

Total Maximum Daily Load (TMDL) Coneross Creek, South Carolina

**Hydrologic Unit
03060101-080**

**South Carolina Water Quality Monitoring Station
SV-333
SV-004**

**South Carolina Department of
Health and Environmental Control
Bureau of Water**

November 30, 2000

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Abstract

Coneross Creek (Stations SV-333 and SV-004) has been placed on the South Carolina's 1998 303 (d) list of impaired waterbodies because of violations of the fecal coliform bacteria water quality standard. This TMDL was developed to determine the maximum amount of the pollutant that the Coneross Creek can receive from point and nonpoint sources and still meet water quality standards. EPA's BASINS model (HSPF) was used to calculate the continuous in-stream concentration of fecal coliform bacteria. Based on this estimation, we calculated the sum of the allowable loads of the single pollutant from all contributing point and nonpoint sources. This TMDL includes a margin of safety and seasonality to ensure that the waterbody can be used for the recreational use purposes that the State has designated. This TMDL recommends a reduction of 50 % in the loading from un-identified sources, which includes sanitary sewers overflows, leaking sanitary sewers, failing septic systems, and direct discharges. The reduction would be 2.88×10^{12} counts/30 days from these sources or a 50 % reduction in these possible sources.

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Coneross Creek, South Carolina

1. Introduction

The South Carolina Department of Health & Environmental Control (DHEC), Bureau of Water, listed the Coneross Creek on its 1998 Section 303(d) list due to violation of recreational use support for the water body based on fecal coliform monitoring data. The impaired segment is 18.26 miles long.

The Coneross Creek watershed (hydrologic unit 03060101-080) is located in Oconee County, South Carolina (Figure 1), approximately 3.56 miles west of Seneca, South Carolina. Coneross Creek flows generally northwest to southeast, draining a 47,016 acre watershed that is a part of the Seneca River Basin (hydrologic unit 03060101). Land uses in the watershed include: 50% forested land, 39% agricultural/grass land, 10% urban land, and less than 1% other land uses. This watershed is dominated by forested and agricultural/grass land uses. The principal agricultural practice in the watershed is poultry production.

Clean Water Act (CWA) Section 303(d) and its implementation regulations require a TMDL to be developed for those water bodies identified as impaired by the State where technology-based and other required controls do not provide for attainment of water quality standards. In its 1998 Section 303(d) list of such waters, we identified Coneross Creek as failing to attain its designated uses, as a result of multiple exceedences of the water quality standard for fecal coliform and therefore for violations of recreational use support. We developed the fecal coliform TMDL to achieve full compliance with the water quality standard for fecal coliform. Table 1 below summarizes the elements of this TMDL.

Table 1. Summary of fecal coliform TMDL allocation (Counts/30-days)

Parameter	TMDL ^(a)	WLA	LA	MOS
Fecal Coliform	8.58×10^{12} ^(b)	1.77×10^{12} ^(c)	5.73×10^{12} ^(d)	1.08×10^{12} & Implicit

Table Notes:

- a) TMDL represents loading that would correspond to compliance with the 200 counts/100ml geometric mean criterion including a margin of error.
- b) $TMDL = \Sigma WLA + \Sigma LA + MOS$
- c) Derived from *Table 2. Fecal Coliform Waste Load Allocation, Calculated on a Daily Basis*. Daily loadings from Table 2 were multiplied by 30 days.
- d) From *Table 11. Summary of Combined Load Allocations for Fecal Coliform in Coneross Creek*.

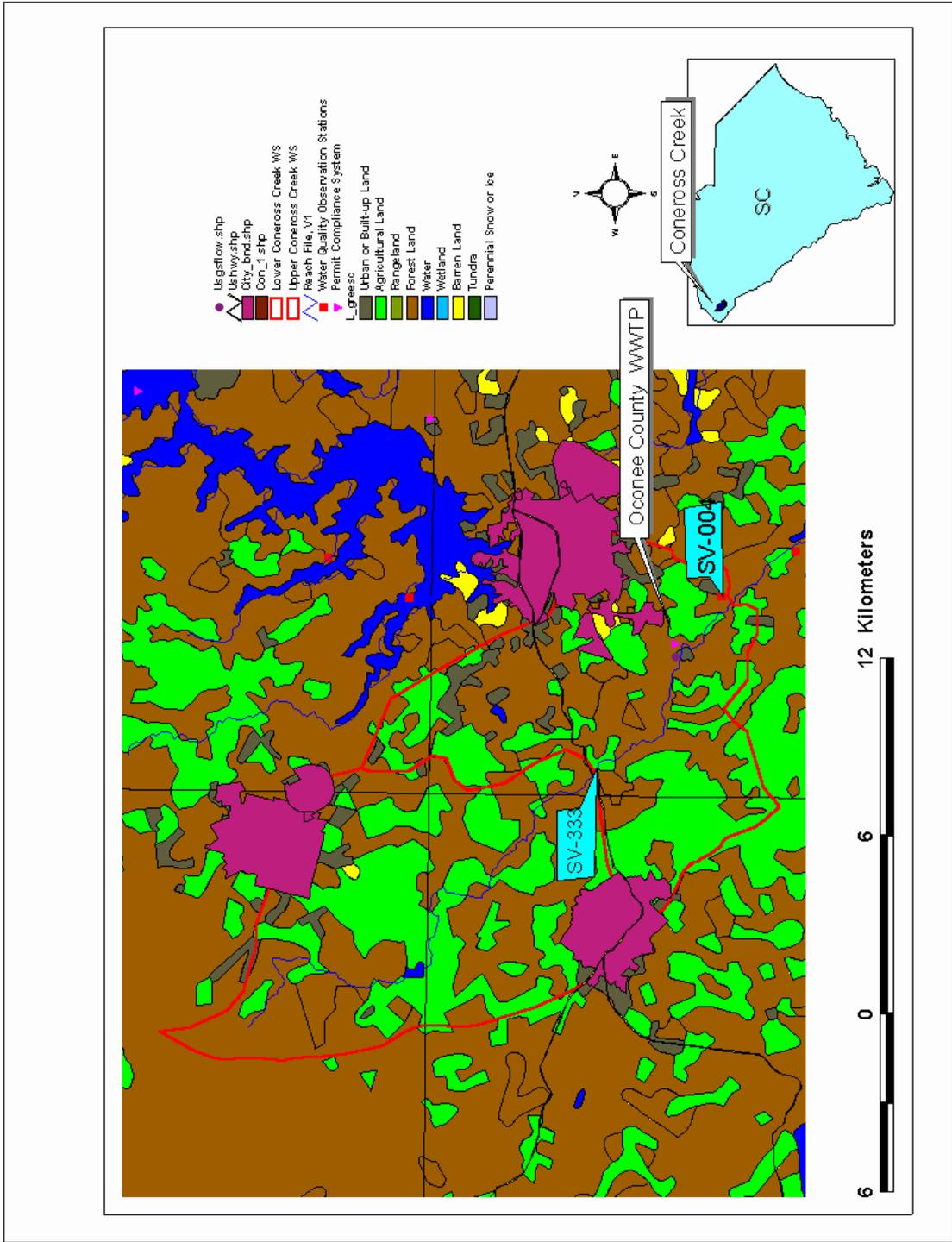


Figure 1. Coneross Creek watershed in Oconee County, SC

Although Coneross Creek was originally placed on our 1998, 303(d) list based on the violations for the fecal coliform standard (400 counts/100ml for fecal coliform), we believe that the geometric mean criterion also set forth in our fecal coliform water quality standard (200 counts/100ml) is the applicable criterion for TMDLs supported by continuous modeling. Therefore, in designing this TMDL to achieve Coneross Creek’s full compliance with the water quality standard, we have developed loading models, which address the geometric mean criterion. This geometric mean criterion is based on a 30-day (or monthly, for practical purposes) assessment period.

2. Water Quality Standard

This TMDL ensures that the Coneross Creek will meet the applicable numeric water quality criteria for fecal coliform thus ensuring that the water supports its designated uses. The Coneross Creek is designated for the aquatic life use and recreational use. The aquatic life uses are fully supported but recreational uses are only partially supported due to fecal coliform bacteria excursions at water quality stations SV-333 (Latitude: 34.64, Longitude: -83.58) and SV-004 (Latitude: 34.63, Longitude: -82.97). The applicable water quality criteria are as shown in Table 2.

Table 2. Water quality standards applicable to Coneross Creek

Pollutant	Criteria (counts/100ml)	
	Instantaneous ^a	30-day Geometric Mean ^b
Fecal Coliform	400	200

Table Notes:

- a. Not to exceed in more than 10% of samples taken during any 30day period.
- b. Not to exceed a geometric mean of 200 counts/100ml, based on five consecutive samples during any 30day period.

3. Model Decision

The US Environmental Protection Agency’s (US EPA) nonpoint source model (NPSM/HSPF), in Better Assessment Science Integrating Point and Nonpoint Sources (BASINS), was selected as the modeling framework to simulate existing conditions and perform TMDL allocations. This model explicitly accounts for seasonal variations in hydrology, climatic conditions, and watershed activities in order to establish the existing and allocation conditions. NPSM provides a continuous simulation of the watershed response to selected climatic, land use, point source, and other factors.

4. Wasteload Allocations

There is one permitted point source in the Coneross Creek watershed: Coneross Creek Wastewater Treatment Facility (NPDES #: SC0033553). The WLA was derived from the permitted limit of 200 counts/100ml and the permitted discharge flow of 12.07 cfs for

this facility. This TMDL prescribes no reduction in loads from this facility, because the discharge meets the standard at the end of the pipe. Any new facility will be required to meet the fecal coliform standard at their discharge point. The existing and proposed WLAs for the Oconee County WWTP are shown in Table 3.

Table 3. Fecal Coliform Waste Load Allocation, calculated on a daily basis

Point source	Existing Load	WLA	% Reduction
Oconee County WWTF	5.91×10^{10}	5.91×10^{10}	0

5. Assessment of Nonpoint Sources

The origins of fecal coliform found in streams usually are runoff of animal wastes both in place and applied, wildlife, failing septic systems, leakage from sanitary sewers, and overflows of sanitary sewers. The transport of fecal coliform from these sources to the water body is a function of various biological, chemical, and geological factors. Table 4. shows the different land uses found in the Coneross Creek Watershed. The nonpoint sources discussed in this section include

- Failing septic systems and other uncontrolled discharges
- Wildlife
- Land application of poultry litter
- Cattle-in-streams

5.1 Failing Septic Systems and Uncontrolled Discharges

We utilized GIS layers (i.e. Cities, census data, etc) for this watershed and estimated numbers of septic tanks proportionally based on US census data. In representing the fecal coliform contribution from failing septic systems, it was assumed that 100 percent of the fecal coliform load reached the receiving waters at a concentration of 10^4 counts/100ml (Horsley & Witten, 1996). The 10^4 counts /100ml concentrations is the low end of a range of typical values of fecal coliform concentration for raw sewage (Horsley & Witten, 1996). The low end was chosen to account for die-off of bacteria during transport to receiving water. The assumed septic system waste flow was calculated based on a typical value of 70 gallons per capita per day (Horsley & Witten, 1996) and an average of 2.55 persons per household in Oconee County. The spreadsheet used to estimate loading is provided in Appendix B.

Other unknown sources of fecal coliform bacteria in the Coneross Creek watershed include direct discharges, leaking sanitary sewers, and overflows of sanitary sewers. We have no information on direct discharges. However, in this watershed sanitary sewers are located along much of the Coneross Creek and several tributaries (Figure 2). Therefore the likelihood of leaking sewers and sewer overflows becomes relatively large. Further analysis of the fecal coliform concentrations and stream flow indicates that many of the fecal coliform standard violations occurred during low flow periods (Figure 3).

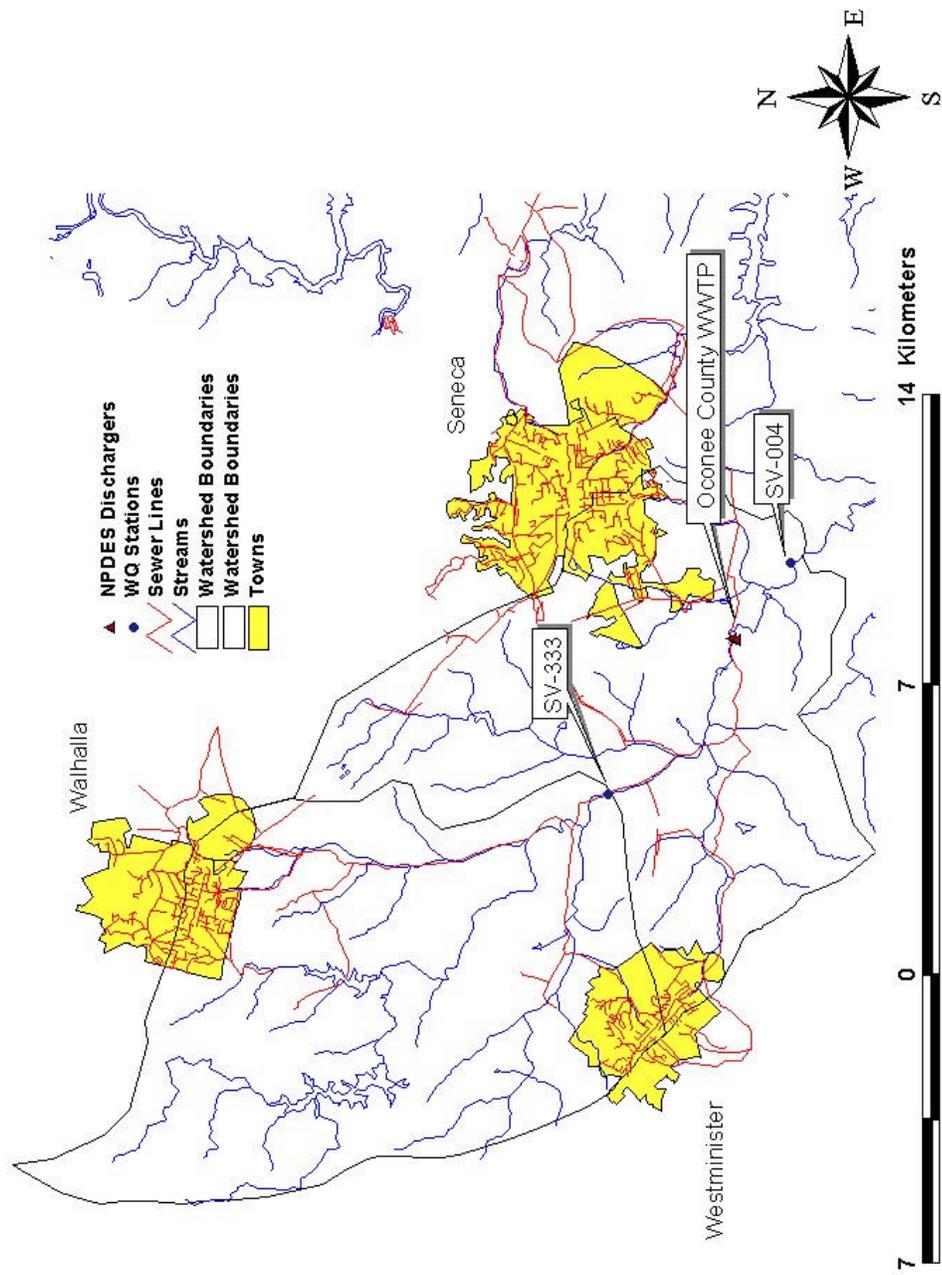


Figure 2. Sewer lines in the Coneross Creek watershed.

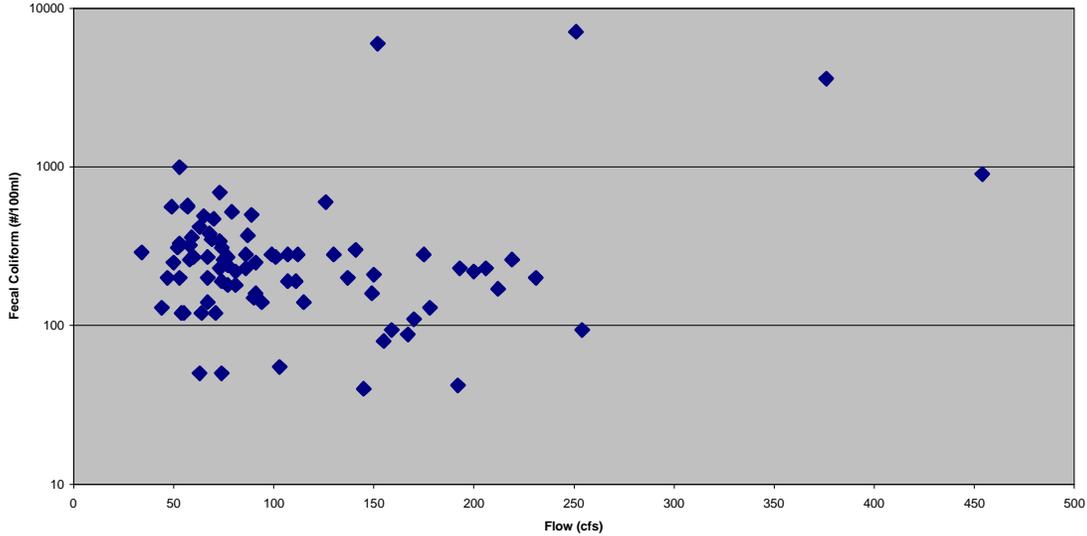


Figure 3. Relationship between flow and fecal coliform concentrations in Coneross Creek at SV-004, 1993-98.

5.2 Wildlife

The Department of Natural Resources in South Carolina estimated a deer density of 10 deer per square mile of deer habitat (personal communication, Charles Ruth, Deer Project Supervisor, DNR, 1/11/00). Deer habitat includes the Forested, Agricultural/Grass and Scrub/Shrub land uses. Using the provided deer density and the area of deer habitat available in the watershed, the total estimated number of deer in the watershed is calculated at 588. The fecal coliform production rate for deer was estimated by linear interpolation using the rate for other animals, such as turkey and cattle, which are available in the Metcalf & Eddy (1991). The interpolation was conducted based on each animal weight. This method gives a rate of 5.0×10^8 counts/animal/day for deer. Using this rate and the assumption of equally distributed population of deer between forest and agricultural land uses, the fecal coliform accumulation rates were determined.

5.3 Land Application of Poultry Litter

Poultry litter is applied to Agricultural/Grass land within the Coneross Creek watershed in compliance with Poultry Waste Management Plan for each farm. According to the Waste Management Plan, total numbers and accompanying litter production for the watershed are 3,962,800 broilers and 26,022 tons/yr. Table 4 shows the fraction of monthly litter applied on the land. The fraction reflects the type of crops and the available lands for manure application. Based on the assumption that all litter produced within the watershed is applied in the watershed, the amount of litter applied on Agricultural/Grass land was calculated. The literature value, 1.36×10^8 counts/animal/day (ASAE, 1998), of

fecal coliform production by broilers was used for the loading calculations for Agriculture/Grass land. The monthly accumulation of fecal coliform on the land surface was determined according to litter available for runoff.

Table 4. Fraction of litter applied each month on agricultural/grass land.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Fraction of litter applied each month	0	0	0.122	0.078	0.078	0.078	0.078	0.078	0.122	0.122	0.122	0.122

5.4 Cattle-in-stream

Loading of fecal coliform bacteria from cattle defecating directly into streams was estimated from the agricultural census of cattle and an assumption about the time cattle would be expected to be standing in the streams. We estimated the beef cattle population to be 1112 in this watershed. These cattle are not usually confined and so are grazing in the pastures all the time. We assumed a factor of 0.00025 to account for the time that the cattle would be in streams (personal communication, EPA Region 4, 2000). The estimated loading from the cattle was treated as a continuous source for the model with a loading rate of 1.2×10^9 counts/hr.

6. Load Allocations

The fecal coliform loadings were estimated by NPSM first for the entire delineated watershed. This watershed was further delineated into two subwatersheds at the water quality stations, SV-333 (refer to Table 5 and Figure 1). The delineation was performed based on the topographic features of the land. The simulated fecal coliform loads from the watershed were allocated to these two subwatersheds proportionally based on their land use areas. This was done in order to assess the impact of fecal coliform loadings from each subwatershed. The critical total existing 30-day loads (Table 6) were derived from the allocated loads for each subwatershed, based on the selected ten-year modeling period. The highest instream fecal concentration was determined based on the highest geometric 30-day mean of fecal coliform counts in the creek. Load reductions in the stream that meet the standard during this critical period will meet the standard at all other times simulated by the model. Although the fecal loading from Agricultural/Grass land is relatively high among the existing loads, assuming the poultry waste management plan is properly conducted, we decided on the load reduction from uncontrolled discharges.

Table 5. The area of each land use in the two subwatersheds and whole watershed

	The Upper Subwatershed (acres)	The Lower Subwatershed (acres)	Land Use by Watershed (acres)
Urban/Build up	2,290	2,373	4663
Agriculture/Grass	9,602	8,641	18,243
Forested	13,393	10,451	23,844
Barren	53	1	54
Unclassified	2	209	211
Total	25,340	21,675	47,015

Table 6. Fecal coliform loading by land use by subwatershed and whole watershed for Coneross Creek

Land Use Category	Fecal Coliform Loading (Total counts/30days)		
	Upper Subwatershed	Lower Subwatershed	Whole Watershed
Urban/Build-Up	8.49×10^{11}	8.81×10^{11}	1.73×10^{11}
Forest	1.87×10^7	1.75×10^9	3.7×10^7
Agricultural/Grass	1.38×10^{11}	1.16×10^{11}	2.65×10^{11}
Barren/Disturbed	Negligible	Negligible	Negligible
Total	9.87×10^{11}	9.97×10^{11}	1.99×10^{12}

Table 7. Summary of “direct” NPS fecal coliform loading to Coneross Creek

Source Category	Fecal Coliform (Total counts/30days)		
	Existing Load	TMDL Load Allocation	% Reduction from current load
Cattle-in-streams	8.64×10^{11}	8.64×10^{11}	0
Uncontrolled Discharges	5.76×10^{12}	2.88×10^{12}	50
Total	6.62×10^{12}	3.74×10^{12}	43.5

Table 8. Summary of all load allocations of fecal coliform to Coneross Creek

NPS Source Category	Fecal Coliform (Total counts/30days)		
	Existing Load	TMDL Load Allocation	% Reduction from current load
Land-Use	1.99×10^{12}	1.99×10^{12}	0
Direct	6.62×10^{12}	3.74×10^{12}	43.5
Total	8.61×10^{12}	5.73×10^{12}	33.4

7. Background Pollutant Contributions

A natural background contribution of fecal coliform is included as a loading from forested land use. This loading implies sources from other wildlife, different from the one that was considered here (deer). Based on flow and fecal coliform monitoring data in forested land, we have identified a baseline background concentration of 25 counts/100ml in the watershed. This concentration was included during the modeling process.

8. Critical Environmental Conditions

EPA regulations at 40 CFR 130.7(c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality is protected during times when it is most vulnerable. The selection of a critical environmental condition sometimes corresponds to a specific stream flow condition. However, for this TMDL the 30-day period for which the model predicts the largest violation of the geometric mean standard was identified (EPA 1991). Basing the TMDL on this period ensures that the standard can be met throughout the period of simulation. The critical period for this TMDL was the 30-day period prior to November 5, 1993 (Figure 4).

9. Seasonal Environmental Variations

The NPSM/HSPF model generates a continuous simulation over the period for which input data is available. The model thus allows for consideration of seasonal variation as well as annual variation and changes in flow and other conditions. The use of monthly average build-up rates for each land-use in the watershed allows us to account for seasonal management practices relating to fecal coliform loading.

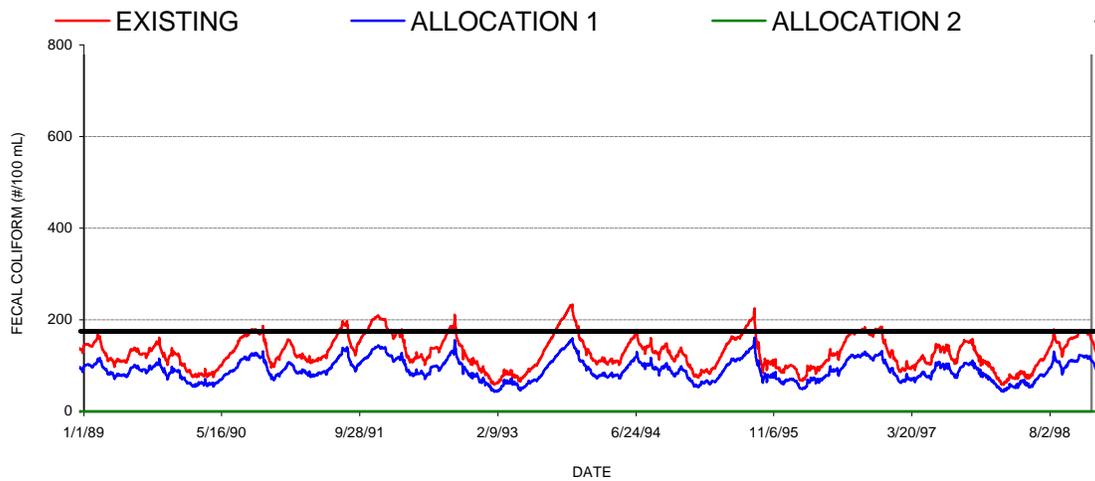


Figure 4. Existing and allocation scenario of 30-day geometric mean and the standard with a Margin of Safety at SV-004

10. Margin of Safety

This requirement is intended to add a level of safety to the TMDL-development process to account for uncertainty. Margins of Safety (MOS) may be implicit, built into the modeling process, or explicit, taken as a percentage or portion of the waste-load allocation, the load allocation, or the TMDLs. We chose both the implicit MOS and explicit MOS. An implicit MOS results from basing the TMDL on a period when loading is highest. An explicit MOS was provided by making the target fecal coliform concentration 175 counts/100ml, which is equal to 1.08×10^{12} counts/100ml.

11. Modeling Processes

A hydrologic calibration of the model was conducted for the period from 10/6/93 to 11/4/93 by comparing the model output to observed flow data from the USGS gauge (02186645). The model was validated for flow by comparing the model output to USGS flow data for the period from 10/1/92 to 9/30/93. Figures 5 and 6 show the result of calibration and validation. The model was then calibrated for water quality (fecal coliform) for the period from October 1992 to September 1994. The simulated fecal coliform concentrations were compared with observed concentrations from EPA's STORET database. Once the model was calibrated for hydrology and water quality, it was run to determine existing loadings and allocation loadings for the representative time period of January 1989 through December 1998 (See Figures 4, 7, and 8). A period of more than a year prior to January 1989 was used to allow the model to stabilize.

Flow (Calibration)

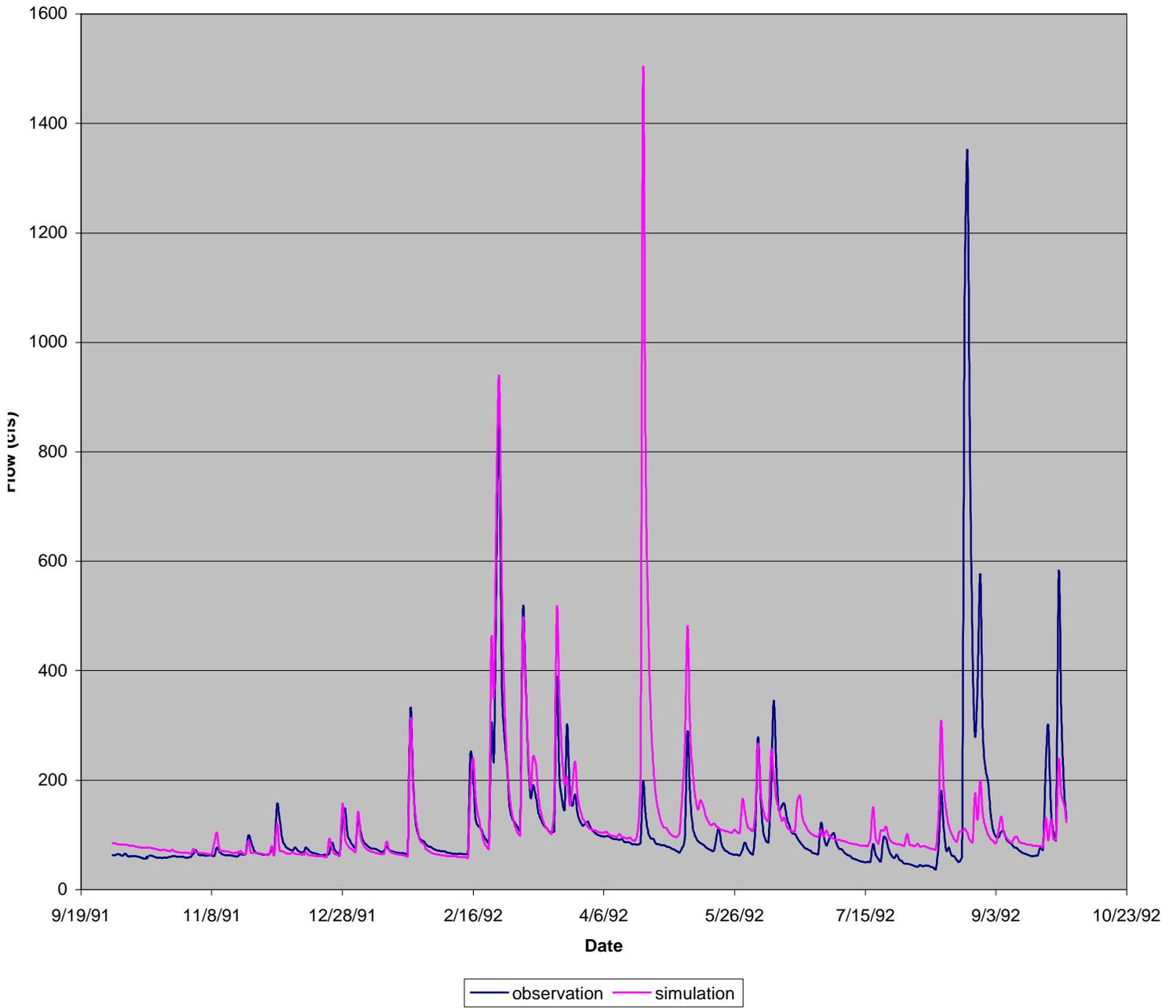


Figure 5. Flow Calibration

Flow (Validation)

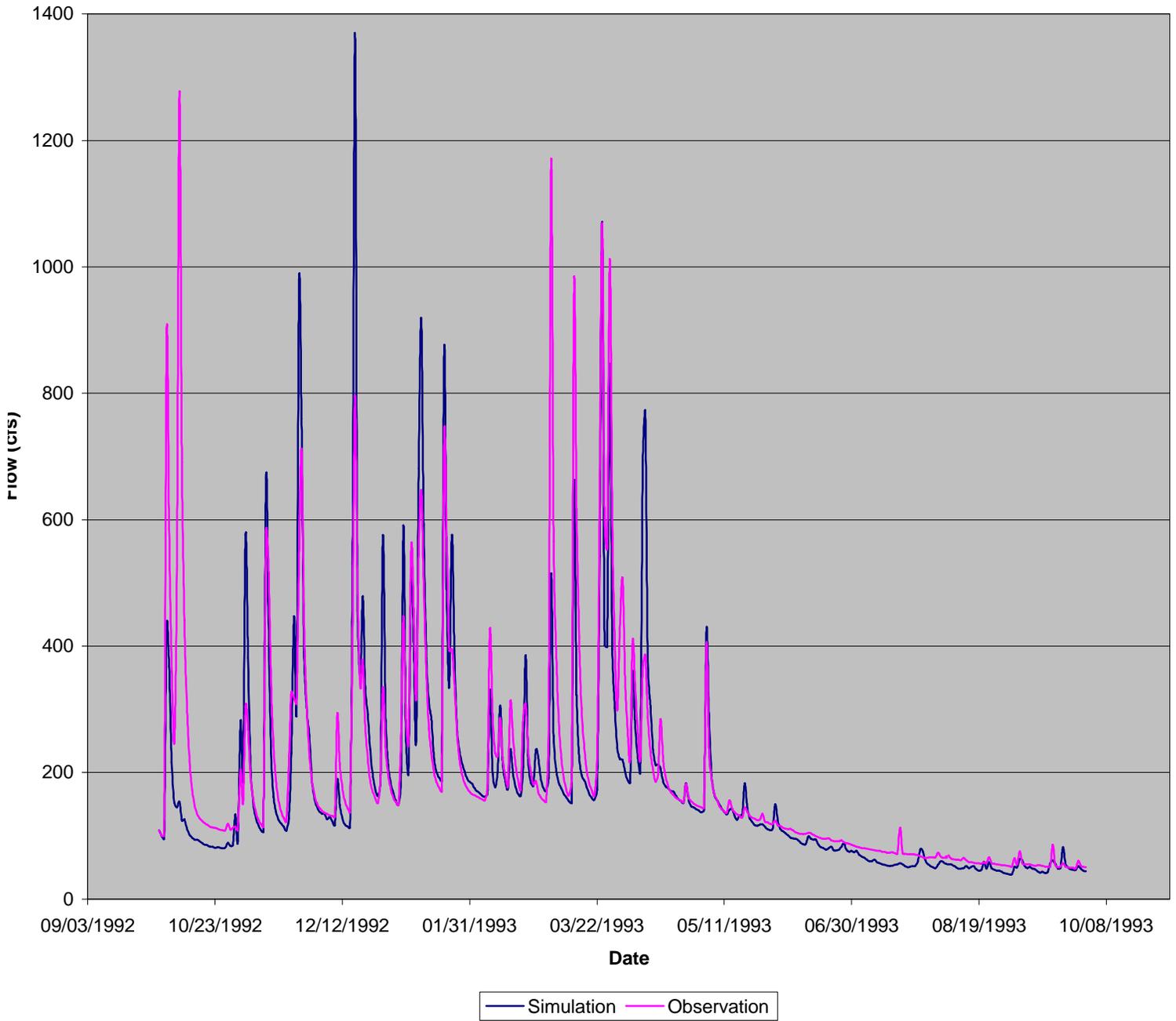


Figure 6. Flow Validation

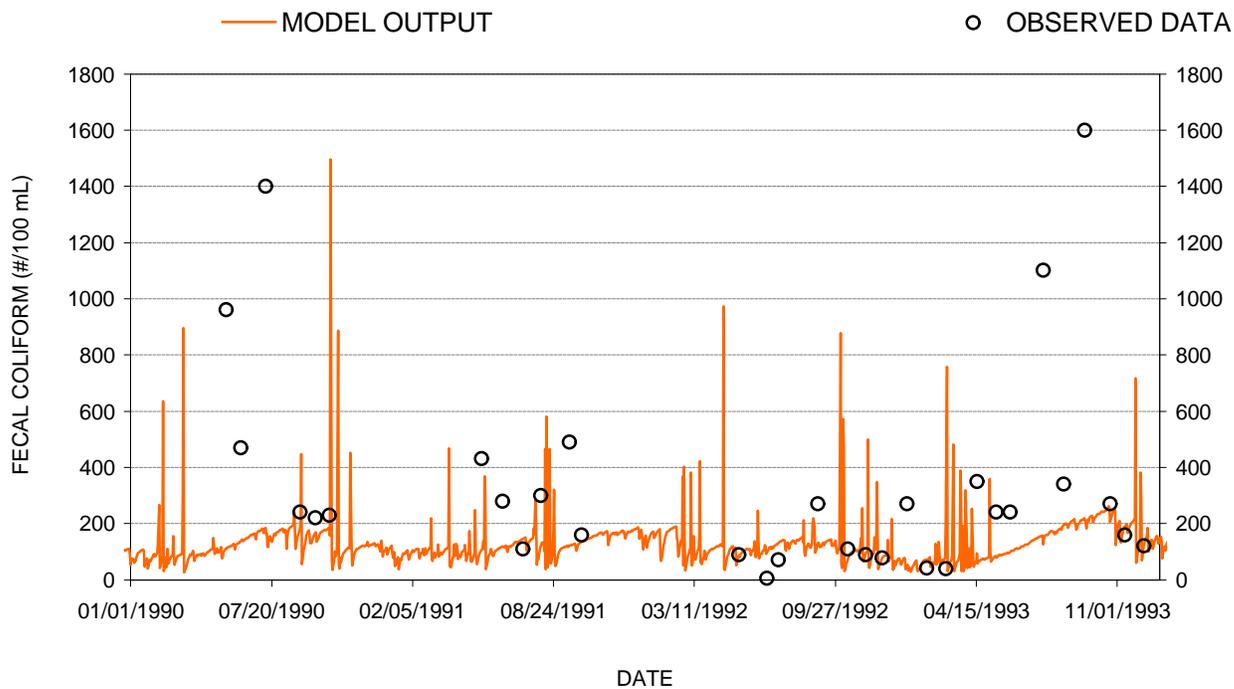


Figure 7. Comparison between simulated and observed fecal coliform counts at SV-004, 1990-93.

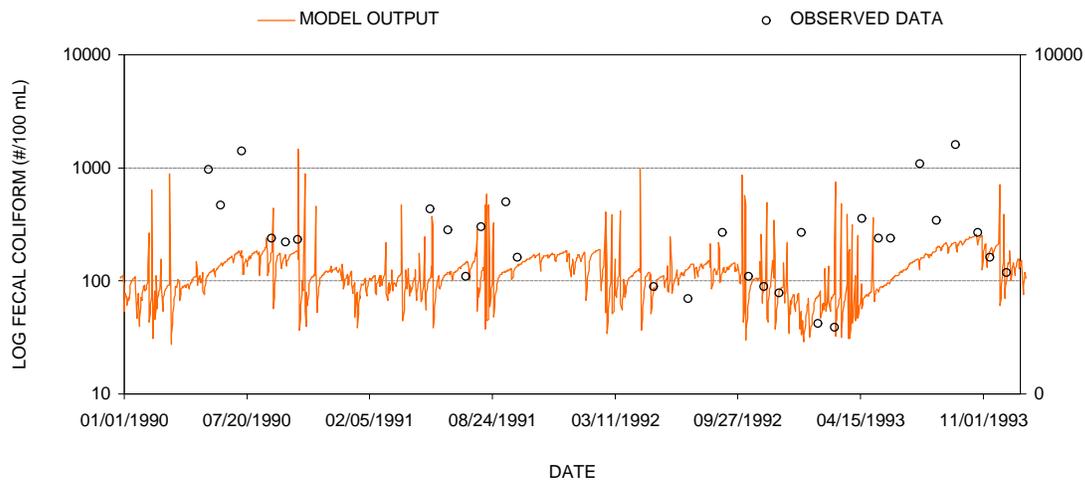


Figure 8. Comparison between simulated and observed fecal coliform counts expressed in logarithmic scale at SV-004, 1990-93.

The model simulation of the existing loading, displayed as a running 30-day geometric mean, is shown as a red line in Figure 4. The proposed TMDL (allocation 1) is shown as the blue line. The TMDL simulation shows that fecal coliform concentrations will not exceed the 175 counts/100ml target.

12. Implementation

The model shows that a 50% reduction from uncontrolled discharges (such as straight pipes, failing septic systems, leaking sewer lines, and sewer overflows) is critical to reduce the geometric mean concentration of 200counts/100ml. Although the locations of these discharges are currently not known; we have initiated a study to locate them with Appalachia I EQC District Office, Clemson University and other related DHEC offices. As an implementation plan, we will continuously monitor the water quality conditions at three existing monitoring stations along the creek while determining exact locations and eliminating these discharges into the creek. In addition, given the uncertainties which exist in the developed TMDL, we will need to pay particularly close attention to the trend of fecal number changes in future water samplings from the creek in order to make sure that the reduction is occurring. Farmers should be encouraged to use good NRCS management practices to reduce the loading due to cattle.

13. References

American Society of Agricultural Engineers (ASAE). 1998. ASAE Standards, 45th edition: Standards, Engineering Practices, Data. St. Joseph, MI.

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

Metcalf & Eddy. 1991. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd edition. McGraw-Hill, Inc., New York.

US Environmental Protection Agency. 1991. Guidance for Water Quality-based Decisions: The TMDL Process. Office of Water, Washington. EPA 440/4-91-001

Appendix A

Public Participation

Public Notice

The public notice on page 17 was sent to a mailing list of over 300 individuals statewide interested in water quality issues. This notice was also posted on DHEC's web site at "<http://www.state.sc.us/dhec/eqpubnot.htm>" from August 14 through September 13, 2000. Additionally, this public notice was published in *The State* and the Anderson *Independent-Mail* newspapers on Monday, August 14, 2000.

Responsiveness Summary

The opportunity for public comment began on August 14, 2000 and continued for over 30 days closing on September 13, 2000. During this period, no comments were received.

PUBLIC NOTICE

Date: August 14, 2000

NOTICE OF AVAILABILITY OF PROPOSED TOTAL MAXIMUM DAILY LOAD
FOR WATERS AND POLLUTANTS OF CONCERN IN THE STATE OF SOUTH
CAROLINA

Cedar Creek in Fairfield and Richland Counties
Coneross Creek in Oconee County
Lake Edgar Brown in Barnwell County
Little Eastatoe Creek in Pickens County
Rawls Creek in Richland and Lexington Counties

Section 303(d)(1) of the Clean Water Act (CWA), 33 U.S.C. §1313(d)(1)(C), and the US Environmental Protection Agency's (EPA) implementing regulation, 40 C.F.R. § 130.7(c) (1), require the establishment of total maximum daily loads (TMDLs) for waters identified as impaired pursuant to § 303(d)(1)(A) of the CWA. Each of these TMDLs is to be established at a level necessary to implement applicable water quality standards with seasonal variations and a margin of safety, accounting for lack of knowledge concerning the relationship between effluent limitations and water quality. At this time, the South Carolina Department of Health and Environmental Control (DHEC) has developed proposed TMDLs for the § 303(d)(1)(A) waters:

Water Body	County/Counties	Pollutant of Concern	Watershed Unit
Cedar Creek	Fairfield and Richland	Fecal Coliform	03050106-090
Coneross Creek	Oconee	Fecal Coliform	03060101-080
Lake Edgar Brown	Barnwell	Phosphorus	03050207-020
Little Eastatoe Creek	Pickens	Fecal Coliform	03060101-030
Rawls Creek	Richland and Lexington	Fecal Coliform	03050109-210

SC DHEC is proposing to establish these as final TMDLs. Upon review of any public comment and revision, if necessary, the Department will submit these TMDLs to EPA for approval as final TMDLs.

Persons wishing to comment on the proposed TMDLs or to offer new data regarding the proposed TMDLs are invited to submit the same in writing no later than September 13, 2000, to:

South Carolina Department of Health and Environmental Control
Bureau of Water
2600 Bull St.
Columbia, S.C. 29201
Attn: Andy Miller

Mr. Miller's phone number is 803-898-4031. His E-mail address is millerca@columb32.dhec.state.sc.us.

Copies of individual TMDLs can be obtained by calling, writing, or e-mailing Mr. Miller at the address above. The administrative record, including technical information, data and analyses supporting the proposed TMDLs, are available for review. Requests to review this information must be submitted in writing to DHEC's Freedom of Information Office at 2600 Bull Street, Columbia, SC 29201 or requests can be submitted via FAX to the Freedom of Information Office at 803.898.3816. Reproduction of documents is available at a cost of \$0.25 per page.

Appendix B

This sheet contains information related to the contribution of failing septic systems to streams.

The direct contribution of fecal coliform from septic systems to a stream can be represented as a point source in the model.

Required input for point sources in NPSM are loading rate (counts/hr) and flow (cfs).

The following assumptions are made for septic contributions.

Estimated # septic systems:	2863
Estimated # people served by septic systems:	7300
Avg # people served per septic:	2.55
Assume a failure rate for septic systems in the watershed (as provided by Appalachia I District):	2

Therefore the number of failing septic systems in the watershed is: 57

Assume failing septic systems are distributed evenly across watershed based on land area.

Therefore, density of failing septic systems is: 0.009748485

Assume the average FC concentration reaching the stream (from septic overcharge) is: * 1.00E+04

Assume a typical septic overcharge flow rate of: * 70

Assume the average FC concentration reaching the stream (from uncontrolled direct discharges) is: 1.00E+06

Septic as a Point Source

Sub-watershed	Total area (acres)	# failing septic systems	Tot. # people served	Septic flow (gal/day)	Septic flow (mL/hr)	FC rate (counts/hr)	Septic flow (cfs)
P1	5,874	57.3	146.0	10220	1,611,779	1.61E+08	1.58E-02
P2		0.0	0.0	0	0	0.00E+00	0.00E+00
P3		0.0	0.0	0	0	0.00E+00	0.00E+00
P4		0.0	0.0	0	0	0.00E+00	0.00E+00
P5		0.0	0.0	0	0	0.00E+00	0.00E+00
Total:	5,874	57	146	10,220	1,611,779	1.61E+08	1.58E-02

Direct Waste Discharge as a Point Source