EPA FINALIZED TMDL

Watershed Characterization Document for Lorick Branch: (Hydrologic Unit Code: 03050109-210-010); Station S-150 Fecal Coliform Bacteria

Bureau of Water
2600 Bull Street
Columbia, SC 29201

September 29, 2004

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 the Lorick Branch Basin. Subsequent actions must be consistent with this TMDL.

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James D. Giattina, Director Date
Water Management Division

Abstract

A TMDL was developed for Lorick Branch, a small, suburban stream in Lexington County, SC. This stream was placed on South Carolina's 303(d) list of waters that are impaired, because 53 % of water samples in the 1998 - 2002 assessment period exceeded the standard for fecal coliform. The Lorick Branch watershed was 66 % urban and 28 % forest in 1992. All of the watershed has been designated as an MS4.

The load-duration curve methodology was used to calculate the existing load and the TMDL load for Lorick Branch at S-150. The existing load was estimated to be 4.7E+10 cfu/day. The TMDL load was determined to be 5.41E+09 cfu/day, which equates to a reduction in the load of fecal coliform into the creek of 88 %. The MS4 area, which is the complete watershed, was determined to have a WLA of 88 %. Resources and several TMDL implementation strategies to bring about this reduction are suggested.

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Tables and 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

Lorick Branch is a small creek in Lexington County, in the greater Columbia area (Figure 1). The branch is a tributary of the Saluda River, joining the river just downstream of Lake Murray. The watershed is in the lower Piedmont region of South Carolina. The area of the watershed is quite small, only 162 hectares (399 acres). The lower half of the watershed is in the Town of Seven Oaks; the upper half is in unincorporated Lexington County (Figure 2). The watershed had a population of approximately 1300 people in 2000.

The predominant land uses in the watershed, based on the National Land Cover Dataset (NLCD) (circa 1992), were urban (66 %) and forest (28 %); see Table 1 and Figure 2. There is no significant agriculture in this suburban watershed. Irmo High School is occupies a large section of the upper end of the Lorick Branch watershed. There are also several ponds that feed the branch.

Lorick Branch has a single water quality monitoring station (S-150), which is located just upstream of the General Electric plant's intake. This TMDL applies to the watershed upstream of this point.

1.3 Water Quality Standard

The impaired stream segment, Lorick Branch, is 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)

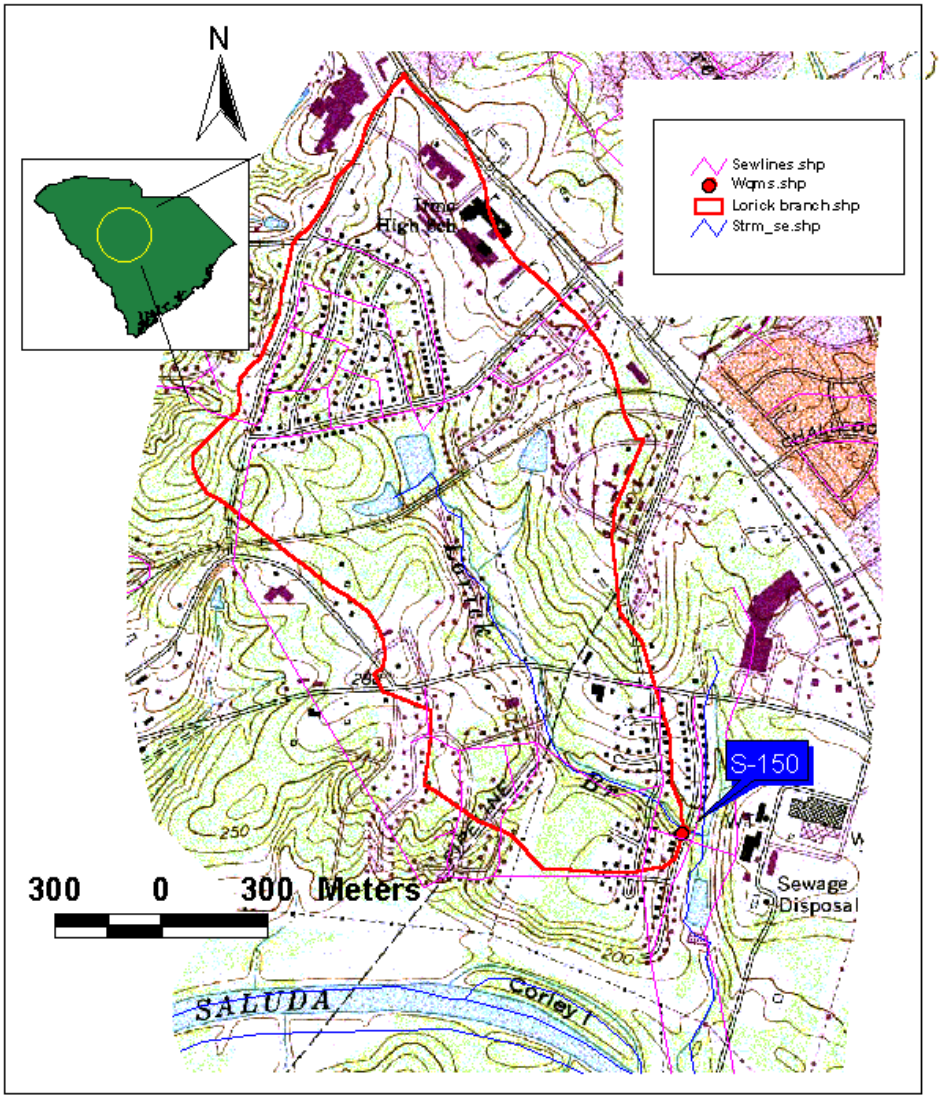

Figure 1. Map of the Lorick Branch watershed.

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).

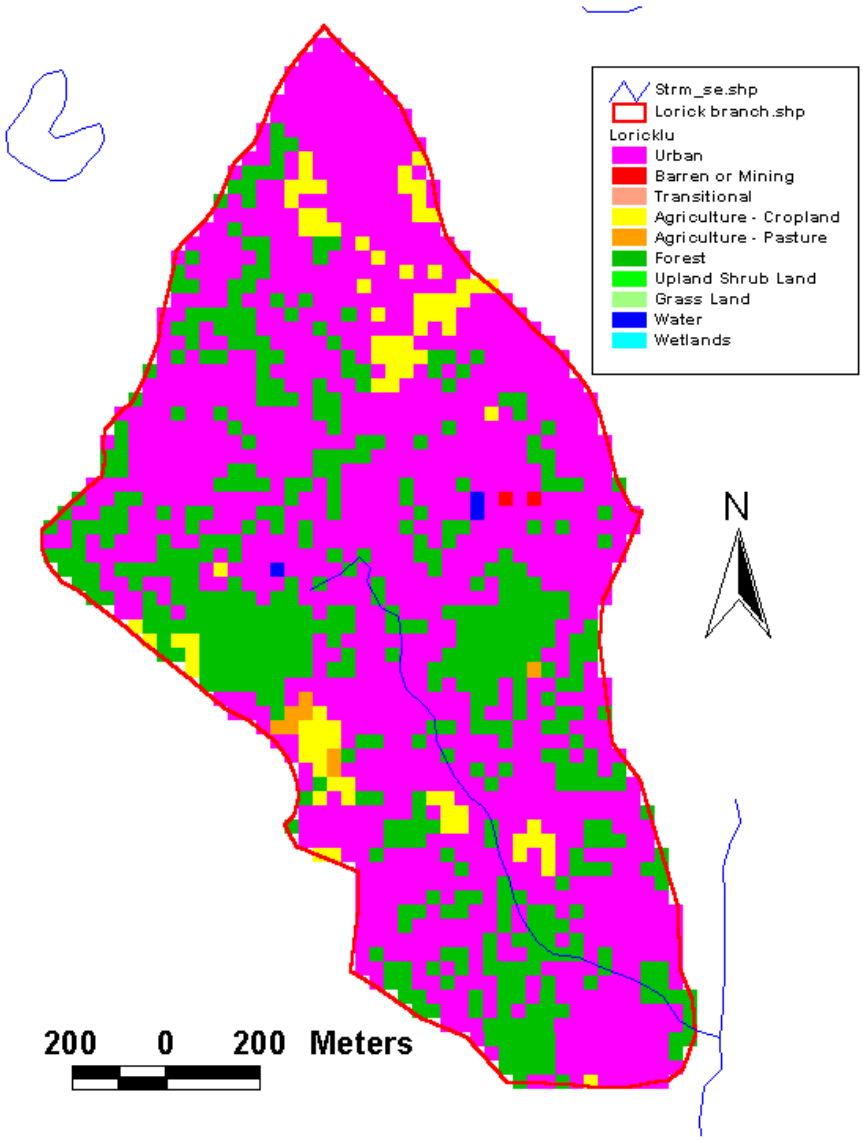

Figure 2. Map showing land uses in the Lorick Branch watershed.

Table 1. Land uses in the Lorick Branch watershed.

Land Use Groups	Land Use	Area (hectares)	Area Sub-totals (hectares)	% Land Use	Sub-totals %
	Water	0.3		0.2%	
Developed	Residential Low Density	59.6		36.8%	
	Residential High Density	23.6		14.6%	
	Commercial, Industrial, & Transportation	24.3		15.0%	
			107.5		**66.3%**
	Barren	0.2		0.1%	
Forest	Forest Deciduous	8.9		5.5%	
	Forest Evergreen	28.1		17.3%	
	Forest Mixed	8.7		5.4%	
			45.7		**28.2%**
Agricultural	Pasture/Hay	0.7		0.4%	
	Cropland	4.0		2.4%	
	Urban Grasses	3.7		2.3%	
			8.4		**5.2%**
Total for Watershed		**162.0**		**100.0%**	**99.7%**

2.0 WATER QUALITY ASSESSMENT

An assessment of water quality data collected in 1998 through 2002 at water quality monitoring station S-150 indicated that Lorick Branch is impaired for recreational use. In addition to being listed on the 2004 303(d) list, Lorick Branch was also on the 1998, 2000, and 2002 lists. 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 by fecal coliform bacteria and are placed on South Carolina's 303(d) list. During the assessment period (1996-2000), 53 % of the samples did not meet the fecal coliform criterion at S-150. Fecal coliform data for the period of 1990-2001 are provided in Appendix A.

Fecal coliform concentrations in Lorick Branch do not appear to be related to flow (Figure 3). Flow in Lorick Branch was estimated from the flow in Smith Branch (USGS #02162093), which is somewhat larger watershed about 10 miles away in Columbia. High fecal coliform concentrations occur at the whole range of flow values.

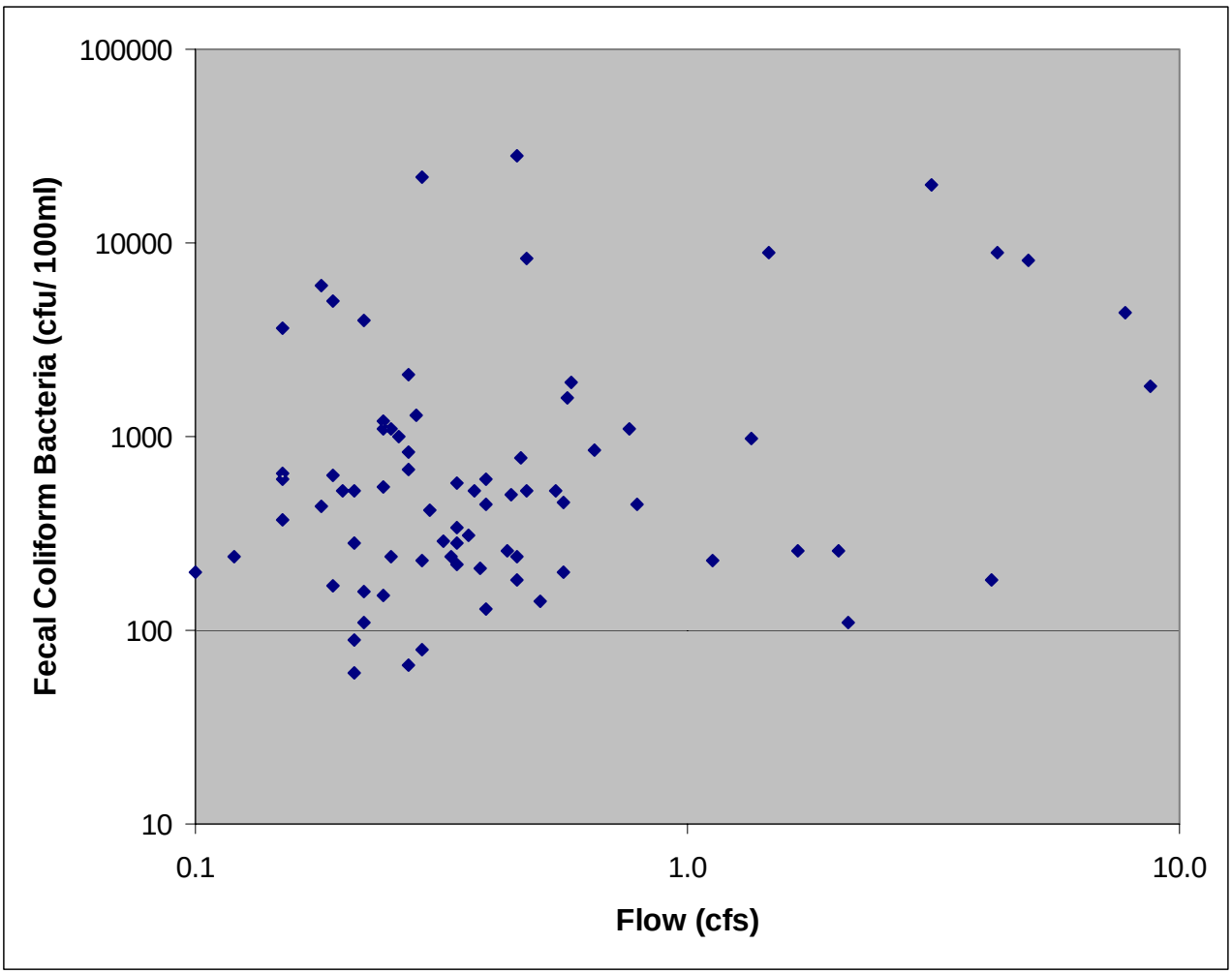

Figure 3. Comparison between flow and fecal coliform concentrations in Lorick Branch.

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 Lorick Branch Watershed

3.1.1 Municipal Separate Storm Sewer Systems (MS4)

There is no currently operating NPDES facility (point source) in this watershed. The whole watershed however has been designated as a MS4. There are two municipalities in the watershed that have or will have NPDES MS4 (Municipal Separate Storm Sewer System) permits. These permitted sewer systems will be treated as point sources in the TMDL calculations below. However the load-duration curve method does not evaluate sources or land use differences.

3.1.2 Sewage Collection Systems

Though there is no treatment facility or outfall in this watershed, there are sewer lines. 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.

3.2 Nonpoint Sources in Lorick Branch Watershed

3.2.1 Wildlife

In this suburban watershed wildlife (mammals and birds), which is a source of fecal coliform bacteria, is likely to be a significant though not major contributor. Many animals, such as squirrels, raccoons, and geese, have adapted to live in suburban environments. The population density of these animals seems often to be higher than in more natural environments.

3.2.2 Failing Septic Systems

Because this area has many sewer lines, it likely that most of the population has sewer service rather than septic systems. Therefore failing septic systems are less likely to be a significant source of fecal coliform bacteria.

3.2.3 Urban Runoff

Urbanized or developed land typically generates an increased loading for pollutants relative to forest and other undeveloped land uses. Dogs, cats, and other pets are the primary source of fecal coliform deposited on the urban landscape. Impervious surfaces increase the amount of runoff relative to predevelopment. The increased storm runoff washes more of this fecal material into streams directly or through the storm sewers.

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. Lorick Branch, like most small streams in South Carolina is not gauged. Smith Branch, a nearby urban watershed, is a comparable, gauged stream with similar land uses and topography. Data from the gauge (USGS # 02162093) on Smith Branch in Columbia, South Carolina for the period of record (October 1, 1976 to September 30, 2001) was used to generate the flow-duration curve. The Smith Branch watershed is substantially larger, 1444 hectares, compared to 162 hectares for the Lorick Branch watershed. The watersheds are only 10 miles apart so that rainfall would like be the same at both watersheds.

The flows for Lorick Branch were estimated by multiplying the daily flow rates from Smith Branch by the ratio of the Lorick Branch drainage area to that of Smith Branch (0.1122). The flows were ranked from low to high and the values that exceed certain selected percentiles determined. 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 (Figure 4). The target line was created by calculating the allowable load from the flow (at 5 % recurrence intervals) and the instantaneous fecal coliform standard concentration. The points were connected to make the line. Sample loads above this line are violations of the standard, while loads below the line are in compliance.

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.

The best fitting trend line for loads that were above the target line was a power function. This trend line has an r^2 of 0.6362 and has a similar shape to the target line. The existing load to Lorick

Branch was calculated from the mean of all loads exceeding the standard that were between the 10 % and 90 % flow recurrence intervals. This excludes flows that occur infrequently.

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 MOS. Calculations for both existing and TMDL loads are provided in Appendix B.

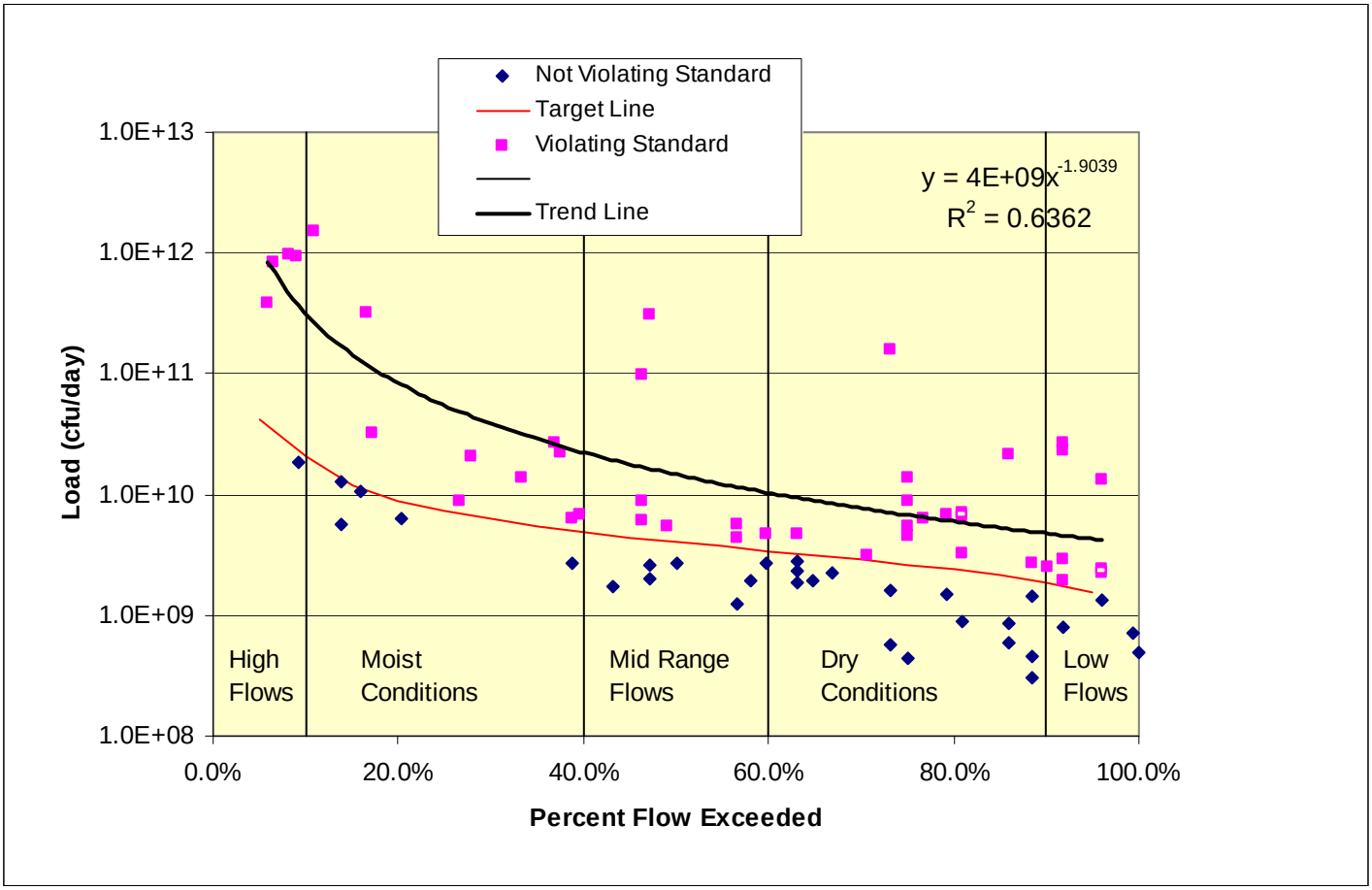

Figure 4. Load-duration curve for Lorick Branch at S-150. Trend line for loads that are above the allowable limit is a power function.

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:

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

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.

5.1 Critical Conditions

This TMDL is based on the flow recurrence interval between 10 % and 90 %. This encompasses 80 % of flows in Lorick Branch. Only flows that are characterized as 'High' or 'Low' flows in Figure 4 are not included in the analysis. For this TMDL critical conditions are this range of the flow recurrence interval.

5.2 Seasonality

The data used to derive the TMDL includes data from all months of the year, though the data were biased toward the warm months of the season. The warm season is the time of the year when children are more likely to be playing in the creek or adults are likely to be engaging in recreation activities in the creek or the river downstream of the mouth of Lorick Branch.

5.3 Margin of Safety

The explicit margin of safety is 5% of the geometric mean standard or 20 cfu/ 100ml of the instantaneous criterion of 400 cfu/100 ml. For S-150 this is equivalent to 2.8 E+08 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.

Table 2. TMDL components for Lorick Branch.

Impaired Station	WLA cfu/day	WLA for MS4s	LA cfu/day	MOS cfu/day	TMDL cfu/day	Percent Reduction
S-150	NA	88 %	5.41×10^{9}	2.8×10^{8}	5.69×10^{9}	88.5 %

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 Lorick Branch requires a reduction of 88.5 % from the current load of 4.7 E+10 cfu/day for S-150.

There are two municipalities in the watershed that have or will have NPDES MS4 permits. About half of the watershed is in unincorporated Lexington County and half in the Town of Seven Oaks. The entire watershed will eventually be covered by one or two NPDES phase II stormwater permits. 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.

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. SCDHEC will work with the existing agencies in the area to provide nonpoint source education in the Lorick Branch Watershed. Local sources of nonpoint source education and assistance include Clemson Extension Service, the Lexington County Soil and Water Conservation Services, and the South Carolina Department of Natural Resources.

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 Lorick Branch. TMDL implementation projects are given highest priority for 319 funding.

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.

In addition to the resources cited above for the implementation of this TMDL in the Lorick Branch Watershed, Clemson Extension has developed a Home-A-Syst handbook that can help urban or 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 the Lorick Branch Watershed in order to bring about an 88 % reduction in fecal coliform bacteria loading to the branch. 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 AND BIBLIOGRAPHY

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APPENDIX A Fecal Coliform Data

Table A-1 Lorick Branch (S-150) upstream GE Intake

Date	Time	Fecal Coliform (cfu/ 100ml)
18-May-90	1210	550
21-Jun-90	1030	650
12-Jul-90	1350	110
23-Aug-90	1240	260
28-Sep-90	1015	240
23-Oct-90	1230	8400
26-Nov-90	1330	66
16-May-91	1320	180
17-Jun-91	1330	520
17-Jul-91	1330	8100
1-Aug-91	1040	9000
24-Sep-91	1225	260
16-Oct-91	1240	290
19-May-92	1150	630
25-Jun-92	1105	90
28-Jul-92	1305	680
13-Aug-92	1100	1800
8-Sep-92	1300	1300
15-Oct-92	905	460
11-May-93	1030	220
8-Jun-93	910	280
20-Jul-93	1015	240
5-Aug-93	1150	440
1-Sep-93	1233	200
5-Oct-93	1145	370
18-May-94	900	280
14-Jun-94	1125	570
6-Jul-94	1140	1100
24-Aug-94	1420	520
7-Sep-94	1055	240
11-Oct-94	1340	450
16-May-95	1240	840
13-Jun-95	909	20000
27-Jul-95	915	22000
1-Aug-95	1442	1200
8-Aug-95	1155	1100
21-Sep-95	1110	2100
3-Oct-95	1240	420
2-May-96	1350	28000
5-Jun-96	1225	780

Date	Time	Fecal Coliform (cfu/ 100ml)
23-Jul-96	1145	1900
20-Aug-96	1210	150
5-Sep-96	1200	1000
8-Oct-96	1020	4400
13-May-97	955	180
9-Jun-97	1200	60
15-Jul-97	915	980
13-Aug-97	1210	230
4-Sep-97	1120	450
14-Oct-97	1210	200
12-May-98	955	140
9-Jun-98	1300	240
21-Jul-98	945	4000
11-Aug-98	1130	1100
22-Sep-98	1000	500
20-Oct-98	1030	160
26-May-99		*Present <QL
17-Jun-99		9000
27-Jul-99		600
18-Aug-99		110
21-Sep-99		1600
19-Oct-99		860
17-May-00		80
14-Jun-00		340
5-Jul-00		600
16-Aug-00		530
12-Sep-00		230
31-Oct-00		170
22-Jan-01		130
28-Feb-01		260
13-Mar-01		210
3-Apr-01		520
1-May-01		310
11-Jun-01		520
11-Jul-01		5000
2-Aug-01		6000
10-Sep-01		3600
2-Oct-01		860
13-Nov-01		10
12-Dec-01		50

APPENDIX B Calculations

Table B-1 Calculation of Existing Load

Calculation of Existing Load
Equation: y = 4E+09 X ^ -1.9039

% Exceeded	Load (cfu/day)
0.10	3.21E+11
0.15	1.48E+11
0.20	8.57E+10
0.25	5.60E+10
0.30	3.96E+10
0.35	2.95E+10
0.40	2.29E+10
0.45	1.83E+10
0.50	1.50E+10
0.55	1.25E+10
0.60	1.06E+10
0.65	9.08E+09
0.70	7.89E+09
0.75	6.92E+09
0.80	6.12E+09
0.85	5.45E+09
0.90	4.89E+09
Mean Load	4.70E+10

Table B-2 Calculation of TMDL Load

Calculation of TMDL Load
Target Conc 380 cfu/100ml
From Target Line

% Exceeded	Load (cfu/day)	Flow (cfs)
0.10	1.98E+10	2.13
0.15	1.15E+10	1.23
0.20	8.45E+09	0.91
0.25	6.99E+09	0.75
0.30	6.05E+09	0.65
0.35	5.22E+09	0.56
0.40	4.69E+09	0.50
0.45	4.17E+09	0.45
0.50	3.86E+09	0.42
0.55	3.55E+09	0.38
0.60	3.23E+09	0.35
0.65	3.02E+09	0.33
0.70	2.71E+09	0.29
0.75	2.50E+09	0.27
0.80	2.29E+09	0.25
0.85	2.09E+09	0.22
0.90	1.77E+09	0.19
Mean Load	**5.41E+09**	

Table B-3 Calculation of Percent Reduction

Percent Reduction Required:		
Existing Load:	4.70E+10	cfu/day
TMDL Load:	5.41E+09	cfu/day
Load Reduction:	4.16E+10	cfu/day
Percent reduction:	88.5%	

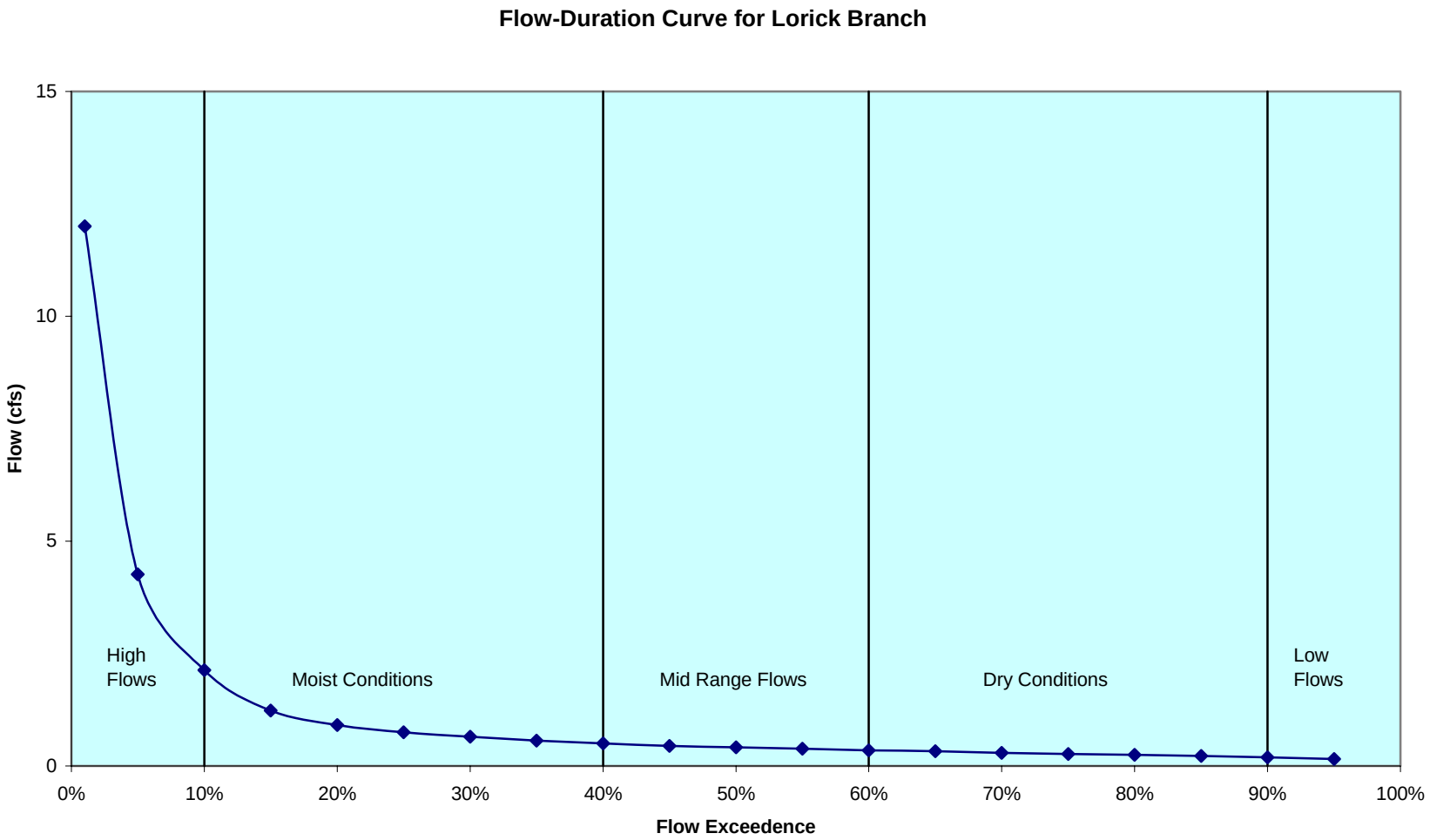

Figure B-1 Flow-Duration Curve for Lorick Branch.

APPENDIX C Public Participation

The following notice was published in *The State* newspaper on , sent to a list of persons whom had requested to be notified of TMDL notices, and placed on the EPA Region 4 web site.

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 impairment on South Carolina's 303(d) list that will be addressed by the TMDL is listed below. This impaired waterbody is located in the Saluda Basin in Lexington County.

Waterbody Name	Station ID	§303(d) List Pollutants
Lorick Branch, headwaters to just upstream of GE Plant Intake	SC-S-150	Fecal Coliform Bacteria

Persons wishing to comment on the proposed TMDL or to offer new data or information regarding the proposed TMDL are invited to submit the same in writing no later than August 16, 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 TMDL 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 TMDL is: http://www.epa.gov/region4/water/tmdl/tennessee/index.htm#sc.
The proposed TMDL 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/region4

/s/

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

NO COMMENTS RECIEVED