EPA FINALIZED TMDL

South Carolina
Department of Health and Environmental Control

Total Maximum Daily Load Development for Spears and Kelly Creeks (Hydrologic Unit Code: 03050104-090 & Stations: CW-154 and CW-166) Fecal Coliform Bacteria

September 1, 2004

Bureau of Water

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PROMOTE PROTECT PROSPER
South Carolina Department of Health
and Environmental Control

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 bacteria in Spears Creek and Kelly Creek. Subsequent actions must be consistent with this TMDL.

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James D. Giattina, Director Date
Water Management Division

Abstract

Kelly Creek, in Kershaw County, drains into Spears Creek, in Kershaw and Richland Counties. Spears Creek in turn drains into the Wateree River. Both creeks have been placed on South Carolina's 303(d) list of impaired waters for violations of the fecal coliform standard. Kelly Creek is impaired at water quality monitoring station, CW-154 (Kelly Creek at S-28-367). Spears Creek is impaired at water quality monitoring station CW-166 (Spears Creek at US-601 near Elgin). During the assessment period for the 2004 303(d) list (1998-2002), 13 % of samples from Kelly Creek and 25 % from Spears Creek violated the standard. The watersheds of these creeks are largely rural and agricultural. At the time of the NLCD data collection (early 1990's) the Spears Creek watershed was 58 % forest and 19 % cropland, with the balance wetlands, transitional, and developed. Kelly Creek's watershed is similar – somewhat less forest and much higher percentage of cropland. However, a windshield survey of both watersheds found little cropland and much pasture. There are no active point sources in either watershed. Small areas of both watersheds have been designated as MS4s. The probable sources of fecal coliform bacteria in these two creeks are runoff from pasture land, failing septic systems, and cattle-in-streams.

The load-duration curve methodology was used to calculate the existing loads and the TMDL loads for Spears and Kelly Creeks. The existing load for Spears Creek was estimated to be 6.6E+11 cfu/day and for Kelly Creek, 2.2E+11 cfu/day. The TMDL loads were determined to be 2.7E+11 and 7.9E+10 cfu/day, respectively. The WLA for Kelly Creek MS4s, which is expressed as a percent reduction, is 65 %; for the MS4s in the Spears Creek watershed the TMDL is 61 %. Resources and several TMDL implementation strategies to bring about this reduction are suggested.

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Tables and Figures

Spears and Kelly Creeks (HUC 03050104-090)

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

Spears Creek is in Richland and Kershaw Counties, in the Southeastern Plains Ecoregion of South Carolina (Figure 1). Kelly Creek (Kershaw County) is a tributary of Spears Creek, which flows into the Wateree River some 10 miles upstream of its confluence with Congaree River. These TMDLs apply to the parts of the watersheds upstream of the monitoring station indicated in Table 1. References to either of the watersheds apply only to the cited parts of the watershed.

The predominant land uses in the Spears Creek watershed (91.3 km^2 or 35 mi^2) according to EPA's MLRC database (Figure 1 and Table 2) from the mid 1990s are forest (58 %), cropland (19 %), wetlands (8.5 %), transitional (6.4 %), and developed (6.1 %). Pasture according to this data is insignificant (1.5 %), however a windshield survey of the watershed shows much more pasture than cropland. Cropland may have been converted to pasture since 199 or the analytical method cannot distinguish between crop and pasture lands. Kelly Creek's watershed has similar land uses (Figure 2, Table 3), though there is nearly twice as much, by percent, cropland/pasture as in the larger watershed. The population in the Spears Creek watershed in 2000 was about 7500 people. Most of the watershed does not have sewer service and therefore most houses must use septic systems or other on-site wastewater treatment.

The upper part of the Spears Creek watershed, including Kelly Creek, is experiencing development pressure as growth extends along US-1 from Columbia. Urbanization of this watershed will tend to adversely impact these creeks by increasing runoff, making the stream flow flashier, and increasing the load of pollutants (including fecal coliform bacteria) available to be washed into the creeks.

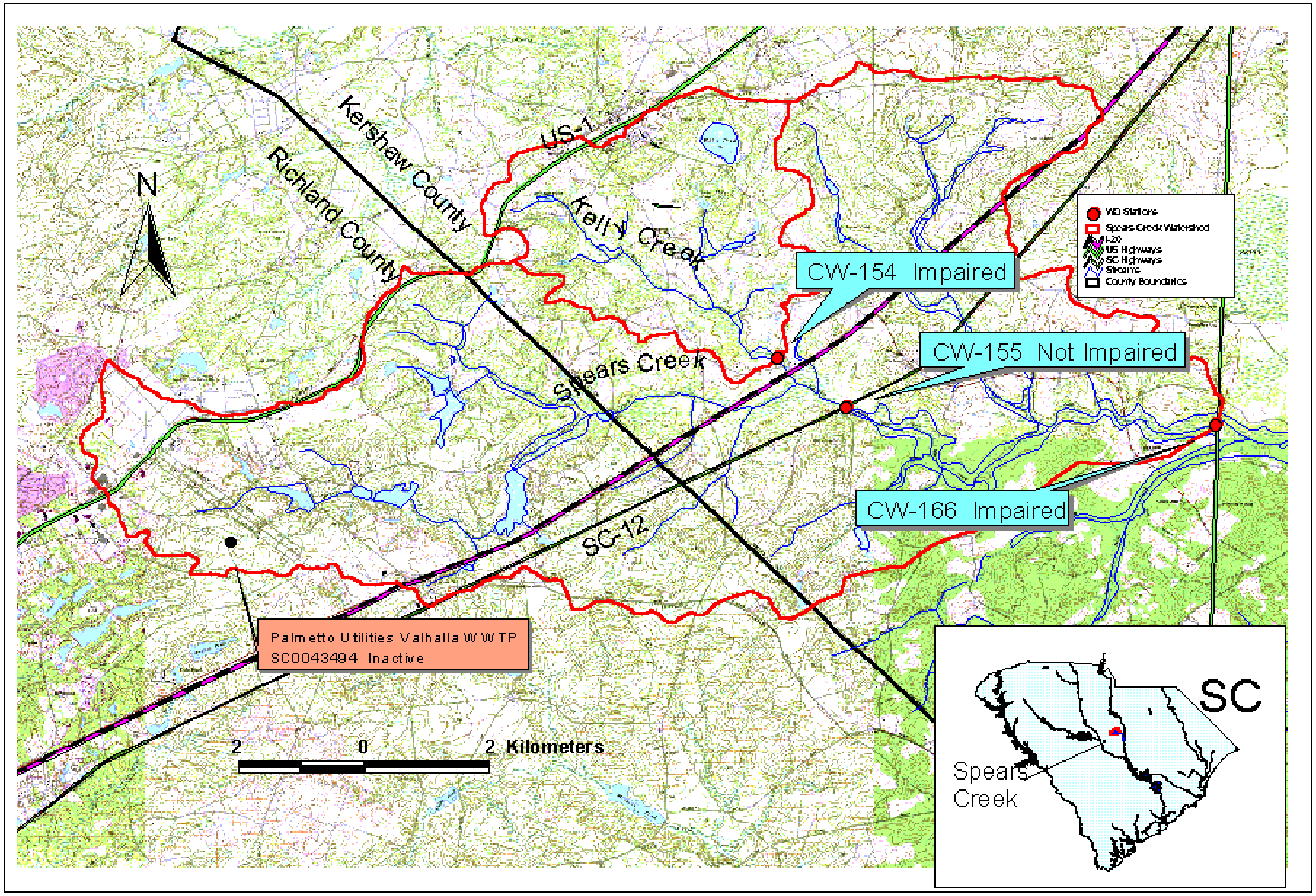

Figure 1. Map of the Spears Creek watershed above CW-166.

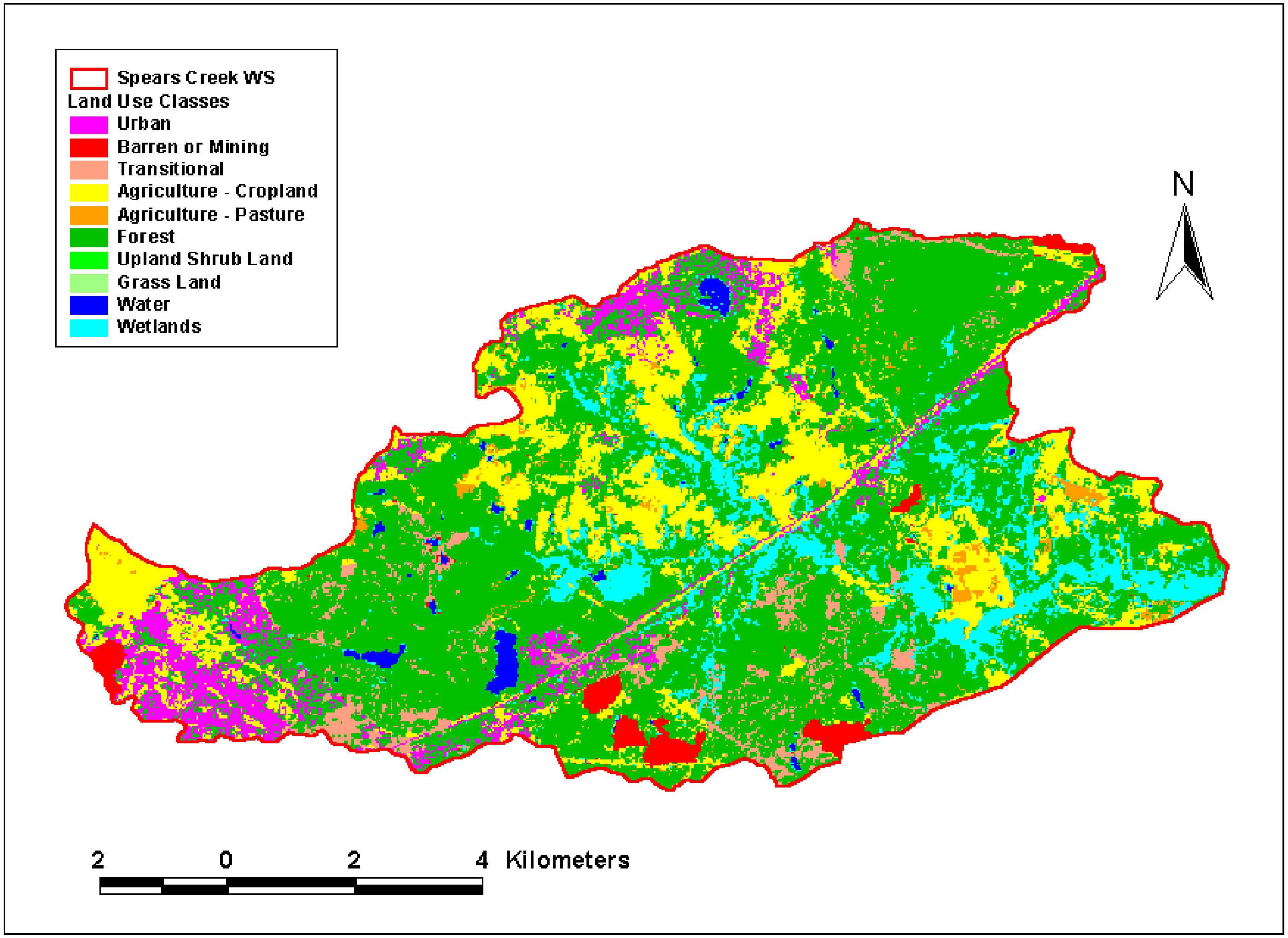

Figure 2. Map showing land uses in the Spears Creek watershed above CW-166.

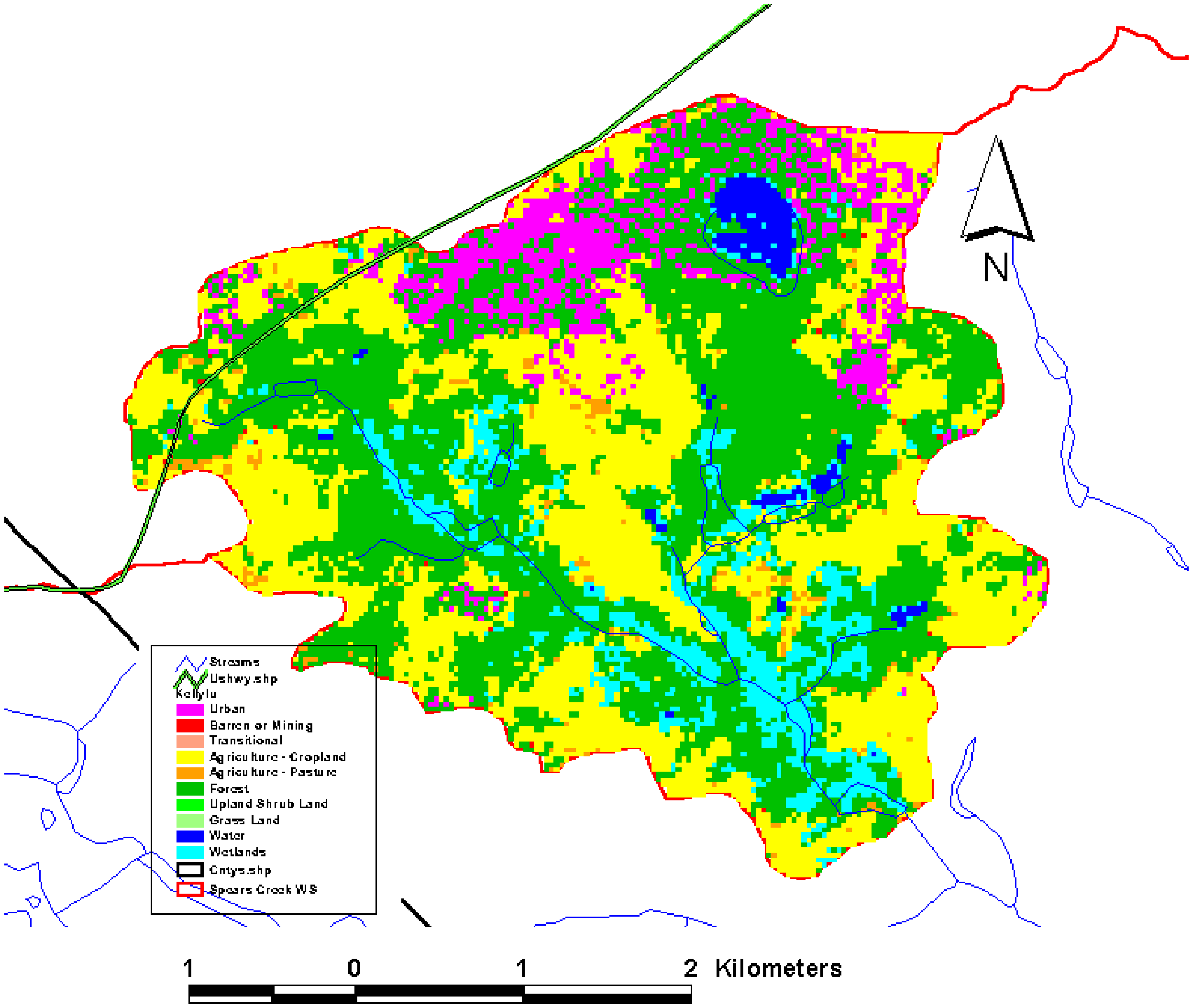

Figure 3. Land use in the Kelly Creek watershed upstream of CW-154.

1.3 Water Quality Standard

The impaired stream segments of Spears and Kelly 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)

Table 1. Water quality monitoring sites in the Spears Creek watershed.

Station ID	Location Description	Samples collected in 1998 - 2002	% Samples Exceeding Standard
CW-154	Kelly Creek at S-28-367, 2.9 miles SE of Elgin	31	12.9%
CW-155	Spears Creek at SC-12, 3.6 miles SE of Elgin	48	8.3%
CW-166	Spears Creek at US-601	32	25.0%

Table 2. Land uses in the Spears Creek watershed above CW-166.

Land Use Class	Land Use	Area (km^2)	Percent	Area (mi^2)
	Water	1.0	1.1%	0.4
Developed	Residential Low Density	3.4	3.7%	1.3
	Residential High Density	0.7	0.7%	
	Commercial, Industrial, & Transportation	2.1	2.3%	0.8
		5.5	**6.1%**	**2.1**
Transitional etc.	Barren	0.2	0.2%	0.1
	Mining, Quarries	1.6	1.8%	0.6
	Transitional	4.0	4.3%	1.5
		5.8	**6.4%**	**2.2**
Forest	Forest Deciduous	17.3	18.9%	6.7
	Forest Evergreen	18.9	20.7%	7.3
	Forest Mixed	16.6	18.2%	6.4
		52.8	**57.8%**	**20.4**
Pasture	Pasture	1.4	1.5%	0.5
Cropland	**Cropland**	**17.0**	**18.6%**	**6.6**
Wetlands	Woody Wetlands	7.8	8.5%	3.0
	Emergent Herbaceous Wetlands	0.0	0.0%	0.0
		7.8	**8.5%**	**3.0**
Total for Watershed		**91.3**	**100.0%**	**35.3**

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 seem to 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.

Table 3. Land use in the Kelly Creek watershed.

Land Use Class	Land Use	Area (km^2)	Percent	Area (mi^2)
Water		0.3	1.8%	0.1
Developed		**1.2**	**8.0%**	**0.5**
Transitional etc.	Barren	0.0	0.2%	0.0
Forest		**6.8**	**44.8%**	**2.6**
Pasture		0.3	1.7%	0.1
Agricultural		**5.3**	**35.1%**	**2.1**
Wetlands		**1.3**	**8.4%**	**0.5**
Total for Watershed		**15.2**	**100.0%**	**5.9**

2.0 WATER QUALITY ASSESSMENT

There are three water quality monitoring stations in the Spears Creek watershed (Figure 1 and Table 1). Kelly Creek has one monitoring site (CW-154). Spears Creek has two sites (CW-155 and CW-166) both downstream of the confluence with Kelly Creek. An assessment of water quality data collected in 1996 through 2000 at these stations indicated that Spears Creek at CW-166 only was impaired for recreational use. The assessment for the 2004 303(d) list using 1998-2002 data found that Kelly Creek at CW-154 was also impaired. 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 and listed for fecal coliform bacteria on South Carolina's 303(d) list. The percentage of samples collected during the assessment period (1998-2002) that exceeded the 400 cfu/100ml standard are shown in Table 1. Stream fecal coliform data are provided in Appendix A.

A comparison of fecal coliform concentrations at the three sites is provided in Figure 4. Where there are data for all three sites, they tend to track together, which suggests that Spears Creek at CW-155 would be considered impaired if it had been sampled only during the warm months as were the other two. Conversely if Kelly Creek had been sampled year round it probably would not be considered impaired. The increase in percentage of violations between CW-155 and CW-166 suggests that fecal coliform sources are located in the watershed between these two sites.

All three sites exhibit a linear relationship between precipitation and fecal coliform concentration in the water (Figures 5, 6, and D-1). Precipitation was measured at the Clemson Sandhills Experiment Station, which is at the western edge of the watershed. Fecal coliform concentrations tended to increase with rainfall. The location of the rain gauge so near the watershed is unusual and makes the rainfall data quite representative of the whole watershed.

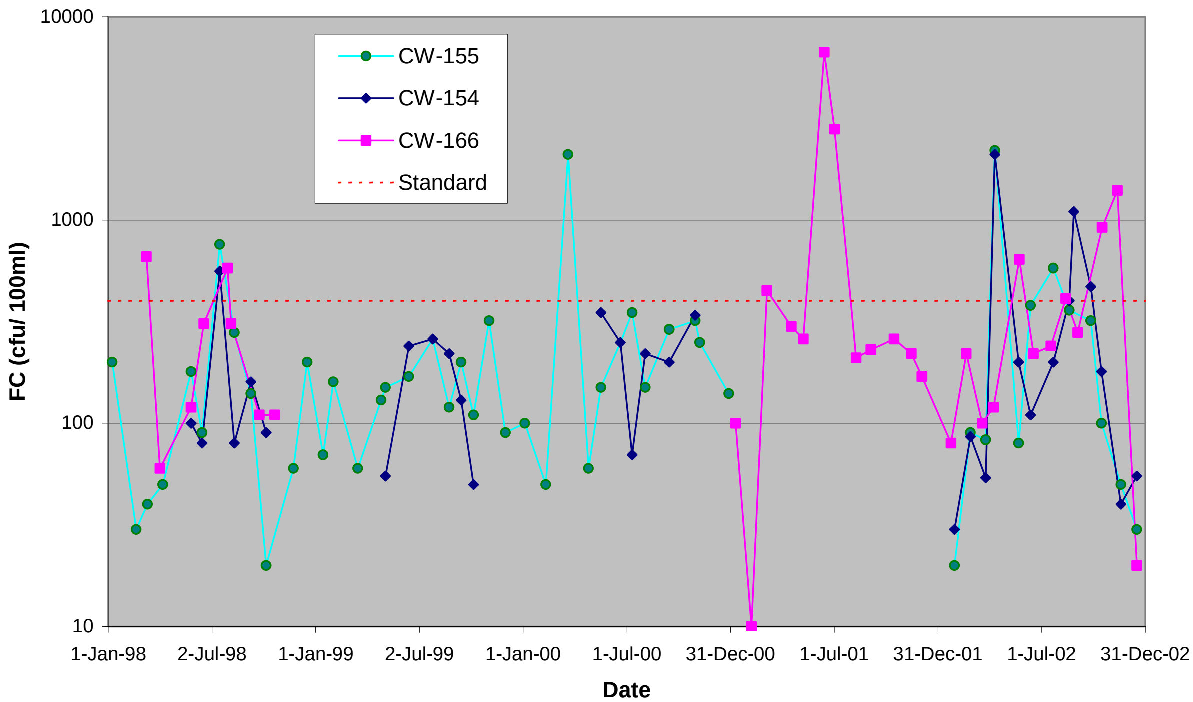

Figure 4. Fecal coliform concentrations at CW-154, Kelly Creek, and CW-155 and CW-166, Spears Creek.

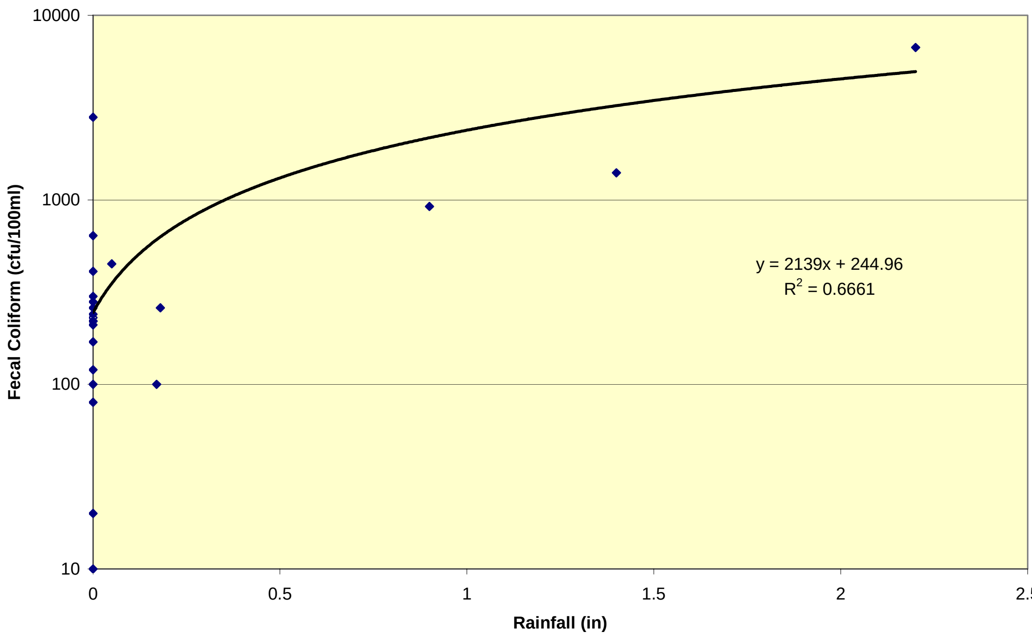

Figure 5. Comparison between precipitation at Clemson Sandhills Experiment Station and fecal coliform concentration in Spears Creek at CW-166.

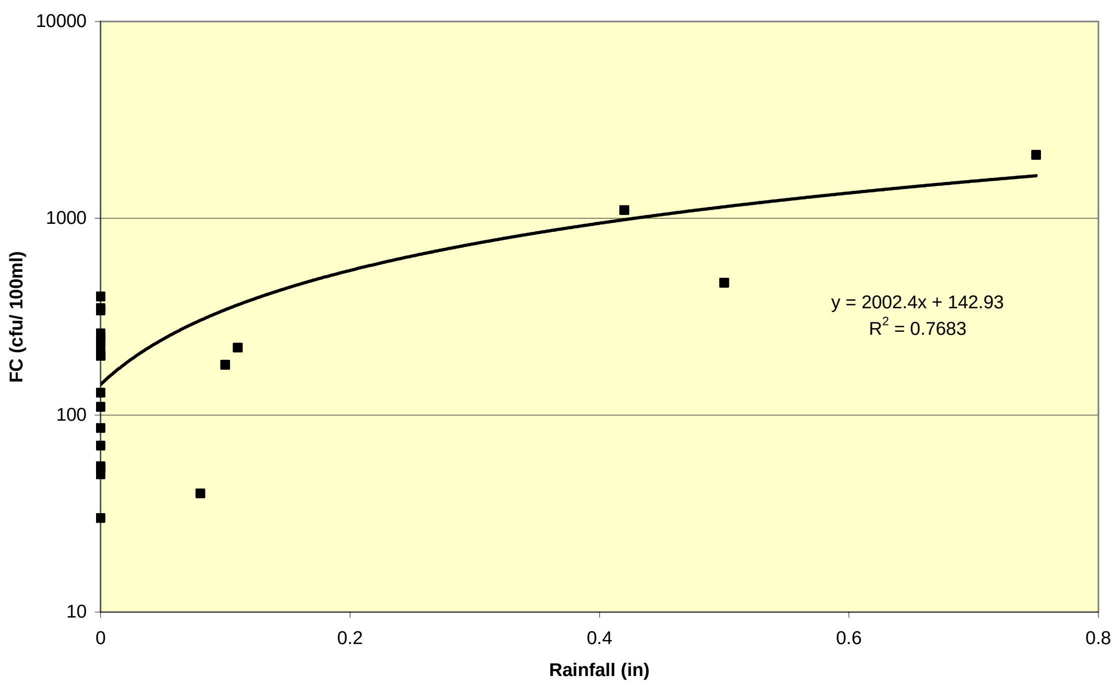

Figure 6. Comparison between precipitation at Clemson Sandhills Experiment Station and fecal coliform concentration in Kelly Creek at CW-154.

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 Spears Creek Watershed

3.1.1 Continuous Discharge Point Sources

There are no currently active NPDES facilities in this watershed. Prior to 2001 Palmetto Utilities operated the Valhalla WWTP on Spears Creek (SC0043494) (Figure 1). This facility had problems meeting its permit limits for fecal coliform, however the location of the facility far upstream of the monitoring station suggests that it is not a contributor to impairment. Wastewater data for this facility are provided in Appendix B.

3.1.2 Municipal Separate Storm Sewer Systems

Small parts of these watersheds, in the headwaters, have been designated as Municipal Separate Storm Sewer Systems or MS4s (Figure 7). Richland County has responsibility for a small area in the upper Spears Creek watershed. Kershaw County also has responsibility for a small MS4 area in the Kelly Creek watershed. These permitted sewer systems will be treated as point sources in the TMDL calculations below. However for modeling purposes all urban areas will be evaluated together as urban nonpoint sources.

3.2 Nonpoint Sources in Spears Creek Watershed

3.2.1 Wildlife

Wildlife (mammals and birds) are contributors of fecal coliform bacteria to surface waters. Wildlife wastes are carried into nearby streams by runoff following rainfall or deposited directly in streams. Deer are the largest and probably most noticeable mammals in this area. The SC Department of Natural Resources (Charles Ruth, DNR Deer Project Supervisor, personal communication, 2000) has estimated a density of between 30 and 45 deer/mi^2 for this area. Deer habitat includes forest, cropland, pastures, and some suburban areas. 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 Application of 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 Spears Creek watershed has no active permitted livestock operations. There are three fields in the watershed that are permitted for land application of poultry litter.

3.2.3 Grazing Animals

In South Carolina livestock such as cattle and horses spend most of their time grazing on pasture land. Runoff following rainfall may wash some of the manure deposited in the pastures into nearby by streams. There are about 150 to 200 cattle in the Kershaw County portion of the watershed (Mike Newman, NRCS District Conservationist, personal communication, 2004). Most of these livestock are south of SC-12, which is downstream of CW-155 and upstream of CW-166. There are also approximately 30 bison in the watershed. Using the ratio of the portion of pasture land in the Richland County part of the watershed to that of the county, there is an estimated 100 cattle and calves in the Richland County part of the Spears Creek watershed. The Richland County part of the watershed does not appear to be causing the impairment at CW-166, because the stream is not impaired at CW-155.

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 because they use the stream as a water source and if it is deep enough as a cooling off spot during hot weather. Manure deposited in streams can be a significant source of fecal coliform bacteria. Fecal coliform bacteria from cattle in pastures and in the streams is apparently the major source of these pollutants to both Kelly and Spears Creeks.

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 maybe systems that no longer function. The number of households that have septic systems was estimated using a GIS. The 2000 census database files for Kershaw and Richland Counties were compared to the watershed. The population was estimated to be approximately 7600 people in 2800 households. Most of this watershed does have not have sewerage service. If each household has its own system, there would be about 2800 septic systems in the watershed. With a failure rate of 10 % (Schueler, 1999) for the septic systems, there could be 280 septic systems that are failing. Failing septic systems may be a significant source of fecal coliform loading to Spears and Kelly Creeks.

3.2.5 Urban Nonpoint Sources

Parts of this watershed are being urbanized as sprawl from Columbia spreads. The increase in impervious surfaces increases runoff and reduces infiltration. The population of pets increases. Sewer lines are subject to leaking and overflows. However there are at present few sewer lines in this watershed. Another potential source of the fecal coliform bacteria in Spears Creek is illicit discharges into creeks, ditches, or storm sewers.

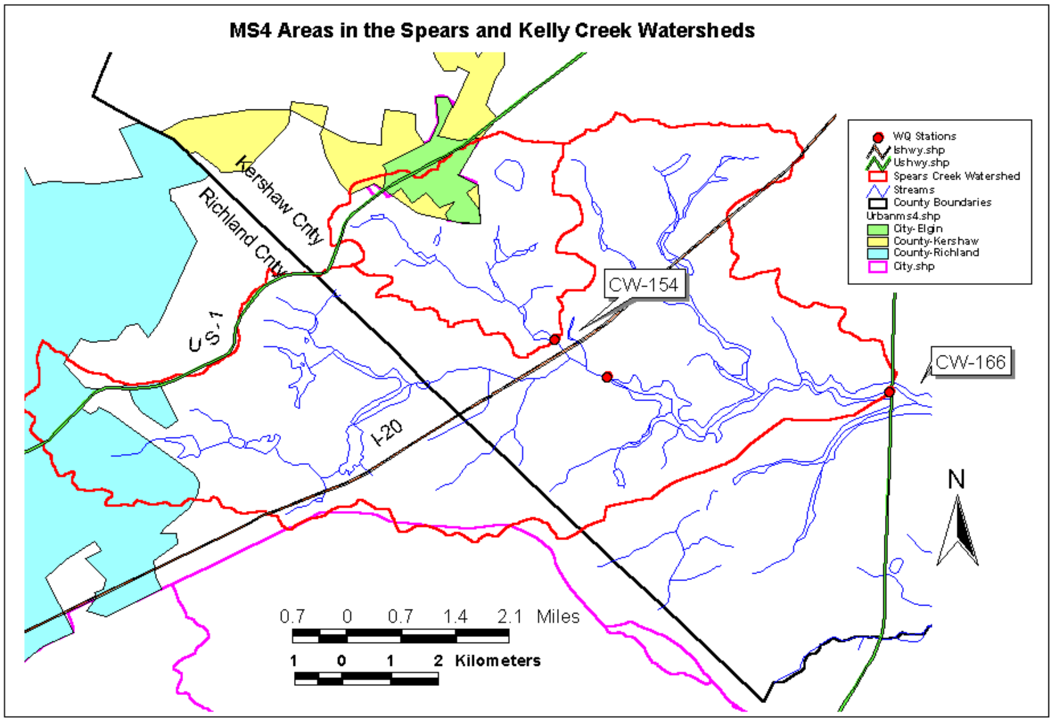

Figure 7. MS4 areas in the Spears and Kelly Creek watersheds.

4.0 LOAD-DURATION CURVE METHOD

Load-duration curves provide 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.

Neither Kelly nor Spears Creek are gauged for flow. Therefore USGS flow data from two similar sized watersheds was used to estimate flow in the creeks. Flow data from USGS 02172640 on the Dean Swamp Creek near Perry, SC was used for Spears Creek. For Kelly Creek, data from USGS 02102908 on Flat Creek in Fort Bragg, NC was used to generate the flow-duration curve. Information about the gauging stations is presented in Table 4.

Table 4. Water quality stations and associated USGS gauging stations.

Station	USGS Gauge #	Stream	Period of Record	DA (km^2)	Land Uses (%)			
					Forest	Agri-cultural	Transi-tional	Wet-lands
CW-154	02102908	Flat Creek	6/1/68 - 12/31/02	19.8	65	< 1	28	7
CW-166	02172640	Dean Swamp Creek	10/1/80 - 9/30/00	80.8	56	27	10	< 1

Dean Swamp Creek, a tributary of the South Edisto River in Aiken County, has a similar sized drainage area, land uses, and topography to Spears Creek (92.3 km^2). Flat Creek is a tributary of Little River and is also similar to Kelly Creek (15.2 km^2). All watersheds are in the Southeastern Coastal Plain ecoregion.

The flows for Spears and Kelly Creeks were estimated by multiplying the daily flow rates from respective gauged stream by the ratio of the TMDL Creek drainage area to that of gauged creek (1.14 and 0.77 respectively). The flows were ranked from low to high and the values that exceed certain selected percentiles determined. The load-duration curves were generated by calculating the loads from the observed fecal coliform concentrations, the flow rate that corresponds to the date of sampling, and a conversion factor. The loads were plotted against the appropriate flow recurrence interval to generate the curve (Figures 8 and 9). The target lines were 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.

Trend lines were determined for loads that were above the target line (load values that violated the water quality standard). The equations for the best-fit trend lines determined by the Excel spreadsheet are presented in Table 5. The existing loads to Kelly and Spears Creeks were calculated from the mean of all loads that were between the 0.1 % and 80 % flow recurrence intervals. This range favors the high flows that occur infrequently, but where two of the five violations occurred.

Table 5. Trend line equations and information.

Station	Stream	Trend Line Equation	Type	r^2
CW-154	Kelly Creek	$y = 5E+10 \, x \, X^{-1.013}$	Power	0.7411
CW-166	Spears Creek	$y = -2E+11 \, x \, Ln(X) + 4E+11$	Log	0.9335

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 and this value was reduced by 5 %, which represents the Margin of Safety. The Load Allocation (LA) values are 95 % of the loads from the target line, that is the TMDL load minus the 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

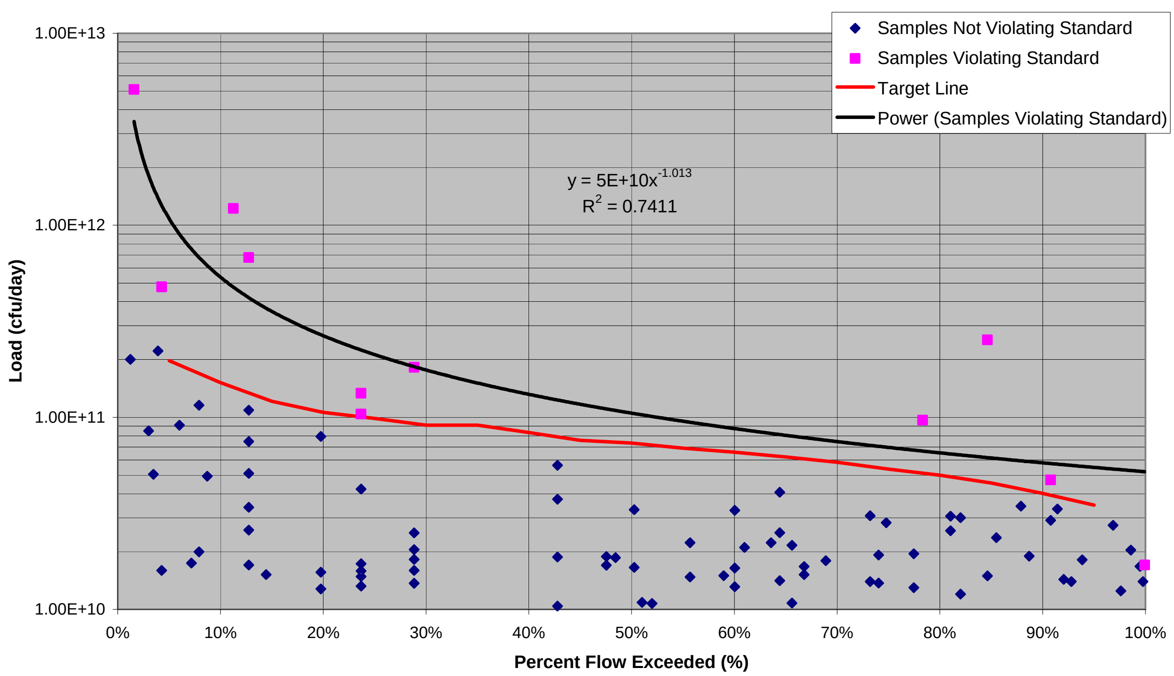

Figure 8. Load-Duration Curve for Spears Creek at CW-166.

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:

$$\textbf{TMDL} = \sum \textbf{WLAs} + \sum \textbf{LAs} + \textbf{MOS}$$

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).

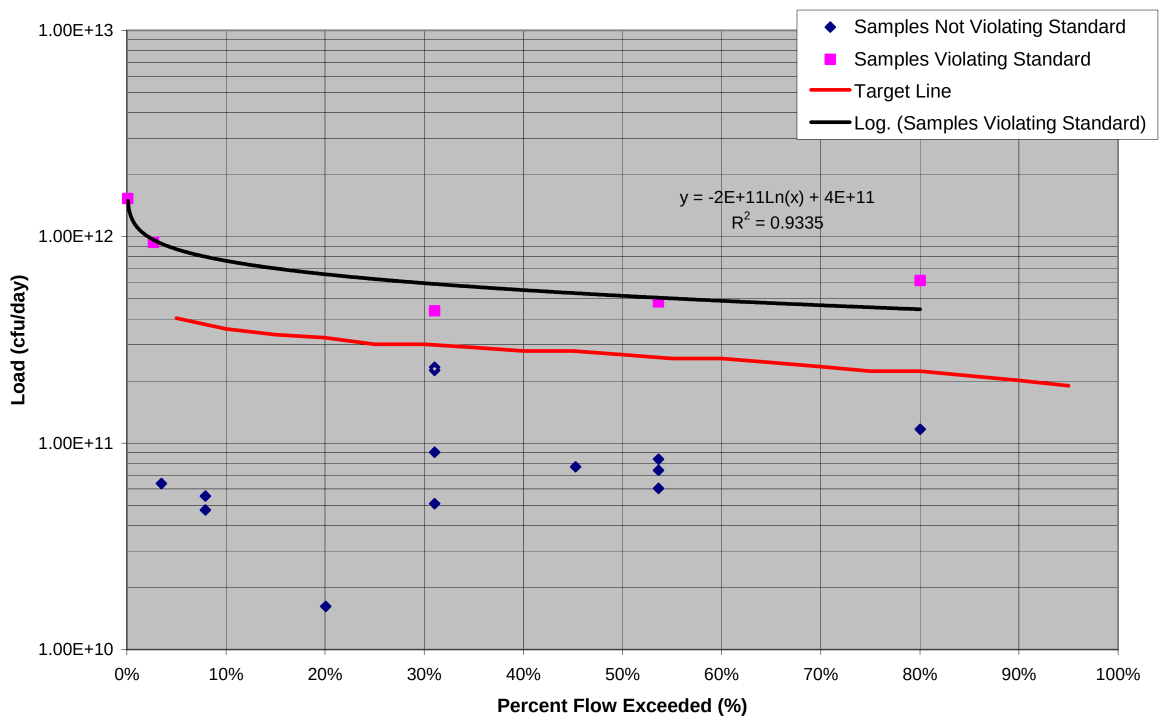

Figure 9. Load-Duration Curve for Kelly Creek at CW-154.

5.1 Critical Conditions

Critical conditions for Spears and Kelly Creeks occur when a long period of low flow is followed by rainfall event that produces runoff. Most violations of the water quality standard for fecal coliform occur in both creeks during medium to high flow events. During dry periods, fecal coliform bacteria build up on the land surface and are flushed into the creeks by rainfall. The inclusion of all flow conditions in the load-duration curve analysis insures that the critical conditions are protected.

5.2 Existing Load

Existing loads were calculated from the 0.1 % – 80 % flow exceedence intervals for Spears Creek and 0.5 % to 80 % for Kelly Creek. That is the load was calculated from the trend line of observed values that exceeded the water quality standard that was between and including the 0.1 or 0.5 and 80 % reoccurrence limits. Loadings from all sources are included in this figure: failing septic systems, cattle-in-streams, and loading from runoff. The total existing load for CW-154 (Kelly Creek) is 2.16E+11 and for CW-166 (Spears Creek) it is 6.57 E+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 counts/ 100ml. For CW-166 this is equivalent to 1.34E+10 cfu/day**.** For CW-154 the MOS is 3.9E+09 cfu/day. Through the use of conservative assumptions in developing the TMDL, such as determining the percent reduction in load required, on the highest part of the trend line and calculating point source loads from permit limits, the margin of safety also has an implicit component.

5.4 Total Maximum Daily Load

The Total Maximum Daily Load (TMDL) represents the maximum load the stream may carry and meet the water quality standard for the pollutant of interest. For this TMDL the load will be expressed as cfu/day (colony forming units/day) and as a percent reduction for the MS4 WLA.

There is one Waste Load Allocation (WLA) for this TMDL. This WLA is the allocation for the MS4s (Kershaw and Richland Counties). Richland County became covered under NPDES Phase I in April of 2000. A designated part of Kershaw County will eventually be covered under a NPDES phase II stormwater permit. The reduction percentages in this TMDL apply also to the fecal coliform waste load attributable to those areas of the watershed which are covered or will be covered under NPDES MS4 (Municipal Separate Storm Sewer System) permits. Compliance by these municipalities with the terms of their individual MS4 permits will fulfill any obligations they have towards implementing this TMDL

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 Spears Creek requires a reduction of 61 % from the current load of 6.57E+11 cfu/day for CW-166. The target loading for Kelly Creek at CW-154 requires a reduction of 65 % from the existing load of 2.16E+10 cfu/day.

Table 6. TMDL components for Kelly and Spears Creek.

Impaired Station	WLA-MS4 % Reduction	LA cfu/day	MOS cfu/day	TMDL cfu/day	Target cfu/day
CW-154	65 %	7.47E+10	3.9E+09	7.9E+10	7.47E+10
CW-166	61 %	2.57E+11	1.3E+10	2.7E+11	2.57E+11

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 Spears Creek watershed. Local sources of nonpoint source education and assistance include Clemson Extension Service, the Natural Resource Conservation Service (NRCS), the Kershaw and Richland Counties 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 Kelly and Spears Creeks. TMDL implementation projects are given highest priority for 319 funding.

In addition to the resources cited above for the implementation of this TMDL in these 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.

The iterative BMP approach as defined in the general storm water NPDES MS4 permit is expected to provide significant implementation of this TMDL. Discovery and removal of illicit storm drain cross connection is one important element of the storm water NPDES permit. Public nonpoint source pollution education is another

Using existing authorities and mechanisms, these measures will be implemented in the Spears Creek and Kelly Creek watersheds in order to bring about 61 % and 65 % reductions in fecal coliform bacteria loading to these creeks. 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.

7.0 REFERENCES

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APPENDIX A   Fecal Coliform Data

Water Quality Data for Spears and Kelly Creeks

	Spears	Kelly
	Fecal Coliform (cfu/100ml)	
Date	CW-166	CW-154
21-May-90	160	140
12-Jun-90	100	290
16-Jul-90	220	140
7-Aug-90	900	300
18-Sep-90	150	230
16-Oct-90	140	60
29-May-91	80	110
12-Jun-91	45	40
2-Jul-91	86	130
12-Aug-91	3400	1600
10-Sep-91	100	190
21-Oct-91	90	20
20-May-92	100	60
17-Jun-92	50	40
28-Jul-92	110	140
26-Aug-92	180	150
15-Sep-92	10	40
22-Oct-92	40	40
18-Nov-92	60	
8-Dec-92	50	
19-Jan-93	60	
11-Feb-93	15	
4-Mar-93	230	
1-Apr-93	45	
18-May-93	100	200
2-Jun-93	100	140
13-Jul-93	470	520
18-Aug-93	140	330
8-Sep-93	420	240
2-Dec-93	120	
12-Jan-94	290	
2-Feb-94	20	
8-Mar-94	50	
7-Apr-94	20	
5-May-94	540	180
8-Jun-94	180	140
9-Aug-94	340	90

	Fecal Coliform (cfu/100ml)	
Date	CW-166	CW-154
25-Aug-94	20	30
15-Sep-94	60	180
18-Oct-94	60	40
6-Dec-94	60	
15-Dec-94	30	
5-Jan-95	14	
2-Feb-95	25	
30-Mar-95	39	
26-Apr-95	86	
9-May-95	130	290
13-Jun-95	390	170
5-Jul-95	130	150
10-Aug-95	130	220
20-Sep-95	210	160
4-Oct-95	6400	8300
30-Nov-95	90	
7-Dec-95	100	
30-Jan-96	60	
8-Feb-96	55	
20-Mar-96	80	
10-Apr-96	90	
14-May-96	80	150
26-Jun-96	210	300
22-Jul-96	210	420
5-Aug-96	270	790
10-Oct-96	220	140
13-Nov-96	800	
11-Dec-96	70	
15-Jan-97	80	
12-Feb-97	25	
4-Mar-97	70	
17-Apr-97	50	
14-May-97	30	80
19-Jun-97	90	130
1-Jul-97	100	200
6-Aug-97	66	170
2-Sep-97	250	280
9-Oct-97	70	70
24-Nov-97	37	
11-Dec-97	40	

	Fecal Coliform (cfu/100ml)	
Date	CW-166	CW-154
8-Jan-98	200	
19-Feb-98	30	
9-Mar-98		
11-Mar-98	40	
2-Apr-98		
7-Apr-98	50	
27-May-98	180	100
15-Jun-98	90	80
18-Jun-98		
16-Jul-98	760	560
30-Jul-98		
5-Aug-98		
11-Aug-98	280	80
9-Sep-98	140	160
24-Sep-98	110	
6-Oct-98	20	90
21-Oct-98		
23-Nov-98	60	
17-Dec-98	200	
14-Jan-99	70	
1-Feb-99	160	
16-Mar-99	60	
26-Apr-99	130	
4-May-99	150	55
14-Jun-99	170	240
26-Jul-99	260	260
24-Aug-99	120	220
14-Sep-99	200	130
6-Oct-99	110	50
2-Nov-99	320	
1-Dec-99	90	
4-Jan-00	100	
10-Feb-00	50	
20-Mar-00	2100	
25-Apr-00	60	
17-May-00	150	350
20-Jun-00	250	250
11-Jul-00	350	70
3-Aug-00	150	220
14-Sep-00	290	200

	Fecal Coliform (cfu/100ml)	
Date	CW-166	CW-154
30-Oct-00	320	340
7-Nov-00	250	
28-Dec-00	140	
9-Jan-01	100	
6-Feb-01	10	
5-Mar-01	450	
17-Apr-01	300	
8-May-01	260	
14-Jun-01	6700	
2-Jul-01	2800	
9-Aug-01	210	
4-Sep-01	230	
15-Oct-01	260	
14-Nov-01	220	
3-Dec-01	170	
23-Jan-02		
29-Jan-02	20	30
19-Feb-02		
26-Feb-02	90	86
19-Mar-02	100	
25-Mar-02	83	54
8-Apr-02		
10-Apr-02	2200	2100
22-May-02	80	200
23-May-02	640	
12-Jun-02	380	110
17-Jun-02		
18-Jul-02		
22-Jul-02	580	200
13-Aug-02		
19-Aug-02	360	400
8/27/02		1100
3-Sep-02		
26-Sep-02	320	470
15-Oct-02	100	180
18-Nov-02	50	40
16-Dec-02	30	55

APPENDIX B DMR Data

Fecal Coliform Load calculated from DMR Data for Palmetto Utlilities - Valhalla WWTP (SC0043494)

Permit Inactivated April 3, 2000

	Flow (mgd)			Fecal Coliform (cts/ 100ml)				Load
Date	**Mean**	**Max**	**C**	**Mean**	**C**	**Max**		**cts/day**
5/31/91		0.25		10		10		9.46E+07
7/31/91		0.26		60000		60000		5.91E+11
11/30/91	0.189	0.23		889		3800		6.36E+09
12/31/91		0.245		148.3		220		1.38E+09
7/31/92		0.235		16.4		27		1.46E+08
8/31/92		0.256		19.7		39		1.91E+08
9/30/92		0.258		15.2		23		1.48E+08
10/31/92		0.262		122.4		125		1.21E+09
11/30/92		0.267		17.9		32		1.81E+08
12/31/92		0.246		41		105		3.82E+08
1/31/93		0.255		498		1200		4.81E+09
2/28/93		0.29		165.9	>	6000		1.82E+09
3/31/93		0.249		10.7		58		1.01E+08
4/30/93		0.237		158.7		210		1.42E+09
5/31/93		0.266		5.57		60		5.61E+07
6/30/93		0.247	<	2	<	2		1.87E+07
7/31/93		0.245	<	2	<	2		1.85E+07
8/31/93		0.256	<	2	<	2		1.94E+07
9/30/93		0.272		7.75		30		7.98E+07
10/31/93		0.245		61.6		450		5.71E+08
11/30/93		0.237	<	2	<	2		1.79E+07
1/31/94		0.249	<	2	<	2		1.89E+07
2/28/94		0.239		71.8		3500		6.50E+08
3/31/94		0.281		5.29		14		5.63E+07
4/30/94		0.262		4.9		12		4.86E+07
5/31/94		0.289	<	2	<	2		2.19E+07
6/30/94		0.258		3.46		6		3.38E+07
7/31/94		0.253	<	2	<	2		1.92E+07
8/31/94				8		16		0.00E+00
10/31/94		0.261		50.4		320		4.98E+08
11/30/94		0.254		200		360		1.92E+09
12/31/94		0.282		5.66		16		6.04E+07
1/31/95		0.247	<	2	<	2		1.87E+07
2/28/95		0.253		12.8		82		1.23E+08
3/31/95		0.266		392.4		2200		3.95E+09

	Flow (mgd)		Fecal Coliform (cts/ 100ml)					Load
Date	Mean	Max	C	Mean	C	Max		cts/day
5/31/95		0.277		21.2		32		2.22E+08
6/30/95		0.293		8		16		8.87E+07
7/31/95			<	2	<	2		0.00E+00
8/31/95		0.287		7.48		14		8.13E+07
9/30/95		0.276		243.3		740		2.54E+09
10/31/95		0.287		33.5		56		3.64E+08
11/30/95		0.261		179.5		260		1.77E+09
12/31/95		0.258		6.63		22		6.48E+07
1/31/96		0.263	<	2	<	2		1.99E+07
2/29/96		0.258	<	2	<	2		1.95E+07
3/31/96		0.259		113.4		270		1.11E+09
4/30/96		0.273		353		20000		3.65E+09
5/31/96		0.297		98.1		370		1.10E+09
6/30/96		0.296		91.7		200		1.03E+09
7/31/96		0.326		4		8		4.94E+07
8/31/96		0.317		2		2		2.40E+07
9/30/96		0.308		5.29		14		6.17E+07
10/31/96		0.279		7.21		26		7.61E+07
11/30/96		0.266		121.3		230		1.22E+09
12/31/96		0.3		30.7		94		3.49E+08
1/31/97		0.302		59.3		88		6.78E+08
2/28/97		0.285		47.3		56		5.10E+08
3/31/97		0.301		2		2		2.28E+07
4/30/97		0.295	<	2	<	2		2.23E+07
5/31/97		0.295		15.5		120		1.73E+08
6/30/97		0.28		6.93		24		7.35E+07
7/31/97	0.259	0.267		2.83		4		2.77E+07
8/31/97	0.256	0.27		16.1		130		1.56E+08
9/30/97	0.246	0.253		4.47		5		4.16E+07
10/31/97	0.232	0.282		14.4		52		1.26E+08
11/30/97	0.221	0.235		8.94		20		7.48E+07
12/31/97	0.22	0.231		2		2		1.67E+07
1/31/98	0.227	0.24	<	2	<	2		1.72E+07
2/28/98	0.216	0.227	<	2	<	2		1.64E+07
3/31/98	0.22	0.23		4		8		3.33E+07
4/30/98	0.223	0.226		2		2		1.69E+07
5/31/98	0.227	0.244		26		349		2.23E+08
6/30/98	0.244	0.26		13.3		88		1.23E+08
7/31/98	0.25	0.253		2.8		4		2.65E+07
8/31/98	0.265	0.296		20		200		2.01E+08
9/30/98	0.234	0.256		38		254		3.37E+08
10/31/98	0.227	0.239		100		318		8.59E+08

	Flow (mgd)		Fecal Coliform (cts/ 100ml)					Load
Date	Mean	Max	C	Mean	C	Max		cts/day
11/30/98	0.219	0.225		21		74		1.74E+08
12/31/98	0.218	0.25		2		2		1.65E+07
1/31/99	0.213	0.224		14.4		16		1.16E+08
2/28/99	0.207	0.234		15		28		1.18E+08
3/31/99	0.214	0.235		106		963		8.59E+08
5/31/99	0.221	0.224		7		10		5.86E+07
6/30/99	0.223	0.262		74		82		6.25E+08
7/31/99	0.244	0.265		20.7		60		1.91E+08
8/31/99	0.24	0.259		434		450		3.94E+09

APPENDIX C Calculation of Existing and TMDL Loads

Spears Creek at CW-166:

Calculation of Existing Load

From equation of Trend Line: y = 9E+12 e ^ -4.2373 x

Percentile	Load	
0.10	5.89E+12	
0.15	4.77E+12	
0.10	5.89E+12	
0.20	3.86E+12	
0.25	3.12E+12	
0.30	2.52E+12	
0.35	2.04E+12	
0.40	1.65E+12	
0.45	1.34E+12	
0.50	1.08E+12	
0.55	8.75E+11	
0.60	7.08E+11	
0.65	5.73E+11	
0.70	4.64E+11	
0.75	3.75E+11	
0.80	3.03E+11	
0.85	2.45E+11	
0.90	1.99E+11	
Mean Load	**1.99E+12**	**cfu/day**

Calculation of TMDL Load

Target Conc 380 cfu/100ml

From Target Line

% Exceeded	Load (cfu/day)		Flow (cfs)
0.10	5.53E+11		59.50
0.15	4.59E+11		49.42
0.20	4.03E+11		43.36
0.25	3.66E+11		39.33
0.30	3.38E+11		36.31
0.35	3.09E+11		33.28
0.40	2.91E+11		31.26
0.45	2.63E+11		28.24
0.50	2.44E+11		26.22
0.55	2.25E+11		24.20
0.60	2.06E+11		22.19
0.65	1.88E+11		20.17
0.70	1.69E+11		18.15
0.75	1.50E+11		16.14
0.80	1.41E+11		15.13
0.85	1.22E+11		13.11
0.90	1.09E+11		11.09
Mean Load	**2.67E+11**		

Data used to calculate Load-Duration curve:

Samples Not Violating Standard

Date	**FC (cfu/100ml)**	**Flow**	**Rank**	**Percen-tile**	**Load (cfu/day)**
15-Sep-93	120	6.4	214	97.8%	1.88E+10
28-Oct-93	300	11.1	1024	89.3%	8.15E+10
18-Jul-94	350	16.1	2139	77.6%	1.38E+11
6-Oct-94	390	16.1	2139	77.6%	1.54E+11
14-Oct-94	300	64.5	8697	8.8%	4.73E+11
6-Oct-95	80	72.6	8863	7.0%	1.42E+11
28-Jun-96	320	17.1	2403	74.8%	1.34E+11
19-Sep-96	330	14.1	1497	84.3%	1.14E+11
29-Oct-96	180	15.1	1808	81.0%	6.65E+10
7-Jul-97	400	17.1	2403	74.8%	1.67E+11
17-Sep-98	280	12.1	1024	89.3%	8.29E+10

Mean Load of Samples Not Violating Standard: 1.43E+11

Samples Violating Standard

Date	FC (cfu/100ml)	Flow	Rank	Percen-tile	Load (cfu/day)
30-May-90	1000	23.2	4130	56.7%	5.68E+11
19-Jun-90	31000	15.1	1808	81.0%	1.15E+13
23-Jul-90	7100	12.1	1024	89.3%	2.10E+12
9-Aug-90	20000	9.2	553	94.2%	4.50E+12
14-Sep-90	440	8.6	461	95.2%	9.26E+10
11-Oct-90	2200	11.1	1024	89.3%	5.97E+11
9-May-91	5700	40.3	7176	24.7%	5.62E+12
20-Jun-91	2000	30.3	5710	40.1%	1.48E+12
11-Jul-91	3300	17.1	2403	74.8%	1.38E+12
8-Aug-91	1000	13.1	1273	86.6%	3.21E+11
25-Sep-91	190000	20.2	3427	64.0%	9.39E+13
16-Oct-91	4900	13.1	1273	86.6%	1.57E+12
17-May-93	620	33.3	6232	34.6%	5.05E+11
16-Jun-93	3600	24.2	4130	56.7%	2.13E+12
20-Jul-93	720	20.2	3427	64.0%	3.56E+11
4-Aug-93	820	10.1	832	91.3%	2.03E+11
26-May-94	460	15.1	1808	81.0%	1.70E+11
16-Jun-94	2300	21.2	3670	61.5%	1.19E+12
24-Aug-94	500	27.2	4844	49.2%	3.33E+11
16-May-95	880	25.2	4370	54.2%	5.43E+11
2-Jun-95	1200	23.2	4130	56.7%	6.81E+11
27-Jul-95	44000	7.6	343	96.4%	8.18E+12
3-Aug-95	1500	6.4	214	97.8%	2.35E+11
6-Sep-95	1300	34.3	6449	32.3%	1.09E+12
31-May-96	420	35.3	6623	30.5%	3.63E+11
26-Jul-96	5700	41.3	7305	23.4%	5.76E+12
9-Aug-96	700	16.1	2139	77.6%	2.76E+11
23-May-97	450	24.2	4130	56.7%	2.66E+11
6-Jun-97	600	24.2	4130	56.7%	3.55E+11
7-Aug-97	1000	35.3	6623	30.5%	8.64E+11
26-Sep-97	2800	42.4	7554	20.8%	2.90E+12
16-Oct-97	6000	13.1	1273	86.6%	1.92E+12
6-May-98	3100	55.5	8441	11.4%	4.21E+12
16-Jun-98	4200	28.2	5094	46.6%	2.90E+12
21-Jul-98	500	25.2	4370	54.2%	3.08E+11
14-Aug-98	8600	15.1	1808	81.0%	3.18E+12
26-Oct-98	620	12.1	1024	89.3%	1.84E+11

Mean Load of Samples Violating Standard: 4.40E+12

Kelly Creek at CW-154:

Calculation of Existing Load for Kelly Creek at CW-154

Trend Line: Exponential

Equation: $\mathbf{y} = 5E+10 \; x \; \mathbf{X}^{-1.013}$

x % Exceedence	**y Load**
0.05	1.04E+12
0.10	5.15E+11
0.15	3.42E+11
0.20	2.55E+11
0.25	2.04E+11
0.30	1.69E+11
0.35	1.45E+11
0.40	1.26E+11
0.45	1.12E+11
0.50	1.01E+11
0.55	9.16E+10
0.60	8.39E+10
0.65	7.74E+10
0.70	7.18E+10
0.75	6.69E+10
0.80	6.27E+10
Mean:	2.16E+11

Existing Load: **2.16E+11 cfu/day**

Calculation of TMDL Load

% Exceeded	TMDL Load	
	MOS: 0.05 %	
10%	1.44E+11	
15%	1.15E+11	
20%	1.01E+11	
25%	9.36E+10	
30%	8.64E+10	
35%	8.64E+10	
40%	7.92E+10	
45%	7.20E+10	
50%	6.98E+10	
55%	6.55E+10	
60%	6.26E+10	
65%	5.90E+10	
70%	5.54E+10	
75%	5.11E+10	
80%	4.75E+10	
85%	4.32E+10	
90%	3.82E+10	
	7.47E+10	**cfu/day**

Samples Violating Standard

Date	FC (cfu/100ml)	Flow	Load	Rank	Exceedence
7-Aug-90	900	21.7	4.78E+11	12499	4.3%
12-Aug-91	3400	14.7	1.22E+12	11589	11.2%
13-Jul-93	470	4.1	4.71E+10	1204	90.8%
8-Sep-93	420	10.1	1.04E+11	9966	23.7%
5-May-94	540	10.1	1.33E+11	9966	23.7%
4-Oct-95	6400	32.5	5.09E+12	12850	1.6%
13-Nov-96	800	9.3	1.82E+11	9292	28.8%
16-Jul-98	760	5.2	9.67E+10	2829	78.3%
20-Mar-00	2100	13.2	6.78E+11	11392	12.8%
10-Apr-02	2200	4.7	2.53E+11	2008	84.6%
22-Jul-02	580	1.2	1.70E+10	9	99.9%

Samples Not Violating Standard

Date	FC (cfu/ 100ml)	Flow	Load	Rank	Exceed ence
21-May-90	160	6.4	2.51E+10	4646	64.40%
12-Jun-90	100	6.2	1.52E+10	4338	66.80%
16-Jul-90	220	5.7	3.07E+10	3497	73.20%
18-Sep-90	150	3.9	1.43E+10	1037	92.10%
16-Oct-90	140	5.6	1.92E+10	3390	74.00%
29-May-91	80	4.7	9.20E+09	2008	84.60%
12-Jun-91	45	3.6	3.96E+09	712	94.50%
2-Jul-91	86	24	5.05E+10	12603	3.50%
10-Sep-91	100	5.6	1.37E+10	3390	74.00%
21-Oct-91	90	6.8	1.50E+10	5357	59.00%
20-May-92	100	5.3	1.30E+10	2944	77.50%
17-Jun-92	50	16.3	1.99E+10	12025	7.90%
28-Jul-92	110	6.2	1.67E+10	4338	66.80%
26-Aug-92	180	8	3.30E+10	6494	50.30%
15-Sep-92	10	6.7	1.64E+09	5216	60.10%
22-Oct-92	40	6.2	6.07E+09	4338	66.80%
18-Nov-92	60	6.8	9.98E+09	5357	59.00%
8-Dec-92	50	8.5	1.04E+10	7469	42.80%
19-Jan-93	60	10.8	1.59E+10	9966	23.70%
11-Feb-93	15	10.1	3.71E+09	9966	23.70%
4-Mar-93	230	35.6	2.00E+11	12897	1.20%
1-Apr-93	45	11.6	1.28E+10	10477	19.80%
18-May-93	100	6.7	1.64E+10	5216	60.10%
2-Jun-93	100	7.6	1.86E+10	6734	48.40%
18-Aug-93	140	24.8	8.49E+10	12665	3.00%
2-Dec-93	120	6.1	1.79E+10	4060	68.90%
12-Jan-94	290	16.3	1.16E+11	12025	7.90%
2-Feb-94	20	7.7	3.77E+09	6850	47.50%
8-Mar-94	50	10.8	1.32E+10	9966	23.70%
7-Apr-94	20	7.7	3.77E+09	6850	47.50%
8-Jun-94	180	4.3	1.89E+10	1477	88.70%
9-Aug-94	340	4	3.33E+10	1117	91.40%
25-Aug-94	20	4.8	2.35E+09	2109	83.80%
15-Sep-94	60	5.8	8.51E+09	3603	72.40%
18-Oct-94	60	7.4	1.09E+10	6395	51.00%
6-Dec-94	60	7.3	1.07E+10	6269	52.00%
15-Dec-94	30	6.7	4.92E+09	5216	60.10%
5-Jan-95	14	6.7	2.29E+09	5216	60.10%
2-Feb-95	25	11.6	7.10E+09	10477	19.80%
30-Mar-95	39	8.5	8.11E+09	7469	42.80%
26-Apr-95	86	7	1.47E+10	5785	55.70%

Date	FC (cfu/ 100ml)	Flow	Load	Rank	Exceed ence
9-May-95	130	6.6	2.10E+10	5093	61.00%
13-Jun-95	390	23.2	2.21E+11	12546	3.90%
5-Jul-95	130	15.5	4.93E+10	11919	8.70%
10-Aug-95	130	7	2.23E+10	5785	55.70%
20-Sep-95	210	5.5	2.83E+10	3294	74.80%
30-Nov-95	90	9.3	2.05E+10	9292	28.80%
7-Dec-95	100	13.9	3.40E+10	11392	12.80%
30-Jan-96	60	10.1	1.48E+10	9966	23.70%
8-Feb-96	55	11.6	1.56E+10	10477	19.80%
20-Mar-96	80	13.2	2.58E+10	11392	12.80%
10-Apr-96	90	8.5	1.87E+10	7469	42.80%
14-May-96	80	6.7	1.31E+10	5216	60.10%
26-Jun-96	210	4.6	2.36E+10	1895	85.50%
22-Jul-96	210	5	2.57E+10	2477	81.00%
5-Aug-96	270	8.5	5.61E+10	7469	42.80%
10-Oct-96	220	13.9	7.48E+10	11392	12.80%
11-Dec-96	70	10.1	1.73E+10	9966	23.70%
15-Jan-97	80	9.3	1.82E+10	9292	28.80%
12-Feb-97	25	8.5	5.20E+09	7469	42.80%
4-Mar-97	70	9.3	1.59E+10	9292	28.80%
17-Apr-97	50	6.5	7.95E+09	4755	63.60%
14-May-97	30	6.3	4.62E+09	4491	65.60%
19-Jun-97	90	7.5	1.65E+10	6494	50.30%
1-Jul-97	100	5.7	1.39E+10	3497	73.20%
6-Aug-97	66	5.8	9.37E+09	3603	72.40%
2-Sep-97	250	5	3.06E+10	2477	81.00%
9-Oct-97	70	4.1	7.02E+09	1204	90.80%
24-Nov-97	37	7.1	6.43E+09	5921	54.70%
11-Dec-97	40	7.3	7.14E+09	6269	52.00%
8-Jan-98	200	18.6	9.10E+10	12273	6.00%
19-Feb-98	30	21.7	1.59E+10	12499	4.30%
11-Mar-98	40	17.8	1.74E+10	12122	7.20%
7-Apr-98	50	12.4	1.52E+10	11171	14.40%
27-May-98	180	8.5	3.74E+10	7469	42.80%
15-Jun-98	90	6.4	1.41E+10	4646	64.40%
11-Aug-98	280	11.6	7.95E+10	10477	19.80%
9-Sep-98	140	6.3	2.16E+10	4491	65.60%
6-Oct-98	20	5.3	2.59E+09	2944	77.50%
23-Nov-98	60	5.4	7.93E+09	3062	76.50%
17-Dec-98	200	6.7	3.28E+10	5216	60.10%
14-Jan-99	70	6.3	1.08E+10	4491	65.60%
1-Feb-99	160	10.8	4.23E+10	9966	23.70%
16-Mar-99	60	9.3	1.37E+10	9292	28.80%
26-Apr-99	130	4.7	1.49E+10	2008	84.60%

Date	FC (cfu/ 100ml)	Flow	Load	Rank	Exceed ence
4-May-99	150	5.3	1.95E+10	2944	77.50%
14-Jun-99	170	3	1.25E+10	312	97.60%
26-Jul-99	260	6.4	4.07E+10	4646	64.40%
24-Aug-99	120	3	8.81E+09	312	97.60%
14-Sep-99	200	3.7	1.81E+10	803	93.90%
6-Oct-99	110	9.3	2.50E+10	9292	28.80%
2-Nov-99	320	13.9	1.09E+11	11392	12.80%
1-Dec-99	90	7.7	1.70E+10	6850	47.50%
4-Jan-00	100	7.7	1.88E+10	6850	47.50%
10-Feb-00	50	10.8	1.32E+10	9966	23.70%
25-Apr-00	60	7.3	1.07E+10	6269	52.00%
17-May-00	150	3.8	1.39E+10	942	92.80%
20-Jun-00	250	5	3.06E+10	2477	81.00%
11-Jul-00	350	3.2	2.74E+10	412	96.80%
3-Aug-00	150	13.9	5.10E+10	11392	12.80%
14-Sep-00	290	4.1	2.91E+10	1204	90.80%
30-Oct-00	320	4.4	3.44E+10	1583	87.90%
7-Nov-00	250	4.9	3.00E+10	2348	82.00%
28-Dec-00	140	6.5	2.23E+10	4755	63.60%
29-Jan-02	20	5.9	2.89E+09	3846	70.50%
26-Feb-02	90	4.2	9.25E+09	1407	89.20%
25-Mar-02	83	4.1	8.33E+09	1204	90.80%
22-May-02	80	2.7	5.28E+09	213	98.40%
12-Jun-02	380	1.5	1.39E+10	30	99.80%
19-Aug-02	360	1.9	1.67E+10	68	99.50%
26-Sep-02	320	2.6	2.04E+10	185	98.60%
15-Oct-02	100	4.9	1.20E+10	2348	82.00%
18-Nov-02	50	13.9	1.70E+10	11392	12.80%
16-Dec-02	30	6.5	4.77E+09	4755	63.60%

APPENDIX D Selected Figures and Tables

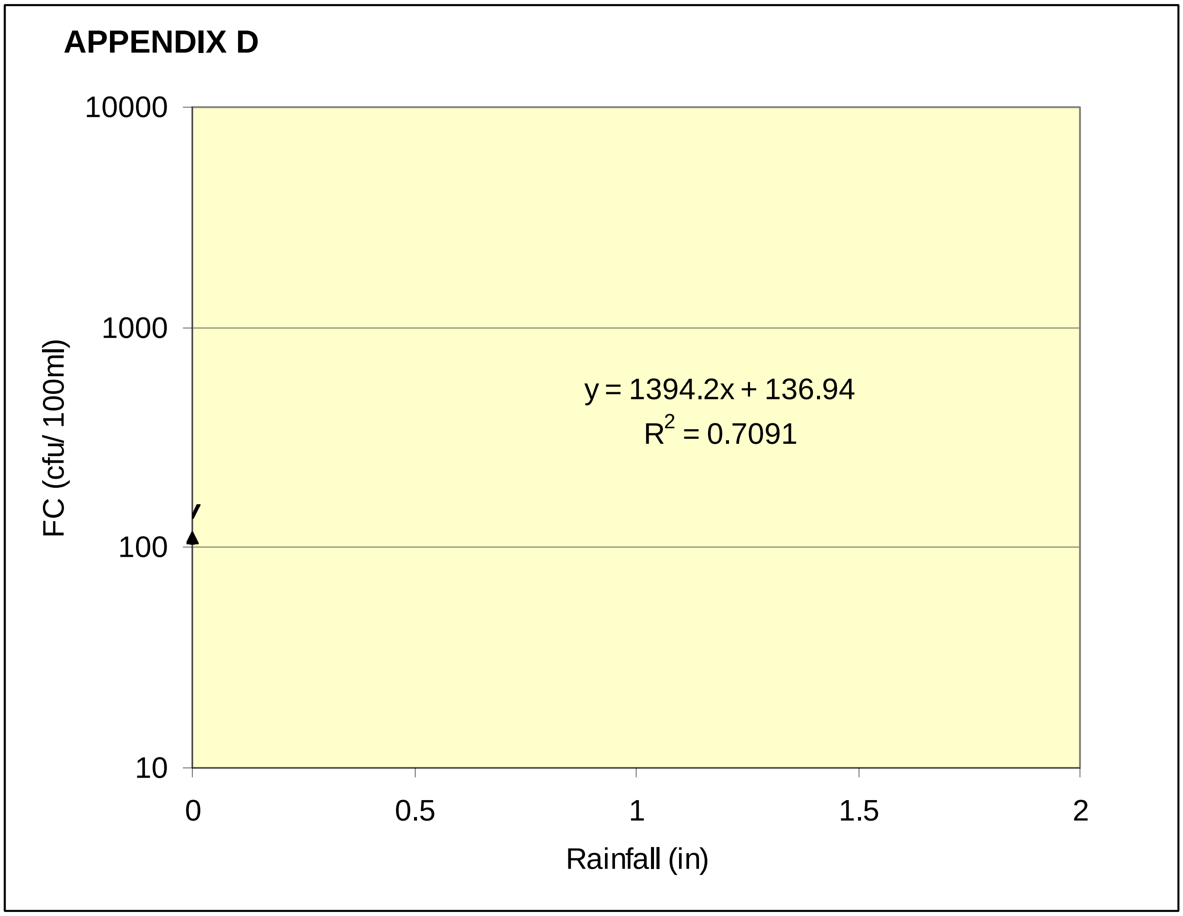

Figure D-1 Rainfall at Clemson Sandhills Station and fecal coliform concentrations in Spears Creek at CW-155, which is not impaired.

Table D-1. Flat Creek Watershed, NC Land Uses (USGS Gauging Station #02102908).

Land Use Class	**Drainage Area (hectares)**	**Percentage**
Urban		
	3.6	0.2%
Transitional		
	568.1	28.0%
Forest		
	1308.4	64.6%
Wetlands	146.4	7.2%
Totals	2027	100.0%

Table D-2. Dean Swamp Creek Watershed, SC Land Uses (USGS Gauging Station #02172640).

Land Use Class	**Area (hectares)**	**Percentage**
Water	33.1	0.4%
Built-up	90.7	1.1%
Transitional	758.7	9.6%
Forest	4440.7	55.9%
Pasture	170.7	2.1%
Agriculture	2179.8	27.4%
Wetlands	269.0	3.4%
Total	7942.8	100.0%

APPENDIX E Public Notification

PUBLIC NOTICE

U.S. Environmental Protection Agency, Region 4
Water Management Division
61 Forsyth Street, S.W.
Atlanta, GA 30303-8960

NOTICE OF AVAILABILITY
TOTAL MAXIMUM DAILY LOADS (TMDLS)
FOR WATER AND POLLUTANTS IN THE STATE OF SOUTH CAROLINA

Section 303(d)(1)(C) of the Clean Water Act (CWA), 33 U.S.C. §1313(d)(1)(C), and the U.S. Environmental Protection Agency's implementing regulation, 40 CFR §130.7(c)(1), require the establishment of Total Maximum Daily Loads (TMDLs) for waters identified by states as not meeting water quality standards under authority of §303(d)(1)(A) of the CWA. These TMDLs are to be established levels necessary to implement applicable water quality standards with seasonal variations and a margin of safety, accounting for lack of knowledge concerning the relationship between pollutant loading and water quality.

The waterbody impairments on South Carolina's 303(d) list that will be addressed by the TMDLs are listed below. These impaired waterbodies are located in the Wateree Basin in Kershaw and Richland Counties.

Waterbody Name	Station ID	§303(d) List Pollutants
Spears Creek	CW-166	Fecal Coliform Bacteria
Kelly Creek	CW-154	Fecal Coliform Bacteria

Persons wishing to comment on the proposed TMDLs or to offer new data or information regarding the proposed TMDLs are invited to submit the same in writing no later than May 14, 2004 to the U.S. Environmental Protection Agency, Region 4, Water Management Division, 61 Forsyth Street, S.W., Atlanta, Georgia 30303-8960, ATTENTION: Ms. Sibyl Cole, Standards, Monitoring, and TMDL Branch.

A copy of the proposed TMDLs can be obtained through the Internet or by contacting Ms. Cole at (404) 562-9437 or via electronic mail at cole.sibyl@epa.gov. The URL address for the proposed TMDLs is: http://www.epa.gov/region4/water/tmdl/tennessee/index.htm#sc. The proposed TMDLs and supporting documents, including technical information, data, and analyses, may be reviewed at 61 Forsyth Street, S.W., Atlanta, Georgia, between the hours of 8 AM and 4:30 PM, Monday through Friday. Persons wishing to review this information should contact Ms. Cole to schedule a time for that review.

http://www.epa.gov/region

/s/
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James D. Giattina, Director   Date
Water Management Division
Region 4
U.S. Environmental Protection Agency

RESPONSE TO COMMENTS
No Comments Received