimar Creek
9/18/98			9375	Pep Boys (Montlimar Drive)	Montlimar Creek
10/7/98			28500	Wal-Mart at Festival Center	Montlimar Creek
10/13/98			6000	50 Beltline Highway South	Montlimar Creek
11/25/98			5250	3600 Michael Boulevard	Montlimar Creek
1/15/99			6000	Highway 90 W 3941	Montlimar Creek
10/13/99			9000	Claridge Road East 107	Montlimar Creek
6/27/98			180000	974 Highpoint Drive West	Moore Creek
6/3/97			200000	Coca Cola Lift Station	Rabbit Creek
10/5/97			9498	Hamilton Boulevard Lift Station	Rabbit Creek
11/11/97			6930	Woodchase Lift Station	Rabbit Creek
3/10/98			7560	Woodchase L/S #98	Rabbit Creek
3/18/98			12750	Andrew Road & Highway 90	Rabbit Creek
3/18/98			10080	Woodchase L/S #98	Rabbit Creek
7/25/98			27000	Giblin L/S #91	Rabbit Creek
8/3/98			9000	Giblin Road L/S #91	Rabbit Creek
8/15/98			36000	Giblin Road L/S #91	Rabbit Creek
9/30/98			5040	Woodchase L/S #98	Rabbit Creek
1/19/99			5040	Woodchase LS #98	Rabbit Creek
2/2/99			60000	Old Pascagoula Road 5982	Rabbit Creek
2/3/99			9000	Giblin Road [#91]	Rabbit Creek

Table 9-3 (continued)

Date of Spill	Reported Cause	Duration	Estimated Reported Volume (gallons)	Location	Reported Stream Impacted*
2/4/99			50000	Giblen Rd 4315 (Lift Station #91)	Rabbit Creek
2/6/99			9000	Giblin Road [#91]	Rabbit Creek
2/8/99			51000	Giblin Road [#91]	Rabbit Creek
5/14/99			18000	Giblin Road 4315	Rabbit Creek
12/7/99			8745	Tillman's Corner Parkway	Rabbit Creek
12/13/99			9000	Hamilton Boulevard behind Winn Dixie	Rabbit Creek
4/28/98			6000	5451 Halls Mill Road	Rattlesnake Bayou
9/30/98			21000	Inn Road	Rattlesnake Bayou
11/13/99			27000	Inn Boulevard	Rattlesnake Bayou
11/14/99			9000	Inn Boulevard	Rattlesnake Bayou
12/31/99			9125	McGough Drive 3007	Robinson Creek
10/20/98			180000	Wall Street	Second Creek
12/29/98			30000	8040 Cottage Hill Road	Second Creek
1/2/99			32400	Schillinger Road	Second Creek
3/15/99			10400	Quincy Dr S 7561	Second Creek
11/24/98			5250	Cottage Hill and Freemont	Spencer Branch
12/31/98			28500	6609 Bentley Court	Spencer Branch
6/10/97			18000	Englewood Drive	Storm drain to Dog River
1/10/00	line failure	6	36000	7453 Burning Tree Ct.	Milkhouse Creek
4/17/00	broken main	1	33000	Hurtel St. / Antwerp St.	
5/4/00	sand/grease	3	1000000	5260 Hwy 90	Halls Mill Creek
5/4/00	sand/grease	3	1000000	US Hwy 90	Halls Mill Creek
7/18/00	broken line	2	4500	606 Bel Air Blvd.	Eslava Creek
7/28/00	roots/grease	3	2000	5928 Cinnamon Ct.	Milkhouse Creek
8/8/00	broken line	2	12000	south of Cottage Hill Rd.	Milkhouse Creek
8/11/00	grease	2	2400	442 Azalea Rd.	Bolton Branch Creek
8/22/00	grease/paper	3	1800	5409 Crosscreek Dr.	Halls Mill Creek
8/23/00	broken line	24	1440	764 Lundy Ln.	Bolton Branch Creek
8/28/00	obstruction	9	13500	Short Leaf Dr. & Cross Creek	Spring Creek
10/2/00	stoppage	3	100000	S Florida St. & Walton Ave.	Woodcock Creek
10/22/00	grease	1	1100	505 Bel Air Blvd.	Eslava Creek
11/2/00	roots/grease	4	10000	450 Azalea Rd.	Montlimar Creek
11/19/00	overtapped with rainwater	1	3000	1761 Quincy Dr.	Second Creek
11/24/00	grease/ heavy rain	4	165000	Service Rd. / Airport Rd. / Baby Superstore	Montlimar Creek

Table 9-3 (continued)

Date of Spill	Reported Cause	Duration	Estimated Reported Volume (gallons)	Location	Reported Stream Impacted*
11/25/00	heavy rain	4	240000	Hillcrest Rd. @ Halls Mill Creek	Halls Mill Creek
11/30/00	grease	3	3600	Three Medical Park / Girby Rd.	Halls Mill Creek
11/30/00	grease	2	1800	1997 Ostrom Dr.	Dog River
12/1/00	grease	5	1625	928 Butler Dr.	Montlimar Creek
12/2/00	grease	4	2150	1952 Eagle Dr.	Eslava Creek
12/9/00	manhole break	7	42000	Oakleigh Trace Subdivision	Spring Creek
12/10/00	grease	4	48000	3016 Brookline Dr.	Spring Creek
12/10/00	manhole break	3	18000	Oakleigh Trace Subdivision	Spring Creek
12/13/00	lift station failure	1	36000	Giblin #91 (off Hamilton Blvd.)	Rabbit Creek
12/16/00	roots	1	2500	2914 Longleaf Dr.	Spencer Branch
12/16/00	debris	1	5700	5713 Oakleigh Trace	Spring Creek
12/17/00	grease	1	1350	5255 Maudelayne Dr. N	Spencer Branch
12/22/00	grease	7	3900	3800 Hillcrest Ln. E	Montlimar Creek
12/29/00	grease	4	6000	1402 Arlington St.	Mobile Bay
1/5/01	debris	2	12000	behind Timber Ridge Apts.(between Johnston Ln. & Wall St.	Milkhouse Creek
1/7/01	roots	1	1500	450 Azalea Rd.	Bolton Branch Creek
2/13/01	broken bypass pipe	1	2000	Hwy 90 (near Wiley Orr Rd.)	Halls Creek
2/28/01	grease	2	4500	8305 Reidy Ct.	Second Creek
3/3/01	infil/inflow	3	3800	1254 W. Becker Rd.	Eslava Creek
3/3/01	infil/inflow	3	3800	2118 N. Gimon Cir.	Eslava Creek
3/8/01	grease	2	3600	6229 Brynolyn Ct.	Campground Branch Creek
3/12/01	infil/inflow	3	7500	2112 Gimon Cir.	Eslava Creek
3/12/01	infil/inflow	2	1200	1350 Guffield Dr. E	Eslava Creek
3/12/01	infil/inflow	2	6000	1252 Houston St.	Eslava Creek
3/12/01	force main break	2	4000	Semmes Middle School	Crooked Creek
3/12/01	infil/inflow	3	4500	Homewood St. & Westwood St.	Eslava Creek
3/12/01	infil/inflow	5	36000	120 Demouy Ave.	Eslava Creek
3/12/01	infil/inflow	2	1200	Central Rd. & Gulffield Dr. N	Eslava Creek
3/12/01	infil/inflow	3	9000	Houston St. and Duval St.	Eslava Creek
3/12/01	infil/inflow	6	36000	Conti St. & Demouy Ave.	Eslava Creek
3/14/01	infil/inflow	3	9000	Giblin Rd. @ LS (off Hamiliton Blvd.)	Rabbit Creek
3/18/01	grease	3	5250	133 McGregor Ave.	Eslava Creek
3/30/01	force main break	2	70080	5590 Todd Acres Dr.	Moore Creek
4/4/01	force main break	1	10800	Todd Acres Dr. near Commerce Blvd.	Moore Creek

Table 9-3 (continued)

Date of Spill	Reported Cause	Duration	Estimated Reported Volume (gallons)	Location	Reported Stream Impacted*
4/12/01	grease	2	3000	2060 Japonica Ln.	Montlimar Creek
4/20/01	grease	4	1200	1209 E. Buena Dr.	Eslava Creek
5/1/01	grease	2	1350	3968 Airport Blvd.	Eslava Creek
5/21/01	grease	1	600	1000 Farnell Ln.	Bolton Branch Creek
5/23/01	grease	2	2500	1209 Buena Dr. E	Eslava Creek
5/25/01	grease	3	750	1512 Heron Dr.	Eslava Creek
5/25/01	force main break	3	3300	4386 Fatherbrook Ln.	Spring Creek
5/29/01	force main break	4	1300	5775 Hwy 90 W	
6/4/01	grease	3	900	1364 Plaza Dr.	Eslava Creek
6/4/01	grease	1	120	24 Benedict Place	Eslava Creek
6/11/01	infil/inflow	3	5400	Halls Mill #155	Moore Creek
6/11/01	force main break	0	5	Crenshaw St. near Clearmont St.	Eslava Creek
6/11/01	infil/inflow	1	1000	Conti St. & Demouy Ave.	Eslava Creek
6/11/01	infil/inflow	1	300	Mohawk St. & Elizabeth St.	Eslava Creek
6/11/01	infil/inflow	1	50	Glenwood St. @ Clearmont St.	Eslava Creek
6/11/01	infil/inflow	1	30	Glenwood St. @ Clearmont St.	Eslava Creek
6/11/01	infil/inflow	1	200	2107 Highland Ct.	Eslava Creek
6/11/01	infil/inflow	1	10	1710 Gulffield Dr.	Eslava Creek
6/11/01	grease	2	450	1909 Nice Ave.	Eslava Creek
6/11/01	break	2	6750	2007 Senator St.	Eslava Creek
6/14/01	grease	3	449	7380 Hitt Rd.	Milkhouse Creek
6/14/01	infil/inflow	2	420	Hamilton Blvd. (Gammex LS)	Deer River
7/14/01	grease	3	800	3945 Airport Blvd.	Eslava Creek
7/14/01	grease	5	2850	7380 Hitt Rd.	Milkhouse Creek
7/17/01	grease	1	1500	1475 Goldfinch St.	Eslava Creek
7/19/01	break	6	2100	2610 Schillinger St. @ Cottage Hill Rd.	Second Creek
7/20/01	grease	6	1440	Van Lee Cir.	Eslava Creek
7/25/01	debris	1	112	651 Azalea Rd Apt 35 Blvd D	Bolton Branch Creek
7/25/01	debris	1	112	651 Azalea Rd Apt 35 Blvd D	Bolton Branch Creek
7/26/01	infil/inflow	4	1150	Houston St. and Duval St.	Eslava Creek
7/26/01	infil/inflow	3	825	Hurtel St. and Stewart St.	Eslava Creek
7/26/01	infil/inflow	3	1950	257 Island Ct.	Eslava Creek
7/26/01	infil/inflow	5	27000	Giblin #91 (off Hamiliton Blvd.)	Rabbit Creek
7/26/01	infil/inflow	6	3450	Crenshaw LS #152	Eslava Creek
7/26/01	grease	1	375	422 Durande Dr.	Eslava Creek

Table 9-3 (continued)

Date of Spill	Reported Cause*	Duration*	Estimated Reported Volume (gallons)	Location	Reported Stream Impacted*
7/26/01	infil/inflow	2	6000	2122 Gimon Cir. N	Eslava Creek
7/26/01	infil/inflow	4	240000	Old Military Rd. LS #91	Rabbit Creek
7/26/01	infil/inflow	7	21000	Elizabeth St. & Mohawk St.	Eslava Creek
7/26/01	infil/inflow	7	8400	Gulffield Dr. N & Gulffield Dr. W	Eslava Creek
7/26/01	infil/inflow	9	13500	Gulffield Dr. N & Central Dr.	Eslava Creek
7/26/01	infil/inflow	7	4200	1352 Gulffield Dr. E	Eslava Creek
7/26/01	infil/inflow	9	270000	Conti St. & Demouy Ave.	Eslava Creek
7/26/01	infil/inflow	9	162000	Murray St. & Demouy Ave.	Eslava Creek
7/26/01	infil/inflow	4	24000	5118 Halls Mill Rd.	Halls Creek
7/26/01	infil/inflow	4	288000	5121 Halls Mill Rd.	Halls Creek
7/26/01	infil/inflow	6	36000	5136 Hwy 90	Halls Creek
7/26/01	infil/inflow	6	9000	5136 Hwy 90	Halls Creek
7/26/01	infil/inflow	6	8250	5136 Hwy 90	Halls Creek
7/26/01	infil/inflow	6	396000	5136 Hwy 90	Halls Creek
7/27/01	grease	2	650	155 Sage Ave. S	Eslava Creek
7/27/01	infil/inflow	0	100	Crenshaw LS #152	Eslava Creek
7/31/01	break	0	1496	woods by creek	Eslava Creek
7/31/01	infil/inflow	0	374	woods by creek	Eslava Creek
8/5/01	grease	1	300	3945 Airport Blvd.	Eslava Creek
8/28/01	roots	3	15	720 Raines Dr.	Montlimar Creek
8/8/01	grease	1	300	702 Jemison St.	Eslava Creek
8/11/01	rain event	5	360000	Mohawk St. & Elizabeth St.	Eslava Creek
8/12/01	rain event	5	12000	Mohawk St. & Elizabeth St.	Eslava Creek
8/12/01	rain event	1	94	2459 Mt. Island Dr. N	Eslava Creek
8/12/01	rain event	3	360000	2122 Gimon Cir. W	Eslava Creek
8/16/01	grease	1	300	2007 McVay Dr.	Eslava Creek
8/17/01	infil/inflow	2	14400	Clearmont St. & Kenan St.	Eslava Creek
8/17/01	infil/inflow	2	14400	Westwood St & Homewood St.	Eslava Creek
8/17/01	infil/inflow	2	14400	Mohawk St. & Elizabeth St.	Eslava Creek
8/19/01	grease	2	450	1284-B Bayview Ct.	Robinson Bayou
8/19/01	lift station failure	0	3750	HM #155	Moore Creek
8/23/01	force main break	1	2500	800' W of Navco Rd. on S side of track	Moore Creek
8/30/01	hose came out of manhole pump	1	4800	2610 Schillingers Rd.	Second Creek

Table 9-3 (continued)

Date of Spill	Reported Cause*	Duration*	Estimated Reported Volume (gallons)	Location	Reported Stream Impacted*
9/5/01	grease	2	1400	1000 W. Woodlawn Dr.	Eslava Creek
9/6/01	grease	8	48000	270 Hillcrest in easement	Twelve Mile Creek
9/16/01	grease	1	600	1715 Dog River Dr. W	Dog River
9/16/01	grease	1	449	5901 Live Oak Ct.	Milkhouse Creek
9/17/01	force main break	15	13090	1856 Navco Rd.	Dog River
9/28/01	grease	0	200	Jackson Rd. between State Route 16 & Calhoun Rd.	Halls Creek
10/9/01	debris	3	5672	Michael Blvd. Between Montlimar Dr. & Hutson Dr.	Montlimar Creek
10/17/01	debris	1	120	6600 Wall St.	Milkhouse Creek
10/24/01	grease	3	4875	Springbank Rd. & Rutledge Place	Eslava Creek
11/1/01	grease	1	750	4321 Carlyle Way	Eslava Creek
11/6/01	debris	1	1200	962 Westbury Dr.	Bolton Branch Creek
11/8/01	debris	2	12000	8260 Reidy St.	Second Creek
11/8/01	force main break	4	14500	Pleasant Valley @ Executive Park (Pleasant Valley Rd. & Grayson D	Bolton Branch Creek
11/19/01	grease	5	3000	Southern Oaks Apt- University Blvd.	Bolton Branch Creek
11/22/01	grease	2	450	310 Emelye Dr.	Spring Creek
2/18/02	grease	1	600	3071 Ralston Rd.	Eslava Creek
1/18/02	grease	1	120	Navco St. & McVay St.	Bolton Branch Creek
1/18/02	grease	2	1200	1271 Azalea Rd.	Moore Creek
1/20/02	grease	2	1200	3800 Michael Blvd.	Eslava Creek
1/28/02	grease	2	150	1875 Panorama Blvd.	Bolton Branch Creek
1/31/02	grease	3	1500	557 Azalea Rd.	Bolton Branch Creek
2/4/02	grease	5	3300	3316 Melody Ln.	Payne's Creek
2/6/02	log blockage	6	2250	3316 Melody Ln.	Payne's Creek
2/11/02	grease	2	25	2717 Perin Ct.	Moore Creek
2/13/02	debris	2	1800	4151 Seabreeze Rd. N	Bolton Branch Creek
2/28/02	grease	1	300	133 McGregor Ave.	Eslava Creek
3/4/02	grease	1	200	1717 Dogriver Dr. W @ Bream Dr.	Dog River
3/11/02	debris/grease	1	3000	2750 N Barksdale Dr.	
3/11/02	grease	1	600	90 Spring St.	Eslava Creek
3/13/02	roots	1	600	450 Azalea Rd.	Bolton Branch Creek
3/14/02	debris	4	2700	151 Hillside Ln.	Montlimar Creek
3/14/02	grease	4	1050	262 Glenwood St.	Eslava Creek
3/19/02	grease	1	300	3805 Shelly Dr.	Montlimar Creek
4/2/02	grease	2	1000	1258 Skywood Dr.	Moore Creek