Total Maximum Daily Load

Evaluation

for

Franks Creek

in the

Suwannee River Basin

(Fecal Coliform)

Submitted to:

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

Submitted by:
The Georgia Department of Natural Resources
Environmental Protection Division
Atlanta, Georgia

June 2000

Table of Contents

Section **Page**

List of Tables

List of Figures

Appendices

EXECUTIVE SUMMARY

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into three categories, supporting, partially supporting, or not supporting their designated uses depending on water quality assessment results. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* every two years.

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

The State of Georgia has identified Franks Creek in the Suwannee River basin as partially supporting the water quality standard criteria for fecal coliform bacteria. Franks Creek has a water use classification of fishing and a fecal coliform bacteria water quality standard as described below:

> For the months of May through October, fecal coliform not to exceed a geometric mean of 200 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours. For the months of November through April, fecal coliform not to exceed a geometric mean of 1,000 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours and not to exceed a maximum of 4,000 per 100 ml for any sample.

Sufficient fecal coliform bacteria data were collected at Franks Creek at County Road 775 near Valdosta, Georgia (GAEPD site 09038981) in 1998 to calculate four distinct geometric mean values. There was one exceedence of the geometric mean standard of 200 counts/100 ml (May – October). As a result, nine miles of Franks Creek from State Route S1780 to Little River near Hahira, GA was added to the State's 303(d) list and scheduled for a TMDL evaluation.

The analysis performed to develop the TMDL for fecal coliform bacteria for Franks Creek used dynamic hydrologic and water quality modeling techniques that considered the characteristics of the watershed, meteorology, hydrology, and land use. The model used local meteorological data and local watershed and stream characteristics in the simulation. Land use in the watershed was characterized from Landsat Thematic Mapper digital images developed in 1995. Land use activities contributing fecal coliform bacteria simulated using the model included septic tanks, cattle grazing, poultry operations, manure management, urban development, and wildlife. Model parameterization for urban, agricultural, and forestland uses were provided by the USEPA. National Pollutant Discharge Elimination System (NPDES) permitted discharges were also included in the modeling analysis.

A simulation period of 10 years (1989 – 1998) was used to develop the fecal coliform bacteria TMDL. Load reductions were applied until the simulated 30-day geometric mean of the fecal coliform bacteria counts did not exceed the water quality geometric mean standard. Modeling assumptions were considered conservative to constitute an implied margin of safety.

Model results indicate that nonpoint sources related to agricultural practices have significant impact on the fecal coliform bacteria loadings in the watersheds. Leaking septic systems and stormwater runoff from urban areas are considered secondary sources of fecal coliform. Reductions in these loading rates in the Franks Creek watershed reduce the in-stream fecal coliform bacteria levels.

A possible allocation scenario that would meet in-stream water quality standards in Franks Creek is a 93 percent reduction in nonpoint source fecal loads. Management practices that could be used to implement this TMDL include adoption of NRCS resource management practices including covering manure and poultry litter stacks exposed to the environment; reducing animal access to streams; and applying manure to croplands at agronomical rates. In addition, controlling leaking septic systems and urban runoff could also improve water quality. Best management practices (BMPs) should be developed to address urban and agricultural runoff during extreme storm events.

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into three categories, supporting, partially supporting, or not supporting their designated uses depending on water quality assessment results. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* every two years.

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

The State of Georgia has identified Franks Creek in the Suwannee River basis as violating the water quality standard criteria for fecal coliform bacteria. Fecal coliform bacteria data were collected in 1998 at Franks Creek at State Route S1780 to Little River near Hahira, Georgia (GAEPD site 09038981). Sufficient data were collected at this station to calculate four distinct geometric mean values. As a result the stream was listed as partially supporting its designated use as the summer geometric mean standard of 200 counts/100 ml was exceeded once. Nine miles of Franks Creek in Lowndes County were added to the State's 303(d) list and scheduled for a TMDL evaluation.

1.2 Watershed Description

The Franks Creek watershed is located in the Suwannee River basin in southeastern Georgia, in Cook County (See Figure 1). Franks Creek is a tributary to Little River, which flows into the Withlacoochee River (see Figure 2). The total area of the Franks Creek watershed is approximately 40 square miles.

The land use characteristics of the Franks Creek watershed were determined using data from Georgia's Multiple Resolution Land Coverage (MRLC). This coverage is based on Landsat Thematic Mapper digital images developed in 1995. The classification is based on a modified Anderson level one and two system. Table 1 lists the land use distribution in the watershed. The data show that the watershed is predominately agriculture (pasture/hay and row crops) (43 percent) with the next predominate land use being forest (30 percent). Landuse coverage for the watershed is shown in Figure 3.

Table 1. Landuse Distribution by Subwatershed

Landuse	Franks Creek	
	Area (ac)	Percent
Bare Rock/Sand/Clay	8	0.0
Deciduous Forest	1631	6.3
Emergent Herbaceous Wetlands	233	0.9
Evergreen Forest	4866	18.8
High Intensity Commercial/Industrial/ Transportation	386	1.5
High Intensity Residential	64	0.2
Low Intensity Residential	391	1.5
Mixed Forest	1456	5.6
Open Water	103	0.4
Other Grasses (Urban/recreational; e.g. parks, lawns)	163	0.6
Pasture/Hay	2563	9.9
Quarries/Strip Mines/Gravel Pits	0	0.0
Row Crops	8563	33.2
Transitional	800	3.1
Woody Wetlands	4514	17.5
Total	25816	100.0

1.3 Water Quality Standard

The water use classification for Franks Creek is fishing. The fishing classification water quality standard for fecal coliform bacteria as stated in Georgia's Rules and Regulations for Water Quality Control Chapter 391-3-6-.03(6)(c) is:

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

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

requirements will be consistent with those established by the State and Federal agencies responsible for the National Shellfish Sanitation Program. The requirements are found in the National Shellfish Sanitation Program Manual of Operation, Revised 1988, Interstate Shellfish Sanitation Conference,

U.S. department of Health and Human Services (PHS/FDA), and the Center for Food Safety and Applied Nutrition. Streams designated as generally supporting shellfish are listed in Paragraph 391-3-6-.03(14).

2.0 WATER QUALITY ASSESSMENT

Water quality monitoring data were collected during 1998 at Franks Creek at County Road 775 near Valdosta, Georgia. Table 2 lists the fecal coliform bacteria data results at these stations as well as computed geometric mean values. The data collected were four instantaneous samples obtained within a 30 day period. These data results were compared with the fecal coliform bacteria water quality standard to assess compliance.

Table 2: Fecal Coliform Bacteria Data

Date	Franks Creek at CR 32 Fecal Coliform Bacteria (MPN/100 ml)	Geometric Mean
01/20/98	70	
02/02/98	170	
02/09/98	110	
02/17/98	2400	133
05/07/98	4900	
05/14/98	460	
05/21/98	460	
06/04/98	260	720.6
08/27/98	330	
09/13/98	80	
09/17/98	70	
09/24/98	490	173.5
11/19/98	220	
12/03/98	230	
12/10/98	220	
12/17/98	330	213.5

The data show that sufficient data were collected to calculate four distinct geometric mean values. Franks Creek was listed as partially supporting the designated use as the geometric mean standard of 200 counts/100 ml was exceeded the May/June sampling period.

3.0 SOURCE ASSESSMENT

A source assessment is used to characterize the known and suspected sources of fecal coliform bacteria in the watershed for use in the water quality model, and the development of the TMDL. The general sources of fecal coliform bacteria are point and non-point sources. National Pollutant Discharge Elimination System (NPDES) permittees discharging treated domestic waste are the primary point sources of fecal coliform bacteria.

Nonpoint sources of fecal coliform bacteria are diffuse sources that cannot be identified as entering the water body at a single location. These sources generally involve land activities that contribute fecal coliform bacteria to streams during a rainfall runoff event. Nonpoint sources of fecal coliform bacteria considered in the analysis include:

- Wildlife,
- Land application of agricultural manure,
- Grazing animals,
- Leaking septic systems, and
- Urban development.

For nonpoint sources involving agricultural activities, the Natural Resources Conservation Service (NRCS) was consulted for information and parameters to be used to characterized agricultural activities represented in the water quality model.

3.1 Point Source Assessment

There is one permitted NPDES discharge of fecal coliform bacteria identified in the Franks Creek watershed upstream of the listed segment. This facility is the City of Hahira WPCP (GA0037974). The facility has a permitted flow rate of 0.275 MGD and discharges into an unnamed tributary to Franks Creek. However, this point source does not discharge during critical period. Future facility permits will require end-of-pipe criteria equivalent to the water quality standard of 200 counts/100 ml.

3.2 Nonpoint Source Assessment

3.2.1 Wildlife

Wildlife deposit fecal coliform bacteria with their feces onto the land where it can be transported during a rainfall runoff event to nearby streams. In the water quality model, the wildlife fecal coliform contribution is accounted for in the deer population. The deer population is estimated to be 30 to 45 animals per square mile in this area (personal communication, NRCS and Georgia WRD State Deer Biologist, Nov. 1999). The upper limit of 45 deer per square mile has been chosen to account for deer and all other wildlife present in the watershed. It is assumed that the wildlife population remains constant throughout the year, and that wildlife is uniformly distributed on all land classified in the MRLC database as forest, pasture, cropland, and wetlands.

3.2.2 Land Application of Agricultural Manure

Processed agricultural manure from confined hog, dairy cattle, and poultry operations is generally collected in lagoons and applied to land surfaces during the months April through October. Hog

manure is applied only to cropland. NRCS estimates that 75 percent of cattle manure and poultry litter is applied to cropland and 25 percent is applied to pasture land. Manure application rates are included in Appendix A.

Data sources for confined feeding operations include the 1997 Census of Agriculture. Table 3 shows animal distribution in the watershed. The livestock data are also based on the 1997 Census of Agriculture and is reported by county. The county data are distributed to the watersheds based on the percentage of agricultural area in each subwatershed classified as pasture/hay. Cattle numbers reported in the census data also represent other breeds of cattle and calves besides dairy and beef.

Table 3. Livestock Distribution

Livestock	Franks Creek (animals)
Beef Cow	769
Milk Cow	0
Cattle	1451
Chickens	0
Chickens Sold	0
Hogs	966
Sheep	0

Hog farms in the watershed operate by confining the animals or allowing them to graze in small pastures or pens. It is assumed that all of the hog manure produced by either farming method is applied evenly to available cropland. Application rates of hog manure to cropland vary monthly according to management practices.

As shown in Table 3, cattle operations in the watershed are exclusively beef cattle. There are no dairy or chicken farms operating in the watershed.

3.2.3 Grazing Animals

Cattle, including beef and hogs, spend time grazing on pasture land and depositing manure onto the land. During a rainfall runoff event, a portion of this manure containing fecal coliform bacteria is transported to streams.

In south Georgia, animal access to pasture land varies monthly, resulting in varying fecal coliform loading rates throughout the year. Beef cattle spend all their time in pasture, while dairy cattle and hogs are confined periodically. The percentage of manure deposited during grazing time is used to estimate the fecal coliform loading rates from pasture land.

In addition, cattle and other unconfined animals often have direct access to streams that pass through pastures. Manure deposited in these streams by grazing animals is included in the water quality model as a point source having constant flow and concentration. To calculate the amount of bacteria introduced into streams by cattle, it is assumed that only beef cow population have access to the streams and of those approximately 12 percent defecate in the stream (personal communication, EPA, NRCS, Univ. of GA, Georgia Agribusiness Council, and others).

3.2.4 Leaking Septic Systems

Table 4 shows estimates from county census data of people in the watershed on septic systems. In south Georgia, USEPA estimates that there are approximately 2.37 people per household on septic systems. For modeling purposes, it is assumed that 20 percent of the septic systems in the watershed leak. Leaking septic systems are included in the water quality model as a point source having constant flow and concentration.

Table 4. Septic Systems

Watershed	Number of Septic Systems
Franks Creek	1014

3.2.5 Urban Development

Fecal coliform bacteria from urban areas may originate from various sources including urban runoff (e.g., residential, commercial, industrial, and road transportation), illicit discharges of sanitary waste, and runoff from improper disposal of waste materials. Overflowing sanitary sewers and leaking collection lines are not considered a source of fecal coliform bacteria in the Franks Creek watershed.

4.0 MODELING APPROACH

Establishing the relationship between the in-stream water quality and the source loadings is an important component of TMDL development. It provides for both the identification of sources, and their relative contribution, as well as the examination of potential water quality changes resulting from varying management options to meet the water quality standard. This relationship can be developed using a variety of techniques ranging from qualitative assumptions based on scientific principles to numerical computer modeling techniques. In this section, the numerical modeling techniques developed to simulate fecal coliform bacteria fate and transport in the watershed are discussed.

4.1 Model Selection

A dynamic computer model was selected for the fecal coliform bacteria TMDL evaluation in order to satisfy a variety of objectives. The first objective is to simulate the time varying behavior of fecal coliform bacteria deposition on the land surface and transport to receiving water bodies. The second objective was to use a continuous simulation period to identify the critical condition and from which to develop the TMDL. Finally, the continuous simulation model provides the means to incorporate seasonal effects on the production and fate of fecal coliform bacteria. A series of computer-based tools were used to accomplish these objectives.

First, the Watershed Characterization System (WCS – developed by EPA and Tetra tech), a geographic information system (GIS) tool, was used to display and analyze GIS information including land use, land type, point source discharges, soil types, population, and stream characteristics. The WCS was used to identify and summarize the sources of fecal coliform bacteria in the watershed, as well the other factors that affect its fate and transport.

Information collected using WCS was used in a series of spreadsheet applications designed to compute fecal coliform bacteria loading rates in the watershed from varying land uses including urban, agricultural, and forestry as described in Section 3.0. Computed loading rates were used in a hydrologic and water quality model, NPSM (Non-Point Source Model), to simulate the deposition and transport of fecal coliform bacteria, and the resulting water quality response. The NPSM program uses the Hydrologic Simulation Program Fortran (HSPF) to develop the TMDL. NPSM simulates nonpoint source runoff as well as the transport and flow of pollutants in stream reaches. A necessary feature of NPSM is its ability to integrate both point and nonpoint sources of fecal coliform bacteria and determine the in-stream water quality response.

4.2 Model Set Up

The Franks Creek watershed was delineated in order to characterize the relative fecal coliform bacteria contributions from the significant contributing area (see Figure 2). Watershed delineation was based on the RF3 stream coverage and elevation data. In addition, this discretization allows for management and load reduction alternatives to be varied by subwatershed.

A continuous simulation period from January 1, 1988 to December 31, 1998, was used in the analysis. The period from January 1, 1988 to December 31, 1988, was used to allow the model results to stabilize. The period from January 1, 1989 to December 31, 1998, was used to identify the critical condition period from which to develop the TMDL. Since field data were collected during the period January 1, 1998 to December 31, 1998, this period was used for model calibration.

An important factor driving model results is the precipitation data contained in the meteorological data file used in the simulation. The pattern and intensity of rainfall affects the build-up and wash-off

of fecal coliform bacteria from the land into the streams, as well as the dilution potential of the stream. Data from the Valdosta, Georgia meteorological station were used in the simulation.

4.3 Fecal Coliform Bacteria Source Representation

Both point and nonpoint sources of fecal coliform bacteria are represented in the water quality model. Because of varying decay or die-off rates for fecal coliform bacteria, and varying transport assumptions, the fecal coliform bacteria loadings from these sources are computed separately. The following sections describe the assumptions used for the various sources described in Section 3.0.

4.3.1 NPDES Discharge

There is one permitted NPDES discharge of fecal coliform bacteria identified in the Franks Creek watershed upstream of the listed segment. This facility is the City of Hahira WPCP (GA0037974). The facility has a permitted flow rate of 0.275 MGD and discharges into an unnamed tributary to Franks Creek. However, this point source does not discharge during critical period. Future facility permits will require end-of-pipe criteria equivalent to the water quality standard of 200 counts/100 ml.

4.3.2 Wildlife

Fecal coliform contributions from wildlife are represented in the model based on deer population. In the model, deer are uniformly distributed to forest, pasture, cropland and wetland areas at a density of 45 deer per square mile. The assumed loading rate from wildlife is 5.0×10^{8} counts/animal/day. This is based upon best professional judgment.

4.3.3 Land Application of Agricultural Manure

Fecal coliform accumulation and build-up rates resulting from the land application of hog and cattle manure and poultry litter are represented using monthly input values. The animal fecal loading rates are: 1.24×10^{10} counts/day/hog (NCSU, 1994) and 1.06×10^{11} counts/day/cow (NCSU, 1994).

4.3.4 Grazing Animals

Beef cows and other cattle in the watershed contribute manure containing fecal coliform bacteria directly to pastures during grazing. Because there is no monthly variation in animal access to pastures in south Georgia, the fecal loading rates to pasture land does not vary significantly throughout the year. Contributions of fecal coliform from wildlife are included in the pasture loading rate.

4.3.5 Urban Development

Urban land use represented in the MRLC database includes areas classified as: high intensity commercial, industrial, transportation, low intensity residential, high intensity residential, and transitional. A single, area-weighted loading rate from urban areas is used in the model and is

based on the percentage of each urban land use type in the watershed and build-up and accumulation rates referenced in Horner (1992). This rate of 5.97 x 10^7 counts/acre-day is assumed constant throughout the year.

4.4 Model Calibration

The calibration of the watershed model involves both hydrology and water quality components. The hydrology calibration is performed first and involves comparing simulated streamflows to historic

streamflow data from a U.S. Geological Survey (USGS) stream gaging station for the same period of time. Calibration of the hydrologic model involves adjusting model parameters (e.g., evapotranspiration, infiltration, upper and lower zone storage, groundwater storage and recession, and interflow discharge) used to represent the hydrologic cycle, until an acceptable agreement is achieved between simulated and observed streamflows. There is no streamflow gage in the Franks Creek watershed. The USGS gage 023177483 located on the Withlacoochee River was used to calibrate the flow model. Results of the hydrology calibration are included in Appendix B.

The only fecal coliform bacteria data available for Franks Creek were those data collected during 1998. These data were used to calibrate the water quality model. Model calibration results are shown in Appendix B. Results show that the model adequately simulates peaks in fecal coliform bacteria in response to rainfall events. Often a high observed value is not simulated in the model due to lack of rainfall at the meteorological station as compared to the rainfall occurring in the watershed, or an unknown source that is not included in the model. A comparison of simulated and observed water quality concentrations for the station on Franks Creek are included in Appendix B.

4.5 Critical Conditions

The critical condition for fecal coliform impairment from nonpoint sources is a rainfall runoff event preceded by an extended period of dry weather. The dry weather allows a build-up of fecal coliform bacteria, which is then washed off the ground by rainfall. Critical conditions for point sources occur during low flow and corresponding reduced dilution. Both conditions are simulated in the NPSM model.

The ten-year simulation period from January 1, 1989 to December 31, 1998, was used to identify the critical conditions from which to base the fecal coliform bacteria TMDL. This ten-year period contained a range of hydrological conditions including low and high streamflows. The range of hydrological conditions provided an opportunity to identify the conditions critical to fecal coliform bacteria, as well as the amount of in-stream fecal coliform bacteria in the stream that can be used to develop the TMDL.

5.0 MODEL RESULTS

5.1 Existing Conditions

Model results indicate that the primary source of fecal coliform bacteria contamination in the Franks Creek watershed is from agricultural runoff and direct input of fecal coliform bacteria into the stream from various sources (e.g., illicit dischargers, cattle, wild hogs, and other animals having access to streams and wetlands). Leaking septic systems also contribute to fecal coliform bacteria contamination in the Franks Creek watershed. Nonpoint source loading rates representing existing model conditions are shown in Table 5.

Table 5. Nonpoint Source Loading Rates for Existing Conditions

Watershed ID	Runoff from all Lands (Counts / 30 day)	Septic Failure (Counts / 30 day)	Unknown Sources (Counts / 30 day)
Franks Creek	4.81×10^{13}	1.65×10^{10}	2.02×10^{10}

5.2 Critical Condition

Results of the ten-year simulation for existing conditions are shown in Figure 3. From this figure critical conditions can be determined. The 30-day critical period in the model is the time period preceding the largest simulated violation of the geometric mean standard (EPA, 1991). Achieving water quality standards during this time period ensures that water quality standards can be achieved for the ten-year period. For the listed segments in the Franks Creek watershed, the highest violation of the 30-day geometric mean occurred on June 29, 1993. The critical period is May 30, 1993 through June 28, 1993.

6.0 ALLOCATION

6.1 Total Maximum Daily Load

A TMDL is the sum of the individual waste load allocations (WLA) for point sources and load allocations (LA) for nonpoint sources and natural background (40 CFR 130.2). The sum of these components may not result in an exceedence of water quality standards for that water body. To protect against exceedences, the TMDL must also include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the water quality response of the receiving water body. Conceptually, a TMDL can be expressed as follows:

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while maintaining water quality standards. TMDLs establish allowable pollutant loadings that are less than or equal to the TMDL, and thereby provide the basis to establish water quality based controls. For some pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). For fecal coliform bacteria the TMDL are expressed as counts per 30 days. Therefore, the TMDL represents the maximum fecal coliform bacteria load that can be assimilated by the stream during the critical 30-day period while maintaining the fecal coliform bacteria water quality standard of 200 counts/100 ml.

The total maximum daily load of fecal coliform bacteria was determined by adding the WLA and the LA. The MOS (as described in Section 6.5) was implicitly included in the TMDL analysis and does not factor directly in the TMDL equation as shown above. Table 6 shows the computation of the total maximum daily load using the WLAs and the LAs for the critical condition. The TMDLs are summarized in Appendix C. The TMDL for fecal coliform bacteria in Franks Creek is 3.17×10^{12} counts per 30 days.

6.2 Waste Load Allocations

There is one permitted NPDES discharge of fecal coliform bacteria identified in the Franks Creek watershed upstream of the listed segment. This facility is the City of Hahira WPCP (GA0037974). The facility has a permitted flow rate of 0.275 MGD and discharges into an unnamed tributary to Franks Creek. However, this point source does not discharge during critical period. Future facility permits will require end-of-pipe criteria equivalent to the water quality standard of 200 counts/100 ml.

6.3 Load Allocations

The nonpoint fecal coliform bacteria sources in the model have two transportation modes. First, animals in the stream, leaking septic systems, and leaking sewer collection lines are modeled as direct sources to the stream. The other nonpoint sources result from fecal coliform bacteria that are applied to land. Fecal coliform applied to land is subject to a die-off rate and an absorption rate before it is transported to the stream.

Model results indicate that nonpoint sources related to agricultural practices have a significant impact on the fecal coliform bacteria loadings in the watersheds. Leaking septic systems and stormwater runoff from urban areas are considered secondary sources of fecal coliform.

Reductions in these loading rates in the Franks Creek watershed reduce the in-stream fecal coliform bacteria levels.

A possible allocation scenario that would meet in-stream water quality standards is a 94 percent reduction in runoff from nonpoint sources and a 30 percent reduction in direct input to the stream (e.g., animal access and failing septic systems). Fecal coliform loading rates for this allocation scenario are shown in Table 5. Fecal coliform loading from wildlife is represented in the model as background conditions. Management practices that could be used to implement this TMDL include adoption of NRCS resource management practices including covering manure and poultry litter stacks exposed to the environment; reducing animal access to streams; and applying manure to croplands at agronomical rates. Replacement of leaking septic systems and controlling stormwater runoff from urban areas could also improve water quality. Best management practices (BMPs) should be developed to address urban and agricultural runoff during extreme storm events. Additional monitoring and characterization of the watershed could be conducted to verify the various unknown sources of fecal coliform bacteria in the watershed.

Table 5. Load Allocations in the Franks Creek Watershed

Watershed ID	Existing Load (Counts / 30 days)	Allocated Load (Counts / 30 days)	Percent Reduction
Franks Creek	4.92×10^{13}	3.17×10^{12}	94

Table 6. TMDL Components (counts/30 days)

Watershed ID	WLA	LA	MOS	TMDL
Franks Creek	0	3.17×10^{12}	Implicit	3.17×10^{12}

6.4 Seasonal Variation

Seasonal variability was incorporated in the continuous simulation water quality model by using varying monthly loading rates and daily meteorological data. The combination of a continuous simulation with varying loading rates and meteorological conditions creates a condition of seasonal variation.

6.5 Margin of Safety

The MOS is a required component of TMDL development. There are two basic methods for incorporating the MOS: 1) Implicitly incorporate the MOS using conservative model assumptions to develop allocations; or 2) Explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For this TMDL the MOS was implicitly incorporated into the modeling process by selecting a critical time period and critical default values for each of the summer and winter seasons based on the results of a 10-year simulation.

7.0 Recommendations

7.1 Monitoring

GAEPD has adopted the Basin Approach to Water Quality Management, a plan that divides Georgia's major river basins in to five groups. During each year-long cycle, GAEPD's water quality monitoring resources are concentrated in one of the basin groups. In watersheds identified as having both urban and agricultural activities, microbial source tracking may be used in the future to clarify the specific sources of fecal coliform bacteria. During the next phase of monitoring in the south Georgia river basins, water quality monitoring in the watershed will identify current water quality conditions resulting from the implementation of management practices. Additional characterization may be needed in the watershed to clarify the unknown sources of fecal coliform bacteria.

7.2 Point and Nonpoint Approaches

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

7.3 Public Participation

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

REFERENCES

American Society of Agricultural Engineers (ASAE), 1998. ASAE Standards, 45th Edition, Standards Engineering Practices Data.

GAEPD, *Rules and Regulations For Water Quality Control, Chapter 391-3-6,* April 2000, Georgia Department of Natural Resources, Environmental Protection Division.

Horner, 1992. Water Quality Criteria/Pollutant Loading Estimation/Treatment Effectiveness Estimation. In R.W. Beck and Associates, Covington Master Drainage Plan, King County Surface Water Management Division, Seattle, Washington.

Horsley & Whitten, Inc., 1996. Identification and Evaluation of Nutrient Bacterial Loadings to Maquiot Bay, Brunswick and Freeport, Maine. Casco Bay Estuary Project.

Metcalf & Eddy, 1991. *Wastewater Engineering: Treatment, disposal, Reuse,* Third Edition, McGraw-Hill, Inc., New York.

North Carolina State University (NCSU), Livestock Manure Production and Characterization in North Carolina, North Carolina Cooperative Extension Service, NCSU College of Agriculture and Live Sciences, Raleigh, NC, January1994.

USEPA. 1991a. *Guidance for Water Quality –based Decisions: The TMDL Process.* U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA-440/4-91-001, April 1991.

USEPA, 1998. Better Assessment Science Integrating Point and Nonpoint Sources (BASINS), Version 2.0 User's Manual, U.S. Environmental Protection Agency, Office of Water, Washington D.C.

APPENDIX A

Water Quality Model Assumptions

Figure 1. Location Map

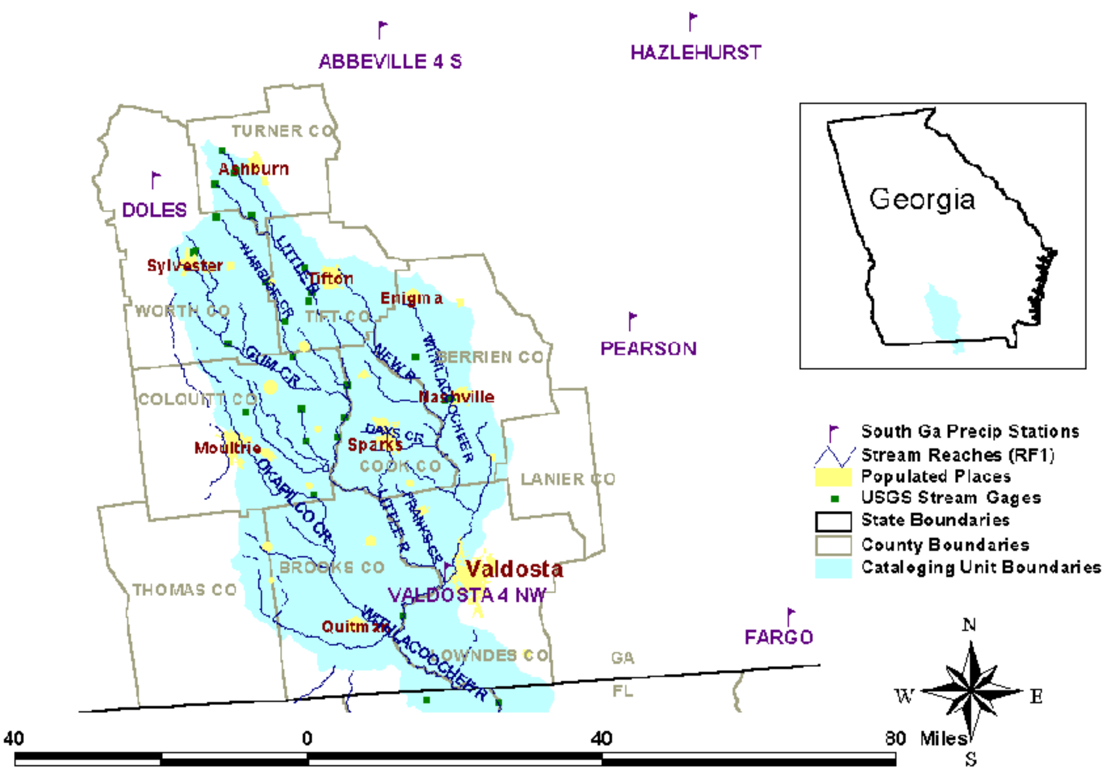
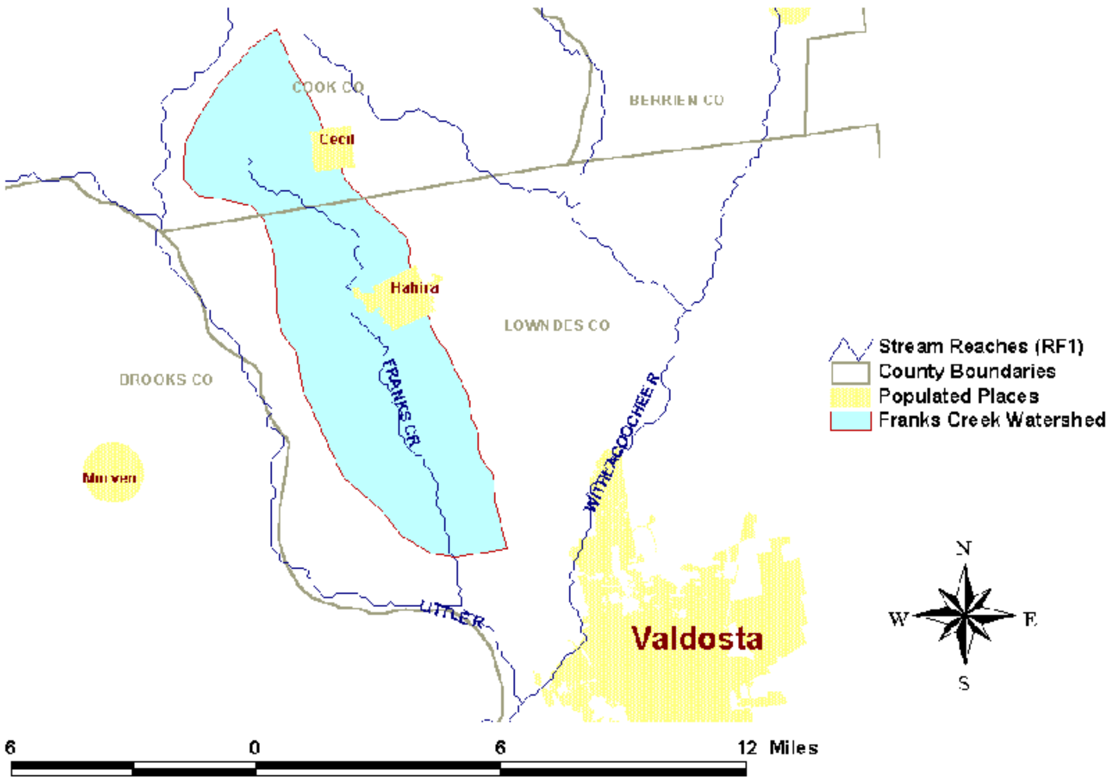


Figure 2. Franks Creek Watershed



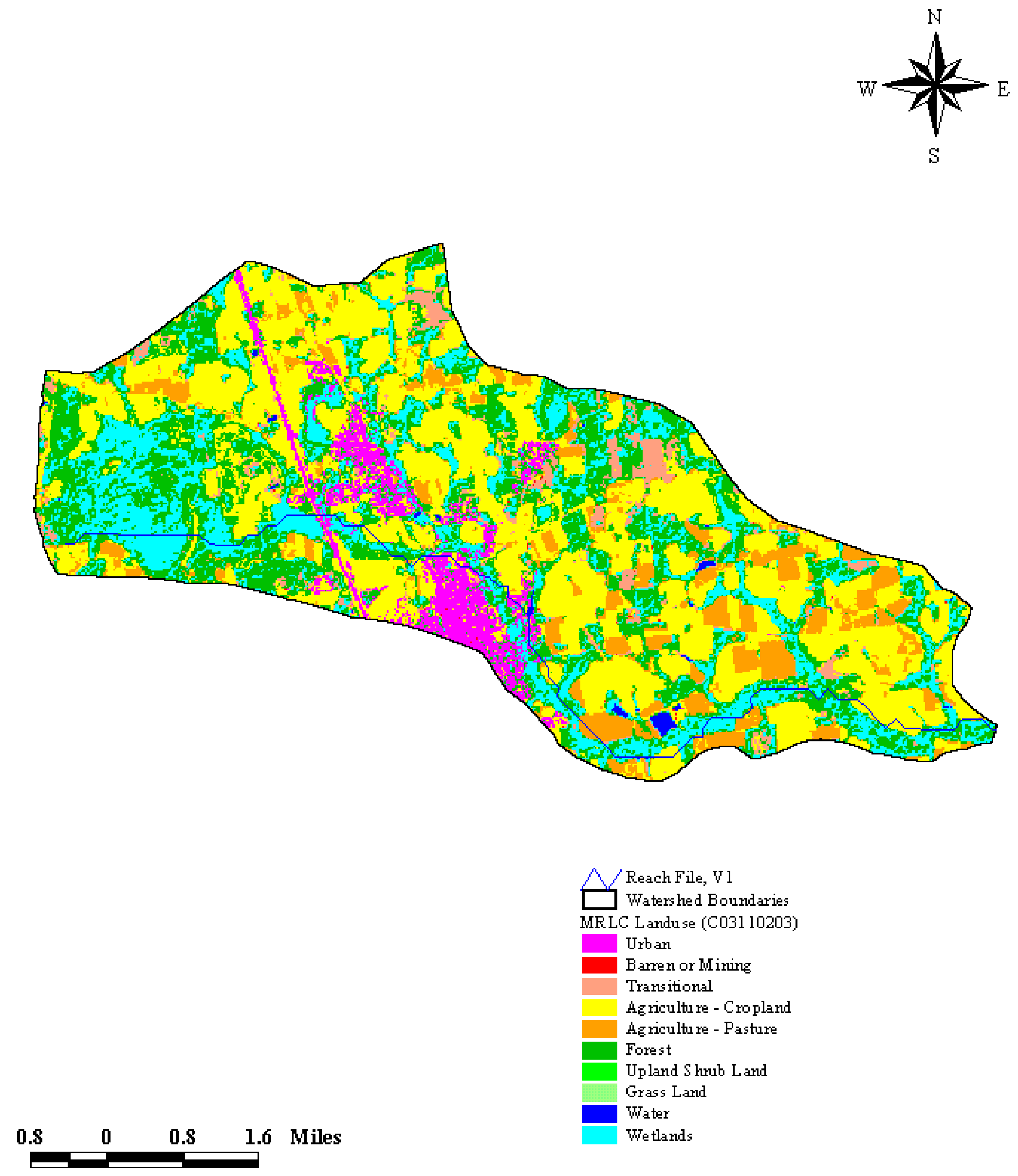


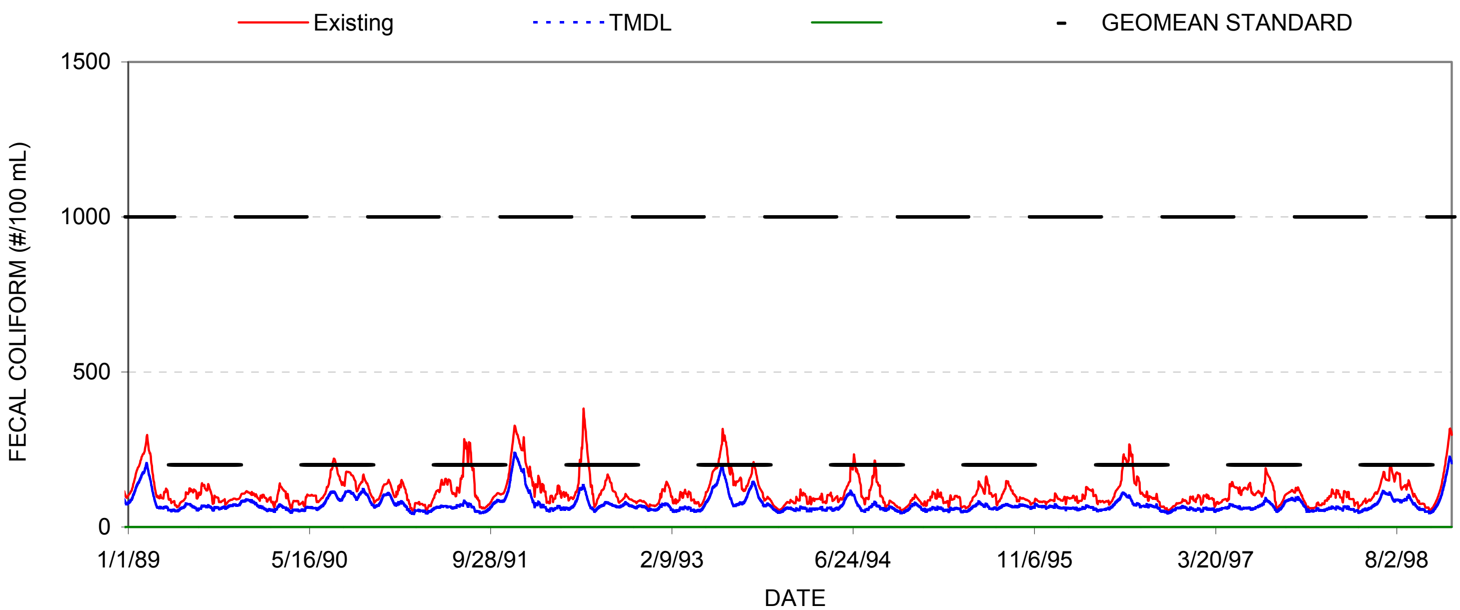
**Figure 3. Land Use Map.
Bear Creek Watershed**

Map Projection: Albers Equal Area Conic
Datum: NAD83
Sphere: GRS 80

Data Sources USEPA; MRLC, 1994

Figure 4. Simulated Geometric Mean of Existing and Allocated Fecal Coliform Bacteria Levels

STATION: FRANKS CR (090390001)



This sheet contains information relevant to land application of waste produced by agricultural animals in the study area.

Application of hog manure, beef cattle manure, dairy cattle manure, horse manure, poultry litter, and manure from import are considered.
Manure generated by in-county animals is assumed to be applied fresh (thus fecal content from fresh manure is used in calculations).
Manure values can be varied using a multiplication factor, in order to consider die-off due to known treatment/storage methods.
Manure imported into the county is assigned a fecal coliform content based on known storage/treatment methods.
The information is presented based on monthly variability of waste application.
note: the fecal die-off rates (fecal content multiplier) are assumed values, adjust accordingly

Hog Manure Available for Wash-off

Storage/treatment of manure prior to application may affect the fecal coliform content in the manure.
The multiplier below can be used to increase or decrease the fecal content in manure that is applied (to consider storage/treatment)
Manure fecal content multiplier 0.75 note: set to 1 for TMDL

This is the fraction of the annual manure application that is applied each month.

	January	February	March	April	May	June	July	August	September	October	November	December	
Fraction of manure applied each month	0	0	0.075	0.1575	0.1335	0.1335	0.1335	0.1335	0.1585	0.075	0	0	1

The fraction of manure available for runoff is dependent on the method of manure application. The fraction available is computed below based on incorporation into soil. These are assumed values.
Fraction incorporated into soil (assumed) 0.80 FRACTION AVAIL FOR RUNOFF = 0.6 = (1 - [fraction incorporated]) + ([fraction incorporated] * 0.5)
Fraction available for runoff 0.6000 For TMDL use NRCS RATE: 0.3354 (INCLUDES DIE OFF)

The following is the resulting fraction of annual manure application available for runoff each month based on the monthly fraction applied and incorporation into the soil.

COUNTY ID	January	February	March	April	May	June	July	August	September	October	November	December
13075	0	0	0.045	0.0945	0.0801	0.0801	0.0801	0.0801	0.0951	0.045	0	0

Beef Cattle Manure Available for Wash-off

Storage/treatment of manure prior to application may affect the fecal coliform content in the manure.
The multiplier below can be used to increase or decrease the fecal content in manure that is applied (to consider storage/treatment)
Manure fecal content multiplier 1 (a value of 1 assumes fresh application) for calibration run and TMDL set to 1

This is the fraction of the annual manure application that is applied each month.

	January	February	March	April	May	June	July	August	September	October	November	December	
Fraction of manure applied each month	0.0833	0.0833	0.0833	0.0833	0.0833	0.0834	0.0834	0.0834	0.0834	0.0833	0.0833	0.0833	1

The fraction of manure available for runoff is dependent on the method of manure application. The fraction available is computed below based on incorporation into soil. These are assumed values.
Fraction incorporated into soil (assumed) 0.80 FRACTION AVAIL FOR RUNOFF = 0.6 = (1 - [fraction incorporated]) + ([fraction incorporated] * 0.5)
Fraction available for runoff 0.6000 For TMDL use NRCS RATE= 0.0098 (INCLUDES DIE OFF)

	% Applied to Cropland:	0.00	% Applied to Pastureland:	1.00	1

The following is the resulting fraction of annual manure application available for runoff each month based on the monthly fraction applied and incorporation into the soil.

COUNTY ID	January	February	March	April	May	June	July	August	September	October	November	December
13075	0.04998	0.04998	0.04998	0.04998	0.04998	0.05004	0.05	0.05004	0.05004	0.04998	0.04998	0.04998

Poultry Litter Available for Wash-off

Storage/treatment of manure prior to application may affect the fecal coliform content in the manure.
The multiplier below can be used to increase or decrease the fecal content in manure that is applied (to consider storage/treatment)
Manure fecal content multiplier 0.5 (a value of 1 assumes fresh application) For TMDL set to 1

This is the fraction of the annual litter application that is applied each month.

	January	February	March	April	May	June	July	August	September	October	November	December	
Fraction of litter applied each month	0	0	0.075	0.1575	0.1335	0.1335	0.1335	0.1335	0.1585	0.075	0	0	1

The fraction of litter available for runoff is dependent on the method of litter application. The fraction available is computed below based on incorporation into soil. These are assumed values.
Fraction incorporated into soil (assumed) 0.96 FRACTION AVAILABLE FOR RUNOFF: 0.36 = (1 - [fraction incorporated]) + ([fraction incorporated] * 0.33)
Fraction available for runoff 0.36000 NRCS VALUES : 0.2029 FOR LAYERS; 0.00496 FOR BROILERS **FOR TMDL USE 0.00496**

	% Applied to Cropland:	0.40	% Applied to Pastureland:	0.60	1

The following is the resulting fraction of annual litter application available for runoff each month based on the monthly fraction applied and incorporation into the soil.

COUNTY ID	January	February	March	April	May	June	July	August	September	October	November	December
13075	0	0	0.027	0.0567	0.04806	0.04806	0.0481	0.04806	0.05706	0.027	0	0

Dairy Cattle Manure Available for Wash-off

Storage/treatment of manure prior to application may affect the fecal coliform content in the manure.
The multiplier below can be used to increase or decrease the fecal content in manure that is applied (to consider storage/treatment)
Manure fecal content multiplier 1 (a value of 1 assumes fresh application) for TMDL set to 1

This is the fraction of the annual manure application that is applied each month.

	January	February	March	April	May	June	July	August	September	October	November	December	
Fraction of manure applied each month	0	0.0835	0.075	0.1585	0.05	0.1335	0.05	0.1335	0.075	0.1585	0	0.0825	1

The fraction of manure available for runoff is dependent on the method of manure application. The fraction available is computed below based on incorporation into soil. These are assumed values.
Fraction incorporated into soil (assumed) 0.80 FRACTION AVAILABLE FOR RUNOFF: 0.6 = (1 - [fraction incorporated]) + ([fraction incorporated] * 0.5)

Fraction available for runoff 0.6000 NRCS VALUES: 0.0965 GRAZING; 0.2048 CONFINED (FOR TMDL, ASSUME CONFINED CONDITIONS)

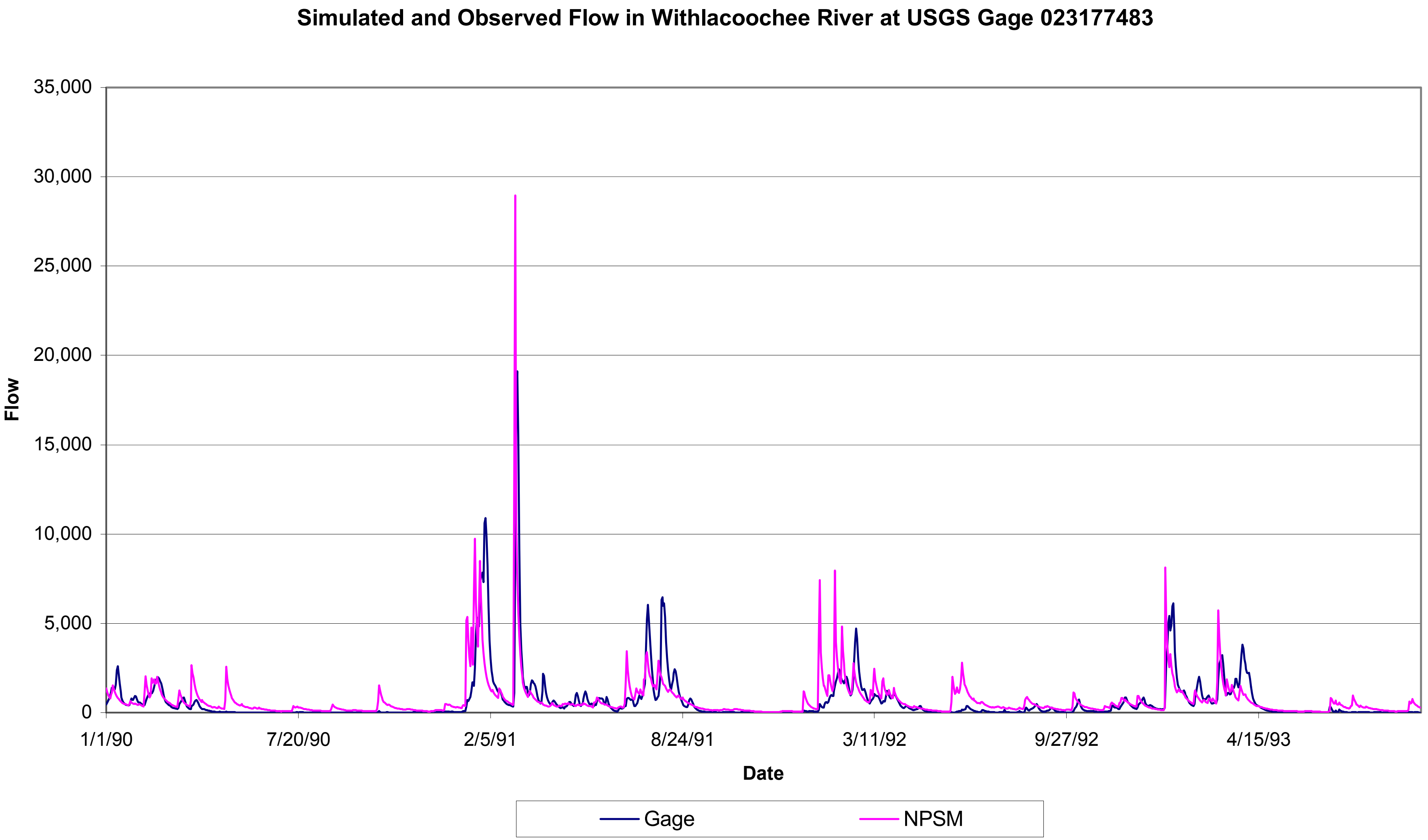
% Applied to Cropland: 0.75 % Applied to Pastureland: 0.25 **1**

The following is the resulting fraction of annual manure application available for runoff each month based on the monthly fraction applied and incorporation into the soil.

COUNTY ID	January	February	March	April	May	June	July	August	September	October	November	December
13075	0	0.0501	0.045	0.0951	0.03	0.0801	0.03	0.0801	0.045	0.0951	0	0.0495

APPENDIX B

Hydrodynamic and Water Quality Model

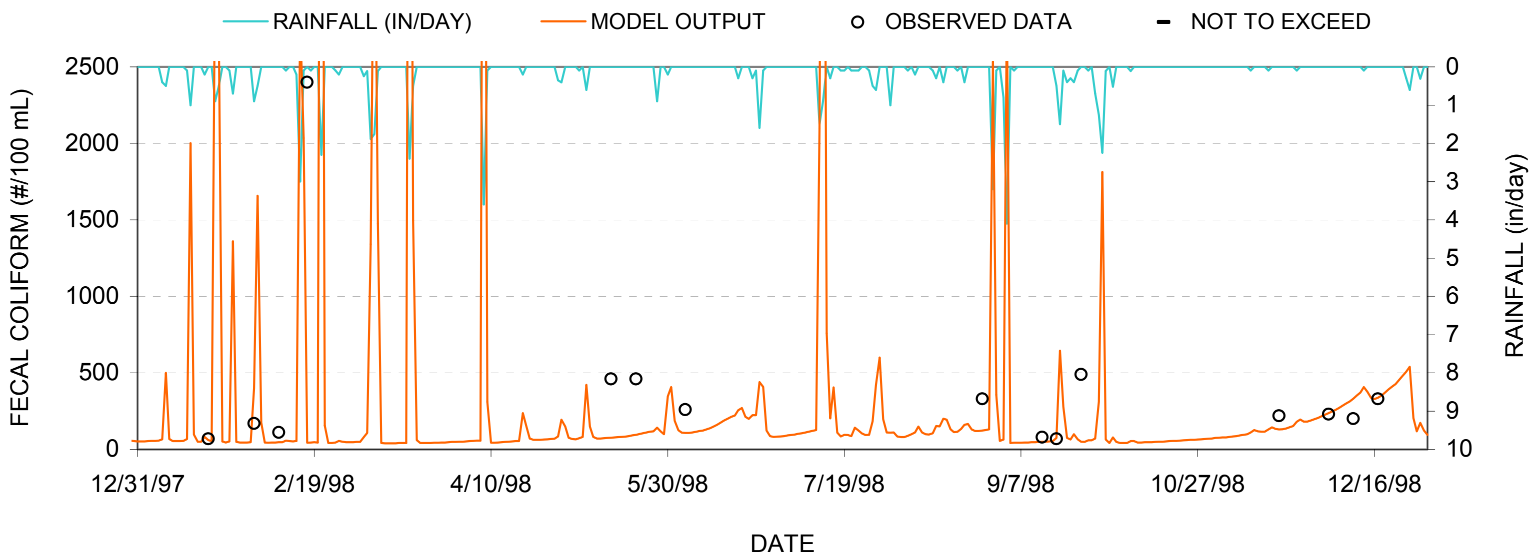

Simulated and Observed Flow in Withlacoochee River at USGS Gage 023177483
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Flow
1/1/90
7/20/90
2/5/91
8/24/91
3/11/92
9/27/92
4/15/93
Date
Gage
NPSM

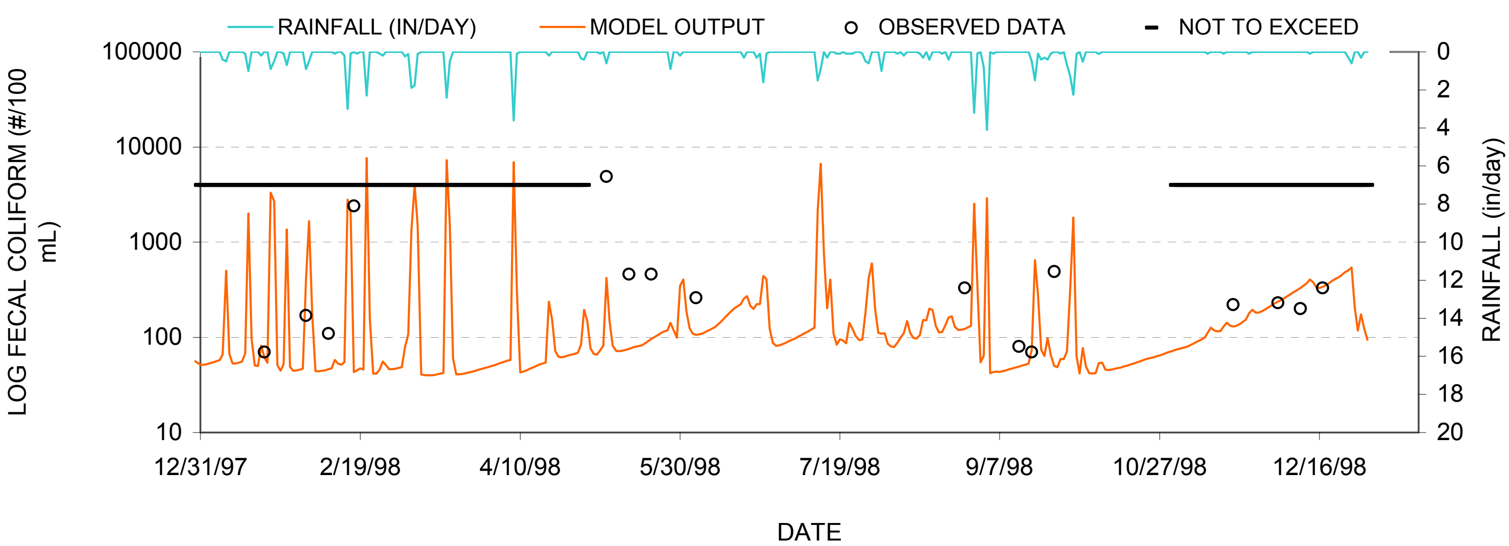
FECAL COLIFORM WATER QUALITY CALIBRATION
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **FRANKS CR (090390001)**

MODEL RUN: 1

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2





APPENDIX C

Total Maximum Daily Load
Summary Memorandum

SUMMARY MEMORANDUM
Total Maximum Daily Load (TMDL)
Franks Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Cook**
Major River Basin:	**Suwannee**
12-Digit Hydrologic Unit Code(s):	**030702020403**
Waterbody Name:	**Franks Creek**
Location:	**State Route S1780 to Little River near Hahira**
Stream Length:	**9 mile**
Watershed Area:	**40 square miles**
Tributary to:	**Little River, which flows in the Withlacoochee River**
Constituent(s) of Concern:	**Fecal Coliform Bacteria**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:

May through October fecal coliform not to exceed a geometric mean of 200 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours. For the months of November through April, fecal coliform not to exceed a geometric mean of 1,000 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours and not to exceed a maximum of 4,000 per 100 ml for any sample.

2. TMDL Development

Analysis/Modeling:

The Non-Point Source Model (NPSM)/Hydrologic Simulation Program Fortran (HSPF) was used to develop this TMDL. A daily time step was used to simulate hydrologic and water quality conditions. The model was developed for the entire watershed upstream from the 303(d) listed segment.

Critical Conditions:

A simulation period of 10 years was used to assess the water quality standards for this TMDL. This period represents a range of hydrologic and meteorologic conditions.

Seasonal Variation:

A simulation period of 10 years was used to assess the water quality standards for this TMDL. This period represents a range of hydrologic and meteorologic conditions including seasonal variations.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA): 0 counts/30 days
Note: All future permitted discharges shall meet the water quality standard for fecal coliform bacteria of 200/100 ml as a geometric mean.

Load Allocation (LA): 3.17×10^{12} counts/30 days

Margin of Safety (MOS): Implicit (conservative modeling assumptions)

Total Maximum Daily Load (TMDL): 3.17×10^{12} counts/30 days