Watershed Characterization Document for Cane and Little Cane Creeks (Hydrologic Unit Code: 03060101-050 & Stations SV-342 & SV-343) Fecal Coliform Bacteria

May 2005

SCDHEC Technical Report Number: 017-05

EPA United States Environmental Protection Agency

Region 4 serving the southeast

In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et.seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S Environmental Protection Agency is hereby establishing a Total Maximum Daily Load (TMDL) for Fecal Coliform for Cane Creek and Little Cane Creek in the Savannah River Basin. Subsequent actions must be consistent with this TMDL.

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Abstract

Total Maximum Daily Loads (TMDLs) have been developed for Cane and Little Cane Creeks, which are tributaries of Lake Keowee in Oconee County, SC. These two creeks, Cane Creek at water quality monitoring station SV-342 (at S-37-63 bridge) and Little Cane Creek at SV-343 (at S-37-63 bridge) have been on South Carolina's 303(d) list since 1998. During the assessment period for the 2004 303(d) list (1998-2002), 29 % of samples from Cane Creek and 52 % of samples from Little Cane Creek violated the standard. The watershed of Cane Creek is largely forested, but has some urban land (part of the town of Walhalla) and pasture and crop land. Little Cane Creek's watershed is similar, except for little urban land. There are no point sources in the either watershed. The probable sources of fecal coliform bacteria in the creeks are runoff from agricultural land, cattle-in-streams, failing septic systems, and in Cane Creek urban runoff, sewer overflows, and sewer leaks.

The load-duration curve methodology was used to calculate the existing loads and the TMDL loads for both creeks. The existing loads were estimated to be 4.2E+11 cfu/day for Cane and 5.2E+11 cfu/day for Little Cane. The TMDL loads were determined to be 2.0E+11 cfu/day and 1.8E+11 cfu/day, respectively. In order to reach the target load for Cane Creek, a reduction in the existing load to Cane Creek of 54 % will be necessary. For Little Cane Creek a reduction of 65 % will be required. Resources and several TMDL implementation strategies to bring about this reduction are suggested.

Table of Contents

Tables and Figures

Tables

Figures

1.0 INTRODUCTION

1.1 Background

Levels of fecal coliform bacteria can be elevated in water bodies as the result of both point and nonpoint sources of pollution. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for water bodies that are not meeting designated uses under technology-based pollution controls. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body 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 and restore and maintain the quality of water resources (USEPA 1991).

1.2 Watershed Description

The watersheds of Cane and Little Cane Creeks are in Oconee County, in the foothills of the Blue Ridge Mountains of northwestern South Carolina (Figure 1). Little Cane Creek is a tributary of Cane Creek, which flows into Lake Keowee. Most of the towns of Walhalla and West Union are in the Cane Creek watershed. There are only several small built-up areas in the Little Cane Creek watershed. Approximately 4500 people live in the Cane Creek watershed and 1700 in the Little Cane Creek watershed (2000 US Census). These TMDLs include those parts of the watersheds upstream of the water quality stations. Information about the watersheds is given in Table 1.

Table 1. Cane and Little Cane Creek Watershed Descriptions.

Watershed	Station ID	Sampling Station Description	Drainage Area Km^2	Drainage Area mi^2
Cane Creek	SV-342	Cane Creek at S-37-63	39.5	(15.3)
Little Cane Creek	SV-343	Little Cane Creek at S-37-63	36	(13.9)

Forest is the principal land use in both Cane and Little Cane Creek watersheds, 76 % and 90 %, respectively. Cane Creek has significant developed land (11 %), but Little Cane Creek does not. Both watersheds have 6 –7 % pasture and smaller percentages of cropland. These land use data are from the National Land Cover Data 1992 (NLCD 1992) (Figures 2 and 3; Tables 1 and 2).

1.3 Water Quality Standard

The impaired stream segments, Cane and Little Cane Creeks, are designated as Class Freshwater. Waters of this class are described as follows:

> "Freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department. Suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Suitable also for industrial and agricultural uses." (R.61-68)

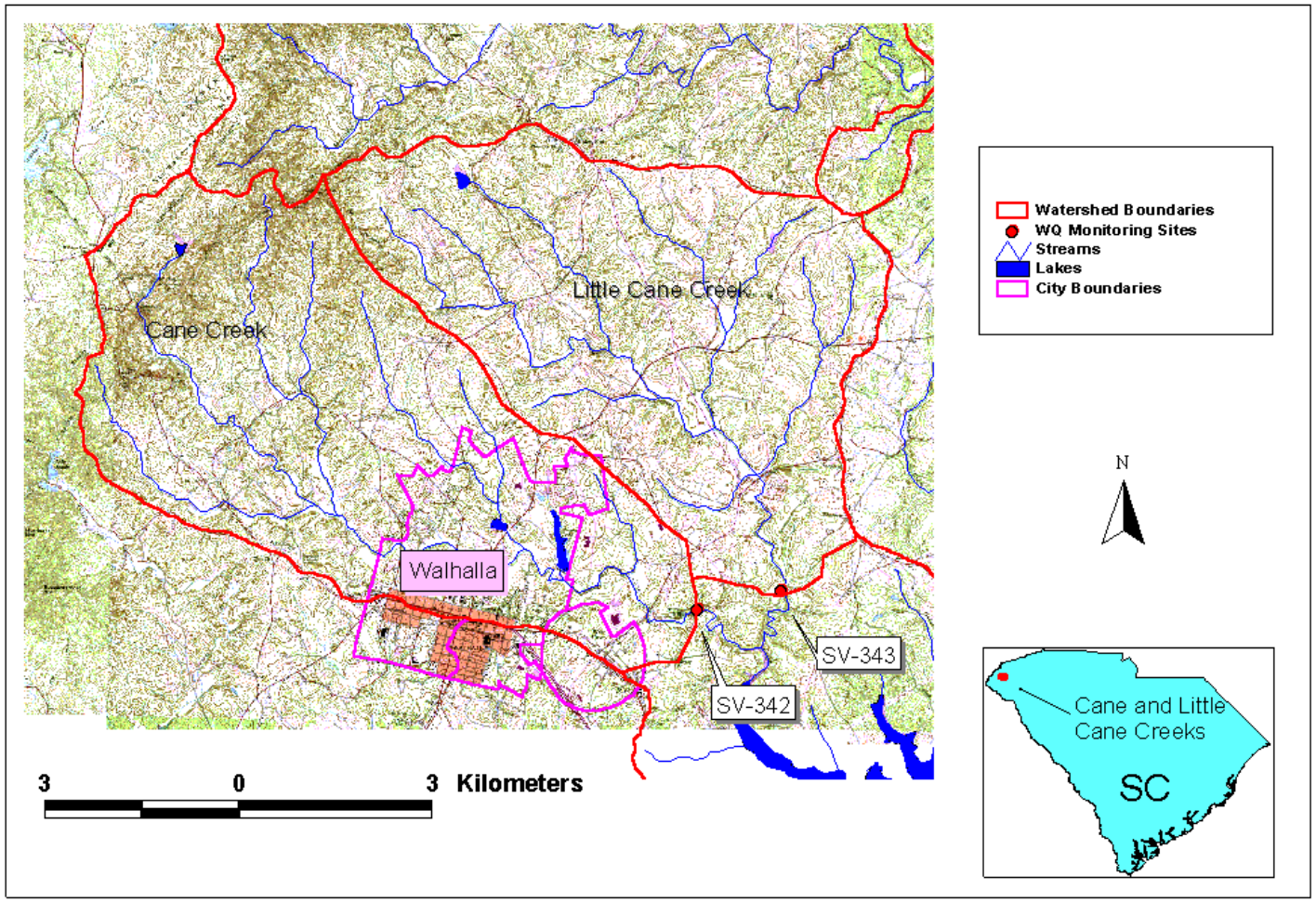

Figure 1. Map of the Cane and Little Cane Creek watersheds, Oconee County.

South Carolina's standard for fecal coliform in Freshwater is:

> "Not to exceed a geometric mean of 200/100 ml, based on five consecutive samples during any 30 day period; nor shall more than 10% of the total samples during any 30 day period exceed 400/100 ml."(R.61-68).

Primary contact recreation is not limited to large streams and lakes. Even streams which may be too small to swim in, will allow small children the opportunity to play and immerse their hands and faces. Essentially all perennial streams should therefore be protected from pathogen impairment.

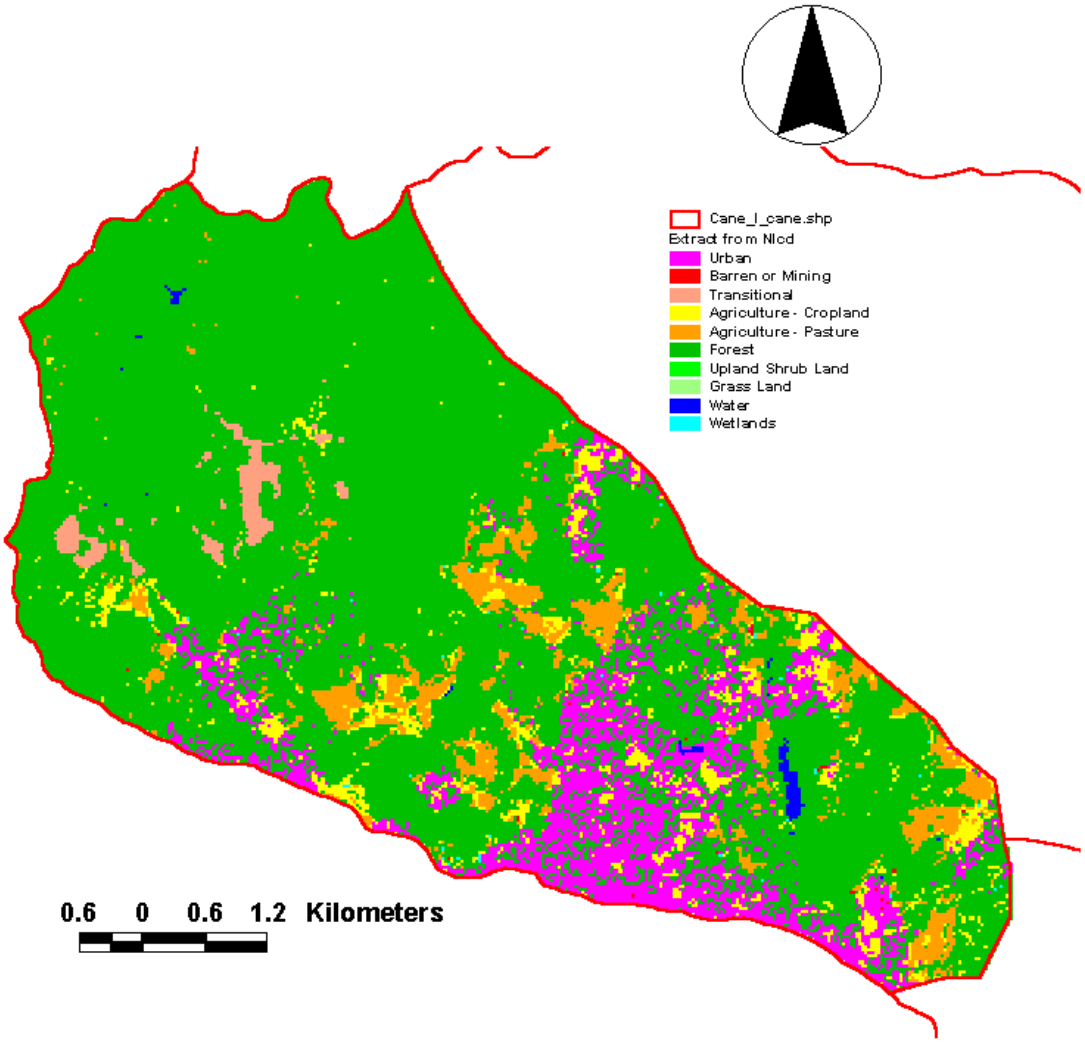

Figure 2. Map showing land uses in the Cane Creek watershed above SV-342.

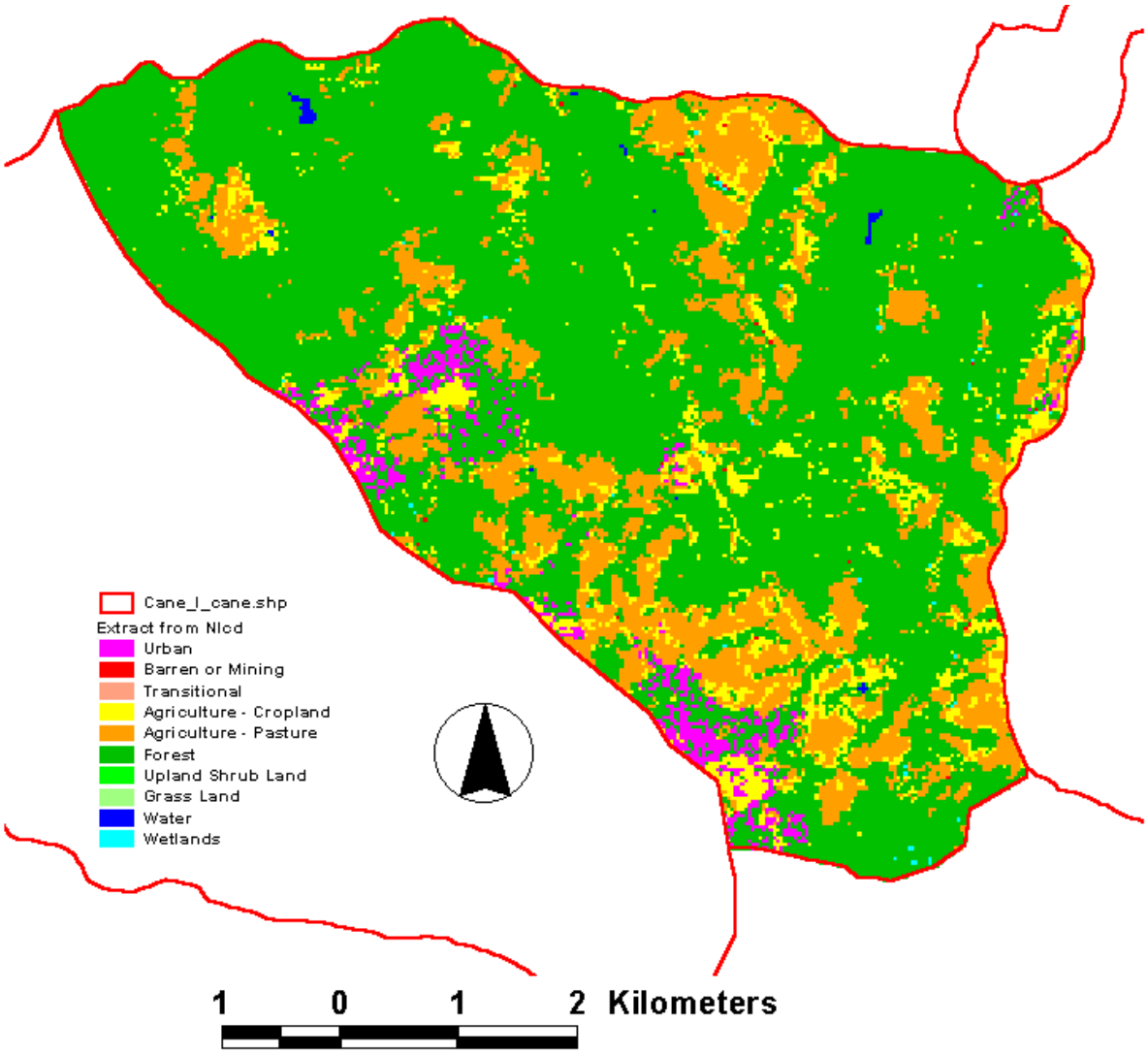

Figure 3. Map showing land uses in the Little Cane Creek watershed above SV-343.

Table 2. Land uses in the Cane Creek watershed above SV-342.

Land Use Class	Land Use	Area (hectare)	Area (acres)	Percent
	Water	13.0	32.0	0.3%
Developed	Residential Low Density	316.6	782.4	
	Residential High Density	17.7	43.8	
	Commercial, Industrial, & Transportation	98.5	243.3	
		432.8	**1069.5**	**10.9%**
	Barren	3.2	8.0	0.1%
	Transitional	51.8	128.1	1.3%
Forest	Forest Deciduous	1470.8	3634.3	
	Forest Evergreen	746.0	1843.4	
	Forest Mixed	783.0	1934.8	
		2999.8	**7412.5**	**75.9%**
Pasture	**Pasture**	**256.9**	**634.7**	**6.5%**
Cropland	Cropland	113.3	280.0	
		78.3	193.5	
		191.6	473.5	4.8%
Wetlands	Woody Wetlands	4.1	10.2	
	Emergent Herbaceous Wetlands	0.2	0.4	
		4.3	10.7	0.1%
Total for Watershed		**3,953.4**	**9,768.9**	**100.0%**

Table 3. Land uses in the Little Cane Creek watershed above SV-343.

Land Use Class	Land Use	Area (hectare)	Area (acres)	Percent
	Water	5.8	14.2	0.1%
Developed	Residential Low Density	83.0	205.0	
	Residential High Density	1.3	3.1	
	Commercial, Industrial, & Transportation	8.6	21.1	
		92.8	229.3	0.9%
	Barren	3.2	7.8	0.0%

Table 3. Continued.

Land Use Class	Land Use	Area (hectare)	Area (acres)	Percent
Forest	Forest Deciduous	1,232.9	3,046.5	
	Forest Evergreen	6,996.8	17,289.0	
	Forest Mixed	631.4	1,560.3	
		8,861.1	**21,895.9**	**89.5%**
Pasture	**Pasture**	**669.3**	**1,653.9**	**6.8%**
Cropland	Cropland	231.7	572.4	
		32.9	81.4	
		264.6	653.8	2.7%
Wetlands	Woody Wetlands	5.0	12.2	
	Emergent Herbaceous Wetlands	0.5	1.1	
		5.4	13.3	0.1%
Total for Watershed		**9,902.2**	**24,468.2**	**100.0%**

2.0 WATER QUALITY ASSESSMENT

Cane and Little Cane Creeks each have a water quality monitoring station (Table 1 and Figure 1). An assessment of water quality data collected from 1998 through 2002 for the 2004 33(d) list at these two stations indicated that both creeks were impaired for recreational use. Both Cane and Little Cane Creeks have been placed on the 303(d) list of impaired waters since 1998. Waters in which no more than 10% of the samples collected over a five year period are greater than 400 fecal coliform counts or cfu / 100 ml are considered to comply with the South Carolina water quality standard for fecal coliform bacteria. Waters with more than 10 percent of samples greater than 400 cfu/ 100 ml are considered impaired for fecal coliform bacteria and placed on South Carolina's 303(d) list. During the most recent assessment period (1998-2002), 29 % of the samples did not meet the fecal coliform criterion at SV-342 (Cane) and 52 % at SV-343 (Little Cane). In the previous assessment (1996-2000), 61 % of samples in both streams exceeded the standard. In Cane Creek at least, there has been an improvement in water quality. Stream fecal coliform data are provided in Appendix A.

There is little indication of any relationship between precipitation and fecal coliform concentrations in Cane Creek (Figure 4). However, there is a fairly strong correlation between turbidity and fecal coliform concentrations in the creek (Figure 5). Indeed, there is little correlation between rainfall and turbidity. The fecal coliform excursions in Cane Creek would appear to be associated with rainfall events that increase turbidity or events that stir up sediment from the creek bed. It may be that the limited sampling following rainfall events is obscuring the relationship between these parameters, or perhaps both higher turbidity and fecal coliform concentrations are caused by the same as-yet unknown source. Cane Creek will continue to be monitored routinely.

In Little Cane Creek neither precipitation nor turbidity exhibited a discernible relationship with fecal coliform concentrations (Figures 6 and 7). Fecal coliform concentrations in Cane and Little Cane Creeks track together much of the time, but not always (Figure A-1). Little Cane Creek is currently being monitored at a number of sites to gain a better understanding of sources of fecal coliform bacteria in the watershed.

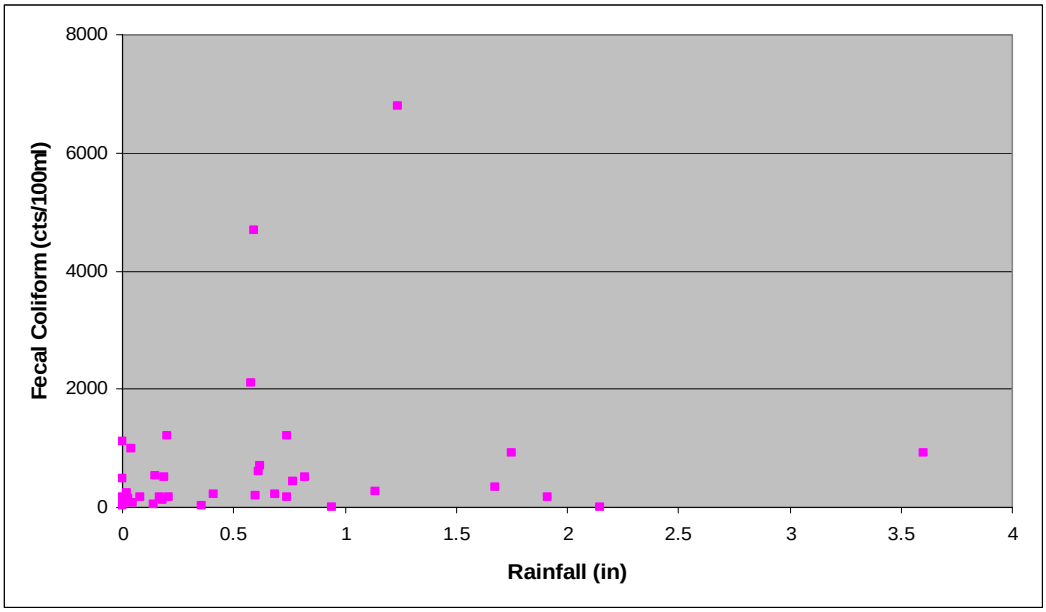

Figure 4. Comparison of precipitation and fecal coliform concentrations in Cane Creek.

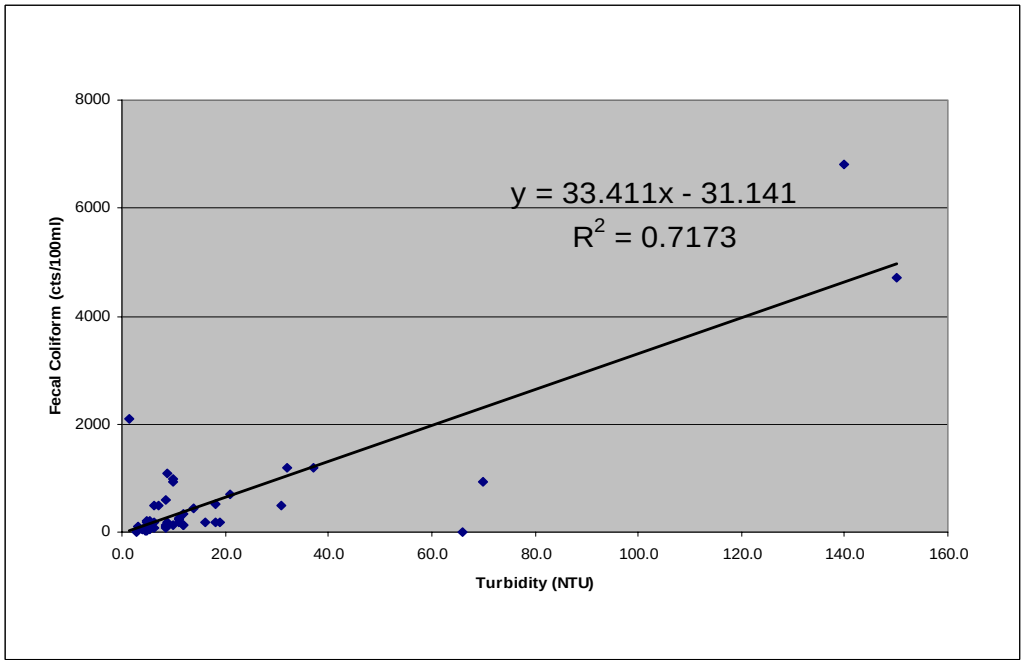

Figure 5. Comparison of turbidity and fecal coliform concentrations in Cane Creek.

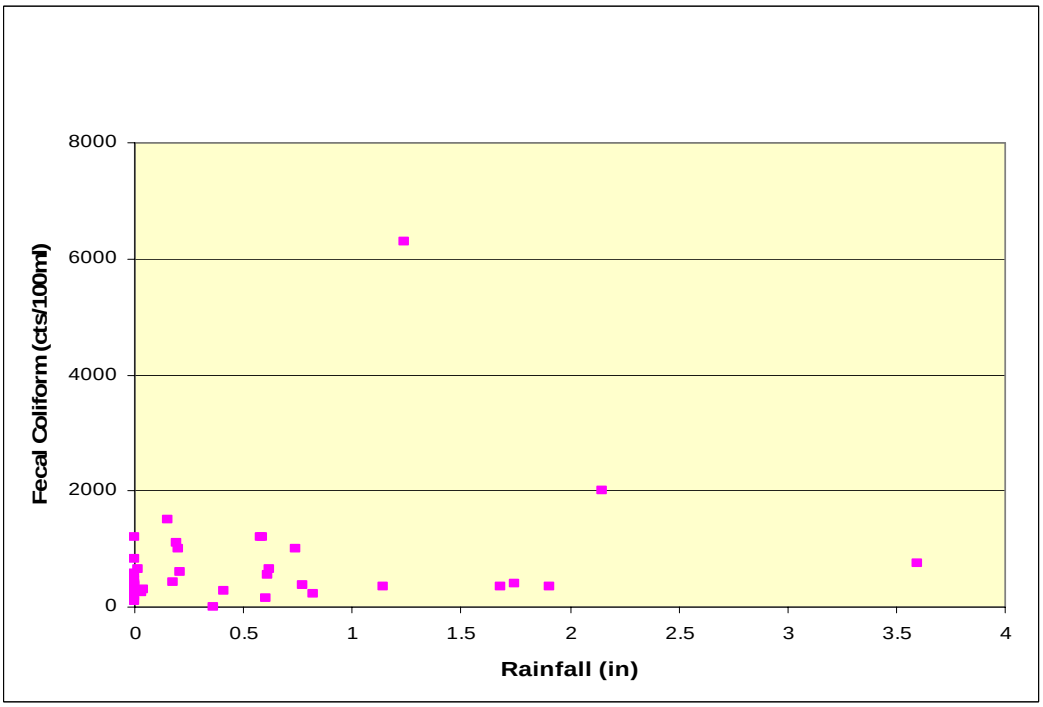

Figure 6. Comparison of precipitation and fecal coliform concentrations in Little Cane Creek.

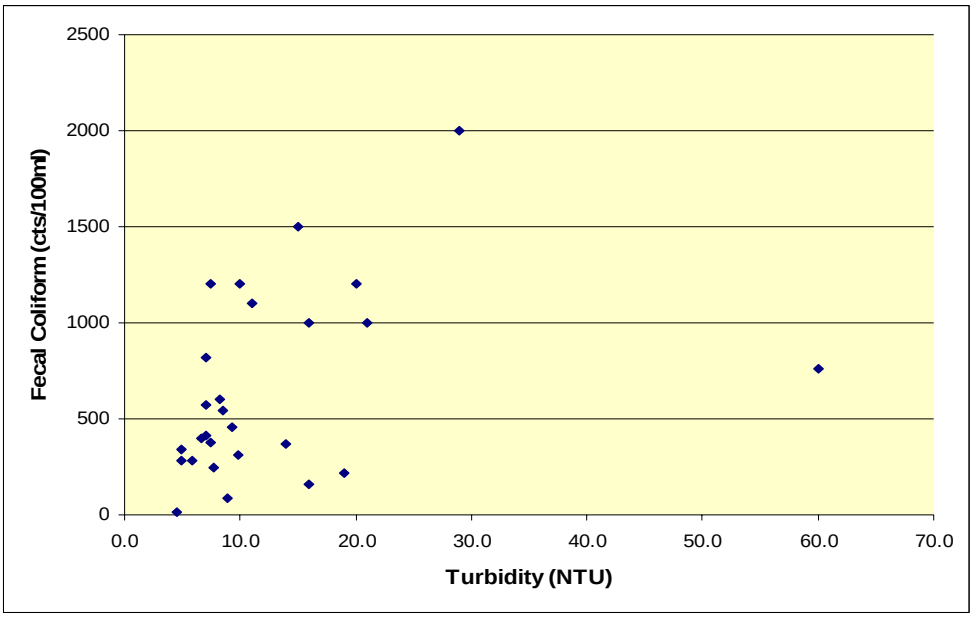

Figure 7. Comparison of turbidity and fecal coliform concentrations in Little Cane Creek.

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

Fecal coliform bacteria are used by the State of South Carolina as the indicator for pathogens in surface waters. Pathogens, which are usually difficult to detect, cause disease and make full body contact recreation in lakes and streams risky. Indicators such as fecal coliform bacteria, enteroccoci, or E. *Coli* are easier to measure, have similar sources as pathogens, and persist a similar or longer length of time in surface waters. These bacteria are not in themselves usually disease causing.

There are many sources of pathogen pollution in surface waters. In general these sources may be classified as point and nonpoint sources. With the implementation of technology-based controls, pollution from point sources, such as factories and wastewater treatment facilities, has been greatly reduced. These point sources are required by the Clean Water Act to obtain a NPDES permit. In South Carolina NPDES permits require that dischargers of sanitary wastewater must meet the state standard for fecal coliform at the point of discharge. Municipal and private sanitary wastewater treatment facilities may occasionally be sources of pathogen or fecal coliform bacteria pollution. However, if these facilities are discharging wastewater that meets their permit limits, they are not causing the impairment. If one of these facilities is not meeting its permit limits, enforcement of the permit limit is required. A TMDL is not necessary for this purpose. Pathogen or fecal coliform TMDLs are therefore essentially nonpoint source TMDLs even though the TMDL may include a wasteload allocation for a point source.

3.1 Point Sources in the Cane and Little Cane Creek Watersheds

There are no NPDES dischargers (point sources) in either of these watersheds. Walhalla, which is the only urban area in these watersheds, has not been designated as a Municipal Separate Storm Sewer System (MS4s).

The town of Walhalla has a sewage collection system that is partly in the Cane Creek watershed. Sewage collection systems typically are placed adjacent to waterways. At these locations, there is a potential for collection system leaks which could result in elevated instream concentrations of fecal coliform bacteria. Sanitary sewer overflows (SSOs) are also a potential source, particularly after periods of intense rainfall. This source is associated with infrequent events, limited in duration and likely to have an insignificant long-term impact instream. Identified collection system and/or SSO problems are addressed by SCDHEC through compliance and enforcement mechanisms. Cane Creek has a sewer line along side it through the town of Walhalla almost to Lake Keowee. Another possible source of the fecal coliform bacteria to Cane and Little Cane Creeks is illicit discharges into creeks, ditches, or storm sewers.

3.2 Nonpoint Sources in Cane and Little Cane Creek Watersheds

3.2.1 Wildlife

In these rural and suburban watersheds wildlife (mammals and birds), which is a source of fecal coliform bacteria, is possibly a significant though not major contributor. Wildlife in this area includes deer and other mammals as well as a variety of birds. Wildlife wastes are carried into nearby streams by runoff following rainfall or deposited directly in streams. Waterfowl also may be significant contributors of fecal coliform bacteria, particularly in urban and suburban ponds, which often provide a desirable habitat for geese and ducks. Forest lands, which typically have only low concentrations of wildlife as sources of fecal coliform bacteria, usually have low loading rates for fecal coliform bacteria.

3.2.2 Land Applied Manure

Turkey or chicken litter that is not properly stored or applied to land is a potential source of fecal coliform bacteria. Application of excessive amounts of litter, that is adding more nitrogen or phosphorus than the crop can use, and applying the litter too close to streams are the principal methods by which litter can pollute streams. The Cane Creek watershed has no active permitted livestock operations. Little Cane Creek has 2 permitted dairy operations and 18 fields in the watershed that are permitted for land application of litter.

3.2.3 Grazing Animals

Livestock, especially cattle, are frequently major contributors of fecal coliform bacteria to streams. Grazing cattle and other livestock may contaminate streams with fecal coliform bacteria in two ways. Runoff from pastures may carry the bacteria into streams following rain events. Cattle that are allowed access to streams deposit manure directly into the streams. Manure deposited in streams can be a significant source of fecal coliform bacteria. Loading of fecal coliform bacteria to both of these creeks by this route is likely to be a major source of loading of fecal coliform. With the larger number of cattle in Little Cane Creek watershed they are almost certainly a more important source in that watershed. The 1997 Agricultural Atlas reported that Oconee County had 18,855 cattle and calves. Using the ratio of pastureland in the two watersheds to that of the county, 315 cattle and calves were estimated to be in Cane Creek watershed and 819 in the Little Cane Creek watershed. Many farmers in both watersheds have utilized BMPs to reduce the impact of the cattle on the streams (Bill Ebeling, personal communication 2004).

3.2.4 Failing Septic Systems

Septic systems that do not function properly may leak sewage unto the land surface where it can reach nearby streams. Failing septic systems may be improperly designed or constructed or they may be systems that no longer function. The number of households that have septic systems was estimated using a GIS. The 2000 census database layer was compared to the town boundaries of Walhalla and West Union and the boundaries of the Cane Creek watershed. In 2000 there were an estimated 1800 people in some 800 households without sewer service in the Cane Creek watershed. All of the population of 1700 (650 households) in Little Cane Creek has no sewer service. If each household had its own system, there were about 800 septic systems in the Cane Creek watershed

and about 650 in the Little Cane Creek watershed. The load of fecal coliform bacteria going into each of these streams from septic systems could be quite substantial if the failure rate of septic systems is significant. However failing septic systems are likely to be a less important source of fecal coliform loading to Little Cane Creek than agricultural sources. Failing septic systems are probably more likely to be important in the Cane Creek watershed.

3.2.5 Urban Nonpoint Sources

Though both Cane and Little Cane Creek watersheds are mostly rural, small parts of these watersheds are urbanized. The town of Walhalla is partly in the Cane Creek watershed. The larger amount of impervious surfaces in built-up areas tends to increase runoff and reduce infiltration. Dogs, cats, and other pets are the primary source of fecal coliform deposited on the urban landscape. There are also 'urban' wildlife, such as squirrels, raccoons, pigeons, and other birds, all of which contribute to the fecal coliform load. The town of Walhalla has not been designated as a Municipal Separate Storm Sewer System (MS4) area at this time.

4.0 LOAD-DURATION CURVE METHOD

Load-duration curves were developed as a method of developing TMDLs that applies to all hydrologic conditions. The load-duration curve method uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the existing and the TMDL loads for a water body. Development of the load-duration curve is described in this chapter.

In the ideal situation a long period of record for flow data would be available for the water body of interest. A longer period of record increases the confidence in the results of the load-duration method. Cane Creek, like most small streams in South Carolina is not gauged. Coneross Creek, which is in the watershed south of Cane Creek, is a comparable, gauged stream with similar land uses and topography. Data from the gauge (USGS 02186645) on Coneross Creek near Seneca, South Carolina for the period of record (April 1, 1989 to September 30, 2002) was used to generate the flow-duration curve. The Coneross Creek watershed is substantially larger, 169 km^2 compared to 39.6 km^2 for the Cane Creek watershed and 36 km^2 for the Little Cane Creek watershed. However, there are no gauged streams in the region with drainage areas more similar to Cane and Little Cane Creeks that are not different in more significant ways.

The flows for Cane and Little Cane Creeks were estimated by multiplying the daily flow rates from Coneross Creek by the ratio of the Cane or Little Cane Creek drainage area to that of Coneross Creek (0.2339 and 0.2125, respectively). The flows were ranked from low to high and the values that exceed certain selected percentiles determined. Flow-duration curves for Cane and Little Cane Creeks are provided in Appendix C (Figures C-1 and C-2). The load-duration curve was generated by calculating the load from the observed fecal coliform concentrations, the flow rate that corresponds to the date of sampling, and a conversion factor. The load was plotted against the appropriate flow recurrence interval to generate the curve (Figures 8 and 9). The target line was created by calculating the allowable load from the flow and the appropriate fecal coliform standard

concentration in the same manner. Sample loads above this line are violations of the standard, while loads below the line are in compliance.

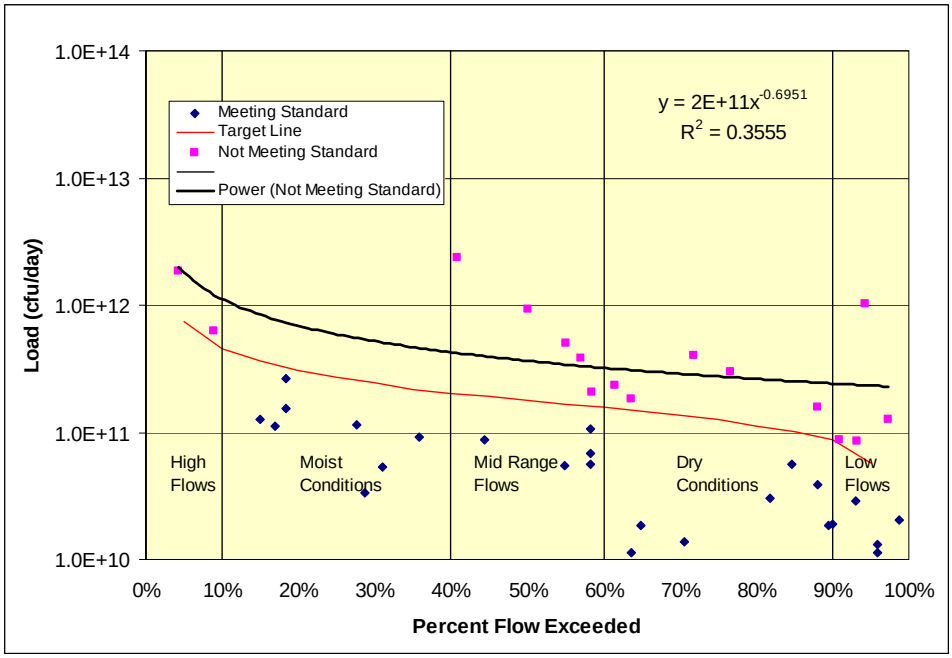

Figure 8. Load-Duration Curve for Cane Creek at SV-342.

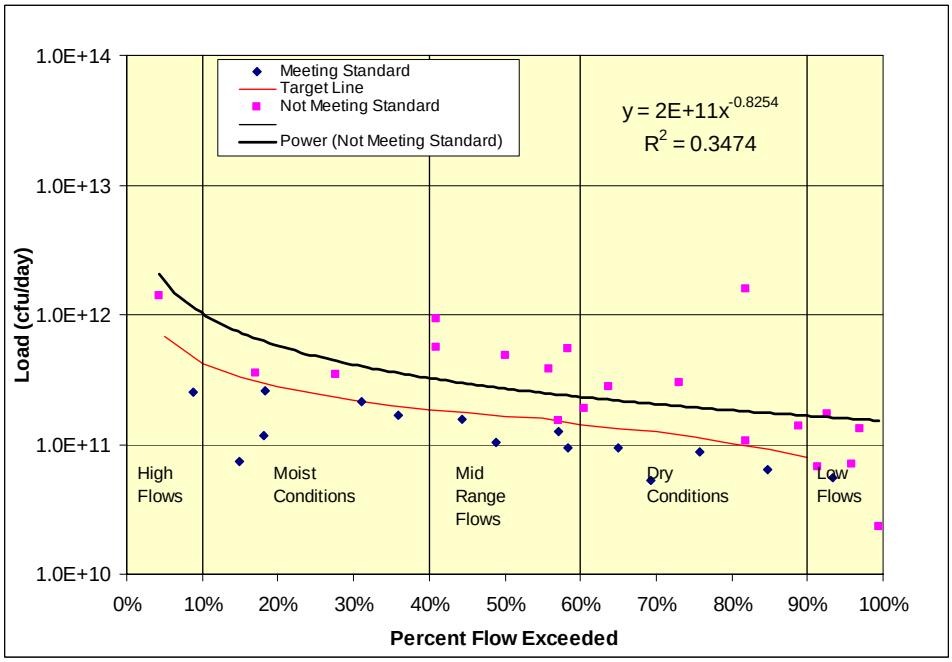

Figure 9. Load-Duration Curve for Little Cane Creek at SV-343.

The water quality target was set at 380 cfu/100ml for the instantaneous criterion, which is five percent lower than the water quality criteria of 400 cfu/100ml. A five percent explicit Margin of Safety (MOS) was reserved from the water quality criteria in developing the load-duration curves. The instantaneous criterion was targeted as a conservative approach and should be protective of both the instantaneous and 30-day geometric mean fecal coliform bacteria standards.

Trend lines were determined for sample loads that did not meet the standard for each creek. The trend line determined for Cane Creek (Figure 8) was a power curve. The r^2 for this correlation was 0.3555. The trend line for loads that did not meet the standard in Little Cane Creek was also a power function, with an $r^2 = 0.3555$ (Figure 9). The existing loads to Cane and Little Cane Creeks were calculated from the means of all loads that were between the 10 % and 90 % flow recurrence intervals. This excludes flows that occur infrequently. These trend lines matched their respective target lines better than the alternatives, though they have relatively low correlation coefficients (r^2).

The TMDL load is calculated from the target line. Load values at 5 % occurrence intervals along the target line from 10 to 90 % were averaged. The Load Allocation (LA) values are derived from the 380 cfu/100ml water quality target, which includes the explicit Margin of Safety. Calculations for both existing and TMDL loads are provided in Appendix B.

5.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

A total maximum daily load (TMDL) for a given pollutant and water body is comprised of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. Conceptually, this definition is represented by the equation:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis to establish water quality-based controls.

For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). For bacteria, however, TMDLs are expressed in terms of number (#), cfu, or organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l).

5.1 Critical Conditions

These TMDLs are based on the flow recurrence interval between 10 % and 90 %. This encompasses 80 % of flows in both Cane and Little Cane Creeks. Only flows that are characterized as 'High' or 'Low' flows in Figures 8 and 9 are not included in the analysis. For these TMDLs critical conditions are this range of the flow recurrence interval.

5.2 Existing Load

The existing loads were calculated from the trend lines of observed values that exceeded the water quality standard and were between and including 10 and 90 % recurrence limits. Loadings from all sources are included in this figure: runoff, cattle-in-streams, and failing septic systems. The total existing load for SV-342 is 4.2 E+11 cfu/day and for SV-343 it is 5.18E+11 cfu/day.

5.3 Margin of Safety

The margin of safety (MOS) may be explicit and/or implicit. The explicit margin of safety is 5 % of the 400 cfu/ 100 ml or 20 cfu/ 100ml of the instantaneous criterion of 400 cfu/100 ml. For SV-342 this is equivalent to 1.0E+10 cfu/day and for SV-343 the MOS is 9.4E+09 cfu/day.

5.4 TMDL

For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). For bacteria, however, TMDLs are expressed in terms of cfu or organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l). The resulting TMDL should be protective of both the instantaneous, per day, and geometric mean, per 30-day, criteria.

The target loading value is the load to the creek that it can receive and meet the water quality standard. It is simply the TMDL minus the MOS. The target loading for Cane Creek requires a reduction of 54 % from the current loads of 4.2E+11 cfu/day for SV-342 (Table 4). For Little Cane Creek the reduction is 65 % from the current load of 5.18E+11 cfu/day (Table 4).

Table 4. TMDL components for Cane (SV-342) and Little Cane (SV-343) Creeks.

Impaired Station	WLA cfu/day	LA cfu/day	MOS cfu/day	TMDL cfu/day	Target cfu/day	% Reduction
SV-342	NA	1.96E+11	1.0E+10	2.06E+11	1.96E+11	54
SV-343	NA	1.79E+11	9.4E+09	1.88E+11	1.79E+11	65

6.0 IMPLEMENTATION

As discussed in the *Implementation Plan for Achieving Total Maximum Daily Load Reductions From Nonpoint Sources for the State of South Carolina* (SCDHEC,1998), South Carolina has several tools available for implementing this nonpoint source TMDL. Specifically, SCDHEC's animal agriculture permitting program addresses animal operations and land application of animal wastes. In addition, SCDHEC will work with the existing agencies in the area to provide nonpoint source education in the Cane and Little Cane Creek watersheds. Local sources of nonpoint source

education and assistance include Clemson Extension Service, the Natural Resource Conservation Service (NRCS), the Oconee County Soil and Water Conservation Services, and the South Carolina Department of Natural Resources. Clemson Extension Service offers a 'Farm-A-Syst' package to farmers. Farm-A-Syst allows the farmer to evaluate practices on their property and determine the nonpoint source impact they may be having. It recommends best management practices (BMPs) to correct nonpoint source problems on the farm. NRCS can provide cost share money to land owners installing BMPs.

SCDHEC is empowered under the State Pollution Control Act to perform investigations of and pursue enforcement for activities and conditions, which threaten the quality of waters of the state.
In addition, other interested parties (universities, local watershed groups, etc.) may apply for section 319 grants to install BMPs that will reduce fecal coliform loading to Cane and Little Cane Creeks. TMDL implementation projects are given highest priority for 319 funding. Both of these creeks have been included in a 319 project that has investigated sources and introduced BMPs. This project will end June 2004.

In addition to the resources cited above for the implementation of this TMDL in the Cane and Little Cane Creek watersheds, Clemson Extension has developed a Home-A-Syst handbook that can help rural homeowners reduce sources of NPS pollution on their property. This document guides homeowners through a self-assessment, including information on proper maintenance practices for septic tanks. SCDHEC also employs a nonpoint source educator who can assist with distribution of these tools as well as provide additional BMP information.

Using existing authorities and mechanisms, these measures will be implemented in these two watersheds in order to bring about a 54 % reduction in fecal coliform bacteria loading to Cane Creek and 65 % to Little Cane Creek. DHEC will continue to monitor, according to the basin monitoring schedule, the effectiveness of implementation measures and evaluate stream water quality as the implementation strategy progresses.

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APPENDIX A Fecal Coliform Data

Table A-1 Fecal coliform data for Cane Creek.

Cane Creek at SV-342			
Sample Date	**Fecal Coliform cfu/100ml**	**Sample Date**	**Fecal Coliform cfu/100ml**
20-Nov-95	90	19-Oct-00	28
13-Dec-95	170	21-Nov-00	220
25-Jan-96	190	6-Mar-01	170
23-Feb-96	140	4-Apr-01	54
20-Mar-96	500	7-Jun-01	170
24-Apr-96	130	6-Jul-01	170
8-May-96	180	17-Aug-01	82
20-Jun-96	4700	24-Sep-01	*Present >QL
31-Jul-96	1200	8-Oct-01	220
30-Aug-96	520	5-Nov-01	100
12-Sep-96	1200	10-Dec-01	84
21-Oct-96	980	2-Jan-02	90
4-Nov-99	920	6-Feb-02	130
13-Dec-99	2100	11-Mar-02	110
5-Jan-00	600	9-Apr-02	140
10-Feb-00	50	6-May-02	180
1-Mar-00	30	6-Jun-02	6800
4-Apr-00	920	22-Jul-02	240
4-May-00	480	14-Aug-02	120
27-Jun-00	430	24-Sep-02	260
20-Jul-00	1100	14-Oct-02	690
3-Aug-00	*Present >QL	13-Nov-02	330
7-Sep-00	500	2-Dec-02	40

Table A-2 Fecal coliform data for Little Cane Creek.

Little Cane Creek at SV-343			
Sample Date	**Fecal Coliform cfu/100ml**	**Sample Date**	**Fecal Coliform cfu/100ml**
20-Nov-95	400	30-Aug-96	1500
13-Dec-95	340	12-Sep-96	1000
25-Jan-96	160	21-Oct-96	310
23-Feb-96	90	4-Nov-99	410
20-Mar-96	220	13-Dec-99	1200
24-Apr-96	460	5-Jan-00	540
8-May-96	600	10-Feb-00	280
20-Jun-96	1200	1-Mar-00	12
31-Jul-96	1000	4-Apr-00	760

Table A-2 Continued.

Little Cane Creek at SV-343				
Sample Date	**Fecal Coliform cfu/100ml**		**Sample Date**	**Fecal Coliform cfu/100ml**
4-May-00	820			
27-Jun-00	370		9-Apr-02	260
3-Aug-00	2000		6-May-02	360
7-Sep-00	1100		6-Jun-02	6300
19-Oct-00	1200		22-Jul-02	640
21-Nov-00	280		14-Aug-02	370
19-Dec-00	250		24-Sep-02	340
14-Nov-01	570		14-Oct-02	660
6-Dec-01	380		13-Nov-02	350
11-Mar-02	430		2-Dec-02	170

Table A-3 Statistics for fecal coliform in Cane and Little Cane Creeks.

Statistics:	
Cane Creek (SV-342):	
Minimum:	28
Geometric mean:	257
Median:	185
Maximum:	6800
Little Cane Creek (SV-343):	
Minimum:	12
Geometric mean:	463
Median:	410
Maximum:	6300

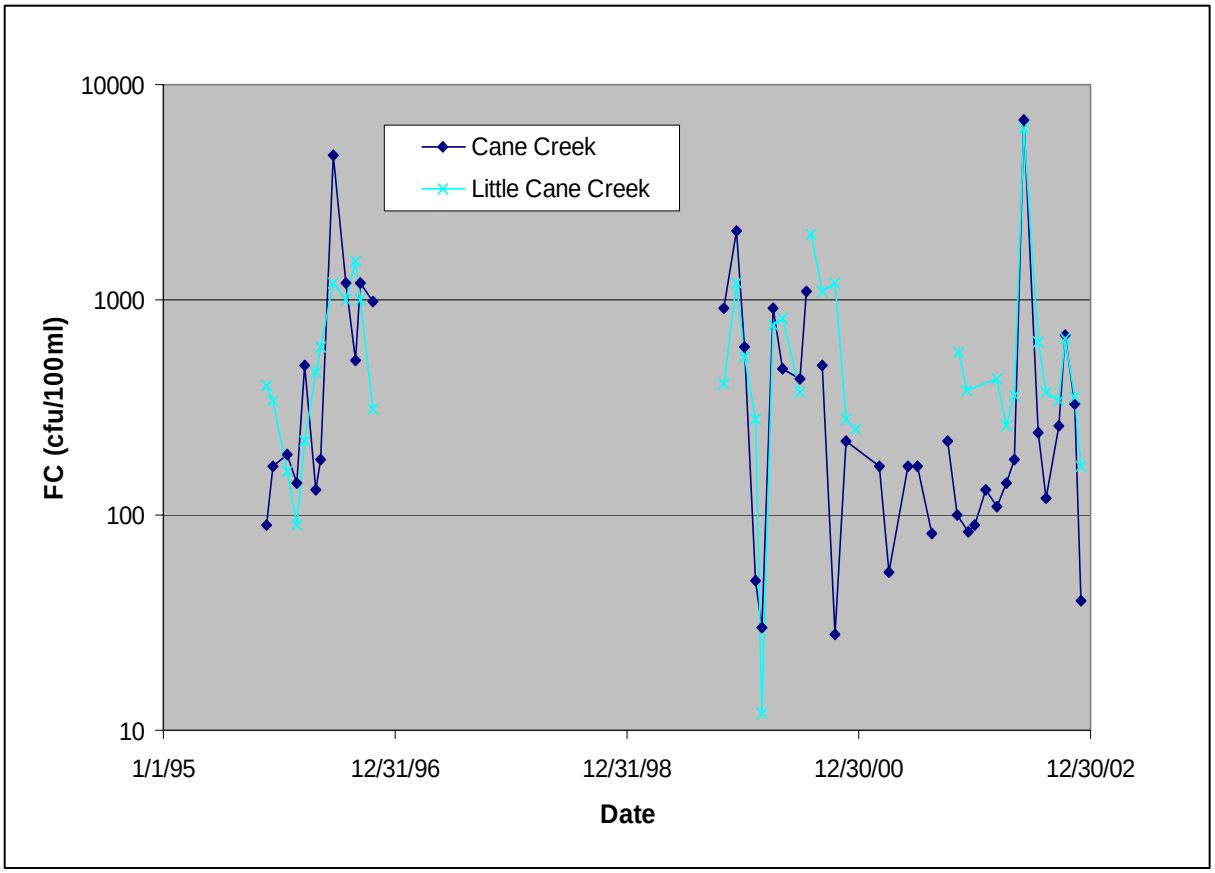

Figure A-1 Comparison between fecal coliform concentrations in Cane and Little Cane Creeks.

APPENDIX B Calculation of Existing and TMDL Loads

Table B-1 Calculation of existing loads.

Cane Creek

From equation of Trend Line:

y = 2E+11 x ^ 0.6951

Percentile	Load	
0.10	9.91E+11	
0.15	7.48E+11	
0.10	9.91E+11	
0.20	6.12E+11	
0.25	5.24E+11	
0.30	4.62E+11	
0.35	4.15E+11	
0.40	3.78E+11	
0.45	3.48E+11	
0.50	3.24E+11	
0.55	3.03E+11	
0.60	2.85E+11	
0.65	2.70E+11	
0.70	2.56E+11	
0.75	2.44E+11	
0.80	2.34E+11	
0.85	2.24E+11	
0.90	2.15E+11	
0.95	2.07E+11	
Mean Load	**4.23E+11**	**cfu/day**

Little Cane Creek

From equation of Trend Line:

y = 2E+11 x ^ -0.8254

Percentile	Load	
0.10	1.34E+12	
0.15	9.57E+11	
0.10	1.34E+12	
0.20	7.55E+11	
0.25	6.28E+11	
0.30	5.40E+11	
0.35	4.76E+11	
0.40	4.26E+11	
0.45	3.87E+11	
0.50	3.54E+11	
0.55	3.28E+11	
0.60	3.05E+11	
0.65	2.85E+11	
0.70	2.68E+11	
0.75	2.54E+11	
0.80	2.40E+11	
0.85	2.29E+11	
0.90	2.18E+11	
Mean Load	**5.18E+11**	**cfu/day**

Table B-2. Calculations of TMDL loads.

Cane Creek
Target Conc 380 cfu/100ml
From Target Line

% Exceeded	Load (cfu/day)	Flow (cfs)
0.10	4.37E+11	47.02
0.15	3.46E+11	37.20
0.20	2.91E+11	31.35
0.25	2.57E+11	27.61
0.30	2.31E+11	24.80
0.35	2.09E+11	22.46
0.40	1.94E+11	20.82
0.45	1.83E+11	19.65
0.50	1.70E+11	18.25
0.55	1.59E+11	17.08
0.60	1.50E+11	16.14
0.65	1.39E+11	14.97
0.70	1.30E+11	14.04
0.75	1.20E+11	12.87
0.80	1.07E+11	11.46
0.85	9.57E+10	10.29
0.90	1.09E+11	8.89
Mean Load	**1.96E+11**	

Little Cane Creek
Target Conc 380 cfu/100ml
From Target Line

% Exceeded	Load (cfu/day)	Flow (cfs)
0.10	3.97E+11	42.72
0.15	3.14E+11	33.79
0.20	2.65E+11	28.48
0.25	2.33E+11	25.08
0.30	2.09E+11	22.53
0.35	1.90E+11	20.40
0.40	1.76E+11	18.92
0.45	1.66E+11	17.85
0.50	1.54E+11	16.58
0.55	1.52E+11	16.38
0.60	1.36E+11	14.67
0.65	1.26E+11	13.60
0.70	1.19E+11	12.75
0.75	1.09E+11	11.69
0.80	9.68E+10	10.41
0.85	8.69E+10	9.35
0.90	1.09E+11	8.08
Mean Load	**1.79E+11**	

Table B-3 Calculation of percent reductions.
Reductions:

Cane Creek:

=(Existing Load - TMDL Load) / Existing Load

% Reduction: 54%

Little Cane Creek:

=(Existing Load - TMDL Load) / Existing Load

% Reduction: 65%

APPENDIX C Flow-duration Curves

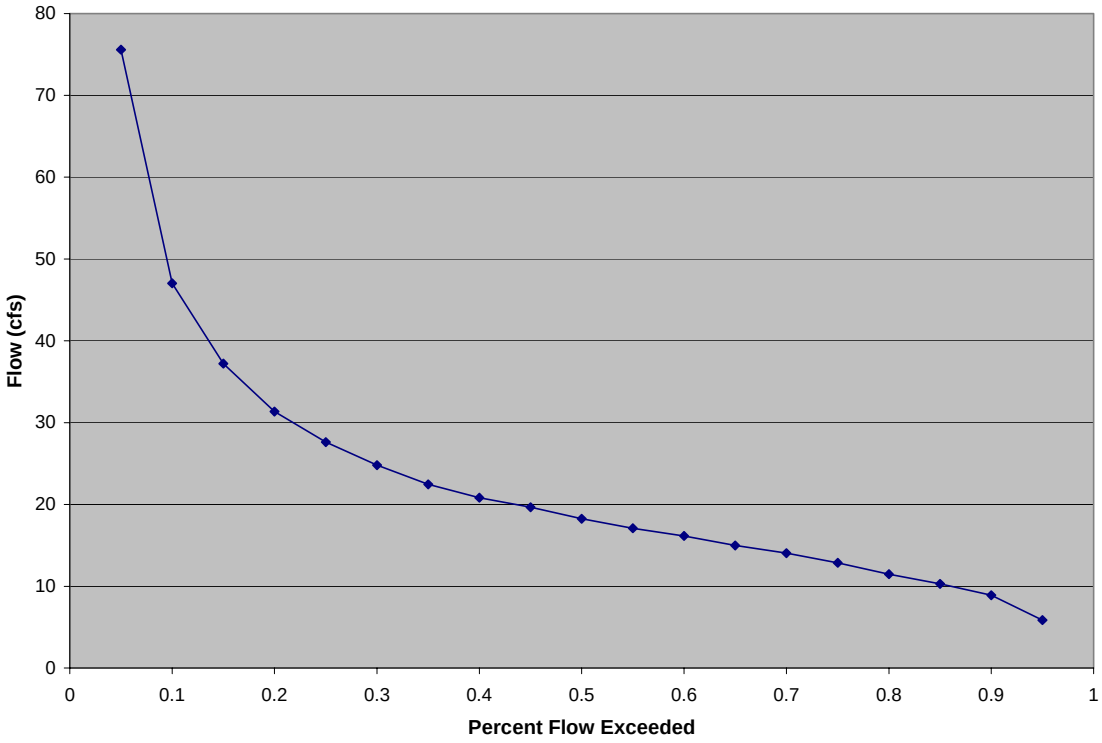

Figure C-1 Flow-duration curve for Cane Creek.

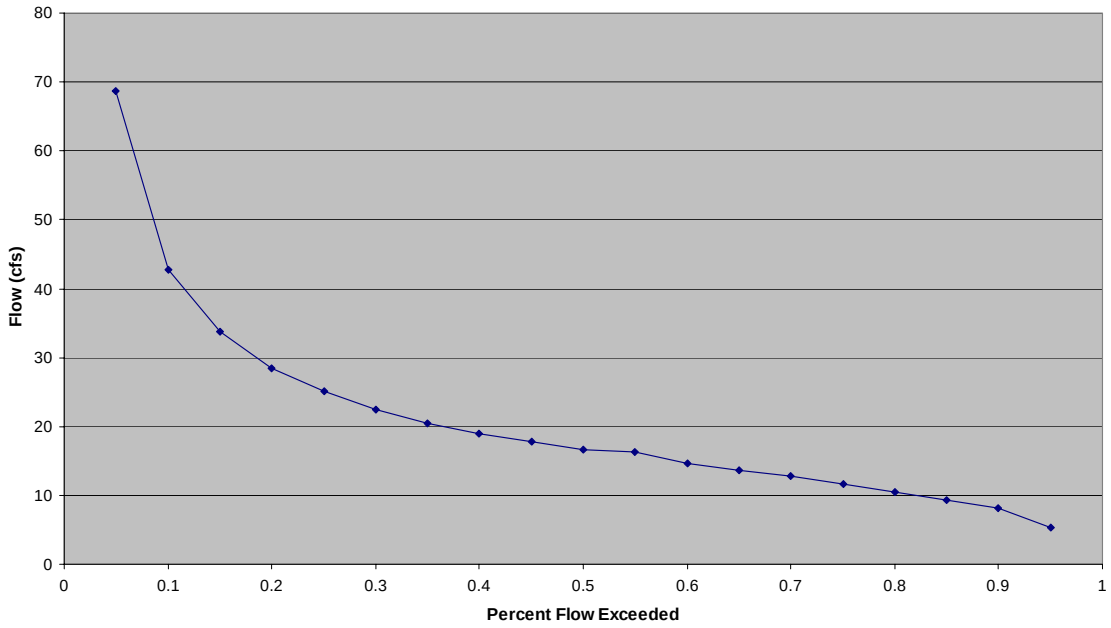

Figure C-2 Flow-duration curve for Little Cane Creek.

APPENDIX D Public Notification